HOARE LEA

EDEN GEOTHERMAL HEAT NETWORK MEP DESIGN

Mechanical and Electrical Engineering Specification

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EDEN GEOTHERMAL HEAT NETWORK MEP DESIGN

MECHANICAL AND ELECTRICAL ENGINEERING REFERENCE SPECIFICATION

Y-SECTIONS
Audit sheet

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IMPORTANT NOTICE

Not all of the systems and pipeline types included in this reference specification may be appropriate to the project. Refer to the individual system specifications and the schedules for particular project requirements.

Refer to A10 of the technical preliminaries for the definition of “concealed” as it relates to this specification.

100 REFERENCE DOCUMENTS

This specification is written based on legislation, standards and guidance in force in the UK generally, and within England by default. For projects in Scotland, Wales, Northern Ireland, the Channel Islands and the Isle of Man, give appropriate consideration to any locally applicable legislation, standards and guidance that deviates from or is additional to those in force within England. Similarly, for projects outside the UK, comply with the corresponding national legislation, standards and guidance.

Comply fully with the edition (including replacements, amendments and normative references) of each of the following, current at the time of tender.

Where a standard referred to in this section conflicts with a standard referred to in an associated ‘engineering system’ section (e.g. S10, T31, V21, etc.) of this specification, the standard referred to in the engineering system section prevails.

Health and Safety at Work etc Act

The Ionising Radiations Regulations

Radioactive Substances Act

The Water Supply (Water Fittings) Regulations

The Pressure Systems Safety Regulations

BS 143 and 1256	Threaded pipe fittings in malleable cast iron and cast copper alloy
BS 1306	Specification for copper and copper alloy pressure piping systems
BS 2633	Specification for Class I arc welding of ferritic steel pipework for carrying fluids
BS 2971	Specification for Class II arc welding of carbon steel pipework for carrying fluids
BS 3416	Specification for bitumen-based coatings for cold application, suitable for use in contact with potable water
BS 3505	Specification for unplasticised polyvinyl chloride (PVC-U) pressure pipes for cold potable water
BS 3506	Specification for unplasticised PVC pipe for industrial use
BS 4105	Specification for liquid carbon dioxide, industrial
BS 4872	Specification for approval testing of welders when welding procedure approval is not required
BS 5391-1	Acrylonitrile-butadiene-styrene (ABS) pressure pipe. Specification
BS 5392-1	Acrylonitrile-butadiene-styrene (ABS) fittings for use with ABS pressure pipe. Specification

BS 5970	Thermal insulation of pipework, ductwork, associated equipment and other industrial installations in the temperature range of -100°C to +870°C. Code of Practice
BS 6129-1	Code of practice for the selection and application of bellows expansion joints for use in pressure systems. Metallic bellows expansion joints
BS 6920	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
BS 6956	Jointing materials and compounds
BS 7531	Rubber bonded fibre jointing for industrial and aerospace purposes. Specification
BS 7786	Specification for unsintered PTFE tapes for general use
BS 7874	Method of test for microbiological deterioration of elastomeric seals for joints in pipework and pipelines
BS 8537	Copper and copper alloys. Plumbing fittings. Specification for press ends of plumbing fittings for use with metallic tubes
BS 8558	Guide to the design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages. Complementary guidance to BS EN 806
BS 8588	Polyethylene pressure pipe with an aluminium barrier layer and associated fittings for potable water supply in contaminated land. Size 20 mm to 630 mm
BS 9990	Non-automatic fire-fighting systems in buildings. Code of practice
BS EN 197-1	Cement. Composition, specifications and continuity criteria for common cements
BS EN 545	Ductile iron pipes, fittings, accessories and their joints for water pipelines. Requirements and test methods
BS EN 598	Ductile iron pipes, fittings, accessories and their joints for sewerage applications. Requirements and test methods
BS EN 681-1	Elastomeric seals. Material requirements for pipe joint seals used in water and drainage applications. Vulcanised rubber
BS EN 681-2	Elastomeric seals. Material requirements for pipe joint seals used in water and drainage applications. Thermoplastic elastomers
BS EN 682	Elastomeric seals. Materials requirements for seals used in pipes and fittings carrying gas and hydrocarbon fluids
BS EN 751-1	Sealing materials for metallic threaded joints in contact with 1st, 2nd and 3rd family gases and hot water. Anaerobic jointing compounds
BS EN 751-2	Sealing materials for metallic threaded joints in contact with 1st, 2nd and 3rd family gases and hot water. Non-hardening jointing compounds
BS EN 751-3	Sealing materials for metallic threaded joints in contact with 1st, 2nd and 3rd family gases and hot water. Unsintered PTFE tapes
BS EN 805	Water supply. Requirements for systems and components outside buildings
BS EN 806-1	Specifications for installations inside buildings conveying water for human consumption. General
BS EN 806-2	Specifications for installations inside buildings conveying water for human consumption. Design

BS EN 806-4	Specifications for installations inside buildings conveying water for human consumption. Installation
BS EN 806-5	Specifications for installations inside buildings conveying water for human consumption. Operation and maintenance
BS EN 969	Ductile iron pipes, fittings, accessories and their joints for gas pipelines. Requirements and test methods
BS EN 1057	Copper and copper alloys. Seamless, round copper tubes for water and gas in sanitary and heating applications
BS EN 1092-1	Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated. Steel flanges
BS EN 1092-3	Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated. Copper alloy flanges
BS EN 1254	Copper and copper alloys. Plumbing fittings
BS EN 1412	Copper and copper alloys - European numbering system
BS EN 1514	Flanges and their joints. Dimensions of gaskets for PN-designated flanges
BS EN 1515-1	Flanges and their joints. Bolting. Selection of bolting
BS EN 1515-2	Flanges and their joints. Bolting. Classification of bolt materials for steel flanges, PN designated
BS EN 1563	Founding. Spheroidal graphite cast irons
BS EN 1976	Copper and copper alloys. Cast unwrought copper products
BS EN 1982	Copper and copper alloys. Ingots and castings
BS EN 10025-2	Hot rolled products of structural steels. Technical delivery conditions for non-alloy structural steels
BS EN 10088-2	Stainless steels. Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes
BS EN 10213	Steel castings for pressure purposes
BS EN 10216-1	Seamless steel tubes for pressure purposes. Technical delivery conditions. Non-alloy steel tube with specified room temperature properties
BS EN 10216-2	Seamless steel tubes for pressure purposes. Technical delivery conditions. Non-alloy and alloy steel tubes with specified elevated temperature properties
BS EN 10217-1	Welded steel tubes for pressure purposes. Technical delivery conditions. Electric welded and submerged arc welded non-alloy steel tubes with specified room temperature properties
BS EN 10217-2	Welded steel tubes for pressure purposes. Technical delivery conditions. Electric welded non-alloy and alloy steel tubes with specified elevated temperature properties
BS EN 10217-7	Welded steel tubes for pressure purposes. Technical delivery conditions. Stainless steel tubes
BS EN 10222-2	Steel forgings for pressure purposes. Ferritic and martensitic steels with specified elevated temperature properties
BS EN 10224	Non-alloy steel tubes and fittings for the conveyance of water and other aqueous liquids. Technical delivery conditions

BS EN 10226-1	Pipe threads where pressure tight joints are made on the threads. Taper external threads and parallel internal threads. Dimensions, tolerances and designation
BS EN 10226-2	Pipe threads where pressure tight joints are made on the threads. Taper external threads and taper internal threads. Dimensions, tolerances and designation
BS EN 10241	Steel threaded pipe fittings
BS EN 10242	Threaded pipe fittings in malleable cast iron
BS EN 10253-1	Butt-welding pipe fittings. Wrought carbon steel for general use and without specific inspection requirements
BS EN 10253-2	Butt-welding pipe fittings. Non alloy and ferritic alloy steels with specific inspection requirements
BS EN 10255	Non-alloy steel tubes suitable for welding and threading. Technical delivery conditions
BS EN 10305-3	Steel tubes for precision applications. Technical delivery conditions. Welded cold sized tubes
BS EN 10311	Joints for the connection of steel tubes and fittings for the conveyance of water and other aqueous liquids
BS EN 10312	Welded stainless steel tubes for the conveyance of aqueous liquids including water for human consumption. Technical delivery conditions
BS EN 12201	Plastic piping systems for water supply, and for drainage and sewerage under pressure. Polyethylene (PE)
BS EN 12449	Copper and copper alloys. Seamless, round tubes for general purposes
BS EN 12451	Copper and copper alloys. Seamless, round tubes for heat exchangers
BS EN 12797	Brazing. Destructive tests of brazed joints
BS EN 12799	Brazing. Non-destructive examination of brazed joints
BS EN 13076	Devices to prevent pollution by backflow of potable water. Unrestricted air gap. Family A. Type A
BS EN 13077	Devices to prevent pollution by backflow of potable water. Air gap with non-circular overflow (unrestricted). Family A. Type B
BS EN 13134	Brazing. Procedure approval
BS EN 13348	Copper and copper alloys. Seamless, round copper tubes for medical gases or vacuum
BS EN 13349	Copper and copper alloys. Pre-insulated copper tubes with solid covering
BS EN 13480-1	Metallic industrial piping. General
BS EN 13480-2	Metallic industrial piping. Materials
BS EN 13480-3	Metallic industrial piping. Design and calculation
BS EN 13480-4	Metallic industrial piping. Fabrication and installation
BS EN 13480-5	Metallic industrial piping. Inspection and testing
BS EN 13480-6	Metallic industrial piping. Additional requirements for buried piping
PD TR 13480-7	Metallic industrial piping. Guidance on the use of conformity assessment procedures

BS EN 13480-8	Metallic industrial piping. Additional requirements for aluminium and aluminium alloy piping
BS EN 13941	District heating pipes. Design and installation of thermal insulated bonded single and twin pipe systems for directly buried hot water networks.
BS EN 14324	Brazing. Guidance on the application of brazed joints
BS EN 14623	Devices to prevent pollution by backflow of potable water. Air gaps with minimum circular overflow (verified by test or measurement). Family A. Type G
BS EN ISO 887	Plain washers for metric bolts, screws and nuts for general purposes. General plan
BS EN ISO 898-1	Mechanical properties of fasteners made of carbon steel and alloy steel. Bolts, screws and studs with specified property classes. Coarse thread and fine pitch thread
BS EN ISO 898-2	Mechanical properties of fasteners made of carbon steel and alloy steel. Nuts with specified property classes. Coarse thread and fine pitch thread
BS EN ISO 1127	Stainless steel tubes. Dimensions, tolerances and conventional masses per unit length
BS EN ISO 1452	Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure. Unplasticized poly (vinyl chloride) (PVC-U)
BS EN ISO 1456	Metallic and other inorganic coatings. Electrodeposited coatings of nickel, nickel plus chromium, copper plus nickel and of copper plus nickel plus chromium
BS EN ISO 2081	Metallic and other inorganic coatings. Electroplated coatings of zinc with supplementary treatments on iron or steel
BS EN ISO 2082	Metallic and other inorganic coatings. Electroplated coatings of cadmium with supplementary treatments on iron or steel
BS EN ISO 2505	Thermoplastics pipes. Longitudinal reversion. Test methods and parameters
BS EN ISO 4014	Hexagon head bolts. Product grades A and B
BS EN ISO 4032	Hexagon regular nuts (style 1). Product grades A and B
BS EN ISO 4033	Hexagon high nuts (style 2). Product grades A and B
BS EN ISO 4042	Fasteners. Electroplated coating systems
BS EN ISO 5817	Welding. Fusion-welded joints in nickel, steel, titanium and their alloys (beam welding excluded). Quality levels for imperfections
BS EN ISO 6509-1	Corrosion of metals and alloys. Determination of dezincification resistance of copper alloys with zinc. Test method
BS EN ISO 7438	Metallic materials. Bend test
BS EN ISO 9000	Quality management systems. Fundamentals and vocabulary
BS EN ISO 9453	Soft solder alloys. Chemical compositions and forms
BS EN ISO 9454-1	Soft soldering fluxes. Classification and requirements. Classification, labelling and packaging
BS EN ISO 9606-1	Qualification testing of welders. Fusion welding. Steels
BS EN ISO 9712	Non-destructive testing. Qualification and certification of NDT personnel

BS EN ISO 10675-1	Non-destructive testing of welds. Acceptance levels for radiographic testing. Steel, nickel, titanium and their alloys
BS EN ISO 11666	Non-destructive testing of welds. Ultrasonic testing. Acceptance levels
BS EN ISO 13585	Brazing. Qualification test of brazers and brazing operators
BS EN ISO 14731	Welding coordination. Tasks and responsibilities
BS EN ISO 14732	Welding personnel. Qualification testing of welding operators and weld setters for mechanized and automatic welding of metallic materials
BS EN ISO 15493	Plastics piping systems for industrial applications. Acrylonitrile-butadiene-styrene (ABS), unplasticized poly(vinyl chloride)(PVC-U) and chlorinated poly(vinyl chloride) (PVC-C). Specifications for components and the system. Metric series
BS EN ISO 15607	Specification and qualification of welding procedures for metallic materials. General rules
BS EN ISO 15609-1	Specification and qualification of welding procedures for metallic materials. Welding procedure specification. Arc welding
BS EN ISO 17635	Non-destructive testing of welds. General rules for metallic materials
BS EN ISO 17636-1	Non-destructive testing of welds. Radiographic testing. X- and gamma-ray techniques with film
BS EN ISO 17637	Non-destructive testing of welds. Visual testing of fusion-welded joints
BS EN ISO 17639	Destructive tests on welds in metallic materials. Macroscopic and microscopic examination of welds
BS EN ISO 17640	Non-destructive testing of welds. Ultrasonic testing. Techniques, testing levels, and assessment
BS EN ISO 17672	Brazing. Filler metals
BS EN ISO 21003-2	Multilayer piping systems for hot and cold water installations inside buildings. Pipes
BS EN ISO 21003-3	Multilayer piping systems for hot and cold water installations inside buildings. Fittings
BS EN ISO 27830	Metallic and other inorganic coatings. Requirements for the designation of metallic and inorganic coatings
BS EN ISO 80601-2-13	Medical electrical equipment. Particular requirements for basic safety and essential performance of an anaesthetic workstation
BS ISO 161-1	Thermoplastics pipes for the conveyance of fluids. Nominal outside diameters and nominal pressures. Metric series
BS ISO 727	Fittings made from unplasticized poly (vinyl chloride) (PVC-U), chlorinated poly(vinyl chloride) (PVC-C) or acrylonitrile/butadiene/styrene (ABS) with plain sockets for pipes under pressure
BS ISO 4065	Thermoplastic pipes. Universal wall thickness table
BS ISO 8992	Fasteners. General requirements for bolts, screws, studs and nuts
BS ISO 11922-1	Thermoplastics pipes for the conveyance of fluids. Dimensions and tolerances. Metric series
DIN 8063	Pipe Joint assemblies and fittings for unplasticized polyvinyl chloride (U-PVC) pressure pipelines

DIN 5096-2	Electrodeposited coatings – Chromated coatings of zinc and zinc alloys on iron and steel
DoH HTM 02-01	Medical gas pipeline systems. Part A: Design, installation, validation and verification
DoH HTM 02-01	Medical gas pipeline systems. Part B: Operational management
DoH HTM 04-01	Safe water in healthcare premises. Part A: design, installation and commissioning
DoH HTM 04-01	Safe water in healthcare premises. Part B: Operational management
GIS/PL2	Specification for polyethylene pipes and fittings for natural gas and suitable manufactured gas
GIS/PL2-1	Part 1: General and polyethylene compounds for use in polyethylene pipes and fittings
GIS/PL2-2	Part 2: Pipes for use at pressures up to 5.5 bar
GIS/PL2-3	Part 3: Butt fusion machines and ancillary equipment
GIS/PL2-4	Part 4: Fusion fittings with integral heating element(s)
GIS/PL2-6	Part 6: Spigot end fittings for electrofusion and/or butt fusion purposes
GIS/PL3	Specification for self-anchoring mechanical fittings for polyethylene pipe for natural gas and suitable manufactured gas
IGE/UP/1	Strength testing, tightness testing and direct purging of industrial and commercial gas installations
IGE/UP/1A	Strength and tightness testing and direct purging of small low pressure industrial and commercial Natural Gas installations
IGEM/UP/1B	Tightness testing and direct purging of small Liquefied Petroleum Gas/Air, Natural Gas and Liquefied Petroleum Gas installations
IGEM/UP/2	Installation pipework on industrial and commercial premises
WRAS	Approvals Directory (formally the Water Fittings and Materials Directory)
WRAS	Water Regulations Guide
Water UK IGN 4-01-03	Guide to pressure testing of pressure pipes and fittings for use by public water suppliers
Water UK IGN 4-25-02	Applications for stainless steel in the water industry
Water UK WIS 4-32-08	Specification for the fusion jointing of polyethylene pressure pipeline systems using PE80 and PE100 materials
BCGA CP4	British Compressed Gases Association Code of Practice 4 - Gas supply and distribution systems (excluding acetylene)

200 STEAM PIPELINES

210 Plant or process steam pipelines (black steel)

211 Application

For all plant steam pipework up to 12 bar gauge maximum pressure and not exceeding 230°C, including blowdown pipework from steam boiler plant and all steam valve safety discharge pipes.

Weld or screw all joints in exposed steam pipework up to and including 25 mm. Weld all other joints.

212 Pipe

Refer to the particular specification clauses (particularly sections S51 and/or S52) to determine whether seamless pipe is to be used for this project.

For pipework from 10 mm up to and including 25 mm nominal diameter use tube to BS EN 10255, heavy series, P235TR1 steel, with factory-applied red paint finish and plain ends or screwed to BS EN 10226 taper.

Minimum wall thicknesses as follows:

Nominal diameter (mm)	Minimum wall thickness (mm)	Outside diameter (mm)
10	2.9	17.2
15	3.2	21.3
20	3.2	26.9
25	4.0	33.7

For pipe sizes greater than 25 mm nominal diameter where use of seamless tube is a specified project requirement use only the seamless specification otherwise use either the seamless or the high frequency induction welded specification:

High frequency induction welded tube

Use high frequency induction welded (HFIW) steel tube, with protective varnish finish, made from fully traceable, high quality fully killed steel all to BS EN 10217-2 grade P235GH/TC1.

Ensure both the external and internal weld beads have been fully trimmed and removed on all pipe used.

All tubes to be either hot finish full body normalised or made from normalised strip with annealed weld line.

For sizes up to and including 150 mm use only tubes which have had their weld seams both ultrasonically and eddy current tested. For sizes 200 mm and above use only tubes whose weld seams have been ultrasonically tested and which have been hydraulically tested for pressure integrity.

Seamless tube

Use hot finished seamless steel tube with protective varnish finish, made from fully traceable, high quality fully killed steel all to BS EN 10216-2 grade P235GH/TC1. Alternatively use hot finished tube which meets either the ASTM A106M grade B or API 5L grade B standard.

Minimum wall thicknesses are as follows for both HFIW and seamless pipe:

Nominal diameter (mm)	Minimum wall thickness (mm)	Outside diameter (mm)
32	4.5	42.4
40	5.0	48.3
50	5.0	60.3

65	5.0	76.1
80	5.0	88.9
100	8.0	114.3
125	8.0	139.7
150	10.0	168.3
200	12.5	219.1
250	12.5	273.0
300	12.5	323.9
350	16.0	355.6
400	16.0	406.4
450	16.0	457.0
500	16.0	508.0

213 Fittings

Use only fittings whose finished minimum wall thickness is at least equal to that of the pipe to which they are fitted, and which are suitable for the full service pressure and temperature.

For sizes 25 mm nominal diameter and below use fittings to BS EN 10241 wrought steel, heavy series, screwed BS EN 10226 taper, with varnish finish.

For sizes from 25 mm to 500 mm nominal diameter use only normalised seamless carbon steel butt welding fittings to BS EN 10253-2 type B, to the same steel grade as the pipe, with varnish finish and suitable for the pipeline full service pressure at elevated temperature. Where using seamless pipe to ASTM/API standards use normalised seamless fittings to ANSI/ASME B16.9 and ASTM A234M or matching API standard.

214 Unions for pipe sizes up to and including 20 mm

Use wrought steel, navy pattern unions with bronze seats PN25 to BS EN 10241 heavy.

215 Flanges: Mild steel, raised face

For pipe sizes 15 mm to 25 mm use screwed boss type flanges to BS EN 1092-1, figure 1, type 13, screwed to BS EN 10226 taper or use welded flanges to the specification below.

For pipe sizes up to and including 500 mm and taking due account of the need to test welds, use hubbed slip-on weld flanges to BS EN 1092-1, figure 1, type 12 PN25.

For all flanges use S235JR grade steel to BS EN 10025-2 or forged steel to BS EN 10222-2 grade P245GH.

Where using seamless pipe to ASTM standards use weld-neck flanges, whose wall thickness matches that of the pipe, to ASTM A105M and ASME/ANSI B16.5, At interfaces with fittings and equipment to European specifications install flanges drilled to suit the necessary hole size/spacing.

216 Flange gaskets

Use compressed sheet flange gaskets of aramid and inorganic fibre with nitrile rubber binder to BS 7531 grade X and BS EN 1514 and suitable for saturated steam at 16 bar gauge and 230°C.

Alternatively, or where particularly specified, use metallic spiral wound gaskets with support ring all to BS EN 1514 and suitable for saturated steam at 16 bar gauge and 230°C.

217 Flange bolts, nuts & washers

Comply with BS EN 1515. Use bolts of grade 8.8 and nuts grade 8, material group 3EO. Bolts and nuts to be bright zinc plated in accordance with BS EN ISO 4042.

Use bolts faced under the head with machined shank. Use nuts faced on one side. Use ISO metric coarse screwed threads.

Use washers to BS EN ISO 887 bright zinc plated to BS EN ISO 4042 and faced on both sides. Fit washers under both bolt head and nut.

220 Clean steam pipelines (stainless steel)

Comply with the requirements of specification section S52.

300 CONDENSATE PIPELINES

310 Condensate pipelines (copper-nickel-iron)

311 Application

For all condensate pipelines starting at the steam trap outlet. Maximum 110°C and 10 bar gauge. Ensure that no isolating valves are installed between the steam trap and open vented receiver.

Braze all joints and fittings.

312 Pipe

For pipe sizes up to and including 108 mm use seamless 90/10 copper-nickel-iron alloy tube having a 25-year guarantee, type CW352H, to BS EN 12449, Table 3.

Minimum wall thicknesses as follows:

Nominal diameter (mm)	Wall thickness (mm)
6, 8, 10 & 12	0.8
15 & 18	1.0
22 & 28	1.2
35 & 42	1.5
54, 67 & 76	2.0
108	2.5

313 Fittings and unions

For unconcealed pipes up to and including 54 mm use LG4 high duty gunmetal (to BS EN 1982, CB492K) steam quality fittings to manufacturers standard, or where available to BS EN 1254-1 or BS EN 1254-5, with silver alloy brazing metal, type AG 155 to BS EN ISO 17672, Table 6.

For all concealed pipes and pipes 67 mm and above use fittings or fabrications produced from copper alloy type CW352H, to BS EN 12449, Table 3, seamless brazing bends and fittings from tube socketed for capillary brazing with silver alloy brazing metal, type AG 155 to BS EN ISO 17672, Table 6.

314 Flanges

Use slip-on flange backing rings of mild steel over CW352H copper alloy collars, capillary type all to BS EN 1092-3, type 07, 37 PN10, with silver alloy brazing metal, type AG 155 to BS EN ISO 17672, Table 6, and protected against electrolytic action and corrosion.

315 Flange gaskets

Use compressed sheet flange gaskets of aramid and inorganic fibre with nitrile rubber binder to BS 7531 grade X and BS EN 1514 and suitable for condensate at 10 bar gauge and 110°C.

316 Flange bolts, nuts & washers

Comply with BS EN 1515. Use bolts of grade 8.8 and nuts grade 8, material group 3EO. Bolts and nuts to be bright zinc plated in accordance with BS EN ISO 4042.

Use bolts faced under the head with machined shank. Use nuts faced on one side. Use ISO metric coarse screwed threads.

Use washers to BS EN ISO 887 bright zinc plated to BS EN ISO 4042 and faced on both sides. Fit washers under both bolt head and nut.

320 Condensate pipelines (copper)

321 Application

For all condensate pipelines starting at the steam trap outlet. Maximum 110°C and 10 bar gauge. Ensure that no isolating valves are installed between the steam trap and open vented receiver.

Braze all joints and fittings.

322 Pipe

For pipe sizes up to and including 28 mm use copper tube to BS EN 1057, type R250 half hard, grade CuDHP/CW024A, and having a 25-year guarantee.

For pipe sizes from 35 mm up to and including 108 mm use copper tube to BS EN 1057, type R290 hard, grade CuDHP/CW024A and having a 25-year guarantee.

Minimum wall thicknesses as follows:

Nominal diameter (mm)	Pipe type	Wall thickness (mm)
6, 8, 10 & 12	R250	0.8
15	R250	1.0
22 & 28	R250	1.2
35 & 42	R290	1.5
54, 67 & 76	R290	2.0
108	R290	2.5

323 Fittings and unions

For unconcealed pipes up to and including 54 mm use LG4 high duty gunmetal (to BS EN 1982, CB492K) steam quality fittings to manufacturers standard or where available to BS EN 1254-1 or BS EN 1254-5, with silver alloy brazing metal, type AG 155 to BS EN ISO 17672, Table 6.

For all concealed pipes and pipes 67 mm and above use fittings or fabrications produced from copper alloy type LG4/CB492K or CW352H, to BS EN 12449, Table 3, seamless brazing bends and fittings from tube socketed for capillary brazing with silver alloy brazing metal, type AG 155 to BS EN ISO 17672, Table 6.

324 Flanges

Use slip-on flange backing rings of mild steel over CW352H, CC498K copper alloy collars, capillary type all to BS EN 1092-3, type 07, 37 PN10, with silver alloy brazing metal, type AG 155 to BS EN ISO 17672, Table 6, and protected against electrolytic action and corrosion.

325 Flange gaskets

Use compressed sheet flange gaskets of aramid and inorganic fibre with nitrile rubber binder to BS 7531 grade X and BS EN 1514 and suitable for condensate at 10 bar gauge and 110°C.

326 Flange bolts, nuts & washers

Comply with BS EN 1515. Use bolts of grade 8.8 and nuts grade 8, material group 3EO. Bolts and nuts to be bright zinc plated in accordance with BS EN ISO 4042.

Use bolts faced under the head with machined shank. Use nuts faced on one side. Use ISO metric coarse screwed threads.

Use washers to BS EN ISO 887 bright zinc plated to BS EN ISO 4042 and faced on both sides. Fit washers under both bolt head and nut.

330 Condensate pipelines (thin wall welded stainless steel)

331 Application

For all condensate pipelines starting at the steam trap outlet. Maximum 110°C and 10 bar gauge.

Use only butt joints and weld all joints. Workshop fabricate pipe sections/spools with flanged ends for site installation. Site made welds are only acceptable where unavoidable and few in number compared to the workshop made welds.

Do not install flanges in concealed locations.

332 Pipe

Use plain end longitudinally welded stainless steel tube manufactured to BS EN 10217-7 and BS EN ISO 1127, with outside weld bead ground flush, weld factor equal to 1.0 and pickled descaled finish.

Use stainless steel to BS EN 10088-2 grade 1.4307 (formerly 304S11 / 304L).

Dimensions as follows:

Nominal diameter (mm)	Minimum wall thickness (mm)	Outside diameter (mm)
25	1.5	28
32	1.5	35
40	1.5	43
50	1.5	53
65	1.5	68
80	1.5	83

100	2.0	104
125	2.0	129
150	2.0	154
200	2.0	204

333 Fittings

Use stainless steel butt welding fittings, made from BS EN 10217-7 pipe, to BS EN 10253-4, weld factor 1.0, with pickled descaled finish and suitable for the pipeline full service pressure at elevated temperature. Use only fittings of steel grade 1.4307 (formerly 304S11 / 304L) or 1.4432 (formerly 316S13 / 316L) and whose finished minimum wall thickness is at least equal to that of the pipe to which they are fitted with the exceptions indicated below:

Nominal diameter (mm)	Minimum wall thickness (mm)
50	2.0
65	2.0
80	2.0
100	2.5

Unless specified otherwise workshop made pulled (square) tees may be used in place of swept tees.

334 Flanges

Use pressed collars or tafted pipe ends in combination with PN16 backing ring flanges. Collars to BS EN 1092-1, figure 1, type 35, 36 or 37 and backing rings to figure 1, type 02. Bore and chamfer backing rings to suit the collars/tafted pipe ends.

For all flange backing rings use S235JR grade steel to BS EN 10025-2 or cast steel to BS EN 10213-2 grade GP240GH or forged steel to BS EN 10222-2 grade P245GH. Use flange backing rings with a fusion-bonded epoxy coating or bright zinc plated coating.

335 Flange gaskets

Use compressed sheet flange gaskets of aramid and inorganic fibre with nitrile rubber binder to BS 7531 grade X and BS EN 1514 and suitable for condensate at 10 bar gauge and 110°C.

336 Flange bolts, nuts & washers

Use bolts and nuts complying with BS ISO 8992 and BS EN ISO 898. Bolts grade 8.8 and nuts grade 8, material group 3EO. Bolts and nuts to be bright zinc plated in accordance with BS EN ISO 4042.

Use bolts faced under the head with machined shank. Use nuts faced on one side. Use ISO metric coarse screwed threads.

Use washers to BS EN ISO 887 bright zinc plated to BS EN ISO 4042 and faced on both sides. Fit washers under both bolt head and nut.

337 Pipe wrap

At each pipe support location wrap the pipe in aluminium foil prior to installing the insulated pipe support ring/block. Extend the aluminium foil a minimum of 75 mm either side of the support block/ring to enable an overlap to be achieved when installing the remainder of the aluminium foil.

After leak testing and prior to applying the insulation carefully wrap all condensate pipes and fittings in aluminium foil.

Comply fully with product and installation requirements stated in BS 5970. Use foil with a thickness not less than 0.06 mm.

400 HIGH TEMPERATURE HOT WATER PIPELINES

410 High temperature hot water pipelines – 10 bar (black steel)

411 Application

For all HTHW pipelines with maximum working pressure of 10.3 bar gauge and temperature 120°C - 180°C.

Weld or screw all joints in exposed HTHW pipework up to and including 25 mm. Weld all other joints.

412 Pipe

Refer to the particular specification clauses (particularly T series sections) to determine whether seamless pipe is to be used for this project.

For pipework from 10 mm up to and including 25 mm nominal diameter use tube to BS EN 10255, heavy series, P235TR1 steel, with factory-applied red paint finish and plain ends or screwed to BS EN 10226 taper.

Minimum wall thicknesses as follows:

Nominal diameter (mm)	Minimum wall thickness (mm)	Outside diameter (mm)
10	2.9	17.2
15	3.2	21.3
20	3.2	26.9
25	4.0	33.7

For pipe sizes greater than 25 mm nominal where use of seamless tube is a specified project requirement use only the seamless specification otherwise use either the seamless or the high frequency induction welded specification:

High frequency induction welded tube

Use high frequency induction welded (HFIW) steel tube, with protective varnish finish, made from fully traceable, high quality fully killed steel all to BS EN 10217-2 grade P235GH/TC1.

Ensure both the external and internal weld beads have been fully trimmed and removed on all pipe used.

All tubes to be either hot finish full body normalised or made from normalised strip with annealed weld line.

For sizes up to and including 150 mm use only tubes which have had their weld seams both ultrasonically and eddy current tested. For sizes 200 mm and above use only tubes whose weld seams have been ultrasonically tested and which have been hydraulically tested for pressure integrity.

Seamless tube

Use hot finished seamless steel tube with protective varnish finish, made from fully traceable, high quality fully killed steel all to BS EN 10216-2 grade P235GH/TC1. Alternatively use hot finished tube which meets either the ASTM A106M grade B or API 5L grade B standard.

Minimum wall thicknesses are as follows for both HFIW and seamless pipe:

Nominal diameter (mm)	Minimum wall thickness (mm)	Outside diameter (mm)
32	4.5	42.4
40	5.0	48.3
50	5.0	60.3
65	5.0	76.1
80	5.0	88.9
100	8.0	114.3
125	8.0	139.7
150	10.0	168.3
200	12.5	219.1
250	12.5	273.0
300	12.5	323.9
350	16.0	355.6
400	16.0	406.4
450	16.0	457.0
500	16.0	508.0

413 Fittings

Use only fittings whose finished minimum wall thickness is at least equal to that of the pipe to which they are fitted, and which are suitable for the full service pressure and temperature.

For sizes 25 mm nominal diameter and below use fittings to BS EN 10241 wrought steel, heavy series, screwed BS EN 10226 taper, with varnish finish.

For sizes from 25 mm to 500 mm nominal diameter use only normalised seamless carbon steel butt welding fittings to BS EN 10253-2 type B, to the same steel grade as the pipe, with varnish finish and suitable for the pipeline full service pressure at elevated temperature. Where using seamless pipe to ASTM/API standards use normalised seamless fittings to ANSI/ASME B16.9 and ASTM A234M or matching API standard.

414 Unions for pipe sizes up to and including 20 mm

Use wrought steel, navy pattern unions with bronze seats PN25 to BS EN 10241 heavy.

415 Flanges: Mild steel, raised face

For pipe sizes 15 mm to 25 mm use screwed boss type flanges to BS EN 1092-1, figure 1, type 13, PN25 screwed to BS EN 10226 taper or use welded flanges to the specification below.

For pipe sizes up to and including 500 mm and taking due account of the need to test welds, use hubbed slip-on weld flanges to BS EN 1092-1, figure 1, type 12 PN25.

For all flanges use S235JR grade steel to BS EN 10025-2 or forged steel to BS EN 10222-2 grade P245GH.

Where using seamless pipe to ASTM standards use weld-neck flanges, whose wall thickness matches that of the pipe, to ASTM A105M and ASME/ANSI B16.5, At interfaces with fittings and equipment to European specifications install flanges drilled to suit the necessary hole size/spacing.

416 Flange gaskets

Use compressed sheet flange gaskets of aramid and inorganic fibre with nitrile rubber binder to BS 7531 grade X and BS EN 1514 and suitable for HTHW at 10.3 bar gauge and 180°C.

Alternatively, or where particularly specified, use metallic spiral wound gaskets with support ring all to BS EN 1514 and suitable for HTHW at 10.3 bar gauge and 180°C.

417 Flange bolts, nuts & washers

Comply with BS EN 1515. Use bolts of grade 8.8 and nuts grade 8, material group 3EO. Bolts and nuts to be bright zinc plated in accordance with BS EN ISO 4042.

Use bolts faced under the head with machined shank. Use nuts faced on one side. Use ISO metric coarse screwed threads.

Use washers to BS EN ISO 887 bright zinc plated to BS EN ISO 4042 and faced on both sides. Fit washers under both bolt head and nut.

420 High temperature hot water pipelines – 25 bar (black steel)

421 Application

For all HTHW pipelines with maximum working pressure of 25 bar gauge and maximum temperature 180°C.

Weld all joints in HTHW pipework.

422 Pipe

Refer to the particular specification clauses (particularly T series sections) to determine whether seamless pipe is to be used for this project.

For all pipe sizes where use of seamless tube is a specified project requirement use only the seamless specification otherwise use either the seamless or the high frequency induction welded specification:

High frequency induction welded tube

Use high frequency induction welded (HFIW) steel tube, with protective varnish finish, made from fully traceable, high quality fully killed steel all to BS EN 10217-2 grade P235GH/TC1.

Ensure both the external and internal weld beads have been fully trimmed and removed on all pipe used.

All tubes to be either hot finish full body normalised or made from normalised strip with annealed weld line.

For sizes up to and including 150 mm use only tubes which have had their weld seams both ultrasonically and eddy current tested. For sizes 200 mm and above use only tubes whose weld seams have been ultrasonically tested and which have been hydraulically tested for pressure integrity.

Seamless tube

Use hot finished seamless steel tube with protective varnish finish, made from fully traceable, high quality fully killed steel all to BS EN 10216-2 grade P235GH/TC1. Alternatively use hot finished tube which meets either the ASTM A106M grade B or API 5L grade B standard.

Minimum wall thicknesses are as follows for both HFIW and seamless pipe:

Nominal diameter (mm)	Minimum wall thickness (mm)	Outside diameter (mm)
10	2.9	17.2
15	3.2	21.3
20	3.2	26.9
25	4.0	33.7
32	4.5	42.4
40	5.0	48.3
50	5.0	60.3
65	5.0	76.1
80	5.0	88.9
100	8.0	114.3
125	8.0	139.7
150	10.0	168.3
200	12.5	219.1
250	12.5	273.0
300	12.5	323.9
350	16.0	355.6
400	16.0	406.4
450	16.0	457.0
500	16.0	508.0

423 Fittings

Use only fittings whose finished minimum wall thickness is at least equal to that of the pipe to which they are fitted, and which are suitable for the full service pressure and temperature.

For all sizes use only normalised seamless carbon steel butt welding fittings to BS EN 10253-2 type B, to the same steel grade as the pipe, with varnish finish and suitable for the pipeline full service pressure at elevated temperature. Where using seamless pipe to ASTM/API standards use normalised seamless fittings to ANSI/ASME B16.9 and ASTM A234M or matching API standard.

424 Flanges: Mild steel, raised face

For all pipe sizes up to and including 500 mm and taking due account of the need to test welds, use hubbed slip-on weld flanges to BS EN 1092-1, figure 1, type 12 PN40.

For all flanges use S235JR grade steel to BS EN 10025-2 or forged steel to BS EN 10222-2 grade P245GH.

Where using seamless pipe to ASTM standards use weld-neck flanges, whose wall thickness matches that of the pipe, to ASTM A105M and ASME/ANSI B16.5, At interfaces with fittings and equipment to European specifications install flanges drilled to suit the necessary hole size/spacing.

425 Flange gaskets

Use metallic spiral wound gaskets with support ring all to BS EN 1514 and suitable for HTHW at 25 bar gauge and 180°C.

426 Flange bolts, nuts & washers

Comply with BS EN 1515. Use bolts of grade 8.8 and nuts grade 8, material group 3EO. Bolts and nuts to be bright zinc plated in accordance with BS EN ISO 4042.

Use bolts faced under the head with machined shank. Use nuts faced on one side. Use ISO metric coarse screwed threads.

Use washers to BS EN ISO 887 bright zinc plated to BS EN ISO 4042 and faced on both sides. Fit washers under both bolt head and nut.

500 MEDIUM TEMPERATURE HOT WATER PIPELINES

510 Medium temperature hot water pipelines (black steel)

511 Application

For all MTHW pipelines with maximum temperature of 120°C and maximum working pressure of either 6 bar gauge or 16 bar gauge.

Weld or screw all joints in exposed MTHW pipework up to and including 25 mm. Weld all other joints.

512 Pipe

Refer to the particular specification clauses (particularly T series sections) to determine whether seamless pipe is to be used for this project.

For pipework from 10 mm up to and including 150 mm nominal diameter, where use of seamless tube is not a specified project requirement, use tube to BS EN 10255, heavy series, P235TR1 steel, with factory-applied red paint finish and plain ends.

Minimum wall thicknesses are as follows:

Nominal diameter (mm)	Minimum wall thickness (mm)	Outside diameter (mm)
10	2.9	17.2
15	3.2	21.3
20	3.2	26.9
25	4.0	33.7
32	4.0	42.4
40	4.0	48.3
50	4.5	60.3

65	4.5	76.1
80	5.0	88.9
100	5.4	114.3
125	5.4	139.7
150	5.4	165.1

Where use of seamless tube is a specified project requirement, for all sizes from 32 mm up to and including 500 mm, use the seamless specification only. Otherwise, for pipe sizes greater than 150 mm up to and including 500 mm nominal, use either high frequency induction welded tube or seamless tube to the applicable following specification:

High frequency induction welded tube

Use high frequency induction welded (HFIW) steel tube, with protective varnish finish, made from fully traceable, high quality fully killed steel all to BS EN 10217-2 grade P235GH/TC1.

Ensure both the external and internal weld beads have been fully trimmed and removed on all pipe used.

All tubes to be either hot finish full body normalised or made from normalised strip with annealed weld line.

For sizes up to and including 150 mm use only tubes which have had their weld seams both ultrasonically and eddy current tested. For sizes 200 mm and above use only tubes whose weld seams have been ultrasonically tested and which have been hydraulically tested for pressure integrity.

Seamless tube

Use hot finished seamless steel tube with protective varnish finish, made from fully traceable, high quality fully killed steel all to BS EN 10216-2 grade P235GH/TC1. Alternatively use hot finished tube which meets either the ASTM A106M grade B or API 5L grade B standard.

Minimum wall thicknesses are as follows for both HFIW and seamless pipe:

Nominal diameter (mm)	Minimum wall thickness (mm)	Outside diameter (mm)
32	4.0	42.4
40	4.0	48.3
50	4.5	60.3
65	4.5	76.1
80	5.0	88.9
100	5.4	114.3
125	5.4	139.7
150	5.4	165.1
200	8.0	219.1
250	8.0	273.0

300	10.0	323.9
350	10.0	355.6
400	12.5	406.4
450	12.5	457.0
500	12.5	508.0

513 Fittings

For operating pressures up to 6 bar gauge for screwed joints use malleable cast iron, reinforced pattern fittings to BS 143 and 1256, or to BS EN 10242 or wrought steel fittings, heavy, to BS EN 10241, all screwed BS EN 10226 taper.

For operating pressures up to 16 bar gauge for screwed joints use wrought steel fittings, heavy, to BS EN 10241, all screwed BS EN 10226 taper.

For welded joints use welding fittings of the same steel grade and whose finished minimum wall thickness is at least equal to that of the pipe to which they are fitted, and which are suitable for the full service pressure.

Use normalised seamless carbon steel butt welding type fittings to BS EN 10253-2 type B with varnish finish and suitable for the pipeline full service pressure at elevated temperature. Where using seamless pipe to ASTM/API standards use normalised seamless fittings to ANSI/ASME B16.9 and ASTM A234M or matching API standard.

514 Unions for pipe sizes up to and including 20 mm

Use wrought steel, navy pattern unions with bronze seats PN25 to BS EN 10241 heavy.

515 Flanges: Mild steel raised face

For operating pressures up to 6 bar gauge, for pipe sizes up to and including 500 mm and taking due account of the need to test welds, use either slip-on weld flanges to BS EN 1092-1, figure 1, type 12 PN10 or weld-neck flanges to BS EN 1092-1 figure 1, type 11 PN10. Where weld-neck flanges are used ensure that the neck wall thickness and internal and external diameters match those of the pipework to which it is attached and not as the standard BS EN 1092-1 neck detail for PN10 flanges.

For operating pressures up to 16 bar gauge for all pipe sizes up to and including 500 mm and taking due account of the need to test welds, use hubbed slip-on weld flanges to BS EN 1092-1, figure 1, type 12 PN25.

Where using seamless pipe to ASTM standards use weld-neck flanges, whose wall thickness matches that of the pipe, to ASTM A105M and ASME/ANSI B16.5, At interfaces with fittings and equipment to European specifications install flanges drilled to suit the necessary hole size/spacing.

For all except ASTM/ASME compliant flanges use S235JR grade steel to BS EN 10025-2 or forged steel to BS EN 10222-2 grade P245GH.

516 Flange gaskets

Use compressed sheet flange gaskets of aramid and inorganic fibre with nitrile rubber binder to BS 7531 grade X and BS EN 1514 and suitable for MTHW at 120°C and either 6 bar gauge or 16 bar gauge as appropriate.

Alternatively, or where particularly specified, use metallic spiral wound gaskets with support ring all to BS EN 1514 and suitable for MTHW at 16 bar gauge and 120°C

517 Flange bolts, nuts & washers

Use bolts and nuts complying with BS ISO 8992 and BS EN ISO 898. Bolts grade 8.8 and nuts grade 8, material group 3EO. Bolts and nuts to be bright zinc plated in accordance with BS EN ISO 4042.

Use bolts faced under the head with machined shank. Use nuts faced on one side. Use ISO metric coarse screwed threads.

Use washers to BS EN ISO 887 bright zinc plated to BS EN ISO 4042 and faced on both sides. Fit washers under both bolt head and nut.

600 LOW TEMPERATURE HOT WATER PIPELINES

610 Low temperature hot water pipelines (black steel) not exceeding 6 bar gauge

611 Application

For all LTHW pipelines with maximum temperature of 95°C and maximum working pressure of 6 bar gauge. For joints on LTHW pipework up to and including 50 mm and where not concealed, use either welded or screwed methods. Weld all other joints and all joints 65 mm and above.

Alternatively, use grooved couplings on joints 65 mm and above where not concealed.

612 Pipe

For pipework from 10 mm up to and including 150 mm nominal diameter, where concealed, use tube to BS EN 10255, heavy series, P235TR1 steel, with factory-applied red paint finish and plain/screwed ends. Screwed ends to BS EN 10226 taper.

Heavy series pipe minimum wall thicknesses as follows:

Nominal diameter (mm)	Minimum wall thickness (mm)	Outside diameter (mm)
10	2.9	17.2
15	3.2	21.3
20	3.2	26.9
25	4.0	33.7
32	4.0	42.4
40	4.0	48.3
50	4.5	60.3
65	4.5	76.1
80	5.0	88.9
100	5.4	114.3
125	5.4	139.7
150	5.4	165.1

For pipework from 10 mm up to and including 150 mm, where not concealed, except sizes 20 mm, 40 mm and 65 mm nominal diameter use tube to BS EN 10255, medium series, P235TR1 steel, with factory-applied red paint finish and plain/screwed ends. Screwed ends to BS EN 10226 taper. For 20 mm, 40 mm and 65 mm sizes use heavy series steel pipe.

Medium series pipe minimum wall thicknesses as follows:

Nominal diameter (mm)	Minimum wall thickness (mm)	Outside diameter (mm)
10	2.3	17.2
15	2.6	21.3
20	3.2*	26.9
25	3.2	33.7
32	3.2	42.4
40	4.0*	48.3
50	3.6	60.3
65	4.5*	76.1
80	4.0	88.9
100	4.5	114.3
125	5.0	139.7
150	5.0	165.1
	* Heavy series	

Do not install medium series steel tube in any location without direct access or where permanently concealed. In those instances use heavy series steel pipe.

For pipework from 200 mm up to 500 mm nominal diameter use high frequency induction welded (HFIW) steel tube, with protective varnish finish, made from fully traceable, high quality fully killed steel all to BS EN 10217-2 grade P235GH/TC1.

Ensure both the external and internal weld beads have been fully trimmed and removed on all pipe used.

All tubes to be either hot finish full body normalised or made from normalised strip with annealed weld line.

For sizes 200 mm and above use only tubes whose weld seams have been ultrasonically tested and which have been hydraulically tested for pressure integrity.

HFIW pipe minimum wall thicknesses as follows:

Nominal diameter (mm)	Minimum wall thickness (mm)	Outside diameter (mm)
200	8.0	219.1
250	8.0	273.0
300	10.0	323.9
350	10.0	355.6

400	12.5	406.4
450	12.5	457.0
500	12.5	508.0

613 Fittings

For screwed joints use malleable cast iron, reinforced pattern fittings to BS 143 and 1256, or to BS EN 10242 or wrought steel fittings, heavy/medium to suit the pipe, to BS EN 10241, all screwed BS EN 10226 taper.

For welded joints use normalised seamless carbon steel butt welding fittings to BS EN 10253-2 type B with varnish finish and suitable for the pipeline full service pressure at elevated temperature. Use only fittings of the same steel grade and whose finished minimum wall thickness is at least equal to that of the pipe to which they are fitted, and which are suitable for the full service pressure.

For grooved joints use grooved end, ductile iron cast fittings to ASTM A-536 grade 65-45-12, wrought steel, or factory fabricated and tested from ASTM A-53 pipe.

614 Unions

Use malleable cast iron, reinforced pattern unions with ground-in spherical bronze seats to BS 143 and 1256, or to BS EN 10242, all screwed BS EN 10226 taper.

615 Flanges: Mild steel, raised face

For pipe sizes up to and including 50 mm use screwed boss type flanges to BS EN 1092-1, figure 1, type 13 all to PN10 or welded flanges to the specification below.

For pipe sizes from 65 mm up to and including 500 mm and taking due account of the need to test welds, use either hubbed slip-on weld flanges to BS EN 1092-1, figure 1, type 12 PN10 or weld-neck flanges to BS EN 1092-1 figure 1, type 11 PN10. Where weld-neck flanges are used ensure that the neck wall thickness and internal and external diameters match those of the pipework to which it is attached and not as the standard BS EN 1092-1 neck detail for PN10 flanges.

For all flanges use S235JR grade steel to BS EN 10025-2 or forged steel to BS EN 10222-2 grade P245GH.

616 Flange gaskets

Use compressed sheet flange gaskets of aramid and inorganic fibre with nitrile rubber binder to BS 7531 grade X and BS EN 1514 and suitable for LTHW at 6 bar gauge and 95°C.

617 Flange bolts, nuts & washers

Use bolts and nuts complying with BS ISO 8992 and BS EN ISO 898. Bolts grade 8.8 and nuts grade 8, material group 3EO. Bolts and nuts to be bright zinc plated in accordance with BS EN ISO 4042.

Use bolts faced under the head with machined shank. Use nuts faced on one side. Use ISO metric coarse screwed threads.

Use washers to BS EN ISO 887 bright zinc plated to BS EN ISO 4042 and faced on both sides. Fit washers under both bolt head and nut.

618 Grooved joint couplings

Use grooved joint couplings consisting of up to four ductile iron housing segments to ASTM A-536 grade 65-45-12, pressure responsive gasket to ASTM D2000 rated for water service to 110ºC. Use nuts, bolts and washers to manufacturers standard; either zinc-electroplated carbon steel heat-treated bolts and nuts meeting the physical and chemical requirements of ASTM A-449 and physical requirements of

ASTM A-183 or use bolts to ASTM F568M, nuts to ASTM A563M Class 9 and coatings to ASTM B633 SC1.

620 Low temperature hot water pipelines (black steel) above 6 bar gauge and not exceeding 16 bar gauge

621 Application

For all LTHW pipelines with maximum temperature of 95°C and maximum working pressure of 16 bar gauge.

Weld or screw all joints in exposed LTHW pipework up to and including 25 mm. Weld all other joints.

622 Pipe

Refer to the particular specification clauses (particularly T series sections) to determine whether seamless pipe is to be used for this project.

For pipework from 10 mm up to and including 150 mm nominal diameter, where use of seamless tube is not a specified project requirement, use tube to BS EN 10255, heavy series, P235TR1 steel, with factory-applied red paint finish and plain ends.

Minimum wall thicknesses are as follows:

Nominal diameter (mm)	Minimum wall thickness (mm)	Outside diameter (mm)
10	2.9	17.2
15	3.2	21.3
20	3.2	26.9
25	4.0	33.7
32	4.0	42.4
40	4.0	48.3
50	4.5	60.3
65	4.5	76.1
80	5.0	88.9
100	5.4	114.3
125	5.4	139.7
150	5.4	165.1

Where use of seamless tube is a specified project requirement, for all sizes from 32 mm up to and including 500 mm, use the seamless specification only. Otherwise, for pipe sizes greater than 150 mm up to and including 500 mm nominal, use either high frequency induction welded tube or seamless tube to the applicable following specification:

High frequency induction welded tube

Use high frequency induction welded (HFIW) steel tube, with protective varnish finish, made from fully traceable, high quality fully killed steel all to BS EN 10217-2 grade P235GH/TC1.

Ensure both the external and internal weld beads have been fully trimmed and removed on all pipe used.

All tubes to be either hot finish full body normalised or made from normalised strip with annealed weld line.

For sizes up to and including 150 mm use only tubes which have had their weld seams both ultrasonically and eddy current tested. For sizes 200 mm and above use only tubes whose weld seams have been ultrasonically tested and which have been hydraulically tested for pressure integrity.

Seamless tube

Use hot finished seamless steel tube with protective varnish finish, made from fully traceable, high quality fully killed steel all to BS EN 10216-2 grade P235GH/TC1. Alternatively use hot finished tube which meets either the ASTM A106M grade B or API 5L grade B standard.

Minimum wall thicknesses are as follows for both HFIW and seamless pipe:

Nominal diameter (mm)	Minimum wall thickness (mm)	Outside diameter (mm)
32	4.0	42.4
40	4.0	48.3
50	4.5	60.3
65	4.5	76.1
80	5.0	88.9
100	5.4	114.3
125	5.4	139.7
150	5.4	165.1
200	8.0	219.1
250	8.0	273.0
300	10.0	323.9
350	10.0	355.6
400	12.5	406.4
450	12.5	457.0
500	12.5	508.0

623 Fittings

For operating pressures up to 16 bar gauge for screwed joints use wrought steel fittings, heavy, to BS EN 10241, all screwed BS EN 10226 taper.

For welded joints use welding fittings of the same steel grade and whose finished minimum wall thickness is at least equal to that of the pipe to which they are fitted, and which are suitable for the full service pressure.

Use normalised seamless carbon steel butt welding type fittings to BS EN 10253-2 type B with varnish finish and suitable for the pipeline full service pressure at elevated temperature. Where using seamless pipe to ASTM/API standards use normalised seamless fittings to ANSI/ASME B16.9 and ASTM A234M or matching API standard.

624 Unions for pipe sizes up to and including 20 mm

Use wrought steel, navy pattern unions with bronze seats PN25 to BS EN 10241 heavy.

625 Flanges: Mild steel, raised face

For operating pressures up to 16 bar gauge for all pipe sizes up to and including 500 mm and taking due account of the need to test welds, use hubbed slip-on weld flanges to BS EN 1092-1, figure 1, type 12 PN25.

Where using seamless pipe to ASTM standards use weld-neck flanges, whose wall thickness matches that of the pipe, to ASTM A105M and ASME/ANSI B16.5, At interfaces with fittings and equipment to European specifications install flanges drilled to suit the necessary hole size/spacing.

For all except ASTM/ASME compliant flanges use S235JR grade steel to BS EN 10025-2 or forged steel to BS EN 10222-2 grade P245GH.

626 Flange gaskets

Use compressed sheet flange gaskets of aramid and inorganic fibre with nitrile rubber binder to BS 7531 grade X and BS EN 1514 and suitable for LTHW at 16 bar gauge and 95°C.

Alternatively, or where particularly specified, use metallic spiral wound gaskets with support ring all to BS EN 1514 and suitable for LTHW at 16 bar gauge and 95°C

627 Flange bolts, nuts & washers

Use bolts and nuts complying with BS ISO 8992 and BS EN ISO 898. Bolts grade 8.8 and nuts grade 8, material group 3EO. Bolts and nuts to be bright zinc plated in accordance with BS EN ISO 4042.

Use bolts faced under the head with machined shank. Use nuts faced on one side. Use ISO metric coarse screwed threads.

Use washers to BS EN ISO 887 bright zinc plated to BS EN ISO 4042 and faced on both sides. Fit washers under both bolt head and nut.

630 Low temperature hot water pipelines (black steel) above 16 bar gauge and not exceeding 25 bar gauge

631 Application

For all LTHW pipelines with maximum temperature of 95°C and maximum working pressure of 25 bar gauge.

Weld all joints in LTHW pipework.

632 Pipe

Refer to the particular specification clauses (particularly T series sections) to determine whether seamless pipe is to be used for this project.

For all pipe sizes where use of seamless tube is a specified project requirement use only the seamless specification otherwise use either the seamless or the high frequency induction welded specification:

High frequency induction welded tube

Use high frequency induction welded (HFIW) steel tube, with protective varnish finish, made from fully traceable, high quality fully killed steel all to BS EN 10217-2 grade P235GH/TC1.

Ensure both the external and internal weld beads have been fully trimmed and removed on all pipe used.

All tubes to be either hot finish full body normalised or made from normalised strip with annealed weld line.

For sizes up to and including 150 mm use only tubes which have had their weld seams both ultrasonically and eddy current tested. For sizes 200 mm and above use only tubes whose weld seams have been ultrasonically tested and which have been hydraulically tested for pressure integrity.

Seamless tube

Use hot finished seamless steel tube with protective varnish finish, made from fully traceable, high quality fully killed steel all to BS EN 10216-2 grade P235GH/TC1. Alternatively use hot finished tube which meets either the ASTM A106M grade B or API 5L grade B standard.

Minimum wall thicknesses are as follows for both HFIW and seamless pipe:

Nominal diameter (mm)	Minimum wall thickness (mm)	Outside diameter (mm)
10	2.9	17.2
15	3.2	21.3
20	3.2	26.9
25	4.0	33.7
32	4.5	42.4
40	5.0	48.3
50	5.0	60.3
65	5.0	76.1
80	5.0	88.9
100	8.0	114.3
125	8.0	139.7
150	10.0	168.3
200	12.5	219.1
250	12.5	273.0
300	12.5	323.9
350	16.0	355.6
400	16.0	406.4
450	16.0	457.0
500	16.0	508.0

633 Fittings

Use only fittings whose finished minimum wall thickness is at least equal to that of the pipe to which they are fitted, and which are suitable for the full service pressure and temperature.

For all sizes use only normalised seamless carbon steel butt welding fittings to BS EN 10253-2 type B, to the same steel grade as the pipe, with varnish finish and suitable for the pipeline full service pressure at elevated temperature. Where using seamless pipe to ASTM/API standards use normalised seamless fittings to ANSI/ASME B16.9 and ASTM A234M or matching API standard.

634 Flanges: Mild steel, raised face

For all pipe sizes up to and including 500 mm and taking due account of the need to test welds, use hubbed slip-on weld flanges to BS EN 1092-1, figure 1, type 12 PN40.

For all flanges use S235JR grade steel to BS EN 10025-2 or forged steel to BS EN 10222-2 grade P245GH.

Where using seamless pipe to ASTM standards use weld-neck flanges, whose wall thickness matches that of the pipe, to ASTM A105M and ASME/ANSI B16.5, At interfaces with fittings and equipment to European specifications install flanges drilled to suit the necessary hole size/spacing.

635 Flange gaskets

Use metallic spiral wound gaskets with support ring all to BS EN 1514 and suitable for LTHW at 25 bar gauge and 95°C.

636 Flange bolts, nuts & washers

Comply with BS EN 1515. Use bolts of grade 8.8 and nuts grade 8, material group 3EO. Bolts and nuts to be bright zinc plated in accordance with BS EN ISO 4042.

Use bolts faced under the head with machined shank. Use nuts faced on one side. Use ISO metric coarse screwed threads.

Use washers to BS EN ISO 887 bright zinc plated to BS EN ISO 4042 and faced on both sides. Fit washers under both bolt head and nut.

640 Low temperature hot water pipelines (copper) not exceeding 6 bar gauge

641 Application

For all LTHW pipelines up to 108 mm with maximum temperature of 95°C and maximum working pressure of 6 bar gauge.

Only use R220 sizes 8, 10 and 12 mm in concealed parts of domestic installations and where shown and sized on the scheme drawings for run outs to individual radiators fed from manifolds or to feed plastic underfloor heating pipework.

For joints on pipework up to and including 54 mm and not concealed, use capillary soldered fittings and unions. For all other joints use brazed fittings and flanges where not concealed. Use brazed fittings where concealed.

642 Pipe

For pipe sizes from 8 mm up to 12 mm use R220 annealed copper tube and for sizes from 15 mm to 54 mm use R250 half hard copper tube all to BS EN 1057, grade CuDHP/CW024A, and having a 25-year guarantee.

For pipe sizes 67 mm and above, and for short connections between tube and screwed components for pipe sizes 35 mm and above, use copper tube to BS EN 1057, type R290 hard, grade CuDHP/CW024A and, having a 25-year guarantee.

Minimum wall thicknesses as follows:

Nominal diameter (mm)	Pipe type	Wall thickness (mm)
8,10 &12	R220	0.6
15	R250	0.7
22 & 28	R250	0.9
35, 42 & 54	R250 *	1.2
67	R290	1.2
76 & 108	R290	1.5

* R290 for short connections between tube and screwed components

643 Fittings and unions

Use capillary type copper or dezincification resistant copper alloy fittings and unions to BS EN 1254-1 with 99/1 tin/copper soft solder integral rings to BS EN ISO 9453 alloy 401.

Use capillary brazing type copper or dezincification resistant copper alloy fittings to BS EN 1254-1 or BS EN 1254-5 with silver alloy brazing metal, type AG 155, to BS EN ISO 17672, Table 6.

644 Flanges

Use slip-on flange backing rings of mild steel over CuDHP/CW024A or CC498K copper alloy collars, capillary type to BS EN 1092-3, type 07, 37 PN10 with silver alloy brazing metal, type AG 155 to BS EN ISO 17672, Table 6, and protected against electrolytic action and corrosion.

645 Flange gaskets

Use compressed sheet flange gaskets of aramid and inorganic fibre with nitrile rubber binder to BS 7531 grade X and BS EN 1514 and suitable for LTHW at 6 bar gauge and 95°C.

646 Flange bolts, nuts & washers

Use bolts and nuts complying with BS ISO 8992 and BS EN ISO 898. Bolts grade 8.8 and nuts grade 8, material group 3EO. Bolts and nuts to be bright zinc plated in accordance with BS EN ISO 4042.

Use bolts faced under the head with machined shank. Use nuts faced on one side. Use ISO metric coarse screwed threads.

Use washers to BS EN ISO 887 bright zinc plated to BS EN ISO 4042 and faced on both sides. Fit washers under both bolt head and nut.

650 Low temperature hot water pipelines (copper) above 6 bar gauge but not exceeding 16 bar gauge

651 Application

For internal LTHW pipelines up to 108 mm with maximum temperature of 95°C and maximum working pressure of 16 bar gauge. For all parts of the system where the maximum working pressure is above 6 bar gauge, use brazed fittings and flanged joints.

652 Pipe

For pipe sizes up to and including 54 mm use copper tube to BS EN 1057, type R250 half hard, grade CuDHP/CW024A, and having a 25-year guarantee.

For pipe sizes 67 mm and above, and for short connections between tube and screwed components for pipe sizes 35 mm and above, use copper tube to BS EN 1057, type R290 hard, grade CuDHP/CW024A and having a 25-year guarantee. Minimum wall thicknesses as follows:

Nominal diameter (mm)	Pipe type	Wall thickness (mm)
15	R250	0.7
22 & 28	R250	0.9
35, 42 & 54	R250 *	1.2
67	R290	2.0
76	R290	2.0
108	R290	2.5

* R290 for short connections between tube and screwed components

653 Fittings

Use capillary brazing type copper or dezincification resistant copper alloy fittings to BS EN 1254-1 or BS EN 1254-5 with silver alloy brazing metal, type AG 155, to BS EN ISO 17672, Table 6. Alternative acceptable brazing alloys are: AG140, and, where nickel is not present, CuP179, CuP182, CuP279, CuP281 or CuP284.

Where fittings have screwed threads ensure that they comply with BS EN 10226-2 and that the joint uses tapered internal and external threads.

654 Flanges

Use slip-on flange backing rings of mild steel over CuDHP/CW024A or CC498K copper alloy collars, capillary type to BS EN 1092-3, type 07, 37 PN16 with silver alloy brazing metal, type AG 155 to BS EN ISO 17672, Table 6, and protected against electrolytic action and corrosion.

655 Flange gaskets

Use compressed sheet flange gaskets of aramid and inorganic fibre with nitrile rubber binder to BS 7531 grade X and BS EN 1514 and suitable for LTHW at 16 bar gauge and 95°C.

656 Flange bolts, nuts & washers

Use bolts and nuts complying with BS ISO 8992 and BS EN ISO 898. Bolts grade 8.8 and nuts grade 8, material group 3EO. Bolts and nuts to be bright zinc plated in accordance with BS EN ISO 4042.

Use bolts faced under the head with machined shank. Use nuts faced on one side. Use ISO metric coarse screwed threads.

Use washers to BS EN ISO 887 bright zinc plated to BS EN ISO 4042 and faced on both sides. Fit washers under both bolt head and nut.

660 Low temperature hot water pipelines (thin wall welded stainless steel) not exceeding 6 bar gauge

661 Application

For all LTHW pipelines up to 500 mm nominal diameter with maximum temperature of 95°C and maximum working pressure of 6 bar gauge.

Use only butt joints and weld all joints. Workshop fabricate pipe sections/spools with flanged ends for site installation. Site made welds are only acceptable where unavoidable and few in number compared to the workshop made welds.

Do not install flanges in concealed locations.

662 Pipe

Use plain end longitudinally welded stainless steel tube manufactured to BS EN 10217-7 and BS EN ISO 1127, with outside weld bead ground flush, weld factor equal to 1.0 and pickled descaled finish.

Use stainless steel to BS EN 10088-2 grade 1.4307 (formerly 304S11 / 304L).

Dimensions as follows:

Nominal diameter (mm)	Minimum wall thickness (mm)	Outside diameter (mm)
25	1.5	28
32	1.5	35
40	1.5	43
50	1.5	53
65	1.5	68
80	1.5	83
100	2.0	104
125	2.0	129
150	2.0	154
200	2.0	204
250	2.0	254
300	2.0	304
350	2.5	355
400	3.0	406
450	3.0	456
500	3.0	506

663 Fittings

Use stainless steel butt welding fittings, made from BS EN 10217-7 pipe, to BS EN 10253-4, weld factor 1.0, with pickled descaled finish and suitable for the pipeline full service pressure at elevated temperature. Use only fittings of steel grade 1.4307 (formerly 304S11 / 304L) or 1.4432 (formerly 316S13 / 316L) and whose finished minimum wall thickness is at least equal to that of the pipe to which they are fitted with the exceptions indicated below:

Nominal diameter (mm)	Minimum wall thickness (mm)

50	2.0
65	2.0
80	2.0
100	2.5
350	3.0

Unless specified otherwise workshop made pulled (square) tees may be used in place of swept tees.

664 Flanges

Use pressed collars or tafted pipe ends in combination with PN16 backing ring flanges. Collars to BS EN 1092-1, figure 1, type 35, 36 or 37 and backing rings to figure 1, type 02. Bore and chamfer backing rings to suit the collars/tafted pipe ends.

For all flange backing rings use S235JR grade steel to BS EN 10025-2 or cast steel to BS EN 10213-2 grade GP240GH or forged steel to BS EN 10222-2 grade P245GH. Use flange backing rings with a fusion-bonded epoxy coating or bright zinc plated coating.

665 Flange gaskets

Use compressed sheet flange gaskets of aramid and inorganic fibre with nitrile rubber binder to BS 7531 grade X and BS EN 1514 and suitable for LTHW at 6 bar gauge and 95°C.

666 Flange bolts, nuts & washers

Use bolts and nuts complying with BS ISO 8992 and BS EN ISO 898. Bolts grade 8.8 and nuts grade 8, material group 3EO. Bolts and nuts to be bright zinc plated in accordance with BS EN ISO 4042.

Use bolts faced under the head with machined shank. Use nuts faced on one side. Use ISO metric coarse screwed threads.

Use washers to BS EN ISO 887 bright zinc plated to BS EN ISO 4042 and faced on both sides. Fit washers under both bolt head and nut.

667 Pipe wrap

At each pipe support location wrap the pipe in aluminium foil prior to installing the insulated pipe support ring/block. Extend the aluminium foil a minimum of 75 mm either side of the support block/ring to enable an overlap to be achieved when installing the remainder of the aluminium foil.

After leak testing and prior to applying the insulation carefully wrap all LTHW pipes and fittings in aluminium foil.

Comply fully with product and installation requirements stated in BS 5970. Use foil with a thickness not less than 0.06 mm.

670 Low temperature hot water pipelines (thin wall welded stainless steel) above 6 bar gauge but not exceeding 16 bar gauge

671 Application

For all LTHW pipelines up to 500 mm nominal diameter with maximum working temperature of 95°C and maximum working pressure of 16 bar gauge.

Use only butt joints and weld all joints. Workshop fabricate pipe sections/spools with flanged ends for site installation. Site made welds are only acceptable where unavoidable and few in number compared to the workshop made welds.

Do not install flanges in concealed locations.

672 Pipe

Use plain end longitudinally welded stainless steel tube manufactured to BS EN 10217-7 and BS EN ISO 1127, with outside weld bead ground flush, weld factor equal to 1.0 and pickled descaled finish.

Use stainless steel to BS EN 10088-2 grade 1.4307 (formerly 304S11 / 304L).

Dimensions as follows:

Nominal diameter (mm)	Minimum wall thickness (mm)	Outside diameter (mm)
25	1.5	28
32	1.5	35
40	1.5	43
50	1.5	53
65	1.5	68
80	1.5	83
100	2.0	104
125	2.0	129
150	2.0	154
200	2.0	204
250	2.0	254
300	2.5	305
350	2.5	355
400	3.0	406
450	4.0	458
500	4.0	508

673 Fittings

Use stainless steel butt welding fittings, made from BS EN 10217-7 pipe, to BS EN 10253-4, weld factor 1.0, with pickled descaled finish and suitable for the pipeline full service pressure at elevated temperature. Use only fittings of steel grade 1.4307 (formerly 304S11 / 304L) or 1.4432 (formerly 316S13 / 316L) and whose finished minimum wall thickness is at least equal to that of the pipe to which they are fitted with the exceptions indicated below:

Nominal diameter (mm)	Minimum wall thickness (mm)
50	2.0
65	2.0

80	2.0
100	2.5
250	3.0
300	3.0
350	4.0
400	4.0
450	5.0
500	6.0

Unless specified otherwise workshop made pulled (square) tees may be used in place of swept tees.

674 Flanges

Use pressed collars or tafted pipe ends in combination with PN16 backing ring flanges. Collars to BS EN 1092-1, figure 1, type 35, 36 or 37 and backing rings to figure 1, type 02.

Bore and chamfer backing rings to suit the collars/tafted pipe ends.

For all flange backing rings use S235JR grade steel to BS EN 10025-2 or cast steel to BS EN 10213-2 grade GP240GH or forged steel to BS EN 10222-2 grade P245GH. Use flange backing rings with a fusion-bonded epoxy coating or bright zinc plated coating.

675 Flange gaskets

Use compressed sheet flange gaskets of aramid and inorganic fibre with nitrile rubber binder to BS 7531 grade X and BS EN 1514 and suitable for LTHW at 16 bar gauge and 95°C.

676 Flange bolts, nuts & washers

Use bolts and nuts complying with BS ISO 8992 and BS EN ISO 898. Bolts grade 8.8 and nuts grade 8, material group 3EO. Bolts and nuts to be bright zinc plated in accordance with BS EN ISO 4042.

Use bolts faced under the head with machined shank. Use nuts faced on one side. Use ISO metric coarse screwed threads.

Use washers to BS EN ISO 887 bright zinc plated to BS EN ISO 4042 and faced on both sides. Fit washers under both bolt head and nut.

677 Pipe wrap

At each pipe support location wrap the pipe in aluminium foil prior to installing the insulated pipe support ring/block. Extend the aluminium foil a minimum of 75 mm either side of the support block/ring to enable an overlap to be achieved when installing the remainder of the aluminium foil.

After leak testing and prior to applying the insulation carefully wrap all LTHW pipes and fittings in aluminium foil.

Comply fully with product and installation requirements stated in BS 5970. Use foil with a thickness not less than 0.06 mm.

680 Low temperature hot water pipelines (thin wall welded stainless steel) above 16 bar gauge but not exceeding 25 bar gauge

681 Application

For all LTHW pipelines up to 150 mm nominal diameter with maximum working temperature of 95°C and maximum working pressure of 25 bar gauge.

Use only butt joints and weld all joints. Workshop fabricate pipe sections/spools with flanged ends for site installation. Site made welds are only acceptable where unavoidable and few in number compared to the workshop made welds.

Do not install flanges in concealed locations.

682 Pipe

Use plain end longitudinally welded stainless steel tube manufactured to BS EN 10217-7 and BS EN ISO 1127, with outside weld bead ground flush, weld factor equal to 1.0 and pickled descaled finish.

Use stainless steel to BS EN 10088-2 grade 1.4307 (formerly 304S11 / 304L).

Dimensions as follows:

Nominal diameter (mm)	Minimum wall thickness (mm)	Outside diameter (mm)
50	2.0	54
65	2.0	69
80	2.0	84
100	2.0	104
125	2.0	129
150	3.0	156

683 Fittings

Use stainless steel butt welding fittings, made from BS EN 10217-7 pipe, to BS EN 10253-4, weld factor 1.0, with pickled descaled finish and suitable for the pipeline full service pressure at elevated temperature. Use only fittings of steel grade 1.4307 (formerly 304S11 / 304L) or 1.4432 (formerly 316S13 / 316L) and whose finished minimum wall thickness is at least equal to that of the pipe to which they are fitted with the exceptions indicated below, and which are suitable for the full service pressure:

Nominal diameter (mm)	Minimum wall thickness (mm)
125	3.0

Unless specified otherwise, workshop made pulled (square) tees may be used in place of swept tees.

684 Flanges

Use pressed collars or tafted pipe ends in combination with PN25 backing ring flanges. Collars to BS EN 1092-1, figure 1, type 35, 36 or 37 and backing rings to figure 1, type 02.

Bore and chamfer backing rings to suit the collars/tafted pipe ends.

For all flange backing rings use S235JR grade steel to BS EN 10025-2 or cast steel to BS EN 10213-2 grade GP240GH or forged steel to BS EN 10222-2 grade P245GH. Use flange backing rings with a fusion-bonded epoxy coating or bright zinc plated coating.

685 Flange gaskets

Use compressed sheet flange gaskets of aramid and inorganic fibre with nitrile rubber binder to BS 7531 grade X and BS EN 1514 and suitable for LTHW at 25 bar gauge and 95°C.

686 Flange bolts, nuts & washers

Use bolts and nuts complying with BS ISO 8992 and BS EN ISO 898. Bolts grade 8.8 and nuts grade 8, material group 3EO. Bolts and nuts to be bright zinc plated in accordance with BS EN ISO 4042.

Use bolts faced under the head with machined shank. Use nuts faced on one side. Use ISO metric coarse screwed threads.

Use washers to BS EN ISO 887 bright zinc plated to BS EN ISO 4042 and faced on both sides. Fit washers under both bolt head and nut.

687 Pipe wrap

At each pipe support location wrap the pipe in aluminium foil prior to installing the insulated pipe support ring/block. Extend the aluminium foil a minimum of 75 mm either side of the support block/ring to enable an overlap to be achieved when installing the remainder of the aluminium foil.

After leak testing and prior to applying the insulation carefully wrap all LTHW pipes and fittings in aluminium foil.

Comply fully with product and installation requirements stated in BS 5970. Use foil with a thickness not less than 0.06 mm.

690 Low temperature hot water pipelines (copper for press-fit jointing)

This pipework system is ONLY to be used on this project if expressly permitted in the pipework schedule and/or specification section T31.

691 Application

For internal LTHW pipelines up to 108 mm with maximum temperature of 82ºC and maximum working pressure of 6 bar gauge. Use press-fit jointing systems in internal locations where not concealed.

Do not use copper press-fit systems in concealed or external locations.

692 Pipe

For pipe sizes from 15 mm to 54 mm use R250 half hard copper tube all to BS EN 1057, grade CuDHP/CW024A, and having a 25-year guarantee.

For pipe sizes 67 mm and above use copper tube to BS EN 1057, type R290 hard, grade CuDHP/CW024A, and having a 25-year guarantee.

Minimum wall thicknesses as follows:

Nominal diameter (mm)	Pipe type	Wall thickness (mm)
15	R250	0.7
22 & 28	R250	0.9
35, 42 & 54	R250	1.2

67	R290	1.2
76 & 108	R290	1.2

693 Fittings

For internal installations only, use press-fit type fittings, in accordance with BS 8537, made from copper, Cu-DHP CW024A in accordance with BS EN 1412.

Use press-fit type fittings factory supplied complete with EPDM or CIIR black O-ring seals already fitted.

Use press-fit type fittings which incorporate visual indication of when the joint has been successfully made, either 'leak before press' design or a sacrificial plastic collar.

700 LOW TEMPERATURE HOT WATER PIPELINES – CONTINUED

710 Low temperature hot water pipelines (thin wall stainless steel for press-fit jointing)

This pipework system is ONLY to be used on this project if expressly permitted in the pipework schedule and/or specification section T31.

711 Application

For internal LTHW pipelines up to 108 mm diameter with maximum temperature of 82°C and maximum working pressure of 6 bar gauge. Use press-fit jointing systems in internal locations where not concealed.

Do not use stainless steel press-fit systems in concealed or external locations.

712 Pipe

Use thin wall stainless steel tube conforming to BS EN 10312 using BS EN 10088-2 grade 1.4401 (formerly 316S31 / 316) or grade 1.4301 (formerly 304S31 / 304) stainless steel having a 25-year guarantee.

713 Fittings

Use press-fit type fittings made from thin wall stainless steel conforming to BS EN 10088-2 grade 1.4404 (formerly 316S11 / 316L) or grade 1.4401 (formerly 316S31 / 316) and all compatible with BS EN 10312.

Use press-fit type fittings factory supplied complete with EPDM or CIIR black O-ring seals already fitted.

Use press-fit type fittings which incorporate visual indication of when the joint has been successfully made, either 'leak before press' design or a sacrificial plastic collar.

714 Pipe wrap

At each pipe support location wrap the pipe in aluminium foil prior to installing the insulated pipe support ring/block. Extend the aluminium foil a minimum of 75 mm either side of the support block/ring to enable an overlap to be achieved when installing the remainder of the aluminium foil.

After leak testing and prior to applying the insulation carefully wrap all LTHW pipes and fittings in aluminium foil

Comply fully with product and installation requirements stated in BS 5970. Use foil with a thickness not less than 0.06 mm.

720 Low temperature hot water pipelines (thin wall carbon steel for press-fit jointing - externally galvanized, polyethylene coated)

This pipework system is ONLY to be used on this project if expressly permitted in the pipework schedule and/or specification section T31.

721 Application

For internal LTHW pipelines with maximum temperature of 82ºC and maximum working pressure of 6 bar gauge, where carbon steel press-fit jointing systems are permitted. Where pipes will be concealed use heavy series steel with welded joints. Do not use carbon steel press-fit systems in concealed or external locations.

722 Pipe

Use polypropylene coated unalloyed high purity low carbon steel tube to BS EN 10305-3 steel grade E195, 1.0034 with the external surface galvanized in accordance with BS EN ISO 2081 and having a 10-year guarantee.

723 Fittings

Use press-fit type fittings made to BS EN 10305-3 steel grade E195, 1.0034 with the external surface galvanized in accordance with BS EN ISO 2081.

Use fittings factory supplied complete with EPDM or CIIR black O-ring seals already fitted.

Use fittings which incorporate visual indication of when the joint has been successfully made, either 'leak before press' design or a sacrificial plastic collar.

724 Pipe wrap

After installation and leak testing but before applying any insulation, protect each fitting and any exposed steel pipework that is to be insulated using a non-adhesive self-amalgamating butyl rubber, polyisobutylene or polythene tape sleeving wrap having an easily-removal disposable interleave. Overlap the tape wrap onto the pipe plastic cover to provide a continuous seal. Use only products recommended by the tubing manufacturer and apply in accordance with the tubing and tape manufacturer's instructions.

730 Low temperature hot water pipelines (multilayer composite pipe for press-fit jointing)

This pipework system is ONLY to be used on this project if expressly permitted in the pipework schedule and/or specification section T31.

731 Application

For internal LTHW pipelines up to 50 mm diameter with maximum temperature of 70°C and maximum working pressure of 6 bar gauge. Make press-fit joints only in internal locations where not concealed.

732 Pipe

Use five-layer diffusion-barrier multilayer composite tube to BS EN ISO 21003-2 comprising cross linked polyethylene (PE-X) inner layer, butt-welded or seamless aluminium core, stabilised polyethylene (PE-X or HDPE) outer layer, with bonding of all interconnected layers, and having a 25-year guarantee.

733 Fittings

Use press-fit type fittings comprising either brass or polyphenylsulphone (PPSU) body and stainless steel pressing sleeve, and having a 25-year guarantee.

Use press-fit type fittings factory supplied complete with EPDM O-ring seals already fitted.

Use press-fit type fittings that incorporate visual indications of the correct pipework tube insertion depth, and when the joint has been successfully made, the fitting indicates a successful joint by either a 'leak before press' design or a sacrificial plastic collar.

800 CHILLED WATER PIPELINES

810 Chilled water pipelines (black steel) not exceeding 6 bar gauge

811 Application

For all chilled water pipelines with working temperature range of 2°C to 20°C and maximum pressure of 6 bar gauge. For joints on chilled water steel pipework up to and including 50 mm and where not concealed, use either welded or screwed methods. Weld all other joints and all joints 65 mm and above.

Alternatively, use grooved couplings on joints 65 mm and above where not concealed.

812 Pipe

For pipework from 10 mm to 150 mm nominal diameter, where concealed, use tube to BS EN 10255, heavy grade, P235TR1 steel, with factory-applied red paint finish and plain/screwed ends. Screwed ends to BS EN 10226 taper.

Dimensions as follows:

Nominal diameter (mm)	Minimum wall thickness (mm)	Outside diameter (mm)
10	2.9	17.2
15	3.2	21.3
20	3.2	26.9
25	4.0	33.7
32	4.0	42.4
40	4.0	48.3
50	4.5	60.3
65	4.5	76.1
80	5.0	88.9
100	5.4	114.3
125	5.4	139.7
150	5.4	165.1

For pipework from 10 mm to 150 mm, where not concealed, except sizes 20 mm, 40 mm and 65 mm nominal diameter, use tube to BS EN 10255, medium series, P235TR1 steel, with factory-applied red paint finish and plain/screwed ends. Screwed ends to BS EN 10226 taper. For 20 mm, 40 mm and 65 mm sizes use heavy series steel pipe.

Dimensions as follows:

Nominal diameter (mm)	Minimum wall thickness (mm)	Outside diameter (mm)
10	2.3	17.2
15	2.6	21.3
20	3.2*	26.9

25	3.2	33.7
32	3.2	42.4
40	4.0*	48.3
50	3.6	60.3
65	4.5*	76.1
80	4.0	88.9
100	4.5	114.3
125	5.0	139.7
150	5.0	165.1
	* Heavy series	

Do not install medium series steel tube in any location without direct access or where permanently concealed. In these instances use heavy series steel pipe.

For pipework from 200 mm up to 500 mm nominal diameter use high frequency induction welded (HFIW) steel tube, with protective varnish finish, made from fully traceable, high quality fully killed steel all to BS EN 10217-2 grade P235GH/TC1.

Ensure both the external and internal weld beads have been fully trimmed and removed on all pipe used.

All tubes to be either hot finish full body normalised or made from normalised strip with annealed weld line.

For sizes 200 mm and above use only tubes whose weld seams have been ultrasonically tested and which have been hydraulically tested for pressure integrity.

Dimensions as follows:

Nominal diameter (mm)	Minimum wall thickness (mm)	Outside diameter (mm)
200	8.0	219.1
250	8.0	273.0
300	10.0	323.9
350	10.0	355.6
400	12.5	406.4
450	12.5	457.0
500	12.5	508.0

813 Fittings

For screwed joints use malleable cast iron, reinforced pattern fittings to BS 143 and 1256, or to BS EN 10242 or wrought steel fittings heavy/medium, to suit pipe, BS EN 10241, all screwed BS EN 10226 taper.

For welded joints use normalised seamless carbon steel butt welding fittings to BS EN 10253-2 type B with varnish finish and suitable for the pipeline full service pressure at elevated temperature. Use only fittings of the same steel grade and whose finished minimum wall thickness is at least equal to that of the pipe to which they are fitted, and which are suitable for the full service pressure.

For grooved joints use grooved end, ductile iron cast fittings to ASTM A-536 grade 65-45-12, wrought steel, or factory fabricated and tested from ASTM A-53 pipe.

814 Unions

Use malleable cast iron, reinforced pattern unions with ground-in spherical bronze seats to BS 143 and 1256, or to BS EN 10242, all screwed BS EN 10226 taper.

815 Flanges: Mild steel, raised face

For pipe sizes up to and including 50 mm use screwed boss type flanges to BS EN 1092-1, figure 1, type 13 PN6, or hubbed slip-on weld flanges to the specification below.

For pipe sizes from 65 mm up to and including 500 mm and taking due account of the need to test welds, use either hubbed slip-on weld flanges to BS EN 1092-1, figure 1, type 12 PN6 or weld-neck flanges to BS EN 1092-1 figure 1, type 11 PN6. Where weld-neck flanges are used ensure that the neck wall thickness and internal and external diameters match those of the pipework to which it is attached and not as the standard BS EN 1092-1 neck detail for PN6 flanges.

For all flanges use S235JR grade steel to BS EN 10025-2 or cast steel to BS EN 10213-2 grade GP240GH or forged steel to BS EN 10222-2 grade P245GH

816 Flange gaskets

Use compressed sheet flange gaskets of aramid and inorganic fibre with nitrile rubber binder to BS 7531 grade X and BS EN 1514 and suitable for CHW at 6 bar gauge and 2 to 20°C.

817 Flange bolts, nuts & washers

Use bolts and nuts complying with BS ISO 8992 and BS EN ISO 898. Bolts grade 8.8 and nuts grade 8, material group 3EO. Bolts and nuts to be bright zinc plated in accordance with BS EN ISO 4042.

Use bolts faced under the head with machined shank. Use nuts faced on one side. Use ISO metric coarse screwed threads.

Use washers to BS EN ISO 887 bright zinc plated to BS EN ISO 4042 and faced on both sides. Fit washers under both bolt head and nut.

818 Grooved joint couplings

Use grooved joint couplings consisting of up to four ductile iron housing segments to ASTM A-536 grade 65-45-12, pressure responsive gasket to ASTM D2000, rated for water service to 110ºC. Use nuts, bolts and washers to manufacturers standard; either zinc-electroplated carbon steel heat-treated bolts and nuts meeting the physical and chemical requirements of ASTM A-449 and physical requirements of ASTM A-183 or use bolts to ASTM F568M, nuts to ASTM A563M Class 9 and coatings to ASTM B633 SC1.

819 Pipe finish

After installation and leak testing but before applying any insulation, protect pipework in accordance with specification section Y50, including the additional protection specified therein where rock/stone mineral wool insulation is to be applied.

820 Chilled water pipelines (black steel) above 6 bar gauge and not exceeding 16 bar gauge

821 Application

For all CHW pipelines with a working temperature range of 2°C to 20°C and maximum working pressure of 16 bar gauge.

Weld or screw all joints in exposed CHW pipework up to and including 25 mm. Weld all other joints.

822 Pipe

Refer to the particular specification clauses (particularly T series sections) to determine whether seamless pipe is to be used for this project.

For pipework from 10 mm up to and including 150 mm nominal diameter, where use of seamless tube is not a specified project requirement, use tube to BS EN 10255, heavy series, P235TR1 steel, with factory-applied red paint finish and plain ends.

Minimum wall thicknesses are as follows:

Nominal diameter (mm)	Minimum wall thickness (mm)	Outside diameter (mm)
10	2.9	17.2
15	3.2	21.3
20	3.2	26.9
25	4.0	33.7
32	4.0	42.4
40	4.0	48.3
50	4.5	60.3
65	4.5	76.1
80	5.0	88.9
100	5.4	114.3
125	5.4	139.7
150	5.4	165.1

Where use of seamless tube is a specified project requirement, for all sizes from 32 mm up to and including 500 mm, use the seamless specification only. Otherwise, for pipe sizes greater than 150 mm up to and including 500 mm nominal, use either high frequency induction welded tube or seamless tube to the applicable following specification:

High frequency induction welded tube

Use high frequency induction welded (HFIW) steel tube, with protective varnish finish, made from fully traceable, high quality fully killed steel all to BS EN 10217-2 grade P235GH/TC1.

Ensure both the external and internal weld beads have been fully trimmed and removed on all pipe used.

All tubes to be either hot finish full body normalised or made from normalised strip with annealed weld line.

For sizes up to and including 150 mm use only tubes which have had their weld seams both ultrasonically and eddy current tested. For sizes 200 mm and above use only tubes whose weld seams have been ultrasonically tested and which have been hydraulically tested for pressure integrity.

Seamless tube

Use hot finished seamless steel tube with protective varnish finish, made from fully traceable, high quality fully killed steel all to BS EN 10216-2 grade P235GH/TC1. Alternatively use hot finished tube which meets either the ASTM A106M grade B or API 5L grade B standard.

Minimum wall thicknesses are as follows for both HFIW and seamless pipe:

Nominal diameter (mm)	Minimum wall thickness (mm)	Outside diameter (mm)
32	4.0	42.4
40	4.0	48.3
50	4.5	60.3
65	4.5	76.1
80	5.0	88.9
100	5.4	114.3
125	5.4	139.7
150	5.4	165.1
200	8.0	219.1
250	8.0	273.0
300	10.0	323.9
350	10.0	355.6
400	12.5	406.4
450	12.5	457.0
500	12.5	508.0

823 Fittings

For operating pressures up to 16 bar gauge for screwed joints use wrought steel fittings, heavy, to BS EN 10241, all screwed BS EN 10226 taper.

For welded joints use welding fittings of the same steel grade and whose finished minimum wall thickness is at least equal to that of the pipe to which they are fitted, and which are suitable for the full service pressure.

Use normalised seamless carbon steel butt welding type fittings to BS EN 10253-2 type B with varnish finish and suitable for the pipeline full service pressure at elevated temperature. Where using seamless pipe to ASTM/API standards use normalised seamless fittings to ANSI/ASME B16.9 and ASTM A234M or matching API standard.

824 Unions for pipe sizes up to and including 20 mm

Use wrought steel, navy pattern unions with bronze seats PN25 to BS EN 10241 heavy.

825 Flanges: Mild steel, raised face

For operating pressures up to 16 bar gauge for all pipe sizes up to and including 500 mm and taking due account of the need to test welds, use hubbed slip-on weld flanges to BS EN 1092-1, figure 1, type 12 PN25.

Where using seamless pipe to ASTM standards use weld-neck flanges, whose wall thickness matches that of the pipe, to ASTM A105M and ASME/ANSI B16.5, At interfaces with fittings and equipment to European specifications install flanges drilled to suit the necessary hole size/spacing.

For all except ASTM/ASME compliant flanges use S235JR grade steel to BS EN 10025-2 or forged steel to BS EN 10222-2 grade P245GH.

826 Flange gaskets

Use compressed sheet flange gaskets of aramid and inorganic fibre with nitrile rubber binder to BS 7531 grade X and BS EN 1514 and suitable for CHW at 16 bar gauge and 2 to 20°C.

Alternatively, or where particularly specified, use metallic spiral wound gaskets with support ring all to BS EN 1514 and suitable for CHW at 16 bar gauge and temperatures of 2 to 20°C

827 Flange bolts, nuts & washers

Use bolts and nuts complying with BS ISO 8992 and BS EN ISO 898. Bolts grade 8.8 and nuts grade 8, material group 3EO. Bolts and nuts to be bright zinc plated in accordance with BS EN ISO 4042.

Use bolts faced under the head with machined shank. Use nuts faced on one side. Use ISO metric coarse screwed threads.

Use washers to BS EN ISO 887 bright zinc plated to BS EN ISO 4042 and faced on both sides. Fit washers under both bolt head and nut.

828 Pipe finish

After installation and leak testing but before applying any insulation, protect pipework in accordance with specification section Y50, including the additional protection specified therein where rock/stone mineral wool insulation is to be applied.

830 Chilled water pipelines (black steel) above 16 bar gauge and not exceeding 25 bar gauge

831 Application

For all CHW pipelines with a working temperature of 2°C to 20°C and maximum working pressure of 25 bar gauge.

Weld all joints in CHW pipework.

832 Pipe

Refer to the particular specification clauses (particularly T series sections) to determine whether seamless pipe is to be used for this project.

For all pipe sizes where use of seamless tube is a specified project requirement use only the seamless specification otherwise use either the seamless or the high frequency induction welded specification:

High frequency induction welded tube

> Use high frequency induction welded (HFIW) steel tube, with protective varnish finish, made from fully traceable, high quality fully killed steel all to BS EN 10217-2 grade P235GH/TC1.

Ensure both the external and internal weld beads have been fully trimmed and removed on all pipe used.

All tubes to be either hot finish full body normalised or made from normalised strip with annealed weld line.

For sizes up to and including 150 mm use only tubes which have had their weld seams both ultrasonically and eddy current tested. For sizes 200 mm and above use only tubes whose weld seams have been ultrasonically tested and which have been hydraulically tested for pressure integrity.

Seamless tube

Use hot finished seamless steel tube with protective varnish finish, made from fully traceable, high quality fully killed steel all to BS EN 10216-2 grade P235GH/TC1. Alternatively use hot finished tube which meets either the ASTM A106M grade B or API 5L grade B standard.

Minimum wall thicknesses are as follows for both HFIW and seamless pipe:

Nominal diameter (mm)	Minimum wall thickness (mm)	Outside diameter (mm)
10	2.9	17.2
15	3.2	21.3
20	3.2	26.9
25	4.0	33.7
32	4.5	42.4
40	5.0	48.3
50	5.0	60.3
65	5.0	76.1
80	5.0	88.9
100	8.0	114.3
125	8.0	139.7
150	10.0	168.3
200	12.5	219.1
250	12.5	273.0
300	12.5	323.9
350	16.0	355.6
400	16.0	406.4
450	16.0	457.0
500	16.0	508.0

833 Fittings

Use only fittings whose finished minimum wall thickness is at least equal to that of the pipe to which they are fitted, and which are suitable for the full service pressure and temperature.

For all sizes use only normalised seamless carbon steel butt welding fittings to BS EN 10253-2 type B, to the same steel grade as the pipe, with varnish finish and suitable for the pipeline full service pressure at elevated temperature. Where using seamless pipe to ASTM/API standards use normalised seamless fittings to ANSI/ASME B16.9 and ASTM A234M or matching API standard.

834 Flanges: Mild steel, raised face

For all pipe sizes up to and including 500 mm and taking due account of the need to test welds, use hubbed slip-on weld flanges to BS EN 1092-1, figure 1, type 12 PN40.

For all flanges use S235JR grade steel to BS EN 10025-2 or forged steel to BS EN 10222-2 grade P245GH.

Where using seamless pipe to ASTM standards use weld-neck flanges, whose wall thickness matches that of the pipe, to ASTM A105M and ASME/ANSI B16.5, At interfaces with fittings and equipment to European specifications install flanges drilled to suit the necessary hole size/spacing.

835 Flange gaskets

Use metallic spiral wound gaskets with support ring all to BS EN 1514 and suitable for CHW at 25 bar gauge a working temperature of 2°C to 20°C.

836 Flange bolts, nuts & washers

Comply with BS EN 1515. Use bolts of grade 8.8 and nuts grade 8, material group 3EO. Bolts and nuts to be bright zinc plated in accordance with BS EN ISO 4042.

Use bolts faced under the head with machined shank. Use nuts faced on one side. Use ISO metric coarse screwed threads.

Use washers to BS EN ISO 887 bright zinc plated to BS EN ISO 4042 and faced on both sides. Fit washers under both bolt head and nut.

837 Pipe finish

After installation and leak testing but before applying any insulation, protect pipework in accordance with specification section Y50, including the additional protection specified therein where rock/stone mineral wool insulation is to be applied.

840 Chilled water pipelines up to 108 mm (polyethylene coated copper) not exceeding 6 bar gauge

841 Application

For all chilled water pipelines up to 108 mm with working temperature range of 2°C to 20°C and maximum pressure of 6 bar gauge. For joints on pipework up to and including 54 mm and not concealed, use capillary soldered fittings and unions. For all other joints use brazed fittings and flanges where not concealed. Use brazed fittings where concealed.

842 Pipe

For pipe sizes up to and including 54 mm use polyethylene coated copper tube complying with BS EN 13349 to BS EN 1057, type R250 half hard, grade CuDHP/CW024A, and having a 25-year guarantee.

For pipe sizes 67 mm and above, and for short connections between tube and screwed components for pipe sizes 35 mm and above, use polyethylene coated copper tube complying with BS EN 13349 to BS EN 1057, type R290 hard, grade CuDHP/CW024A, and having a 25-year guarantee.

Minimum wall thicknesses as follows:

Nominal diameter (mm)	Pipe type	Wall thickness (mm)
15	R250	0.7
22 & 28	R250	0.9
35, 42 & 54	R250 *	1.2
67	R290	1.2
76 & 108	R290	1.5

* R290 for short connections between tube and screwed components

843 Fittings and unions

Use capillary type, copper or dezincification resistant copper alloy fittings and unions to BS EN 1254-1 with 99/1 tin/copper soft solder integral rings to BS EN ISO 9453 alloy 401.

Use capillary brazing type, dezincification resistant, copper or copper alloy fittings to BS EN 1254-1 or BS EN 1254-5 with silver alloy brazing metal, type AG 155 to BS EN ISO 17672, Table 6.

844 Flanges

Use slip-on flange backing rings of mild steel over CuDHP/CW024A or CC498K copper alloy collars, capillary type to BS EN 1092-3, type 07, 37 PN6 at room temperature with silver alloy brazing metal, type AG 155 to BS EN ISO 17672, Table 6, and protected against electrolytic action and corrosion.

845 Flange gaskets

Use compressed sheet flange gaskets of aramid and inorganic fibre with nitrile rubber binder to BS 7531 grade X and BS EN 1514 and suitable for CHW at 6 bar gauge and 2 to 20°C.

846 Flange bolts, nuts & washers

Use bolts and nuts complying with BS ISO 8992 and BS EN ISO 898. Bolts grade 8.8 and nuts grade 8, material group 3EO. Bolts and nuts to be bright zinc plated in accordance with BS EN ISO 4042.

Use bolts faced under the head with machined shank. Use nuts faced on one side. Use ISO metric coarse screwed threads.

Use washers to BS EN ISO 887 bright zinc plated to BS EN ISO 4042 and faced on both sides. Fit washers under both bolt head and nut.

847 Pipe wrap

After installation and leak testing but before applying any insulation, protect each fitting and any exposed copper pipework that is to be insulated using a non-adhesive self-amalgamating butyl rubber, polyisobutylene or polythene tape sleeving wrap having an easily-removal disposable interleave. Overlap the tape wrap onto the pipe plastic cover to provide a continuous seal. Use only products recommended by the tubing manufacturer and apply in accordance with the tubing and tape manufacturer's instructions.

850 Chilled water pipelines up to 108 mm (polyethylene coated copper) above 6 bar gauge but not exceeding 16 bar gauge

851 Application

For internal chilled water pipelines up to 108 mm with working temperature range 2°C to 20°C and maximum pressure of 16 bar gauge.

For all parts of the system where the maximum working pressure is above 6 bar gauge, use brazed fittings and flanged joints.

852 Pipe

For pipe sizes up to and including 54 mm use polyethylene coated copper tube complying with BS EN 13349 to BS EN 1057, type R250 half hard, grade CuDHP/CW024A, and having a 25-year guarantee.

For pipe sizes 67 mm and above, and for short connections between tube and screwed components for pipe sizes 35 mm and above, use polyethylene coated copper tube complying with BS EN 13349 to BS EN 1057, type R290 hard, grade CuDHP/CW024A and having a 25-year guarantee.

Minimum wall thicknesses as follows:

Nominal diameter (mm)	Pipe type	Wall thickness (mm)
15	R250	0.7
22 & 28	R250	0.9
35, 42 & 54	R250 *	1.2
67	R290	1.2
76	R290	1.5
108	R290	2.5

* R290 for short connections between tube and screwed components

853 Fittings

Use capillary brazing type, copper or dezincification resistant copper alloy fittings to BS EN 1254-1 or BS EN 1254-5 with silver alloy brazing metal, type AG 155 to BS EN ISO 17672, Table 6. Alternative acceptable brazing alloys are: AG140, and, where nickel is not present, CuP179, CuP182, CuP279, CuP281 or CuP284.

Where fittings have screwed threads ensure that they comply with BS EN 10226-2 and that the joint uses tapered internal and external threads.

854 Flanges

Use slip-on flange backing rings of mild steel over CuDHP/CW024A or CC498K copper alloy collars, capillary type to BS EN 1092-3, type 07, 37 PN16 at room temperature with silver alloy brazing metal, type AG 155 to BS EN ISO 17672, Table 6, and protected against electrolytic action and corrosion.

855 Flange gaskets

Use compressed sheet flange gaskets of aramid and inorganic fibre with nitrile rubber binder to BS 7531 grade X and BS EN 1514 and suitable for CHW at 16 bar gauge and 2 to 20°C.

856 Flange bolts, nuts & washers

Use bolts and nuts complying with BS ISO 8992 and BS EN ISO 898. Bolts grade 8.8 and nuts grade 8, material group 3EO. Bolts and nuts to be bright zinc plated in accordance with BS EN ISO 4042.

Use bolts faced under the head with machined shank. Use nuts faced on one side. Use ISO metric coarse screwed threads.

Use washers to BS EN ISO 887 bright zinc plated to BS EN ISO 4042 and faced on both sides. Fit washers under both bolt head and nut.

857 Pipe wrap

After installation and leak testing but before applying any insulation, protect each fitting and any exposed copper pipework that is to be insulated using a non-adhesive self-amalgamating butyl rubber, polyisobutylene or polythene tape sleeving wrap having an easily-removal disposable interleave. Overlap the tape wrap onto the pipe plastic cover to provide a continuous seal. Use only products recommended by the tubing manufacturer and apply in accordance with the tubing and tape manufacturer's instructions.

860 Chilled water pipelines (thin wall welded stainless steel) not exceeding 6 bar gauge

For all CHW pipelines up to 500 mm nominal diameter with working temperature range of 2°C to 20°C and maximum pressure of 6 bar gauge.

Use only butt joints and weld all joints. Workshop fabricate pipe sections/spools with flanged ends for site installation. Site made welds are only acceptable where unavoidable and few in number compared to the workshop made welds.

Do not install flanges in concealed locations.

861 Pipe

Use plain end longitudinally welded stainless steel tube manufactured to BS EN 10217-7 and BS EN ISO 1127, with outside weld bead ground flush, weld factor equal to 1.0 and pickled descaled finish.

Use stainless steel to BS EN 10088-2 grade 1.4307 (formerly 304S11 / 304L).

Dimensions as follows:

Nominal diameter (mm)	Minimum wall thickness (mm)	Outside diameter (mm)
25	1.5	28
32	1.5	35
40	1.5	43
50	1.5	53
65	1.5	68
80	1.5	83
100	2.0	104
125	2.0	129
150	2.0	154
200	2.0	204

250	2.0	254
300	2.0	304
350	2.5	355
400	3.0	406
450	3.0	456
500	3.0	506

862 Fittings

Use stainless steel butt welding fittings, made from BS EN 10217-7 pipe, to BS EN 10253-4, weld factor 1.0, with pickled descaled finish and suitable for the pipeline full service pressure at elevated temperature. Use only fittings of steel grade 1.4307 (formerly 304S11 / 304L) or 1.4432 (formerly 316S13 / 316L) and whose finished minimum wall thickness is at least equal to that of the pipe to which they are fitted with the exceptions indicated below:

Nominal diameter (mm)	Minimum wall thickness (mm)
50	2.0
65	2.0
80	2.0
350	3.0

Unless specified otherwise workshop made pulled (square) tees may be used in place of swept tees.

863 Flanges

Use pressed collars or tafted pipe ends in combination with PN16 backing ring flanges. Collars to BS EN 1092-1, figure 1, type 35, 36 or 37 and backing rings to figure 1, type 02.

Bore and chamfer backing rings to suit the collars/tafted pipe ends.

For all flange backing rings use S235JR grade steel to BS EN 10025-2 or cast steel to BS EN 10213-2 grade GP240GH or forged steel to BS EN 10222-2 grade P245GH. Use flange backing rings with a fusion-bonded epoxy coating or bright zinc plated coating.

864 Flange gaskets

Use compressed sheet flange gaskets of aramid and inorganic fibre with nitrile rubber binder to BS 7531 grade X and BS EN 1514 and suitable for CHW at 6 bar gauge and 2 to 20°C.

865 Flange bolts, nuts & washers

Use bolts and nuts complying with BS ISO 8992 and BS EN ISO 898. Bolts grade 8.8 and nuts grade 8, material group 3EO. Bolts and nuts to be bright zinc plated in accordance with BS EN ISO 4042.

Use bolts faced under the head with machined shank. Use nuts faced on one side. Use ISO metric coarse screwed threads.

Use washers to BS EN ISO 887 bright zinc plated to BS EN ISO 4042 and faced on both sides. Fit washers under both bolt head and nut.

866 Pipe wrap

At each pipe support location, wrap the pipe in aluminium foil prior to installing the insulated pipe support ring/block. Extend the aluminium foil a minimum of 75 mm either side of the support block/ring to enable an overlap to be achieved when installing the remainder of the aluminium foil.

After leak testing and prior to applying the insulation, carefully wrap all chilled water pipes and fittings in aluminium foil.

Comply fully with product and installation requirements stated in BS 5970. Use foil with a thickness not less than 0.06 mm.

870 Chilled water pipelines (thin wall welded stainless steel) above 6 bar gauge but not exceeding 16 bar gauge

871 Application

For all CHW pipelines up to 500 mm nominal diameter with working temperature range of 2°C to 20°C and maximum pressure of 16 bar gauge.

Use only butt joints and weld all joints. Workshop fabricate pipe sections/spools with flanged ends for site installation. Site made welds are only acceptable where unavoidable and few in number compared to the workshop made welds.

Do not install flanges in concealed locations.

872 Pipe

Use plain end longitudinally welded stainless steel tube manufactured to BS EN 10217-7 and BS EN ISO 1127, with outside weld bead ground flush, weld factor equal to 1.0 and pickled descaled finish.

Use stainless steel to BS EN 10088-2 grade 1.4307 (formerly 304S11 / 304L).

Dimensions as follows:

Nominal diameter (mm)	Minimum wall thickness (mm)	Outside diameter (mm)
25	1.5	28
32	1.5	35
40	1.5	43
50	1.5	53
65	1.5	68
80	1.5	83
100	2.0	104
125	2.0	129
150	2.0	154
200	2.0	204
250	2.0	254
300	2.0	304
350	2.5	355

400	3.0	406
450	3.0	456
500	3.0	506

873 Fittings

Use stainless steel butt welding fittings, made from BS EN 10217-7 pipe, to BS EN 10253-4, weld factor 1.0, with pickled descaled finish and suitable for the pipeline full service pressure at elevated temperature. Use only fittings of steel grade 1.4307 (formerly 304S11 / 304L) or 1.4432 (formerly 316S13 / 316L) and whose finished minimum wall thickness is at least equal to that of the pipe to which they are fitted with the exceptions indicated below:

Nominal diameter (mm)	Minimum wall thickness (mm)
50	2.0
65	2.0
80	2.0
250	3.0
300	3.0
350	3.0
400	4.0
450	4.0
500	5.0

Unless specified otherwise workshop made pulled (square) tees may be used in place of swept tees.

874 Flanges

Use pressed collars or tafted pipe ends in combination with PN16 backing ring flanges. Collars to BS EN 1092-1, figure 1, type 35, 36 or 37 and backing rings to figure 1, type 02. Bore and chamfer backing rings to suit the collars/tafted pipe ends.

For all flange backing rings use S235JR grade steel to BS EN 10025-2 or cast steel to BS EN 10213-2 grade GP240GH or forged steel to BS EN 10222-2 grade P245GH. Use flange backing rings with a fusion-bonded epoxy coating or bright zinc plated coating.

875 Flange gaskets

Use compressed sheet flange gaskets of aramid and inorganic fibre with nitrile rubber binder to BS 7531 grade X and BS EN 1514 suitable for CHW at 16 bar gauge and 2 to 20°C.

876 Flange bolts, nuts & washers

Use bolts and nuts complying with BS ISO 8992 and BS EN ISO 898. Bolts grade 8.8 and nuts grade 8, material group 3EO. Bolts and nuts to be bright zinc plated in accordance with BS EN ISO 4042.

Use bolts faced under the head with machined shank. Use nuts faced on one side. Use ISO metric coarse screwed threads.

Use washers to BS EN ISO 887 bright zinc plated to BS EN ISO 4042 and faced on both sides. Fit washers under both bolt head and nut.

877 Pipe wrap

At each pipe support location, wrap the pipe in aluminium foil prior to installing the insulated pipe support ring/block. Extend the aluminium foil a minimum of 75 mm either side of the support block/ring to enable an overlap to be achieved when installing the remainder of the aluminium foil.

After leak testing and prior to applying the insulation, carefully wrap all chilled water pipes and fittings in aluminium foil.

Comply fully with product and installation requirements stated in BS 5970. Use foil with a thickness not less than 0.06 mm.

880 Chilled water pipelines up to 108 mm (polyethylene coated copper for press-fit jointing)

This pipework system is ONLY to be used on this project if expressly permitted in the pipework schedule and/or specification section T61.

881 Application

For internal chilled water pipelines up to 108 mm with working temperature range of 2°C to 20°C and maximum pressure of 6 bar gauge. Use press-fit jointing systems in internal locations where not concealed.

Do not use copper press-fit systems in concealed or external locations.

882 Pipe

For pipe sizes up to and including 54 mm use polyethylene coated copper tube complying with BS EN 13349 to BS EN 1057, type R250 half hard, grade CuDHP/CW024A, and having a 25-year guarantee.

For pipe sizes 67 mm and above use polyethylene coated copper tube complying with BS EN 13349 to BS EN 1057, type R290 hard, grade CuDHP/CW024A, and having a 25-year guarantee.

Minimum wall thicknesses as follows:

Nominal diameter (mm)	Pipe type	Wall thickness (mm)
15	R250	0.7
22 & 28	R250	0.9
35, 42 & 54	R250	1.2
67	R290	1.2
76 & 108	R290	1.2

883 Fittings

Use press-fit type fittings, in accordance with BS 8537, made from copper, Cu-DHP CW024A in accordance with BS EN 1412.

Use press-fit type fittings factory supplied complete with EPDM or CIIR black O-ring seals already fitted.

Use press-fit type fittings which incorporate visual indication of when the joint has been successfully made, either 'leak before press' design or a sacrificial plastic collar.

884 Pipe wrap

After installation and leak testing but before applying any insulation, protect each fitting and any exposed copper pipework that is to be insulated using a non-adhesive self-amalgamating butyl rubber, polyisobutylene or polythene tape sleeving wrap having an easily-removal disposable interleave. Overlap the tape wrap onto the pipe plastic cover to provide a continuous seal. Use only products recommended by the tubing manufacturer and apply in accordance with the tubing and tape manufacturer's instructions.

890 Chilled water pipelines (thin wall stainless steel for press-fit jointing)

This pipework system is ONLY to be used on this project if expressly permitted in the pipework schedule and/or specification section T61.

891 Application

For internal chilled water pipelines up to 108 mm diameter with working temperature range of 2°C to 20°C and maximum pressure of 6 bar gauge. Use press-fit jointing systems in internal locations where not concealed.

Do not use stainless steel press-fit systems in concealed or external locations.

892 Pipe

Use thin wall stainless steel tube conforming to BS EN 10312 using BS EN 10088-2 grade 1.4401 (formerly 316S31 / 316) or grade 1.4301 (formerly 304S31 / 304) stainless steel having a 25-year guarantee.

893 Fittings

Use press-fit type fittings made from thin wall stainless steel conforming to BS EN 10088-2 grade 1.4404 (formerly 316S11 / 316L) or grade 1.4401 (formerly 316S31 / 316) and all compatible with BS EN 10312.

Use press-fit type fittings factory-supplied complete with EPDM or CIIR black O-ring seals already fitted.

Use press-fit type fittings which incorporate visual indication of when the joint has been successfully made, either 'leak before press' design or a sacrificial plastic collar.

894 Pipe wrap

At each pipe support location, wrap the pipe in aluminium foil prior to installing the insulated pipe support ring/block. Extend the aluminium foil a minimum of 75 mm either side of the support block/ring to enable an overlap to be achieved when installing the remainder of the aluminium foil.

After leak testing and prior to applying the insulation, carefully wrap all chilled water pipes and fittings in aluminium foil.

Comply fully with product and installation requirements stated in BS 5970. Use foil with a thickness not less than 0.06 mm.

900 CHILLED WATER PIPELINES - CONTINUED

910 Chilled water pipelines up to 54 mm (thin wall carbon steel for press-fit jointing - externally galvanized, polyethylene coated)

This pipework system is ONLY to be used on this project if expressly permitted in the pipework schedule and/or specification section T61.

Y10 PIPELINES

911 Application

For internal chilled water pipelines up to 54 mm diameter with working temperature range of 2°C to 20°C and maximum pressure of 6 bar gauge, where carbon steel press-fit jointing systems are permitted. Where pipes will be concealed use heavy series steel with welded joints. Do not use carbon steel press-fit systems in concealed or external locations.

912 Pipe

Use polypropylene coated unalloyed high purity low carbon steel tube to BS EN 10305-3 steel grade E195, 1.0034 with the external surface galvanized in accordance with BS EN ISO 2081 and having a 10-year guarantee.

913 Fittings

Use press-fit type fittings made to BS EN 10305-3 steel grade E195, 1.0034 with the external surface galvanized in accordance with BS EN ISO 2081.

Use fittings factory supplied complete with EPDM or CIIR black O-ring seals already fitted.

Use fittings which incorporate visual indication of when the joint has been successfully made, either 'leak before press' design or a sacrificial plastic collar.

914 Pipe wrap

After installation and leak testing but before applying any insulation, protect each fitting and any exposed steel pipework that is to be insulated using a non-adhesive self-amalgamating butyl rubber, polyisobutylene or polythene tape sleeving wrap having an easily-removal disposable interleave. Overlap the tape wrap onto the pipe plastic cover to provide a continuous seal. Use only products recommended by the tubing manufacturer and apply in accordance with the tubing and tape manufacturer's instructions.

920 Chilled water pipelines (thin wall welded stainless steel) above 16 bar gauge but not exceeding 25 bar gauge

921 Application

For all CHW pipelines up to 150 mm nominal diameter with working temperature range of 2°C to 20°C and maximum pressure of 25 bar gauge.

Use only butt joints and weld all joints. Workshop fabricate pipe sections/spools with flanged ends for site installation. Site made welds are only acceptable where unavoidable and few in number compared to the workshop made welds.

Do not install flanges in concealed locations.

922 Pipe

Use plain end longitudinally welded stainless steel tube manufactured to BS EN 10217-7 and BS EN ISO 1127, with outside weld bead ground flush, weld factor equal to 1.0 and pickled descaled finish.

Use stainless steel to BS EN 10088-2 grade 1.4307 (formerly 304S11 / 304L).

Dimensions as follows:

Nominal diameter (mm)	Minimum wall thickness (mm)	Outside diameter (mm)
50	2.0	54
65	2.0	69

80	2.0	84
100	2.0	104
125	2.0	129
150	2.0	154

923 Fittings

Use stainless steel butt welding fittings, made from BS EN 10217-7 pipe, to BS EN 10253-4, weld factor 1.0, with pickled descaled finish and suitable for the pipeline full service pressure at elevated temperature. Use only fittings of steel grade 1.4307 (formerly 304S11 / 304L) or 1.4432 (formerly 316S13 / 316L) and whose finished minimum wall thickness is at least equal to that of the pipe to which they are fitted, and which are suitable for the full service pressure.

Unless specified otherwise workshop made pulled (square) tees may be used in place of swept tees.

924 Flanges

Use pressed collars or tafted pipe ends in combination with PN25 backing ring flanges. Collars to BS EN 1092-1, figure 1, type 35, 36 or 37 and backing rings to figure 1, type 02.

Bore and chamfer backing rings to suit the collars/tafted pipe ends.

For all flange backing rings use S235JR grade steel to BS EN 10025-2 or cast steel to BS EN 10213-2 grade GP240GH or forged steel to BS EN 10222-2 grade P245GH. Use flange backing rings with a fusion-bonded epoxy coating or bright zinc plated coating.

925 Flange gaskets

Use compressed sheet flange gaskets of aramid and inorganic fibre with nitrile rubber binder to BS 7531 grade X and BS EN 1514 suitable for CHW at 25 bar gauge and 2 to 20°C.

926 Flange bolts, nuts & washers

Use bolts and nuts complying with BS ISO 8992 and BS EN ISO 898. Bolts grade 8.8 and nuts grade 8, material group 3EO. Bolts and nuts to be bright zinc plated in accordance with BS EN ISO 4042.

Use bolts faced under the head with machined shank. Use nuts faced on one side. Use ISO metric coarse screwed threads.

Use washers to BS EN ISO 887 bright zinc plated to BS EN ISO 4042 and faced on both sides. Fit washers under both bolt head and nut.

927 Pipe wrap

At each pipe support location, wrap the pipe in aluminium foil prior to installing the insulated pipe support ring/block. Extend the aluminium foil a minimum of 75 mm either side of the support block/ring to enable an overlap to be achieved when installing the remainder of the aluminium foil.

After leak testing and prior to applying the insulation, carefully wrap all chilled water pipes and fittings in aluminium foil.

Comply fully with product and installation requirements stated in BS 5970. Use foil with a thickness not less than 0.06 mm.

930 Chilled water pipelines (ABS plastic)

931 Application

For all chilled water pipelines with working temperature range 2°C to 20°C and maximum pressure of 10 bar gauge. Do not use this material where pipes penetrate fire barriers unless specified to be fitted with a proprietary fire sleeve.

932 Pipe

Use ABS pressure pipe mid-grey quality to BS 5391-1, BS EN ISO 15493 and BS ISO 161-1.

933 Fittings

Use ABS cold solvent welding fittings to BS 5392-1, BS EN ISO 15493 and BS ISO 727-1.

934 Unions

Use ABS unions, cold solvent welding socket/BSP thread.

935 Flanges

Use ABS, cold solvent welding socket, stub type with loose galvanized mild steel flange backing ring, or glass fibre reinforced polypropylene steel core backing ring, to BS EN 1092-1, type 02 PN10 at -10 to 120°C.

936 Flange gaskets

Use flange gaskets supplied by the selected pipe and fitting manufacturer suitable for chilled water at 10 bar gauge and 2 to 20°C, and made from BS EN 681 compliant EPDM synthetic rubber type WA.

937 Flange bolts, nuts & washers

Use bolts and nuts complying with BS ISO 8992 and BS EN ISO 898. Bolts grade 8.8 and nuts grade 8, material group 3EO. Bolts and nuts to be bright zinc plated in accordance with BS EN ISO 4042.

Use bolts faced under the head with machined shank. Use nuts faced on one side. Use ISO metric coarse screwed threads.

Use washers to BS EN ISO 887 bright zinc plated to BS EN ISO 4042 and faced on both sides. Fit washers under both bolt head and nut.

940 Chilled water pipelines (multilayer composite pipe for press-fit jointing)

This pipework system is ONLY to be used on this project if expressly permitted in the pipework schedule and/or specification section T61.

941 Application

For internal chilled water pipelines up to 50 mm diameter with working temperature range of 2°C to 20°C and maximum working pressure of 6 bar gauge. Make press-fit joints only in internal locations where not concealed.

942 Pipe

Use five-layer diffusion-barrier multilayer composite tube to BS EN ISO 21003-2 comprising cross linked polyethylene (PE-X) inner layer, butt-welded or seamless aluminium core, stabilised polyethylene (PE-X or HDPE) outer layer, with bonding of all interconnected layers, and having a 25-year guarantee.

943 Fittings

Use press-fit type fittings comprising either brass or polyphenylsulphone (PPSU) body and stainless steel pressing sleeve, and having a 25-year guarantee.

Use press-fit type fittings factory supplied complete with EPDM O-ring seals already fitted.

Use press-fit type fittings that incorporate visual indications of the correct pipework tube insertion depth, and when the joint has been successfully made, the fitting indicates a successful joint by either a 'leak before press' design or a sacrificial plastic collar.

1000 CONDENSER COOLING WATER PIPELINES

1010 Closed-circuit condenser cooling water pipelines (black steel)

1011 Application

For closed-circuit system pipework between condenser and heat rejection equipment with maximum temperature of 80°C and maximum working pressure of 6 bar gauge. For joints on condenser pipework up to and including 50 mm and where not concealed, use either welded or screwed methods. Weld all other joints and all joints 65 mm and above.

Alternatively, use grooved couplings on joints 65 mm and above where not concealed.

1012 Pipe

For pipework from 10 mm to 150 mm nominal diameter use tube to BS EN 10255, heavy series, P235TR1 steel, with factory-applied red paint finish and plain/screwed ends. Screwed ends to BS EN 10226 taper.

Dimensions as follows:

Nominal diameter (mm)	Minimum wall thickness (mm)	Outside diameter (mm)
10	2.9	17.2
15	3.2	21.3
20	3.2	26.9
25	4.0	33.7
32	4.0	42.4
40	4.0	48.3
50	4.5	60.3
65	4.5	76.1
80	5.0	88.9
100	5.4	114.3
125	5.4	139.7
150	5.4	165.1

For pipework from 200 mm up to 500 mm nominal diameter use high frequency induction welded (HFIW) steel tube, with protective varnish finish, made from fully traceable, high quality fully killed steel all to BS EN 10217-2 grade P235GH/TC1.

Ensure both the external and internal weld beads have been fully trimmed and removed on all pipe used.

All tubes to be either hot finish full body normalised or made from normalised strip with annealed weld line.

For sizes 200 mm and above use only tubes whose weld seams have been ultrasonically tested and which have been hydraulically tested for pressure integrity.

Dimensions as follows:

Nominal diameter (mm)	Minimum wall thickness (mm)	Outside diameter (mm)
200	8.0	219.1
250	8.0	273.0
300	10.0	323.9
350	10.0	355.6
400	12.5	406.4
450	12.5	457.0
500	12.5	508.0

1013 Fittings

For screwed joints use malleable cast iron, reinforced pattern fittings to BS 143 and 1256, or to BS EN 10242 or wrought steel fittings, heavy/medium to suit the pipe, to BS EN 10241, all screwed BS EN 10226 taper.

For welded joints use normalised seamless carbon steel butt welding fittings to BS EN 10253-2 type B with varnish finish and suitable for the pipeline full service pressure at elevated temperature. Use only fittings of the same steel grade and whose finished minimum wall thickness is at least equal to that of the pipe to which they are fitted, and which are suitable for the full service pressure.

For grooved joints use grooved end, ductile iron cast fittings to ASTM A-536 grade 65-45-12, wrought steel, or factory fabricated and tested from ASTM A-53 pipe.

1014 Unions

Use malleable cast iron, reinforced pattern unions with ground-in spherical bronze seats to BS 143 and 1256, or to BS EN 10242, all screwed BS EN 10226 taper.

1015 Flanges: Mild steel, raised face

For pipe sizes up to and including 50 mm use screwed boss type flanges to BS EN 1092-1, figure 1, type 13 or hubbed slip-on weld flanges to the specification below all to PN10.

For pipe sizes up to and including 500 mm and taking due account of the need to test welds, use either slip-on weld flange to BS EN 1092-1, figure 1, type 12 or weld-neck flanges to BS EN 1092-1 figure 1, type 11 all PN10 at room temperature. Where weld-neck flanges are used ensure that the neck wall thickness and internal and external diameters match those of the pipework to which it is attached and not as the standard BS EN 1092-1 neck detail for PN6 flanges.

For all flanges use S235JR grade steel to BS EN 10025-2 or cast steel to BS EN 10213-2 grade GP240GH or forged steel to BS EN 10222-2 grade P245GH.

Y10 PIPELINES

1016 Flange gaskets

Use compressed sheet flange gaskets of aramid and inorganic fibre with nitrile rubber binder to BS 7531 grade X and BS EN 1514 and suitable for condenser cooling water at 6 bar gauge and 80°C.

1017 Flange bolts, nuts & washers

Use bolts and nuts complying with BS ISO 8992 and BS EN ISO 898. Bolts grade 8.8 and nuts grade 8, material group 3EO. Bolts and nuts to be bright zinc plated in accordance with BS EN ISO 4042.

Use bolts faced under the head with machined shank. Use nuts faced on one side. Use ISO metric coarse screwed threads.

Use washers to BS EN ISO 887 bright zinc plated to BS EN ISO 4042 and faced on both sides. Fit washers under both bolt head and nut.

1018 Grooved joint couplings

Use grooved joint couplings consisting of up to four ductile iron housing segments to ASTM A-536 grade 65-45-12, pressure responsive gasket to ASTM D2000, rated for water service to 110ºC. Use nuts, bolts and washers to manufacturers standard; either zinc-electroplated carbon steel heat-treated bolts and nuts meeting the physical and chemical requirements of ASTM A-449 and physical requirements of ASTM A-183 or use bolts to ASTM F568M, nuts to ASTM A563M Class 9 and coatings to ASTM B633 SC1.

1020 Closed-circuit condenser cooling water pipelines (thin wall welded stainless steel)

1021 Application

For closed-circuit system pipework between condenser and heat rejection equipment with maximum temperature of 80°C and maximum working pressure of 6 bar gauge.

Use only butt joints and weld all joints. Workshop fabricate pipe sections/spools with flanged ends for site installation. Site made welds are only acceptable where unavoidable and few in number compared to the workshop made welds.

Do not install flanges in concealed locations.

1022 Pipe

Use plain end longitudinally welded stainless steel tube manufactured to BS EN 10217-7 and BS EN ISO 1127, with outside weld bead ground flush, weld factor equal to 1.0 and pickled descaled finish.

Use stainless steel to BS EN 10088-2 grade 1.4307 (formerly 304S11 / 304L).

Dimensions as follows:

Nominal diameter (mm)	Minimum wall thickness (mm)	Outside diameter (mm)
25	1.5	28
32	1.5	35
40	1.5	43
50	1.5	53
65	1.5	68
80	1.5	83
100	2.0	104

125	2.0	129
150	2.0	154
200	2.0	204
250	2.0	254
300	2.0	304
350	2.5	355
400	3.0	406
450	3.0	456
500	3.0	506

1023 Fittings

Use stainless steel butt welding fittings, made from BS EN 10217-7 pipe, to BS EN 10253-4, weld factor 1.0, with pickled descaled finish and suitable for the pipeline full service pressure at elevated temperature. Use only fittings of steel grade 1.4307 (formerly 304S11 / 304L) or 1.4432 (formerly 316S13 / 316L) and whose finished minimum wall thickness is at least equal to that of the pipe to which they are fitted with the exceptions indicated below:

Nominal diameter (mm)	Minimum wall thickness (mm)
50	2.0
65	2.0
80	2.0
350	3.0

Unless specified otherwise workshop made pulled (square) tees may be used in place of swept tees.

1024 Flanges

Use pressed collars or tafted pipe ends in combination with PN16 backing ring flanges. Collars to BS EN 1092-1, figure 1, type 35, 36 or 37 and backing rings to figure 1, type 02.

Bore and chamfer backing rings to suit the collars/tafted pipe ends.

For all flange backing rings use S235JR grade steel to BS EN 10025-2 or cast steel to BS EN 10213-2 grade GP240GH or forged steel to BS EN 10222-2 grade P245GH. Use flange backing rings with a fusion-bonded epoxy coating or bright zinc plated coating.

1025 Flange gaskets

Use compressed sheet flange gaskets of aramid and inorganic fibre with nitrile rubber binder to BS 7531 grade X and BS EN 1514 and suitable for condenser cooling water at 6 bar gauge and 80°C.

1026 Flange bolts, nuts & washers

Use bolts and nuts complying with BS ISO 8992 and BS EN ISO 898. Bolts grade 8.8 and nuts grade 8, material group 3EO. Bolts and nuts to be bright zinc plated in accordance with BS EN ISO 4042.

Use bolts faced under the head with machined shank. Use nuts faced on one side. Use ISO metric coarse screwed threads.

Use washers to BS EN ISO 887 bright zinc plated to BS EN ISO 4042 and faced on both sides. Fit washers under both bolt head and nut.

1030 Open-circuit condenser cooling water pipelines (galvanized steel)

1031 Application

For open-circuit condenser cooling water pipelines with maximum temperature of 80°C and maximum working pressure of 6 bar gauge.

For unconcealed joints on pre-galvanized pipework up to and including 50 mm use screwed joints with screwed flanges where necessary. For unconcealed joints on pre-galvanized pipework 65 mm and above use grooved couplings; or alternatively use welded black steel pipework and fittings, all hot dip galvanized after manufacture.

For concealed joints and all joints 65 mm or greater use welded black steel pipework and fittings, with flanges in unconcealed locations where necessary, all hot dip galvanized after manufacture.

1032 Pipe

For pipework from 10 mm up to and including 150 mm, where not concealed, except sizes 20 mm, 40 mm and 65 mm nominal diameter, use galvanized tube to BS EN 10255, medium series, P235TR1 steel and plain/screwed ends. Screwed ends to BS EN 10226 taper. For 20 mm, 40 mm and 65 mm sizes use heavy series galvanized steel pipe.

For welded pipework up to 150 mm nominal diameter, that is to be galvanized after manufacture, use tube to BS EN 10255, medium series, P235TR1 steel, with plain ends.

Dimensions as follows:

Nominal diameter (mm)	Minimum wall thickness (mm)	Outside diameter (mm)
10	2.3	17.2
15	2.6	21.3
20	3.2*	26.9
25	3.2	33.7
32	3.2	42.4
40	4.0*	48.3
50	3.6	60.3
65	4.5*	76.1
80	4.0	88.9
100	4.5	114.3
125	5.0	139.7
150	5.0	165.1
	* Heavy series	

Do not install medium series steel tube in any location without direct access or where permanently concealed. In these instances use heavy series steel pipe.

For pipework from 200 mm up to 500 mm nominal diameter use high frequency induction welded (HFIW) steel tube, with hot dip galvanized finish, made from fully traceable, high quality fully killed steel all to BS EN 10217-2 grade P235GH/TC1.

Ensure both the external and internal weld beads have been fully trimmed and removed on all pipe used.

All tubes to be either hot finish full body normalised or made from normalised strip with annealed weld line.

For sizes 200 mm and above use only tubes whose weld seams have been ultrasonically tested and which have been hydraulically tested for pressure integrity.

Dimensions as follows:

Nominal diameter (mm)	Minimum wall thickness (mm)	Outside diameter (mm)
200	12.5	219.1
250	12.5	273.0
300	12.5	323.9
350	16.0	355.6
400	16.0	406.4
450	16.0	457.0
500	16.0	508.0

1033 Fittings

For screwed joints use galvanized malleable cast iron, reinforced pattern fittings to BS 143 and 1256, or to BS EN 10242 or galvanized wrought steel fittings, heavy/medium to suit the pipe, to BS EN 10241, all screwed BS EN 10226 taper.

For welded joints to be galvanized after manufacture use normalised seamless carbon steel butt welding fittings to BS EN 10253-2 type B with varnish finish and suitable for the pipeline full service pressure at room temperature. Use only fittings of the same steel grade and whose finished minimum wall thickness is at least equal to that of the pipe to which they are fitted, and which are suitable for the full service pressure.

Use grooved end, ductile iron cast fittings to ASTM A-536 grade 65-45-12, wrought steel, or factory fabricated and tested from ASTM A-53 pipe.

1034 Unions

Use galvanized malleable cast iron, reinforced pattern unions with ground-in spherical bronze seats to BS 143 and 1256, or to BS EN 10242, all screwed BS EN 10226 taper.

1035 Flanges: Mild steel raised face

For screwed flange jointing use galvanized screwed boss type flanges to BS EN 1092-1, figure 1, type 13, PN10, screwed BS EN 10226 taper.

For welded flange jointing, to be hot dip galvanized after manufacture, and taking due account of the need to test welds, use either slip-on weld flanges to BS EN 1092-1, figure 1, type 12 or weld-neck flanges to BS EN 1092-1 figure 1, type 11 all PN10 at 95°C. Where weld-neck flanges are used ensure that the neck wall thickness and internal and external diameters match those of the pipework to which it is attached and not as the standard BS EN 1092-1 neck detail for PN10 flanges.

For all flanges use S235JR grade steel to BS EN 10025-2 or cast steel to BS EN 10213-2 grade GP240GH or forged steel to BS EN 10222-2 grade P245GH.

1036 Flange gaskets

Use compressed sheet flange gaskets of aramid and inorganic fibre with nitrile rubber binder to BS 7531 grade X and BS EN 1514 and suitable for condenser cooling water at 6 bar gauge and 80°C.

1037 Flange bolts, nuts & washers

Use bolts and nuts complying with BS ISO 8992 and BS EN ISO 898. Bolts grade 8.8 and nuts grade 8, material group 3EO. Bolts and nuts to be bright zinc plated in accordance with BS EN ISO 4042.

Use bolts faced under the head with machined shank. Use nuts faced on one side. Use ISO metric coarse screwed threads.

Use washers to BS EN ISO 887 bright zinc plated to BS EN ISO 4042 and faced on both sides. Fit washers under both bolt head and nut.

1038 Grooved joint couplings

Use grooved joint couplings consisting of up to four ductile iron housing segments to ASTM A-536 grade 65-45-12, pressure responsive gasket to ASTM D2000, rated for water service to 110ºC. Use nuts, bolts and washers to manufacturers standard; either zinc-electroplated carbon steel heat-treated bolts and nuts meeting the physical and chemical requirements of ASTM A-449 and physical requirements of ASTM A-183 or use bolts to ASTM F568M, nuts to ASTM A563M Class 9 and coatings to ASTM B633 SC1.

1040 Condenser cooling water pipelines (ABS plastic)

1041 Application

For all condenser cooling water pipelines with maximum temperature of 45°C and maximum working pressure of 6 bar gauge. Do not use this material where pipes penetrate fire barriers unless specified to be fitted with a proprietary fire sleeve.

1042 Pipe

Use ABS pressure pipe mid-grey quality to BS 5391-1, BS EN ISO 15493 and BS ISO 161-1.

1043 Fittings

Use ABS cold solvent welding fittings to BS 5392-1, BS EN ISO 15493 and BS ISO 727-1.

1044 Unions

Use ABS unions, cold solvent welding socket/BSP thread.

1045 Flanges

Use ABS, cold solvent welding socket, stub type with loose galvanized mild steel flange backing ring, or glass fibre reinforced polypropylene steel core backing ring, to BS EN 1092-1, type 02 PN10 at -10 to 120°C.

1046 Flange gaskets

Use flange gaskets supplied by the selected pipe and fitting manufacturer and suitable for condenser cooling water at 6 bar gauge and 45°C, and made from BS EN 681 compliant EPDM synthetic rubber type WA.

1047 Flange bolts, nuts & washers

Use bolts and nuts complying with BS ISO 8992 and BS EN ISO 898. Bolts grade 8.8 and nuts grade 8, material group 3EO. Bolts and nuts to be bright zinc plated in accordance with BS EN ISO 4042.

Use bolts faced under the head with machined shank. Use nuts faced on one side. Use ISO metric coarse screwed threads.

Use washers to BS EN ISO 887 bright zinc plated to BS EN ISO 4042 and faced on both sides. Fit washers under both bolt head and nut.

1100 HOT AND COLD WATER PIPELINES – INTERNAL AND EXTERNAL NOT BURIED

Use only pipe, fittings, materials and ancillary components listed in the Water Regulations Advisory Scheme (WRAS) Water Fittings and Materials Directory or confirmed in writing by WRAS or the applicable Water Authority as being of appropriate quality under the requirements of the Water Supply (Water Fittings) Regulations part 2 Regulation 4.

Irrespective of the maximum working pressure of the system, use brazed fittings on all piping, of all sizes, where the piping is located in services ducts, services walkways and services shafts.

Where connecting to equipment and ancillaries, screwed connectors, adaptors and couplings are permitted. Where not exposed, pulled bends are permitted. Except for chromium plated applications and connections to equipment, do not use compression joints.

Install all tube and fittings, including polyethylene coated tube, strictly in accordance with the manufacturer’s instructions.

1110 Hot and cold water pipelines, up to 108 mm, including pressurised and mains pressure – internal domestic (copper, polyethylene coated for cold) not exceeding 8 bar gauge

1111 Application

For all internal domestic hot and cold water pipelines with maximum working temperature of 65°C and maximum working pressure of 8 bar gauge.

For joints on pipework up to and including 54 mm and not concealed, use capillary soldered fittings and unions. For all other joints use brazed fittings and flanges where not concealed. Use brazed fittings where concealed.

1112 Pipe

For hot water services and exposed uninsulated cold water services up to and including 54 mm, use copper tube to BS EN 1057, type R250 half hard, grade CuDHP/CW024A, and having a 25-year guarantee, or use tube to the specification for cold water services.

For hot water services and exposed uninsulated cold water services of pipe size 67 mm and above, and for short connections between tube and screwed components for pipe sizes 35 mm and above, use copper tube to BS EN 1057, type R290 hard, grade CuDHP/CW024A, and having a 25-year guarantee.

For all cold water services up to and including 54 mm except those parts exposed and uninsulated, use polyethylene coated copper tube complying with BS EN 13349 to BS EN 1057, type R250 half hard, grade CuDHP/CW024A, and having a 25-year guarantee.

For cold water services, except those parts exposed and uninsulated, of pipe size 67 mm and above, and for short connections between tube and screwed components for pipe sizes 35 mm and above, use polyethylene coated copper tube complying with BS EN 13349 to BS EN 1057, type R290 hard, grade CuDHP/CW024A, and having a 25-year guarantee.

Minimum wall thicknesses as follows:

Nominal diameter (mm)	Pipe type	Wall thickness (mm)
15	R250	0.7
22 & 28	R250	0.9
35, 42 & 54	R250 *	1.2
67	R290	1.2
76 & 108	R290	1.5

* R290 for short connections between tube and screwed components

Install all pipes strictly in accordance with the manufacturer's instructions.

1113 Fittings and unions

For soldered joints up to and including 54 mm size, use capillary type copper or dezincification resistant copper alloy to BS EN 1254-1, having a minimum 25-year manufacturer's guarantee and join with lead-free solder of alloy No. 401 (or any of; 402, 701, 702) to BS EN ISO 9453. Either end-feed or integral-solder-ring type is permitted.

Use capillary brazing type copper or dezincification resistant copper alloy fittings to BS EN 1254-1 or BS EN 1254-5 with silver alloy brazing metal, type AG 155 to BS EN ISO 17672, Table 6. Alternative acceptable brazing alloys are: AG140, and where nickel is not present: CuP179, CuP182, CuP279, CuP281 and CuP284.

1114 Flanges

Use slip-on flange backing rings of mild steel over CuDHP/CW024A or CC498K copper alloy collars, capillary type to BS EN 1092-3, type 07, 37 PN10 with silver alloy brazing metal, type AG 155 to BS EN ISO 17672, Table 6, and protected against electrolytic action and corrosion.

1115 Flange gaskets

Use compressed sheet flange gaskets of aramid and inorganic fibre with nitrile rubber binder to BS 7531 grade X and BS EN 1514 and suitable for wholesome water at 65°C and at the maximum operating pressure.

1116 Flange bolts, nuts & washers

Use bolts and nuts complying with BS ISO 8992 and BS EN ISO 898. Bolts grade 8.8 and nuts grade 8, material group 3EO. Bolts and nuts to be bright zinc plated in accordance with BS EN ISO 4042.

Use bolts faced under the head with machined shank. Use nuts faced on one side. Use ISO metric coarse screwed threads.

Use washers to BS EN ISO 887 bright zinc plated to BS EN ISO 4042 and faced on both sides. Fit washers under both bolt head and nut.

1117 Pipe wrap

For cold fluid installations, after installation and leak testing but before applying any insulation, protect each fitting and any exposed copper pipework that is to be insulated using a non-adhesive self-amalgamating butyl rubber, polyisobutylene or polythene tape sleeving wrap having an easily-removal disposable interleave. Overlap the tape wrap onto the pipe plastic cover to provide a continuous seal. Use only products recommended by the tubing manufacturer and apply in accordance with the tubing and tape manufacturer's instructions.

Y10 PIPELINES

1120 Hot and cold water pipelines, up to 108 mm, including pressurised and mains pressure – internal domestic (copper, polyethylene coated for cold) above 8 bar gauge but not exceeding 16 bar gauge

1121 Application

For all internal domestic hot and cold water pipelines with maximum working temperature of 65°C and maximum working pressure of 16 bar gauge.

For all parts of the system where the maximum working pressure is above 8 bar gauge, use brazed fittings and flanged joints.

1122 Pipe

For hot water services and exposed uninsulated cold water services up to and including 54 mm, use copper tube to BS EN 1057, type R250 half hard, grade CuDHP/CW024A, and having a 25-year guarantee, or use tube to the specification for cold water services.

For hot water services and exposed uninsulated cold water services of pipe size 67 mm and above, and for short connections between tube and screwed components for pipe sizes 35 mm and above, use copper tube to BS EN 1057, type R290 hard, grade CuDHP/CW024A, and having a 25-year guarantee.

For all cold water services up to and including 54 mm except those parts exposed and uninsulated, use polyethylene coated copper tube complying with BS EN 13349 to BS EN 1057, type R250 half hard, grade CuDHP/CW024A, and having a 25-year guarantee.

For cold water services, except those parts exposed and uninsulated, of pipe size 67 mm and above, and for short connections between tube and screwed components for pipe sizes 35 mm and above, use polyethylene coated copper tube complying with BS EN 13349 to BS EN 1057, type R290 hard, grade CuDHP/CW024A, and having a 25-year guarantee.

Minimum wall thicknesses as follows:

Nominal diameter (mm)	Pipe type	Wall thickness (mm)
15	R250	0.7
22 & 28	R250	0.9
35, 42 & 54	R250 *	1.2
67	R290	1.2
76	R290	1.5
108	R290	2.5

* R290 for short connections between tube and screwed components

Install all pipes strictly in accordance with the manufacturer’s instructions.

1123 Fittings

Use capillary brazing type copper or dezincification resistant copper alloy fittings to BS EN 1254-1 or BS EN 1254-5 with silver alloy brazing metal, type AG 155 to BS EN ISO 17672, Table 6. Alternative acceptable brazing alloys are: AG140, and, where nickel is not present, CuP179, CuP182, CuP279, CuP281 or CuP284.

Where fittings have screwed threads ensure that they comply with BS EN 10226-2 and that the joint uses tapered internal and external threads.

1124 Flanges

Use slip-on flange backing rings of mild steel over CuDHP/CW024A or CC498K copper alloy collars, capillary type to BS EN 1092-3, type 07, 37 PN16 with silver alloy brazing metal, type AG 155 to BS EN ISO 17672, Table 6, and protected against electrolytic action and corrosion.

1125 Flange gaskets

Use compressed sheet flange gaskets of aramid and inorganic fibre with nitrile rubber binder to BS 7531 grade X and BS EN 1514 and suitable for wholesome water at 65°C.

1126 Flange bolts, nuts & washers

Use bolts and nuts complying with BS ISO 8992 and BS EN ISO 898. Bolts grade 8.8 and nuts grade 8, material group 3EO. Bolts and nuts to be bright zinc plated in accordance with BS EN ISO 4042.

Use bolts faced under the head with machined shank. Use nuts faced on one side. Use ISO metric coarse screwed threads.

Use washers to BS EN ISO 887 bright zinc plated to BS EN ISO 4042 and faced on both sides. Fit washers under both bolt head and nut.

1127 Pipe wrap

For cold fluid installations, after installation and leak testing but before applying any insulation, protect each fitting and any exposed copper pipework that is to be insulated using a non-adhesive self-amalgamating butyl rubber, polyisobutylene or polythene tape sleeving wrap having an easily-removal disposable interleave. Overlap the tape wrap onto the pipe plastic cover to provide a continuous seal. Use only products recommended by the tubing manufacturer and apply in accordance with the tubing and tape manufacturer’s instructions.

1130 Hot and cold water pipelines including pressurised and mains pressure – internal domestic (thin wall welded stainless steel) not exceeding 16 bar gauge

1131 Application

For all internal domestic hot and cold water pipelines up to 500 mm nominal diameter with maximum working temperature of 65°C and maximum working pressure of 16 bar gauge.

Use only butt joints and weld all joints. Workshop fabricate pipe sections/spools with flanged ends for site installation. Site made welds are only acceptable where unavoidable and few in number compared to the workshop made welds.

Do not install flanges in concealed locations.

1132 Pipe

Use plain end longitudinally welded stainless steel tube manufactured to BS EN 10217-7 and BS EN ISO 1127, with outside weld bead ground flush, weld factor equal to 1.0 and pickled descaled finish.

Use stainless steel to BS EN 10088-2 grade 1.4432 (formerly 316S13 / 316L).

Dimensions as follows:

Nominal diameter (mm)	Minimum wall thickness (mm)	Outside diameter (mm)
25	1.5	28

32	1.5	35
40	1.5	43
50	1.5	53
65	1.5	68
80	1.5	83
100	2.0	104
125	2.0	129
150	2.0	154
200	2.0	204
250	2.0	254
300	2.0	304
350	2.0	354
400	3.0	406
450	3.0	456
500	3.0	506

1133 Fittings

Use stainless steel butt welding fittings, made from BS EN 10217-7 pipe, to BS EN 10253-4, weld factor 1.0, with pickled descaled finish and suitable for the pipeline full service pressure at elevated temperature. Use only fittings of steel grade 1.4432 (formerly 316S13 / 316L) and whose finished minimum wall thickness is at least equal to that of the pipe to which they are fitted, and which are suitable for the full service pressure.

Unless specified otherwise workshop made pulled (square) tees may be used in place of swept tees.

1134 Flanges

Use pressed collars or tafted pipe ends in combination with PN16 backing ring flanges. Collars to BS EN 1092-1, figure 1, type 35, 36 or 37 and backing rings to figure 1, type 02. Bore and chamfer backing rings to suit the collars/tafted pipe ends.

For all flange backing rings use S235JR grade steel to BS EN 10025-2 or cast steel to BS EN 10213-2 grade GP240GH or forged steel to BS EN 10222-2 grade P245GH. Use flange backing rings with a fusion-bonded epoxy coating or bright zinc plated coating.

1135 Flange gaskets

Use compressed sheet flange gaskets of aramid and inorganic fibre with nitrile rubber binder to BS 7531 grade X and BS EN 1514 and suitable for wholesome domestic water at 16 bar gauge and 65°C.

1136 Flange bolts, nuts & washers

Use bolts and nuts complying with BS ISO 8992 and BS EN ISO 898. Bolts grade 8.8 and nuts grade 8, material group 3EO. Bolts and nuts to be bright zinc plated in accordance with BS EN ISO 4042.

Use bolts faced under the head with machined shank. Use nuts faced on one side. Use ISO metric coarse screwed threads.

Use washers to BS EN ISO 887 bright zinc plated to BS EN ISO 4042 and faced on both sides. Fit washers under both bolt head and nut.

1137 Pipe wrap

At each pipe support location, wrap the pipe in aluminium foil prior to installing the insulated pipe support ring/block. Extend the aluminium foil a minimum of 75 mm either side of the support block/ring to enable an overlap to be achieved when installing the remainder of the aluminium foil.

After leak testing and prior to applying the insulation, carefully wrap all pipes and fittings in aluminium foil.

Comply fully with product and installation requirements stated in BS 5970. Use foil with a thickness not less than 0.06 mm.

1140 Hot and cold water pipelines, up to 108 mm, including pressurised and mains pressure - internal domestic (copper, polyethylene coated for cold for press-fit jointing) not exceeding 8 bar gauge

This pipework system is ONLY to be used on this project if expressly permitted in the pipework schedule and/or specification sections S10 and/or S11.

1141 Application

For all internal domestic hot and cold water pipelines with maximum working temperature of 65°C and maximum working pressure of 8 bar gauge. Use press-fit jointing systems in internal locations where not concealed.

Do not use copper press-fit systems in concealed or external locations. For systems served by a water booster, only use press-fit jointing in branches that are downstream of a pressure regulating valve.

1142 Pipe

For hot water services and exposed uninsulated cold water services up to and including 54 mm, use copper tube to BS EN 1057, type R250 half hard, grade CuDHP/CW024A, and having a 25-year guarantee, or use tube to the specification for cold water services.

For hot water services and exposed uninsulated cold water services of pipe size 67 mm and above, use copper tube to BS EN 1057, type R290 hard, grade CuDHP/CW024A, and having a 25-year guarantee.

For all cold water services up to and including 54 mm except those parts exposed and uninsulated, use polyethylene coated copper tube complying with BS EN 13349 to BS EN 1057, type R250 half hard, grade CuDHP/CW024A, and having a 25-year guarantee.

For cold water services, except those parts exposed and uninsulated, of pipe size 67 mm and above, use polyethylene coated copper tube complying with BS EN 13349 to BS EN 1057, type R290 hard, grade CuDHP/CW024A, and having a 25-year guarantee.

Minimum wall thicknesses as follows:

Nominal diameter (mm)	Minimum wall thickness (mm)	Outside diameter (mm)
15	R250	0.7
22 & 28	R250	0.9
35, 42 & 54	R250	1.2
67	R290	1.2
76 & 108	R290	1.5

Install all pipes strictly in accordance with the manufacturer's instructions.

1143 Fittings

Use press-fit type fittings, in accordance with BS 8537, made from copper, Cu-DHP CW024A in accordance with BS EN 1412.

Use press-fit type fittings factory supplied complete with EPDM or CIIR black O-ring seals already fitted.

Use press-fit type fittings which incorporate visual indication of when the joint has been successfully made, either 'leak before press' design or a sacrificial plastic collar.

1144 Pipe wrap

For cold fluid installations, after installation and leak testing but before applying any insulation, protect each fitting and any exposed copper pipework that is to be insulated using a non-adhesive self-amalgamating butyl rubber, polyisobutylene or polythene tape sleeving wrap having an easily-removal disposable interleave. Overlap the tape wrap onto the pipe plastic cover to provide a continuous seal. Use only products recommended by the tubing manufacturer and apply in accordance with the tubing and tape manufacturer's instructions.

1150 Hot and cold water pipelines including pressurised and mains pressure - internal domestic (thin wall stainless steel for press-fit jointing)

This pipework system is ONLY to be used on this project if expressly permitted in the pipework schedule and/or specification sections S10 and/or S11.

1151 Application

For all internal domestic hot and cold water pipelines with maximum working temperature of 65°C and maximum working pressure of 8 bar gauge. Use press-fit jointing systems in internal locations where not concealed.

Do not use stainless steel press-fit systems in concealed or external locations. For systems served by a water booster, only use press-fit jointing in branches that are downstream of a pressure regulating valve.

1152 Pipe

Use thin wall stainless steel tube conforming to BS EN 10312 using BS EN 10088-2 grade 1.4401 (formerly 316S31 / 316) stainless steel having a 25-year guarantee.

1153 Fittings

Use press-fit type fittings made from thin wall stainless steel conforming to BS EN 10088-2 grade 1.4404 (formerly 316S11 / 316L) or grade 1.4401 (formerly 316S31 / 316) and all compatible with BS EN 10312.

Use press-fit type fittings factory supplied complete with EPDM or CIIR black O-ring seals already fitted.

Use press-fit type fittings which incorporate visual indication of when the joint has been successfully made, either 'leak before press' design or a sacrificial plastic collar.

1154 Pipe wrap

At each pipe support location wrap the pipe in aluminium foil prior to installing the insulated pipe support ring/block. Extend the aluminium foil a minimum of 75 mm either side of the support block/ring to enable an overlap to be achieved when installing the remainder of the aluminium foil.

After leak testing and prior to applying the insulation carefully wrap all pipes and fittings in aluminium foil.

Comply fully with installation requirements stated in BS 5970. Use foil with a thickness not less than 0.06 mm.

1160 Hot and cold water pipelines including pressurised and mains pressure – internal domestic (thin wall welded stainless steel) above 16 bar gauge but not exceeding 25 bar gauge

1161 Application

For all internal domestic hot and cold water pipelines up to 150 mm nominal diameter with maximum working temperature of 65°C and maximum working pressure of 25 bar gauge.

Use only butt joints and weld all joints. Workshop fabricate pipe sections/spools with flanged ends for site installation. Site made welds are only acceptable where unavoidable and few in number compared to the workshop made welds.

Do not install flanges in concealed locations.

1162 Pipe

Use plain end longitudinally welded stainless steel tube manufactured to BS EN 10217-7 and BS EN ISO 1127, with outside weld bead ground flush, weld factor equal to 1.0 and pickled descaled finish.

Use stainless steel to BS EN 10088-2 grade 1.4432 (formerly 316S13 / 316L).

Dimensions as follows:

Nominal diameter (mm)	Minimum wall thickness (mm)	Outside diameter (mm)
50	2.0	54
65	2.0	69
80	2.0	84
100	2.0	104
125	2.0	129
150	2.0	154

1163 Fittings

Use stainless steel butt welding fittings, made from BS EN 10217-7 pipe, to BS EN 10253-4, weld factor 1.0, with pickled descaled finish and suitable for the pipeline full service pressure at elevated temperature. Use only fittings of steel grade 1.4432 (formerly 316S13 / 316L) and whose finished minimum wall thickness is at least equal to that of the pipe to which they are fitted with the exception indicated below, and which are suitable for the full service pressure:

Nominal diameter (mm)	Minimum wall thickness (mm)
150	3.0

Unless specified otherwise workshop made pulled (square) tees may be used in place of swept tees.

1164 Flanges

Use pressed collars or tafted pipe ends in combination with PN25 backing ring flanges. Collars to BS EN 1092-1, figure 1, type 35, 36 or 37 and backing rings to figure 1, type 02. Bore and chamfer backing rings to suit the collars/tafted pipe ends.

For all flange backing rings use S235JR grade steel to BS EN 10025-2 or cast steel to BS EN 10213-2 grade GP240GH or forged steel to BS EN 10222-2 grade P245GH. Use flange backing rings with a fusion-bonded epoxy coating or bright zinc plated coating.

1165 Flange gaskets

Use compressed sheet flange gaskets of aramid and inorganic fibre with nitrile rubber binder to BS 7531 grade X and BS EN 1514 and suitable for wholesome domestic water at 25 bar gauge and 65°C.

1166 Flange bolts, nuts & washers

Use bolts and nuts complying with BS ISO 8992 and BS EN ISO 898. Bolts grade 8.8 and nuts grade 8, material group 3EO. Bolts and nuts to be bright zinc plated in accordance with BS EN ISO 4042.

Use bolts faced under the head with machined shank. Use nuts faced on one side. Use ISO metric coarse screwed threads.

Use washers to BS EN ISO 887 bright zinc plated to BS EN ISO 4042 and faced on both sides. Fit washers under both bolt head and nut.

1167 Pipe wrap

At each pipe support location, wrap the pipe in aluminium foil prior to installing the insulated pipe support ring/block. Extend the aluminium foil a minimum of 75 mm either side of the support block/ring to enable an overlap to be achieved when installing the remainder of the aluminium foil.

After leak testing and prior to applying the insulation, carefully wrap all pipes and fittings in aluminium foil.

Comply fully with product and installation requirements stated in BS 5970. Use foil with a thickness not less than 0.06 mm.

1170 Hot and cold water pipelines including pressurised and mains pressure - internal domestic (multilayer composite pipe for press-fit jointing) not exceeding 6 bar

This pipework system is ONLY to be used on this project if expressly permitted in the pipework schedule and/or specification sections S10 and/or S11.

1171 Application

For internal domestic hot and cold water pipelines up to 50 mm diameter with maximum working temperature of 65°C and maximum working pressure of 6 bar gauge. Make press-fit joints only in internal locations where not concealed.

1172 Pipe

Use WRAS-approved five-layer diffusion-barrier multilayer composite tube to BS EN ISO 21003-2 comprising cross linked polyethylene (PE-X) inner layer, butt-welded or seamless aluminium core, stabilised polyethylene (PE-X or HDPE) outer layer, with bonding of all interconnected layers, and having a 25-year guarantee.

1173 Fittings

Use press-fit type fittings comprising either brass or polyphenylsulphone (PPSU) body and stainless steel pressing sleeve, and having a 25-year guarantee.

Use press-fit type fittings factory supplied complete with EPDM O-ring seals already fitted.

Use press-fit type fittings that incorporate visual indications of the correct pipework tube insertion depth, and when the joint has been successfully made, the fitting indicates a successful joint by either a 'leak before press' design or a sacrificial plastic collar.

1180 Chromium plated finish

For those parts of the system where the maximum working pressure is 7.0 bar or below and where exposed piping up to 28 mm size is to be chromium plated, the piping specification is unchanged but with chromium plated finish. Use capillary soldered fittings with chromium plated finish and installed in accordance with the manufacturer’s instructions.

For cold water pipes operating up to 16 bar and hot water pipes operating up to 6 bar and 65°C and only where such piping needs to be readily disassembled and reassembled, use non-manipulative (Type-A) compression fittings to BS EN 1254-2 but with chromium plated finish.

Ensure that all chromium plating is of polished quality, electro-deposited metallic coating to BS EN ISO 1456, and for a service condition no less than No. 2 to BS EN ISO 27830.

1200 MAINS AND PRESSURISED POTABLE COLD WATER PIPELINES – EXTERNAL BURIED

1210 Mains and pressurised potable cold water pipelines – external buried (ductile iron)

1211 Application

For external buried mains and pressurised potable water having maximum working pressure of 16 bar gauge and temperature 10°C.

Use only pipe, fittings, materials and ancillary components listed in the Water Regulations Advisory Scheme (WRAS) Water Fittings and Materials Directory or confirmed in writing by WRAS or the applicable Water Authority as being of appropriate quality under the requirements of the Water Supply (Water Fittings) Regulations part 2 Regulation 4.

Use pipes and fittings which have been externally coated and internally lined at works by the manufacturer in accordance with the requirements of BS EN 545.

Use internal linings of; cement mortar with seal coat, glass enamel, epoxy or approved thermoplastic.

Use external coating comprising; zinc aluminium alloy plus seal coat of epoxy or glass enamel.

1212 Pipe

Use ductile spun iron pipe to BS EN 545 to suit joint type and pressure specified.

1213 Fittings

Use ductile cast iron fittings with push-in or push-in type ‘Anchor’ joints to maker’s standard with BS EN 681 compliant EPDM synthetic rubber gasket, type WA, for push-in joints or stainless steel toothed inserts for ‘Anchor’ joints.

1214 Flanged fittings (at valves)

Use ductile cast iron adaptor with socket and standard PN16 flange, to maker’s standard and BS EN 1092-1.

Use corrosion resistant duplex coated (sheradised layer followed by organic layer) nuts, bolts and washers to manufacturer’s recommendation for buried underground use.

1215 Flange gaskets

Use flange gaskets suitable for potable water at 16 bar gauge and 10°C, and made from BS EN 681 compliant EPDM synthetic rubber type WA.

1220 Mains and pressurised potable cold water pipelines – external buried (MDPE blue)

1221 Application

For external buried mains and pressurised potable water, up to 500 mm nominal diameter, having maximum working pressure of 12 bar gauge and temperature 20°C.

Use only pipe, fittings and ancillary components listed in the Water Regulations Advisory Scheme (WRAS) Water Fittings and Materials Directory.

Use barrier pipes unless the ground has been proven, in writing to the satisfaction of the local water authority, to be uncontaminated.

1222 Pipe: Blue polyethylene MDPE

Use polyethylene (PE) pipe to BS EN 12201, standard dimension ratio 11 (SDR11) using either PE80 or PE100 material as appropriate but do not mix material grade within an installation.

In contaminated land use polyethylene barrier pipe to BS 8588.

1223 Fittings: Blue polyethylene MDPE

Use socket fusion fittings up to and including 63 mm, or butt fusion fittings from 90 mm or electrofusion fittings across the size range all to BS EN 12201.

In contaminated land use fittings to BS 8588.

At changes in direction too abrupt to be achieved using continuous pipe use swept bends for pipe sizes 90 mm and above.

1224 Flanges and adaptors

Use MDPE flange adaptor with loose steel flange to BS EN 1092-1, PN16, galvanized or protected against corrosion.

Use corrosion resistant duplex coated (sheradised layer followed by organic layer) nuts, bolts and washers to manufacturer’s recommendation for buried underground use.

1225 Flange gaskets

Use flange gaskets suitable for potable water at 10 bar gauge, 20°C and 16 bar gauge, and made from BS EN 681 compliant EPDM synthetic rubber type WA.

1226 Workmanship

Carry out the installation of the systems in accordance with WIS 4-32-08.

1300 FIRE MAIN PIPELINES

1310 Fire mains pipelines – internal

1311 Application

For dry and wet risers and return pipes having maximum working pressure of 20 bar gauge at room temperature. For unconcealed joints on pre-galvanized pipework up to and including 50 mm use screwed joints with screwed flanges where necessary. For unconcealed joints on pre-galvanized pipework 65 mm and above use grooved couplings; or alternatively use welded black steel pipework and fittings, all hot dip galvanized after manufacture.

For concealed joints and all joints 65 mm or greater use welded black steel pipework and fittings, with flanges in unconcealed locations where necessary, all hot dip galvanized after manufacture.

1312 Pipe

For screwed or grooved jointing use pre-galvanized carbon steel tube to BS EN 10255, heavy series, P235TR1 steel, for socket fittings and screwed flanges, screwed to BS EN 10226 taper, or grooved.

For welded pipework up to 150 mm nominal diameter, that is to be galvanized after manufacture, use tube to BS EN 10255, heavy series, P235TR1 steel, with plain ends.

Dimensions as follows:

Nominal diameter (mm)	Minimum wall thickness (mm)	Outside diameter (mm)
10	2.9	17.2
15	3.2	21.3
20	3.2	26.9
25	4.0	33.7
32	4.0	42.4
40	4.0	48.3
50	4.5	60.3
65	4.5	76.1
80	5.0	88.9
100	5.4	114.3
125	5.4	139.7
150	5.4	165.1

1313 Fittings

For screwed joints use galvanized malleable cast iron, reinforced pattern fittings to BS 143 and 1256, or to BS EN 10242 or galvanized wrought steel fittings, heavy, to BS EN 10241, all screwed BS EN 10226 taper.

For welded joints to be galvanized after manufacture use normalised seamless carbon steel butt welding fittings to BS EN 10253-2 type B with varnish finish and suitable for the pipeline full service pressure at room temperature. Use only fittings of the same steel grade and whose finished minimum wall thickness is at least equal to that of the pipe to which they are fitted, and which are suitable for the full service pressure.

For grooved joints use grooved end, ductile iron cast fittings to ASTM A-536 grade 65-45-12, wrought steel, or factory fabricated and tested from ASTM A-53 pipe.

1314 Unions

Use galvanized malleable cast iron, reinforced pattern unions with ground-in spherical bronze seats to BS 143 and 1256, or to BS EN 10242, all screwed BS EN 10226 taper.

1315 Flanges: Mild steel raised face

For screwed flange jointing use galvanized screwed boss type flanges to BS EN 1092-1, PN16, figure 1, type 13, screwed BS EN 10226 taper.

For welded flange jointing, to be hot dip galvanized after manufacture, for pipe sizes up to and including 150 mm and taking due account of the need to test welds, use either slip-on weld flanges to BS EN 1092-1, figure 1, type 12 or weld-neck flanges to BS EN 1092-1 figure 1, type 11 all PN16 at room temperature. Where weld-neck flanges are used ensure that the neck wall thickness and internal and external diameters match those of the pipework to which it is attached and not as the standard BS EN 1092-1 neck detail for PN6 flanges.

For all flanges use S235JR grade steel to BS EN 10025-2 or cast steel to BS EN 10213-2 grade GP240GH or forged steel to BS EN 10222-2 grade P245GH

1316 Flange gaskets

Use compressed sheet flange gaskets of aramid and inorganic fibre with nitrile rubber binder to BS 7531 grade X and BS EN 1514 and suitable for fire main water at 16 bar gauge and 65°C.

1317 Flange bolts, nuts & washers

Use bolts and nuts complying with BS ISO 8992 and BS EN ISO 898. Bolts grade 8.8 and nuts grade 8, material group 3EO. Bolts and nuts to be bright zinc plated in accordance with BS EN ISO 4042.

Use bolts faced under the head with machined shank. Use nuts faced on one side. Use ISO metric coarse screwed threads.

Use washers to BS EN ISO 887 bright zinc plated to BS EN ISO 4042 and faced on both sides. Fit washers under both bolt head and nut.

1318 Grooved joint couplings

Use grooved joint couplings consisting of up to four ductile iron housing segments to ASTM A-536 grade 65-45-12, pressure responsive gasket to ASTM D2000, rated for water service to 110ºC. Use nuts, bolts and washers to manufacturers standard; either zinc-electroplated carbon steel heat-treated bolts and nuts meeting the physical and chemical requirements of ASTM A-449 and physical requirements of ASTM A-183 or use bolts to ASTM F568M, nuts to ASTM A563M Class 9 and coatings to ASTM B633 SC1.

1400 FEEDS, OPEN AND CLOSED VENTS, DRAINS, OVERFLOWS AND WARNING PIPES

1410 Feeds, open and closed vents and drains (galvanized steel)

1411 Application

For heating and chilled water systems cold feeds, open and closed vents and drains, galvanized hot water system open vent, AAVs, pump and equipment drains and air bottles where these are not made from copper. Maximum working pressure of 6 bar gauge at 95°C

For unconcealed joints on pre-galvanized pipework up to and including 50 mm use screwed joints with screwed flanges where necessary. For unconcealed joints on pipework 65 mm and above use grooved couplings; or alternatively use welded black steel pipework and fittings, all hot dip galvanized after manufacture.

For concealed joints and all joints 65 mm or greater use welded black steel pipework and fittings, with flanges in unconcealed locations where necessary, all hot dip galvanized after manufacture.

1412 Pipe

For screwed or grooved jointing and pressures up to 6 bar gauge, use galvanized carbon steel tube to BS EN 10255, medium or heavy series, P235TR1 steel, screwed BS EN 10226 taper for socket fittings and screwed flanges. For pressures above 6 bar gauge use heavy series pipe.

For welded pipework up to 150 mm nominal diameter, that is to be galvanized after manufacture, use pipe to BS EN 10255, heavy series, P235TR1 steel, with varnish finish and plain ends.

Dimensions as follows:

Nominal diameter (mm)	Minimum wall thickness (mm)	Outside diameter (mm)
10	2.9	17.2
15	3.2	21.3
20	3.2	26.9
25	4.0	33.7
32	4.0	42.4
40	4.0	48.3
50	4.5	60.3
65	4.5	76.1
80	5.0	88.9
100	5.4	114.3
125	5.4	139.7
150	5.4	165.1

1413 Fittings

For screwed joints use galvanized malleable cast iron, reinforced pattern fittings to BS 143 and 1256, or to BS EN 10242 or galvanized wrought steel fittings, medium/heavy to suit selected pipe, to BS EN 10241, all screwed BS EN 10226 taper.

For welded joints to be galvanized after manufacture use normalised seamless carbon steel butt welding fittings to BS EN 10253-2 type B with varnish finish and suitable for the pipeline full service pressure at room temperature. Use only fittings of the same steel grade and whose finished minimum wall thickness is at least equal to that of the pipe to which they are fitted, and which are suitable for the full service pressure.

For grooved joints use grooved end, ductile iron cast fittings to ASTM A-536 grade 65-45-12, wrought steel, or factory fabricated and tested from ASTM A-53 pipe.

1414 Unions

Use galvanized malleable cast iron, reinforced pattern unions with ground-in spherical bronze seats to BS 143 and 1256, or to BS EN 10242, all screwed BS EN 10226 taper.

1415 Flanges: Mild steel raised face

For screwed flange jointing use galvanized screwed boss type flanges to BS EN 1092-1, figure 1, type 13, PN10 screwed BS EN 10226 taper.

For welded flange jointing, to be hot dip galvanized after manufacture, for pipe sizes up to and including 150 mm and taking due account of the need to test welds, use either slip-on weld flanges to BS EN 1092-1, figure 1, type 12 or weld-neck flanges to BS EN 1092-1 figure 1, type 11 all PN10 at 95°C. Where weld-neck flanges are used ensure that the neck wall thickness and internal and external diameters match those of the pipework to which it is attached and not as the standard BS EN 1092-1 neck detail for PN10 flanges.

For all flanges use S235JR grade steel to BS EN 10025-2 or cast steel to BS EN 10213-2 grade GP240GH or forged steel to BS EN 10222-2 grade P245GH.

1416 Flange gaskets

Use flange gaskets as specification for particular systems.

1417 Flange bolts, nuts & washers

Use bolts and nuts complying with BS ISO 8992 and BS EN ISO 898. Use bolts of grade 8.8 and nuts grade 8, material group 3EO. Use bright zinc plated Bolts and nuts in accordance with BS EN ISO 4042.

Use bolts faced under the head with machined shank. Use nuts faced on one side. Use ISO metric coarse screwed threads.

Use washers to BS EN ISO 887 bright zinc plated to BS EN ISO 4042 and faced on both sides. Fit washers under both bolt head and nut.

1418 Grooved joint couplings

Use grooved joint couplings consisting of up to four ductile iron housing segments to ASTM A-536 grade 65-45-12, pressure responsive gasket to ASTM D2000, rated for water service to 110ºC. Use nuts, bolts and washers to manufacturers standard; either zinc-electroplated carbon steel heat-treated bolts and nuts meeting the physical and chemical requirements of ASTM A-449 and physical requirements of ASTM A-183 or use bolts to ASTM F568M, nuts to ASTM A563M Class 9 and coatings to ASTM B633 SC1.

1420 Feeds, open and closed vents and drains (copper, polyethylene coated for cold)

1421 Application

Maximum working pressure of 6 bar gauge at 95°C. For copper heating, chilled water and hot water system cold feeds, open and closed vents, air bottles and drains, AAVs, pump and equipment drains. For joints on pipework up to and including 54 mm and not concealed, use capillary soldered fittings and unions. For all other joints use brazed fittings and flanges where not concealed. Use brazed fittings where concealed.

1422 Pipe

For hot services and internal exposed uninsulated cold services up to and including 54 mm, use copper tube to BS EN 1057, type R250 half hard, grade CuDHP/CW024A, and having a 25-year guarantee, or use tube to the specification for hot water services.

For hot water services and exposed internal uninsulated cold water services of pipe size 67 mm and above, and for short connections between tube and screwed components for pipe sizes 35 mm and above, use copper tube to BS EN 1057, type R290 hard, grade CuDHP/CW024A, and having a 25-year guarantee.

For all cold services up to and including 54 mm except those parts exposed and uninsulated, use polyethylene coated copper tube complying with BS EN 13349 to BS EN 1057, type R250 half hard, grade CuDHP/CW024A, and having a 25-year guarantee.

For cold water services, except those parts exposed and uninsulated, of pipe size 67 mm and above, and for short connections between tube and screwed components for pipe sizes 35 mm and above, use polyethylene coated copper tube complying with BS EN 13349 to BS EN 1057, type R290 hard, grade CuDHP/CW024A, and having a 25-year guarantee.

Install all pipes strictly in accordance with the manufacturer’s instructions.

Minimum wall thicknesses as follows:

Nominal diameter (mm)	Pipe type	Wall thickness (mm)
15	R250	0.7
22 & 28	R250	0.9
35, 42 & 54	R250 *	1.2
67	R290	1.2
76 & 108	R290	1.5

* R290 for short connections between tube and screwed components

1423 Fittings and unions

Use capillary type, copper or dezincification resistant copper alloy fittings and unions to BS EN 1254-1, having a 25-year guarantee and join with lead-free solder of alloy No. 401 (or any of; 402, 701, 702) to BS EN ISO 9453. Either end-feed or integral-solder-ring type is permitted.

Use capillary brazing type copper or dezincification resistant copper alloy fittings to BS EN 1254-1 or BS EN 1254-5 with silver alloy brazing metal, type AG 155 to BS EN ISO 17672, Table 6. Alternative acceptable brazing alloys are: AG140, and where nickel is not present: CuP179, CuP182, CuP279, CuP281 and CuP284.

1424 Flanges

Use slip-on flange backing rings of mild steel over CuDHP/CW024A copper alloy collars, capillary type to BS EN 1092-3, type 07, 37 PN6 at 150°C with silver alloy brazing metal, type AG 155 to BS EN ISO 17672, Table 6, and protected against electrolytic action and corrosion.

1425 Flange gaskets

Use flange gaskets as specification for particular system.

1426 Flange bolts, nuts & washers

Use bolts and nuts complying with BS ISO 8992 and BS EN ISO 898. Bolts of grade 8.8 and nuts of grade 8, material group 3EO. Use bolts and nuts with bright zinc plated coating in accordance with BS EN ISO 4042.

Use bolts faced under the head with machined shank. Use nuts faced on one side. Use ISO metric coarse screwed threads.

Use washers to BS EN ISO 887 bright zinc plated to BS EN ISO 4042 and faced on both sides. Fit washers under both bolt head and nut.

1427 Pipe wrap

For cold fluid installations, after installation and leak testing but before applying any insulation, protect each fitting and any exposed copper pipework that is to be insulated using a non-adhesive self-amalgamating butyl rubber, polyisobutylene or polythene tape sleeving wrap having an easily-removal disposable interleave. Overlap the tape wrap onto the pipe plastic cover to provide a continuous seal. Use only products recommended by the tubing manufacturer and apply in accordance with the tubing and tape manufacturer’s instructions.

1430 Feeds, open and closed vents and drains (thin wall welded stainless steel)

1431 Application

Maximum working pressure of 6 bar gauge at 95°C. For all stainless steel heating, chilled water, hot and cold water system cold feeds, open and closed vents, air bottles and drains, AAVs, pump and equipment drains up to 108 mm.

Use only butt joints and weld all joints. Workshop fabricate pipe sections/spools with flanged ends for site installation. Site made welds are only acceptable where unavoidable and few in number compared to the workshop made welds.

Do not install flanges in concealed locations.

1432 Pipe

Use plain end longitudinally welded stainless steel tube manufactured to BS EN 10217-7 and BS EN ISO 1127, with outside weld bead ground flush, weld factor equal to 1.0 and pickled descaled finish.

Use stainless steel to BS EN 10088-2 grade 1.4307 (formerly 304S11 / 304L).

Dimensions as follows:

Nominal diameter (mm)	Minimum wall thickness (mm)	Outside diameter (mm)
25	1.5	28
32	1.5	35
40	1.5	43
50	1.5	53
65	1.5	68
80	1.5	83
100	2.0	104
125	2.0	129
150	2.0	154

1433 Fittings

Use stainless steel butt welding fittings, made from BS EN 10217-7 pipe, to BS EN 10253-4, weld factor 1.0, with pickled descaled finish and suitable for the pipeline full service pressure at elevated temperature. Use only fittings of steel grade 1.4307 (formerly 304S11 / 304L) or 1.4432 (formerly 316S13 / 316L) and whose finished minimum wall thickness is at least equal to that of the pipe to which they are fitted, and which are suitable for the full service pressure.

Unless specified otherwise workshop made pulled (square) tees may be used in place of swept tees.

1434 Flanges

Use pressed collars or tafted pipe ends in combination with PN16 backing ring flanges. Collars to BS EN 1092-1, figure 1, type 35, 36 or 37 and backing rings to figure 1, type 02. Bore and chamfer backing rings to suit the collars/tafted pipe ends.

For all flange backing rings use S235JR grade steel to BS EN 10025-2 or cast steel to BS EN 10213-2 grade GP240GH or forged steel to BS EN 10222-2 grade P245GH. Use flange backing rings with a fusion-bonded epoxy coating or bright zinc plated coating.

1435 Flange gaskets

Use compressed sheet flange gaskets of aramid and inorganic fibre with nitrile rubber binder to BS 7531 grade X and BS EN 1514 and suitable for LTHW at 6 bar gauge and 95°C.

1436 Flange bolts, nuts & washers

Use bolts and nuts complying with BS ISO 8992 and BS EN ISO 898. Bolts grade 8.8 and nuts grade 8, material group 3EO. Bolts and nuts to be bright zinc plated in accordance with BS EN ISO 4042.

Use bolts faced under the head with machined shank. Use nuts faced on one side. Use ISO metric coarse screwed threads.

Use washers to BS EN ISO 887 bright zinc plated to BS EN ISO 4042 and faced on both sides. Fit washers under both bolt head and nut.

1437 Pipe wrap

At each pipe support location wrap the pipe in aluminium foil prior to installing the insulated pipe support ring/block. Extend the aluminium foil a minimum of 75 mm either side of the support block/ring to enable an overlap to be achieved when installing the remainder of the aluminium foil.

After leak testing and prior to applying the insulation carefully wrap all pipes and fittings in aluminium foil.

Comply fully with product and installation requirements stated in BS 5970. Use foil with a thickness not less than 0.06 mm.

1440 Feeds, open and closed vents and drains (copper, polyethylene coated for cold, for press-fit jointing)

This pipework system is ONLY to be used on this project if expressly permitted in the pipework schedule and/or specification sections T31/T61/S10 and/or S11.

1441 Application

Maximum working pressure of 6 bar gauge at 82°C. For copper heating, chilled water and hot water system cold feeds, open and closed vents, air bottles and drains, AAVs, pump and equipment drains. Use press-fit jointing systems in internal locations where not concealed.

Do not use copper press-fit systems in concealed or external locations.

1442 Pipe

For hot services and internal exposed uninsulated cold services up to and including 54 mm, use copper tube to BS EN 1057, type R250 half hard, grade CuDHP/CW024A, and having a 25-year guarantee.

For hot services and exposed internal uninsulated cold water services of pipe size 67 mm and above, use copper tube to BS EN 1057, type R290 hard, grade CuDHP/CW024A, and having a 25-year guarantee.

For cold services up to and including 54 mm except those parts exposed and uninsulated, use polyethylene coated copper tube complying with BS EN 13349 to BS EN 1057, type R250 half hard, grade CuDHP/CW024A, and having a 25-year guarantee.

For cold services, except those parts exposed and uninsulated, of pipe size 67 mm and above, use polyethylene coated copper tube complying with BS EN 13349 to BS EN 1057, type R290 hard, grade CuDHP/CW024A, and having a 25-year guarantee.

Minimum wall thicknesses as follows:

Nominal diameter (mm)	Minimum wall thickness (mm)	Outside diameter (mm)
15	R250	0.7
22 & 28	R250	0.9
35, 42 & 54	R250	1.2
67	R290	1.2
76 & 108	R290	1.5

1443 Fittings

Use press-fit type fittings, in accordance with BS 8537, made from copper, Cu-DHP CW024A in accordance with BS EN 1412.

Use press-fit type fittings factory supplied complete with EPDM or CIIR black O-ring seals already fitted.

Use press-fit type fittings which incorporate visual indication of when the joint has been successfully made, either 'leak before press' design or a sacrificial plastic collar.

1444 Pipe wrap

For cold fluid installations, after installation and leak testing but before applying any insulation, protect each fitting and any exposed copper pipework that is to be insulated using a non-adhesive self-amalgamating butyl rubber, polyisobutylene or polythene tape sleeving wrap having an easily-removal disposable interleave. Overlap the tape wrap onto the pipe plastic cover to provide a continuous seal. Use only products recommended by the tubing manufacturer and apply in accordance with the tubing and tape manufacturer's instructions.

1450 Feeds, open and closed vents and drains (thin wall stainless steel for press-fit jointing)

This pipework system is ONLY to be used on this project if expressly permitted in the pipework schedule and/or specification sections T31/T61/S10 and/or S11.

1451 Application

Maximum working pressure of 6 bar gauge at 82°C. For all stainless steel heating, chilled water, hot and cold water system cold feeds, open and closed vents, air bottles and drains, AAVs, pump and equipment drains up to 108 mm. Use press-fit jointing systems in internal locations where not concealed.

Do not use stainless steel press-fit systems in concealed or external locations.

1452 Pipe

Use thin wall stainless steel tube conforming to BS EN 10312 using BS EN 10088-2 grade 1.4401 (formerly 316S31 / 316) or grade 1.4301 (formerly 304S31 / 304) stainless steel having a 25-year guarantee.

1453 Fittings

Use press-fit type fittings made from thin wall stainless steel conforming to BS EN 10088-2 grade 1.4404 (formerly 316S11 / 316L) or grade 1.4401 (formerly 316S31 / 316) and all compatible with BS EN 10312.

Use press-fit type fittings factory supplied complete with EPDM or CIIR black O-ring seals already fitted.

Use press-fit type fittings which incorporate visual indication of when the joint has been successfully made, either 'leak before press' design or a sacrificial plastic collar.

1454 Pipe wrap

At each pipe support location wrap the pipe in aluminium foil prior to installing the insulated pipe support ring/block. Extend the aluminium foil a minimum of 75 mm either side of the support block/ring to enable an overlap to be achieved when installing the remainder of the aluminium foil.

After leak testing and prior to applying the insulation carefully wrap all pipes and fittings in aluminium foil.

Comply fully with product and installation requirements stated in BS 5970. Use foil with a thickness not less than 0.06 mm.

1460 Overflow and warning pipes (uPVC)

Pipe cisterns and equipment requiring cold overflow and warning pipes using uPVC with easy sweep fittings, eccentric reducers and with suitable falls to discharge in accordance with the particular specification and drawings.

For the section of pipe passing through to the outside use either black or white pipe, colour to be agreed with the Contract Administrator.

On overflow pipe discharges of 32 mm and above nominal bore fit a suitable size mesh bird guard which does not impose undue resistance to the outflow.

Comply fully with the requirements of the WRAS Water Regulations Guide.

1500 NATURAL GAS PIPELINES

Where connecting to equipment and ancillaries, screwed connectors, adaptors and couplings are permitted. Where not exposed, pulled bends in copper pipes are permitted. Except for accessible connections to equipment do not use compression joints.

For all but the final building entry of buried sections of pipe use the polyethylene specification. For the final building entry change within 1 m of the building to steel pipe.

Comply with the requirements of IGEM UP/2.

1510 Natural gas pipelines – internal and external (black steel)

1511 Application

For all natural gas pipelines having maximum working pressure of up to 5 bar gauge.

For maximum operating pressures up to 0.5 bar gauge. For joints on steel pipework up to and including 50 mm and where not concealed, not within risers exceeding 20 meters high, not below ground, and not within energy centres, use either welded or screwed methods. Weld all other joints, and joints 65 mm and above. Do not use screwed or flanged joints in concealed locations, in below ground locations or in energy centres (i.e. locations containing combustion plant) unless connecting directly to an item of equipment or unless otherwise accepted in writing by the Contract Administrator.

In addition to and in accordance with the general welding requirements described later in this section, arrange for 100% of welded joints in concealed locations and a minimum of 10% of welded joints in risers exceeding 20 meters high to undergo non-destructive testing.

For maximum operating pressures up to 5 bar gauge. For joints on steel pipework up to and including 25 mm and where not concealed, not below ground, and not within energy centres, use either welded or screwed methods. Weld all other joints, and joints 32 mm and above. Do not use screwed or flanged joints in concealed locations, in below ground locations or in energy centres (i.e. locations containing combustion plant) unless connecting directly to an item of equipment or unless otherwise accepted in writing by the Contract Administrator.

Use the minimum practical number of joints.

For the final underground section of incoming supplies make the transition from MDPE to steel and rise to above ground before entering, via a suitable sleeve, into the building and up to the first internal isolation valve. Weld all joints on this section of pipe.

1512 Pipe

For pipework in internal locations from 10 mm to 150 mm nominal diameter use tube to BS EN 10255, medium series, P235TR1 steel, with factory-applied red paint finish and plain/screwed ends. Screwed ends to BS EN 10226 taper.

Dimensions as follows:

Nominal diameter (mm)	Minimum wall thickness (mm)	Outside diameter (mm)
10	2.3	17.2
15	2.6	21.3
20	2.6	26.9
25	2.6	33.7
32	4.0	42.4
40	4.0	48.3
50	4.5	60.3
65	4.5	76.1
80	5.0	88.9
100	5.4	114.3
125	5.4	139.7
150	5.4	165.1

Do not install medium series steel tube in any location without direct access or where it is permanently concealed. In these instances use heavy series steel pipe.

For pipework in external locations and in buried (below ground) locations from 10 mm to 150 mm nominal diameter, use tube to BS EN 10255, heavy series, P235TR1 steel, with factory-applied red paint finish and plain/screwed ends. Screwed ends to BS EN 10226 taper.

Dimensions as follows:

Nominal diameter (mm)	Minimum wall thickness (mm)	Outside diameter (mm)
10	2.9	17.2
15	3.2	21.3

20	3.2	26.9
25	4.0	33.7
32	4.0	42.4
40	4.0	48.3
50	4.5	60.3
65	4.5	76.1
80	5.0	88.9
100	5.4	114.3
125	5.4	139.7
150	5.4	165.1

For pipework from 200 mm up to 500 mm nominal diameter, use high frequency induction welded (HFIW) steel tube, with protective varnish finish, made from fully traceable, high quality fully killed steel all to BS EN 10217-2 grade P235GH/TC1.

Ensure both the external and internal weld beads have been fully trimmed and removed on all pipe used.

All tubes to be either hot finish full body normalised or made from normalised strip with annealed weld line.

For sizes 200 mm and above use only tubes whose weld seams have been ultrasonically tested and which have been hydraulically tested for pressure integrity.

Dimensions as follows:

Nominal diameter (mm)	Minimum wall thickness (mm)	Outside diameter (mm)
200	8.0	219.1
250	8.0	273.0
300	10.0	323.9
350	10.0	355.6
400	12.5	406.4
450	12.5	457.0
500	12.5	508.0

1513 Fittings

For screwed joints use malleable cast iron, reinforced pattern fittings to BS 143 and 1256, or to BS EN 10242 or wrought steel fittings, heavy, to BS EN 10241, all screwed BS EN 10226 taper.

For welded joints use normalised seamless carbon steel butt welding fittings to BS EN 10253-2 type B with varnish finish and suitable for the pipeline full service pressure at ambient temperature. Use only fittings of the same steel grade and whose finished minimum wall thickness is at least equal to that of the pipe to which they are fitted, and which are suitable for the full service pressure.

Where using seamless pipe to ASTM/API standards use normalised seamless fittings to ANSI/ASME B16.9 and ASTM A234M or matching API standard.

1514 Unions

Use malleable cast iron, reinforced pattern unions with ground-in spherical bronze seats to BS 143 and 1256, or to BS EN 10242, all screwed BS EN 10226 taper.

1515 Flanges: Mild steel, raised face

For pipe sizes up to and including 50 mm use screwed boss type flanges to BS EN 1092-1, figure 1, type 13 or hubbed slip-on weld flanges to the specification below all to PN6 at ambient temperature.

For pipe sizes up to an including 300 mm and taking due account of the need to test welds, use either hubbed slip-on weld flanges to BS EN 1092-1, figure 1, type 12 PN6 at ambient temperature or weld-neck flanges to BS EN 1092-1 figure 1, type 11 PN6 at ambient temperature. Where weld-neck flanges are used ensure that the neck wall thickness and internal and external diameters match those of the pipework to which it is attached and not as the standard BS EN 1092-1 neck detail for PN6 flanges.

For all flanges use S235JR grade steel to BS EN 10025-2 or cast steel to BS EN 10213-2 grade GP240GH or forged steel to BS EN 10222-2 grade P245GH.

1516 Flange gaskets

Use flange gaskets suitable for natural gas.

1517 Flange bolts, nuts & washers

Use bolts and nuts complying with BS ISO 8992 and BS EN ISO 898. Use bolts grade 8.8 and nuts grade 8, material group 3EO. Bolts and nuts to be bright zinc plated in accordance with BS EN ISO 4042.

Use bolts faced under the head with machined shank. Use nuts faced on one side. Use ISO metric coarse screwed threads.

Use washers to BS EN ISO 887 bright zinc plated to BS EN ISO 4042 and faced on both sides. Fit washers under both bolt head and nut.

1518 Buried steel pipe protection

Protect the entire extent of all buried steel pipe from the metallic coupling to the MDPE main up to the first isolation valve inside the building. Wrap the pipe in two opposing layers of overlapping cold applied non-woven synthetic fibre fabric tape impregnated and coated both sides with a neutral compound based on saturated petroleum hydrocarbons (petrolatum) and inert siliceous fillers. Ensure that each layer of the tape overlaps onto itself by at least 55%. Apply a suitable primer if recommended by the manufacturer.

Overwrap the completed petrolatum tape installation with self-adhesive PVC tape also overlapped onto itself by at least 55%.

Use tapes and primers all from the same manufacturer and all designed to work together as an effective corrosion protection system for buried pipes.

Where connections between steel and MDPE require bolted fixing use corrosion resistant duplex coated (sheradised layer followed by organic layer) nuts, bolts and washers to manufacturers recommendation for buried underground use.

1520 Natural gas pipelines – internal (copper)

1521 Application

For internal natural gas copper pipelines from the meter, up to 54 mm and having a maximum working pressure of 5 bar gauge.

For joints on pipework up to and including 54 mm, having a maximum working pressure of 75 mbar and not concealed, use capillary soldered fittings and unions. For all other joints use brazed fittings and flanges where not concealed. Use brazed fittings where concealed.

Only use R220 sizes 8, 10 and 12 mm pipe in concealed parts of domestic installations and where shown and sized on the scheme drawings for final connections after restrictor elbows.

1522 Pipe

For pipe sizes from 8 mm up to 12 mm use R220 annealed copper tube, for sizes from 15 mm to 54 mm use R250 half hard copper tube, and for sizes from 67 mm to 108 mm use R290 hard copper tube, all to BS EN 1057, grade CuDHP/CW024A, and having a 25-year guarantee.

Minimum wall thicknesses as follows:

Nominal diameter (mm)	Pipe type	Wall thickness (mm)
8,10 &12	R220	0.6
15	R250	0.7
22 & 28	R250	0.9
35, 42 & 54	R250	1.2
67	R290	1.2
76 & 108	R290	1.5

1523 Fittings and unions

For soldered joints up to and including 54 mm size and having a maximum working pressure of 75 mbar, use capillary type copper or dezincification resistant copper alloy fittings and unions to BS EN 1254-1 with 99/1 tin/copper soft solder integral rings to BS EN ISO 9453 alloy 401.

For brazed joints, use LG4 high duty gunmetal (to BS EN 1982, CB492K) fittings to manufacturer’s standard with silver alloy brazing metal, type AG 155 to BS EN ISO 17672, Table 6.

1524 Flanges

Use slip-on flange backing rings of mild steel over CuDHP/CW024A copper alloy collars, capillary type to BS EN 1092-3, type 07, 37 PN6 at ambient temperature with silver alloy brazing metal, type AG 155 to BS EN ISO 17672, Table 6, and protected against electrolytic action and corrosion.

1525 Flange gaskets

Use flange gaskets suitable for natural gas.

1526 Flange bolts, nuts & washers

Use bolts and nuts complying with BS ISO 8992 and BS EN ISO 898. Use bolts grade 8.8 and nuts grade 8, material group 3EO. Bright zinc plate bolts and nuts in accordance with BS EN ISO 4042.

Use bolts faced under the head with machined shank. Use nuts faced on one side. Use ISO metric coarse screwed threads.

Use washers to BS EN ISO 887 bright zinc plated to BS EN ISO 4042 and faced on both sides. Fit washers under both bolt head and nut.

1530 Natural gas pipelines - internal (copper for press-fit jointing)

This pipework system is ONLY to be used on this project if expressly permitted in the pipework schedule and/or specification section S32.

1531 Application

For internal natural gas copper pipelines from the meter up to 108 mm which are not concealed, not below ground, and not within energy centres, and having a maximum working pressure of up to 75 mbar gauge. Do not use press-fit jointing in concealed locations, in below ground locations or in energy centres (i.e. locations containing combustion plant) or unless otherwise accepted in writing by the Contract Administrator.

1532 Pipe

For pipe sizes from 15 mm to 108 mm use R250 half hard copper tube all to BS EN 1057, grade CuDHP/CW024A, and having a 25-year guarantee.

Minimum wall thicknesses as follows:

Nominal diameter (mm)	Pipe type	Wall thickness (mm)
15	R250	0.7
22 & 28	R250	0.9
35, 42 & 54	R250	1.2
67	R290	1.2
76 & 108	R290	1.5

1533 Fittings

Use press-fit type fittings, in accordance with BS 8537, made from copper, Cu-DHP CW024A in accordance with BS EN 1412. Use press-fit type fittings suitable for use with natural gas and factory supplied complete with HNBR yellow O-ring seals already fitted.

Where press-fit jointing is used ensure some form of visual indication of when the joint has been successfully made is evident, either by measures incorporated into the manufacture of the fitting, or by site management measures. Clearly identify these measures in the method statement and the training regime (see the 'Method statement' and 'Training' clauses within the Press-fit jointing systems section).

1540 Natural gas pipelines - internal (thin wall stainless steel for press-fit jointing)

This pipework system is ONLY to be used on this project if expressly permitted in the pipework schedule and/or specification section S32.

1541 Application

For internal natural gas stainless steel pipelines from the meter up to 108 mm which are not concealed, not below ground, and not within energy centres, and having a maximum working pressure of up to 75 mbar gauge. Do not use press-fit jointing in concealed locations, in below ground locations or in energy centres (i.e. locations containing combustion plant) or unless otherwise accepted in writing by the Contract Administrator.

1542 Pipe

Use thin wall stainless steel tube conforming to BS EN 10312 using BS EN 10088-2 grade 1.4401 (formerly 316S31 / 316) stainless steel having a 25-year guarantee.

1543 Fittings

Use press-fit type fittings made from thin wall stainless steel conforming to BS EN 10088-2 grade 1.4401 (formerly 316S31 / 316) or grade 1.4571 (formerly 320S31 / 316Ti) and all compatible with BS EN 10312.

Use press-fit type fittings suitable for use with natural gas and factory supplied complete with HNBR yellow O-ring seals already fitted. Ensure some form of visual indication of when the joint has been successfully made is evident, either by measures incorporated into the manufacture of the fitting, or by site management measures. Clearly identify these measures in the method statement and the training regime (see the 'Method statement' and 'Training' clauses within the Press-fit jointing systems section).

1550 Natural gas pipelines – external buried

1551 Application

For external buried natural gas pipelines having a maximum working pressure of 2 bar gauge.

Refer to the clauses for natural gas pipelines – internal and external (black steel) for the final building entry pipe specification.

1552 Pipe

Use yellow polyethylene MDPE, to National Grid standards GIS/PL2-1 and GIS/PL2-2 metric sizes, wall thickness to SDR 11.

1553 Fittings

Use yellow polyethylene MDPE, electrofusion sockets and saddles to GIS/PL2-4 and butt fusion spigot end fittings to GIS/PL2-6.

1554 Adaptors and flanges

Use GIS/PL3 MDPE flange adaptors with loose steel flanges to BS EN 1092-1, minimum PN6 galvanized or protected against corrosion.

1555 Flange gaskets

Use flange gaskets suitable for natural gas.

1556 Jointing tools

Use butt fusion equipment in accordance with GIS/PL2-3.

1600 FUEL OIL PIPELINES

Where connecting to equipment and ancillaries, screwed connectors, adaptors and couplings are permitted. Where not exposed, pulled bends in copper pipes are permitted. Except for accessible connections to equipment do not use compression joints.

1610 Fuel oil pipelines – internal and external (not buried) (black steel)

1611 Application

For fuel oil pipes (not buried) with maximum working pressure of 10 bar gauge. For joints on steel pipework up to and including 50 mm and where not concealed, use either welded or screwed joints.

Weld all other joints and all joints 65 mm and above.

1612 Pipe

For pipework from 10 mm to 150 mm nominal diameter, where concealed, use tube to BS EN 10255, heavy series, P235TR1 steel, with factory-applied red paint finish and plain/screwed ends. Screwed ends to BS EN 10226 taper.

Dimensions as follows:

Nominal diameter (mm)	Minimum wall thickness (mm)	Outside diameter (mm)
10	2.9	17.2
15	3.2	21.3
20	3.2	26.9
25	4.0	33.7
32	4.0	42.4
40	4.0	48.3
50	4.5	60.3
65	4.5	76.1
80	5.0	88.9
100	5.4	114.3
125	5.4	139.7
150	5.4	165.1

For pipework from 10 mm to 150 mm, where not concealed or for vent pipes only, except sizes 20 mm, 40 mm and 65 mm nominal diameter, use tube to BS EN 10255, medium series, P235TR1 steel, with factory-applied red paint finish and plain/screwed ends. Screwed ends to BS EN 10226 taper. For 20 mm, 40 mm and 65 mm sizes use heavy series steel pipe.

Dimensions as follows:

Nominal diameter (mm)	Minimum wall thickness (mm)	Outside diameter (mm)
10	2.3	17.2
15	2.6	21.3
20	3.2*	26.9
25	3.2	33.7
32	3.2	42.4
40	4.0*	48.3
50	3.6	60.3
65	4.5*	76.1
80	4.0	88.9
100	4.5	114.3
125	5.0	139.7
150	5.0	165.1

	* Heavy series	

Do not install medium series steel tube in any location without direct access or where permanently concealed. In those instances use heavy series steel pipe.

1613 Fittings

For screed joints use malleable cast iron, reinforced pattern fittings to BS 143 and 1256, or to BS EN 10242 or wrought steel fittings, heavy/medium to suit the pipe, to BS EN 10241, all screwed BS EN 10226 taper.

~ For welded joints use normalised seamless carbon steel butt welding fittings to BS EN 10253-2 type B with varnish finish and suitable for the pipeline full service pressure at ambient temperature. Use only fittings of the same steel grade and whose finished minimum wall thickness is at least equal to that of the pipe to which they are fitted, and which are suitable for the full service pressure.

1614 Unions

Use malleable cast iron, reinforced pattern unions with ground-in spherical bronze seats to BS 143 and 1256, or to BS EN 10242, all screwed BS EN 10226 taper.

1615 Flanges: Mild steel, raised face

For pipe sizes up to and including 50 mm use screwed boss type flanges to BS EN 1092-1, figure 1, type 13 or hubbed slip-on weld flanges to the specification below all to PN10 at ambient temperature.

For pipe sizes up to and including 150 mm and taking due account of the need to test welds, use either hubbed slip-on weld flanges to BS EN 1092-1, figure 1, type 12 PN10 at ambient temperature or weld-neck flanges to BS EN 1092-1 figure 1, type 11 PN10 at ambient temperature. Where weld-neck flanges are used ensure that the neck wall thickness and internal and external diameters match those of the pipework to which it is attached and not as the standard BS EN 1092-1 neck detail for PN10 flanges.

For all flanges use S235JR grade steel to BS EN 10025-2 or cast steel to BS EN 10213-2 grade GP240GH or forged steel to BS EN 10222-2 grade P245GH.

1616 Flange gaskets

Use oil resistant grade flange gaskets.

1617 Flange bolts, nuts & washers

Use bolts and nuts complying with BS ISO 8992 and BS EN ISO 898. Use bolts grade 8.8 and nuts grade 8, material group 3EO. Bright zinc plate bolts and nuts in accordance with BS EN ISO 4042.

Use bolts faced under the head with machined shank. Use nuts faced on one side. Use ISO metric coarse screwed threads.

Use washers to BS EN ISO 887 bright zinc plated to BS EN ISO 4042 and faced on both sides. Fit washers under both bolt head and nut.

1620 Fuel oil pipelines – internal and external (not buried) (copper)

1621 Application

For fuel oil pipelines (not buried) up to 54 mm with maximum working pressure of 5 bar gauge pressure.

For joints on pipework up to 54 mm and not concealed, use capillary soldered fittings and unions. Use brazed fittings where concealed.

Only use R220 sizes 8, 10 and 12 mm pipe in concealed parts of domestic installations and where shown and sized on the scheme drawings for final connections.

1622 Pipe

For pipe sizes from 8 mm up to 12 mm use R220 annealed copper tube and for sizes from 15 mm to 54 mm use R250 half hard copper tube all to BS EN 1057 grade CuDHP/CW024A, and having a 25-year guarantee.

Minimum wall thicknesses as follows:

Nominal diameter (mm)	Pipe type	Wall thickness (mm)
8,10 &12	R220	0.6
15	R250	0.7
22 & 28	R250	0.9
35, 42 & 54	R250	1.2

1623 Fittings and unions

For pipes up to and including 54 mm use LG4 high duty gunmetal (to BS EN 1982, CB492K) fittings to manufacturers standard with silver alloy brazing metal, type AG 155 to BS EN ISO 17672, Table 6.

1624 Flanges

Use slip-on flange backing rings of mild steel over CuDHP/CW024A copper alloy collars, capillary type to BS EN 1092-3, type 07, 37 PN10 at ambient temperature with silver alloy brazing metal, type AG 155 to BS EN ISO 17672, Table 6, and protected against electrolytic action and corrosion.

1621 Flange bolts, nuts & washers

Use bolts and nuts complying with BS ISO 8992 and BS EN ISO 898. Use bolts grade 8.8 and nuts grade 8, material group 3EO. Bright zinc plate bolts and nuts in accordance with BS EN ISO 4042.

Use bolts faced under the head with machined shank. Use nuts faced on one side. Use ISO metric coarse screwed threads.

Use washers to BS EN ISO 887 bright zinc plated to BS EN ISO 4042 and faced on both sides. Fit washers under both bolt head and nut.

1622 Flange gaskets

Use oil resistant grade flange gaskets.

1630 Fuel oil pipelines – external buried

Not available.

1700 COMPRESSED AIR PIPELINES

Use only products and materials confirmed by the manufacturer as suitable for the application.

1710 Compressed air pipelines – industrial (copper)

1711 Application

For dry and humid compressed air either oiled or oil free with pipe sizes up to 108 mm and maximum working pressures of 10 bar gauge.

Use only brazed joints.

1712 Pipe

Use copper tube to BS EN 1057, type R250 half hard for sizes up to and including 54 mm and R290 hard for sizes 67 mm and above, grade CuDHP/CW024A, and having a 25-year guarantee.

1713 Fittings and unions

Use LG4 high duty gunmetal (to BS EN 1982, CB492K) fittings to manufacturer’s standard, or where available to BS EN 1254-1 or BS EN 1254-5, with silver alloy brazing metal, type AG 155 to BS EN ISO 17672, Table 6.

1714 Flanges

Use slip-on flange backing rings of mild steel over CB492K copper alloy collars, capillary type all to BS EN 1092-3, type 07, 37 PN16 at 150°C with silver alloy brazing metal, type AG 155 to BS EN ISO 17672, Table 6, and protected against electrolytic action and corrosion.

1715 Flange gaskets

Use flange gaskets suitable for compressed air at 10 bar gauge.

1716 Flange bolts, nuts & washers

Use bolts and nuts complying with BS ISO 8992 and BS EN ISO 898. Use bolts grade 8.8 and nuts grade 8, material group 3EO. Bright zinc plate bolts and nuts in accordance with BS EN ISO 4042.

Use bolts faced under the head with machined shank. Use nuts faced on one side. Use ISO metric coarse screwed threads.

Use washers to BS EN ISO 887 bright zinc plated to BS EN ISO 4042 and faced on both sides. Fit washers under both bolt head and nut.

1720 Compressed air pipelines - industrial (copper for press-fit jointing)

This pipework system is ONLY to be used on this project if expressly permitted in the pipework schedule and/or specification section S30.

1721 Application

For dry and humid compressed air either oiled or oil free with pipe sizes up to 108 mm and maximum working pressures of 10 bar gauge. Use press-fit jointing systems in internal locations where not concealed.

Do not use copper press-fit systems in concealed or external locations.

1722 Pipe

Use copper tube to BS EN 1057, type R250 half hard for sizes up to and including 54 mm and R290 hard for sizes 67 mm and above, grade CuDHP/CW024A, and having a 25-year guarantee.

1723 Fittings and unions

Use press-fit type fittings, in accordance with BS 8537, made from copper, Cu-DHP CW024A in accordance with BS EN 1412.

For oil free compressed air use press-fit type fittings factory supplied complete with EPDM or CIIR black O-ring seals already fitted.

For oiled compressed air use fittings factory supplied complete with FPM red O-ring seals already fitted.

Use press-fit type fittings which incorporate visual indication of when the joint has been successfully made, either 'leak before press' design or a sacrificial plastic collar.

1730 Compressed air pipelines - industrial (thin wall stainless steel for press-fit jointing)

This pipework system is ONLY to be used on this project if expressly permitted in the pipework schedule and/or specification section S30.

1731 Application

For dry and humid compressed air, either oiled or oil free, with pipelines up to 108 mm and maximum working pressure of 10 bar gauge.

Use press-fit jointing systems in internal locations where not concealed.

Do not use stainless steel press-fit systems in concealed or external locations.

1732 Pipe

Use thin wall stainless steel tube conforming to BS EN 10312 using BS EN 10088-2 grade 1.4401 (formerly 316S31 / 316) or grade 1.4301 (formerly 304S31 / 304) stainless steel having a 25-year guarantee.

1733 Fittings

Use press-fit type fittings made from thin wall stainless steel conforming to BS EN 10088-2 grade 1.4404 (formerly 316S11 / 316L) or grade 1.4401 (formerly 316S31 / 316) and all compatible with BS EN 10312.

For oil free compressed air use press-fit type fittings factory supplied complete with CIIR black O-ring seals already fitted.

For oiled compressed air use fittings factory supplied complete with FPM red O-ring seals already fitted.

Use press-fit type fittings which incorporate visual indication of when the joint has been successfully made, either 'leak before press' design or a sacrificial plastic collar.

1740 Compressed air pipelines - industrial (internally and externally galvanized thin wall carbon steel)

1741 Application

For dry compressed air pipelines up to 108 mm with maximum working pressure of 10 bar gauge at ambient temperature. Use press-fit jointing in internal locations where not concealed.

Do not use carbon steel press-fit systems in concealed or external locations.

1742 Pipe

Use unalloyed high purity low carbon steel tube to BS EN 10305-3 steel grade E195, 1.0034 with both internal and external surfaces galvanized in accordance with BS EN ISO 2081 and having a 10-year guarantee.

1743 Fittings

Use press-fit type fittings made to BS EN 10305-3 steel grade E195, 1.0034 with both internal and external surfaces galvanized in accordance with BS EN ISO 2081.

For oil free dry compressed air use fittings factory supplied complete with CIIR black O-ring seals already fitted.

For oiled dry compressed air use fittings factory supplied complete with FPM red O-ring seals already fitted.

Use fittings which incorporate visual indication of when the joint has been successfully made, either 'leak before press' design or a sacrificial plastic collar.

1750 Compressed air pipelines – industrial (ABS plastic)

1751 Application

For compressed air pipework downstream of any air receiver with maximum working pressure of 12.5 bar gauge and temperature range 20°C to 35°C.

1752 Pipe

Use ABS pressure pipe ‘air-line’ light blue quality, metric sizes, generally to BS ISO 161-1.

1753 Fittings

Use ABS fittings, cold solvent welding to DIN 8063 and ISO 727.

1754 Unions

Use ABS unions, cold solvent welding socket/BSP thread.

1755 Flanges

Use ABS cold solvent welding socket, full face type with loose galvanized mild steel flange to BS EN 1092-1.

1756 Flange gaskets

Use flange gaskets suitable for compressed air at 12.5 bar gauge.

1757 Flange bolts, nuts & washers

Use bolts and nuts complying with BS ISO 8992 and BS EN ISO 898. Use bolts grade 8.8 and nuts grade 8, material group 3EO. Bright zinc plate bolts and nuts in accordance with BS EN ISO 4042.

Use bolts faced under the head with machined shank. Use nuts faced on one side. Use ISO metric coarse screwed threads.

Use washers to BS EN ISO 887 bright zinc plated to BS EN ISO 4042 and faced on both sides. Fit washers under both bolt head and nut.

1800 MEDICAL GAS SYSTEMS PIPELINES

1810 Medical gas pipelines, compressed air and vacuum including anaesthetic gas scavenging systems (copper)

1811 Application

For medical gases, compressed air and vacuum and anaesthetic gas scavenging system pipelines having a maximum working pressure of 10 bar gauge.

Comply with HTM 02-01.

1812 Pipe (marked “DEG”)

Use phosphorous de-oxidised non-arsenical copper Grade Cu-DHP/CW024A, to BS EN 13348, R250 (half hard) for sizes up to and including 54 mm and R290 (hard) for sizes above 54 mm, cleaned, degreased, dried and end capped or sealed in polythene bags and labelled "Degreased for Medical Gas Installation" with 25-year guarantee.

Cut pipes only using wheel cutting devices. Do not use hacksaws or any other cutting method which may result in particles entering the pipe.

1813 Fittings

Use phosphorous de-oxidised non-arsenical copper fittings to BS EN 1254-1, Grade Cu-DHP/CW024A, capillary type, cleaned, degreased, dried and end capped or sealed in polythene bags and labelled "Degreased for Medical Gas Installation".

Supply brass, gunmetal and bronze fittings with copper tails pre-brazed off site and of sufficient length to ensure the site brazing process does not damage the fitting.

1814 Joints

For site made copper to copper joints use silver-copper-phosphorous brazing alloy type CP104 (min 5% silver no cadmium) BS EN ISO 17672 and no flux.

Prior to and during fluxless jointing and hot forming of bends introduce inert oxygen free nitrogen gas internally to prevent formation of oxides. After brazing/forming and once cooled safely purge the inert gas and any residual particles from the pipe.

For copper to brass and copper to gunmetal joints, manufactured off site, use silver brazing alloy type AG 245 to BS EN ISO 17672 with flux recommended by manufacturers to suit copper to brass or gunmetal jointing. After brazing, chemically clean, degrease and dry each assembly and either install protective end caps or seal each assembly in a polythene bag labelled "Degreased for Medical Gas Installation".

Carry out the extensions to existing installations in accordance with the requirements of the Permit to Work system.

Physically separate the medical gases pipework from metal sheathed electric cable and metal conduits, trunking and bare earth conductors.

1900 LABORATORY GAS SYSTEMS PIPELINES

1910 Laboratory gas systems pipelines (stainless steel)

1911 Application

For laboratory gas pipelines and fittings up to 54mm and not concealed and having a maximum working pressure of 50 bar gauge.

Install pipes in accordance with the British Compressed Gases Association Code of Practice CP4, and the Pressure Systems Safety Regulations.

Weld all joints.

Support pipelines with rubber lined pipe clamps at spacing detailed in the Pipelines Supports clause of this specification, and where passing through walls, ceiling or partitions.

1912 Pipe

Use stainless steel pipe manufactured to ASTM 269, of 16 SWG wall thickness, cleaned, degreased, dried and end capped or sealed in polythene bags and labelled "For laboratory gas use".

Use stainless steel to BS EN 10088-2, grade 1.4404 (formerly 316L).

Only install pipes and fittings that have been delivered to site clean and degreased, with both ends capped and sealed with protective wrapping, marked for laboratory gas use.

Install acetylene pipelines at least 50mm from all electrical apparatus and wiring.

1913 Fittings

Use stainless steel butt welding fittings, made from ASTM 269 pipe. Use only fittings of stainless steel to BS EN 10088-2, grade 1.4404 (formerly 316L).

1920 Laboratory gas systems pipelines (copper)

1921 Application

Install pipes in accordance with British Compressed Gases Association Code of Practise CP4 and Pressure Systems regulations 2000.

Only install pipes and fittings that have been delivered to site clean and degreased, with both ends capped and sealed with protective wrapping, marked for laboratory gas use.

Ensure that all laboratory pipes and fittings are of specially degreased copper tubing.

Support pipelines with rubber lined pipe clamps at spacing detailed in the Pipelines Supports clause of this specification, and where passing through walls, ceiling or partitions. Install acetylene pipelines at least 50mm from all electrical apparatus and wiring.

1922 Pipe

Use copper tube to BS EN 1057, type R259, half hard, non-arsenical, phosphorous de-oxidised type.

1923 Fittings

Use copper fittings to BS EN 1057, type R259, half hard, non-arsenical, phosporous de-oxidised type.

2000 INSTALLATION

2010 Pipelines installation

2011 Pipeline installation – generally

Carry out the complete installation using new materials and a high quality standard of workmanship with proper supervision at all times.

Select materials of construction used in all components of each pipework system, including associated pipework fittings and ancillaries, to mitigate against the risk of galvanic action or other forms of corrosion.

Where copper and steel are both used in the same system ensure that the two materials are connected with a gunmetal or brass component.

Take account of the Quality Management requirements of BS EN ISO 9000, and wherever possible select products that are manufactured under BSI Kitemark Scheme, from Firms of Assessed Capability.

For domestic water installations use only materials, fittings, gaskets and construction methods that do not impart taste, odour, colour, release of toxic substances or support microbiological growth. Use only tube, fittings, materials and ancillary components listed in the Water Regulations Advisory Scheme (WRAS) Water Fittings and Materials Directory or confirmed in writing by WRAS or the applicable Water Authority as being of appropriate quality under the requirements of the Water Supply (Water Fittings) Regulations part 2 Regulation 4

Supply and install all the materials equipment and accessories required to complete the installation including all necessary pre-fabricated module and pipework supports, the drilling, plugging, screw, bolt and clamp fixings, of all such items assembled together or secured to any part of the building structural elements.

An entire installation or any part of it may be rendered unacceptable at the Contract Administrator’s discretion where there is evidence of materials incorrect for the purpose, in any way damaged, misaligned, insecurely fixed, not to manufacturers recommendations, or where sub-standard workmanship is evident in the preparation of pipes, fittings and supports or where failure to provide a sound, safe installation, free from potential difficulties due to air-locking, blockages, contamination or other hazards is suspected. Subsequent rectification of any identified defects will be the responsibility of the Installer at no cost or delay to the contract works.

Machine cut pipe ends clean and square. Prepare pipes and joints for jointing, deburr, make free from rust, scale or any other foreign matter and thoroughly clean before erection. Use temporary screwed plugs, caps or flanges to seal open ends of pipe during construction.

For connection of copper pipework to galvanized cold water cisterns use non-metallic couplers. For flanged connections use flanges with rubber or vulcanite ferrules and washers for the bolt holes and non-conductive rubber rings for the full diameter of the flange faces.

Where pipework exposed to view has been specified to be chromium-plated finish, fabricate, dismantle and then chromium plate the whole of the pipework, fittings, valves and stopcocks and then re-fit.

Paint screw threads cut on galvanized pipework paint with calcium plumbate primer.

Bond metallic pipework systems as necessary to maintain complete continuity between all metallic parts in accordance with BS 7671. Main equipotential bonding and supplementary bonding, as defined within BS 7671, will be undertaken by the electrical installer, but the mechanical installer will be responsible for all other bonding required as part of the mechanical work.

Where pipework is installed in areas at risk of freezing and it is not to be trace heated use only pipes of 20 mm nominal bore or larger.

When installing stainless steel pipes take care not to scratch the surface of the pipe or to touch it with bare hands.

When metal pipes are to be insulated ensure that the proposed insulation product does not contain appreciable amounts of sodium silicate so creating a corrosion risk as detailed in BS 5970 clause 8.3.3.

Irrespective of insulation material proposed, for cold services installed using copper or thin wall carbon steel tube use only plastic coated tube with fittings suitably wrapped in accordance with the piping system manufacturer’s instructions. For the avoidance of doubt do not use phenolic foam insulation on bare copper or thin wall carbon steel tube for cold services.

For cold fluid installations, where plastic coated pipework has been installed, prior to installing the insulation, prime and wrap all valves and fittings, in accordance with the system manufacturer’s recommendations, to provide a complete protective installation inside the insulation.

Give particular attention to maintaining the pipe bores clean during the work where the pipework is to be covered later. On pipework to be heat tested make provision for carrying out such tests before ducts are sealed and the pipework concealed.

Observe the manufacturer’s minimum bending radius requirements for all semi-rigid and flexible pipework tube.

2012 Pipe runs and gradients

Take into account the natural building line and other structural elements of the building.

Install pipe runs to follow the horizontal line, paralleled with walls, set neatly and evenly around projections and to follow the vertical line plumb without offsets. Allow adequate clearance between pipes and from surfaces for valve access and insulation. Do not make any joints within the thickness of the building structure or so close to the surface that access is difficult.

Install pipes for venting and draining purposes with the following minimum gradients:

- ~ Steam: 1 in 100 fall in direction of flow
- ~ Gravity condensate: 1 in 250 fall in direction of flow (for long runs), 1 in 70 elsewhere
- ~ Pumped condense: 1 in 400 fall in direction of flow
- ~ Liquids: 1 in 400 fall in direction of flow
- ~ Gas: 1 in 100 fall in direction of flow
- ~ Compressed air: 1 in 40 above ground, 1 in 80 in ducts or trench

Ensure that fuel fill pipes fall continuously toward the tank with no inverted loops.

Arrange pipework crossing subways, ducts or corridors to rise to high level prior to crossing, to maintain maximum access beneath.

Take branch connections (other than for gravity-circulation systems) off the top of the mains if serving to above for venting purposes and off the bottom of the mains if serving to below for draining purposes. Take steam, condense and compressed air connections off the top of the mains.

Install steam and compressed air pipelines free of undrained pockets and at all low points fit drain pockets of equal diameter to the main and connected to the type of automatic trap assembly specified.

2013 Pipeline clearance and segregation

Fix pipes with the following minimum distance between the outer surface of any service or insulation and any obstruction:

- ~ 25 mm for pipes
- ~ 25 mm for cables
- ~ 75 mm for union joints
- ~ 100 mm for ducts, ceilings or finished floor
- ~ 150 mm for lighting fittings

Space pipes to allow for the application of thermal insulation, for adjacent fittings, valves, flanges, boxes and for future access to pipes in concealed ducts without disturbance to remaining pipes.

In district heating networks provide a minimum separation distance of 0.4 m from adjacent services and 0.2 m from crossing services, in accordance with BS EN 13941.

To prevent heat gain (Legionnaires’ disease) to cold water cisterns and mains do not install pipework in close proximity to hot pipes or above hot areas of the building.

Do not install ventilation and air conditioning ductwork and flammable gas services in the same services duct.

Where possible, locate the main soil and surface water drainage below all other services.

2014 Pipe sleeves and cover plates

Fit pipework passing through walls partitions, floors, ceilings and roofs with pipework sleeves on each pipe. Ensure neither pipework joints nor fittings extend into the sleeves. Sleeve sizes to provide at least 10 mm clearance around the external diameter of the passing pipework or where pipework is to have continuous thermal insulation or be otherwise covered, at least 10 mm clearance around that covering surface. Fit pipework subject to sideways movement due to expansion with appropriately oversized sleeves.

Use sleeve material sufficiently rigid to retain its shape and position both during installation and in use with lugs to locate in floors and ceilings and treated against corrosion where necessary. Use steel, stainless steel, copper or plastic tube for sleeves.

Position sleeves correctly around the pipe, normally centrally except where lateral movement of the pipe requires off-setting of the sleeve and for finally building-in by others.

Finish sleeves flush with the finished face(s) of walls, partitions, floors and ceilings but project 75 mm above the finished floor level in wet working areas, plantrooms and washrooms, with the clearance around the pipe sealed with waterproof mastic. Where the sleeve projects above the floor fit a cover plate around the sleeve.

Project sleeves 150 mm above the finished face of roofs and fit sheet metal weathering aprons and skirts for flashing up by others. Galvanize steel fabrications after manufacture.

Without restricting pipework movement within the sleeve pack the gap with; mineral wool for general internal surfaces, with fire stopping in fire rated structures to satisfy Building Regulations, and using non-combustible material, with caulked-in weatherproof material in external walls and roofs and with waterproof mastic in wet areas.

For pipework passing through finished surfaces in areas occupied or otherwise in regular usage fit cover plates around the pipes and where the sleeve projects beyond the finished surface install additional cover plates around the sleeve. Ensure the plates cover the sleeve end even where oversize sleeves are necessary and the pipe spacing allows for this provision to produce a neat and tidy appearance.

Use cover plates of plastic, polished aluminium, or chrome-plate material, to suit the application specified and to match the outside diameter of the pipe or pipe sleeve.

2015 Puddle flanges

Fit puddle flanges where pipes pass through waterproof or oil-proof structures or enter a pipe duct below ground level. Fabricate the unit to allow access for flange connection, treat it against corrosion, and arrange for it to be built into the structure by others.

2016 Expansion, anchors and guides

Take up the expansion of pipework in allowance at bends, changes of direction natural deflection or where expansion dictates by the fitting of expansion devices or expansion loops and in each case suitable anchors and guides.

Make allowance for the effect of expansion when pipes are cold by leaving appropriate gaps in the pipework, to be taken up by cold draw during final erection of the pipework. Apply the amount of cold draw, normally 50% of total expansion of the length under consideration, using flanges and long bolts to the ends being pulled together. Comply with BS EN 1515. Use bolts of grade 8.8 and nuts grade 8, flange material group 3EO. Follow the manufacturer’s data and recommendations in the correct allowance for cold draw.

Where branch connections are taken off mains, make full allowance for expansion in different planes by suitable anchors and guides.

Provide expansion loops of the same material as the pipework, formed in one length, with ends flanged and dimensions and thickness suitable for the movement to be accommodated.

Provide expansion bellows axial joints in accordance with BS 6129-1, fully articulated with suitable number of convolutions to accommodate the movement required. Select and fit the joint in accordance with the manufacturer's data and recommendations. Do not use screwed connections unless otherwise specified.

Use axial compensator joints, to accommodate larger movement of the pipework and to reduce undue stress on the structure, at changes of direction in the pipework in accordance with the manufacturer’s recommendations. Where grooved jointing has been specified as an acceptable jointing method for the service in question, flexible grooved joints may be used to accommodate such movement provided the specialist manufacturer/supplier determines the required numbers, type and positioning of such joints to achieve the required result.

Where anchor brackets are required rigidly attach them to the building structural element to ensure correct expansion movement of the pipework.

Where buried mains are not self-anchoring or where joints are not designed to take end loads, install anchor brackets in ducts or attached to concrete blocks designed to prevent movement at stop ends, bends, junctions, valve positions and steep gradients.

Fit suitable 'U' bolts, flat strap or other type guides in conjunction with design of anchor and roller/slider supports to ensure that expansion movement takes place in the same plane as the pipe run without deflection of the pipework.

For securing steel pipework weld the anchor bracket directly to the pipe. Where this is impracticable use cast iron chairs and at least two mild steel stirrups bolts (not screwed rod) to grip the pipe.

For securing copper pipework use anchors with wide copper straps brazed to the pipework such that no part of the pipe touches the steel structure.

Alternatively for securing steel or copper pipework use slip-on flanges with an interposed mild steel channel section attached to the building structure.

For securing plastic pipes use the pipeline fitting flanges or slip-on flanges with interposed mild steel channel section attached to the building structure. Do not use pipe clamps likely to cause damage to the pipe.

For hot services including steam, HTHW, MTHW and LTHW, reduce the transfer of heat through the anchor bracket by inserting an insulation barrier between the anchor device and where it bolts or is fixed to the structure. Insulate all exposed bracket and anchor parts that are expected to get hot in service.

2017 Pipeline supports

Support the pipework in accordance with the manufacturer’s recommendations. Fix pipework support systems to the building structure, generally conforming with manufacturers recommendations and where specified elsewhere.

Submit detailed proposal drawings and/or description of the pipework support system to the Contract Administrator for comment, in adequate time before work commences on the manufacture or installation of any of the supports proposed.

Securely support pipework, singly or in groups, graded to levels required for venting and draining and having regard to the requirements for differential expansion, anchors and guides, restraint at bends and thermal insulation sizing.

Install load-bearing insulation rings/blocks at all pipe support positions for all insulated services, incorporating steel spreader plates as necessary, fully in accordance with the manufacturer’s recommendations and requirements detailed in specification section Y50.

Ensure that insulated pipe support blocks consist of pre-formed lengths, manufactured from the required base material and in compliance with the applicable normalised BS EN standard. Ensure that the sections have a bore size corresponding to the outside diameter of the pipe to which they are fitted. Where available supply supports as one-piece, hinged snap-on tubes, complete with factory bonded, B_L-s1,d0 (Class 0) surface laminate of glass reinforced aluminium foil, except for nitrile rubber which will not have a surface laminate of glass reinforced aluminium foil but will be of B_L-s3,d0/Class 0 surface rated material.

Refer to specification section Y50 for the required insulation thicknesses. When selecting insulation thickness from the Y50 tables, use the greater thickness when results fall between scheduled temperature differences or thermal conductivity figures.

Ensure that all rigid support blocks are concentric and precisely matched for thickness.

Where pipe support blocks are supplied with a foil flap use products having a self-adhesive overlap whose width does not exceed the thickness of the insulation. For cold fluid installations install regular vapour check points by ensuring that each and every support installed on cold services is fully and carefully vapour sealed both to itself as well as on both sides to the pipe it is supporting

At each stainless steel pipe support location wrap the pipe in aluminium foil prior to installing the insulated pipe support ring/block. Extend the aluminium foil a minimum of 75 mm either side of the support block/ring to enable an overlap to be achieved when installing the remainder of the aluminium foil. Comply fully with installation requirements stated in BS 5970. Use foil with a thickness not less than 0.06 mm.

Support external pipes from below to remove the risk of rain etc penetrating the insulation/cladding via drop rods.

Install supports at the base of vertical pipes and at appropriate intermediate positions to allow for the additional loading and removal of components without detriment to the adjoining pipework.

Install additional supports adjacent to valves, expansion fittings and other special pipeline components, to allow for the additional loading and removal of components without detriment to the adjoining pipework.

Install additional supports to provide restraint at bends, tees or similar fittings giving rise to changes of direction; and having compression or press-fit jointing, where dynamic shock pressures in the pipework system may exceed the end-loading capabilities of the joint.

For internal pipework exposed to view, fit brackets, hangers or clips as appropriate and of neat appearance, fixed to the wall/soffit at intervals to give uniform spacing and neat appearance.

Where pipes are suspended use threaded rods of not less than 8 mm diameter but otherwise sized by the specialist supplier. Small single pipes may be suspended using threaded rods of not less than 6 mm diameter. Do not use calliper hooks.

For metal pipes carrying domestic hot water and any short final run sections of uninsulated metal domestic cold water pipework either use clips/hangers meeting the specification for vapour sealed services or use clips which incorporate noise suppression rubber strip to provide both noise and pipe to clip/hanger isolation.

For uninsulated copper pipes carrying fluids other than water use non-ferrous clips/hangers/rollers, or if steel clips are used and the pipe is to operate no hotter than 90°C use noise suppression rubber strip between pipe and clip/hanger. Nylon coated ferrous pipe clips may be used.

For plastic pipework systems, other than those carrying a service requiring load bearing insulation inserts use clips/hangers or rollers and chairs specifically designed for use with plastic pipe systems. Incorporate noise suppression and isolating rubber strip supports for uninsulated sections of plastic domestic hot and cold water pipework.

Support other services and pipe materials using zinc coated/plated steel clips/hangers that may incorporate noise suppression rubber strip on services operating up to 90°C.

Support mains in ducts on rollers and chairs using fabricated mild steel brackets (painted) or galvanized channel sections with allowance for building-in or bolting on to the surface of the duct wall.

For pipes at ceiling level or in roof spaces, suspend from rods or straps using adjustable mild steel hangers with swinging joints or purpose-made angle iron cradles or other steel sections. Use clips on cold pipes and rollers and chairs on hot pipes and where expansion cannot be readily taken up on hanging brackets.

Fabricate then hot dip galvanize exposed external steel brackets before erection, unless otherwise specified.

For pipework installed across flat roofs use proprietary pedestal supports mounted on plinths or bases in accordance with both the support system specialist and the roofing specialist's requirements. Support all such pipework from below i.e. not using drop rods to prevent rain penetration inside the insulation and/or cladding.

Make allowance for the fitting of pipe covering protection, specified in specification section Y50, at the support positions on mains that require continuous unbroken weatherproof or vapour proof seal finish, as in the case of chilled water or cold water pipes.

Install supports at the spacing detailed in the following tables with multiple pipe supports spaced to suit the smallest size and material of pipe. Spacing intervals shown for uPVC and ABS pipes are for an ambient working temperature of 20°C and continuous supports are required for uPVC pipes at 60°C and for ABS pipes at 80°C. Refer to and comply with the plastic pipe system manufacturer's requirements for support at the required service temperature.

Support ABS plastic pipes and pipe systems utilising grooved flexible couplings by brackets or clips which allow axial movement but provide lateral restraint of the pipes.

Pipe support spacing intervals (maximum) for stated pipe materials

Nominal pipe size (mm)	Maximum support spacing (m)			
	Steel pipe		Copper pipe	
	Horizontal	Vertical	Horizontal	Vertical
up to 15	1.8	2.4	1.2	1.8
20	2.4	3.0	1.4	2.1
25	2.4	3.0	1.8	2.4
32	2.7	3.0	2.4	3.0
40	3.0	3.6	2.4	3.0
50	3.0	3.6	2.7	3.0
65	3.7	4.6	3.0	3.6
80	3.7	4.6	3.0	3.6
100	3.7	4.6	3.0	3.6
125	3.7	5.4	3.0	3.6
150	4.5	5.4	3.6	4.2
200	5.0	6.0		
250	5.0	6.0		
300	6.1	10.0		
350	10.0	12.0		
400	10.5	12.6		
450	11.0	13.2		
500	12.0	14.4		

600	14.0	16.8		

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Nominal pipe size (mm)	Maximum support spacing (m)							
	UPVC		Polyethylene		Glass		ABS	
	Class O, B, C	Class D, E, 6, 7	Type 32	Type 50			Fluid temp < 20°C	
	Horizontal	Horizontal	Horizontal	Horizontal	Horizontal	Vertical	Horizontal	Vertical
up to 10		0.6	0.3	0.45				
16		0.6	0.4	0.6			0.7	0.9
20		0.65	0.4	0.6			0.8	1
25		0.75	0.4	0.6			0.8	1
32		0.8	0.45	0.7			1	1.3
40		0.9	0.45	0.7	0.9	1.7	1.1	1.4
50	1.1	1.2	0.55	0.85	1.2	1.7	1.1	1.4
63	1.2	1.4	0.55	0.85			1.3	1.6
75	1.4	1.5	0.6	0.9	1.2	1.7	1.5	1.9
90	1.5	1.7	0.7	1.1	1.2	1.7	1.6	2
110	1.7	1.9					1.8	2.3
140	1.8	2.1		1.3	1.2	1.7	2	2.6
160	2	2.3					2.2	2.8
200	2.1	2.5					2.3	2.9
225	2.3	2.7					2.4	3.1
250	2.4	2.9					2.5	3.2
280	2.6	3.1					2.6	3.3
315	2.9	3.4					2.8	3.6
400	3.1	3.7						
450	3.4	3.7						
above 450	3.7	3.7						

2018 Electrical plant rooms and other sensitive areas

Where possible avoid routing pipework through electrical plantrooms or above sensitive equipment. Where this is unavoidable liaise with other trades to avoid installing pipework above any electrical plant or trunking.

Where pipes routed above electrical plant are unavoidable, where practicable, install pipework without any joints. Where this is not possible use only welded or brazed joints.

Install suitable protection for pipes at risk of impact damage.

2020 Pipeline assembly

2021 Pipeline fittings and joints

Install fittings appropriate for the application and either, screwed BS EN 10226-2 taper thread, or suitable for soldering, steel welding, brazing or fusion welding. Use eccentric pattern reducers with the taper of the fitting arranged to facilitate venting and draining. Do not use bushes for reducing purposes other than for thermometer or other control items. Do not use long screw fitting connections.

Form sets and bends without a joint of any kind within its length and without evidence of rippling, thinning or other damage or distortion.

Use pulled bends wherever practicable in preference to round elbows unless appearance dictates. For welded stainless steel pipework use pulled square tees or sweep tees as specified, otherwise use sweep tees or twin elbow parallel tees on water circulation pipework with square tees or round elbows only on final draw-off branches of less than 13 metres, to facilitate draining or venting, or at steam trap assemblies. Only use elbows and bends whose centre line radius is at least 1.5x the pipe diameter.

For headers, where fitted with flanged pipe connections, fit flanges on all connections and one or both ends of the header as appropriate.

For fittings and jointing of domestic water pipelines follow the recommendations of BS 8558, BS EN 805 and BS EN 806.

For steel pipes paint screwed threads and exposed pipe threads with zinc phosphate paint immediately after joint has been made.

Make screwed joints generally in accordance with BS 7786, BS 6956 and BS EN 751 parts 1 to 3 inclusive using the following:

- ~ PTFE tape for LTHW, chilled water, condenser cooling water, ABS or uPVC plastic pipe fittings
- ~ PTFE heavy grade tape, Permanite GT for natural gas
- ~ PTFE tape or Boss Green for potable hot and cold water
- ~ Non-curing coated multifilament thread sealant cord for LTHW, chilled water, condenser cooling water, domestic hot and cold water and gas. Install strictly in accordance with its manufacturer's instructions
- ~ Boss White or similar jointing compound for steam and condense
- ~ For screwed stainless steel joints use jointing tape suitable for use with stainless steel and where necessary also suitable for use in potable water installations. For soldered or brazed jointing requiring a clean, flux and scale free bore to the pipe after jointing introduce a flow of dry nitrogen during the process.

Make capillary solder joints in accordance with BS EN 1254-1 (lead free), capillary brazed joints in accordance with BS EN 12797, BS EN 12799, BS EN ISO 13585, BS EN 13134 and where appropriate BS 1306 (silver brazing). Ensure all joints in healthcare premises comply with HTM 04-01 for hot and cold water pipelines.

2022 Equipment connection joints

Make connections to equipment using flanges or union connections and any necessary reducing fittings. Where the equipment flange is of a higher PN rating than the specified pipeline fit a matching flange and bolts to the pipe. Where the equipment size is less make the reduction from the pipe size close to the equipment followed by an isolating valve of the same size as the pipework.

2023 Pipeline dismantling joints

Provide pipeline break points, for disconnection at branches from headers, mains and risers, at connection to plant and equipment and at maximum intervals of 24 metres or other convenient lengths in the pipe run. This does not apply in concealed locations and where continuously secure pipe runs are specified, such as in ducts or above ceiling in special areas.

Install break points comprising unions on pipe sizes up to and including 50 mm for screwed steel, 50 mm plastic and 54 mm copper and install flanges on; welded steel pipe and screwed steel pipe 65 mm and above, 63 mm plastic and 67 mm copper, and where specified for smaller pipe sizes.

2030 Venting and draining

2031 Pipeline venting and draining

For pipework graded to levels required for venting and draining all parts of the system, fit air vents and drain cocks, as specified in specification section Y11, using square tees.

Introduce air venting devices at high points in water circulation pipework, and all places not naturally vented. Insulate the venting devices and air release pipes against freezing in exposed positions:

~ Fit vertical air bottles at least 50 mm diameter and 100 mm long as extensions to the pipework. Where access to the air bottle is difficult fit an 8 mm copper extension tube to bring the manual 8 mm vent cock within reach at low level.

~ Fit automatic air vents, controlled by lockshield, valves and air release copper pipes run to discharge at the nearest agreed visible point or drain gully. Install vents as specified under valves and fittings in specification section Y11.

Where possible make air venting points self-venting on pipe coils and equipment.

Introduce drain cocks, as specified in Y11, under valves and fittings, at low points on the pipework and on any equipment forming a low point and positioned allowing good access for operation. Also position drain cocks on the downstream dead side of isolating valves or other valves used to isolate sections of the system for draining down.

Ensure sufficient air venting provisions are incorporated into each section of pipework that may be individually drained to facilitate adequate draining and to prevent the risk of pipework imploding anywhere in the pipework system under vacuum conditions.

Ensure mains in permanently sealed or screeded over floor ducts are self-venting and of welded or brazed construction throughout.

Do not install valves or drain cocks in sealed ducts, unless otherwise specified.

2032 Equipment venting and draining

Fit air cocks to heating and cooling appliances. Where access would be difficult without removing front panels, extend the air cock to a readily accessible position. Introduce air venting devices at high level pipe coils and high level heaters

Provide drain connections for all plant and equipment drain points including pumps, glands, drain trays, etc. using single or common (where appropriate) drain lines to discharge into tundishes and then into the most convenient gullies (preferably back entry) or other drains with trap. On drain lines use fittings with removable plugs or caps for rodding purposes. End drain lines 100 mm to 150 mm above the top of the tundishes to provide adequate air breaks.

Always position temperature and pressure relief pipe outlets so that when they operate unexpectedly they do so safely.

2040 External pipelines

2041 Buried pipelines – trenching, ducted and moled

Refer to specification section A and or the particular specification for details of who is to carry out all trenching, backfilling and moleing.

Use a specialist installer for directly installed (moled) ducts and pipes.

Trench/installation depths will vary to suit requirements of earth cover, frost protection and may vary to suit mains or distribution pipes and where pipes/services are to be laid together, e.g. NJUG requirements for a minimum of 300 mm between gas main and electricity cable. Provide earth cover above buried pipes of 750 mm (max 1350 mm) for water pipes and pipes under roadways, 600 mm for gas and 750 mm for oil pipes.

Where not directly installed by moleing, lay the pipes/ducts on a level bed of sharp sand or granular material such as pea gravel, free from sharp stones and other sharp objects, to provide 100 mm clear thickness under and around the sides of the pipe and 75 mm over the top of the pipe. Make allowance for pockets at joints etc. to ensure that the pipe rests along its entire length.

Backfill trenches with selected backfill material compacted by hand tool tamping to a depth of 200 mm with further backfilling to surface level using machine compaction. Pressure test buried pipes with joints exposed before completion of backfilling of trench.

Lay plastic warning marker tapes 150 mm wide and suitably labelled for each service in a continuous length along each service within the trench during backfilling at a depth of approximately 200 mm below ground level. For plastic pipes, use marker tape with a stainless steel insert wire brought out to suitable test point positions at ground level. On no account let the insert wire rest on the pipe.

Position above ground pipeline markers at intervals along the line of the pipe trench, at changes of direction etc. using flush concrete blocks in level ground and raised concrete marker posts in unmade ground. Securely attach non-corrodible plates permanently marked with pipe size, contents, depth and direction of flow to each concrete block or marker post.

2042 External pipelines – building entry

Terminate the external pipeline close to the entry into the building space before or at the first isolating position, i.e. stopvalve or isolating valve as appropriate (water) or valve or meter (gas).

Terminate the external main with a suitable end connection adaptor for the attachment of the stopvalve or isolating valve for the internal mains or distribution pipework.

Continue the installation from the external pipeline termination point into the building via a suitable entry sleeve or where specified a puddle flange or other proprietary sealing device. Install services entry sleeves to meet the requirements of the utility provider or for non-utility services, this specification.

Completely enclose polyethylene pipe taken inside the building in a continuous metal sleeve (anti-corrosion protected) bedded in the pipe trench, extending at least 1m from the building and sealed with a mastic material. Inside the building terminate the sleeve in an approved adaptor before the isolating valve.

Change polyethylene pipes for gas systems to steel pipe, suitably protected, one metre from the building. Refer to the clauses for natural gas pipelines – internal and external (black steel) for the required specification.

2050 Welding and brazing

2051 Welding carbon and stainless steels

Welding standards:

Carry out welding and weld testing of low carbon steel and stainless steel pipework in accordance with the requirements of BS EN 13480, except where more onerous requirements are detailed in this specification in which case follow those. Where welded heating pipework operating up to 120°C is to be buried comply with the requirements of specification section T34 and BS EN 13941.

From the definition within BS EN 13480 the only Group 1 fluids covered by this section Y10 welding specification are fuel oils and natural gas. The only Group 2 gas covered by this specification is steam. All other fluids covered by this Y10 specification are Group 2 liquids. All fluids covered by this specification are hazard category 0. Inform the Contract Administrator of any situation where a higher hazard category is expected.

In addition for stainless steel pipework make all joints in accordance with the requirements of the Water UK IGN 4-25-02 using a single pass fully penetrative TIG butt welding process with inert gas purging of the pipe.

Competence standards:

For welds of steel, including stainless steel, use only welders qualified under BS EN ISO 9606-1, and for automated welding use only welding personnel qualified to BS EN ISO 14732, for the material group, joint type, weld type and method of working and as certified by an appropriate independent third party.

Ensure production welding is carried out by holders of a current valid ‘Certificate of Competence’ appropriate to the type of work and issued by an approved UK authority.

Use only Non-Destructive Testing (NDT) personnel qualified to BS EN ISO 9712 and for steam, HTHW and MTHW services use welding co-ordinators qualified to BS EN ISO 14731.

Prior to any welding being carried out provide evidence of the identity and certification of each welder who is to work on the project. Further random checks may be made by the Contract Administrator during the works.

Ensure that each welder marks each weld made with a unique and indelible mark particular to the welder who made the joint.

Weld testing and acceptance standards:

Test welds in accordance with this specification as though all welds were for hazard category I fluids and materials group 1.1 or 8.1 to CEN ISO TR 15608.

For all welds carry out visual non-destructive testing for surface discontinuities of each welded joint in accordance with the requirements of BS EN ISO 17635, BS EN ISO 17637.

Carbon steel (For each welder test five of the first 10 site completed welds and 10% of all subsequent site welds plus 10% of all workshop completed welds. The welds to be tested shall be randomly selected by the Contract Administrator):

~ For butt and circumferential welds carry out radiographic tests in accordance with BS EN ISO 17635, BS EN ISO 17636 using Class B, and to BS EN ISO 10675 acceptance level 2.

~ For fillet and other non-butt welds carry out ultrasonic testing in accordance with BS EN ISO 17640 to testing level A and BS EN ISO 11666 acceptance level 3.

Stainless steel:

Carry out radiographic and ultrasonic tests as for carbon steel but test 100% of all site completed welds.

Should any weld be rejected or require rectification then select a further two welds by the same welder for examination. In the event of a further failure in these two welds the whole of the welds performed by a particular welder may be liable to rejection or require the provision of radiographic evidence of the acceptability of all the welds in question.

For stainless steel installations use fittings to ensure that only butt welds are required.

Production work:

Avoid making welds which cannot be subject to volumetric testing by radiographic or ultrasonic means.

Do not use oxy-acetylene welding for steel pipework.

For steel pipework, immediately after completion of a welded joint or following radiographic/ultrasonic examination, paint the pipework with zinc phosphate anti-corrosion primer.

Do not weld galvanized pipework. Where welding is appropriate and a galvanized finish is required, use carbon steel pipe, welded then hot-dip galvanized after manufacture.

Where arc welding is to be used provide the necessary electrical generating plant.

Do not use gusseted, segmented or cut and shut bends as an alternative to standard fittings. Ensure all pipe ends are machine cut, bevelled square and dressed smooth and free from burrs.

For butt welds use matched bores and prepare pipe ends in accordance with BS EN 13480.

Form branch welds using proprietary reinforced tees with centre of adjacent branch welds at a distance of not less than twice the diameter of the largest branch.

For mounting of test points and control sensors use tees, mountings or properly selected and installed weldolets to a suitable specification, with or without stub pipe(s) as needed.

Locate welded joints more than 600 mm from an anchor point or guide.

During the progress of the work and on request, include in the tender sum to cut up to six welded or brazed joints, randomly selected by the Contract Administrator, for examination and testing. Test welded steel joints in accordance with BS EN ISO 17639. Rectify or replace any failures. If consistently poor results are found, replace the complete sections of the work and/or the operative concerned.

Documentation:

Provide welding and weld testing documentation, including interpretation of test results, as detailed in BS EN 13480 part 5.

2052 Brazing copper and its alloys

Brazing standards:

Carry out brazing of copper pipework and fittings in accordance with brazing procedure(s) approved under BS EN 13134 using brazers qualified under BS EN ISO 13585 and BESA TR3.

Competence standards:

Provide brazer approved tests before carrying out any production work on or off site. Arrange for each brazer to carry out standard test piece procedures to BS EN ISO 13585.

Ensure production brazing is carried out by holders of a current valid ‘Certificate of Competence’ appropriate to the type of work and issued by an approved UK authority.

Braze testing and acceptance standards:

Carry out destructive and non-destructive testing of completed brazed joints as required by the brazer qualification and brazing procedures all in accordance with BS EN 12797 and BS EN 12799.

Production work:

Do not use filler metals containing cadmium.

Do not use copper phosphorus filler metals for jointing any copper alloy containing nickel.

Locate brazed joints more than 600 mm from an anchor point or guide.

2053 Safety during weld testing

Advise radiographic/magnetic particle/ultrasound examination testing procedures to all interested parties, indicating Inspection Authority, notification requirements, the method to be employed, the location, timing and protection measures to be instituted by way of ensuring no one is present in the affected area during testing, barriers, shields, warning lights, notices and emergency procedure.

2060 Press-fit jointing systems

2061 General

Obtain written confirmation from the press-fit jointing system manufacturer that correct type of press-fit jointing components have been selected for the particular requirements. Where press-fit jointing is to be used on more than one service/system, obtain specific confirmation for each service/system. Ensure that the press-fit jointing components selected are compatible with the selected pipework and proposed use.

Do not use a press-fit jointing system on pipework to be installed in areas which are liable to mechanical damage.

Do not use a press-fit jointing system on boosted hot and cold water services pipework upstream of pressure reducing valves.

Do not use a press-fit jointing system incorporating thin wall carbon steel (where permitted) or stainless steel pipework or in conjunction with copper pipework in external locations.

Do not use a press-fit jointing system incorporating stainless steel pipework or in conjunction with copper pipework in external locations.

Install press-fit joints in accordance with the manufacturer's installation instructions, and the practices demonstrated during their site training sessions.

Ensure all pipe ends on which press-fit joints are to be made are clean and free from swarf, burrs, abrasions, indentations, projections and any other form of damage to at least the depth of the fitting.

Ensure that connecting pipes are inserted fully into the fitting prior to carrying out the crimping operation. Achieve this by putting a mark on the prepared pipe end running all around the circumference of the pipe, indicating the point to which the pipe is to be inserted into the fitting, and then push the pipe into the fitting until it reaches a definite stop.

Provide all press-fit joint couplings, fittings and accessories from a single manufacturer. Provide tools either manufactured by the same manufacturer as the press-fit jointing system, or which are approved by them for use on their systems, and that have a current certificate of calibration.

Ensure that all press-fit joint couplings and fittings are of the correct size for the connecting pipework and have the appropriate O-ring.

Arrange for the press-fit jointing system manufacturer to design the expansion and movement measures required for the systems and provide such measures accordingly.

Ensure a quality management scheme is in place to provide an audit trail for manufacture and traceability of all press-fit system components.

Supply and install all copper material press-fit systems in accordance with BS 8537.

For domestic water installations use only pipe, fittings and ancillary components listed in the Water Regulations Advisory Scheme (WRAS) Water Fittings and Materials Directory.

Install disconnection points or unions at future connection positions and at branches to aid dismantling.

2062 Water treatment

Carry out water treatment of all water distribution systems utilising press-fit jointing systems in accordance with section Y25 of this specification.

Once the system has been filled with water, do not subsequently drain the system down and leave it empty of water.

Obtain written verification from the press-fit jointing system manufacturer that their products are compatible with the cleaning and chemical treatment measures being proposed.

2063 Method statement

Submit, with the tender return documentation, a method statement for the installation of press-fit jointing systems. Ensure that the method statement is specific to the particular manufacturer being used.

Include in the method statement, as a minimum, the following information:

~ training, including a training programme of site personnel, frequency, certification, retraining/refreshing

~ system components

~ procedure

~ provision for planning and installation of pipe supports

~ provision for stability of pipework to ensure correct alignment and insertion depth within the fittings during the pressing operation

~ pipe preparation

~ monitoring/identification of correct assembly operation, including provision of suitable access to pipework where in confined spaces, to enable the correct operation of the pressing tools

~ use of correct tools

~ calibration certificates for tools

Obtain the acceptance of the Contract Administrator to the use of press-fit jointing systems prior to commencing any work on site.

2064 Training

Arrange for the press-fit jointing system manufacturer's factory trained representative to provide on-site training for field personnel in the use of press-fit tools and the installation of the press-fit jointing system.

Arrange for the training to be carried out periodically throughout the construction programme to ensure all personnel required to carry out press-fit jointing installations have been suitably trained prior to starting work on the system.

Arrange for the press-fit jointing system manufacturer to provide certification to all personnel trained. Keep a copy of all such certifications on site for inspection by the Contract Administrator. Ensure that only personnel trained and certified by the press-fit jointing system manufacturer install the press-fit joining system.

Arrange for the manufacturer to review installation practices and to ensure that they are in accordance with their requirements.

2065 Site inspection

Carry out inspections on a joint by joint basis, with each joint being clearly marked to indicate its acceptance. Arrange for the system manufacturer to visit site at strategic times to inspect the works in progress and approve the installation. Provide written confirmation of the manufacturer's acceptance of the joints.

2066 Manufacturer warranty

Arrange for the press-fit jointing system manufacturer to provide a replacement installation warranty against manufacturing defects for the copper and/or stainless steel installation(s) for 25 years, and for carbon steel installations (where permitted) for 10 years.

2070 Grooved jointing system

2071 General

Obtain written confirmation from the grooved jointing system manufacturer that the correct type of grooved jointing components have been selected for the particular requirements. Where grooved jointing is to be used on more than one service/system, obtain specific confirmation for each service/system.

Do not use a grooved jointing system on pipework to be installed in areas which are liable to mechanical damage.

Install grooved joints in accordance with the manufacturer’s published installation instructions, and the practices demonstrated during their site training sessions.

Ensure all grooved pipe ends are clean and free from indentations, projections and roll marks between the pipe end and the groove.

Provide all grooved joint couplings, fittings and accessories from a single manufacturer. Provide tools either manufactured by the same manufacturer as the grooved joint system, or approved by them for use with their systems, and that have a current certificate of calibration.

Arrange for the grooved jointing system manufacturer to design the expansion and movement measures required for the systems, and oversee their successful installation accordingly.

Ensure a quality management scheme is in place to provide an audit trail for manufacture and traceability of all grooved jointing system components.

Where grooved joint couplings are used in an installation, flanges do not need to be provided for disconnection since the couplings provide this function.

Install all couplings so they can be visually inspected and ensure that installed housing bolt pad sections are not in contact with each other.

2072 Grooved joint couplings

Ensure the working pressure, end load, temperature rating and finish of the housing and gasket are suitable for the intended application.

Direct connection to flanged components: Use flat face, ductile iron flange adaptors with elastomer pressure responsive gaskets.

Rigid type: Use housings which provide a rigid anti-rotational joint. Use rigid joints on pipe and fitting connections and on connections to groove end valves.

Flexible type: Use housings designed to provide a clearance fit at the joint, with controlled linear and/or angular deflection of the pipe. Use flexible joints to provide noise and vibration attenuation and to accommodate thermal movement of pipelines. Provide calculations to demonstrate the correct design of the support/attenuation/movement system, including calculations and pipe support requirements. Ensure the entire system design is approved by the manufacturer.

Couplings 350 mm and larger: Use couplings comprising up to four pieces, each with a lead-in chamfer on the housing key and having a wide gasket.

2073 Grooved joint gaskets

Provide EPDM gaskets for use on grooved jointing systems, rated for the system operating conditions on which they are to be installed. Obtain manufacturer's approval/confirmation in writing of the gasket selection for each system on which they are to be used.

Where connecting to flexible fittings, such as anti-vibration or expansion bellows, ensure that adequately sized gaskets are selected to prevent the grooved coupling face coming into contact with the fitting's flexible medium.

Ensure all gaskets are clearly marked with a colour coding system so they can be identified prior to installation.

2074 Method statement

Submit, with the tender return documentation, a method statement for the installation of grooved jointing systems. Ensure that the method statement is specific to the particular manufacturer being used.

Include in the method statement, as a minimum, the following information:

- ~ training (training programme of site personnel, frequency, certification, retraining/refreshing)
- ~ system components
- ~ procedure
- ~ pipe preparation
- ~ monitoring/identification of groove compliance
- ~ monitoring/identification of correct assembly operation
- ~ use of correct tools
- ~ calibration certificates for tools

Obtain the acceptance of the Contract Administrator to the use of grooved jointing systems prior to commencing any work on site.

2075 Training

Arrange for the grooved jointing system manufacturer's factory trained representative to provide on-site training for field personnel in the use of grooving tools and the installation of the grooved jointing system.

Arrange for the training to be carried out periodically throughout the construction programme to ensure all personnel required to carry out grooved jointing installations have been suitably trained prior to starting work on the system.

Arrange for the grooved jointing system manufacturer to provide certification to all personnel trained. Keep a copy of all such certifications on site for inspection by the Contract Administrator. Ensure that only personnel trained and certified by the grooved jointing system manufacturer install the grooved joining system.

Arrange for the manufacturer to review installation practices and to ensure that they are in accordance with their requirements.

2076 Site inspection

Carry out inspections on a joint by joint basis, with each joint being clearly marked to indicate its acceptance. Arrange for the system manufacturer to visit site at strategic times to inspect the works in progress and approve the installation. Provide written confirmation of the manufacturer's acceptance of the joints.

2077 Manufacturer warranty

Arrange for the grooved jointing system manufacturer to provide a replacement installation warranty against manufacturing defects in the installation for 10 years.

2100 SCHEDULE OF INSTALLER'S SUBMITTALS

2110 At tender submission

Submit the following documentation to the Contract Administrator at the time of tender:

~ confirmation of the pipework and jointing method proposals for each combination of pipework service, system pressure and temperature, and pipework size

Include sufficient detail for indicating how compliance with each of the following specification requirements (where relevant) will be achieved:

~ a protective coating to insulated copper pipework conveying cold services

~ a protective coating to insulated copper fittings conveying cold services

~ a protective coating to stainless steel pipework conveying hot services

~ a protective coating to stainless steel fittings conveying hot services

~ a protective coating to stainless steel pipework conveying cold services

~ a protective coating to stainless steel fittings conveying cold services

~ full compatibility between pipework materials and insulation materials (including pipework support blocks)

~ methodology for insulating flanges and fittings to maintain vapour barrier integrity

~ methodology for achieving electrical bonding where fabrication techniques do not otherwise assure this through metallic contact alone

Alternative materials and fabrication techniques to those indicated in the specification may not be considered unless such alternative proposals are notified with the tender return.

There is however, no obligation by the Contract Administrator to consider any such alternative materials and fabrication techniques either at the time of tender or post-tender.

2120 Post tender acceptance

Submit the following documentation to the Contract Administrator in good time for comment prior to ordering components or commencing any installation works:

~ full technical submission details confirming pipework and jointing methods for each combination of pipework service, system pressure and temperature, and pipework size

~ full technical submission details indicating how compliance with all aspects of this specification will be achieved

~ method statements and operative training/competency certificates

Y10 PIPELINES

2130 Samples of pipes and fittings

If requested by the Contract Administrator, submit samples of any pipe materials, joints, fixings and pipe supports offered for incorporating into the Works, in the specific sizes requested or a range of representative sizes. Submit samples in good time for comment prior to commencing any installation works.

2140 Site-fabricated samples of pipes and fittings

Produce site-fabricated samples of all types of pipe materials, joints, fixings and pipe supports intended for incorporating into the Works. Ensure that samples are sufficiently complete to form representative mock-ups that fully demonstrate the intended site fabrication techniques. Submit site-fabricated samples to the Contract Administrator in good time for comment prior to commencing any installation works.

END OF SECTION Y10

Y11 PIPELINE ANCILLARIES

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IMPORTANT NOTICE

Not all of the systems and pipeline ancillaries types included in this reference specification may be appropriate to the project. Refer to the individual system specifications and the schedules for particular project requirements.

100 REFERENCE DOCUMENTS

This specification is written based on legislation, standards and guidance in force in the UK generally, and within England by default. For projects in Scotland, Wales, Northern Ireland, the Channel Islands and the Isle of Man, give appropriate consideration to any locally applicable legislation, standards and guidance that deviates from or is additional to those in force within England. Similarly for projects outside the UK comply with the corresponding national legislation, standards and guidance.

Comply fully with the edition (including amendments, replacements and associated normative references) of each of the following, current at the time of tender.

Where a standard referred to in this section conflicts with a standard referred to in an associated ‘engineering system’ section (eg S10, T31, V21, etc) of this specification, the standard referred to in the engineering system section prevails.

The Pressure Equipment Regulations (PER)

The Pressure Systems Safety Regulations (PSSR)

BS 336	Specification for fire hose couplings and ancillary equipment
BS 750	Specification for underground fire hydrants and surface box frames and covers
BS 759-1	Valves, gauges and other safety fittings for application to boilers and to piping installations for and in connection with boilers. Specification for valves, mountings and fittings
BS 779	Specification for cast iron boilers for central heating and indirect hot water supply rated output (44 kW rating and above)
BS 855	Specification for welded steel boilers for central heating and indirect hot water supply (rated output 44 kW to 3 MW)
BS 1212-1	Float operated valves. Specification for piston type float operated valves (copper alloy body) (excluding floats)
BS 1212-2	Float operated valves. Specification for diaphragm type float operated valves (copper alloy body) (excluding floats)
BS 1868	Specification for steel check valves (flanged and butt-welding ends) for the petroleum, petrochemical and allied industries
BS 1873	Specification for steel globe and globe stop and check valves, (flanged and butt-welding ends) for the petroleum, petrochemical and allied industries
BS 1968	Specification for floats for ballvalves (copper)
BS 2456	Specification for floats (plastic) for float operated valves for cold water services
BS 2751	General purpose acrylonitrile - butadiene rubber compounds. Specification
BS 2767	Specification for manually operated copper alloy valves for radiators
BS 2879	Specification for draining taps (screw-down pattern)
BS 3251	Specification for indicator plates for fire hydrants and emergency water supplies

BS 5041-1	Fire hydrant systems equipment. Specification for landing valves for wet risers
BS 5041-2	Fire hydrant systems equipment. Specification for landing valves for dry risers
BS 5041-3	Fire hydrant systems equipment. Specification for inlet breechings for dry riser inlets
BS 5041-4	Fire hydrant systems equipment. Specification for boxes for landing valves for dry risers
BS 5041-5	Fire hydrant systems equipment. Specification for boxes for foam inlets and dry riser inlets
BS 5158	Specification for cast iron plug valves
BS 5163	Valves for waterworks purposes. Predominantly key-operated cast iron gate valves. Code of practice
BS 5306-1	Code of practice for fire extinguishing installations and equipment on premises. Hose reels and foam inlets
BS 5353	Specification for steel plug valves
BS 5392-1	Acrylnitride-butadiene-styrene (ABS) fittings for use with ABS pressure pipe. Specification
BS 5433	Specification for underground stop valves for water services
BS 6920	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 7350	Specification for double regulating globe valves and flow measurement devices for heating and chilled water systems
BS 7942	Thermostatic mixing valves for use in care establishments. Requirements and test methods
BS 8558	Guide to the design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages. Complementary guidance to BS EN 806
BS EN 215	Thermostatic radiator valves. Requirements and test methods
BS EN 303-1	Heating boilers. Heating boilers with forced draught burners. Terminology, general requirements, testing and marking
BS EN 331	Manually operated ball valves and closed bottom taper plug valves for gas installations for buildings
BS EN 558	Industrial valves. Face-to-face and centre-to-face dimensions of metal valves for use in flanged pipe systems. PN and Class designated valves
BS EN 593	Industrial valves. Metallic butterfly valves for general purposes
BS EN 751-1	Sealing materials for metallic threaded joints in contact with 1st, 2nd and 3rd family gases and hot water. Anaerobic jointing compounds
BS EN 751-2	Sealing materials for metallic threaded joints in contact with 1st, 2nd and 3rd family gases and hot water. Non-hardening jointing compounds
BS EN 751-3	Sealing materials for metallic threaded joints in contact with 1st, 2nd and 3rd family gases and hot water. Unsintered PTFE tapes
BS EN 805	Water supply. Requirements for systems and components outside buildings
BS EN 806-1	Specifications for installations inside buildings conveying water for human consumption. General

BS EN 806-2	Specifications for installations inside buildings conveying water for human consumption. Design
BS EN 806-4	Specifications for installations inside buildings conveying water for human consumption. Installation
BS EN 837-1	Pressure gauges. Bourdon tube pressure gauges. Dimensions, metrology, requirements and testing
BS EN 1074-1	Valves for water supply. Fitness for purpose requirements and appropriate verification tests. General requirements
BS EN 1074-2	Valves for water supply. Fitness for purpose requirements and appropriate verification tests. Isolating valves
BS EN 1074-3	Valves for water supply. Fitness for purpose requirements and appropriate verification tests. Check valves
BS EN 1074-4	Valves for water supply. Fitness for purpose requirements and appropriate verification tests. Air valves
BS EN 1074-6	Valves for water supply. Fitness for purpose requirements and appropriate verification tests. Hydrants
BS EN 1057	Copper and copper alloys. Seamless, round copper tubes for water and gas in sanitary and heating applications
BS EN 1092-1	Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated. Steel flanges
BS EN 1092-2	Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated. Cast iron flanges
BS EN 1092-3	Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated. Copper alloy flanges
BS EN 1111	Sanitary tapware. Thermostatic mixing valves (PN10). General technical specification
BS EN 1171	Industrial valves. Cast iron gate valves
BS EN 1561	Founding. Grey cast irons
BS EN 1563	Founding. Spheroidal graphite cast irons
BS EN 1567	Building valves. Water pressure reducing valves and combination water reducing valves. Requirements and tests
BS EN 1717	Protection against pollution of potable water in water installations and general requirements of devices to prevent pollution by backflow
BS EN 1982	Copper and copper alloys. Ingots and castings
BS EN 1984	Industrial valves. Steel gate valves
BS EN 10213	Steel castings for pressure purposes
BS EN 10226-1	Pipe threads where pressure tight joints are made on the threads. Taper external threads and parallel internal threads. Dimensions, tolerances and designation
BS EN 10226-2	Pipe threads where pressure tight joints are made on the threads. Taper external threads and taper internal threads. Dimensions, tolerances and designation
BS EN 10226-3	Pipes threads where pressure-tight joints are made on the threads. Verification by means of limit gauges

BS EN 10273	Hot rolled weldable steel bars for pressure purposes with specified elevated temperature properties
BS EN 10283	Corrosion resistant steel castings
BS EN 10293	Steel castings. Steel castings for general engineering uses
BS EN 12164	Copper and copper alloys. Rod for free machining purposes
BS EN 12165	Copper and copper alloys. Wrought and unwrought forging stock
BS EN 12266-1	Industrial valves. Testing of metallic valves. Pressure tests, test procedures and acceptance criteria. Mandatory requirements
BS EN 12288	Industrial valves. Copper alloy gate valves
BS EN 12729	Devices to prevent pollution by backflow of potable water. Controllable backflow preventer with reduced pressure zone. Family B. Type A
BS EN 13190	Dial thermometer
BS EN 13348	Copper and copper alloys. Seamless, round copper tubes for medical gases or vacuum
BS EN 13709	Industrial valves. Steel globe and globe stop and check valves
BS EN 13789	Industrial valves. Cast iron globe valves
BS EN 13397	Industrial valves. Diaphragm valves made of metallic materials
BS EN 13774	Valves for gas distribution systems with maximum operating pressure less than or equal to 16 bar. Performance requirements
BS EN 14814	Adhesives for thermoplastic piping systems for fluids under pressure. Specifications
BS EN 16767	Industrial valves. Steel and cast iron check valves
BS EN ISO 228-1	Pipe threads where pressure-tight joints are not made on the threads. Dimensions, tolerances and designation
BS EN ISO 1452	Plastics piping systems for water supply. Unplasticized poly (vinyl chloride) (PVC-U)
BS EN ISO 4126-1	Safety devices for protection against excessive pressure. Safety valves
BS EN ISO 6509	Corrosion of metals and alloys. Determination of dezincification resistance of brass
BS EN ISO 7396-1	Medical gas pipeline systems. Pipeline systems for compressed medical gases and vacuum
BS EN ISO 7396-2	Medical gas pipeline systems. Anaesthetic gas scavenging disposal systems
BS EN ISO 9000	Quality management systems. Fundamentals and vocabulary
BS EN ISO 13485	Medical devices. Quality management systems. Requirements for regulatory purposes
BS EN ISO 17292	Metal ball valves for the petroleum, petrochemical and allied industries
BS EN ISO 18082	Anaesthetic and respiratory equipment. Dimensions of non-interchangeable screw-threaded (NIST) low-pressure connectors for medical gases
BS ISO 7121	Steel ball valves for general-purpose industrial applications
BSRIA AG 16/2002	Variable-flow water systems. Design, installation and commissioning guidance
BSRIA BG 2/2010	Commissioning water systems

BSRIA BG 29/2012	Pre-commission cleaning of pipework systems
BSRIA BG 44/2013	Seasonal Commissioning
BSRIA BG 50/2013	Water treatment for closed heating and cooling systems
BSRIA BG 51/2014	Selection of control valves in variable flow systems
CIBSE CCW	Commissioning Code 'W', Water distribution systems
DoH HTM 02-01	Medical gas pipeline systems
GIS/PL3	Self-anchoring mechanical fittings for natural gas and suitable manufactured gas
GIS/V7-2	Plastic bodied valves of sizes up to and including 180 mm suitable for operations at pressures not exceeding 5.5 bar
GIS/V7-3	Brass bodied manually operated ball and taper plug valves not exceeding 5 bar maximum operating pressures
GIS standards	Other applicable Gas Industry Standards
HSE HSG253	HSE guidance note. The safe isolation of plant and equipment
IGEM/TD/3	Steel and PE pipelines for gas distribution
IGEM/TD/4	PE and steel gas services and service pipework
WIS standards	Other applicable Water Industry Standards
WRAS	Water Fittings and Materials Directory

200 PLANT STEAM

210 Application

211 Maximum working pressure of 16 bar gauge

For steam distribution systems having a maximum working pressure of 16 bar gauge. Provide valves and fittings of metric standard to a pressure/temperature rating of PN40 minimum for ferrous valves and PN32, series 'A' minimum for copper alloy valves. Provide a small bore valves bypass on valves 200 mm and above.

212 Maximum working pressure of 12 bar gauge

For steam distribution systems having a maximum working pressure of 12 bar gauge. Provide valves and fittings of metric standard to a pressure/temperature rating of PN25 minimum for ferrous valves and PN25 series 'A' minimum for copper alloy valves. Provide a small bore valves bypass on valves 200 mm and above.

213 Maximum working pressure of 8 bar gauge

For steam distribution systems having a maximum working pressure of 8 bar gauge. Provide valves and fittings of metric standard to a pressure/temperature rating of PN16 minimum for ferrous valves and PN25, series 'A' minimum for copper alloy valves. Provide a small bore valves bypass on valves 200 mm and above.

220 Globe valves – bellows sealed

Screwed, sizes DN15 – DN40, forged steel

- ~ Standard: ASTM A105N
- ~ Type: Screwed bellows sealed, in-line globe pattern stop valve
- ~ Pressure rating: PN40, max 400°C

- Material: Forged steel ASTM A105N
- Connections: Taper thread to BS EN 10226-1

Flanged, sizes DN15 – DN50, forged steel
- Standard: PED 97/3/EC
- Type: Flanged bellows sealed, in-line globe pattern stop valve
- Pressure rating: PN40, max 400°C
- Material: Forged steel BS EN 10273 P250GH, 1.0460
- Connections: Flanged to BS EN 1092-1

Flanged, sizes DN15 – DN350, SG iron
- Standard: PED 97/3/EC
- Type: Flanged bellows sealed, in-line globe valve stop valve
- Pressure rating: PN25
- Material: SG iron BS EN 1563 EN-GJS-400-18U-LT, 5.3103
- Connections: Flanged to BS EN 1092-1

Fit all valves DN200 and above with balancing discs.

Flanged, sizes DN15 – DN350, cast steel
- Standard: PED 97/3/EC
- Type: Flanged bellows sealed, in-line globe valve stop valve
- Pressure rating: PN40 (DN15 – DN150), PN25 (DN200 – DN350)
- Material: Cast steel BS EN 10213 GP240GH+N, 1.0619+N
- Connections: Flanged to BS EN 1092-1

Fit all valves DN200 and above with balancing discs.

230 Globe valves – gland sealed

Screwed, sizes DN15 – DN25, bronze
- Standard: BS 5154/BS EN 12288
- Type: Rising stem, union or screwed bonnet, and renewable nickel alloy or stainless steel plug disc and seat
- Pressure rating: PN40, 18 bar g at saturated steam pressure
- Material: Bronze BS EN 1982 CC491K
- Connections: Taper thread to BS EN 10226-1

Flanged, sizes DN15 – DN50, bronze
- Standard: BS 5154/BS EN 12288
- Type: Rising stem, union or screwed bonnet, and renewable nickel alloy or stainless steel plug disc and seat
- Pressure rating: PN16
- Material: Bronze BS EN 1982 CC491K
- Connections: Flanged to BS EN 1092-3

Flanged, sizes DN15 – DN50, forged / cast steel

- ~ Standard: BS 1873 or BS EN 13709
- ~ Type: Outside screw, rising stem, bolted bonnet, and renewable stainless steel trim and plug disc
- ~ Pressure rating: PN40
- ~ Material: Cast steel BS EN 10213 GP240GH+N, 1.0619+N or forged steel BS EN 10273 P250GH, 1.0460
- ~ Connections: Flanged to BS EN 1092-1

Flanged, sizes DN50 – DN250, cast steel

- ~ Standard: BS 1873 or BS EN 13709
- ~ Type: Outside screw, rising stem, bolted bonnet, and renewable stainless steel trim and plug disc
- ~ Pressure rating: PN40
- ~ Material: Cast steel BS EN 10213 GP240GH+N, 1.0619+N
- ~ Connections: Flanged to BS EN 1092-1

240 Parallel-slide gate valves

Screwed, sizes DN15 – DN25, bronze

- ~ Standard: BS EN 12288
- ~ Type: Rising stem, union or screwed bonnet, and stainless steel trim
- ~ Pressure rating: PN40
- ~ Material: Bronze BS EN 1982 CC491K
- ~ Connections: Taper thread to BS EN 10226-1

Flanged, sizes DN15 – DN50, bronze

- ~ Standard: BS EN 12288
- ~ Type: Rising stem, union or screwed bonnet, and stainless steel trim
- ~ Pressure rating: PN40
- ~ Material: Bronze BS EN 1982 CC491K
- ~ Connections: Flanged to BS EN 1092-3

Flanged, sizes DN65 – DN300, cast steel

- ~ Standard: BS EN 1984
- ~ Type: Outside screw, rising stem, bolted bonnet, and stainless steel trim
- ~ Pressure rating: PN40
- ~ Material: Cast steel BS EN 10213 GP240GH+N, 1.0619+N
- ~ Connections: Flanged to BS EN 1092-1

250 Ball valves

Screwed, sizes DN15 – DN25, carbon steel

- ~ Standard: PED 97/3/EC

- ~ Type: Three-piece design, full-bore ball pattern, lever action with extended stems or oval handles as applicable
- ~ Pressure rating: PN40, 17.5 bar g at saturated steam pressure
- ~ Material: Zinc-plated carbon steel ASTM A216 WC
- ~ Connections: Taper thread to BS EN 10226-1

Flanged, sizes DN15 – DN150, carbon steel

- ~ Standard: PED 97/3/EC
- ~ Type: Single-piece design, reduced-bore ball pattern, lever action with extended stems or oval handles as applicable
- ~ Pressure rating: PN40, 17.5 bar g at saturated steam pressure
- ~ Material: Zinc-plated carbon steel ASTM A216 WC
- ~ Connections: Flanged to BS EN 1092-1

260 Check valves

Screwed, sizes DN15 – DN25, bronze

- ~ Standard: BS 5154/BS EN 12288
- ~ Type: Horizontal lift pattern, union cap, and renewable nickel alloy disc and seat
- ~ Pressure rating: PN32, 14 bar g at saturated steam pressure
- ~ Material: Bronze BS EN 1982 CC491K
- ~ Connections: Taper thread to BS EN 10226-1

Screwed, sizes DN15 – DN25, austenitic stainless steel

- ~ Standard: PED 97/23/EC
- ~ Type: Disc pattern, with metal seat
- ~ Pressure rating: PN50, 33 bar g at saturated steam pressure
- ~ Material: Austenitic stainless steel ASTM A351 CF3M
- ~ Connections: Taper thread to BS EN 10226-1

Wafer, sizes DN15 – DN100, stainless steel

- ~ Standard: PED 97/23/EC
- ~ Type: Disc pattern, with spring and metal seat to suit steam application
- ~ Pressure rating: PN40 (ferric stainless steel), PN40 (austenitic stainless steel)
- ~ Material: Ferric stainless steel, or austenitic stainless steel
- ~ Connections: Mounted between flanges BS EN 1092-1

Wafer, sizes DN50 – DN300, carbon steel

- ~ Standard: PED 97/23/EC
- ~ Type: Split-disc pattern, with spring and metal seat to suit steam application
- ~ Pressure rating: PN40
- ~ Material: Carbon steel body, austenitic stainless steel disc

- ~ Connections: Mounted between flanges BS EN 1092-1

270 Strainers

Screwed, sizes DN15 – DN50, bronze

- ~ Standard: PED 97/23/EC
- ~ Type: ‘Y’-type, screwed cap, with stainless steel screen, 0.75 mm diameter perforations
- ~ Pressure rating: PN32
- ~ Material: Bronze BS EN 1982 CC491K
- ~ Connections: Taper thread to BS EN 10226-1

Screwed, sizes DN15 – DN50, SG iron

- ~ Standard: PED 97/23/EC
- ~ Type: ‘Y’-type, screwed cap, with stainless steel or monel screen, 0.8 mm diameter perforations
- ~ Pressure rating: PN25
- ~ Material: SG iron BS EN 1563 EN-GJS-400-15, 5.3106
- ~ Connections: Taper thread to BS EN 10226-1

Screwed, sizes DN15 – DN50, carbon steel

- ~ Standard: PED 97/23/EC
- ~ Type: ‘Y’-type, screwed cap, with stainless steel or monel screen, 0.8 mm diameter perforations
- ~ Pressure rating: ANSI 300
- ~ Material: Carbon steel BS EN 10213 GP240GH+N, 1.0619+N or BS EN 10273 P250GH, 1.0460
- ~ Connections: Taper thread to BS EN 10226-1

Flanged, sizes DN15 – DN200, SG iron

- ~ Standard: PED 97/23/EC
- ~ Type: ‘ Y’-type, screwed cap (DN15 to DN50), flanged cap (DN65 and above), with stainless steel screen, 0.8 or 1.6 mm diameter perforations
- ~ Pressure rating: PN40 (DN15 – DN150), PN25 (DN200)
- ~ Material: SG iron BS EN 1563 EN-GJS-400-15, 5.3106
- ~ Connections: Flanged to BS EN 1092-1

Flanged, sizes DN15 – DN200, carbon steel

- ~ Standard: PED 97/23/EC
- ~ Type: ‘Y’-type, screwed cap (DN15 to DN25), bolted cap (DN32 and above), with stainless steel or monel screen, 0.8 or1.6 mm diameter perforations
- ~ Pressure rating: PN40
- ~ Material: Carbon steel ASTM A216 WC

- ~ Connections: Flanged to BS EN 1092-1

Flanged, sizes DN50 – DN300, ductile iron

- ~ Standard: PED 97/23/EC
- ~ Type: 'Y'-type, flanged cap, with stainless steel screen, 1.5 mm diameter perforations
- ~ Pressure rating: PN25
- ~ Material: Ductile iron BS EN 1563 EN-GJS-500-7, 5.3200
- ~ Connections: Flanged to BS EN 1092-2

300 STEAM CONDENSATE

310 Application

For condensate systems having a maximum working pressure of 10 bar gauge and temperature 185°C. Provide valves and fittings of metric standard to a pressure/temperature rating of PN16 minimum for ferrous valves and PN16 series 'B' minimum for copper alloy valves.

Commence condensate pipelines at the steam trap outlet.

320 Wedge gate valves

Screwed, sizes DN15 – DN50, bronze

- ~ Standard: BS EN 12288
- ~ Type: Solid bronze wedge disc, non-rising stem, screwed-in bonnet
- ~ Pressure rating: PN20
- ~ Material: Bronze BS EN 1982 CC491K
- ~ Connections: Taper thread to BS EN 10226-1

Flanged, sizes DN65 – DN100, bronze

- ~ ,Standard: BS EN 12288
- ~ Type: Inside screw, non-rising stem, bronze trim
- ~ Pressure rating: PN16
- ~ Material: Bronze BS EN 1982 CC491K
- ~ Connections: Flanged to BS EN 1092-3

330 Ball valves

Screwed, sizes DN15 – DN50, carbon steel

- ~ Standard: PED 97/3/EC
- ~ Type: Three-piece design, full-bore ball pattern, lever action with extended stems or oval handles as applicable
- ~ Pressure rating: PN40, 17.5 bar g at saturated steam pressure
- ~ Material: Zinc-plated carbon steel ASTM A216 WC
- ~ Connections: Taper thread to BS EN 10226-1

Flanged, sizes DN15 – DN20, carbon steel

- ~ Standard: PED 97/3/EC

- ~ Type: Single-piece design, reduced-bore ball pattern, lever action with extended stems or oval handles as applicable
- ~ Pressure rating: PN40, 17.5 bar g at saturated steam pressure
- ~ Material: Zinc-plated carbon steel ASTM A216 WC
- ~ Connections: Flanged to BS EN 1092-1

340 Check valves

Screwed, sizes DN15 – DN50, bronze

- ~ Standard: BS 5154/ BS EN 12288
- ~ Type: Horizontal lift pattern, union cap, and renewable nickel alloy disc and seat
- ~ Pressure rating: PN32, 14 bar g at saturated steam pressure
- ~ Material: Bronze BS EN 1982 CC491K
- ~ Connections: Taper thread to BS EN 10226-1

Screwed, sizes DN15 – DN25, austenitic stainless steel

- ~ Standard: PED 97/23/EC
- ~ Type: Disc pattern, with metal seat
- ~ Pressure rating: PN50, 33 bar g at saturated steam pressure
- ~ Material: Austenitic stainless steel ASTM A351 CF3M
- ~ Connections: Taper thread to BS EN 10226-1

Flanged, sizes DN15 – DN100, bronze

- ~ Standard: PED 97/23/EC
- ~ Type: ‘Y’-type, screwed cap (DN15 to DN25), flanged cap (DN32 and above), with stainless steel screen, 0.8 or 1.6 mm diameter perforations
- ~ Pressure rating: PN25
- ~ Material: Bronze BS EN 1982 CC491K
- ~ Connections: Flanged to BS EN 1092-3

Wafer, sizes DN15 – DN100, bronze, ferric stainless steel, austenitic stainless steel

- ~ Standard: PED 97/23/EC
- ~ Type: Disc pattern, with spring and seat to suit steam application
- ~ Pressure rating: PN16 (bronze), PN40 (ferric stainless steel), PN40 (austenitic stainless steel)
- ~ Material: Bronze 2.1050, ferric stainless steel 1.4313, austenitic stainless steel 1.4581
- ~ Connections: Mounted between flanges BS EN 1092-1

Wafer, sizes DN50 – DN300, carbon steel

- ~ Standard: PED 97/23/EC
- ~ Type: Split-disc pattern, with spring and metal seat to suit steam application

- ~ Pressure rating: PN40
- ~ Material: Carbon steel body, austenitic stainless steel disc
- ~ Connections: Mounted between flanges BS EN 1092-1

350 Strainers

Screwed, sizes DN15 – DN50, bronze

- ~ Standard: PED 97/23/EC
- ~ Type: Y'-type, screwed cap, with stainless steel screen, 0.75 mm diameter perforations
- ~ Pressure rating: PN32
- ~ Material: Bronze BS EN 1982 CC491K
- ~ Connections: Taper thread to BS EN 10226-1

Flanged, sizes DN50 – DN300, ductile iron

- ~ Standard: PED 97/23/EC
- ~ Type: 'Y'-type, flanged cap, complete with stainless steel screen, 1.5 mm diameter perforations
- ~ Pressure rating: PN25
- ~ Material: Ductile iron BS EN 1563 EN-GJS-500-7, 5.3200
- ~ Connections: Flanged to BS EN 1092-2

360 Steam traps

Use steam traps as detailed within specification section S51.

400 HIGH TEMPERATURE HOT WATER

410 Application

For high temperature hot water systems having a maximum working pressure of 10 bar gauge and temperature 120°C to 180°C. Provide valves and fittings of metric standard to a pressure/temperature rating of PN16 minimum for ferrous valves and PN16 series 'A' for copper alloy valves.

420 Globe valves – bellows sealed

Screwed, sizes DN15 – DN50, bronze

- ~ Standard: BS 5154/BS EN 12288
- ~ Type: Rising stem, union or screwed bonnet, and renewable nickel alloy or stainless steel plug disc and seat
- ~ Pressure rating: PN40
- ~ Material: Bronze BS EN 1982 CC491K
- ~ Connections: Taper thread to BS EN 10226-1

Flanged, sizes DN15 – DN50, bronze

- ~ Standard: BS 5154/ BS EN 12288
- ~ Type: Rising stem, union or screwed bonnet, and renewable nickel alloy or stainless steel plug disc and seat
- ~ Pressure rating: PN16

- ~ Material: Bronze BS EN 1982 CC491K
- ~ Connections: Flanged to BS EN 1092-3

Flanged, sizes DN15 – DN350, cast steel

- ~ Standard: PED 97/3/EC
- ~ Type: Flanged bellows sealed, in-line globe valve stop valve
- ~ Pressure rating: PN40 (DN15 – DN150), PN25 (DN200 – DN350)
- ~ Material: Cast steel BS EN 10213 GP240GH+N, 1.0619+N
- ~ Connections: Flanged to BS EN 1092-1

Fit all valves DN200 and above with balancing discs.

430 Globe valves – gland sealed

Flanged, sizes DN15 – DN50, forged / cast steel

- ~ Standard: BS 1873 or BS EN 13709
- ~ Type: Outside screw, rising stem, bolted bonnet, and renewable stainless steel trim and plug disc
- ~ Pressure rating: PN40
- ~ Material: Cast steel BS EN 10213 GP240GH+N, 1.0619+N or forged steel BS EN 10273 P250GH, 1.0460
- ~ Connections: Flanged to BS EN 1092-1

Flanged, sizes DN50 – DN400, cast steel

- ~ Standard: BS 1873 or BS EN 13709
- ~ Type: Outside screw, rising stem, bolted bonnet, and renewable stainless steel trim and plug disc
- ~ Pressure rating: PN40 (DN15 – DN150), PN25 (DN200 – DN400)
- ~ Material: Cast steel BS EN 10213 GP240GH+N, 1.0619+N
- ~ Connections: Flanged to BS EN 1092-1

Flanged, sizes DN50 – DN250, SG iron

- ~ Standard: BS 1873 or BS EN 13709
- ~ Type: Outside screw, rising stem, bolted bonnet, and renewable stainless steel trim and plug disc
- ~ Pressure rating: PN16
- ~ Material: SG iron BS EN 1563 EN-GJS-400-18U-LT, 5.3103
- ~ Connections: Flanged to BS EN 1092-1

440 Wedge gate valves

Screwed, sizes DN15 – DN25, bronze

- ~ Standard: BS EN 12288
- ~ Type: Rising stem, union or screwed bonnet and stainless steel trim
- ~ Pressure rating: PN32 17 bar g at 198°C
- ~ Material: Bronze BS EN 1982 CC491K

~ Connections: Taper thread to BS EN 10226-1

Flanged, sizes DN15 – DN300, ductile iron

~ Standard: BS EN 1171

~ Type: Outside screw, non-rising stem, bolted bonnet and stainless steel trim

~ Pressure rating: PN25

~ Material: Ductile iron BS EN 1563 EN-GJS-500-7, 5.3200

~ Connections: Flanged to BS EN 1092-2

450 Check valves

Screwed, sizes DN15 – DN50, bronze

~ Standard: BS 5154/BS EN 12288

~ Type: Horizontal lift pattern, union cap with renewable nickel alloy disc and seat

~ Pressure rating: PN32 14 bar g at 198°C

~ Material: Bronze BS EN 1982 CC491K

~ Connections: Taper thread to BS EN 10226-1

Flanged, sizes DN50 – DN250, ductile iron

~ Standard: BS EN 16767

~ Type: Swing pattern, bolted bonnet with bronze trim

~ Pressure rating: PN25

~ Material: Ductile iron BS EN 1563 EN-GJS-500-7, 5.3200

~ Connections: Flanged to BS EN 1092-2

460 Disc valves

Wafer, sizes DN15 – DN100, bronze, ferric stainless steel, austenitic stainless steel

~ Standard: PED 97/23/EC

~ Type: Disc pattern, with spring and seat to suit HTHW application

~ Pressure rating: PN16 (bronze), PN40 (ferric stainless steel), PN40 (austenitic stainless steel)

~ Material: Bronze 2.1050, ferric stainless steel 1.4313, austenitic stainless steel 1.4581

~ Connections: Mounted between flanges BS EN 1092-1

Wafer, sizes DN50 – DN300, carbon steel

~ Standard: PED 97/23/EC

~ Type: Split-disc pattern, with spring and metal seat to suit HTHW application

~ Pressure rating: PN40

~ Material: Carbon steel body, austenitic stainless steel disc

~ Connections: Mounted between flanges BS EN 1092-1

470 Strainers

Flanged, sizes DN15 – DN50, bronze

- ~ Standard: PED 97/23/EC
- ~ Type: ‘Y’-type, screwed cap, with stainless steel screen, 0.75 mm diameter perforations
- ~ Pressure rating: PN32
- ~ Material: Bronze BS EN 1982 CC491K
- ~ Connections: Flanged to BS EN 1092-3

Flanged, sizes DN50 – DN300, ductile iron

- ~ Standard: PED 97/23/EC
- ~ Type: ‘Y’-type, flanged cap, with stainless steel screen, 1.5 mm diameter perforations
- ~ Pressure rating: PN25
- ~ Material: Ductile iron BS EN 1563 EN-GJS-450-10, 5.3107
- ~ Connections: Flanged to BS EN 1092-2

500 MEDIUM TEMPERATURE HOT WATER

510 Application

For medium temperature hot water systems having a maximum working pressure of 6 bar gauge and temperature 95°C to 120°C. Provide valves and fittings of metric standard to a pressure/temperature rating of PN16 minimum for ferrous valves and PN16 series 'B' for copper alloy valves.

520 Globe valves – bellows sealed

Screwed, sizes DN15 – DN50, bronze

- ~ Standard: BS 5154/BS EN 12288
- ~ Type: Rising stem, union or screwed bonnet, and renewable nickel alloy or stainless steel plug disc and seat
- ~ Pressure rating: PN40
- ~ Material: Bronze BS EN 1982 CC491K
- ~ Connections: Taper thread to BS EN 10226-1

Flanged, sizes DN15 – DN50, bronze

- ~ Standard: BS 5154/BS EN 12288
- ~ Type: Rising stem, union or screwed bonnet, and renewable nickel alloy or stainless steel plug disc and seat
- ~ Pressure rating: PN16
- ~ Material: Bronze BS EN 1982 CC491K
- ~ Connections: Flanged to BS EN 1092-3

Flanged, sizes DN15 – DN350, cast steel

- ~ Standard: PED 97/3/EC
- ~ Type: Flanged bellows sealed in-line globe valve stop valve

- ~ Pressure rating: PN40 (DN15 – DN150), PN25 (DN200 – DN350)
- ~ Material: Cast steel BS EN 10213 GP240GH+N, 1.0619+N
- ~ Connections: Flanged to BS EN 1092-1

Fit all valves DN200 and above with balancing discs.

530 Globe valves – gland sealed

Flanged, sizes DN15 – DN50, forged / cast steel

- ~ Standard: BS 1873 or BS EN 13709
- ~ Type: Outside screw, rising stem, bolted bonnet, and renewable stainless steel trim and plug disc
- ~ Pressure rating: PN40
- ~ Material: Cast steel BS EN 10213 GP240GH+N, 1.0619+N or forged steel BS EN 10273 P250GH, 1.0460
- ~ Connections: Flanged to BS EN 1092-1

Flanged, sizes DN50 – DN400, cast steel

- ~ Standard: BS 1873 or BS EN 13709
- ~ Type: Outside screw, rising stem, bolted bonnet, and renewable stainless steel trim and plug disc
- ~ Pressure rating: PN40 (DN15 – 250), PN25 (DN200 – DN400)
- ~ Material: Cast steel BS EN 10213 GP240GH+N, 1.0619+N
- ~ Connections: Flanged to BS EN 1092-1

Flanged, sizes DN50 – DN250, SG iron

- ~ Standard: BS 1873 or BS EN 13709
- ~ Type: Outside screw, rising stem, bolted bonnet, and renewable stainless steel trim and plug disc
- ~ Pressure rating: PN16
- ~ Material: SG iron BS EN 1563 EN-GJS-400-18U-LT, 5.3103
- ~ Connections: Flanged to BS EN 1092-1

540 Wedge gate valves

Screwed, sizes DN15 – DN50, bronze

- ~ Standard: BS EN 12288
- ~ Type: Rising stem, union or screwed bonnet and stainless steel trim
- ~ Pressure rating: PN32 17 bar g at198°C
- ~ Material: Bronze BS EN 1982 CC491K
- ~ Connections: Taper thread to BS EN 10226-1

Flanged, sizes DN50 – DN300, ductile iron

- ~ Standard: BS EN 1171
- ~ Type: Outside screw, non-rising stem, bolted bonnet and stainless steel trim

- ~ Pressure rating: PN25
- ~ Material: Ductile iron BS EN 1563 EN-GJS-500-7, 5.3200
- ~ Connections: Flanged to BS EN 1092-2

550 Butterfly valves

Wafer, sizes DN65 – DN600, steel, fully lugged

- ~ Standard: BS EN 593
- ~ Type: Fully lugged, PTFE lining, stainless steel disc, lever operated to DN150 size, gear operated DN200 and above
- ~ Pressure rating: PN16
- ~ Material: Steel BS EN 10213-2 GP240GH
- ~ Connections: Fully lugged, to suit flanges to BS EN 1092-2

560 Check valves

Screwed, sizes DN15 – DN50, bronze

- ~ Standard: BS 5154/ BS EN 12288
- ~ Type: Horizontal lift pattern, union cap with renewable nickel alloy disc and seat
- ~ Pressure rating: PN32 14 bar g at 198°C
- ~ Material: Bronze BS EN 1982 CC491K
- ~ Connections: Taper thread to BS EN 10226-1

Flanged, sizes DN50 – DN250, ductile iron

- ~ Standard: BS EN 16767
- ~ Type: Swing pattern, bolted bonnet with bronze trim
- ~ Pressure rating: PN25
- ~ Material: Ductile iron BS EN 1563 EN-GJS-500-7, 5.3200
- ~ Connections: Flanged to BS EN 1092-2

570 Disc valves

Wafer, sizes DN15 – DN100, bronze, ferric stainless steel, austenitic stainless steel

- ~ Standard: PED 97/23/EC
- ~ Type: Disc pattern, with spring and seat to suit MTHW application
- ~ Pressure rating: PN16 (bronze), PN40 (ferric stainless steel), PN40 (austenitic stainless steel)
- ~ Material: Bronze 2.1050, ferric stainless steel 1.4313, austenitic stainless steel 1.4581
- ~ Connections: Mounted between flanges BS EN 1092-1

Wafer, sizes DN50 – DN300, carbon steel

- ~ Standard: PED 97/23/EC
- ~ Type: Split-disc pattern, with spring and metal seat to suit MTHW application

- Pressure rating: PN40
- Material: Carbon steel body, austenitic stainless steel disc
- Connections: Mounted between flanges BS EN 1092-1

580 Strainers

Flanged, sizes DN15 – DN50, bronze

- Standard: PED 97/23/EC
- Type: ‘Y’-type, screwed cap, with stainless steel screen, 0.75 mm diameter perforations
- Pressure rating: PN32
- Material: Bronze BS EN 1982 CC491K
- Connections: Flanged to BS EN 1092-3

Flanged, sizes DN50 – DN300, ductile iron

- Standard: PED 97/23/EC
- Type: ‘Y’-type, flanged cap, with stainless steel screen, 1.5 mm diameter perforations
- Pressure rating: PN25
- Material: Ductile iron BS EN 1563 EN-GJS-450-10, 5.3107
- Connections: Flanged to BS EN 1092-2

590 Control valves

Refer to specification section T30 for descriptions of the following control valves:

- Differential pressure control valves
- Differential pressure relief valves
- Three port control valves
- Three port zone changeover valves
- Two port control valves
- Two port zone shut-off valves
- Pressure independent control valves

600 LOW TEMPERATURE HOT WATER

610 Application

For low temperature hot water systems having a maximum working pressure of 6 bar gauge and temperature 95°C. Provide valves and fittings of metric standard to a pressure/temperature rating of PN10 minimum for ferrous valves and PN16 series 'B' minimum for copper alloy valves.

620 Ball valves

Screwed, sizes DN15 – DN50, DZR brass

- Standard: BS 5154/ BS EN 12288
- Type: PTFE seat and packing, lever handle or lockshield operation, with DZR brass chrome plated ball

- Pressure rating: PN25
- Material: DZR brass BS EN 12165 CW602N
- Connections: Taper thread to BS EN 10226-1

Screwed, filter type, sizes DN15 – DN50, DZR brass

- Standard: BS 5154/ BS EN 12288
- Type: Combined ball valve and fully isolated integral stainless steel strainer, with PTFE seat and packing
- Pressure rating: PN20 or PN25
- Material: DZR brass BS EN 12165 CW602N
- Connections: Taper thread to BS EN 10226-1

630 Wedge gate valves

Screwed, sizes DN15 – DN50, DZR brass

- Standard: BS EN 12288
- Type: Non-rising stem, screwed bonnet, and solid DZR brass wedge, wheelhead or lockshield operation
- Pressure rating: PN20
- Material: DZR brass BS EN 12165 CW602N
- Connections: Taper thread to BS EN 10226-1

Flanged, sizes DN20 – DN100, cast iron

- Standard: BS EN 1171
- Type: Wheelhead pattern, inside screw, non-rising stem, and bronze trim
- Pressure rating: PN10
- Material: Cast iron BS EN 1561 EN-GLS-250, EN-JL1040
- Connections: Flanged to BS EN 1092-2

640 Butterfly valves

Wafer, sizes DN65 – DN300, SG iron, semi lugged

- Standard: BS EN 593
- Type: Semi lugged, EPDM lining, stainless steel or aluminium bronze or nickel plated SG iron disc, lever operated to DN150 size, gear operated DN200 and above
- Pressure rating: PN16
- Material: SG iron BS EN 1563 EN-GJS-400-15, 5.3106
- Connections: Semi lugged, to suit flanges to BS EN 1092-2

Wafer, sizes DN65 – DN600, ductile iron, fully lugged

- Standard: BS EN 593
- Type: Fully lugged, EPDM lining, stainless steel or bronze disc, lever operated to DN150 size, gear operated DN200 and above
- Pressure rating: PN16

- ~ Material: Ductile iron BS EN 1563 EN-GJS-500-7, 5.3200
- ~ Connections: Fully lugged, to suit flanges to BS EN 1092-2

650 Check valves

Screwed, sizes DN15 – DN50, bronze

- ~ Standard: BS 5154/ BS EN 12288
- ~ Type: Horizontal lift pattern, union cap with renewable nickel alloy disc and seat
- ~ Pressure rating: PN32
- ~ Material: Bronze BS EN 1982 CC491K
- ~ Connections: Taper thread to BS EN 10226-1

Flanged, sizes DN50 – DN250, ductile iron

- ~ Standard: BS EN 16767
- ~ Type: Swing pattern, bolted bonnet with bronze trim
- ~ Pressure rating: PN25
- ~ Material: Ductile iron BS EN 1563 EN-GJS-500-7, 5.3200
- ~ Connections: Flanged to BS EN 1092-2

Flanged, sizes DN50 – DN300, cast iron

- ~ Standard: BS EN 16767
- ~ Type: Swing pattern, bolted bonnet with bronze trim
- ~ Pressure rating: PN16
- ~ Material: Cast iron BS EN 1561 EN-GLS-250, EN-JL1040
- ~ Connections: Flanged to BS EN 1092-2

660 Disc valves

Wafer, sizes DN15 – DN100, bronze

- ~ Standard: PED 97/23/EC
- ~ Type: Disc pattern, with spring and seat to suit LTHW application
- ~ Pressure rating: PN16
- ~ Material: Bronze body, austenitic stainless steel disc
- ~ Connections: Mounted between flanges BS EN 1092-1

Wafer, sizes DN50 – DN300, carbon steel

- ~ Standard: PED 97/23/EC
- ~ Type: Split-disc pattern, with spring and metal seat to suit LTHW application
- ~ Pressure rating: PN40
- ~ Material: Carbon steel body, austenitic stainless steel disc
- ~ Connections: Mounted between flanges BS EN 1092-1

Wafer, sizes DN65 – DN600, cast iron

- ~ Standard: PED 97/23/EC

- ~ Type: Split-disc pattern, with spring and metal seat to suit LTHW application
- ~ Pressure rating: PN16
- ~ Material: Cast iron body, gunmetal disc
- ~ Connections: Mounted between flanges BS EN 1092-2

670 Strainers

Screwed, sizes DN15 – DN50, bronze

- ~ Standard: PED 97/23/EC
- ~ Type: 'Y'-type, screwed cap, with stainless steel screen, 0.75 mm diameter perforations
- ~ Pressure rating: PN32
- ~ Material: Bronze BS EN 1982 CC491K
- ~ Connections: Taper thread to BS EN 10226-1

Flanged, sizes DN50 – DN300, ductile iron

- ~ Standard: PED 97/23/EC
- ~ Type: 'Y'-type, flanged cap, with stainless steel screen, 1.5 mm diameter perforations
- ~ Pressure rating: PN25
- ~ Material: Ductile iron BS EN 1563 EN-GJS-450-10, 5.3107
- ~ Connections: Flanged to BS EN 1092-2

Flanged, sizes DN65 – DN400, cast iron

- ~ Standard: PED 97/23/EC
- ~ Type: 'Y' type, flanged cap, with stainless steel screen, 1.5 mm diameter perforations
- ~ Pressure rating: PN16
- ~ Material: Cast iron BS EN 1561 EN-GLS-250, EN-JL1040
- ~ Connections: Flanged to BS EN 1092-2

680 Radiator valves

Matt finish

- ~ Standard: BS 2767
- ~ Type: Angle or straight pattern, handwheel or lockshield, with union nut and tailpiece. Handwheel and lockshield head in white or ivory-coloured, tough stain-free plastic.
- ~ Pressure rating: PN10
- ~ Material: Brass body
- ~ Connections Taper thread to BS EN 10226-1

Polished finish

- ~ Standard: BS 2767

- ~ Type: Angle or straight pattern, handwheel or lockshield, with union nut and tailpiece. Handwheel and lockshield head in white or ivory-coloured, tough stain-free plastic.
- ~ Pressure rating: PN10
- ~ Material: Polished brass body
- ~ Connections: Taper thread to BS EN 10226-1

Chromium plated finish

- ~ Standard: BS 2767
- ~ Type: Angle or straight pattern, handwheel or lockshield, with union nut and tailpiece. Handwheel and lockshield head in white or ivory-coloured, tough stain-free plastic.
- ~ Pressure rating: PN10
- ~ Material: Brass chrome plated body

Nickel plated finish

- ~ Standard: BS 2767
- ~ Type: Angle or straight pattern, handwheel or lockshield, with union nut and tailpiece. Handwheel and lockshield head in white or ivory-coloured, tough stain-free plastic.
- ~ Pressure rating: PN10
- ~ Material: Brass nickel plated body
- ~ Connections: Taper thread to BS EN 10226-1

Thermostatic radiator valves

- ~ Standard: BS EN 215
- ~ Type: Reverse-angle or straight pattern, with union nut and tailpiece
- ~ Pressure rating: PN10
- ~ Material: Brass chrome or nickel plated body, and plastic sensing head
- ~ Connections: Taper thread to BS EN 10226-1

Provide valves suitable for the system temperature range.

Provide valves capable of replacement of head, stem, seal and valve seat, without shutting down the system, and capable of positive shut-off for isolation.

Fit valves with in-built sensors and setting devices, or remote sensors and capillary tubes, as indicted by the radiator schedule or specification.

Where thermostatic radiator valves are positioned in flow connections to radiators, fit a matching finish lockshield valve in the return connections. Fit a ‘ballofix’ ballvalve for radiator isolation upstream of the thermostatic radiator valve.

Where thermostatic radiator valves are positioned in return connections from the radiator, fit a matching finish lockshield valve in the flow connections. Fit a ‘ballofix’ ballvalve for radiator isolation downstream of the thermostatic radiator valve.

Where the main flow pipe is exposed under radiator, fit a thermostatic valve on the radiator top entry.

Return temperature limiters

~ Type: Reverse-angle or straight pattern, with union nut and tailpiece

~ Pressure rating: PN10

~ Material: Brass chrome or nickel plated body, and plastic sensor head

~ Connections: Taper thread to BS EN 10226-1

Provide valves suitable for the system temperature range positioned in the return connection from the radiator or alternative heat emitter as specified.

Provide valves capable of replacement of head, stem, seal and valve seat, without shutting down the system, and capable of positive shut-off for isolation.

Fit valves with in-built sensor, self-acting regulator and setting device which can be limited and locked to provide automatic control of the return water temperature, by closing the valve to throttle flow when the return water temperature rises above a pre-set value and opening as the water temperature decreases.

690 Control Valves

Refer to specification section T31 for descriptions of the following control valves:

~ Differential pressure control valves

~ Differential pressure relief valves

~ Three port mixing valves

~ Three port zone changeover valves

~ Two port control valves

~ Two port zone shut-off valves

~ Energy valves

~ Pressure independent control valves

~ Electronic pressure independent control valves

700 CHILLED WATER AND CONDENSER COOLING WATER

710 Application

For chilled water and condenser cooling water systems having a maximum working pressure of 6 bar gauge and temperature 5°C to 15°C for CHW pipes and up to 50°C for condenser pipework. Provide valves and fittings of metric standard to a pressure/temperature rating of PN10 minimum for ferrous valves and PN16 series 'B' minimum for copper alloy valves.

720 Ball valves

Screwed, sizes DN15 – DN50, DZR brass

~ Standard: BS 5154/ BS EN 12288

~ Type: PTFE seat and packing, lever handle or lockshield operation.with DZR brass chrome plated ball

~ Pressure rating: PN25

~ Material: DZR brass BS EN 12165 CW602N

- ~ Connections: Taper thread to BS EN 10226-1

Screwed, filter type, sizes DN15 – DN50, DZR brass

- ~ Standard: BS 5154/ BS EN 12288
- ~ Type: Combined ball valve and fully isolated integral stainless steel strainer, with PTFE seat and packing
- ~ Pressure rating: PN20 or PN25
- ~ Material: DZR Brass BS EN 12165 CW602N
- ~ Connections: Taper thread to BS EN 10226-1

730 Wedge gate valves

Screwed, sizes DN15 – DN50, DZR brass

- ~ Standard: BS EN 12288
- ~ Type: Non-rising stem, screwed bonnet, and solid DZR brass wedge, wheelhead or lockshield operation
- ~ Pressure rating: PN20
- ~ Material: DZR brass BS EN 12165 CW602N
- ~ Connections: Taper thread to BS EN 10226-1

Flanged, sizes DN65 – DN300, cast iron

- ~ Standard: BS EN 1171
- ~ Type: Wheelhead pattern, inside screw, non-rising stem, and bronze trim
- ~ Pressure rating: PN10
- ~ Material: Cast iron BS EN 1561 EN-GLS-250, EN-JL1040
- ~ Connections: Flanged to BS EN 1092-2

740 Butterfly valves

Wafer, sizes DN65 – DN300, SG iron, semi lugged

- ~ Standard: BS EN 593
- ~ Type: Semi lugged, EPDM lining, stainless steel or aluminium bronze or nickel plated SG iron disc, lever operated to DN150 size, gear operated DN200 and above
- ~ Pressure rating: PN16
- ~ Material: SG iron BS EN 1563 EN-GJS-400-15, 5.3106
- ~ Connections: Semi lugged, to suit flanges to BS EN 1092-2

Wafer, sizes DN65 – DN600, ductile iron, fully lugged

- ~ Standard: BS EN 593
- ~ Type: Fully lugged, EPDM lining, stainless steel or bronze disc, lever operated to DN150 size, gear operated DN200 and above
- ~ Pressure rating: PN16
- ~ Material: Ductile iron BS EN 1563 EN-GJS-500-7, 5.3200
- ~ Connections: Fully lugged, to suit flanges to BS EN 1092-2

Y11 PIPELINE ANCILLARIES

750 Check valves

Screwed, sizes DN15 – DN50, bronze

- ~ Standard: BS 5154/ BS EN 12288
- ~ Type: Horizontal lift pattern, union cap with renewable nickel alloy disc and seat
- ~ Pressure rating: PN32
- ~ Material: Bronze BS EN 1982 CC491K
- ~ Connections: Taper thread to BS EN 10226-1

Flanged, sizes DN50 – DN250, ductile iron

- ~ Standard: BS EN 16767
- ~ Type: Swing pattern, bolted bonnet with bronze trim
- ~ Pressure rating: PN25
- ~ Material: Ductile iron BS EN 1563 EN-GJS-500-7, 5.3200
- ~ Connections: Flanged to BS EN 1092-2

Flanged, sizes DN50 – DN300, cast iron

- ~ Standard: BS EN 16767
- ~ Type: Swing pattern, bolted bonnet with bronze trim
- ~ Pressure rating: PN16
- ~ Material: Cast iron BS EN 1561 EN-GLS-250, EN-JL1040
- ~ Connections: Flanged to BS EN 1092-2

760 Disc valves

Wafer, sizes DN15 – DN100, bronze

- ~ Standard: PED 97/23/EC
- ~ Type: Disc pattern, with spring and seat to suit CHW application
- ~ Pressure rating: PN16
- ~ Material: Bronze body, austenitic stainless steel disc
- ~ Connections: Mounted between flanges BS EN 1092-1

Wafer, sizes DN50 – DN300, carbon steel

- ~ Standard: PED 97/23/EC
- ~ Type: Split-disc pattern, with spring and metal seat to suit CHW application
- ~ Pressure rating: PN40
- ~ Material: Carbon steel body, austenitic stainless steel disc
- ~ Connections: Mounted between flanges BS EN 1092-1

Wafer, sizes DN65 – DN600, cast iron

- ~ Standard: PED 97/23/EC
- ~ Type: Split-disc pattern, with spring and metal seat to suit CHW application
- ~ Pressure rating: PN16

- Material: Cast iron body, gunmetal disc
- Connections: Mounted between flanges BS EN 1092-2

770 Strainers

Screwed, sizes DN15 – DN50, bronze

- Standard: PED 97/23/EC
- Type: 'Y'-type, screwed cap, with stainless steel screen, 0.75 mm diameter perforations
- Pressure rating: PN32
- Material: Bronze BS EN 1982 CC491K
- Connections: Taper thread to BS EN 10226-1

Flanged, sizes DN50 – DN300, ductile iron

- Standard: PED 97/23/EC
- Type: 'Y'-type, flanged cap, with stainless steel screen, 1.5 mm diameter perforations
- Pressure rating: PN25
- Material: Ductile iron BS EN 1563 EN-GJS-450-10, 5.3107
- Connections: Flanged to BS EN 1092-2

Flanged, sizes DN65 – DN400, cast iron

- Standard: PED 97/23/EC
- Type: 'Y' type, flanged cap, with stainless steel screen, 1.5 mm diameter perforations
- Pressure rating: PN16
- Material: Cast iron BS EN 1561 EN-GLS-250, EN-JL1040
- Connections: Flanged to BS EN 1092-2

780 Control valves

Refer to specification section T61 for descriptions of the following control valves:

- Differential pressure control valves
- Differential pressure relief valves
- Three port mixing valves
- Three port zone changeover valves
- Two port control valves
- Two port zone shut-off valves
- Energy valves
- Pressure independent control valves
- Electronic pressure independent control valves

800 HOT WATER AND COLD WATER INTERNAL DOMESTIC

810 Application

For hot water and cold water internal domestic systems having a maximum working pressure of 6 bar gauge and temperature 65°C, or working pressure 7 bar gauge and temperature 10°C respectively. Provide valves and fittings of metric standard to a pressure/temperature rating of PN10 minimum for ferrous valves and PN16 series 'B' minimum for copper alloy valves.

Use only fittings, materials and ancillary components listed in the Water Regulations Advisory Scheme (WRAS) Water Fittings and Materials Directory. Use listed valves with parts in contact with the water constructed from dezincification resistant materials, or confirmed in writing by WRAS or the applicable Water Authority as being of appropriate quality under the requirements of the Water Supply (Water Fittings) Regulations Part 2 Regulation 4.

820 Ball valves

Screwed, sizes DN15 – DN50, DZR brass

~ Standard: BS 5154/ BS EN 12288, WRAS approved

~ Type: PTFE seat and packing, lever handle or lockshield operation with DZR brass chrome plated ball

~ Pressure rating: PN25

~ Material: DZR brass BS EN 12165 CW602N

~ Connections: Taper thread to BS EN 10226-1

830 Wedge gate valves

Screwed, sizes DN15 – DN50, DZR brass

~ Standard: BS EN 12288, WRAS approved

~ Type: Rising stem, union or screwed bonnet, and renewable nickel alloy or stainless steel plug disc and seat

~ Pressure rating: PN16

~ Material: DZR brass BS EN 12165 CW602N

~ Connections: Taper thread to BS EN 10226-1

840 Butterfly valves

Wafer, sizes DN65 – DN300, ductile iron, semi lugged

~ Standard: BS EN 593, WRAS approved

~ Type: Semi lugged, EPDM lining, stainless steel or aluminium bronze or nickel plated SG iron disc, lever operated to DN150 size, gear operated DN200 and above

~ Pressure rating: PN16 minimum

~ Material: Ductile iron BS EN 1563 EN-GJS-400-15, 5.3106

~ Connections: Semi lugged, to suit flanges to BS EN 1092-2

Wafer, sizes DN65 – DN300, ductile iron, fully lugged

~ Standard: BS EN 593, WRAS approved

~ Type: Fully lugged, EPDM lining, stainless steel or aluminium bronze or nickel plated SG iron disc, lever operated to DN150 size. gear operated DN200 and above

- ~ Pressure rating: PN16 minimum
- ~ Material: Ductile iron BS EN 1563 EN-GJS-400-15, 5.3106
- ~ Connections: Fully lugged, to suit flanges to BS EN 1092-2

850 Check valves

Screwed, sizes DN15 – DN50, bronze

- ~ Standard: BS 5154/ BS EN 12288, WRAS approved
- ~ Type: Horizontal swing pattern, union cap with renewable bronze disc and seat
- ~ Pressure rating: PN25
- ~ Material: Bronze BS EN 1982 CC491K
- ~ Connections: Taper thread to BS EN 10226-1

Wafer, sizes DN65 – DN300, ductile iron

- ~ Standard: BS EN 16767, WRAS approved
- ~ Type: Spring loaded axially guided disc
- ~ Pressure rating: PN16
- ~ Material: Ductile iron BS EN 1563 EN-GJS-400-15, 5.3106
- ~ Connections: Mounted between flanges to BS EN 1092-2

Single & double check valves, sizes DN15 – DN28, DZR brass

- ~ Standard: BS 5154/ BS EN 12288, WRAS approved
- ~ Type: Backflow prevention device single check (fluid category 2) or double check (fluid category 3)
- ~ Pressure rating: PN16 compression (15 to 28mm), PN25 threaded (1 1/4” to 2”)
- ~ Material: DZR brass chrome plated or polished finish
- ~ Connections: Taper thread to BS EN 10226-1, or compression ends to BS EN 1254

860 Strainers

Screwed, sizes DN15 – DN50, bronze

- ~ Standard: WRAS approved
- ~ Type: ‘Y’-type, screwed cap, with stainless steel screen, 0.75 mm diameter perforations
- ~ Pressure rating: PN16
- ~ Material: Bronze BS EN 1982 CC491K
- ~ Connections: Taper thread to BS EN 10226-1

Flanged, sizes DN65 – DN400, cast iron

- ~ Standard: WRAS approved
- ~ Type: 'Y' type, flanged cap, with stainless steel screen, 1.5 mm diameter perforations
- ~ Pressure rating: PN16
- ~ Material: Cast iron BS EN 1561 EN-GLS-250, EN-JL1040

- ~ Connections: Flanged to BS EN 1092-2

Flanged, sizes DN65 – DN150, ductile iron

- ~ Standard: WRAS approved
- ~ Type: 'Y'-type, flanged cap with stainless steel screen, 1.5 mm diameter perforations
- ~ Pressure rating: PN25
- ~ Material: Ductile iron BS EN 1563 EN-GJS-500-7, 5.3200
- ~ Connections: Flanged to BS EN 1092-2

870 Service ball valves

Ball valves, sizes DN15 – DN22, DZR brass

- ~ Standard: BS 5154/BS EN 12288
- ~ Type: PTFE seat and packing, lever handle or lockshield operation with DZR brass chrome plated ball
- ~ Pressure rating: PN16
- ~ Material: DZR brass BS EN 12165 CW602N
- ~ Connections: Compression ends to BS EN 1254-2

Ball valves, sizes DN15 – DN22, DZR brass, chrome plated

- ~ Standard: BS 5154/BS EN 12288
- ~ Type: PTFE seat and packing, nylon finger operated handle with DZR brass chrome plated ball
- ~ Pressure rating: PN16
- ~ Material: DZR brass BS EN 12165 CW602N chromium plated
- ~ Connections: Compression ends to BS EN 1254-2

880 Thermal circulation valve, sizes DN15 – DN20, bronze

- ~ Standard: BS 5154/BS EN 12288
- ~ Type: Thermal circulation valve, which provides self-balancing, thermostatically controlled regulation of flow and disinfection
- ~ Pressure rating: PN16
- ~ Material: Bronze BS EN 1982 CC491K
- ~ Connections: Taper thread to BS EN 10226-2

890 Thermostatic mixing valves

Thermostatic mixing valve (TMV3), sizes DN15 – DN22, DZR brass

- ~ Standard: BS EN 1111, BS 7942 and NHS MES DO8
- ~ Type: Blends hot and cold water to ensure constant, controlled safe outlet temperature. Fail-safe pre-set @ 38^{o}C
- ~ Pressure rating: PN10
- ~ Material: DZR brass BS EN 12165 CW602N chromium or nickel plated
- ~ Connections: Compression ends to BS EN 1254-2

Thermostatic mixing valve (TMV2), sizes DN15 – DN22, DZR brass

- ~ Standard: BS EN 1111, BS 7942
- ~ Type: Blends hot and cold water to ensure constant, controlled safe outlet temperature. Fail-safe pre-set @ 38ºC
- ~ Pressure rating: PN10
- ~ Material: DZR brass BS EN 12165 CW602N chromium or nickel plated
- ~ Connections: Compression ends to BS EN 1254-2

900 MAINS AND PUMPED POTABLE COLD WATER APPLICATION

910 Application

For mains and pumped potable cold water systems having a maximum working pressure of 16 bar gauge and temperature 20°C. Provide valves and fittings of metric standard to a pressure/temperature rating to PN16 minimum for ferrous valves and PN16 series 'B' minimum for copper alloy valves.

Use only fittings, materials and ancillary components listed in the Water Regulations Advisory Scheme (WRAS) Water Fittings and Materials Directory. Use listed valves with parts in contact with the water constructed from dezincification resistant materials, or confirmed in writing by WRAS or the applicable Water Authority as being of appropriate quality under the requirements of the Water Supply (Water Fittings) Regulations Part 2 Regulation 4.

920 Principal stop valves

Capillary or screwed, sizes DN15 – DN54, gunmetal

- ~ Standard: BS 5154/BS EN 12288, WRAS approved
- ~ Type: Screw down stop valve
- ~ Pressure rating: PN16
- ~ Material: Gunmetal
- ~ Connections: Capillary or taper thread to BS EN 10226-2

Capillary or screwed, sizes DN15 – DN28, DZR brass

- ~ Standard: BS 5154/BS EN 12288, WRAS approved
- ~ Type: Screw down stop valve
- ~ Pressure rating: PN16
- ~ Material: DZR brass BS EN 12165 CW602N
- ~ Connections: Capillary or taper thread to BS EN 10226-2

930 Wedge gate valves, below ground resilient-seated

Flanged, sizes DN65 – DN400, ducted iron, PN25

- ~ Standard: BS EN 1074-2/BS 5163-1, WRAS approved
- ~ Type: Stem cap pattern, inside screw, non-rising stem, and resilient seat wedge gate valve
- ~ Pressure rating: PN25
- ~ Material: Ductile iron BS EN 1563 EN-GJS-500-7, 5.3200
- ~ Connections: Flanged to BS EN 1092-2

Flanged, sizes DN65 – DN400, ducted iron, PN16

- Standard: BS EN 1074-2/BS 5163-1, WRAS approved
- Type: Stem cap pattern, inside screw, non-rising stem, and resilient seat wedge gate valve
- Pressure rating: PN16
- Material: Ductile iron BS EN 1563 EN-GJS-500-7, 5.3200
- Connections: Flanged to BS EN 1092-2

Flanged, sizes DN65 – DN400, cast iron, PN10

- Standard: BS EN 1074-2/BS 5163-1, WRAS approved
- Type: Stem cap pattern, inside screw, non-rising stem, and resilient seat wedge gate valve
- Pressure rating: PN10
- Material: Cast iron EN-GJL-250
- Connections: Flanged to BS EN 1092-2

940 Pressure reducing valves

Screwed, sizes DN15 – DN50, bronze, PN25

- Standard: BS EN 1567, WRAS approved
- Type: PRV to enable control of pressure from mains fed or boosted cold water supplies to match site requirements
- Pressure rating: PN25
- Material: Bronze
- Connections: Taper thread to BS EN 10226-2

Screwed, sizes DN15 – DN50, bronze, PN16

- Standard: BS EN 1567, WRAS approved
- Type: PRV to enable control of pressure from mains fed or boosted cold water supplies to match site requirements
- Pressure rating: PN16
- Material: Bronze
- Connections: Taper thread to BS EN 10226-2

Flanged, sizes DN65 – DN100, ductile iron, PN25

- Standard: BS EN 1567, WRAS approved
- Type: PRV to enable control of pressure from mains fed or boosted cold water supplies to match site requirements
- Pressure rating: PN25
- Material: Ductile iron BS EN 1563 EN-GJS-500-7, 5.3200
- Connections: Flanged to BS EN 1092-2

Flanged, sizes DN65 – DN100, ductile iron, PN16

- Standard: BS EN 1567, WRAS approved

- ~ Type: PRV to enable control of pressure from mains fed or boosted cold water supplies to match site requirements
- ~ Pressure rating: PN16
- ~ Material: Ductile iron BS EN 1563 EN-GJS-500-7, 5.3200
- ~ Connections: Flanged to BS EN 1092-2

950 Reduced pressure zone (RPZ) valves

Use RPZ anti-pollution valves where detailed within specification section S10 or S13 as applicable.

960 Float operated valves

Piston type, sizes DN15 – DN25
Copper alloy, screwed, with copper floats to BS 1968 on hot water cisterns and plastic floats to BS 2456 on cold water storage cisterns.

- ~ Standard: BS 1212-1
- ~ Type: Piston type for high pressure, with non-return valve
- ~ Pressure rating: PN10
- ~ Material: DZR brass, bronze for DN25
- ~ Connections: BSP(G) male parallel thread

Piston type, sizes DN15 – DN22
Copper alloy, screwed, with copper floats to BS 1968 on hot water cisterns and plastic floats to BS 2456 on cold water storage cisterns.

- ~ Standard: BS 1212-2
- ~ Type: Diaphragm type
- ~ high pressure bronze seat, low pressure nylon seat
- ~ Pressure rating: PN10
- ~ Material: DZR brass
- ~ Connections: BSP(G) male parallel thread

Equilibrium type, sizes DN25 – DN150
Copper alloy, double-seat balanced equilibrium type, suitable for working pressures up to 10 bar gauge (full bore) or 5 bar (reduced bore). Comprising spindle and head guided with stops to prevent over-travel, adjustable and lockable fulcrum linkage and spun copper float brazed or welded. Use the long arm type for feed and expansion applications, arranged to close when the water level in cistern is at 150 mm depth.

- ~ Standard: BS 1212
- ~ Type: Piston type for high pressure
- ~ Pressure rating: PN10
- ~ Material: Gunmetal
- ~ Connections: BSP(G) male parallel thread up to DN50, flanged to BS EN 1092-3 above

970 Delayed-action float valves

Equilibrium type, fixed delay, sizes DN15 – DN80

Delayed action with adjustable close level, and non-adjustable 75 mm operating differential between open and closed water levels. Comprising weighted key-shaped float accurately set on a brass actuating arm. Use twin valves with T-connection to a common inlet where flow rate requires. Use an extended actuating arm for raised valve chambers.

- ~ Standard: BS 1212 (as relevant)
- ~ Type: Ceramic disc-seal type for water pressure up to 10 bar
- ~ Pressure rating: PN10
- ~ Material: DZR brass
- ~ Connections: BSP(G) male parallel thread

Equilibrium type, fully variable delay, sizes DN15 – DN80
Delayed action with adjustable close level, and fully-variable operating differential between open and closed water levels. Comprising float and buoy assembly, linked via an adjustable chain to an actuator tube operating on the transfer of a weight within. Use twin valves with T-connection to a common inlet where flow rate requires. Adjust the chain to suit the closed water level and the operating differentials.

- ~ Standard: BS 1212 (as relevant)
- ~ Type: Ceramic disc-seal type for water pressure up to 10 bar
- ~ Pressure rating: PN10
- ~ Material: DZR brass
- ~ Connections: BSP(G) male parallel thread

Pilot-operated in-line control valve kit, DN40 – DN150

Delayed action kit comprising full-bore pilot-operated in-line control valve operated by a reduced-size equilibrium type, fixed delay, float valve.

1000 FIRE MAINS INSTALLATIONS

1010 Application

For fire mains having a maximum working pressure 16 bar gauge and temperature nominal 20°C.For fire service requirements, from a dedicated pressurised water mains/tanked supply or where specified, from a separate branch, suitably valved with bypass, from the mains cold water supply serving one or more buildings.

Provide valves and fittings of metric standard to a pressure/temperature rating of PN16 minimum for ferrous valves and PN20 Series ‘B’ minimum for copper alloy valves.

Use only fittings, materials and ancillary components listed in the Water Regulations Advisory Scheme (WRAS) Water Fittings and Materials Directory. Use listed valves with parts in contact with the water constructed from dezincification resistant materials, or confirmed in writing by WRAS or the applicable Water Authority as being of appropriate quality under the requirements of the Water Supply (Water Fittings) Regulations Part 2 Regulation 4.

Use lockable valves where specified.

1020 Ball valves

Screwed, sizes DN15 – DN50, DZR brass

- ~ Standard: BS 5154/ BS EN 12288

- ~ Type: PTFE seat and packing, lever handle or lockshield operation with DZR brass chrome plated ball
- ~ Pressure rating: PN25
- ~ Material: DZR brass BS EN 12165 CW602N
- ~ Connections: Taper thread to BS EN 10226-1

1030 Wedge gate valves

Screwed, sizes DN15 – DN50, bronze

- ~ Standard: BS EN 12288
- ~ Type: Rising stem, union or screwed bonnet and stainless steel trim
- ~ Pressure rating: PN32
- ~ Material: Bronze BS EN 1982 CC491K
- ~ Connections: Taper thread to BS EN 10226-1

Flanged, sizes DN65 – DN400, below ground resilient seated, PN25

- ~ Standard: BS EN 1074-2/BS 5163-1, WRAS approved
- ~ Type: Stem cap pattern, inside screw, non-rising stem, and resilient seat wedge gate valve WRAS approved
- ~ Pressure rating: PN25
- ~ Material: Ductile iron BS EN 1563 EN-GJS-500-7, 5.3200
- ~ Connections: Flanged to BS EN 1092-2

Flanged, sizes DN50 – DN300, ductile iron

- ~ Standard: BS EN 1171
- ~ Type: Outside screw, non-rising stem, bolted bonnet and stainless steel trim
- ~ Pressure rating: PN25
- ~ Material: Ductile iron BS EN 1563 EN-GJS-500-7, 5.3200
- ~ Connections: Flanged to BS EN 1092-2

1040 Butterfly valves

Wafer, sizes DN65 – DN300, ductile iron, semi lugged

- ~ Standard: BS EN 593, WRAS approved
- ~ Type: Semi lugged, EPDM lining, stainless steel or aluminium bronze or nickel plated SG iron disc, lever operated to DN150 size, gear operated DN200 and above
- ~ Pressure rating: PN16 minimum
- ~ Material: Ductile iron BS EN 1563 EN-GJS-400-15, 5.3106
- ~ Connections: Semi lugged, to suit flanges to BS EN 1092-2

Wafer, sizes DN65 – DN300, ductile iron, fully lugged

- ~ Standard: BS EN 593, WRAS approved

- ~ Type: Fully lugged, EPDM lining, stainless steel or aluminium bronze or nickel plated SG iron disc, lever operated to DN150 size gear operated DN200 and above
- ~ Pressure rating: PN16 minimum
- ~ Material: Ductile iron BS EN 1563 EN-GJS-400-15, 5.3106
- ~ Connections: Semi lugged, to suit flanges to BS EN 1092-2

1050 Check valves

Screwed, sizes DN15 – DN50, bronze

- ~ Standard: BS 5154/BS EN 12288, WRAS approved
- ~ Type: Horizontal lift pattern, union cap with renewable nickel alloy disc and seat
- ~ Pressure rating: PN32
- ~ Material: Bronze BS EN 1982 CC491K
- ~ Connections: Taper thread to BS EN 10226-1

Flanged, sizes DN50 – DN250, ductile iron

- ~ Standard: BS EN 16767
- ~ Type: Swing pattern, bolted bonnet with bronze trim
- ~ Pressure rating: PN25
- ~ Material: Ductile iron BS EN 1563 EN-GJS-500-7, 5.3200
- ~ Connections: Flanged to BS EN 1092-2

Flanged, sizes DN50 – DN300, cast iron

- ~ Standard: BS EN 16767
- ~ Type: Swing pattern, bolted bonnet with bronze trim
- ~ Pressure rating: PN16
- ~ Material: Cast iron BS EN 1561 EN-GLS-250, EN-JL1040
- ~ Connections: Flanged to BS EN 1092-2

1060 Disc valves

Wafer, sizes DN50 – DN300, carbon steel

- ~ Standard: PED 97/23/EC
- ~ Type: Split-disc pattern, with spring and metal seat to suit CHW application
- ~ Pressure rating: PN40
- ~ Material: Carbon steel body, austenitic stainless steel disc
- ~ Connections: Mounted between flanges to BS EN 1092-1

Wafer, sizes DN65 – DN600, cast iron

- ~ Standard: PED 97/23/EC
- ~ Type: Split-disc pattern, with spring and metal seat to suit CHW application
- ~ Pressure rating: PN16

~ Material: Cast iron body, gunmetal disc

~ Connections: Mounted between flanges BS EN 1092-2

1070 Strainers

Screwed, sizes DN15 – DN50, bronze

~ Standard:

~ Type: 'Y'-type, screwed cap, with stainless steel screen, 0.75 mm diameter perforations

~ Pressure rating: PN32

~ Material: Bronze BS EN 1982 CC491K

~ Connections: Taper thread to BS EN 10226-1

Flanged, sizes DN50 – DN300, ductile iron

~ Standard:

~ Type: 'Y'-type, flanged cap, with stainless steel screen, 1.5 mm diameter perforations

~ Pressure rating: PN25

~ Material: Ductile iron BS EN 1563 EN-GJS-450-10, 5.3107

~ Connections: Flanged to BS EN 1092-2

Flanged, sizes DN65 – DN400, cast iron

~ Standard:

~ Type: 'Y' type, flanged cap, with stainless steel screen, 1.5 mm diameter perforations

~ Pressure rating: PN16

~ Material: Cast iron BS EN 1561 EN-GLS-250, EN-JL1040

~ Connections: Flanged to BS EN 1092-2

1080 Fire hydrant underground valves

Cast iron sluice valve and hydrant to BS 750, copper alloy trim, 80 mm inlet, 65 mm male thread gun metal outlet with loose blank cap and chain where outlet is not more than 300 mm below chamber cover level to BS 5306, Part 1.

Hydrants, complete with, spindle cap, turnkey, separate hydrant indicator plate to BS 3251, Class A, mounted where specified, and cast iron surface box frame to BS 750 and BS 5306, Part 1, built-in by others. Ensure that chamber covers are capable of bearing the maximum vehicle load specified and are complete with two lifting keys.

Screw down pattern to BS 750, Type 2, surface box opening 380 mm x 230 mm

Wedge gate pattern with duckfoot bend to BS 750, Type 1, surface box opening 495 mm x 215 mm.

1090 Fire landing valves

1091 Wet risers

Copper alloy 65 mm screw-down valve to BS 5041-1 and BS 5154, with 65 mm female instantaneous hose coupling to BS 336 and loose outlet blank cap and chain.

Landing valve boxes with 2 mm thick corrosion resistant metal construction to BS 5041-4, with wired glass lockable door (2 Keys) and identified on inside of glass in red letters 75 mm high "FIREMAIN OUTLET - WET RISER".

1092 Dry risers

Copper alloy 65 mm wedge gate vale to BS 5041-2 and BS 5154, with 65 mm female instantaneous hose coupling to BS 336 and loose outlet blank cap and chain.

Landing valve boxes, with 2 mm thick corrosion resistant metal construction to BS 5041-4 with wired glass lockable door (2 keys) identified on inside of glass in red letters 75 mm high "FIREMAIN OUTLET - DRY RISER".

Two way or four way inlet branching, to suit mains specified to BS 5041-3 with each inlet having a non-return valve to BS 5154, a 65 mm male instantaneous hose coupling to BS 336 and loose outlet blank cap and chain.

Inlet branching boxes, 2 mm thick corrosion resistant metal construction to BS 5041-5 with wired glass lockable doors, (2 keys) identified on inside of glass in red letters 75 mm high "FIRE BRIGADE - DRY RISER INLET", complete with 25 mm drain valves (padlocked), drain valve notices and high point air release valves.

10100 Foam inlets

Fit each inlet, serving one space only, with a foam inlet adaptor to BS 336, housed in an inlet box to BS 5041-5 built in by others, and complete with delivery pipe outlets terminating in foam spreader heads to BS 5306, Part 1, Clause 24.

1100 NATURAL GAS

1110 Application

Provide valves and fittings to metric standard to a pressure/temperature rating of PN 6 minimum for ferrous valves and PN16 Series 'B' minimum for copper alloy valves.

Select valves in accordance with IGEM standards for the particular specified application.

1120 Parallel plug valves, DZR brass

Screwed, sizes DN15 – DN20

~ Standard: BS 5158/ BS EN 12288

~ Type: PTFE seat and packing, lever handle or lockshield operation with DZR brass chrome plated ball

~ Pressure rating: PN25

~ Material: DZR brass BS EN 12165 CW602N

~ Connections: Taper thread to BS EN 10226-1

1130 Ball valves

Screwed, sizes DN15 – DN50, DZR brass

~ Standard: BS 5154/BS EN 12288

~ Type: PTFE seat and packing, lever handle or lockshield operation with DZR brass chrome plated ball, yellow plastic coated lever

~ Pressure rating: PN25

~ Material: DZR brass BS EN 12165 CW602N

~ Connections: Taper thread to BS EN 10226-1

Screwed, size DN15, service valve, DZR brass
~ Standard: BS 5154/BS EN 12288

~ Type: PTFE seat and packing, screw driver operation with DZR brass chrome plated ball. Body painted yellow finish

~ Pressure rating: PN25

~ Material: DZR brass BS EN 12165 CW602N

~ Connections: Taper thread to BS EN 10226-1

Flanged, size DN65 – DN300, carbon steel
~ Standard: PED 97/3/EC Gas approved

~ Type: Two-piece design, full bore ball pattern, lever action with extended stems or oval handles as applicable

~ Pressure rating: PN40

~ Material: Zinc-plated carbon steel ASTM A216 WC

~ Connections: Flanged to BS EN 1092-1

1140 Butterfly valves

Wafer, sizes DN65 – DN600, ductile iron, fully lugged
~ Standard: BS EN 593

~ Type: Fully lugged, EPDM lining, stainless steel or aluminium bronze disc, lever operated to DN150 size, gear operated DN200 and above

~ Pressure rating: PN16

~ Material: Ductile iron BS EN 1563 EN-GJS-500-7, 5.3200

~ Connections: Fully lugged, to suit flanges to BS EN 1092-2

1150 Gate valves

Flanged, sizes DN 50 – DN300, cast iron
~ Standard: BS EN 1171, BS EN 12266, BS EN 13774, GIS/V7 Part 2 & 3

~ Type: Cast iron, soft seat, hand wheel pattern

~ Pressure rating: PN16 Max working 7 bar g

~ Material: Cast iron

~ Connections: Flanged to BS EN 1092-2

Flanged, sizes DN 50 – DN300, ductile iron
~ Standard: BS EN 1171, BS EN 12266, BS EN 13774, GIS/V7 Part 2 & 3

~ Type: Ductile iron, soft seat, hand wheel pattern

~ Pressure rating: PN16 Max working 10 bar g

~ Material: Ductile iron

~ Connections: Flanged to BS EN 1092-2

Flanged, sizes DN 50 – DN300, cast steel
~ Standard: BS 6755, BS EN 12266, GIS/V7 Part 2 & 3

- ~ Type: Cast steel, soft seat, fitted with stem cap
- ~ Pressure rating: PN40
- ~ Material: Cast steel
- ~ Connections: Flanged to BS EN 1092-1

Flanged, size DN98 – DN315, cast iron for buried PE services
- ~ Standard: BS EN 12266, GIS/PL3, GIS/V7 Part 2 & 3
- ~ Type: Cast iron gate valve soft seat fitted with stem cap
- ~ Pressure rating: PN16 Max working 7 bar g
- ~ Material: Cast iron/PE
- ~ Connections: PE 100 ends for fusion welding

1160 Check valves

Screwed, sizes DN15 – DN50, bronze
- ~ Standard: BS 5154/ BS EN 12288, WRAS approved
- ~ Type: Horizontal swing pattern, union cap with resilient disc
- ~ Pressure rating: PN25
- ~ Material: Bronze BS EN 1982 CC491K
- ~ Connections: Taper thread to BS EN 10226-1

Flanged, sizes DN50 – DN300, cast iron
- ~ Standard: BS EN 16767
- ~ Type: Swing pattern, bolted bonnet with bronze trim, resilient seated
- ~ Pressure rating: PN16
- ~ Material: Cast iron BS EN 1561 EN-GLS-250, EN-JL1040
- ~ Connections: Flanged to BS EN 1092-2

1200 SPRINKLER SYSTEM

1210 Valves

1211 Generally

Stamp and test any valves required by the Water Authority and bear the full cost of doing so.

1212 Alarm Valves

Use only alarm valves of the type approved and listed by the Loss Prevention Council (LPC).

1213 Stop Valves

Use sluice valves conforming to BS 5163. Use gear-operated butterfly valves conforming to BS EN 593. All valves must be right-handed. Clearly mark the controlling wheels of all stop valves showing the direction the wheel is turned to close the valve. Provide an indicator which shows whether the valve is open or shut.

1214 Non-Return Valves

Use only valves of the type approved and listed by the LPC and the Water Authority.

Install a test cock for each valve between the non-return valve and the supply control valve.

1215 Drainage

Use sprinkler installation valves with a minimum 50 mm (2") drain facility.

Install drain valves at the lowest point where pipework within the system will not drain back via the installation control valves in accordance with the following:-

- ~ up to 50 mm pipework — 20 mm drain valve
- ~ 65 mm and 80 mm pipework — 32 mm drain valve
- ~ 100 mm and above — 50 mm drain valve

1216 Securing and labelling of valves

Secure all stop valves on the incoming supply main connection, pump suctions, pump delivery, pump test and the main stop valve at the installation control valves by leather straps and padlocks.

Secure all other valves by leather straps. Provide all valves with traffolyte labels with the valve number and service engraved thereon, securely fixed in an accepted manner.

1220 Water motor alarm gong

Provide each sprinkler installation with a water motor alarm gong of the type approved and listed by the LPC. Locate these on the external face of the building and not located higher than 6 m above the alarm valve.

Provide a 15 mm test valve on the installation side of the alarm valve.

Arrange the pipework to the water motor alarm to drain through a fitting having an orifice not larger than 3 mm diameter. Use either stainless steel or a suitable non-ferrous material for the orifice plate pressure gauges

Fit a pressure gauge (gauge 'C') on all sprinkler installations immediately above the alarm valve and another gauge (gauge 'B') immediately below the alarm and main stop valve. Fit a pressure gauge on the supply side of the non-return valve on the incoming supply main (gauge 'A').

Use pressure gauges conforming to BS EN 837-1. Pressure gauges shall have scales with divisions not exceeding 0.2 bar.

Provide means to enable each pressure gauge to be readily removed without interruption of installation water supplies.

1230 Flow measuring device

Install on the sprinkler water supply main, a direct reading flowmeter of the type approved and listed by the LPC. Isolate the flowmeter from the system with two isolating valves as recommended by the manufacturers.

1240 Pressure switch

Provide each sprinkler installation with a pressure switch at the installation control valves.

1250 Sprinkler test valve

Provide a test valve adjacent to the highest sprinkler on the installation, capable of discharging a flow at a rate of not less than that of the equivalent of one sprinkler head operating.

Y11 PIPELINE ANCILLARIES

1300 FUEL OIL

1310 Application

Provide valves and fittings to metric standard to a pressure/temperature rating of PN10 minimum for ferrous valves and PN16series ‘B’ minimum for copper alloy valves.

1320 Ball valves

Screwed, sizes DN15 – DN50, DZR brass

- ~ Standard: BS 5154/BS EN 12288
- ~ Type: PTFE seat and packing, lever handle or lockshield operation with DZR brass chrome plated ball
- ~ Pressure rating: PN25
- ~ Material: DZR brass BS EN 12165 CW602N
- ~ Connections: Taper thread to BS EN 10226-1

Flanged, sizes DN65 – DN300, carbon steel

- ~ Standard: PED 97/3/EC
- ~ Type: Two-piece design, full bore ball pattern, lever action with extended stems or oval handles as applicable. Suitable for fuel oil
- ~ Pressure rating: PN40
- ~ Material: Zinc-plated carbon steel ASTM A216 WC
- ~ Connections: Flanged to BS EN 1092-1 PN25

1330 Wedge gate valves

Screwed, sizes DN15 – DN50, bronze

- ~ Standard: BS EN 12288
- ~ Type: Rising stem, union or screwed bonnet and stainless steel trim
- ~ Pressure rating: PN32
- ~ Material: Bronze BS EN 1982 CC491K
- ~ Connections: Taper thread to BS EN 10226-1

Flanged, sizes DN65 – DN100, cast iron

- ~ Standard: BS EN 1171
- ~ Type: Wheelhead pattern, inside screw, non-rising stem, and bronze trim
- ~ Pressure rating: PN10
- ~ Material: Cast iron BS EN 1561 EN-GLS-250, EN-JL1040
- ~ Connections: Flanged to BS EN 1092-2

1340 Strainers

Screwed, sizes DN15 – DN50, bronze

- ~ Standard:
- ~ Type: ‘Y’-type, screwed cap, with stainless steel screen, 0.75 mm diameter perforations
- ~ Pressure rating: PN32

- ~ Material: Bronze BS EN 1982 CC491K
- ~ Connections: Taper thread to BS EN 10226-1

Flanged, sizes DN65 – DN400, cast iron

- ~ Standard:
- ~ Type: 'Y' type, flanged cap, with stainless steel screen, 1.5 mm diameter perforations
- ~ Pressure rating: PN16
- ~ Material: Cast iron BS EN 1561 EN-GLS-250, EN-JL1040
- ~ Connections: Flanged to BS EN 1092-2

1400 COMPRESSED AIR – INDUSTRIAL

1410 Application

Provide valves and fittings to metric standard to a pressure/temperature rating of PN16 minimum for ferrous valves and PN16 Series 'B' minimum for copper alloy valves.

1420 Ball valves

Screwed, sizes DN15 – DN50, DZR brass

- ~ Standard: BS 5154/BS EN 12288
- ~ Type: PTFE seat and packing, lever handle or lockshield operation with DZR brass chrome plated ball
- ~ Pressure rating: PN25
- ~ Material: DZR brass BS EN 12165 CW602N
- ~ Connections: Taper thread to BS EN 10226-1

1430 Globe valves – gland sealed

Screwed, sizes DN15 – DN50, bronze

- ~ Standard: BS 5154/BS EN 12288
- ~ Type: Rising stem, union or screwed bonnet, and renewable nickel alloy or stainless steel plug disc and seat
- ~ Pressure rating: PN40
- ~ Material: Bronze BS EN 1982 CC491K
- ~ Connections: Taper thread to BS EN 10226-1

Flanged, sizes DN15 – DN50, bronze

- ~ Standard: BS 5154/BS EN 12288
- ~ Type: Rising stem, union or screwed bonnet, and renewable nickel alloy or stainless steel plug disc and seat
- ~ Pressure rating: PN16
- ~ Material: Bronze BS EN 1982 CC491K
- ~ Connections: Flanged to BS EN 1092-3

Flanged, sizes DN65 – DN350, cast iron

- ~ Standard: PED 97/3/EC
- ~ Type: Flanged bellows sealed in-line globe valve stop valve
- ~ Pressure rating: PN25 (DN65 – DN 150), PN16 (DN200 – DN350)
- ~ Material: Cast iron BS EN 1561 EN-GLS-250, EN-JL1040
- ~ Connections: Flanged to BS EN 1092-2
- ~ Fit all valves DN200 and above with balancing discs.

1440 Diaphragm valves

Screwed, sizes DN15 – DN50, SG iron, bronze, stainless steel

- ~ Standard: BS EN 558
- ~ Type: Screwed diaphragm valve
- ~ Pressure rating: PN10, PN16
- ~ Material: SG iron BS EN 1563 EN-GJS-450-10 (5.3107), Bronze BS EN 1982 CC491K, Stainless steel BS EN 10283 1.4408
- ~ Connections: Taper thread to BS EN 10226-1

Flanged, sizes DN65 – DN150, cast iron, SG iron, bronze, cast steel, stainless steel

- ~ Standard: BS EN 558
- ~ Type: Flanged diaphragm valve
- ~ Pressure rating: PN10, PN16/PN25
- ~ Material: Cast iron BS EN 1561 EN-GLS-250 (EN-JL1040), SG iron BS EN 1563 EN-GJS-450-18 (5.3105), Cast steel ASTM A216 WCB, Bronze BS EN 1982 CC491K, Stainless steel BS EN 10283 1.4408
- ~ Connections: Flanged to BS EN 1092-1, BS EN 1092-3

1500 MEDICAL GASES, COMPRESSED AIR AND VACUUM

1510 Application

For medical oxygen (O_2), medical nitrous oxide (N_2O), medical compressed air (SA7 & MA4), medical vacuum (VAC), and medical oxygen / nitrous oxide mixture (O_2/N_2O), as specified in specification section S35.

1520 General

Use valves with handles lockable in both open and closed positions; level pattern on line valves and 'T' pattern on area valves.

Ensure that valves are degreased and re-greased with oxygen-resistant lubricant.

Refer to specification section S35 for all other pipeline ancillary components.

1530 Ball valves, AVSUs and terminal outlets

Use medical lockable line valves, NIST tee assemblies conforming with HTM 02-01, BS EN ISO 7396 and BS EN ISO 18082 standards.

Y11 PIPELINE ANCILLARIES

1600 INDUSTRIAL VACUUM

1610 Application

Provide valves and fittings of metric standard to a pressure/temperature rating of PN16 minimum for ferrous valves and PN16 Series 'B' for copper alloy valves.

1620 Ball valves

Screwed, sizes DN15 – DN50, DZR brass

- ~ Standard: BS 5154/BS EN 12288
- ~ Type: PTFE seat and packing, lever handle or lockshield operation with DZR brass chrome plated ball
- ~ Pressure rating: PN25
- ~ Material: DZR brass BS EN 12165 CW602N
- ~ Connections: Taper thread to BS EN 10226-1

1630 Globe valves – gland sealed

Screwed, sizes DN15 – DN50, bronze

- ~ Standard: BS 5154/BS EN 12288
- ~ Type: Rising stem, union or screwed bonnet, and renewable nickel alloy or stainless steel plug disc and seat
- ~ Pressure rating: PN40
- ~ Material: Bronze BS EN 1982 CC491K
- ~ Connections: Taper thread to BS EN 10226-1

1640 Diaphragm valves

Screwed, sizes DN15 – DN50, SG iron, bronze, stainless steel

- ~ Standard: BS EN 558
- ~ Type: Screwed diaphragm valve
- ~ Pressure rating: PN10, PN16
- ~ Material: SG iron BS EN 1563 EN-GJS-450-10 (5.3107), Bronze BS EN 1982 CC491K, Stainless steel BS EN 10283 1.4408
- ~ Connections: Taper thread to BS EN 10226-1

Flanged, sizes DN65 – DN150, cast iron, SG iron, bronze, cast steel, stainless steel

- ~ Standard: BS EN 558
- ~ Type: Flanged diaphragm valve
- ~ Pressure rating: PN10, PN16/PN25
- ~ Material: Cast iron BS EN 1561 EN-GLS-250 (EN-JL1040), SG iron BS EN 1563 EN-GJS-450-18 (5.3105), Cast steel ASTM A216 WCB, Bronze BS EN 1982 CC491K, Stainless steel BS EN 10283 1.4408
- ~ Connections: Flanged to BS EN 1092-1, BS EN 1092-3

Y11 PIPELINE ANCILLARIES

1700 ABS AND UPVC PIPELINE (WORKING PRESSURE 10 BAR GAUGE - TEMPERATURE 20°C)

1710 Application

For valves and fittings in ABS and UPVC pipelines, for chilled water/condenser water, other cold water systems, chemical/solvents, compressed air and industrial vacuum. Ensure materials are non-toxic and suitable for potable water where required.

1720 Ball valves, sizes DN16 – DN110

- ~ Standard: WRAS approved
- ~ Type: Anti-blow-out feature, key locking and bubble tight shut off.
- ~ Pressure rating: PN16 (up to DN50), PN10 (DN65 – DN110)
- ~ Material: ABS plastic BS 5392-1, UPCV plastic BS 4346-1, PTFE seats, EPDM seals
- ~ Connections: Union ends, plain sockets

1730 Diaphragm valves, sizes DN20 – DN90

- ~ Standard: BS EN 558
- ~ Type: Weir type, with diaphragm, and rising handwheel indicator
- ~ Pressure rating: To suit
- ~ Material: ABS plastic
- ~ Connections: plain spigot ends

1740 Butterfly valves, wafer, sizes DN63 – DN315

Plastic, flanges wafer type to

- ~ Standard: BS EN 593
- ~ Type: EPDM lining, reinforced epoxy composite disc, lever operated to DN150 size, gear operated DN200 and above
- ~ Pressure rating: PN10
- ~ Material: ABS plastic
- ~ Connections: Mounted between flanges

1800 AUTOMATIC AIR VENTS

Provide AAVs constructed as noted below and a ½” BSP connection on the vent outlet to allow a tail pipe to run to waste. Fit each AAV with a ventcap. Ensure that the valve is hand assembled with a pre-stressed stainless steel spring to close the valve, is 100% tested at works, with a 40 mm gap between the water level and the Viton valve seat, and has polycarbonate floats. Ensure that the valve and the float are not mechanically joined together to allow safe venting. Arrange that the AAVs have a 3-year leakproof guarantee.

Bronze or copper alloy automatic ball, float type air vents complete with strainer and suitable supporting bracket.

- ~ Standard: BS 5154/BS EN 12288
- ~ Type: Vertical inlet with integral lockshield valve and check valve

~ Pressure rating: PN10
~ Material: Bronze BS EN 1982 CC491K
~ Inlet connections: Taper thread to BS EN 10226-1 Rp 1/2” female or flanged PN16
~ Outlet BS EN ISO 228-1 G 3/8” male

Route the discharge from each vent to a common tundish (15 mm or 22 mm), using 3/8” (10mm) copper pipework and discharge to a suitable and safe position. Where a discharge passes through an outside wall, fit a water tight sleeve and provide a method of frost protection.

1900 AIR COCKS

Use standard flush type air cocks for equipment and pipework venting as indicated in specification section Y10.

2000 THREE-WAY GLAND VENT COCKS

Bronze or dezincification resistant copper alloy, screwed to BS EN 10226, with tapered plug, square shank for loose lever, bolted gland, plug position indicator and port markings to indicate: inlet, vent, waste.

2100 DRAIN COCKS

Bronze or copper alloy, screwed to BS EN 10226, lockshield ball valve, loose lever, detachable hose union end and blank cap and chain. For pressures up to 10 bar and temperatures up to 120°C.

For HTHW and MTHW, fit drain positions with a flanged wedge gate valve, with handwheel removed followed by a screwed low temperature drain cock.

For industrial vacuum, fit drain positions with a copper alloy, screwed globe valve, sizes 15-50 mm, rising stem, screwed bonnet, suitable rubber faced disc to BS EN 12288 or PFEE glass filled disc.

2200 TEST POINTS

Install test points in positions indicated on the drawings.

Provide test points to indicate plant and system operating conditions including boilers, calorifiers, pumps, regulating valves, thermal air and water batteries, and install on the inlet and outlet connections.

Use test points with a spring-loaded ball type self-sealing outlet, capped with a re-sealable washer protected by a lockshield type needle valve.

For HTHW and MTHW, use test points with a flanged needle valve fitted adjacent to the service connection with 500 mm extended capillary tubing terminating in a combined lockshield screwed valve and spring-loaded ball type self-sealing outlet, capped with a re-sealable washer, all suitably fixed.

Use 6 mm test points with extended length to protrude above the insulation, with screwed self-sealing cap. Select the core of suitable material for the purpose.

2300 HANDWHEEL / LEVER LOCKING DEVICES

Provide valves with handwheel or level locking devices where required.

2400 THERMOMETERS

2410 General

Use either stem or dial types thermometers directly mounted in vertical or angled screwed pockets, filled with oil.

Use Stem thermometers with minimum length of 150 mm. Use dial thermometers with a minimum of 100 mm diameter generally and 150 mm diameter minimum in plant rooms where ease of reading is restricted.

Select cases with a black stove enamelled finish in plant rooms, a chromium plated finish in specified occupied areas, and a brass finish elsewhere. In external locations select cases and stems of stainless steel fabrication with IP67 level of protection. Use scales with white faces with black figures, calibrated at 1°C intervals and numbered at 10°C intervals with bold figures.

Select scale ranges for dial gauges to indicate 'normal' operating temperatures when the pointer is vertical, or central on the scale.

Select scale ranges that are appropriate to the system operating temperatures, ie 0°C-120°C for LTHW, -10°C-40°C for CHW, and submit to the Contract Administrator for acceptance prior to placing the order.

Fit thermometers complete with copper alloy, lever handled, taper plug gauge cock or ball pattern gauge cock and union connections. Where fitted to steam systems, use a 'U' pattern siphon.

2420 Stem thermometers

Shall be alcohol in glass type with plain glass dustproof front, revolving cover and perforated stem and pocket.

2430 Dial thermometers

Direct reading, back or bottom mounted:

~ bi-metal
~ gas filled
~ mercury-in-steel
~ vapour pressure

Remote reading, back or bottom capillary entry:

~ gas filled
~ mercury-in-steel
~ vapour pressure

Protect capillaries using flexible sheath along their length. Maintain slack capillary for application of immersion bulb into pockets.

2500 ALTITUDE AND PRESSURE/VACUUM GAUGES

2510 General

Use either single or combined pressure/vacuum gauges with a minimum of 100 mm diameter generally and 150 mm diameter minimum in plant rooms where ease of reading is restricted.

Select dial cases with a black stove enamelled finish in plant rooms, a chromium plated finish in specified occupied areas, and a brass finish elsewhere. In external locations select cases and stems of stainless steel fabrication with IP67 level of protection

Use dials with white faces with black figures.

Use gauges conforming to BS EN 837-1, complete with copper alloy, lever handled, taper plug gauge cock or ball pattern gauge cock and union connections. Where fitted to steam and compressed air systems, use a 'U' pattern siphon.

2520 Pressure gauges

Calibrate dials on their inside scale in bar or metre head to between 1.5 and 2.5 times the working pressure or head, with an adjustable red pointer set at the 'normal' working pressure or head of the system.

Where fitted to boilers or pressure vessels, clearly mark gauge dials with the operating and maximum working heads in accordance with BS 759.

2530 Pressure gauges (vapours and gases)

Calibrate dials on their outside scale in bars and on their inside scale with an appropriate additional unit.

2540 Vacuum gauges

Calibrate dials in bars on their outside scale and mm of mercury on their inside scale.

2600 FLOW MEASUREMENT

2610 Commissioning set selection

Unless specified otherwise in the particular specification, use fixed orifice commissioning sets only: Do not use variable orifice commissioning sets or cartridge type automatic balancing valves.

Select commissioning set sizes against the manufacturer’s recommendations for flow rate, flow velocity and signal pressure. Ensure the signal pressure generated by the commissioning set, at the specified water flow rate, is between 1.0kPa and 4.5kPa. Verify the pressure loss imposed on the system by the commissioning set (allowing for the combined effect of the orifice plate and the regulating valve) does not exceed 8.0kPa. Where it is necessary to meet the above requirements reduce or expand from the line size shown on the general arrangement drawing to the size of commissioning set selected. Include for all necessary fittings and pipe lengths necessary to accommodate this change of size. Install minimum straight upstream and downstream pipe lengths as recommended by the manufacturer at the size of the commissioning set selected.

2620 Application

Maximum operating pressures as detailed for each system. For commissioning, continuous flow metering, and bypass regulation in one- and two-valve systems, on LTHW, chilled water, hot and cold water, MTHW and HTHW pipelines as indicated.

Comply BSRIA BG 2/2010 and BS 7350.

LTHW, chilled water, **hot and cold water**

Dezincification resistant copper alloy, screwed to BS EN 10226, DN15 – DN50

Cast iron, flanged to BS EN 1092-2, sizes DN65 – DN300

MTHW

Dezincification resistant copper alloy or cast iron, flanged to BS EN 1092-3, sizes DN15 – DN50

Cast steel, flanged to BS EN 1092-1, sizes DN65 – DN200

HTHW

Dezincification resistant copper alloy, flanged to BS EN 1092-3, sizes DN15 – DN50

Cast steel, flanged to BS EN 1092-1, sizes DN65 – DN300

LTHW and chilled water **for ultra-low flow rates**

Dezincification resistant copper alloy, screwed to BS EN 10226, size DN15

2630 One-valve system

Use only where specifically permitted by the relevant engineering 'system' particular specification. Comprising on the system return, a variable-orifice flow measuring device forming an integral part of a double regulating valve, and an isolating valve on the system flow.

2640 Two-valve system

Comprising, on the system flow, an orifice flow measuring device, either close-coupled to or forming an integral part of an isolating valve, and a double regulating valve on the system return.

2650 Double regulating valves

Providing approximately equal regulation over full movement of plug with regulation setting remaining, even after valve has been turned to the off position.

Comprising, regulating disc, double regulating device, set point indicator, rising stem, screwed bonnet, metal to metal or PTFE seat on copper alloy valves, plus outside screw, bolted bonnet and locking device on cast iron valves. Copper alloy trim (up to 180°C), nickel alloy trim (above 180°C) and stainless steel trim on cast steel valves.

Dezincification resistant copper alloy, screwed to BS EN 10226, sizes DN15 – DN50

Cast iron, flanged to BS EN 1092-2, sizes DN65 – DN300

Cast steel, flanged to EN 1092-1, sizes DN65 – DN300

2660 Differential pressure control valves (DPCVs)

Provide DPCVs in accordance with the relevant engineering 'system' particular specification.

2670 Pressure Independent Control valves (PICVs)

Provide PICVs in accordance with the relevant engineering 'system' particular specification.

2700 INSTALLATION

Install all pipeline ancillaries fully in accordance with the manufacturer's instructions.

Ensure that materials of construction used in all pipeline ancillaries are compatible with the materials of construction in the pipework system to mitigate against the risk of galvanic action or other forms of corrosion.

Use brass or DZR brass valves, or dielectric unions for joining steel and copper components within pipework systems.

Where intended by the design or where otherwise required, provide independent support to the body of pipeline ancillaries to prevent undue stressing of the connecting joints or adjoining pipework.

For copper alloy and plastic valves and fittings having flat-face flanged connections in accordance with BS EN 1092-3, use flat-face mounting pipeline flanges to suit.

For iron and steel valves and fittings having raised-face flanged connections in accordance with BS EN 1092-1, use raised-face mounting pipeline flanges to suit.

For copper alloy valves with capillary ends for copper pipelines, take adequate care to ensure that there is no damage to the valve operation resulting from the application of heat during the making of the joint. Equip screwed valves specified for non-ferrous pipelines with appropriate non-ferrous adaptors to make the necessary pipeline joints.

Do not use semi-lugged wafer valves for end-of-line service applications or for applications requiring ‘live dismantling’. Use semi-lugged wafer valves only where the application is ‘isolation without live dismantling’.

For fully-lugged wafer valves, securely attach the valve to both adjoining flanges such that full water pressure is held back upon dismantling at one flange. Use either through stud-bolts and nuts, or hexagon-headed bolts / cap screws from both sides.

Adjust glands on valve stuffing boxes at normal plant operating conditions in accordance with the manufacturer's recommendations, without impairing the valve action by over tightening.

Install flow measurement and regulation devices in pipeline positions in accordance with manufacturer's recommendations.

Install all valves such that their visibility, functionality and manual adjustability is not compromised by their location or orientation, and ensure that:

~ calibrated scales and position indictors are fully visible

~ easy manual adjustment of the valve is assured for an operator

~ adequate spatial allowance exists for the swing of valve levers or rise of valve stems

~ levers on lever-operated valves align parallel with the pipeline when in the open position and point in the direction of flow

Provide two complete sets of appropriate keys, wrenches, to fit each range of valves, cocks and taps, for handing over to the Contract Administrator on completion of the Works. Fix within each plant room, painted, labelled boards with hooks for the keys.

Select thermometers and altitude/pressure/vacuum gauges of similar diameter, quality and general construction to provide a uniform appearance in each situation. Where there is difficulty in access for ease of reading, mount gauges remotely using a capillary tube extension.

Use boiler mountings that comply with BS 759, BS 779 or BS 855 as appropriate to the system.

Where an automatic control function, self-actuating function, or status monitoring of a valve is specified or otherwise required, achieve the requirements of the relevant engineering ‘system’ specification.

2800 VALVE SELECTIONS

Take account of the Quality Management requirements of BS EN ISO 9000, and wherever possible select products that are manufactured under a BSI Kitemark Scheme, from Firms of Assessed Capability, and the BVMA Quality Scheme in respect of valves.

Ensure that pipeline ancillary selections are generally made using products by the same manufacturer except where a full range of products is not available from the one manufacturer.

Ensure that all pipeline ancillaries are suitable for the pressure and temperature of the system, and the environmental conditions in which they are installed

Make all pipeline ancillaries line-size unless their correct functioning (eg flow/pressure measurement, flow/pressure regulation, flow/pressure control, etc) specifically requires an appropriate size reduction.

Select check valves to ensure they are sized above the manufacturer’s minimum velocity. Ensure that where check valves are on pump discharges the check valves’ sizes is the same as pump discharge bore and not the adjacent pipe size.

Ensure that all pipeline ancillaries are permanently marked during manufacturer with, as appropriate, the manufacturer’s identification, pressure rating, size, and direction of flow.

2900 SCHEDULE OF INSTALLER’S SUBMITTALS

2910 At tender submission

Submit the following documentation to the Contract Administrator at the time of tender:

- ~ confirmation of the valves and pipeline ancillary proposals for each combination of pipework service, system pressure and temperature, and pipework size

Alternative proposals to those indicated in the specification may not be considered unless such alternative proposals are notified with the tender return.

There is however, no obligation by the Contract Administrator to consider any such alternatives either at the time of tender or post-tender.

2920 Post tender acceptance

Submit the following documentation to the Contract Administrator in good time for comment prior to ordering components or commencing any installation works:

- ~ full technical submission details confirming valves and pipeline ancillary products for each combination of pipework service, system pressure and temperature, and pipework size
- ~ full technical submission details indicating how compliance with all aspects of this specification will be achieved
- ~ confirmation of the manufacturer's flow coefficient and pressure loss data for the selected valves
- ~ technical and appearance details for the selected firefighting system inlet and outlet valve/breeching boxes
- ~ details of the proposed automatic gas shut-off valve including pressure drop at design flow rate and power/control details

2930 Samples of valves and pipeline ancillaries

If requested by the Contract Administrator, submit samples of any valves and pipeline ancillary products offered for incorporating into the Works, in the specific sizes requested or a range of representative sizes. Submit samples in good time for comment prior to commencing any installation works.

END OF SECTION Y11

Y20 PUMPS AND PRESSURISATION UNITS

CONTENTS

100 REFERENCE DOCUMENTS

This specification is written based on legislation, standards and guidance in force in the UK generally, and within England by default. For projects in Scotland, Wales, Northern Ireland, the Channel Islands and the Isle of Man, give appropriate consideration to any locally applicable legislation, standards and guidance that deviates from or is additional to those in force within England. Similarly for projects outside the UK comply with the corresponding national legislation, standards and guidance.

Comply fully with the edition (including amendments, replacements and associated normative references) of each of the following, current at the time of tender.

Where a standard referred to in this section conflicts with a standard referred to in an associated ‘engineering system’ section (eg S10, T31, V21, etc) of this specification, the standard referred to in the engineering system section prevails.

BS 3790	Specification for belt drives. Endless wedge belts, endless V-belts, banded wedge belts, banded V-belts and their corresponding pulleys
BS 5944	Measurement of airborne noise from hydraulic fluid power systems and components
BS 7074-1	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	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 7074-3	Application, selection and installation of expansion vessels and ancillary equipment for sealed water systems. Code of practice for chilled and condenser systems
BS EN 614-1	Safety of machinery. Ergonomic design principles. Terminology and general principles.
BS EN 809	Pumps and pump units for liquids. Common safety requirements
BS EN 1092	Flanges and their joints. Circular flanges for pipes, vales, fittings and accessories, PN designated steel flanges
BS EN 1151-2	Pumps. Rotodynamic pumps. Circulation pumps having a rated power input not exceeding 200 W for heating installations and domestic hot water installations. Noise test code (vibro-acoustics) for measuring structure and fluid-borne noise
BS EN 10226-1	Pipe threads where pressure tight joints are made on the threads. Taper external threads and parallel internal threads. Dimensions, tolerances and designation
BS EN 10226-2	Pipe threads where pressure tight joints are made on the threads. Taper external threads and taper internal threads. Dimensions, tolerances and designation
BS EN 10226-3	Pipes threads where pressure-tight joints are made on the threads. Verification by means of limit gauges
BS EN 12828	Heating systems in buildings. Design for water-based heating systems
BS EN 13831	Closed expansion vessels with built-in diaphragm for installation in water

BS EN 16297-1	Pumps. Rotodynamic pumps. Glandless circulators. General requirements and procedures for testing and calculation of energy efficiency index (EEI)
BS EN 60034-1	Rotating electrical machines. Rating and performance
BS EN 60204-1	Safety of machinery. Electrical equipment of machines. General requirements
BS EN 60335-2.51	Household and similar electrical appliances. Safety. Particular requirements for stationary circulation pumps for heating and service water installations
BS EN 60947-3	Low-voltage switchgear and control gear. Switches, disconnectors, switch-disconnectors and fuse-combination units
BS EN 60947-4-1	Low-voltage switchgear and control gear. Contactors and motor-starters. Electromechanical contactors and motor-starters
BS EN IEC 61800-3	Adjustable speed electrical power drive systems. EMC requirements and specific test methods
BS ISO 21940-21	Mechanical vibration. Rotor balancing. Description and evaluation of balancing machines
BS EN ISO 2858	End-suction centrifugal pumps (rating 16 bar). Designation, nominal duty point and dimensions
BS EN ISO 5198	Centrifugal, mixed flow and axial pumps. Code for hydraulic performance tests. Precision class
BS EN ISO 9906	Rotodynamic pumps. Hydraulic performance acceptance tests. Grades 1, 2 and 3
PD 5304	Guidance on safe use of machinery
DIN 4809-1	Compensators made of elastomeric compound materials (rubber-compensators) for warm water heating-plants; up to a maximum operating-temperature of 100 °C and a maximum pressure of 10 bar
HM Government	Non-domestic Building Services Compliance Guide
HM Government	Domestic Building Services Compliance Guide

200 DEFINITIONS

The following definitions apply to pumps and equipment used to construct the works.

210 Glandless or canned rotor pump

A pump with an integral motor, the rotating parts of which run, with the impeller, within a sealed ‘can’. The motor stator windings are outside of the ‘can’ and thus kept dry by being separated from the wet rotor compartment. This configuration avoids the need for a seal (gland) at the pump shaft. Duty is adjusted by varying the speed of the motor.

220 Glanded pump

A pump whose impeller shaft extends through the impeller casing by means of a suitable seal (gland). There are four alternative configurations, namely, belt driven, direct coupled, close coupled and in-line.

221 Belt driven

A glanded pump indirectly coupled to a motor by pulleys and belt(s). Usually mounted to one side or on top of the impeller casing, the motor has shaft bearings that are completely independent of the bearing(s) of the impeller shaft. Duty is adjusted by selection of drive pulley diameters and/or by varying the speed of the motor.

222 Direct coupled

A glanded (usually end-suction) pump the shaft of which is directly coupled to the shaft of its motor. Both pump and motor are mounted on a common base with the ends of their shafts aligned and joined, usually by a flexible coupling. Duty is adjusted by selection of impeller diameter and/or by varying the speed of the motor.

223 Close coupled

A glanded (usually end-suction) pump the motor of which has a specially extended shaft that enters the pump casing and to which the impeller is directly fitted. The pump does not have its own bearings, and the end thrust developed has to be withstood by the bearings in the motor. Such pumps are arranged either for front or for back ‘pull-out’ when accessing the impeller. Duty is adjusted by selection of the impeller diameter and/or by varying the speed of the motor.

224 In-line pump

A glanded pump where the inlet and outlet water connections are in line with each other enabling the pump to be readily fitted in a straight section of piping. The inlet water connection turns the water flow through a right angle before it impinges on the impeller centre. There are two alternative configurations, namely, in-line (pipeline mounted) and in-line (base mounted). Duty is adjusted by selection of the impeller diameter and/or by varying the speed of the motor.

230 Split coupled in-line pump

A type of in-line pump where removal of a split spacer coupling allows all mechanical seal components to be withdrawn for servicing through the resulting space between pump and motor shafts without disturbing other pump components or motor connection.

240 End-suction pump

A pump where the water inlet is in line with and at right angles to the impeller centre.

300 PUMPS GENERAL AND PUMP SELECTION

310 General

Select, if possible, a single common pump manufacturer to provide all pump units for the entire mechanical engineering services installation.

Select pumps that meet the requirements of this specification and the Pump Schedule(s). Wherever possible select pumps and their motor drives for maximum wire-to-water efficiency. Ensure that every pump is suitable to handle the duty, the fluid and the range of fluid temperatures and pressures specified in the pump schedules and is resistant to erosion, corrosion or attack from the fluid being pumped.

Unless stated otherwise in the system specification sections and / or pump schedules, select all pumps to have a Minimum Efficiency Index (MEI) ≥0.7. With the Contract Administrators written acceptance this requirement may be relaxed to a MEI ≥0.4.

Select all glandless standalone circulators to have an Energy Efficiency Index (EEI) of no more than 0.23.

Obtain the selected pump manufacturer's confirmation that the pumps finally selected are suitable for the duty and other details specified.

Provide complete pump and motor assemblies that are efficient, mechanically balanced, quiet, and smooth running.

Mount pumps and motor drives according to the pump manufacturer’s written installation instructions.

For belt-driven pumps tailor the pump impeller speed to the required design duty but ensure that the motor has sufficient capacity to provide the capability duty specified in the pump schedule when the belt drive is altered. Allow for changing belts and pulleys on each pump once, as directed by the Contract Administrator, during commissioning.

For direct-coupled pumps, close-coupled pumps and in-line pumps tailor the pump impeller diameter to the required design duty but ensure that the pump casings are capable of accepting an impeller that is able to provide the capability duty specified in the pump schedule. Select the motor and drive mechanism to be able to accommodate the resulting increased power demand. Allow for changing each impeller once, as directed by the Contract Administrator, during commissioning.

Check that the electrical power circuit supplying each pump is appropriately configured and of adequate capacity for the pump and its motor drive installed; report to the Contract Administrator any pump for which this requirement is not met.

Ensure that water pumps used on closed-loop variable-volume circuits using a motor rated above 750 W are fitted with or controlled by an appropriate variable speed controller.

Ensure all glandless circulators up to 2.5 kW are labelled under the Europump Labelling Scheme, and are rated within the range A to G. On variable volume systems where glandless circulators are specified in the specification, in the pump schedules and/or on the drawings, use variable speed glandless circulators.

Ensure pumps and their drives are segregated such that failure of pump motor, impeller or shaft allows replacement of components without influencing the working operation of the system.

Where the weight of an item of equipment exceeds 20 kg include a suitable lifting ring, lug or other device to aid transportation.

Ensure that all threaded parts such as bolts, nuts and plugs conform to metric standards.

Ensure that no threaded holes are exposed to the pumped fluid.

Ensure that the direction of rotation of the impeller is clockwise when viewed from the coupling end. Provide an arrow showing the direction of rotation on the pump casing.

Give preference to pumps that exhibit design features that allow for ease of maintenance and easy replacement of components liable to wear, such as shaft sleeves, wearing rings etc.

Fit twin-head pumps only where specified or agreed with the Contract Administrator. Provide twin-head pumps with integral non-return valves or changeover flaps and casing cover plates to enable maintenance on the standby pump to be carried out whilst the running pump is in operation.

Design the pump casing to withstand a hydrostatic test of 1.5 times the working pressure.

Provide all spare domestic hot water return pumps with suitable end caps to prevent the ingress of debris.

Ensure that in-line pumps are installed with an associated method of support which is independent from the pipework system to which they are connected.

Install wall-mounted pumps either in the vertical or horizontal plane in accordance with the manufacturer’s instructions. Provide vibration isolation measures to ensure no vibration is transmitted to the wall.

Where specified mount each pump on a fully matched inertia base provided by the pump manufacturer. Mount the inertia base on spring vibration isolators to a plinth upon the plant room slab. Manufacturer inertia base frames from mild steel channel and plate and incorporate reinforcing mesh welded into place together with drilled steel members. Locate a suitably sized spring isolator at each corner. The main contractor is responsible for the supply and installation of mass concrete to the frame base. Do not install rigid pipework or conduit across the inertia base which may reduce its effectiveness.

320 Pump selection points

321 Constant volume circuits

Select pumps operating in constant volume circuits to have the best efficiency point on the system resistance curve.

Select pumps in constant volume circuits to have a closed valve head of between 120% and 140% of the head at the best efficiency point.

322 Variable volume circuits

Select pumps operating in variable volume circuits to have the best efficiency point to the left hand side of the system resistance curve.

Select pumps in variable volume circuits to have a closed valve head of not greater than 120% of the head at the best efficiency point.

323 General

Select pump to be non-overloading, except when motor drives with load-limiting logic are fitted.

Do not select the pump on a flat head part of the curve.

Provide all pumps other than small glandless pumps with a rising pressure characteristic as flow reduces sufficient to ensure correct and unambiguous control of pump speed. Ensure that no pump flow / resistance curve has a negative gradient at any point.

Provide each pump, motor and, where applicable, inverter drive as a package from one supplier.

Provide details of the minimum running speed for each pump as installed.

330 Fire Pumps

Select fire protection pumps of rated duty that includes the requirements of the recalculated pump flows and pressures based on shop drawings.

400 PRODUCTS AND MATERIALS

410 General

Ensure all the materials of construction are as specified in the pump schedules. Use industry standard materials if there is no indication in the pump schedules.

Ensure that pumps used for potable water applications are manufactured using material that will not have a detrimental effect on the water quality.

420 Pump materials

421 Casing

Use the pump casing material specified in the pump schedule.

Suitably support the casing from the pump baseplate if the pump is not of the close coupled type.

Supply the pump casing and stuffing box with vents, if not self-venting.

Provide all pumps complete with a drain plug.

Design the pump to permit removal of the rotating element from the casing without disturbing the suction and discharge connections.

Unless specified otherwise in the pump schedules, for domestic hot water service secondary distribution provide pumps with bronze or stainless steel casings; for low temperature hot water heating and chilled water circuits provide pumps with cast iron casings.

422 Impeller

Dynamically balance the impeller after assembly, at the manufacturer’s works.

Provide impellers that are keyed to the shaft, or threaded to the shaft with rotation to tighten.

Protect shaft keys and threads such that they will not be wetted by the pumped media.

Ensure that the impeller material has no detrimental effect on the fluid it conveys.

Resin / composite impellers may be used provided they are suitable for the particular application.

423 Mechanical seal

Provide the pump with dripless mechanical shaft seals as specified in the pump schedule.

Ship pumps with mechanical seals installed.

When specified, ensure that double shaft seals are suitable for steam sterilising at 130°C.

424 Bearings

Provide bearings as recommended by the manufacturer for each type of pump, either sleeve type with oiling ring and reservoir, ball or roller type with grease lubricator, or “sealed-for-life” bearings. Provide bearings with a minimum rated life of 30,000 hours at maximum load. Ensure that bearings are outside the stuffing box and shaft seal.

Take responsibility for determining the optimum number and type of bearing assemblies included in the pump.

Construct the bearing housings to protect the bearings from moisture, dust, dirt and other contaminants.

Ensure that the arrangement of components facilitates ease of maintenance, lubrication and bearing replacement.

425 Nameplates

Provide stainless steel nameplates on the pumps and ensure that these state the manufacturer’s name, pump model reference, pump serial number, size, impeller diameter, maximum design pressure and temperature, MEI rating, design flow rate and head, pump speed, date of manufacture and material of construction.

430 Suction and delivery connections

Unless otherwise shown in the pump schedules, where pumps have both connection sizes 65 mm or greater, use flanged connections conforming to the Table of BS EN 1092 appropriate to the maximum working pressure.

Unless otherwise shown in the pump schedules, where pumps have both connection sizes 50 mm or less, provide screwed connections in accordance with BS 21. Provide unions or tapped counter flanges with each pump for connection to pipework.

Provide isolating valves on the suction and discharge side of each pump. Provide a strainer on the suction side and a non-return valve on the discharge side of each pump. Ensure that the isolating valves, non-return valves and strainers associated with each pump are of pipeline size, not pump connection size. Provide long taper pieces or reducing bends where necessary to connect to pipework.

Provide a pressure gauge with isolating valve on the suction and discharge side of each pump.

Provide valved universal test points in the piping at the suction and discharge side of each pump.

Ensure that the thickness of the flat faced flanges is equal to the full raised face thickness.

431 Flexible connections

Where recommended by the pump manufacturer, or where otherwise required to control the transmission of vibration to the pipework system, install line-sized flexible connections on both suction and discharge sides of the pump using a suitable material and thickness for the application and ensuring adequate movement is available to both sides. Install flexible connections fully in accordance with the manufacturer's recommendations.

Use flexible connections of the rubber bellows type, manufactured from a single convolution of multi-ply EPDM rubber with wire-reinforced cuffs. Provide flanges that are able to swivel and are removable. Mould the date of manufacturer on the bellows. For traceability provide membranes with an indelible identification showing manufacturer, country of origin, type and batch number. Use tie bars with rubber top-hat washers where the working pressure exceeds 1 bar gauge. Where untied bellows are used, follow the manufacturer's recommendations for anchors and guides. Ensure tie bars are threaded and their length is adjustable. Provide flexible connections with a design life of 120 months at the operating conditions and after this time a minimum burst pressure of 30 bar, in compliance with DIN 4809 Part 2. Reinforce the bellows carcass with Polymer Textile Polyester Ether Keytone (PEEK) or Aramid Fibre (Kevlar) to DIN 4809 Part 1. Colour Code Double Red Band - Elaflex Rotex or equal and approved.

Under no circumstances use flexible hoses on domestic hot and cold water or cold water humidification systems.

440 Drip trays

Fit a stainless steel drip tray beneath every chilled water pump or any other pump where condensation is likely to occur, or where the pump's shaft seal may leak. Connect to every such drip tray a plastic drain pipe (with flexible connection in the case of inertia bases), routed to discharge over the nearest suitable floor drain. Note that this work is not necessarily detailed on the tender drawings.

Where the pump is pipeline-mounted install the drip tray on brackets, preferably fixed to an adjoining wall.

Where the pump is of the bedplate-mounted or base-mounted type, mount the drip tray on a concrete or inertia base prior to fitting the pump. Seal watertight all penetrations of the tray where fixings are made.

450 Pressurisation units

451 General

Select, if possible for common methods of pressurisation, a common pressurisation unit manufacturer to provide all pressurisation units for the entire mechanical engineering services installation.

Provide a packaged pressurisation unit set to maintain system pressure between safe working limits all in accordance with the equipment schedules, the manufacturer's recommendations and the requirements detailed below.

Install a single check valve in the branch serving the pressurisation unit adjacent to the cold water supply branch. Install a suitable line strainer on the cold water supply to the unit, with isolating valves to enable it to be serviced.

Interlock heating / cooling generator and pump operation with the pressurisation unit such that no heating / cooling generator or pump can operate when the pressurisation unit is in high or low pressure alarm condition.

Connect the pressurisation unit to the system via a lockshield isolating valve.

Provide the pressurisation unit with a 230 V, 1-phase, 50 Hz electrical supply from the plant room MCCP.

Install the unit as shown on the drawings and in accordance with the manufacturer's recommendations.

Verify the actual system water content based upon your installation drawings and equipment selections.

Select the final working pressure such that it is no greater than 50% of the maximum test pressure of the lowest pressure rated component of the system, providing that all components are adequately selected.

Assemble, test and commission the unit in accordance with ISO 9001 standards and the Pressure Equipment Regulations.

452 Fully pumped microprocessor controlled pressurisation unit

Install, test and commission a fully pumped microprocessor controlled pressurisation unit.

Include the following features unless indicated otherwise in the schedules:

- ~ stove enamelled or powder coated IP55-rated sheet steel casing with hinged lockable front cover
- ~ break cistern with lid and ball valve, all to comply with the Water Supply (Water Fittings) Regulations, especially regarding back siphonage protection
- ~ duty and standby pumps, with direct-on-line (DOL) starters
- ~ gate valves or quarter-turn ball valves on the inlet and outlet of each individual pump and a non-return valve for each individual pump
- ~ expansion vessel(s) (mounted externally to the enclosure) of steel ‘water in bag’ type of correct size to suit system parameters, with an air cushion pressure to match the initial system pressure and clearly visible pressure/temperature rating and test plate
- ~ manual ‘on’ test button for testing of pumps operation
- ~ microprocessor controller, see below for details
- ~ multi-volt transformer to provide all necessary signal voltages
- ~ pressure transducer and lead
- ~ lockshield isolating valve on connection to system
- ~ all necessary interconnecting pipework, valves, etc
- ~ pump suction strainers
- ~ intermediate cooling vessel, if recommended by the manufacturer for the system design flow temperature
- ~ door interlocked mains isolator
- ~ break cistern low water level float switch
- ~ Water Supply (Water Fittings) Regulations compliant quick-fill connection
- ~ water meter on the cold inlet complete with pulsed output for monitoring by the BMS
- ~ test certificates in the Operation and Maintenance manuals

Provide the microprocessor-based controller with the following control functions and with the facility for simple on-site adjustment by site personnel of all control parameters:

- ~ alternating pump starting
- ~ leakage detection alarms
- ~ high and low pressure alarms
- ~ system pressure
- ~ high pressure alarm setting and status
- ~ low pressure alarm setting and status
- ~ break cistern low water level float switch wired to isolate pumps
- ~ pump frequency start alarm and status

Arrange all alarms for manual reset.

Configure the control panel to provide a common alarm via volt-free contacts back to the (plant room motor control centre panel and BMS), via terminal strip, for the following signals:

- ~ high pressure alarm
- ~ low pressure alarm
- ~ break cistern low water level alarm
- ~ pump start frequency alarm

453 Pressurisation unit using cold water system pressure and suitable for fluid category 4 – basic (RPZ valve) with or without on-board pump)

Install, test and commission a permanently connected system pressure control unit which utilises a type BA backflow prevention device.

Use stainless steel or DZR brass/copper alloy fittings.

Include the following features unless indicated otherwise in the schedules:

- ~ stove enamelled or powder coated IP55-rated sheet steel casing with hinged lockable front cover
- ~ control circuit fuse
- ~ pressure regulating valve to prevent over-pressurising the system on fill
- ~ internal mechanical quick-fill valve
- ~ high and low pressure gauges
- ~ high and low pressure switches with common fault BMS output and volt-free contacts for system healthy
- ~ lockshield isolating valve on connection to system
- ~ all necessary interconnecting pipework, valves, etc
- ~ lamps indicating filling and standby modes
- ~ expansion vessel(s) (mounted externally to the enclosure) of steel ‘water in bag’ type of correct size to suit system parameters, with an air cushion pressure to match the initial system pressure and clearly visible pressure/temperature rating and test plate
- ~ intermediate cooling vessel, if recommended by the manufacturer for the system design flow temperature

- integral discharge device to maintain the required air gap for the type BA backflow preventer
- (where specified) integral pump to boost the supply pressure by up to a further 2 bar
- lamps indicating both high and low pressure cut out
- water meter on the cold inlet complete with pulsed output for monitoring by the BMS (can be omitted if the water connection to the unit has a dedicated meter monitored by the BMS)
- test certificates in the Operation and Maintenance manuals

454 Pressurisation unit using cold water system pressure and suitable for fluid category 4 – no RPZ valve

Install, test and commission a permanently connected system pressure control unit which utilises a type BA backflow prevention device.

Use stainless steel or DZR brass/copper alloy fittings.

Include the following features unless indicated otherwise in the schedules:

- stove enamelled or powder coated IP55-rated sheet steel casing with hinged lockable front cover
- control circuit fuse
- multifunction display with scroll buttons
- high and low pressure switches with common fault BMS output and volt-free contacts for system healthy
- lockshield isolating valve on connection to system
- all necessary interconnecting pipework, valves, etc
- expansion vessel(s) (mounted externally to the enclosure) of steel 'water in bag' type of correct size to suit system parameters, with an air cushion pressure to match the initial system pressure and clearly visible pressure/temperature rating and test plate
- intermediate cooling vessel, if recommended by the manufacturer for the system design flow temperature
- integral discharge device to maintain the required air gap for the type BA backflow preventer
- onboard water consumption monitoring with alarm output (can be omitted if the water connection to the unit has a dedicated meter monitored by the BMS)
- system leak and frequent use alerts with volt-free contacts to provide an alarm to the plant room motor control centre panel and BMS
- audible alarm with mute
- test certificates in the Operation and Maintenance manuals

455 Pressurisation unit using cold water system pressure and suitable for fluid category 3

Install, test and commission a permanently connected system pressure control unit which utilises a type CA backflow preventer device.

Use stainless steel or DZR brass/copper alloy fittings.

Include the following features:

- stove enamelled or powder coated IP55-rated sheet steel casing with hinged lockable front cover

- control circuit fuse
- internal mechanical quick-fill valve
- high and low pressure gauges
- high and low pressure switches with common fault BMS output and volt-free contacts for system healthy
- lamps indicating filling and standby modes
- expansion vessel(s) (mounted externally to the enclosure) of steel 'water in bag' type of correct size to suit system parameters, with an air cushion pressure to match the initial system pressure and clearly visible pressure/temperature rating and test plate
- integral discharge device to maintain the required air gap for the type CA backflow preventer
- lamps indicating both high and low pressure cut out
- water meter on the cold inlet complete with pulsed output for monitoring by the BMS
- test certificates in the Operation and Maintenance manuals

456 Pressurisation unit – 'fill and spill' type

Install, test and commission a 'fill and spill' type pressurisation unit.

Install an overflow pipe from the spill tank, through the external wall of the building, discharging in a safe location, eg over an external drainage gulley.

Include the following features unless indicated otherwise in the schedules:

- stove enamelled or powder coated IP55-rated sheet steel casing with hinged lockable front cover
- microprocessor pressure transducer controller
- duty and standby variable speed pumps, having automatic alternation of duty pump and anti-seizure pulsing
- delayed initiation of high and low system pressure cut outs to allow circulator pump pressures to stabilise
- expansion vessel of appropriate capacity, acting as a hydraulic accumulator, to stabilise the measured control pressure and avoid excessive filling and spilling
- hand-off-auto switches for each pump
- pump run and tripped lamps
- pump hours run meters
- door interlocked mains isolator
- low water level sensing in spill tank coupled to volt-free relay
- alarm buzzer, alarm mute and reset buttons / indicators
- digital pressure, fault and parameter indicator
- combined spill and mains water break tank complete with float valve with type AB air gap, overflow connection and low water level protection
- high water level alarm switch mounted in spill tank
- spill valve with strainer and isolating valves

- interconnecting piping to spill tank
- intermediate cooling vessel, if recommended by the manufacturer for the system design flow temperature
- all of the above mounted on a steel base frame
- lockshield isolating valve on connection to system
- all necessary interconnecting pipework, valves, etc
- Water Supply (Water Fittings) Regulations compliant quick-fill connection
- water meter on the cold inlet complete with pulsed output for monitoring by the BMS
- test certificates in the Operation and Maintenance manuals

Provide a single layer ball blanket floating in the spill tank's surface to reduce liquid evaporation and oxygen ingress.

Provide the microprocessor-based controller with the following control functions and with the facility for simple on site adjustment by site personnel of all control parameters:

- data logging function; indicators for pumps run, hand, off and auto
- fascia-mounted keyboard for entering, retrieving data and parameters
- illuminated two-line LCD display for pressure, faults and information including Power On, System Working Pressure, System Status, Low System Pressure, High System Pressure, Pumps Hours Run, Transducer Failed and Service Reminder
- alternating pump starting

Arrange all alarms for manual reset.

Configure the control panel to provide volt-free contacts back to the plant room motor control centre panel and BMS, for each of the points listed above.

460 Cold water boost pump sets

Install, test and commission fully automatic, packaged cold water pressure boost pump set, having the following features (refer to specification section S13 and schedules for project-specific details):

- microprocessor controller, see below for details
- flexible connections on inlet and discharge piping
- a suitable capacity pressure vessel with fabricated steel shell and removable flexible butyl rubber bladder arranged so that water is wholly contained within the bladder and does not make contact with the shell
- the vessel design pressure suitable for the system's test and working pressures
- all components constructed of corrosion-resistant materials of types and combinations suitable for use with potable water systems
- a listing in the WRAS Water Fittings and Materials Directory
- gate valves or quarter-turn ball valves on the inlet and outlet of each individual pump and, where a pressure boost pump set has multiple pumps, a non-return valve for each individual pump
- a pressure gauge to BS EN 837-1 with a 100 mm diameter dial indicating discharge pressure in bar

~ a heavy duty pressure transducer with copper alloy contact parts

~ pump motors complying with section Y92 of this specification

~ a heavy gauge galvanized mild steel base complete with lifting facilities

~ as defined in the particular specification, all interconnecting piping either of copper to BS EN 1057 type R250 half hard, or stainless steel to BS EN 10088-2 grade 1.4301 and BS EN ISO 1127; with wall thickness in accordance with specification section Y10

Provide the microprocessor-based controller with the following control functions and with the facility for simple on-site adjustment by site personnel of all control parameters:

~ stove enamelled or powder coated IP55-rated sheet steel casing with hinged lockable front cover

~ door interlocked main isolator

~ individual motor inverter, direct-on-line (DOL) or star-delta (SD) starters, as appropriate, complete with overload relays

~ control circuit fuses

~ individual pump motor fuses

~ hand-off-auto switches

~ pump duty selector switch

~ pump run and trip lamps

~ panel live lamp

~ interlock and selector switch for low water level from either level switch in each compartment of the CWS cistern

~ volt-free contacts for each pump to indicate ‘pump tripped’ at BMS console

volt-free contacts to indicate boost pump Install, test and commission fully automatic, packaged cold water pressure boost pump set, having the following features (refer to specification section S13 and schedules for project-specific details):

~ a listing in the WRAS Water Fittings and Materials Directory

~ all components constructed of corrosion-resistant materials of types and combinations suitable for use with potable water systems

~ microprocessor controller, see below for details

~ pump motors complying with section Y92 of this specification

~ flexible connections on inlet and discharge piping

~ line-size strainer on the cold water supply to the unit, with isolating valves to enable it to be serviced

~ a suitable capacity ‘’flow-through’’ type pressure vessel with fabricated steel shell and removable flexible butyl rubber bladder arranged so that water is wholly contained within the bladder and does not make contact with the shell. Select the vessel with a design pressure suitable for the system’s test and working pressures

~ gate valves or quarter-turn ball valves on the inlet and outlet of each individual pump and, where a pressure boost pump set has multiple pumps, a non-return valve for each individual pump

- a pressure gauge to BS EN 837-1 with a 100 mm diameter dial indicating discharge pressure in bar
- a heavy-duty pressure transducer with copper alloy contact parts
- a heavy gauge galvanized mild steel base complete with lifting facilities

Include the following features in the packaged control panel:

- stove enamelled or powder coated IP55-rated sheet steel casing with hinged lockable front cover
- multi-volt transformer to provide all necessary signal voltages
- door interlocked main isolator
- individual motor inverter, direct-on-line (DOL) or star-delta (SD) starters, as appropriate, complete with overload relays
- control circuit fuses
- individual pump motor fuses
- panel live lamp
- hand-off-auto switches
- pump run and trip lamps
- pump duty selector switch
- manual ‘on’ test button for testing of pumps operation
- interlock and selector switch for low water level from either level switch in each compartment of the CWS cistern
- volt-free contacts for each pump to indicate ‘pump tripped’ at BMS console
- volt-free contacts to indicate boost pump set status (ie on/off or failed) at BMS console
- volt-free contacts to indicate low water level at BMS console
- volt-free contacts to indicate high-pressure alarm at BMS console
- volt-free contacts to indicate low-pressure alarm at BMS console
- volt-free contacts to indicate pump start frequency alarm at BMS console
- an hours-run meter for each pump giving a visible read-out and capable of being monitored by the BMS
- manual/automatic speed control selector switch, with manual speed control potentiometer (to enable the pumps to be controlled manually and run at slow speed during system start-up by the commissioning engineer or by maintenance operatives)
- soft fill, ie a software-controlled routine whereby the booster set refills the system after a power outage and drain-down without causing a pressure / air surge
- variable speed control of each pump by means of integral static frequency inverters connected via a suitable interface to enable multiple pumps to operate in a cascade system and to alternate their sequence between lead, lag and standby duties
- pressure transducers installed in the discharge of the pumps that relay signals to control the variation of motor speeds

Provide the microprocessor-based controller with the following control functions and with the facility for simple on-site adjustment by site personnel of all control parameters:

- alternating pump starting
- high- and low-pressure alarms
- system pressure
- high-pressure alarm setting and status
- low-pressure alarm setting and status
- pump frequency start alarm and status

Arrange all alarms for manual reset.

470 Motor Drives

471 General

Install test and commission motor drives in accordance with section Y92 of this specification, with starters and controllers in accordance with section Y72.

On glanded pumps fit three-phase motors to BS EN 60034-1 and certified by their supplier to be suitable for the duty specified and for the environmental conditions in which they are required to operate. For duty inside buildings fit motors protected to IP55 and for outside fit motors protected to IP56.

Fit glandless pumps with energy-efficient 230 V single-phase motors.

Where a choice of motor speed is available, provide 1450 rpm motors for fixed speed pumps, and provide 2900 rpm motors for variable speed pumps. Give particular attention to airborne noise if using 2-pole (2900 rpm) motors.

Where belt drives are required fit raw edge, moulded notch V-belt drives. Select pulleys to run the pump at the appropriate speed to suit the duty required with the motor running at its nameplate rated speed. Select, install and adjust belt drives according to the belt manufacturer's instructions.

Wherever a belt driven pump has a variable frequency inverter, select the drive pulley ratio such that the pump is operating at maximum efficiency at its design output with the motor operating at its rated speed.

Design all chilled water pump sets to eliminate the possibility of condensation forming within the pump motors. Supply all motors complete with anti-condensation heaters (by the manufacturers), together with IP55 protection. Ensure that the anti-condensation heater is activated when the pump motor stops and the surrounding air temperature is below 15°C.

Install pumps so that the motor is always above the impeller casing.

472 Variable speed motor drives

Ensure that each variable frequency inverter drive is mounted in an enclosure protected to IP55 where installed inside buildings and to IP56 for external applications.

For every inverter and motor combination, obtain the motor and inverter manufacturer's written certification that the combination will operate safely under the required load conditions and in the plant room environment specified.

Install each inverter, its connections and controls fully in accordance with the inverter manufacturer's written installation instructions.

Where specified provide each pump with integral inverter and controls. For motors with non-integral inverters mount the inverters as specified in section Y72.

Do not commission inverters to operate at a frequency greater than 50 Hz unless both the pump manufacturer and the motor manufacturer confirm it is acceptable to do so. In addition, do not commission inverters to operate at a frequency greater than 60 Hz without written agreement from the Contract Administrator.

500 SPECIAL PUMPS

510 Oil circulating pumps

Use oil circulating pumps of the electrically driven positive displacement screw or gear type, suitable for the viscosity and temperature of the grade of oil to be pumped as specified in the schedules or system specification.

Fit each pump with an integral pressure relief valve and provide isolating valves on the suction and discharge sides of the pump.

520 Sump pumps

Construct sump pumps of materials specified in the pump schedules.

Protect each sump pump with a non-ferrous strainer on the suction side which can be removed for cleaning.

Terminate each sump pump suction connection with a foot valve of diameter not less than one pipe size greater than the connecting pipework.

Ensure that sump pumps operate automatically under level control with provision for an alarm to be sent to the BMS or to a permanently manned location to indicate when normal high water level is exceeded.

530 Submersible pumps

Construct submersible pumps of materials specified in the pump schedules.

Provide bolts, nuts and fastenings generally of stainless steel and ensure electrical cable entry is of watertight construction.

Ensure all materials used are compatible with the fluid in which they are immersed.

540 Semi-rotary hand pumps

Provide semi-rotary hand pumps complete with foot valve and strainer. Fix them securely in position.

For the drainage of boiler houses and plant rooms, provide pumps suitable for hot water with a maximum temperature of 99°C.

For the drainage of oil storage catchpits, provide pumps and shaft seals of the type recommended by the pump manufacturer for this application.

600 INSTALLER’S SUBMITTALS

Provide a copy of the manufacturer’s pump curve for each pump, with the design, capability, installer’s selection and commissioned duties marked on.

Provide pumps type-tested in accordance with the requirements of BS EN ISO 9906, and capable of the specified selection duty. Submit type-test certificates, stating duty, head and motor speed under test, and performance curves, to the Contract Administrator for comment prior to ordering the equipment.

Y20 PUMPS AND PRESSURISATION UNITS

Provide the following information for each pump and each variable frequency inverter and/or motor drive installed, as applicable:

~ dimensioned drawings

~ full technical specification confirming: materials, dimensions, weights, motor rating and absorbed power, current (running and starting), pumps speed at operating point and at capability duty, noise rating and sound power spectrum

~ power wiring and control wiring connection details

~ pump motor operating frequency

~ warranty certificate

Provide the following information for each pressurisation unit, as applicable:

~ dimensioned drawings

~ full technical specification confirming: materials, dimensions, weights, motor rating and absorbed power

~ pressure set-points

~ expansion vessel capacities

~ calculation details for selecting the system pressure parameters and expansion vessel capacities

~ power wiring and control wiring connection details

~ warranty certificate

Provide the following information for each cold water boost pump set, as applicable:

~ dimensioned drawings

~ full technical specification confirming: materials, dimensions, weights, motor rating and absorbed power, current (running and starting), pumps speed at operating point and at capability duty, noise rating and sound power spectrum

~ pressure set-points

~ expansion vessel capacity

~ power wiring and control wiring connection details

~ warranty certificate

END OF SECTION Y20

Y22 PLATE HEAT EXCHANGERS

CONTENTS

Y22 PLATE HEAT EXCHANGERS

100 REFERENCE DOCUMENTS

This specification is written based on legislation, standards and guidance in force in the UK generally, and within England by default. For projects in Scotland, Wales, Northern Ireland, the Channel Islands and the Isle of Man, give appropriate consideration to any locally applicable legislation, standards and guidance that deviates from or is additional to those in force within England. Similarly for projects outside the UK comply with the corresponding national legislation, standards and guidance.

Comply fully with the edition (including amendments, replacements and associated normative references) of each of the following, current at the time of tender.

Where a standard referred to in this section conflicts with a standard referred to in an associated 'engineering system' section (eg S10, T31, V21, etc) of this specification, the standard referred to in the engineering system section prevails.

The Pressure Equipment Regulations (PER)

BS EN 1092	Flanges and their joints – Circular flanges for pipes, valves, fittings and accessories, PN designated.
BS EN 10088-2	Part 2: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes
BS EN 10226	Pipe threads where pressure tight joints are made on the threads.

200 GENERAL

Comply with the requirements of the associated equipment schedules.

Install plate heat exchangers where indicated on the drawings and where otherwise required to provide hydraulic separation between circuits.

Use construction materials and fabrication techniques suitable for the chemical composition of the primary and secondary fluids conveyed, their operating temperatures, their working and test pressures, and such that all components have a minimum operating life of at least 15 years under these conditions.

Ensure that plate heat exchangers can safety withstand the prevailing operating pressure at their point of installation, without permanent deformation of plates or other damage, when the opposing fluid side is open to atmospheric pressure.

Select plate heat exchangers to achieve the heat transfer performance at the circuit temperature and fluid flow conditions detailed elsewhere in this specification or in the equipment schedules.

Determine the number and heat transfer areas of plates within the heat exchangers from the physical properties of the fluids, heat transfer requirements, circuit temperature requirements, fluid flow rates and hydraulic pressure drop limitations. Apply the fouling factors specified for the heat transfer surfaces, or apply an equivalent over-surface area allowance, to ensure that the overall heat transfer requirements are achieved throughout the service life of the plate heat exchangers.

Select plate heat exchangers such that the velocity in the fluid channels is the minimum required to achieve turbulent flow for optimum heat transfer, and self-cleansing of the channels, without causing excessive hydraulic pressure drops within the primary and secondary circuits. Unless indicated otherwise, target a maximum hydraulic pressure drop at full fluid flow rate of 35 kPa for each circuit.

Where plate heat exchangers fall within the scope of the Pressure Equipment Directive (PED), comply with the requirements of the directive and ensure that the units carry a CE mark. Where plate heat exchangers fall outside the scope of the PED, manufactured units in accordance with sound engineering practice. Ensure full traceability on all pressure retaining components.

Install strainers at the inlet connections to each heat exchanger circuit. Follow the manufacturer's recommendations on mesh size, and as a minimum use mesh sizes of 0.8 mm.

Mount heat exchangers on concrete plinth bases with a minimum height of 150 mm. Ensure adequate spatial provisions for inspection, maintenance and replacement of components.

300 PRODUCTS/MATERIALS

310 Gasketed liquid-to-liquid plate heat exchangers

311 General

Use heat exchangers designed on plate technology, and sourced from a supplier with production facilities certified according to ISO 9001 and who undertakes to supply all essential spare parts for at least 15 years from the date of initial supply.

Factory-assemble heat transfer plates between a fixed frame plate and a movable pressure plate, and compress the assembly by tightening tensioning bolts. Fit heat transfer plates with gaskets that seal the interpolate channel and direct the fluids into alternate channels. Suspend the heat transfer plates and the pressure plate from an upper carrying bar and locate within a lower guiding bar, both of which fixed to a support column. Locate connections in the frame plate or, if either or both fluids make more than a single pass within the unit, in the frame plate and pressure plates. Use plastic 'bolt socks' throughout the length of tensioning bolts.

Allow a minimum extension capacity (for additional future load) of 10% by ensuring that the heat exchanger frame can accommodate 10% additional plates, and that this extension covers both the length of the carrying bar and the tensioning bolts.

312 Frames

Do not use a welded-frame assembly. Use a bolted frame to allow field assembly and to permit rigging into place.

Use a frame assembly with a steel roller for ease of movement of the movable pressure plate without additional rigging or handling equipment. Arrange tensioning bolts to permit plate-pack tightening at the fixed frame plate only, and without requiring special tools. Use bolts with rolled threads to reduce galling, and minimum high-width hexagonal nuts to adequately distribute the load, plus ball bearing boxes at all critical closing bolts.

Use frame plates and pressure plates of sufficient thickness for the design pressure and code requirements, without welded reinforcements or stiffeners.

Frame plates and pressure plates may have tilted bolt hole geometry to allow for smaller footprint and installation area and easier maintenance.

Equip frame plates with stud bolts or threaded pipes assembled around the primary and secondary connections.

Use upper and lower carrying bars that are precision manufactured to facilitate easy movement of the plates during assembly or servicing, and with the plate contact area made of stainless steel. Use heat transfer plates having an inherent self-aligning system to accurately locate the plates in the frame assembly, prevent lateral plate movement, and maintain maximum gasket contact under pressure. Use plates with reinforcement on the upper and lower mounting slots to avoid bending hangers on the plates. Ensure that an individual plate can be removed without having to remove any plates in front or behind that particular plate.

Tighten tensioning bolts to compress the plate pack to the correct length within the frame.

Equip frame plates and pressure plates with lifting holes in the upper corners.

Equip heat exchangers with feet mounted on the frame plate and support column.

Mark frame plates and pressure plates, tensioning bolts/nuts and pipe connections with a unique number for full traceability.

Unless otherwise indicated, use these materials for the following components:

~ frame plate and pressure plate, carbon steel

~ carry bar and guide bar, carbon steel support column, carbon steel

~ tensioning bolts, high tensile steel, zinc plated with plastic ’bolt socks’

During manufacturer, clean all carbon steel surfaces thoroughly, prepare for painting, and apply a two-part aliphatic acrylic polyurethane or two-part epoxy paint.

313 Heat transfer plates

Use pressed heat transfer plates with herringbone pattern corrugations to promote maximum turbulence and contact points, and to enable full fluid distribution over the plates, thereby optimizing heat transfer capacity whilst minimizing hydraulic pressure losses. Arrange heat transfer plates to direct the flow of fluid into alternative inter-plate channels in a counter-current flow configuration. Design corrugations to provide support to adjacent plates at evenly distributed support points.

Use heat transfer plates pressed in a single step to ensure uniform thickness and avoid weak spots, and with an indented groove to give accurate seating of the gasket around the edge of the plate and around the porthole areas. Do not use plates with holes for sealing of the gasket.

Select heat transfer plates thickness to allow pressurization of each circuit to a full differential of 1.3 times the design pressure without buckling or deformation of the heat transfer plates.

Wash heat transfer plates after pressing to avoid greasy plates, and mark with a unique number for full traceability.

Select plate material that is suitable for the fluids conveyed, and their operating temperatures and pressures, and unless otherwise indicated, use:

~ stainless steel conforming to BS EN 10088-2 grade 1.4301 (formerly 304S31), for general applications

~ stainless steel conforming to BS EN 10088-2 grade 1.4401 (formerly 316S31), for increased corrosion resistance

~ titanium material for seawater, similar corrosive fluids, or high chloride applications

314 Gaskets

Use one-piece moulded gaskets with relieving grooves to prevent intermixing of fluids and leakage to outside of unit.

Use gaskets with a roof-top cross section, or other similar design feature, to ensure superior sealing performance.

Use gaskets that lock into the groove by a clip-on concept, and do not use gaskets for locking of plates before tightening of tensioning bolts..

Select gasket materials that are suitable for the fluids conveyed, and their operating temperatures and pressures, and unless otherwise indicated, use:

~ EDPM (S) material for water, including potable

- ~ EDPM (P) material for higher temperature water or steam
- ~ Nitrile material for general applications, including oils
- ~ Viton material for steam

Mark all gaskets with:

- ~ a colour code for identification of the gasket material
- ~ manufacturer and tool number
- ~ production year and production quarter

315 Connections

Size primary and secondary connections to ensure that the manufacturer's required fluid flow velocities are achieved at the connection ports. Use flange connections to BS EN 1092 for pipe sizes 65 mm and above, and screwed connections screwed to BS EN 10226 with union joints for pipe sizes up to and including 50 mm.

320 Brazed liquid-to-liquid plate heat exchangers

321 General

Use heat exchangers designed on plate technology, and sourced from a supplier with production facilities certified according to ISO 9001.

Allow a minimum spare capacity (for additional future load) of 10%.

322 Brazed assembly

Use copper brazed fabrication for general use.

Use nickel brazed fabrication for enhanced corrosion resistance.

Use end plates with compact flanges or threaded pipes assembled around the connections.

Mark the completed assembly with a unique number for full traceability.

323 Heat transfer plates

Use pressed heat transfer plates with herringbone pattern corrugations to promote maximum turbulence and contact points, and to enable full fluid distribution over the plates, thereby optimizing heat transfer capacity whilst minimizing hydraulic pressure losses. Arrange heat transfer plates to direct the flow of fluid into alternative inter-plate channels in a counter-current flow configuration.

Use heat transfer plates pressed in a single step to ensure uniform thickness and avoid weak spots.

Select heat transfer plates thickness to allow pressurization of each circuit to a full differential of 1.3 times the design pressure without buckling or deformation of the heat transfer plates.

Wash heat transfer plates after pressing to avoid greasy plates.

Select plate material that is suitable for the fluids conveyed, and their operating temperatures and pressures, and unless otherwise indicated, use:

- ~ stainless steel conforming to BS EN 10088-2 grade 1.4301 (formerly 304S31), for general applications
- ~ stainless steel conforming to BS EN 10088-2 grade 1.4401 (formerly 316S31), for increased corrosion resistance

324 Connections

Size primary and secondary connections to ensure that the manufacturers required fluid flow velocities are achieved at the connection ports. Use flange connections to BS EN 1092 for pipe sizes 65 mm and above, and screwed connections screwed to BS EN 10226 with union joints for pipe sizes up to and including 50 mm.

400 ACCESSORIES

410 Thermal insulation, vapour sealing and drip trays

411 General

Use thermal insulation, vapour sealing and drip tray products provided by the plate heat exchanger manufacturer specifically for their products.

Limit the heat transfer from the insulated assembly to less than 0.03% of the heat transfer capacity of the plate heat exchanger, when calculated using the mean temperatures of combined fluid flows and the ambient temperature of the surrounding space.

For gasketed plate heat exchangers, select insulation box and drip tray dimensions to accommodate the possibility of 10% capacity extension to the heat exchanger.

Comply with the requirements of section Y50 of this Specification.

412 Hot/warm (heating) applications

Use 65 mm mineral wool insulation, supplied as pre-insulated panels clad within 1 mm thick stucco aluminium. Fit panels with stainless steel snap-lock fasteners to enable easy assembly, removal and reassembly of insulation panels.

413 Cold/chilled (cooling) applications

Use 60 mm phenolic foam insulation, with 0.05 mm aluminium foil inside layer and 20 mm nitrile rubber insulation lining the bolt holes and connection port apertures, supplied as pre-insulated panels clad within 1 mm thick stucco aluminium. Vapour seal internal joints in the insulation with self-adhesive glass-reinforced aluminium foil tape before applying the stucco aluminium cladding. Fit panels with stainless steel snap-lock fasteners to enable easy assembly, removal and reassembly of insulation panels.

414 Condensate drip trays

For cold/chilled (cooling) applications, use a drip tray constructed of 0.75 mm galvanized steel sheet with 50 mm nitrile rubber insulation as an external lining. Support plate heat exchangers assemblies on waterproof wooden blocks or high-density plastic blocks. Slope the base of drip trays towards a drain connection with a valve pipework connection to enable any condensate to be drained away easily.

420 Manufacturer’s nameplate labels

Ensure each plate heat exchanger is fitted with the manufacturer’s embossed metal name plate detailing the selection criteria and design performance, including.

- manufacturer’s name
- type of unit
- frame and serial number
- year of manufacture
- fluid group
- inlet/outlet connections

- volume
- design pressure, design temperature
- test pressure

430 Equipment asset reference labels

Fit a traffolyte label locally to each plate heat exchanger with its unique reference number as identified by the record drawings.

500 TESTING

Test each complete plate heat exchanger assembly at the factory in accordance with The Pressure Equipment Regulations pressure vessel code requirements, and issue a certificate for the stated design pressure for both circuits.

Unless otherwise indicated, use test pressures of:

- 1.3 x design pressure (PER category SEP), or
- 1.43 x design pressure (PER category 1 to 4)

Apply the full test pressure on one circuit with the other circuit open to atmosphere, and then repeat in reverse, maintaining the test pressure for 10 minutes per side. Examine all joints, connections and all regions of high stress outside and inside the openings. No leakage or deformation will be accepted.

Issue test certificates for each plate heat exchanger showing:

- serial number
- test specification number
- test pressure
- pressure holding time
- date and signature of the inspector

600 SCHEDULE OF INSTALLER'S SUBMITTALS

Submit the following documentation to the Contract Administrator for comment prior to ordering equipment:

- schedule of plate heat exchangers
- confirmation from the plate heat exchangers manufacturers that the materials of construction and fabrication details are suitable for the intended applications, fluids conveyed, temperatures and pressures
- full technical submission details confirming selection criteria, performance and construction materials for all plate heat exchangers and thermal insulation products
- dimensioned drawings for all plate heat exchangers and associated equipment

Four weeks before handing over the completed installation submit the following documents to the Contract Administrator for comment:

- manufacturer's test certificates
- installation manuals

- maintenance manuals
- record drawings
- part hanging lists
- spare parts lists

END OF SECTION Y22

Y23 STORAGE CALORIFIERS AND CYLINDERS

CONTENTS

Y23 STORAGE CALORIFIERS AND CYLINDERS

100 REFERENCE DOCUMENTS

This specification is written based on legislation, standards and guidance in force in the UK generally, and within England by default. For projects in Scotland, Wales, Northern Ireland, the Channel Islands and the Isle of Man, give appropriate consideration to any locally applicable legislation, standards and guidance that deviates from or is additional to those in force within England. Similarly for projects outside the UK comply with the corresponding national legislation, standards and guidance.

Comply fully with the edition (including amendments, replacements and normative references) of each of the following, current at the time of tender.

Where a standard referred to in this section conflicts with a standard referred to in an associated 'engineering system' section (eg S10, T31, V21, etc.) of this specification, the standard referred to in the engineering system section prevails.

The Building Regulations, Part G

The Building Regulations, Part L

The Water Supply (Water Fittings) Regulations

Second tier documentation associated with the Building Regulations including the applicable Domestic and Non-Domestic Building Services Compliance Guide

BS 417-2	Specification for galvanized low carbon steel cisterns, cistern lids, tanks and cylinders. Metric units.
BS 853-1	Specification for vessels for use in heating systems. Calorifiers and storage vessels for central heating and hot water supply
BS 853-2	Specification for vessels for use in heating systems. Tubular heat exchangers and storage vessels for building and industrial services
BS 1566-1	Copper indirect cylinders for domestic purposes. Open vented copper cylinders. Requirements and test methods
BS 1566-2	Copper indirect cylinders for domestic purposes. Specification for single feed indirect cylinders
BS 3198	Specification for copper hot water storage combination units for domestic purposes
BS 5546	Specification for installation and maintenance of gas-fired water-heating appliances of rated input not exceeding 70 kW net
BS 5615	Specification for insulating jackets for domestic hot water storage cylinders
BS 8580	Water quality. Risk assessments for legionella control. Code of practice
BS 8558	Guide to the design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages – Complementary guidance to BS EN 806
BS EN 806-1	Specifications for installations inside buildings conveying water for human consumption. General
BS EN 806-2	Specifications for installations inside buildings conveying water for human consumption. Design
BS EN 806-3	Specifications for installations inside buildings conveying water for human consumption. Pipe sizing. Simplified method
BS EN 806-4	Specifications for installations inside buildings conveying water for human consumption. Installation

BS EN 806-5	Specifications for installations inside buildings conveying water for human consumption. Operation and maintenance
BS EN 12451	Copper and copper alloys. Seamless round tubes for heat exchangers
BS EN 12897	Water supply. Specification for indirectly heated unvented (closed) storage water heaters
BS EN 60335-2-73	Household and similar electrical appliances. Particular requirements for fixed immersion heaters
BS EN 60730-2-9	Automatic electrical controls for household and similar use. Particular requirements for temperature sensing controls
BSRIA BG 57/2015	Legionnaires' disease. Risk assessment
BSRIA BG 58/2015	Legionnaires' disease. Operation and maintenance logbook
CIBSE TM13	Minimising the risk of Legionnaires' disease
HSE ACoP L8	Legionnaires' disease – The control of Legionella bacteria in water systems
HSE HSG274	Part 2: Legionnaires' disease – The control of legionella bacteria in hot and cold water systems
HTM 04-01	Department of Health, Health Technical Memorandum – Safe water in healthcare premises
WRAS	Water Fittings and Materials Directory
WRAS	Water Regulations Guide

Hoare Lea standard specification sections, in particular: Y10, Y11, Y25, Y50, Y51

200 GENERAL

Select all hot water storage calorifiers and cylinders to meet the performance requirements of this specification and the performance requirements indicated by the equipment schedules, including all connection requirements.

Select all hot water storage calorifiers and cylinders to ensure that the temperature of the water stored within the vessel does not fall below 60ºC.

Check that the heat source for all hot water storage calorifiers and cylinders (including the temperatures, pressures and flow rates) are as specified by the equipment schedules. Where this is not the case notify the Contract Administrator in writing.

Provide thermal insulation and cladding to each hot water storage calorifier and cylinder as defined in clause Y23.350.

Install each hot water storage calorifier or cylinder so that both, its associated pressure gauge, and its thermometer, can readily be observed by personnel standing nearby.

Mount each hot water storage calorifier and cylinder on a concrete plinth base with a minimum height 150 mm unless shown otherwise on the drawings. Ensure adequate spatial provisions for inspection, maintenance and replacement of components.

210 Definitions

The following definitions shall apply to hot water storage calorifiers and cylinders used to construct the works.

Y23 STORAGE CALORIFIERS AND CYLINDERS

211 Indirect cylinder (heated electrically)

A closed cylindrical vessel with domed ends having a separate integral means of heating the contents by annular or coil type electric heating element.

Unvented cylinders are those provided with a water supply directly from a mains cold water service or a boosted cold water system.

Open vented cylinders are those provided with a water supply from a cistern elevated above the level of the cylinder.

212 Calorifier (heated by a fluid)

A closed cylindrical vessel with domed ends, one of which may be removable, the contents of which are heated by a primary fluid in a removable heat exchanger formed from one or more coils or a 'battery' of 'U' tubes.

Unvented calorifiers are those provided with a water supply directly from a mains cold water service or a boosted cold water system.

Open vented calorifiers are those provided with a water supply from a cistern elevated above the level of the calorifier.

213 Combination unit

An indirect hot water storage cylinder or rectangular tank, of double or single feed type, coupled with a cold water storage feed cistern above it, including all interconnecting piping.

300 PRODUCTS AND MATERIALS

Ensure that the construction of every hot water storage calorifier and cylinder is as specified by the equipment schedules.

Manufacture all hot water storage calorifiers and cylinders from one of the following materials:

- ~ copper
- ~ steel (copper lined)
- ~ steel (glass lined)
- ~ stainless steel

Note that where reference is made by the specification and/or equipment schedules to 'steel' calorifiers, this refers to copper-lined steel or glass-lined steel as listed above.

Where reference is made by the specification and/or equipment schedules to 'direct' cylinders, this refers to cylinders provided with an electric immersion heater as their only means of heating. A direct cylinder allowing water from a LTHW system to mix with the domestic hot water system is not acceptable under any circumstances.

Ensure that the size of each heat exchanger is at least that recommended in BS 1566, BS 3198 or BS EN 12897 as applicable.

Ensure that all primary heating bundles are manufactured to BS EN 12451.

Ensure that hot water storage cylinders of capacity up to 2000 litres meet the requirements of the ErP Directive (EU) No 814/2013, and that hot water storage cylinders of capacity up to 500 litres have an ecodesign label appropriate to the system components installed.

310 Storage vessels

311 Unvented

Where the hot water storage volume is 500 litres or less, use a proprietary packaged unit.

Fit to all unvented calorifiers and indirect cylinders the following components each as an integral part of the vessel:

~ a pressure and temperature relief valve

~ a high temperature limit control system

In the event of a failure of the temperature control thermostat of any immersion heater, ensure that the energy input from the immersion heater is automatically cut when the vessel temperature reaches a maximum of 85ºC. Ensure that the high limit control for units with immersion heaters each have a manual reset facility.

Fit a high limit control for units heated using LTHW as the primary fluid, using a two-port shut-off valve on the primary flow to the heat exchanger, which shuts off the energy input to the cylinder when its vessel temperature reaches a maximum of 85ºC. For electrically powered high limit control, arrange the two-port valve to fail closed and therefore be capable of being open only when its power supply is healthy.

Fit the following components to the cold water supply of each unvented calorifier and indirect cylinder:

~ an isolating valve

~ a strainer

~ a pressure reducing valve

~ a double check valve

~ an expansion vessel

~ an expansion relief valve

312 Open vented hot water cylinders and calorifiers

Ensure that the cylinder grade complies with the requirements of BS 1566, table 1, for the metal thickness used to form the cylinder and the associated maximum working head. The maximum head requirements of each grade are:

~ Grade 1 – maximum working head of 25 m

~ Grade 2 – maximum working head of 15 m

~ Grade 3 – maximum working head of 10 m

Ensure that the calorifier complies with BS 853.

Fit to all open vented cylinders and calorifiers a high temperature limit control system as an integral part of the vessel.

In the event of a failure of the temperature control thermostat of any immersion heater, ensure that the energy input from the immersion heater is automatically cut when the vessel temperature reaches a maximum of 90ºC. Ensure that the high limit control for units with immersion heaters each have a manual reset facility.

Fit a high limit control for units heated using LTHW as the primary fluid, using a two-port shut-off valve on the primary flow to the heat exchanger, which shuts off the energy input to the cylinder or calorifier when its vessel temperature reaches a maximum of 90ºC. For electrically powered high limit control, arrange the two-port valve to fail closed and therefore be capable of being open only when its power supply is healthy.

Fit the following components to the cold water supply of each open vented cylinder or calorifier:

- ~ an isolating valve
- ~ a strainer
- ~ a double check valve

313 Combination units

Ensure that all combination units comply with BS 3198 and are WRAS approved.

Use units that are pre insulated by the manufacturer at their factory.

Ensure that all combination units have capacities and fittings as required by the equipment schedules including the following as a minimum:

- ~ single point of connection for the cold water supply, complete with isolating valve
- ~ independent drain cocks for the cylinder and the cold water storage cistern
- ~ expansion pipe connecting the cylinder and cold water storage cistern, including a connection point with isolating valve for the hot water draw off
- ~ screened overflow from the cold water storage cistern
- ~ float valve with Type A air gap in the cold water storage cistern
- ~ all pipework pre insulated

320 Connections

Ensure that every hot water storage calorifier and cylinder is manufactured with all its connections of the required type and size for correct functioning of the unit, and with connections positioned to suit proper co-ordination with site conditions.

Provide the connections indicated by the drawings and/or equipment schedules, including any connections required for sensors and ancillary devices.

Provide each calorifier with a baffle plate on the cold feed inlet to the unit, arranged to disperse the incoming cold water and achieve mixing of the cold with the stored warm water.

Where valves are fitted to relieve temperature or pressure, install relief stream piping from them to discharge to a safe discharge point within the plant room (eg a floor drain), terminating 150 mm above floor drains and, where required, incorporating a tundish.

Where the calorifier shell is manufactured to a design pressure lower than the working pressure of the primary fluid, in addition to a secondary fluid pressure relief valve or safety valve, fit a bursting disc to the shell. Install relief stream piping from the bursting disc to a safe discharge point.

Where a calorifier/cylinder is of the copper-lined steel or glass-lined steel type, fit a vacuum breaker to the shell to prevent the implosion of the lining.

Provide an adequately sized (minimum 100 mm clear internal diameter), accessible clean out access door/port at low level on each calorifier/cylinder/buffer vessel.

330 Immersion heaters

Provide immersion heater(s) where required by the equipment schedules or as specified in section S11 of this specification, fitted by the hot water storage calorifier or cylinder manufacturer as an integral part of the calorifier or cylinder. Ensure that all immersion heaters comply with BS EN 60335-2-73 and are provided with a thermostat to BS EN 60730-2-9.

Provide each immersion heater with an integral thermostat allowing the heater to maintain the water temperature at the pre-set value. Unless specified elsewhere arrange the thermostat temperature setting to be manually adjustable locally to the immersion heater.

Ensure that the rating and number of immersion heaters are as indicated by the equipment schedules.

340 Sacrificial anodes

Provide readily replaceable sacrificial anode(s) in each cylinder/calorifier where required by the equipment schedules.

350 Thermal insulation

Ensure that all hot water storage cylinders and all combination units are pre-insulated by the manufacturer at their factory using 35 mm thick PU-foam having a minimum density of 30 kg/m^3, or alternatively as recommended in BS 1566, BS 3198 or BS EN 12897 as applicable.

Ensure that all hot water calorifiers are insulated in accordance with specification section Y50.

Unless stated otherwise in specification section S11 or by the equipment schedule(s), fit protective cladding to the thermal insulation of hot water storage calorifiers and cylinders, in accordance with specification section Y50.

360 Supports

Mount each hot water storage calorifier or cylinder on a purpose made support comprising either frame, cradle or feet. Ensure that the support is capable of bearing the weight of the calorifier or cylinder when in operation and full of water, and provides a secure and stable fixing for the calorifier or cylinder.

Provide protective isolation material between the support frame/cradle/feet and the calorifier or cylinder shell to prevent electrolytic action between them.

370 Pumps

371 Secondary circulating pumps

Provide the hot water service secondary circulation pump(s) referred to in section S11 of this specification.

Where required by the equipment schedules, provide such secondary circulation pump(s) as part of the calorifier/cylinder package. Select each pump to achieve the duty as indicated by the equipment schedules and in accordance with the requirements of section Y20 of this specification.

Use pump sets of stainless steel or bronze construction, continuously variable-speed centrifugal in-line full-way pattern.

372 Anti-stratification pumps

Provide, for each calorifier/cylinder, an anti-stratification (or top-to-bottom) pump and the means to control the pump with the objective of raising the entire contents to a minimum of 60°C for one continuous hour per day.

Select each pump to achieve the duty required for raising the entire contents to a minimum of 60°C for one continuous hour per day and in accordance with the requirements of specification section Y20.

Connect each such pump to circulate the water within the storage vessel between a region near its top and a region near its base.

Use pump sets of stainless steel or bronze construction, each complete with an isolation valve on the suction and discharge sides of the pump.

Operate each pump via either an adjustable time switch or the automatic control system, for a minimum of one hour per day at a time when the primary heat source is available.

400 TESTING AND COMMISSIONING

Obtain from the manufacturer a certificate of static hydraulic pressure test and a performance test for the supplied equipment. Where required by specification sections A32 or S11, include within the tender for arranging for such tests to be witnessed by the Contract Administrator and include for all the Contract Administrator's associated travel costs.

Make all such static hydraulic pressure tests at 1.5 times the working pressure defined by the equipment schedules or to the test pressure determined by the British Standard to which the equipment is manufactured.

Prior to commissioning any hot water storage calorifier and cylinder and its associated components, clean, flush out and sterilise the water distribution system(s) in accordance with specification section Y25.

Commission each hot water storage calorifier and cylinder in accordance with specification section Y51 and the manufacturer's written instructions.

Check the operation of the temperature controls and safety devices of each hot water storage calorifier and cylinder and, where required to do so, demonstrate them to the Contract Administrator.

END OF SECTION Y23

Y24 TRACE HEATING

CONTENTS

Y24 TRACE HEATING

100 REFERENCE DOCUMENTS

This specification is written based on legislation, standards and guidance in force in the UK generally, and within England by default. For projects in Scotland, Wales, Northern Ireland, the Channel Islands and the Isle of Man, give appropriate consideration to any locally applicable legislation, standards and guidance that deviates from or is additional to those in force within England. Similarly for projects outside the UK comply with the corresponding national legislation, standards and guidance.

Comply fully with the edition (including amendments, replacements and associated normative references)) of each of the following, current at the time of tender.

Where a standard referred to in this section conflicts with a standard referred to in an associated ‘engineering system’ section (eg S10, T31, V21, etc.) of this specification, the standard referred to in the engineering system section prevails.

BS 7671	Requirements for Electrical Installations. IET Wiring Regulations
BS EN 60079-30-1	Explosive atmospheres. Electrical resistance trace heating. General and testing requirements.
BS EN 60079-30-2	Explosive atmospheres. Electrical resistance trace heating. Application guide for design, installation and maintenance
BS EN 62395-1	Electrical resistance trace heating systems for industrial and commercial applications. General and testing requirements
BS EN 62395-2	Electrical resistance trace heating systems for industrial and commercial applications. Applications guide for system design, installation and maintenance
CIBSE TM13	Minimising the risk of Legionnaires’ disease
HSE ACoP L8	Legionnaires’ disease – The control of Legionella bacteria in water systems
HSE HSG274	Part 2: Legionnaires’ disease – The control of legionella bacteria in hot and cold water systems

200 GENERAL

Provide trace heating systems to compensate for heat losses from pipes or vessels, and to ensure that the contents within are held at an acceptable temperature for the system’s function or for frost protection purposes.

Design, supply and install trace heating systems and their associated components in accordance with the trace heating manufacturer's written guidance and instructions.

Determine which method of trace heating, ie tapes, jackets or mats, to employ for each specific application with regards to its particular requirements.

Do not mixed different types of trace heating system, ie tapes, jackets, or mats, on a single circuit unless all components are specifically intended for this purpose.

Ensure that the trace heating methods adopted are suitable to operate with the pipes or vessels, pipework jointing and thermal insulation materials installed.

Ensure that the thermal insulation system is compatible with the trace heating (in terms of thickness, conductivity and material) and that pipework insulation is appropriately oversized to accommodate the trace heating tape. Do not cut pipework insulation or pipework support blocks to accommodate trace heating tapes.

300 PRODUCTS/MATERIALS

Use trace heating tapes of the self-limiting (or self-regulating) type that are capable of being cut to length on site, and are constructed and tested in accordance with BS EN 62395-1.

Use trace heating components of a service category and temperature rating appropriate to the environment in which they are installed.

Use trace heating components suitable for operation on a 230-V, single-phase 50-Hz electrical supply.

Ensure that the insulating sheath covering the metal electrical conductors of every trace heating element is itself enclosed by metallic braiding for the entire length of the element. Ensure that the braiding in turn is covered with suitable electrical insulation material (modified polyolefin electrical insulation) in the form of an overall sheath.

Ensure that the electrical insulation materials used in the construction of the tape are not adversely affected by either:

~ liquids or vapours, contained within the pipe or vessel being trace heated

~ liquids and vapours in the atmosphere surrounding the pipe or vessel concerned

~ the pipework thermal insulation materials and associated items used in its installation

Ensure that all trace heating system components mounted externally have an ingress protection rating of at least IP65.

In areas with explosive atmospheres, select trace heating so that the sheath temperature of the heating element while energized will not exceed the T-rating appropriate to the explosive atmosphere.

Ensure that the thermal insulation materials used to cover the tape and surfaces upon which it is installed, are suitable for temperatures at least 20ºC in excess of the highest temperature normally achievable by the mechanical services system, whether or not the tape is in operation.

400 SYSTEM REQUIREMENTS

410 General

Design and install trace heating systems and their associated components in accordance with BS EN 62395-2 and the trace heating manufacturer's requirements.

Liaise with the thermal insulation installer to ensure compatibility between the insulation material thickness/conductivity and the trace heating systems.

Allocate independent trace heating systems dedicated to each particular mechanical services system (CWS, HWS, oil, LTHW, CHW, etc), and arrange the trace heating elements logically to follow the routes of the pipework, components, and vessels etc of each particular mechanical services system.

Determine the thermal heat output required of each trace heating system to achieve the required objectives at the relevant contents temperature and ambient temperature specified.

Select the number/length of trace heating elements connected to each electrical circuit to suit a maximum circuit rating of 16A per circuit and subject to the maximum circuit lengths determined by the manufacturer. Submit proposals for acceptance by the Contract Administrator.

Connect each trace heating circuit to a dedicated electrical supply.

Ensure that the trace heating system cannot overheat the pipe, its joints or its contents. This is especially important where trace heating is needed for non-metallic pipes (plastic pipes), for metallic pipes with liners or protective plastic coatings, for metallic pipes conveying temperature sensitive fluids, and where EDPM gaskets or O-rings are used within pipework jointing.

420 Hot water service (HWS) – temperature maintenance

Trace heat HWS systems where indicated by the drawings or specification section S11.

Design and install 'temperature maintenance' trace heating systems to maintain the temperature of the contents to 55ºC ± 5ºC irrespective of pipe diameter and ambient temperature.

Ensure HWS 'temperature maintenance' trace heating systems comply with HSE ACoP L8 and HSE HSG274 Part 2.

Install trace heating tapes to at least within 300 mm of every hot water outlet.

430 Freeze protection of mechanical services

Trace heat mechanical services systems where indicated by the drawings or relevant system specification section, or where pipework, vessels or associated components are outside the heated envelope of the building.

For warm/hot services (eg heating, hot water, condenser water, heat rejection, etc), design and install 'freeze protection' trace heating systems to maintain the temperature of the contents to a minimum of 5°C when the external ambient temperature is -15°C and the service is idle (so without the benefit of any other heat input).

For cold services (eg cold water), design and install 'freeze protection' trace heating systems to maintain the temperature of the contents to a minimum of 5°C when the external ambient temperature is -15°C.

For chilled services (eg chilled water), design and install 'freeze protection' trace heating systems to maintain the temperature of the contents to 3°C below the chilled water supply temperature, or as necessary to prevent freezing, when the external ambient temperature is -15°C.

500 CONTROL REQUIREMENTS

Provide energy efficient temperature control by means of line-sensing temperature sensors that measure pipe or vessel surface temperature and, where relevant, an ambient air temperature sensors.

Use controllers with the following functions:

- ~ digital display
- ~ 25-Amp switching rating
- ~ sensor failure identification/alarm
- ~ voltage failure identification/alarm
- ~ low temperature identification/alarm
- ~ selectable failsafe mode (either ON or OFF)
- ~ alarm relays for remote BMS monitoring where BMS monitoring is specified
- ~ adjustable hysteresis and high temperature alarm, for line sensing temperature sensors

Where indicated by the relevant system specification section or BMS points schedule, provide controllers with volt-free contacts for monitoring by the BMS.

600 INSTALLATION AND TESTING

610 General

Ensure that piping systems are complete, pressure tested, cleaned of all abrasive material and (if required by the system section specification), painted prior to the installation of the trace heating elements.

620 Installation

Install all trace heating elements such that the correct installation of thermal insulation materials and its cladding is not prevented.

Install all trace heating tapes in a manner (eg reverse wrap) that does not inhibit removal for maintenance of components in the piping systems (eg non return valves, strainers and control valves, etc).

Where trace heating tapes or cables penetrate the external surface or cladding of thermal insulation, use the manufacturer's proprietary accessory to properly seal every tape or cable to prevent ingress of moisture and (for cold services) to maintain the integrity of the insulation’s vapour barrier.

Avoid jointing the trace heating tapes. Where jointing is essential, carry the tapes outside the thermal insulation to a suitably IP-rated junction box and do not then cover over the junction box with insulation.

For interconnection and terminations, use insulation displacement connectors and gel type end seals.

Connect the braiding of every trace heating element to the earthing point of its power supply.

630 Thermoplastic pipework

For thermoplastic pipework, limit the maximum thermal rating of trace heating tape to 12 W/m.

Wrap and secure aluminium foil around the pipe, then install and secure trace heating tape over the aluminium foil. Ensure that the sensing element of pipework temperature sensors are in direct contact with the pipework surface.

Do not use trace heating tape sheathed in plasticised PVC, due to the potential for pipework damage caused by plasticisers in the sheath affecting the pipework.

640 Testing

Inspect, test and commission each circuit of all trace heating systems in accordance with BS EN 62395-2 and the manufacturer’s written instructions.

Obtain approval from the trace heating manufacturer's authorised representative or agent of:

- ~ the installation of all trace heating elements prior to their enclosure by thermal insulation
- ~ the installation of proprietary weatherproofing accessories where tapes or cables penetrate the external surface or cladding of thermal insulation, after application of insulation/cladding

Provide a certificate of completion for incorporation into the operating and maintenance instruction manual.

Demonstrate the operation of the trace heating system controls.

650 Labelling

Label trace heating equipment in accordance with specification section Y54. Label cables and electrical equipment in accordance with specification section Y82. Ensure that labelling includes a unique description for the trace heating circuit (eg “Trace Heating No. 2, Roof Level, Variable Temperature LTHW”) and the unique electrical circuit reference number.

Fix warning labels to the outside of thermal insulation or its covering to warn that the pipe, vessel or component beneath is electrically trace heated. Ensure that labelling is clear, located so as to be easily visible, and constructed so as to remain legible and in place for the design life of the system. Locate labels at maximum 3 m intervals, immediately either side of service penetrations through walls or floors, at other changes of service direction or orientation, and as otherwise directed by the Contract Administrator.

700 SCHEDULE OF INSTALLER'S SUBMISSIONS

Submit the following to the Contract Administrator for comment:

~ calculations determining the thermal heat output required of each trace heating system to achieve the specified contents temperature at the ambient temperature

~ installation drawings indicating: trace heating circuits, their power ratings and element lengths; pipework surface and ambient air temperature sensors, controller locations, etc

~ technical submissions for all trace heating components

~ schedule of electrical supply requirements; number of circuits and power ratings

~ schedule of BMS interfaces

~ installation method statements

~ operating and maintenance instructions

END OF SECTION Y24

Y25 CLEANING AND CHEMICAL TREATMENT

CONTENTS

Y25 CLEANING AND CHEMICAL TREATMENT

900 DOMESTIC WATER SERVICES

Y25 CLEANING AND CHEMICAL TREATMENT

100 REFERENCE DOCUMENTS

This specification is written based on legislation, standards and guidance in force in the UK generally, and within England by default. For projects in Scotland, Wales, Northern Ireland, the Channel Islands and the Isle of Man, give appropriate consideration to any locally applicable legislation, standards and guidance that deviates from or is additional to those in force within England. Similarly for projects outside the UK comply with the corresponding national legislation, standards and guidance.

Except where explicitly stated otherwise, comply fully with the edition (including amendments, replacements and associated normative references) of each of the following, current at the time of tender.

Where a standard referred to in this section conflicts with a standard referred to in an associated 'engineering system' section (e.g. S10, T31, V21, etc.) of this specification, the standard referred to in the engineering system section prevails.

The Water Supply (Water Fittings) Regulations

The Water Supply (Water Quality) Regulations

The Biocide Products Regulations

BS 7593	Code of practice for the preparation, commissioning and maintenance of domestic central heating and cooling water systems
BS 8551	Provision and management of temporary water supplies and distribution networks (not including provisions for statutory emergencies). Code of practice
BS 8552	Sampling and monitoring of water from building services closed systems. Code of practice
BS 8558	Guide to the design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages. Complementary guidance to BS EN 806
BS 8580-1	Water quality. Risk assessments for Legionella control. Code of practice
BS EN 806-1	Specifications for installations inside buildings conveying water for human consumption. General
BS EN 806-4	Specifications for installations inside buildings conveying water for human consumption. Installation
BS EN 806-5	Specifications for installations inside buildings conveying water for human consumption. Operation and maintenance
BS ISO 5667-24:2016	Water quality. Sampling. Guidance on the auditing of water quality sampling
BSRIA BG 29/2021	Pre-commission cleaning of pipework systems (except as modified by the requirements of this Y25 specification)
BSRIA BG 50/2013	Water treatment for closed heating and cooling systems
CIBSE Code W	Commissioning Code W: Water distribution systems
CIBSE TM13	Minimising the risk of Legionnaires' disease
HSE ACOP L8	Legionnaires' disease. The control of legionella bacteria in water systems. Approved Code of Practice and Guidance
HSE HSG 274	Legionnaires' disease: Technical Guidance. Parts 1, 2 and 3
PD 855468	Guide to the flushing and disinfection of services supplying water for domestic use within buildings and their curtilages

200 GENERAL

210 General

Design, provide and carry out appropriate flushing, chemical cleaning and water treatment procedures, including all necessary equipment. Do so in compliance with the above reference documents to prevent during the Works, and to enable risk control during the lifetime operation of: contamination, scale build-up, corrosion, erosion, and general fouling.

Comply with the principles within BSRIA BG 29/2021 for all closed pipework systems having a water capacity in excess of 200 litres, except as modified by the requirements of this Y25 specification.

For domestic-sized heating and cooling systems within residential dwellings, i.e. those with a water capacity below 200 litres, comply with BS 7593.

Where connections are required between new and existing systems, adopt the procedures in BSRIA BG 29/2021, Section 8, except as modified by the requirements of this Y25 specification.

In all cases, comply with BSRIA BG 29/2021, clause 4.1.2 Organisation and Planning.

220 Cleaning and water treatment specialist.

Within four weeks of appointment, and before carrying out any of the installer’s design responsibilities relating to water systems, appoint a suitably qualified, ISO certified cleaning and water treatment specialist to carry out the following:

- ~ Advise on pipework system design/layouts and methods of water treatment.
- ~ Ensure adequate provision of dirt pockets at the base of risers, full-bore flushing drains and connections, header flanges, commissioning sets, strainers, air vents and dirt separators, flushing loops, etc. for flushing, chemical cleaning and water treatment, including pre-treatment, chemical and physical methods and for system lifetime general maintenance.
- ~ Sample and analyse the incoming mains water service at an early stage to inform the development of the flushing, chemical cleaning and water treatment strategy.
- ~ Sample and analyse the water quality within any existing system to which the Works are to be connected upon completion and advise on any remedial action required before such connection can occur.
- ~ Confirm the volume of each of the pipework systems.
- ~ Confirm all manufacturers/suppliers of chemical treatments to be used, including their detailed chemical content.
- ~ Confirm inhibitor manufacturer’s target range concentration.
- ~ Confirm the concentrations and quantities each of biocide wash, intermediate inhibitor and final inhibitors and biocides.
- ~ Confirm that biocides meet the requirements of the Biocide Products Regulations.
- ~ Confirm the water quality Employer’s Requirement for all water and other fluid systems.
- ~ Produce a programme and (as detailed in clause 230) method statements for carrying out flushing, chemical cleaning and water treatment works.
- ~ Produce risk assessments in accordance with HSE ACOP L8 and associated guidance.
- ~ Obtain approvals from the local water authority for disposal of contaminated water.

- Carry out pre-commissioning checks.
- Carry out water chemical and microbiological sampling throughout the Works, seven days before Practical Completion and at one-month intervals for six months after practical completion.
- Carry out flushing, chemical cleaning and water treatment in accordance with the method statements, the above reference documents and the particular requirements of the building.
- Demonstrate to the Contract Administrator that the flushing, chemical cleaning and water treatment works have been successfully carried out.
- Produce detailed records of the complete flushing, chemical cleaning and water treatment procedure, for inclusion in the O&M manuals.
- Produce written procedures and method statements for ongoing water treatment to comply with the above reference documents.

230 Method statements

Arrange for the cleaning and water treatment specialist to produce a detailed written strategy for flushing, chemical cleaning and water treatment in accordance with the above reference documents, this Y25 specification and the particular requirements of the building. As a minimum in the strategy include a method statement that has been agreed with the Contract Administrator and make any amendments required in the event of non-compliance with the reference documents. Ensure the method statement includes a step-by-step procedure for achieving and demonstrating flushing and cleaning velocities, and includes each of the following requirements:

- dynamic flushing
- degreasing
- biocide wash
- removal of surface oxides
- effluent disposal/final flushing
- passivation
- corrosion inhibitor/biocide dosing
- disinfection of domestic water services and open systems
- the dates on which sampling will take place
- locations from where samples will be taken
- water properties to be analysed and pass/fail criteria
- the person/company who will carry out the analysis
- the need for duplicate sampling (such as separate samples being taken by each party).

240 Mains water

Provide a dedicated mains water supply, where necessary, for system flushing, of adequate size and pressure, to ensure that the minimum flushing velocities/flow rates can be achieved.

250 Pipework distribution

251 Regulating valves

Ensure that all regulating valves are sized in accordance with CIBSE Commissioning Code W such that at the design flow rate the valve is not less than 25% open.

During the flushing and cleaning procedure bypass low flow, high resistance regulating valves, if necessary, to ensure that the minimum flushing velocities/flow rates are achieved.

252 Control valves

Ensure that automatic control valves do not hinder the cleaning and flushing process by arranging that their control function(s) are temporarily overridden to promote full flow through the device during flushing.

253 Dead legs and dirt pockets

Ensure that all pipework systems are designed to eliminate dead legs of length exceeding three internal pipework diameters. In the situations where dead legs are unavoidable such as dirt pockets, incorporate suitably sized drain valves to facilitate draining and flushing.

Loop all dead legs to allow effective circulation during the cleaning process and in the permanent installation. Size the loop at full bore up to 50 mm diameter and a minimum of either 50 mm diameter or 50% full bore (whichever is the greater) above 50 mm diameter. Install a lock shield valve in the loop to allow full flow for flushing and a pressure independent control valve set to establish a trickle flow at all other times.

Where the loop is for a future tenant connection extension, or similar with a particular flow requirement, install a commissioning set in the loop to simulate the pressure loss of the future tenant equipment and a pressure independent control valve set to establish a trickle flow at all other times.

254 Strainers

Ensure that all strainers have a basket capable of withstanding the maximum pump head without distortion. Provide pressure test points across all strainers so that the pressure drop can be monitored. Provide drain valves on the flanges and/or end caps of all Y-pattern strainers larger than DN50 to facilitate local draining of the body and local pipework prior to basket removal, and to allow back-flushing of the strainer. Ensure that the mesh size of the basket is selected with regard to the particular application and with reference to the manufacturer’s recommendations. Provide additional strainer baskets of the mesh gauges needed to suit flushing and cleaning. Inspect the condition of, and clean, all strainer baskets at each stage of flushing and cleaning.

255 Test points

Ensure all test points are located at the side of pipework systems, not at the top or bottom where they can become air locked or act as dirt pockets.

256 Plant and component isolation

Ensure that all systems are designed to enable the isolation and bypass of all sensitive plant and equipment such as boilers, chillers, fan coil units, radiators, other terminal units, expansion units, control valves, etc. during the course of the flushing and cleaning operation.

Provide fixed full-bore bypasses, complete with associated isolating valves, as close to the plant as possible. Where significant length of ferrous pipe remains between an isolating valve and the plant item being isolated, provide a removable spade in the terminating flange to the plant item or provide means of temporary capping for alternative types of connection.

Only carry out flushing or cleaning of sensitive plant items and components with the approval of the cleaning/water treatment specialist and the plant or component manufacturer.

257 Pumps

Agree the use of system pumps for dynamic flushing with the Contract Administrator via the specialist's method statement. Provide additional suitable pumps in the event that all cleaning and flushing velocities are not able to be demonstrated with either the available mains water pressure or using the system pumps, or if approval to use the system pumps is withheld for whatever reason.

Where system pumps are to be used, replace all pump seals on completion of the cleaning process.

258 Drainage

Ensure that there are adequate drain points, of either full-bore capacity or of sufficient dimension to achieve the required flushing velocity and to provide drainage, within close proximity to gullies that can be used for draining and flushing. Obtain approvals from the local water authority for disposal of contaminated water.

259 Pipework visual inspection

Specially prepare easily demountable sections of pipework, complete with isolation valves, on each system to allow visual inspection of the internal surfaces after chemical cleaning. Agree locations with the Contract Administrator.

260 Chemical treatment

Employ a suitably qualified water treatment specialist to carry out the following work.

Assess water treatment requirements for cleaning and chemical treatment of the systems, provide all necessary components and consumables, and undertake appropriate tests. Add to all non-potable systems all necessary water treatment chemicals to inhibit the growth of microbiological organisms, limit the build-up of solids and scale and prevent corrosion.

Use only established methods of chemical treatment that have a proven track record of successful performance over a minimum period of 5 years under conditions comparable to those in the applicable systems within the Works. Refer any alternative or innovate technologies to the Contract Administrator for consideration.

Ensure that the chemicals proposed are entirely compatible with all material and components present in the system. Provide written evidence from all suppliers confirming acceptance.

Prior to the application of the water treatment chemicals to the pipework system and the system being finally filled, set to work and commissioned, undertake a thorough pre-commissioning clean.

Add no water treatment chemicals to the system until the water treatment specialist provides the Contract Administrator with a certificate detailing the pre-commissioning cleaning actions undertaken, and the areas affected once this work has been undertaken. Do not drain the system once the water treatment chemicals are added. Should draining of the system be necessary for any reason completely re-dose the system.

Use only the minimum amount of chemicals to meet the manufacturer's recommended concentration levels. Handle chemicals in accordance with the requirements of the HSE. Obtain the local water authority's approval before discharging any chemicals to drain.

Provide for maintenance purposes sufficient quantities of both corrosion/scale and biological growth inhibitor to completely re-dose the system. Provide these chemicals in fully enclosed containers constructed to the manufacturer's recommendations, adequately labelled and stored safely in the plant room. Provide a pair of safety gloves and goggles for the administering of the chemicals. Provide full instruction on the dosing procedure and fix them adjacent to the dosing pot in a framed melamine poster. Provide an eye irrigation kit, wall-mounted adjacent to the dosing pot. Provide all chemicals in containers that are suitably-sized for easy and safe handling.

Y25 CLEANING AND CHEMICAL TREATMENT

270 Corrosion monitoring equipment

Where scheduled and/or indicated by the drawings, supply and install corrosion monitoring devices complete with pipework probe and corrosion coupon of identical metal to that of the pipework system in which they are installed. Provide devices that are either mains or battery powered complete with on-board processing and algorithms to facilitate corrosion and temperature measuring and logging. Incorporate warning function by LED and volt-free contact to transmit to BMS, LAN or cloud-based readout for remote monitoring as appropriate.

280 Limestone scale prevention equipment

Where scheduled and/or indicated in the drawings, provide a limestone scale prevention unit based on the controlled release of zinc into the water stream, incorporating a powered electrolytic anode with controller, pulse output water meter and filter.

Where possible install the anode in the rising main before any cold water storage cistern. If space is limited, and with the Contract Administrator’s agreement, install the anode downstream of the storage cistern. For direct feed systems, install the unit in the pipework feeding the hot and cold outlets, with the anode no less than 3m before the water heater. Select and size the anode based on pipework size and flow demand with the pulse output water meter connected to the controller to ensure correct zinc treatment dosing. If required install a water filter, particularly if the anode system is to be installed in an area where construction is taking place.

Ensure that the system is WRAS approved and that the system is commissioned by the manufacturer.

300 SCOPE OF WORKS

310 General

The following systems are included in the scope of this specification:

- ~ low temperature hot water (LTHW)
- ~ chilled water cooling (CHW)
- ~ condenser water (closed circuit)
- ~ cooling tower make-up water
- ~ domestic cold water
- ~ domestic hot water
- ~ rainwater harvesting
- ~ irrigation water system (fluid category 5 break cistern)

Carry out flushing, chemical cleaning and water treatment for closed recirculation systems (e.g. LTHW, CHW, closed circuit condenser water) in accordance with BSRIA BG 29/2021 (as modified by the requirements of this Y25 specification), BSRIA BG 50/2013, HSE ACOP L8, CIBSE TM13, The Water Supply (Water Fittings) Regulations and this specification.

Carry out flushing, chemical cleaning and water treatment for domestic water services (e.g. domestic cold, domestic hot, cooling tower make-up, rainwater harvesting, irrigation water) in accordance with BS 8558, BS EN 806-4, HSE ACOP L8, CIBSE TM13, The Water Supply (Water Fittings) Regulations and this specification. Take account of the pipework system manufacturers’ recommendations on disinfection.

320 Open evaporative cooling systems, showers, spray taps and all hot and cold water systems

Engage a competent person with the necessary understanding of the particular systems and of the ecology of legionella to carry out a detailed risk assessment on all new or existing systems that form part of the Works.

If a risk of exposure to water droplets and aerosol is identified, control that risk in accordance with HSE ACOP L8, associated guidance and CIBSE TM13.

Develop a written scheme for controlling risk. One month before contract programmed Practical Completion present the scheme to the Contract Administrator and Employer for approval. Ensure the scheme is fully capable of being implemented and properly managed by the building owner/occupier, and includes the following:

- ~ an up-to-date plan showing the layout of the plant or system, including any parts temporarily out of use (a schematic plan would suffice)
- ~ a description of the correct and safe operation of the system
- ~ the precautions to be taken
- ~ checks to be carried out to ensure efficacy of the scheme and the frequency of such checks
- ~ remedial action to be taken in the event that the scheme is shown not to be effective

Control the risk from exposure by means that include:

- ~ controlling the risk of water spray
- ~ avoidance of water temperatures and conditions that favour the proliferation of legionella bacteria and other micro-organisms
- ~ avoidance of water stagnation
- ~ avoidance of the use of materials that harbour bacteria and other micro-organisms, or provide nutrients for microbial growth
- ~ maintenance of the cleanliness of the system and the water in it
- ~ use of water treatment techniques
- ~ action to ensure the correct and safe operation and maintenance of the water system

Provide details of how to use and carry out the various control measures and water treatment regimes including:

- ~ the physical treatment programme – e.g. the use of temperature control
- ~ the chemical treatment programme, including a description of the manufacturer’s data on effectiveness, the concentrations and the contact time required
- ~ health and safety information for storage, handling, use and disposal of chemicals
- ~ system control parameters (together with allowable tolerances), physical, chemical and biological parameters, together with measurement methods and sampling locations, test frequencies and procedures for maintaining consistency
- ~ remedial measures to be taken in case the control limits are exceeded, including lines of communication
- ~ cleaning and disinfection procedures

Include a description of the correct operation of the system plant including:

- ~ commissioning and re-commissioning procedures
- ~ shutdown procedures
- ~ checks of warning systems and diagnostic systems in case of system malfunctions
- ~ maintenance requirements and frequencies
- ~ operating cycles – including when the system plant is in use or idle

To enable the building owner/occupier to monitor the condition and performance of the system, include in the scheme clear instructions for:

- ~ checking the performance of the system and its component parts
- ~ inspecting the accessible parts of the system for damage and signs of contamination
- ~ monitoring to ensure that the treatment regime continues to control to the required standard.

400 CHEMICAL AND MICROBIOLOGICAL ANALYSIS

Arrange for all tests to be undertaken at an independent UKAS accredited test laboratory with specialist experience of the systems from which the water is sampled. Issue a report and all the test results to the Contract Administrator, indicating any non-compliances and contaminants likely to have a detrimental effect on water systems.

At an early stage of the project sample and analyse the incoming water supplies, to inform the development of the flushing, chemical cleaning and water treatment strategy. Include a microbiological analysis of the water, including, as a minimum, readings for TVC (total viable count) at 37ºC at 48 hours, TVC at 22ºC at 72 hours, iron bacteria, identifying bacteria pseudomonads, sulphate-reducing bacteria and nitrate-oxidising bacteria, plus any criteria that do not comply with the EU Drinking Water Standards and Water Supply (Water Quality) Regulations.

Repeat the chemical and microbiological analysis of the incoming water and system water one week before any pressure testing (and again one week before flushing if any of the systems have been filled for more than one week).

For each system, or hydraulically separated sub-system therein, select numbers and locations of sample points and carry out sampling at frequencies in accordance with BSRIA BG 29/2021, Appendix A, Table 8 and Table 9.

Sample, analyse and report results of chemical and microbiological water samples from each system for record purposes during both flushing stages. For steel systems carry out a soluble iron test immediately after completion of the dynamic flush.

Carry out distributed random sampling from each closed system and any non-domestic open system following the introduction of corrosion inhibitors and biocide dosing. Take water from representative system extremities and low points. At an agreed position in each system take two samples simultaneously for record purposes, one to be kept by the Contract Administrator and one for testing by the specialist. Ensure the test samples include, as a minimum:

Chemical analysis

- ~ sample number
- ~ sample point
- ~ system

- colour
- clarity
- odour
- solids-visual
- pH at 20ºC
- electrical conductivity at 20ºC
- total dissolved solids at 105ºC
- suspended solids
- ammonical nitrogen as N
- nitrate as N
- nitrite as $NaNO_2$
- total alkalinity as $CaCO_3$
- alkalinity, bicarbonate, as $CaCO_3$
- alkalinity, hydroxide, as $CaCO_3$
- hardness, total, as $CaCO_3$
- chloride
- sulphate
- soluble iron
- total iron
- soluble copper
- total copper
- soluble zinc
- total zinc
- molybdate or chemical inhibitor levels

Microbiological analysis

- TVC at 37ºC/24 hours
- TVC at 22ºC/72 hours
- microfungi
- coliform bacteria including E.coli
- pseudomonads species at 30ºC including pseudomonads aeruginosa
- flavobacterium
- bacillus
- nitrate / nitrite-reducing bacteria
- sulphate-reducing bacteria

~ nitrate-oxidising bacteria

Repeat this test within seven days before practical completion to demonstrate compliance and provide results to the Contract Administrator.

500 FILLING AND FLUSHING

510 General

Check the contents of all strainers for potential microbiological activity on a regular basis during these procedures. Analyse any solid contaminants to check whether they have a microbiological content.

If there are any potential detrimental contaminants, provide for comment a detailed method statement for determining the most appropriate method of water treatment.

Carry out all necessary corrective water treatment remedial works to the satisfaction of the Contract Administrator, to provide at Practical Completion, systems that are not conducive to microbiological growth.

Re-visit site each month for six months after Practical Completion to carry out full microbiological testing as detailed above, and any necessary corrective measures to ensure the procedures continue to control contamination, scale build-up, corrosion, erosion, general fouling, and biological fouling; and that the system continues to operate safely.

520 Filling and flushing - dynamic

Carry out all filling, flushing and cleaning of each closed system and any non-domestic open system in accordance with BSRIA BG 29/2021.

Do not commence filling unless the means of maintaining positive pressurisation within the system has been commissioned and is fully operational.

During filling, flushing and cleaning, maintain a positive pressure (relative to atmosphere) at all times within all of the pipework system to avoid creating unnecessary levels of dissolved oxygen in the water.

Minimise water consumption, without compromising the efficacy of the flushing process, by adopting closed-loop recirculation techniques in conjunction with temporary high-flow side-stream filtration devices.

Assemble each pipework system from pipework and ancillaries that have been stored in a clean condition. Form joints to leave a clean bore, check for internal contaminants and cap pipework open ends as the Works proceed.

Prior to commencing filling and/or flushing of the pipework systems, carry out a thorough inspection of the system to ensure that the system is complete and watertight.

Programme the Works to ensure that, once filled, the system clean (dynamic flushing) commences within 48 hours, to minimise the risk of biofilm development. If the system is to be left for more than 48 hours before the commencement of dynamic flushing, re-fill with biocide-dosed water (and antifreeze chemical if external ambient temperatures are likely to drop below 2ºC).

Ensure that all equipment that is sensitive to sediment remains valved off and bypassed throughout the flushing procedure.

During flushing, temporarily replace sensitive components such as control valves with purpose-made spool pieces where those components are suspectable to damage from debris or impose a high resistance to the flushing path.

Inject mains cold water into the pipework system via a temporary connection from the mains or via a flushing tank and temporary high-pressure pump. Employ suitable back-flow prevention devices between the incoming main and the system fill point.

Leave the system charged for 48 hours to soften any sediment and then drain down and clean out all dirt pockets and strainers. Refill and drain the system at least two more times checking, dirt pockets and strainers each time.

Carry out dynamic flushing at the velocities identified in Table 7 of BSRIA BG 29/2021 or design velocity plus 10%, whichever is the greater. Where it is not possible to achieve these velocities, ie large bore pipework, employ alternative cleaning methods to the water treatment specialist's recommendations and the Contract Administrator's approval.

Commence the flushing of horizontal mains to each floor at the top floor and work down through the building.

Take flow measurements at each floor branch commissioning station and any other commissioning station and provide a record of proof that the required flushing velocity was achieved. Record the values obtained and offer for demonstration to the Contract Administrator.

600 FINAL FLUSHING AND PASSIVATION

610 Final flushing

Remove all chemicals by clean water rinsing and flushing to achieve a neutral pH value of approximately seven. Achieve this by a dynamic flush of the system, in accordance with BSRIA BG 29/2021, taking particular care to ensure that there are no dead legs.

Forward and backward flush all plant, chillers, boilers, fan coils, radiators, etc.

620 Overall benchmark of success of system cleaning and flushing

At all stages of the cleaning and treatment process for closed and non-domestic open systems achieve the requirements set out in BSRIA BG 29/2021, Section 3, except where specifically varied from in this specification. At each stage inform the Contract Administrator of the times of demonstration of completion of the process so as to allow witnessing, and certify the conditions achieved at each stage. Advise the Contract Administrator at the earliest opportunity of any indication from test results that water quality at Practical Completion may not be acceptable.

Achieve the following requirements from BSRIA BG 29/2021 with results obtained from laboratory analysis for each system or hydraulically separated sub-system therein.

- ~ The criteria for physical and chemical parameters, identified in Table 4 and agreed in the sampling and analysis plan, at seven days after completion of pre-commission cleaning. The cleaning specialist is responsible for achieving compliant values, and non-compliant values will not be acceptable.
- ~ Regular monitoring and maintenance of water quality through to Practical Completion, at least every two weeks up to Practical Completion with pass criteria as defined in Table 4, and as described in the sampling and analysis plan.
- ~ The criteria in Table 5 at Practical Completion.

Prior to connecting new system(s) to an existing system(s), achieve the following requirements from BSRIA BG 29/2021 with results obtained from laboratory analysis for the new system(s).

- ~ The criteria for physical and chemical parameters, identified in Table 4 and agreed in the sampling and analysis plan, at seven days after completion of pre-commission cleaning.

The cleaning specialist is responsible for achieving compliant values, and non-compliant values will not be acceptable.

~ The criteria in Table 5 at Practical Completion.

630 Passivation

Carry out passivation immediately after the final flushing in order to render the active metal surfaces passive. Achieve this by introducing a passivating agent, either as a separate chemical or as part of water treatment corrosion inhibitor chemicals.

700 CHEMICAL CLEANING

710 General

Carry out a soluble iron test to ensure that the concentration of the system does not exceed 3 mg/l. Close all drain cocks and remove, clean and replace all strainers. Commence chemical cleaning within 24 hours of the completion of the dynamic flushing.

If it is thought that chemical treatment of any part of the plant would prove detrimental, even though the cleaner is a neutral and non-aggressive formulation, valve these off and exclude them from the entire cleaning procedure.

720 Degreasing

Degrease the internal surface of the pipework to ensure that subsequent chemical cleaning operations are successful. Use a mild alkali formulation such as caustic solution or a detergent, or alternatively an organic solvent. Arrange for the specialist to provide a detailed method statement confirming the preferred product and procedure.

730 Biocide wash

Where systems have not been filled with biocide treated water during pressure testing, subject them to a biocide wash as part of the chemical cleaning process in order to control bacteria and biofilms which may become established inside pipework during the installation process.

740 Removal of surface oxides

Do not use inhibited acid cleaning for the removal of surface oxides. Use a formulated product such as polymer cleaners (dispersants), chelants (complexing agents) or neutral pH cleaners.

Provide a detailed method statement confirming the preferred product and procedure.

Carry out a pressure test of the system after cleaning as the scavenging effect of some cleaning may remove scale or other heavy deposits.

750 Visual inspection

Demonstrate the condition of the internal pipework surfaces to the Contract Administrator by removal of demountable sections of pipework on each system as detailed in this specification.

800 CORROSION INHIBITOR/BIOCIDE DOSING

On completion of the foregoing actions, dose the system with a suitable corrosion/scale inhibitor and biocide dosing. Determine the exact type and concentration following the water analysis described previously.

Give consideration to the use of molybdate-based inhibitor in preference to nitrate-based inhibitors in order to mitigate the risk of the formation of biofilms within sealed systems.

For systems that include copper and other metals also include appropriate inhibitors.

900 DOMESTIC WATER SERVICES

Do not charge, even for pressure testing, any water system, until immediately prior to it being brought into regular use. If a system is charged, for any reason, more than seven days before regular use, do not drain it down. After the disinfection process charge the system and keep it charged.

For all systems, hot or cold, including calorifiers, water heaters, etc. in which all outlets are not in regular use, i.e. daily, thoroughly flush at a minimum frequency of once per week by opening all taps/valves in sequence working away from the source to progressively draw the fresh water through the system. This applies to premises temporarily taken out of use or the period between commissioning and regular use.

Use the disinfectant chemical chlorine dioxide to carry out disinfection of the entire domestic hot and cold water services (including supplementary systems detailed above) throughout the building, in accordance with BS 8558, BS EN 806-4, PD 855468 and to the satisfaction of the employer's microbiologist (if appointed) and Health Care Premises microbiologist (if appointed) and the local water authority's representative. Carry out tests sufficient to demonstrate compliance with the microbiologist's and authority's requirements and forward the supervised sampling and bacteriological and chemical results of such tests to the Contract Administrator.

Obtain written confirmation from the respective product manufacturers that all plastic pipework and other products containing plastics (e.g. 'O' rings) that are likely to come into contact with the chemicals that may be added to the system during installation, or as part of an ongoing water treatment maintenance regime, are suitable for such use. Provide copies of confirmation to the Contract Administrator prior to installation, and include copies in the O&M Manual.

Prior to carrying out any system disinfection verify and record the quality of the chemicals to be used by means of appropriate tests. Reject and do not use any sub-standard chemical.

Repeat the disinfection until a satisfactory bacteriological and chemical level is achieved. It is permissible to employ the local water authority to carry out the disinfection of the systems.

Send copies of the bacteriological analysis results, carried out by an accredited laboratory, certifying the water to be suitable for consumption and fitness for purpose to the Contract Administrator for record purposes, and include them in the commissioning report.

END OF SECTION Y25

Y50 PAINTING AND THERMAL INSULATION

CONTENTS

Ensure that the termination of ductwork insulation and cladding adjacent to uninsulated ductwork or equipment is capped with cladding.

Y50 PAINTING AND THERMAL INSULATION

100 PERFORMANCE OBJECTIVES

110 General

The objectives of this specification are, for the building engineering services systems referred to herein:

- ~ To prevent burn injury to personnel caused by contact with the hot or very cold surfaces of such systems.
- ~ To reduce to acceptable levels for such systems:
  - ~ the deterioration of their external metal surfaces by corrosion
  - ~ their indirect release of atmospheric pollutants caused by the combustion of fossil fuels, by heat gain from, or heat loss to, their surroundings
  - ~ their wastage of energy by heat gain from, or heat loss to, their surroundings
  - ~ the risk of the freezing of water contained in them
  - ~ the risk of condensation on their external surfaces
- ~ To improve the appearance of such systems by painting or covering them where they are exposed to view by building occupants or the general public, (i.e. not where concealed from view by being in ceiling voids, services ducts – including walkway ducts, trenches, etc)
- ~ To protect insulation from mechanical damage in all situations where it is vulnerable such as plant rooms.
- ~ To provide protection from adverse operating conditions, the elements and from attack by wildlife for exposed/external services.
- ~ To comply with statutory maximum heat loss/gain requirements where these apply.
- ~ To achieve the BREEAM credit for MAT 04 Insulation.
- ~ To only use insulation materials whose global warming potential is less than 5.

Do not use this specification for the thermal insulation of pipework or ductwork directly buried in the ground or in floor screeds.

As far as energy wastage and indirect atmospheric pollution from combustion of fossil fuels is concerned, the thicknesses of pipeline thermal insulation given in this specification are generally based upon compliance with maximum heat loss/gain defined by Part L of The Building Regulations, the Non-domestic Building Services Compliance Guide and thicknesses defined in BS 5422 and the TIMSA Guidance for Achieving Compliance with the Building Regulations. Where some other specification is applicable comply with that other specification in all respects where instructed, instead of the rest of this specification section Y50.

Where insulated support blocks used are a less effective insulator than the main insulation sections re-calculate the required thicknesses to ensure that the overall installation heat loss/gain meets the required W/m maxima.

Where segmental insulation is used ensure that all section faces mate closely together when installed.

200 REFERENCE DOCUMENTS

This specification is written based on legislation, standards and guidance in force in the UK generally, and within England by default. For projects in Scotland, Wales, Northern Ireland, the Channel Islands and the Isle of Man, give appropriate consideration to any locally applicable legislation, standards and guidance that deviates from or is additional to those in force within England. Similarly for projects outside the UK comply with the corresponding national legislation, standards and guidance.

Comply fully with the edition (including amendments and normative references) of each of the following, current at the time of tender:

Where a standard referred to in this section conflicts with a standard referred to in an associated ‘engineering system’ section (e.g. S10, T31, T61, etc) of this specification, the standard referred to in the engineering system section prevails.

The Control of Asbestos Regulations

The Control of Substances Hazardous to Health Regulations

The Building Regulations, Approved Documents and associated second tier documentation including both the Domestic Building Services Compliance Guide and the Non-Domestic Building Services Compliance Guide as applicable

The Water Supply (Water Fittings) Regulations

BS 3533	Glossary of thermal insulation terms
BS 3958-2	Thermal insulating materials. Calcium silicate preformed insulation
BS 3958-3	Thermal insulating materials. Metal mesh faced man-made mineral fibre mattresses
BS 3958-4	Thermal insulating materials. Bonded preformed man-made mineral fibre pipe sections
BS 3958-5	Thermal insulating materials. Specification for bonded man-made mineral fibre slabs
BS 5422	Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range -40°C to +700°C
BS 5970	Thermal insulation of pipework, ductwork, associated equipment and other industrial installations in the temperature range of -100°C to +870°C. Code of practice
BS EN 10085	Nitriding steel. Technical delivery conditions
BS EN 10095	Heat resisting steels and nickel alloys
BS EN 10223-2	Steel wire and wire products for fencing and netting. Hexagonal steel wire netting for agricultural, insulation and fencing purposes
BS EN 10250-4	Open steel die forgings for general engineering purposes. Stainless steels
BS EN 10346	Continuously hot-dip coated steel flat products for cold forming. Technical delivery conditions
BS EN 12664	Thermal performance of building materials and products. Determination of thermal resistance by means of guarded hot plate and heat flow meter methods. Dry and moist products of medium and low thermal resistance
BS EN 12667	Thermal performance of building materials and products. Determination of thermal resistance by means of guarded hot plate and heat flow meter methods. Products of high and medium thermal resistance
BS EN 12939	Thermal performance of building materials and products. Determination of thermal resistance by means of guarded hot plate and heat flow meter methods. Thick products of high and medium thermal resistance

BS EN 13166	Thermal insulation products for buildings. Factory made products of phenolic foam (PF). Specification
BS EN 13467	Thermal insulating products for building equipment and industrial installations. Determination of dimensions, squareness and linearity of preformed pipe insulation
BS EN 13468	Thermal insulating products for building equipment and industrial installations. Determination of trace quantities of water soluble chloride, fluoride, silicate, sodium ions and pH
BS EN 13469	Thermal insulating products for building equipment and industrial installations. Determination of water vapour transmission properties of preformed pipe insulation
BS EN 13470	Thermal insulating products for building equipment and industrial installations. Determination of the apparent density of preformed pipe insulation
BS EN 13471	Thermal insulating products for building equipment and industrial installations. Determination of the coefficient of thermal expansion
BS EN 13472	Thermal insulating products for building equipment and industrial installations. Determination of short term water absorption by partial immersion of preformed pipe insulation
BS EN 13501-1	Fire classification of construction products and building elements. Classification using test data from reaction to fire tests
BS EN 14303	Thermal insulation products for building equipment and industrial installations. Factory made mineral wool products (MW). Specification
BS EN 14304	Thermal insulation products for building equipment and industrial installations. Factory made flexible elastomeric foam (FEF) products. Specification
BS EN 14306	Thermal insulation products for building equipment and industrial installations. Factory made calcium silicate (CS) products. Specification
BS EN 14314	Thermal insulation products for building equipment and industrial installations. Factory made phenolic foam (PF) products. Specification
BS EN ISO 683-1	Heat-treatable steels, alloy steels and free-cutting steels. Non-alloy steels for quenching and tempering
BS EN ISO 683-2	Heat-treatable steels, alloy steels and free-cutting steels. Alloy steels for quenching and tempering
BS EN ISO 683-3	Heat-treatable steels, alloy steels and free-cutting steels. Case-hardening steels
BS EN ISO 683-4	Heat-treatable steels, alloy steels and free-cutting steels. Free-cutting steels
BS EN ISO 8990	Thermal insulation. Determination of steady-state thermal transmission properties. Calibrated and guarded hot box
BS EN ISO 12944-5	Paints and varnishes. Corrosion protection of steel structures by protective paint systems. Protective paint systems
ASFP	Fire resisting ductwork (Blue book). European version
BESA TR/70	External Corrosion Protection And Insulation Of Building Services Pipework
WRAS	Water Regulations Guide

Y50 PAINTING AND THERMAL INSULATION

300 SCOPE OF WORKS

310 General

This specification is based on the understanding that any/all necessary asbestos removal/treatment work will have been arranged and both adequately and competently carried out by others with appropriate independent sign off by an HSE licenced analyst in advance of any work related to this specification commencing.

As required by the specific project arrange for the removal from the site and proper disposal, with appropriate chain of custody documentation, of any existing non-asbestos containing thermal insulation materials, together with their associated coverings and cladding, that are specified or noted within the contract documents for removal.

Be responsible for the preparation and, where specified, the painting of the surfaces to be insulated, the preparation and painting of brackets and supports of surfaces to be insulated, and the supply, delivery, handling, application, sealing, protection and finishing of all materials necessary to complete the thermal insulation, vapour sealing and cladding works, and for ensuring that for all building engineering services systems where their specification refers to this section Y50, unacceptable energy wastage, condensation, ice formation, ingress of moisture, penetration by oil and flammable liquids, and thermal danger to personnel, is prevented.

Be responsible for the preparation and painting of ferrous parts of pipework and ductwork systems where uninsulated.

Ensure that the whole of the thermal insulation works is executed by a specialist Insulation Installer that is a member of the Thermal Insulation Contractors Association (TICA). Provide the name of the intended specialist Insulation Installer and their association membership on the documents returned with the Tender.

Ensure that all preparation and painting works are executed by suitably skilled and properly supervised personnel.

Apply thermal insulation, and where specified vapour sealing and cladding, to the pipework and ductwork systems described herein including all supports and hangers and ancillaries (e.g. joints, fittings, flanged joints, unions, valves, commissioning sets, dirt pockets, steam trap sets, separators, strainers, steam meters and orifice plates, expansion bellows and compensators, pipework anti-vibration flexible couplings, filters, dampers, duct access doors/panels), and associated plant and equipment (e.g. cisterns, overflows, warning pipes, tanks, buffer vessels, calorifiers, cylinders, heat exchangers, unguarded blow down vessels, condensate receivers, pressure driven condensate pumps, relief stream pipework from safety devices, the impeller casing of electrically driven pumps [except those in HWS secondary and Condenser water systems], boiler feed tanks, boilers, flues, the internally mounted exhaust pipes and silencers of CHP units and electricity generators, air handling units, supply and recirculation fan casings, thermal wheels, duct mounted heating and cooling coil casings, duct mounted humidifiers, supply duct attenuators), where they are not themselves manufactured with integral insulation.

Unless otherwise particularly specified do not thermally insulate nor clad: disposal (including rainwater, drains, soil, waste and vent pipes), swimming pool water, compressed air, instrument air, natural gas, LPG, medical gas, laboratory gas, fuel oil, vacuum and fire-fighting (including hose reel, dry riser, wet riser, sprinkler, suppressant gas and foam) systems; drain pipework from cooling equipment condensate trays nor associated traps; discharge pipes from manual and automatic air vents; automatic air vents (except on CHW systems); drain cocks and drain valves (except on MTHW and HTHW systems); chemical dosing pots; vacuum breakers; the actuators of safety valves; pressure and temperature relief valves; sight glasses; HWS and Condenser water pumps; expansion vessels; electric motors and associated drives; valve and damper actuators and linkages; instruments; gauges and their associated siphons and isolating cocks; flue dilution ducts; non-recirculation air extract ducts; exhaust ducts; ductwork anti-vibration flexible connections, sound attenuators in recirculation ducts and sound attenuators in exhaust ducts.

Co-ordinate with the pipework and ductwork installers to ensure that the thermal insulation work and vapour sealing work are fully effective when complete, and that sections of insulation and cladding are arranged to be readily removable and able to be refitted where access for maintenance is required.

Co-ordinate with the electrical installer to ensure that all metal cladding is satisfactorily electrically bonded.

Be responsible for the supply, delivery, offloading and temporary storage of all materials required for the preparation, painting, insulation, vapour sealing and cladding works, including paints, insulation, fixings, insulation hangers, self-adhesive tapes, sealants, cleaning fluids, solvents, adhesives and paints, and ensure that sufficient quantities are supplied to allow a reasonable margin for cutting, waste and making good damage and loss.

Be responsible for the supply, delivery, offloading, storage and maintenance of all tools and equipment required for the preparation, painting, insulation, vapour sealing and cladding works, including the erection, moving, manhandling and dismantling of all access equipment needed for the safe implementation of the works.

Be responsible for the proper removal from site of all waste materials, tools and equipment associated with the preparation, painting, insulation, vapour sealing and cladding works.

Formally bring to the attention of the Employer the fact that the thicknesses of insulation specified herein are equal to or greater than those that appear in the Energy technology Criteria List qualifying thickness tables given in BS 5422 and hence qualify for ‘enhanced capital allowances’ against taxation under the UK Government’s package of climate change measures. For refrigeration applications, confirm in writing that the requirements of BS 5422 2009 Annexe F are met.

The installer, and all sub-contractors and suppliers, is required to operate, in accordance with the BREEAM NC 2018 MAT 03 methodology, an Environmental Management System (EMS) in accordance with the latest edition of ISO 14001.

320 Insulation adjacent to fire barriers

For a distance of 1.0 m. on both the upstream and downstream sides of fire dampers in insulated ductwork and of fire stopped pipe sleeves adjoining insulated pipework, supply and install rigid rock/stone mineral wool insulation with a B_l (or B)-s1,d0 (formerly Class 0) rated surface finish, irrespective of what is specified elsewhere, for fire control purposes.

This clause does not apply where building engineering services are fire-clad, as specified elsewhere.

Do not use proprietary insulation fire sleeves unless they have been successfully tested in accordance with BS 476-20, agreed with the Contract Administrator and the Employer, and approved by Building Control.

Comply with the additional requirements in specification section P10.

400 CLEANING AND PAINTING

410 Scope of work

Clean all items, and paint items specified herein, that have been installed within the scope of the Mechanical Installer’s contract or sub-contract, together with those parts of existing building engineering services systems to which connections are being made, and limited to the immediate vicinity of such connections.

Y50 PAINTING AND THERMAL INSULATION

Except where otherwise specified, paint only those items that are ferrous (including: cast iron, cast steel, malleable iron, mild steel and wrought iron) but not stainless steel, nor those items treated and coated at works with a primer paint or a finish intended as the final protective finish or final decorative finish (including: anodised, chromium plated, electroplated, electro-painted, electrostatic powder coated, galvanized, painted, plastic coated, polyester powder coated, powder coated, stove enamelled, zinc plated).

Paint items listed as follows:

- ~ the following items to which thermal insulation is applied: (a) pipework (including joints, fittings, flanged joints, unions, air bottles and dirt pockets, and including vent and pressure relief stream pipework) for steam, condensate associated with steam systems, HTHW, MTHW, LTHW, condenser water and chilled water systems, as described herein; (b) plant and equipment (including tanks, buffer vessels, calorifiers, heat exchangers, blow down vessels, condensate receivers, boiler feed tanks, and exhaust pipes and silencers of electricity generators) where they are not themselves manufactured with integral final finish; (c) ductwork, but limited to touching-up damage to zinc coating;
- ~ the following uninsulated fluid carrying items: (a) pipework (including joints, fittings, flanged joints and unions) for disposal (including rainwater, drains, soil, waste and vent pipes), industrial compressed air, natural gas, fuel oil, fire-fighting (including hose reel, dry riser, wet riser, sprinkler, suppressant gas and foam), LTHW and condenser water systems, as described herein; (b) plant and equipment (including oil and gas storage tanks, expansion vessels, radiators, radiant panels, convectors, chilled ceiling panels, valves, cooling towers, canopies, hoods, diffusers, grilles, louvres and cowls (where they are not themselves manufactured with primer or final finish); (c) externally mounted ductwork and touching-up damage to zinc coating of internally mounted ductwork;
- ~ all items not directly a fluid carrying part of building engineering services systems (including: pipe clips; drop rods; threaded rods; hangers; clamps; brackets; secondary steelwork; services support frames in walkway ducts, trenches and service shafts; cistern, tank and plant support frames and feet; trench and duct covers; services support gantries; secondary steelwork; access or maintenance ladders, stairs and platforms; services 'walkover' walkways; safety handrails and balustrades).

Paint ferrous items that have a works applied black varnish finish including steel and iron piping and fittings.

Do not paint bearings, pipe expansion rollers, other moving parts, test points, and all other similarly inappropriate items.

Do not paint damper operating and/or locking mechanisms, valve operating levers, hand wheels and spindles.

Do not paint pipework, ductwork and other items made of aluminium, brass, bronze, copper, or gunmetal, except where installed outside of buildings.

Do not paint plastic.

Do not paint stainless steel threaded drop or support rods.

Do not paint the components of proprietary pipe and duct hanging systems that have a factory-applied protective finish.

Do not use aluminium based paints in the vicinity of flammable liquids or gases, nor of pipes conveying them.

Where items that are factory finished are in such close proximity to items that require painting (e.g. the bolts, nuts and washers of a flanged joint or the screw fixing of a bracket to a wall) that it is impractical to avoid painting them, paint them.

Ensure that all paints are suitable for the operating temperatures of the installations for which they are used, and that they are applied in accordance with the manufacturers' instructions.

On completion of all painting, grease all rollers, sliding pipe supports and other moving parts with graphite grease unless contrary to the manufacturer's recommendations.

After painting, installations that are uninsulated and exposed within buildings, co-operate with the contractor responsible for decoratively painting them, in all appropriate respects including:

~ temporarily lowering and subsequently re-hanging radiators and convectors, once

~ temporarily removing and refitting duct mounted diffusers and grilles, once

~ identifying pipework installations that need to be decoratively painted particular colours (e.g. natural gas (yellow) and hose reel fire main (red))

Clauses of this specification apply to normal environments within buildings and to normal external rural and urban environments as defined in BS EN ISO 12944. Where internal environments are of high humidity or bear corrosive chemicals, and where external environments are industrial or near the sea, use a cleaning regime and paint system that achieves medium durability in accordance with BS EN ISO 12944.

420 Cleaning

Thoroughly clean all items where required by removing rust, white rust (from zinc coatings), loose mill scale, loose material, defective coatings, grit, weld spatter, welding and brazing residues, salts, plaster, concrete, cement, dust, dirt and all other debris from their surfaces using hand methods (including scraping, chipping, brushing and emery cloth, as appropriate) without damaging their surfaces and leaving factory-applied protective coatings intact. On ferrous items use a steel wire brush.

Additionally, from the external surfaces of all copper pipework and fittings that are to be uninsulated and exposed, remove all oil, grease, soldering fluxes and brazing residues by degreasing using suitable solvents, without damage to the installation.

Additionally, degrease the external surfaces of all items that are installed outside of buildings and required to be painted, using suitable solvents, without damage to the installation.

430 Painting internal installations

Immediately after cleaning, paint all pipework system installations within buildings, where required, with one coat of zinc phosphate anti-corrosion paint.

Immediately after cleaning, touch-up damage to the zinc coating on the inside and on the outside of all steel ductwork installations within buildings, with zinc-rich paint, to the satisfaction of the Contract Administrator.

Immediately after cleaning, treat, with an approved proprietary cold paint-bond fluid, all galvanized items and all galvanized steel ductwork installations within buildings, where required, that will remain uninsulated, be exposed and be decoratively painted.

Where items with a factory applied primer or finished coating suffer damage, bring the matter promptly to the attention of the Contract Administrator and either touch-up the damaged coating to the satisfaction of the Contract Administrator, or implement such other course of action that the Contract Administrator decides is appropriate.

Additionally, paint with one coat of black heat-resisting paint prior, where insulated, to the installation of thermal insulation, and where located in:

- walkway ducts, trenches, service shafts and plant rooms, and where not of stainless steel nor treated and coated at works with a finish intended as the final protective finish or final decorative finish,

all of the following:

- pipe clips; drop rods; threaded rods; hangers; clamps; brackets; building engineering services support frames; cistern, tank and plant support frames and feet.

440 Painting external installations

Immediately after cleaning and degreasing, paint all items installed outside of buildings, and where required, with the appropriate paint system listed as follows:

~ Plain steel/iron:	Primer 1: zinc phosphate	75DFT
	Primer 2: micaceous iron oxide	75DFT
	Undercoat to suit finished coat	35DFT
	Finish gloss coat	35DFT
~ Galvanized steel:	Wash etch primer	-
	Primer micaceous iron oxide	50DFT
	Undercoat and finish coats as for plain steel	
~ Non-ferrous metals:	Wash chromate etch primer	-
	Primer micaceous iron oxide	50DFT
	Undercoat and finish coats as for steel	

Apply all paint coats in appropriate weather conditions (i.e. dry, dew-free, moderate temperature, not windy and without strong sunlight) to the minimum dry film thicknesses (DFT) in microns shown.

Where the faces of items will be concealed once fixed (e.g. mounting plates that will bear on concrete bases) arrange that such faces are cleaned, degreased and primed before final fixing.

Ensure that all paints are compatible with any adjacent paint systems applied by others, and that final gloss coat colours are as required by the Contract Administrator.

Do not apply undercoat and finish coat to thermally insulated items.

500 DETERIORATION

Should any plant, equipment, duct or pipe supplied and installed by the Installer, become rusty or lose its works-applied paint (or primer) due to the duration of the contract and/or water/humidity on site or any other reason, clean off and prime the whole of the work throughout the affected section(s) with one coat of the appropriate anti-corrosion paint as specified above, prior to final painting or insulating and as soon as the deterioration is noticed.

Remove from the site and replace at no cost to the contract all plant or equipment supplied and installed by the Installer, that has not been kept in good rust-free condition, and cannot be refurbished to the Contract Administrator’s satisfaction, whether it is to be insulated or not.

600 THERMAL INSULATION - MATERIALS

610 General requirements

Ensure that all materials comply with the standards listed for manufacture and testing of their properties.

Do not use thermal insulation materials containing machine-made mineral fibres unless the manufacturer confirms that they meet the criteria to be classified as non-carcinogenic under The Classification, Labelling And Packaging Regulations.

Do not use polyisocyanurate, polystyrene or polyurethane thermal insulation materials.

Ensure that all materials are completely free of chlorofluorocarbons (CFCs), hydrochlorofluoro-carbons (HCFCs) and asbestos of any type.

Ensure that all insulation products have a Declaration of Performance (DoP) certificate and are compliance marked in accordance with the Construction Products Regulations (CPR).

Ensure that all insulation materials are odourless, non-hygroscopic, non-toxic, do not decompose or otherwise suffer deterioration within the applicable operating range of temperature and vibration, do not support fungal life and do not attract vermin or rodent attack.

Ensure that only first class quality new materials are used. Use materials that have been produced by a manufacturer operating a certified Quality Assurance system.

Ensure that the tender sum includes only for the insulation as specified. At tender stage, in a Schedule of Alternatives, propose alternative types of insulation to those specified provided that they have the same or improved thermal conductivity and quality as those specified, and that a reduction of cost is achieved.

Whether the completed (composite) insulation works are concealed or exposed to view, ensure that all finished thermal insulation work, including cladding, vapour barriers, adhesives and paints, have a B_L-s1,d0 reaction to fire performance as tested to BS EN 13501-1 (formerly Class 0) , except that PVC sheet finish having a CL-s3,d0 (formerly Class 1 surface spread of flame fire rating to BS 476-7) is acceptable.

Ensure that sectional pipe insulation and support blocks consist of pre-formed lengths, manufactured from the required base material and) in compliance with the applicable normalised BS EN standard. Ensure that the sections have a bore size corresponding to the outside diameter of the pipe to which they are fitted. Where available supply sections as one-piece, hinged snap-on tubes, complete with factory bonded, B_L-s1,d0 (formerly Class 0) surface laminate of glass-reinforced aluminium foil, except for nitrile rubber which will not have a surface laminate of glass-reinforced aluminium foil but will be of B_L-s3,d0 (formerly Class 0) surface rated material. For fibrous insulation sections and support blocks use products having a self-adhesive overlap whose width does not exceed the thickness of the insulation.

When selecting insulation thickness from the following tables, use the greater thickness when results fall between scheduled temperature differences or thermal conductivity figures.

Ensure that all rigid circular sections are concentric and precisely matched for thickness.

Where pipe sections and pipe support blocks are supplied with a foil flap use products having a self-adhesive overlap whose width does not exceed the thickness of the insulation.

Irrespective of insulation material proposed, for cold services installed using copper tube or thin-wall carbon steel tube (if specified), use only plastic-coated tube with fittings suitably wrapped in accordance with the piping system manufacturer’s instructions. For the avoidance of doubt do not use any type of insulation material on bare copper or thin-wall carbon steel tube for cold services.

For cold fluid installations, where plastic coated pipework has been installed, prior to installing the insulation, prime and wrap all valves and pipework ancillaries to the same standard as applied to pipework tube in accordance with the piping system manufacturer's recommendations, to provide a complete protective installation inside the insulation.

On cold fluid installations install regular vapour check points by ensuring that each and every pipe and duct support installed on cold services is fully and carefully vapour sealed both to itself as well as on both sides to the pipe/duct it is supporting. Butt the system insulation closely to the supports and join the vapour seals using suitable tape.

Submit samples of all types of materials intended to be used including paints, insulation, proprietary load-bearing insulation rings/inserts/strips for use at pipework and ductwork supports, valve and flange insulating mattresses, vapour seals, coverings, finishing materials, sealants, adhesives, insulation hangers and other fixing materials, to the Contract Administrator for approval, prior to installation.

Deliver the sections to the site suitably packed in protective cartons that provide protection from the weather and from physical damage, and that show clearly the diameter(s) of pipework for which they are suitable.

House all materials in a dry place until required for use.

On metal pipes use only thermal insulation free from nitrites and whose ammonia content does not exceed 0.2% by mass. Do not exceed 0.05% by mass of water-soluble chloride ions in insulating material used for stainless steel.

When metal pipes are to be insulated ensure that the proposed insulation product does not contain appreciable amounts of sodium silicate so creating a corrosion risk as detailed in BS 5970 clause 8.3.3.

For service temperatures below 100°C only use insulation material having a declared thermal conductivity, at mean operating temperature, of less than 0.050 W/mK.

When selecting phenolic foam insulation thicknesses use the aged conductivity value not the initial conductivity.

620 Particular requirements for phenolic resin foam insulation and support block/ring materials

Closed cell phenolic resin based foam, complying with BS EN 14314 for pipe and support sections and BS EN 13166 for segmented large bore and flat sections, is tabled herein as a permitted insulation and pipe/duct support material for a number of building engineering services systems and is suitable for acting as a secondary vapour barrier to further inhibit the ingress of moisture to the surface of the pipe or duct.

Only use >90% closed cell phenolic resin foam insulation sections and pipe support blocks whose inside/bore surfaces have been completely treated, at the insulation manufacturer's works, with a suitable dust suppressant, acid neutralising and passivating coating or liner. For large bore cold services where segmented insulation cut from flat board is used ensure that the bulk foam is also treated with acid neutralising passivation chemical.

Seal all exposed edges of phenolic resin foam insulation to the surface being insulated with a suitable vapour sealing mastic.

Ensure that all phenolic resin foam insulation sections and rings/blocks are guaranteed by the manufacturer as having an aged value (conditioned at 70°C for not less than 90 days) thermal conductivity of 0.025 W/mK at 10°C, or equivalent.

Ensure that all phenolic resin foam thermal insulating materials are manufactured with a glass-reinforced aluminium foil facing to achieve B_L-s1,d0 (formerly Class 0) surface spread of flame rating, as defined in BS EN 13501-1, and are produced without the use of either CFCs or HCFCs.

Before phenolic resin foam sectional insulation is applied, ensure that all pipework is clean and dry and free of corrosive substances such as excess soldering flux, building materials debris and moisture.

Ensure that all insulating materials used on the hot water cylinder, pipework and other thermal stores, and on the cold water storage tank, only use substances that have a global warming potential (GWP) of less than 5 (to achieve Code for Sustainable Homes credit Pol 1). For foamed insulation, ensure that the blowing agent used is either “deemed to satisfy” based on Table 6.2 in the Code for Sustainable Homes Technical Guide, or has a GWP of less than 5.

This clause relates to thermal insulation only. Where acoustic insulation is specified, it must comply with the same requirements.

700 VAPOUR SEALING – MATERIALS AND WORKMANSHIP

710 Vapour barrier

Where a vapour barrier is specified in the following clauses (except when using closed cell, flexible, elastomeric, nitrile-rubber-based foam insulation), ensure that it has the following features:

- outer facing of aluminium foil factory bonded to the insulation material with suitable adhesive or heat sealing, and that achieves a B_l (or B)-s1,d0 (formerly Class 0) surface spread of flame
- 5 mm x 5 mm rectangular pattern of glass fibre filament threads, to provide integral reinforcement for the aluminium foil
- inner facing of polyethylene, factory bonded to the insulation material with suitable adhesive or heat sealing

Where joints are not sealed by the standard self-adhesive lap of the factory applied foil facing, seal them all (including cut longitudinal and circumferential joints) on site using self-adhesive glass-reinforced aluminium foil tape of 75 mm minimum width and suitable for the application, rated at B-s1,d0 (formerly Class 0) surface spread of flame, located centrally on each joint, to maintain the continuity of the vapour seal that has been established.

Apply a suitable primer on the foil surface before applying the tape, if recommended by the tape manufacturer. A vapour sealant may be used where tape is inappropriate.

Ensure that all surfaces to be jointed are free from dust and moisture, etc and achieve neat, firm and continuous joints throughout the installation.

Protect the external surface of the vapour barrier, wherever there is a risk of damage. Damaged foil-faced laminate material will not be accepted at handover regardless of the cause of damage.

Where thermal insulation is not available from any manufacturer, with a foil facing that is bonded at the factory to the insulation (e.g. for large diameter steam piping), supply insulation sections that are inherently water repelling.

720 Enhanced vapour barrier

Where an “enhanced vapour barrier” is specified for cold (S10, S12, S13, S20, T90), refrigeration (T60, T62, T70, T71, T72) and chilled water (T61) pipework systems, achieve it by using, throughout the installation, suitable cellular insulation materials of low permeability, complying with BS EN 14304, BS EN 13166 or BS EN 14314 as appropriate, properly secured and sealed. The following alternatives are acceptable:

- phenolic foam insulation and support blocks complying with clause Y50.620, together with the vapour barrier specified in clause Y50.710
- closed cell, flexible, elastomeric, nitrile rubber based foam insulation and support blocks

Arrange the insulation and its vapour barrier to be continuous without being punctured or fouled by pipe clips or supports.

For nitrile rubber based foam insulation, seal all circumferential and longitudinal insulation joints of the insulating material itself with a suitable waterproof bonding adhesive in accordance with the manufacturer's instructions.

800 THERMAL INSULATION - WORKMANSHIP

810 General

Only first class workmanship will be accepted. Carry out all installation in accordance with BS 5970 and the selected insulation manufacturer(s) installation instructions. Replace, free of charge, all work condemned by the Contract Administrator as having been carried out in an untidy or inappropriate fashion.

Do not apply any insulation to systems of pipework, ductwork and associated plant and equipment before they have been inspected, nor until their surfaces are clean and dry, nor before the required 'cold draw' has been applied to thermal expansion bellows, nor before the specified static pressure testing or leakage testing of them has been successfully completed to the satisfaction of the Contract Administrator, nor before any required trace heating has been installed.

Thoroughly clean all surfaces of all pipework and ductwork and associated brackets and supports, until free of all of corrosive substances (such as excess soldering flux), building materials, debris and moisture, shortly before any paint or insulation is applied.

Prepare and paint all pipe and duct supports and associated brackets and all ferrous pipework before the application of insulation.

Ensure that materials that can cause galvanic corrosion are not installed in contact.

Ensure that all insulation is applied strictly in accordance with the manufacturer's recommendations.

Do not use mineral fibre insulation on any services within food preparation, food storage, sterile or clean room areas, nor in any ceiling voids above, floor ducts within, nor hollow partitions adjacent to, such areas.

Ensure that all adhesive, vapour seal and joint cover materials are non-flammable, suitable for the range of ambient temperature and humidity encountered and compatible with the insulation and pipework materials used.

Ensure that all insulation, however fixed, fits tightly in contact with the surface to which it is applied and that all abutting sections, segments and slabs are close butted with their edges being mitred, chamfered or otherwise shaped to suit. Take account of the need for oversized sections to accommodate fittings, protection applied to the pipework tube and fittings (plastic-coating to pipework tube or tape wrapping of joints), and any trace heating tape, without deforming the insulation.

Ensure that thermal insulation completely covers the surfaces to be insulated with no unsealed gaps and no 'cold bridging' except where unavoidable.

For vessel and duct insulation, ensure that complete overall contact is maintained by fixing the insulation on to the vessel or duct surface by means of a suitable adhesive compound, which has no corrosive or detrimental effect on the vessel or duct, thoroughly applied to both the vessel or duct surface and the insulation.

Where possible, on pipework to be trace heated with electric tape, install pre-formed pipework insulation lengths profiled at the factory to accommodate the trace heating tape. Where the insulation cannot be profiled use oversize sections to accommodate the trace heating tape. Do not profile insulation on site.

Where insulated pipework or ductwork passes through the roof or external walls of a building, or passes from an external underground services duct into a building, extend the insulation and protection of the external services for a minimum of 100 mm beyond the internal face of the building's walls or roof. Arrange for a sleeve of appropriate dimensions to be installed for every such pipe or duct for the full thickness of the wall or roof, and seal it to the insulation's protection by a suitable weatherproof flexible sealant.

Ensure that all insulation work is of even thickness and homogenous, has no irregularities either in the insulation material or in the material covering and is left securely fixed, smooth, clean, neat, tidy and is properly finished.

Ensure that all pipes and ducts are insulated individually, and that no adjacent pipes or adjacent ducts are combined together in a common insulation covering.

Cut away the insulation and neatly finish and vapour seal its edges around instrument points, tappings, pressure sensors, thermostats, sensing devices, detectors, name plates, plant instructions, access doors, damper spindles and quadrants, etc so that these components are clearly visible and accessible.

At all tees and at all bends in pipes up to 100 mm external diameter, form single mitred joints in the insulation. At all bends in pipes of external diameter greater than 100 mm external diameter, form segmented joints with a minimum of three mitres in the insulation or use preformed profiled insulated bends.

At all air flow and air pressure test points in insulated ductwork form a removable area of sealed and cladded insulation.

At all pipework anti-vibration couplings insulate with flexible insulation material and, where the system requires a vapour barrier, ensure that it is continuous.

Where insulation is manufactured with an aluminium foil facing ensure that at all joints, cut edges, exposed ends and abutting pieces of insulation the facing is sealed with self-adhesive foil tape to prevent the release or migration of fibres and particles of insulation material.

For all insulated pipework and insulated ductwork install the insulation and vapour barrier continuous through and inside of all pipework and ductwork supports to ensure that the effectiveness of thermal insulation is not undermined by the brackets. At every such support achieve this by installing a proprietary 'load-bearing insulation ring'/insert to BS 5970, Figures 12, and 14 for pipes and Figures 15 and 17 for ducts, of adequate compressive strength to ensure that it does not deform in service, and of the same thickness as the adjoining insulation, to enable the insulation finish to be smoothly continuous across the support. Install every such insulation ring/insert/strip so that it is centred on the point of support, extends 50 mm beyond the support both upstream and downstream, is made of high density insulating material suitable for the temperature condition of the pipework/ductwork system concerned, and is fitted with a metal load distribution plate where recommended by the ring/insert/strip manufacturer.

For all pipework and ductwork that conveys fluid at 15°C or less during normal operation carefully seal each pipe/duct support vapour barrier to the pipe/duct itself at the time of installation and where recommended by the insulation manufacturer seal the internal and end surfaces of the insulation ring/insert with suitable sealer prior to applying the vapour seal.

Ensure that all vapour barriers are continuous. At all exposed edges of insulation (e.g. where pipe insulation meets valve insulation; where insulated parts of the system are adjacent to uninsulated parts; where the insulation adjoins a removable component;) seal the insulating material to the surface being insulated with a suitable vapour sealing mastic to prevent any ingress of moisture or water vapour. Additionally (except for closed cell, flexible, elastomeric nitrile-rubber-based foam material), fix to the duct or pipe an 'end-cap' for the insulation, made of sheet cladding material folded in 'angle' or 'Z bar' form ('crocodile-cut' to fit curved surfaces), to provide a means for protecting the exposed edge of the insulation and to provide a surface for the fixing of self-adhesive glass-reinforced aluminium foil tape, to effectively seal the vapour barrier of the insulation by ‘dressing’ it to the pipe or duct surface. Where the vapour barrier is penetrated (e.g. by instrument tappings) seal the vapour barrier to the penetrating component with a suitable vapour sealing mastic to ensure that an unbroken vapour seal finish is achieved.

Ensure that insulation applied to calorifier tube chests, steam trap sets and suchlike, is contained within purpose-made removable metal boxes fitted with quick release spring clip fasteners.

Form all valve, flange or other removable boxes without sharp edges that could damage the vapour barrier.

Wherever possible arrange joints in cladding on the face of the installation not normally in view.

Where closed cell, flexible, elastomeric, nitrile-rubber-based, foam insulation is fitted inside buildings and exposed to sunlight, or fitted external to buildings, apply the manufacturer’s recommended UV-protection paint system immediately after installation with a second coat applied within 3 days. Alternatively, use the manufacturer’s proprietary cladding system or one of the alternative cladding system options below.

Clear away waste materials, spillages, etc. regularly during the period of the insulation work and finally on the completion of this work. At final completion of this work, or of sections of this work, clean up thermal insulation fibres and particles by vacuum cleaner.

820 Sample testing of insulation materials

Remove a 1.0 m length sample of every type of insulation used on this contract, from positions selected by the Contract Administrator, and forward them to an industrial research laboratory or testing laboratory to determine if they comply with the specification.

The actual tests required to be carried out will be decided by the Contract Administrator dependent upon the particular circumstances and will be any combination of: specified composition, thickness, vapour barrier permeability or means of application.

Should any of the samples fail to meet the specified requirement(s), take two further samples of the same type of insulation from locations agreed with the Contract Administrator, and similarly forward them for testing.

In the event that either of these two samples fail the tests, remove from site all insulation of the failed type already fixed, together with any unfixed materials of the same type on site. Subsequently replace the failed materials with materials of the correct type without additional cost to the Contract. If the samples taken meet the specification, a variation order will be issued for any documented out of pocket expenses incurred in the removal, testing and replacement of the samples.

900 DAMAGE OR DISTURBANCE OF EXISTING INSULATION

Where damage is caused to existing insulation or finishes on any building engineering service, make good the damage to restore the integrity of the existing installation.

1000 INSULATION OF PIPEWORK INSTALLATIONS GENERALLY

Verify that the appropriate pipework protective finish has been correctly applied to pipework before pipework insulation is applied.

Clean off all loose material before pipework insulation is applied.

Verify that the load-bearing insulation rings/blocks at support positions have been correctly installed including, where appropriate, any integral vapour barrier provisions.

Replace any load-bearing insulation rings/blocks at support positions that have been damaged before pipework insulation is applied.

Insulate the pipework installations (including piping, ancillaries, plant and equipment) in accordance with the following clauses (which are arranged on a 'services system' basis), using insulation of thermal conductivities in the ranges given in the following tables and with thicknesses consequently derived from the following tables.

Explanatory note: Part 'L' of The Building Regulations 2000 differentiates between 'dwellings' and 'buildings other than dwellings'. The standard BS 5422:2009 differentiates between 'domestic' and 'non-domestic' buildings. The use of these different terminologies in these two documents may lead to misinterpretation. Therefore in the following tables these terms have been avoided but the tables for HWS and LTHW installations have been prepared to distinguish between 'heated' and 'unheated/external' parts of buildings. Apply the tables to all buildings irrespective of the purposes for which the buildings are designed. For this purpose an 'unheated' part of a building is a part where the temperature may fall to -1.0°C because it is outside of the thermal envelope of the building (e.g. a garage attached to a house; a ventilated loft above the layer of thermal insulation on the ceiling below); and a 'heated' part of a building is one where the temperature will not normally fall to as low as -1.0°C because it is inside of the thermal envelope of the building (e.g. between the joists of the upper floors of a house; a ceiling void above a heated office space; a services shaft) and the building has a heating system which either operates continuously or has a building fabric frost protection control routine.

Insulate heating and domestic hot water services, installed in internal areas/ceiling voids etc where heat gain from pipes may cause overheating, using thicknesses from the 'Ext' columns in the relevant tables.

Where a nominal pipe diameter is not listed in the tables below, use the nearest larger diameter listed. If plastic pipework is permitted and used, ignore the thermal properties of the plastic material and do not reduce the minimum thicknesses of insulation required.

For elastomeric nitrile rubber insulation and fibrous insulation, where more than one layer of insulation may be required to achieve the specified thickness, build up the subsequent layers where possible using pre-formed sections otherwise use sheet material, and always stagger the joints where using multiple layers.

1010 Cold water installations (S10, S12, S13, S20, T90) (including mains, tank, boosted and treated water)

1011 Preparation and painting before insulation is applied

Painting not applicable to the pipework materials specified.

For external pipework ensure that the need for trace heating is considered and where required has been installed and tested.

1012 Insulation materials

To control heat gain, prevent moisture ingress and the condensation of moisture from the surrounding air, insulate all cold water service pipework installations, except where exposed to view in rooms (e.g. those under or adjacent to sanitary fittings), with pre-formed insulation sections, having an enhanced vapour barrier.

For external pipework and pipework at risk of freezing use only materials with a declared thermal conductivity of 0.04 W/mK or less and do not install pipes of less than 22 mm nominal bore where there is a risk of freezing unless they are to be trace heated.

Use insulation material of one of the following types, as indicated by equipment schedule Y50, or any one of the following types where the schedule is silent on a preferred choice:

	Insulation material	Nominal density	Additional requirements
1	Bore-coated/lined phenolic foam	35 or 40 kg/m^3	Produced without CFCs or HCFCs
2	Closed cell, flexible, elastomeric, nitrile-rubber-based foam	65 kg/m^3	Produced without CFCs or HCFCs
3	Rigid rock/stone mineral wool	120 kg/m^3	Internal applications only

1013 Insulation thicknesses

In unheated and external areas where freezing is a risk use the required minimum thicknesses of insulation from the ‘Ext’ column from the following table, and where freezing is not a risk use the required minimum thicknesses of insulation from the ‘Int’ column. Minimum insulation thicknesses for internal pipework are based on Table 8 of BS 5422:2009; and for unheated spaces and freeze protection, thicknesses are based on a combination of Table 29 from BS 5422:2009 for specified conditions 2 (up to and including 20 mm pipe size) and Table 14 of BS 5422:2001 with some interpolation:

Nominal pipe size (mm)	**Max heat gain (W/m)**	**Minimum insulation thickness for fluid temperature of 10°C, ambient at 25°C and surface emissivity of 0.05 Declared thermal conductivity (W/mK) at insulation mean temperature**											
		0.025		**0.03**		**0.035**		**0.04**		**0.045**		**0.05**	
		Int	**Ext**	**Int**	**Ext**	**Int**	**Ext**	**Int**	**Ext**	**Int**	**Ext**	**Int**	**Ext**
15*	2.72	14	30	16	42	18	58	20	78	23	-	25	-
20	3.05	15	30	17	42	20	58	22	78	24	-	27	
25	3.41	16	21	18	26	21	38	24	49	26	64	29	
32	3.86	17	22	20	28	22	39	25	51	28	64	31	
40	4.11	17	23	20	30	23	41	26	52	29	65	32	
50	4.78	18	25	22	31	25	42	28	53	31	65	34	
65	5.51	20	27	23	33	27	44	30	54	33	66	37	
80	6.17	20	29	24	35	28	46	31	55	35	66	38	
100	7.28	22	31	26	37	30	48	34	56	37	66	41	
150	9.89	24	33	29	39	33	50	38	57	42	66	46	
Other/flat	14.74	33	35	40	42	46	50	52	58	59	67	65	-

* Where there is a risk of freezing do not install 15 mm pipework unless it is trace heated for freeze protection.

For ‘internal’ insulation the above thicknesses are based on a nominal water temperature of 10°C. For lower water temperatures, increase the thicknesses in accordance with Table 8 of BS 5422:2009.

1020 Hot water service installations (S11, S12 and T90)

1021 Preparation and painting before insulation is applied

Painting not applicable to the pipework materials specified.

Where trace heating is specified in section S11, S12 or T90 of this specification ensure that it has been installed and tested.

1022 Insulation materials

To control heat loss and prevent moisture ingress, insulate all hot water service pipework installations (including cold feed and open vent pipes) except where exposed to view in rooms (e.g. those under or adjacent to sanitary fittings) with pre-formed insulation sections, having a vapour barrier.

For external pipework and pipework at risk of freezing use only materials with a declared thermal conductivity of 0.04 W/mK or less and do not install pipes of less than 22 mm nominal bore where there is a risk of freezing unless they are to be trace heated.

Use insulation material of one of the following types, as indicated by equipment schedule Y50, or any one of the following types where the schedule is silent on a preferred choice:

	Insulation material	Nominal density	Additional requirements
1	Rigid glass mineral wool	80 kg/m^3	
2	Rigid rock/stone mineral wool	120 kg/m^3	
3	Bore-coated/lined phenolic foam	35 or 40 kg/m^3	Produced without CFCs or HCFCs
4	Closed cell, flexible, elastomeric, nitrile-rubber-based foam	65 kg/m^3	Produced without CFCs or HCFCs

1023 Insulation thicknesses

Where freezing is not a risk, use the required minimum thicknesses of insulation from the ‘Int’ column in the following table, which, for heated spaces of buildings is based on a combination of Table 17 of BS 5422:2009, and Table 4.5 of Approved Document L2 for thermal conductivities of 0.025 W/mK and 0.040 W/mK.. In unheated spaces of buildings and where freezing is a risk, and where installed in internal areas/ceiling voids etc where heat gain from pipes may cause overheating, use the required minimum thicknesses of insulation from column ‘Ext’ which is based on a combination of Table 14, of BS 5422:2001 and Table 29 from BS 5422:2009 for specified conditions 2 (up to and including 20 mm pipe size) with some interpolation:

Nominal pipe size (mm)	Max heat loss (W/m)	Minimum insulation thickness for fluid temperature of 60°C, ambient at 15°C and surface emissivity of 0.05 Declared thermal conductivity (W/mK) at insulation mean temperature											
		0.025		0.03		0.035		0.04		0.045		0.05	
		Int	Ext	Int	Ext	Int	Ext	Int	Ext	Int	Ext	Int	Ext
15*	7.13	20	30	19	42	25	58	35	78	43	-	55	-
20	7.83	20	30	21	42	27	58	35	78	45	-	57	
25	8.62	25	25	22	28	29	38	40	49	47	64	58	
32	9.72	25	25	23	30	30	39	40	51	47	64	57	
40	10.21	25	25	25	31	32	41	40	52	49	65	60	
50	11.57	25	25	26	33	33	42	45	53	50	65	60	
65	13.09	25	28	28	35	35	44	45	55	52	66	61	
80	14.58	25	31	28	37	35	46	45	56	51	66	60	
100	17.20	30	33	29	40	36	48	45	57	51	67	60	
Other/flat	32.40	27	35	33	42	39	50	46	58	53	67	60	

* Where there is a risk of freezing do not install 15 mm pipework unless it is trace heated for freeze protection.

1030 Steam installations (S51)

1031 Preparation and painting before insulation is applied

For ferrous pipework with a factory-applied red paint finish, coat thoroughly with zinc phosphate anti-corrosion paint any damaged finish before pipework insulation is applied. For ferrous pipework with a varnished (transit protection) finish, clean and coat thoroughly with one coat of zinc phosphate anti-corrosion paint before pipework insulation is applied.

1032 Insulation materials

To control heat loss, prevent moisture ingress and protect personnel, insulate all steam pipework installations (including steam vent, pressure relief stream, and blow down pipes), with pre-formed insulation sections, having a vapour barrier.

Use insulation material of one of the following types, as indicated by equipment schedule Y50, or any one of the following types where the schedule is silent on a preferred choice:

	Insulation material	Nominal density	Additional requirements
1	Rigid glass mineral wool	80 kg/m^3	
2	Rigid rock/stone mineral wool	120 kg/m^3	
3	Calcium silicate	240 kg/m^3	

1033 Insulation thicknesses

For all steam installations operating up to 150°C where any space heating or cooling is provided use the required minimum thicknesses of insulation from the following table, which is based on Table 15 of BS 5422:2009. Where the steam temperature exceeds 150°C and where any space heating or cooling is provided by the steam system calculate, to the satisfaction of the Contract Administrator, and install the required thickness of insulation to meet the maximum heat loss per metre stated in the table. Where the steam installation serves only process loads use thicknesses from Table 21 of BS 5422:2009.

Nominal pipe size (mm)	**Max heat loss (W/m)**	**Minimum insulation thickness for fluid temperature of 125°C, ambient at 15°C and surface emissivity of 0.05 Declared thermal conductivity (W/mK) at insulation mean temperature**								
		0.025	**0.03**	**0.035**	**0.04**	**0.045**	**0.05**	**0.055**	**0.06**	**0.065**
		Minimum thickness of insulation (mm)								
15	18.32	12	17	22	29	38	48	61	-	-
20	18.70	16	22	28	37	47	60	76	-	-
25	19.02	20	27	36	46	59	74	93	-	-
32	19.25	26	35	45	59	74	93	117	-	-
40	20.17	28	37	48	61	77	97	120	-	-
50	21.96	31	41	52	66	83	102	125	147	-
65	24.21	34	45	57	71	88	107	129	152	179
80	25.99	36	47	60	74	91	110	132	154	180
100	29.32	40	51	64	79	96	115	136	155	183
125	32.47	43	55	68	83	100	118	139	159	186
150	36.04	46	58	71	86	103	121	141	161	184
200	42.16	49	62	75	90	106	124	144	161	185
Other/flat	48.48	52	64	78	93	109	127	145	163	184

Where insulation is solely for personnel protection (e.g. steam vents and pressure relief streams) use Table 23 of the BS 5422:2009.

1040 Condensate installations (S51) (i.e. condensate associated with steam systems)

1041 Preparation and painting before insulation is applied

1042 Painting not applicable to the pipework materials specified. Insulation materials

To control heat loss, prevent moisture ingress and protect personnel, insulate all gravity and pumped condensate pipework installations (including receiver and feed tank vent pipes; boiler feed water supply, recirculation and heat recovery pipes; but excluding sight glasses on steam trap sets), with pre-formed insulation sections, having a vapour barrier.

Use insulation material of one of the following types, as indicated by equipment schedule Y50, or any one of the following types where the schedule is silent on a preferred choice:

	Insulation material	Nominal density	Additional requirements
1	Rigid glass mineral wool	80 kg/m^3	
2	Rigid rock/stone mineral wool	120 kg/m^3	
3	Bore-coated/lined phenolic foam	35 or 40 kg/m^3	Produced without CFCs or HCFCs

1043 Insulation thicknesses

For all condensate installations forming part of steam systems providing any space heating or cooling use the required minimum thicknesses of insulation from the following table, which is based on Table 15 of BS 5422:2009. Where the condensate serves only process loads use thicknesses from Table 21 of BS 5422:2009.

Nominal pipe size (mm)	**Max heat loss (W/m)**	**Minimum insulation thickness for fluid temperature of 100°C, ambient at 15°C and surface emissivity of 0.05 Declared thermal conductivity (W/mK) at insulation mean temperature**					
		0.025	**0.03**	**0.035**	**0.04**	**0.045**	**0.05**
		Minimum thickness of insulation (mm)					
15	13.56	14	18	25	32	42	54
20	13.83	17	24	31	41	53	67
25	14.39	21	28	37	48	62	78
32	15.66	24	32	41	52	66	83
40	16.67	25	33	42	53	67	83
50	18.25	27	36	46	57	71	87
65	20.42	30	39	49	60	74	89
80	22.09	31	40	51	62	76	91
100	25.31	34	43	54	65	79	93
Other/flat	43.72	42	52	63	74	87	100

Where insulation is solely for personnel protection (e.g. receiver vents) use Table 23 of BS 5422:2009.

1050 High temperature hot water (HTHW) installations (T20)

Operating temperature not exceeding 170ºC, but above 120ºC.

1051 Preparation and painting before insulation is applied

For ferrous pipework with a factory-applied red paint finish, coat thoroughly with zinc phosphate anti-corrosion paint any damaged finish before pipework insulation is applied. For ferrous pipework with a varnished (transit protection) finish, clean and coat thoroughly with one coat of zinc phosphate anti-corrosion paint before pipework insulation is applied.

1052 Insulation materials

To control heat loss, prevent moisture ingress and protect personnel, insulate all HTHW heating pipework installations (including pressure relief streams, cold feeds and discharges from air vents, but not those parts used as useful heating surfaces) with pre-formed insulation sections, having a vapour barrier.

Use insulation material of one of the following types, as indicated by equipment schedule Y50, or any one of the following types where the schedule is silent on a preferred choice:

	Insulation material	Nominal density	Additional requirements
1	Rigid glass mineral wool	80 kg/m^3	
2	Rigid rock/stone mineral wool	120 kg/m^3	
3	Calcium silicate	240 kg/m^3	

1053 Insulation thicknesses

For all HTHW installations operating up to 150°C and where any space heating or cooling is provided use the required minimum thickness from the following table, which is based on Table 15 of BS 5422:2009, For temperatures beyond 150°C and where any space heating or cooling is served by the system calculate, to the satisfaction of the Contract Administrator, and install the required thickness of insulation to meet the maximum heat loss per metre stated in the table. Where the HTHW serves only process loads use thicknesses from Table 21 of BS 5422:2009.

Nominal pipe size (mm)	**Max heat loss (W/m)**	**Minimum insulation thickness for fluid temperature of 125°C, ambient at 15°C and surface emissivity of 0.05 Declared thermal conductivity (W/mK) at insulation mean temperature**								
		0.025	**0.03**	**0.035**	**0.04**	**0.045**	**0.05**	**0.055**	**0.06**	**0.065**
		Minimum thickness of insulation (mm)								
15	18.32	12	17	22	29	38	48	61	-	-
20	18.70	16	22	28	37	47	60	76	-	-
25	19.02	20	27	36	46	59	74	93	-	-
32	19.25	26	35	45	59	74	93	117	-	-
40	20.17	28	37	48	61	77	97	120	-	-
50	21.96	31	41	52	66	83	102	125	150	179
65	24.21	34	45	57	71	88	107	129	152	182
80	25.99	36	47	60	74	91	110	132	154	184
100	29.32	40	51	64	79	96	115	136	158	183
125	32.47	43	55	68	83	100	118	139	159	186
150	36.04	46	58	71	86	103	121	141	161	186
200	42.16	49	62	75	90	106	124	144	164	185
Other/flat	48.48	52	64	78	93	109	127	145	163	186

Where insulation is solely for personnel protection (e.g. vents and pressure relief streams) use Table 23 of the BS 5422:2009. Insulate drain valves..

Y50 PAINTING AND THERMAL INSULATION

1060 Medium temperature hot water (MTHW) installations (T30)

Operating temperature not exceeding 120ºC, but above 95ºC.

1061 Preparation and painting before insulation is applied

For ferrous pipework with a factory-applied red paint finish, coat thoroughly with zinc phosphate anti-corrosion paint any damaged finish before pipework insulation is applied. For ferrous pipework with a varnished (transit protection) finish, clean and coat thoroughly with one coat of zinc phosphate anti-corrosion paint before pipework insulation is applied.

1062 Insulation materials

To control heat loss, prevent moisture ingress and protect personnel, insulate all MTHW heating pipework installations (including pressure relief streams, cold feeds and discharges from air vents, but not parts used as useful heating surfaces) with pre-formed insulation sections, having a vapour barrier.

Use insulation material of one of the following types, as indicated by equipment schedule Y50, or any one of the following types where the schedule is silent on a preferred choice:

	Insulation material	Nominal density	Additional requirements
1	Rigid glass mineral wool	80 kg/m^3	
2	Rigid rock/stone mineral wool	120 kg/m^3	
3	Calcium silicate	240 kg/m^3	
4	Bore-coated/lined phenolic foam	35 or 40 kg/m^3	Produced without CFCs or HCFCs

1063 Insulation thicknesses

For all MTHW installations where any space heating or cooling is provided use the required minimum thicknesses of insulation from the following table, which is based on Table 15 of BS 5422:2009. Where the MTHW serves only process loads use thicknesses from Table 21 of BS 5422:2009.

Nominal pipe size (mm)	**Max heat loss (W/m)**	**Minimum insulation thickness for fluid temperature of 100°C, ambient at 15°C and surface emissivity of 0.05 Declared thermal conductivity (W/mK) at insulation mean temperature**							
		0.025	**0.03**	**0.035**	**0.04**	**0.045**	**0.05**	**0.055**	**0.06**
		Minimum thickness of insulation (mm)							
15	13.56	14	18	25	32	42	54	69	84
20	13.83	17	24	31	41	53	67	85	103
25	14.39	21	28	37	48	62	78	98	118
32	15.66	24	32	41	52	66	83	103	122
40	16.67	25	33	42	53	67	83	102	120
50	18.25	27	36	46	57	71	87	106	124
65	20.42	30	39	49	60	74	89	107	124
80	22.09	31	40	51	62	76	91	108	124
100	25.31	34	43	54	65	79	93	110	125
125	28.23	36	46	57	68	82	96	112	127
150	31.61	38	48	59	70	83	98	113	127
200	37.66	40	50	61	72	85	98	113	126
Other/flat	43.72	42	52	63	74	87	100	114	126

Insulate drain valves. Where insulation is solely for personnel protection (e.g. pressure relief streams) use Table 23 of BS 5422:2009.

1070 Low temperature hot water (LTHW) installations (T31)

Operating temperature not exceeding 95ºC (including heat recovery systems).

1071 Preparation and painting before insulation is applied

For ferrous pipework with a factory-applied red paint finish, coat thoroughly with zinc phosphate anti-corrosion paint any damaged finish before pipework insulation is applied. For ferrous pipework with a varnished (transit protection) finish, clean and coat thoroughly with one coat of zinc phosphate anti-corrosion paint before pipework insulation is applied.

For external pipework ensure that the need for trace heating is considered and where required has been installed and tested.

1072 Insulation materials

To control heat loss, prevent moisture ingress, reduce the risk of freezing and protect personnel, insulate all LTHW heating pipework installations (including cold feeds and open vents, but not those parts used as useful heating surfaces or exposed in rooms) with pre-formed insulation sections, having a vapour barrier.

Use insulation material of one of the following types, as indicated by equipment schedule Y50, or any one of the following types where the schedule is silent on a preferred choice:

	Insulation material	Nominal density	Additional requirements
1	Rigid glass mineral wool	80 kg/m^3	
2	Rigid rock/stone mineral wool	120 kg/m^3	
3	Bore-coated/lined phenolic foam	35 or 40 kg/m^3	Produced without CFCs or HCFCs
4	Closed cell, flexible, elastomeric, nitrile-rubber-based foam	65 kg/m^3	Produced without CFCs or HCFCs

1073 Insulation thicknesses

For all system temperatures and within heated parts of buildings, use the required minimum thicknesses of insulation from the 'Int' column from the following table, which is based on a combination of Table 15 of BS 5422:2009, and Table 4.4 of Approved Document L2 for thermal conductivities of 0.025 W/mK and 0.040 W/mK. For unheated parts of buildings, external locations, and where installed in internal areas/ceiling voids etc where heat gain from pipes may cause overheating, use the required minimum thicknesses of insulation from the 'Ext' column from the following table, which is based on a combination of Table 29 of BS 5422:2009 (up to and including 20 mm pipe size) and Table 14 of BS 5422:2009 with some interpolation, and Table 4.4 of Approved Document L2 for thermal conductivities of 0.025 W/mK and 0.040 W/mK.

Nominal pipe size (mm)	**Max heat loss (W/m)**	**Minimum insulation thickness for fluid temperature of 75°C, ambient at 15°C and surface emissivity of 0.05 Declared thermal conductivity (W/mK) at insulation mean temperature**											
		0.025		**0.03**		**0.035**		**0.04**		**0.045**		**0.05**	
		Minimum thickness of insulation (mm)											
		Int	**Ext**	**Int**	**Ext**	**Int**	**Ext**	**Int**	**Ext**	**Int**	**Ext**	**Int**	**Ext**
15*	9.28	15	28	20	39	26	52	35	68	46	--	59	
20	10.06	20	28	22	39	29	52	40	68	49		62	

25	11.07	20	21	24	28	31	38	40	49	51		64	
32	12.30	20	22	26	30	33	39	45	51	52		65	
40	12.94	25	25	27	31	35	41	45	52	55		67	
50	14.45	25	25	29	33	37	42	50	53	56		68	
65	16.35	25	26	31	34	39	43	50	54	58		70	
80	17.91	25	27	32	35	40	45	50	55	59		70	
100	20.77	30	30	34	37	42	46	55	55	61		71	
125	23.71	28	30	35	38	43	47	52	56	61		71	
150	26.98	29	31	37	39	44	48	53	56	62		72	
200	32.54	30	32	38	40	45	49	54	57	62		72	
250	38.83	31	33	38	41	46	50	54	57	62		72	
Other/flat	38.83	32	35	39	42	46	50	54	58	63		72	

Do not use materials with a conductivity exceeding 0.04 W/mK for insulating LTHW pipework in unheated spaces.

* Where there is a risk of freezing do not install 15 mm pipework unless it is trace heated for freeze protection.

1080 Heat network installations

Comply with the following clauses for all above ground primary and secondary distribution pipework in heat network installations incorporating District Heating, which is defined as a heat network that serves more than one building, and Communal Heating, which is defined as a heat network that serves a single building with more than one customer. For pre-insulated underground heating distribution pipework refer to specification section T34.

1081 Preparation and painting before installation

For ferrous pipework with a factory-applied red paint finish, coat thoroughly with zinc phosphate anti-corrosion paint any damaged finish before pipework insulation is applied. For ferrous pipework with a varnished (transit protection) finish, clean and coat thoroughly with one coat of zinc phosphate anti-corrosion paint before pipework insulation is applied.

For external pipework ensure that the need for trace heating is considered and where required has been installed and tested.

1082 Insulation materials

To control heat loss, prevent moisture ingress, reduce the risk of freezing and protect personnel, insulate all heat network pipework installations with pre-formed insulation sections, having a vapour barrier.

Use insulation material of one of the following types, as indicated by equipment schedule Y50, or any one of the following types where the schedule is silent on a preferred choice:

	Insulation material	Nominal density	Additional requirements
1	Rigid glass mineral wool	70 kg/m^3	
2	Rigid rock/stone mineral wool	70 kg/m^3	
3	Bore-coated/lined phenolic foam	37 kg/m^3	Produced without CFCs or HCFCs

1083 Insulation thicknesses

Use the required minimum thicknesses of insulation from the following table, which is based on Heat networks: Code of Practice for the UK, CP1 2020, clause 3.9.7, Table 8.

Nominal pipe diameter (mm)	Phenolic foam		Mineral fibre	
	Internal space (mm)	External space (mm)	Internal space (mm)	External space (mm)
15	50	50	50	50
20	50	50	50	50
25	50	50	50	50
32	50	50	50	50
40	50	50	50	50
50	50	50	60	60
65	50	50	60	60
80	50	50	60	60

Note: the above figures are calculated assuming mineral fibre insulation having a conductivity value of 0.035 W/mK and phenolic foam insulation having a conductivity value of 0.025 W/mK, and with low surface emissivity of 0.05.

1100 INSULATION OF PIPEWORK INSTALLATIONS GENERALLY – CONTINUED

1110 Chilled water installations (T61)

Operating temperature between 5ºC and 12ºC.

1111 Preparation and painting before insulation is applied

For ferrous pipework with a factory-applied red paint finish, coat thoroughly with zinc phosphate anti-corrosion paint any damaged finish before pipework insulation is applied. For ferrous pipework with a varnished (transit protection) finish, clean and coat thoroughly with one coat of zinc phosphate anti-corrosion paint before pipework insulation is applied. Apply an additional coat of zinc phosphate anti-corrosion paint to ferrous pipework where rock/stone mineral wool insulation is to be applied.

For external pipework ensure that the need for trace heating is considered and where required has been installed and tested.

1112 Insulation materials

To control heat gain, prevent moisture ingress and prevent the condensation of moisture from the surrounding air, insulate all chilled water pipework installations (including cold feed and open vent pipes) with pre-formed insulation sections, having an enhanced vapour barrier.

Use insulation material of one of the following types, as indicated by equipment schedule Y50, or any one of the following types where the schedule is silent on a preferred choice:

	Insulation material	Nominal density	Additional requirements
1	Bore-coated/lined phenolic foam	35 or 40kg/m^3	Produced without CFCs or HCFCs
2	Closed cell, flexible, elastomeric nitrile-rubber-based foam	65kg/m^3	Produced without CFCs or HCFCs See note below if using ABS pipework
3	Rigid rock/stone mineral wool	120 kg/m^3	Internal applications only

Verify compatibility, with both insulation and pipework manufacturers, if using ABS pipework and elastomeric nitrile rubber materials.

1113 Insulation thicknesses

For control of both surface condensation and heat gain for internal services use the required minimum thicknesses of insulation from the ‘Int’ column from the following table, which is based on Table 8 of BS 5422:2009 for a fluid temperature of 5°C; and for external services where the ambient temperature will be hotter, use the required minimum thicknesses of insulation from the ‘Ext’ column which is based on Table 8 of BS 5422:2009 for a fluid temperature of 0°C with interpolation for other pipe sizes.

Nominal pipe size (mm)	**Max heat gain (W/m)**	**Minimum insulation thickness for fluid temperature of 5°C, ambient at 25°C and surface emissivity of 0.05 Declared thermal conductivity (W/mK) at mean insulation temperature**									
		0.025		**0.03**		**0.035**		**0.04**		**0.045**	
		Minimum thickness of insulation (mm)									
		Int	**Ext**	**Int**	**Ext**	**Int**	**Ext**	**Int**	**Ext**	**Int**	**Ext**
15*	3.27	19	24	22	28	25	32	28	36	31	40
20	3.58	20	26	24	30	27	35	30	39	34	43
25	4.01	21	27	25	32	29	37	32	41	36	46
32	4.53	23	29	27	34	31	40	35	44	39	49
40	4.82	24	31	28	36	32	42	36	47	40	52
50	5.48	26	33	30	38	34	44	39	49	43	55
65	6.30	27	35	32	41	37	47	42	53	46	59
80	6.90	29	37	34	43	39	50	44	57	48	63
100	8.31	31	39	36	46	42	53	47	60	52	67
125	9.49	32	42	38	49	44	56	50	64	55	71
150	10.97	34	44	40	51	46	59	52	67	58	75
200	13.57	37	47	43	55	50	64	56	72	63	81
250	14.50	39	50	46	59	53	68	60	77	67	86
300	15.50	41	56	48	66	55	77	63	87	70	98
Other/flat	16.28	47	61	56	73	65	85	74	97	83	110

* Where there is a risk of freezing do not install 15 mm pipework unless it is trace heated for freeze protection.

1120 Refrigerant installations (T60, T70, T71, T72) (e.g. R134a, R407c, including VRF systems)

1121 Preparation and painting before insulation is applied

Where condensation can occur provide load-bearing insulation rings at support positions.

1122 Insulation materials

Do not use polyethylene foam.

To prevent moisture ingress and the condensation of moisture from the surrounding air, control heat gain and loss (e.g. in cooling and heating VRF systems), protect personnel, and separate copper piping from galvanized steel support tray, insulate refrigerant pipework installations with pre-formed insulation tubes or sections having an enhanced vapour barrier. Use tube rather than split insulation wherever possible.

Use insulation material of the following type:

Insulation material	Nominal density	Additional requirements

1	Closed cell, flexible, elastomeric nitrile-rubber-based foam	65 kg/m^3	Produced without CFCs or HCFCs

1123 Insulation thicknesses

For factory-made packaged equipment (e.g. packaged chillers) accept the thicknesses provided by the manufacturer. For all refrigerant installations where any space heating or cooling is provided (such as split DX cooling or heating systems, VRF cooling, and VRF cooling and heating systems) use insulation thicknesses to refrigerant piping in accordance with the following table. The thicknesses have been derived from Tables 11 and 16 of BS 5422:2009 using the temperature differential between fluid and ambient as stated in the table below. Where the DX or VRF system manufacturer or specialist installer recommends thicker insulation than shown in this table, install it. Where refrigerant systems are only used for process loads and the proposed product has a high emissivity use thicknesses from Table 4 of BS 5422:2009; for suction gas pipes and other low temperature surfaces and use thicknesses from Table 16 of BS 5422:2009 for other pipes and surfaces. Where the emissivity is low use Tables 5 and 15 of BS 5422:2009 respectively.

	Declared thermal conductivity (W/mK) 0.035 and surface emissivity of 0.9					
	Minimum thickness of insulation (mm)					
	Suction gas pipe (nominal 25 to 40°C)		**Discharge gas pipe (nominal 50 to 70°C)**		**“Liquid” pipe (nominal -5 to +10C)**	
Controlling:	Max Heat Gain	Thickness (mm)	Max Heat loss	Thickness (mm)	Surface condensate and max heat gain	Thickness (mm)
Nominal pipe size	W/m	Table 11 (15°C difference fluid to ambient)	W/m	Table 16 (75°C fluid 15°C ambient)	W/m	Table 11 (25°C difference fluid to ambient)
15	2.72	21	9.28	30	3.81	30
20	3.05	22	10.06	33	4.18	33
50	4.78	26	14.45	41	6.17	39
100	7.28	29	20.77	47	9.15	43
150	9.89	29	26.89	49	11.86	45
Other/flat	14.74	30	38.83	51	17.48	46

Note: In this table “liquid” pipe includes ‘the pipe downstream of the refrigerant expansion valve and upstream of the refrigerant evaporator’.

1130 Condenser water installations (T60)

Operating temperature up to 35ºC. Above 35°C use thicknesses for LTHW.

1131 Preparation and painting before insulation is applied

For ferrous pipework with a factory-applied red paint finish, coat thoroughly with zinc phosphate anti-corrosion paint any damaged finish before pipework insulation is applied. For ferrous pipework with a varnished (transit protection) finish, clean and coat thoroughly with one coat of zinc phosphate anti-corrosion paint before pipework insulation is applied. For ferrous pipework with a galvanised finish, coat thoroughly with calcium plumbate primer paint any damaged finish before pipework insulation is applied.

For external pipework ensure that the need for trace heating is considered and where required has been installed and tested.

1132 Insulation materials

To control heat gain, reduce the risk of freezing to an acceptable level and prevent moisture ingress, insulate all condenser water pipework installations (including cold feed and open vent pipes) with pre-formed insulation sections, having a vapour barrier.

Use insulation material of one of the following types, as indicated by equipment schedule Y50, or any one of the following types where the schedule is silent on a preferred choice:

	Insulation material	Nominal density	Additional requirements
1	Rigid glass mineral wool	80 kg/m^3	
2	Rigid rock/stone mineral wool	120 kg/m^3	
3	Bore-coated/lined phenolic foam	35 or 40 kg/m^3	Produced without CFCs or HCFCs
4	Closed cell, flexible, elastomeric nitrile-rubber-based foam	65 kg/m^3	Produced without CFCs or HCFCs See note below if using ABS pipework

Verify compatibility, with both insulation and pipework manufacturers, if using ABS pipework and elastomeric nitrile rubber materials.

1133 Insulation thicknesses

Use the required minimum thicknesses of insulation from the following table, which has been derived from Tables 10 and 29 from BS 5422:2009 taking the greater of the two thicknesses for each pipe size to cover minimisation of heat gain and protection from freezing.

Nominal pipe size (mm)	**Max heat gain (W/m)**	**Minimum insulation thickness for 15°C difference between fluid temperature and ambient at a surface emissivity of 0.05 Declared thermal conductivity (W/mK) at insulation mean temperature**			
		0.025	**0.03**	**0.035**	**0.04**
		Minimum thickness of insulation (mm)			
15*	2.72	9	12	16	21
20	3.05	28	39	52	68
25	3.41	18	23	29	36
32	3.86	12	15	19	24
40	4.11	13	16	20	25
50	4.78	13	16	20	26
65	5.51	14	17	21	26
80	6.17	14	18	21	27
100	7.28	15	19	22	27
125	8.52	15	19	22	26
150	9.89	15	19	22	26
200	12.27	15	19	22	26
Other/flat	14.74	16	19	22	26

* Where there is a risk of freezing do not install 15 mm pipework unless it is trace heated for freeze protection.

For direction on whether it is necessary to insulate within plant rooms, see section T60 of this specification.

1140 Cold condensate installations (i.e. condensate associated with air systems)

1141 Preparation and painting before insulation is applied

For external pipework ensure that the need for trace heating is considered and where required has been installed and tested.

1142 Insulation materials

To prevent moisture ingress and prevent the condensation of moisture from the surrounding air, insulate all cold condensate pipework installations with pre-formed insulation sections, having an enhanced vapour barrier.

Use insulation material of one of the following types, as indicated by equipment schedule Y50, or any one of the following types where the schedule is silent on a preferred choice:

	Insulation material	Nominal density	Additional requirements
1	Bore-coated/lined phenolic foam	35 or 40 kg/m^3	Produced without CFCs or HCFCs
2	Closed cell, flexible, elastomeric nitrile-rubber-based foam	65 kg/m^3	Produced without CFCs or HCFCs See note below if using ABS pipework
3	Rigid rock/stone mineral wool	120 kg/m^3	Internal applications only

Verify compatibility, with both insulation and pipework manufacturers, if using ABS pipework and elastomeric nitrile rubber materials.

1143 Insulation thicknesses

For control of surface condensation use the required minimum thicknesses of insulation from the following table, which is based on Table 8 of BS 5422:2009 for internal services (using the part of the table for a fluid temperature of 10°C).

Nominal pipe size (mm)	**Minimum insulation thickness for fluid temperature of 10°C, ambient at 25°C and relative humidity 80%, surface emissivity of 0.05 Declared thermal conductivity (W/mK) at mean insulation temperature**				
	0.025	**0.03**	**0.035**	**0.04**	**0.045**
	Minimum thickness of insulation (mm)				
15*	14*	16*	18*	20*	23*
20	15	17	20	22	24
25	16	18	21	24	26
32	17	20	22	25	28
40	17	20	23	26	29
50	18	22	25	28	31
65	20	23	27	30	33
80	20	24	28	31	35
100	22	26	30	34	37

* Where there is a risk of freezing do not install 15 mm pipework unless it is trace heated for freeze protection.

1150 Freeze protection to pipework services that are normally uninsulated

For internal pipework services that are normally uninsulated, but require protection against freezing where they are routed within unheated areas and trace heating is not otherwise specified, including sprinklers, wet risers and other fire protection services.

1151 Preparation and painting before insulation is applied

For ferrous pipework, coat thoroughly with zinc phosphate anti-corrosion paint before pipework insulation is applied.

For external pipework ensure that the need for trace heating is considered and where required has been installed and tested.

1152 Insulation materials

To minimise the risk of freezing where pipework services are routed within internal areas of the building that are within the thermal insulation envelope but where those areas are unheated, insulate all such pipework with pre-formed insulation sections.

Use insulation material of one of the following types, as indicated by equipment schedule Y50, or any one of the following types where the schedule is silent on a preferred choice:

	Insulation material	Nominal density	Additional requirements
1	Bore-coated/lined phenolic foam	35 or 40kg/m^3	Produced without CFCs or HCFCs
2	Closed cell, flexible, elastomeric nitrile-rubber-based foam	65kg/m^3	Produced without CFCs or HCFCs See note below if using ABS pipework
3	Rigid rock/stone mineral wool	120 kg/m^3	
4	Rigid glass mineral wool	80 kg/m^3	Warm systems only (not for cold or chilled systems)

Verify compatibility, with both insulation and pipework manufacturers, if using ABS pipework and elastomeric nitrile rubber materials.

1153 Insulation thicknesses

To minimise the risk of freezing use the required minimum thicknesses of insulation from the following table, which is based on Table 28 of BS 5422:2009 (using specified conditions 1).

Nominal pipe size (mm)	**Minimum insulation thickness for fluid temperature of 5°C, ambient at -10°C, 12 h evaluation period, Nil permitted ice formation Declared thermal conductivity (W/mK) at mean insulation temperature**			
	0.020	**0.030**	**0.040**	**0.050**
	Minimum thickness of insulation (mm)			
15*	---*	---*	---*	---*
20	---*	---*	---*	---*
25	---*	---*	---*	---*
32	---*	---*	---*	---*
40	---*	---*	---*	---*
50	66	---*	---*	---*
65	41	75	---*	---*

80	31	54	84	---*
100	22	35	51	70
150	14	21	29	37
200	10	16	21	27

* Where there is a risk of freezing do not install these pipework sizes unless they are trace heated for freeze protection.

1200 INSULATION OF ASSOCIATED PIPEWORK SYSTEM COMPONENTS

1210 Insulation of stainless steel pipework

Irrespective of the pipework operating temperature, in accordance with BS 5970, wrap and secure aluminium foil of 0.06 mm minimum thickness around stainless steel pipework, with a water shedding overlap, to act as an anti-corrosion barrier between the insulation and the stainless steel.

1220 Insulation of brass valves and fittings operating at or below 15°C

After installation and leak testing but before applying any insulation, protect each brass valve and fitting with primer followed by butyl rubber tape sleeving wrap both meeting the manufacturer's specification, all applied in accordance with the manufacturer's instructions.

1230 Cold water service storage cisterns and feed & expansion cisterns

Do not insulate the faces nor the external flanges of cisterns/tanks that incorporate an insulated 'sandwich' construction.

To prevent moisture ingress and the condensation of moisture from the surrounding air, insulate all external surfaces of all internally located cold water service bulk storage cisterns/ tanks and feed and expansion cisterns (including both 'one-piece' and sectional types) with insulation having an enhanced vapour barrier, using material of one of the following types:

	Insulation Material	Nominal Density	Additional Requirements
1	Foil-faced phenolic foam slab	35 or 40 kg/m^3	Produced without CFCs or HCFCs
2	Closed cell, flexible, elastomeric, nitrile-rubber-based foam sheet	65 kg/m^3	Produced without CFCs or HCFCs
3	Rigid rock/stone mineral wool	120 kg/m^3	Internal applications only

For externally mounted cisterns use the thickness from the 'Ext' column and 'flat/other' pipe size in the table for cold water services, and for internally mounted cisterns that are not pre-insulated use thicknesses from the 'Int' column and 'flat/other' pipe size.

Apply the insulation to the top, bottom (except where support positions are at centres of 500 mm or less) and all sides of the tank. Insulate inspection covers individually.

Attach the insulation to the cistern/tank surfaces with sufficient suitable adhesive to provide a secure fixing. Use metal or nylon 'insulation hangers' on the insulation material providing their 'clips' are pulled in tight, their 'spindles' cut off close and, in the case of phenolic foam material, they are successfully sealed with aluminium tape. Do not use wire nor wire mesh to secure the insulation.

For externally flanged sectional cisterns/ tanks, fix the insulation material to the surface of the cistern/tank panels leaving the flanged joints exposed and uninsulated. Where using phenolic foam slab in such cases, terminate it short of the panel flanges and seal the edges of the insulation to the panel surface with self-adhesive glass-reinforced aluminium foil tape.

For internally flanged sectional cisterns/tanks, fix the insulation material to the surface of the cistern/tank panels covering the panel joints.

For any large internally installed sectional cistern/ tank where it is necessary to walk or crawl on its top for access to instruments, vent connections, inspection manholes, and suchlike, use insulation materials that are able to withstand such periodic access without damage and provide further fixed protection outside the insulation in the form of appropriate crawl-way/walkway access board(s).

Insulate overflows and warning pipes as for cold water services.

1240 Pumps and drip trays

Ensure that every baseplate-mounted and pedestal-mounted type cold water and chilled water pump or pump set, is mounted on a sheet galvanized steel drip tray, and that every such drip tray has been fitted with a plastic drain pipe routed to discharge over the nearest suitable floor drain.

To prevent condensation and control heat gain, apply vapour-sealed thermal insulation to the impeller casing of every cold water or chilled water pump. Use either a 50 mm thickness flexible rock/stone mineral wool layer overwrapped with glass-reinforced aluminium foil to form a vapour barrier and a removable stucco-embossed aluminium sheet purpose-made box, or a removable proprietary made pre-insulated jacket/muff of a type accepted by the Contract Administrator.

To provide personnel protection and control heat loss, insulate the impeller casing only, of every condensate (S51), HTHW, MTHW or LTHW pump. Use the thickness required by ‘Nominal pipe size’ in the particular table above for the respective pipework service, according to the nominal size of the pump discharge.

Do not insulate condenser water pumps.

1250 Valves, pipe joints and other equipment of pipework systems

Do not insulate nor clad the actuator (including the handwheel, hand lever, spring of pressure relief valves, electric motor, pneumatic actuator, diaphragm housing, lock shield) of valves.

Where purpose-made valve insulation boxes are in wet areas or external locations, seal them with suitable flexible sealant to produce a completely watertight installation.

Where such purpose-made boxes are in external installations for which hot-dip zinc-aluminium coated steel sheet cladding is used, make them of the same material as the cladding.

1251 Hot fluid installations

The term ‘hot fluid’ here means ‘steam (S51), condensate (S51), HTHW (T20), MTHW (T30), LTHW (T31), HWS (S11), solar and heat recovery’ systems.

Do not insulate (a) drain valves and drain cocks on condensate, LTHW, HWS and heat recovery systems, and (b) valves and union joints on uninsulated LTHW and HWS pipework exposed in rooms.

Other than the above, insulate every valve, every flanged joint, every union joint, every strainer and every steam trap set (except sight glasses) on such ‘hot fluid’ installations by enclosing it with removable insulation of one of the following types:

~ A proprietary insulated jacket packed with 60 kg/m^3 density mineral wool of sufficient initial thickness that its final worked thickness is not less than 25 mm (35 mm for steam, HTHW and MTHW systems). Use hard-wearing aluminium coloured flexible silicone rubber-impregnated/coated glass fibre fabric with a minimum finished weight of 580 g/m^2 and suitable for the temperature range of -36 to +260°C. Ensure that the composite fabric is fire resistant to BS 476-4 or BS EN 13501-1 rating B-s1,d0.

  Seal all joints and splits with industrial grade hook and loop fastening tape attached to the main body of the cover.

Use lubricated polyester cotton for all seam and edge stitching with 6 to 8 stitches per inch. Top-stitch all edges to the same specification.

Provide side-sealing by means of draw tapes manufactured from pre-stretched siliconised glass fibre fabric with industrial grade hook and loop 'Velcro' sewn on to both sides of the fabric. Arrange that the tapes are capable of being pulled tight to give a close fit on to the adjacent pipe insulation and are then held in place by the industrial grade hook and loop fastening tape.

Submit a sample jacket to, and obtain the acceptance of the Contract Administrator, before installation of any such jacket for the Works.

~ A proprietary two-part box made from a rigid thermal insulating material specified in the above tables for the service concerned, and complying with the following:

i) having a B-s1,d0 (formerly Class 0) surface spread of flame finish, and
ii) having re-usable quick-release stainless steel or aluminium spring clip fasteners for securing its two halves but enabling its removal and refitting for the purpose of inspection, and
iii) not being dependent upon anything else (including adhesive tape) for its fixing.

Cut square the insulation of the adjoining pipework leaving space for the removal of flange bolts and the use of pipefitting tools. Seal such cut ends.

Arrange such jackets and rigid thermal insulation boxes to overlap the insulation of the adjoining pipework.

Ensure that the box is free of sharp edges that could cause injury or could damage the jacket and is in accordance with BS 5970 Figure 25 or Figure 26 as appropriate.

1252 Cold fluid installations (with an enhanced vapour barrier)

The term 'cold fluid' here means cold water (S10, S12, S13, S20, T90), refrigeration (T60, T62, T70, T71, T72) and chilled water (T61) systems.

Insulate every valve, every automatic air vent, every flanged joint, every union joint and every strainer, by enclosing it with removable insulation of one of the following types:

~ A jacket of closed-cell, flexible, elastomeric nitrile-rubber-based foam material with all circumferential and longitudinal insulation joints sealed with a suitable waterproof bonding adhesive in accordance with the manufacturer's instructions. Use the thickness required by 'Nominal pipe size' in the particular table above for the respective pipework service.

~ A proprietary two-part box made from a rigid thermal insulating material specified in the above tables for the service concerned, and complying with the following:

i) having a B-s1,d0 (formerly Class 0) surface spread of flame finish, and
ii) with its joints sealed with self-adhesive glass-reinforced aluminium foil tape, and
iii) having re-usable quick-release stainless steel or aluminium spring clip fasteners for securing its two halves but enabling its removal and refitting for the purpose of inspection, and
iv) not being dependent upon anything else (including adhesive tape) for its fixing.

Cut square the insulation of the adjoining pipework leaving space for the removal of flange bolts and the use of pipefitting tools. Seal such cut ends.

Arrange such jackets and rigid thermal insulation boxes to overlap the insulation of the adjoining pipework.

Ensure that the box is free of sharp edges that could cause injury or could damage the jacket and is in accordance with BS 5970 Figure 25 or Figure 26 as appropriate.

If such jackets or rigid thermal insulation boxes are removed for any reason (e.g. inspection, maintenance or repairs of insulated fittings or equipment) ensure that, at their subsequent reinstallation, all joints are re-sealed with adhesive or with self-adhesive glass-reinforced aluminium foil tape, as appropriate, to achieve a complete enhanced vapour barrier as required for their original installation.

1300 THERMAL INSULATION OF DUCTWORK INSTALLATIONS (U10 TO U72, AS APPLICABLE)

1310 Preparation and painting before insulation is applied

Clean off all loose material and touch-up with zinc phosphate anti-corrosion paint all parts of the external surfaces of sheet galvanized steel ductwork where the galvanizing is damaged, before thermal insulation is applied.

Where externally mounted horizontal rectangular ductwork is to be fitted with zinc-aluminium coated sheet steel cladding, fix, before its insulation is applied, the required ‘Z’ section to its underside.

1320 Ductwork insulation generally

To control heat gain, control heat loss, prevent moisture ingress and prevent the condensation of moisture from the surrounding air, insulate with an insulation material having a vapour barrier, all rectangular, circular and flat-oval:

~ supply ductwork (including fresh air intakes and supply ductwork that forms part of a recirculation or heat recovery system);

~ extract ductwork that forms part of a recirculation or heat recovery system;

~ exhaust discharge ductwork that forms part of a heat recovery system (ie carrying extract air from which heat has been recovered).

Do not insulate non-recirculation extract ducts except where required to provide fire protection/resistance or acoustic insulation.

For rectangular ducts, use only individually-cut slabs applied to each surface; do not wrap insulation around the corner edges of the ductwork. On horizontal rectangular ducts arrange the insulation of the top and bottom surfaces of the duct to overlap that of the sides. On vertical rectangular ducts arrange the insulation of two opposite surfaces to overlap that of the other two.

Secure the insulation to the ducts with sufficient suitable insulation bonding adhesive, fully in accordance with the insulation and adhesive manufacturers’ written installation instructions.

On every rectangular or flat-oval insulated duct where any duct width, height or side is greater than 300 mm, in addition to adhesive, use proprietary glued-on or self-adhesive nylon ‘insulation hangers’ on the duct’s underside and on its vertical sides, so that no ‘insulation hanger’ is more than 300 mm from another, and no insulation edge or corner is more than 150 mm from an ‘insulation hanger’. Secure the insulation to the hangers with proprietary 50 mm diameter plastic clips and cut off the ‘pin’ of every hanger close to the clip fully in accordance with the hanger manufacturer’s written installation instructions. Vapour-seal the hanger clip by covering with a crossed double layer of self-adhesive glass-reinforced aluminium foil tape, rated at B-s2,d0 (formerly Class 0) surface spread of flame, except where nitrile rubber insulation material is used in which case cover the clip with a glued-on layer of nitrile rubber foam to maintain the vapour barrier. Where the cut ends of the clips may penetrate the insulation vapour barrier install additional anti-penetration protection over the clip ends prior to over-taping.

On every circular insulated duct up to 315 mm diameter, in addition to adhesive, secure the insulation by aluminium bands of 12 mm minimum width, at 600 mm intervals. On every circular insulated duct over 315 mm diameter, in addition to adhesive, secure the insulation by aluminium bands of 12 mm minimum width, at 450 mm intervals.

Seal all cut edges of insulation at access doors, dampers, control sensors and the like, using self-adhesive glass-reinforced aluminium foil tape, rated at B-s1,d0 (formerly Class 0) surface spread of flame, or, where nitrile rubber insulation material is used, with a suitable waterproof bonding adhesive in accordance with the manufacturer’s instructions.

1330 Insulation materials for rectangular ducts

Insulate rectangular ductwork using insulation material of one of the following types, as indicated by equipment schedule Y50, or any one of the following types where the schedule is silent on a preferred choice:

	Insulation material	Nominal density	Declared conductivity at 10°C	Additional requirements
1	Semi-rigid glass mineral wool slabs	48 kg/m^3	0.037 W/mK	Insulation to be resin bonded
2	Semi-rigid rock/stone mineral wool slabs	45 kg/m^3	0.037 W/mK	Insulation to be resin bonded
3	Phenolic foam slabs with glass tissue finish on the inside face	40 kg/m^3	0.021 W/mK	Produced without CFCs or HCFCs
4	Closed cell, flexible, elastomeric, nitrile-rubber-based foam sheet	65 kg/m^3	0.035 W/mK	Produced without CFCs or HCFCs

1340 Insulation materials for circular and flat-oval ducts

Insulate circular and flat-oval ductwork using insulation material of one of the following types, as indicated by equipment schedule Y50, or any one of the following types where the schedule is silent on a preferred choice:

	Insulation material	Nominal density	Declared conductivity at 10°C	Additional requirements
1	Flexible glass mineral wool lamella mat	28 kg/m^3	0.042 W/mK	
2	Flexible rock/stone mineral wool lamella mat	45 kg/m^3	0.042 W/mK	

3	Phenolic foam 'v-slot' material with glass tissue finish on the inside face	40 kg/m^3	0.021 W/mK	Produced without CFCs or HCFCs. Use flat slabs on the flat sides of flat-oval ducts
4	Closed cell, flexible, elastomeric, nitrile-rubber-based foam sheet	65 kg/m^3	0.035 W/mK	Produced without CFCs or HCFCs

1350 Insulation thicknesses for ductwork

Take the required minimum thicknesses of insulation from the following tables, which are based on Tables 12, 13 and 14 of BS 5422:2009:

Indicative minimum thickness of insulation for ductwork carrying warm air to control heat loss; maximum permissible loss 16.34 W/m^2 (BS 5422 Table 13)

Minimum insulation thickness for air at 35°C with ambient at 15°C. Thermal conductivity at insulation mean temperature (W/mK)						
0.02	**0.025**	**0.03**	**0.035**	**0.04**	**0.045**	**0.05**
Thickness of insulation (mm) with low emissivity facing: 0.05						
17	21	25	29	33	38	42
Thickness of insulation (mm) with medium emissivity facing: 0.44						
21	26	31	36	41	46	51
Thickness of insulation (mm) with high emissivity facing: 0.90						
22	27	33	38	44	49	54

Indicative minimum thickness of insulation for chilled and dual-purpose ducting to control heat transfer; maximum permissible gain 6.45 W/m^2 (BS 5422 Table 14)

Minimum insulation thickness for air at 13°C with ambient at 25°C. Thermal conductivity at insulation mean temperature (W/mK)						
0.02	**0.025**	**0.03**	**0.035**	**0.04**	**0.045**	**0.05**
Thickness of insulation (mm) with low emissivity facing: 0.05						
29	36	43	50	57	64	71
Thickness of insulation (mm) with medium emissivity facing: 0.44						
33	41	49	58	66	74	82
Thickness of insulation (mm) with high emissivity facing: 0.90						
35	43	52	61	69	78	86

Minimum insulation thickness for condensation control on ductwork carrying chilled air in ambient conditions (BS 5422 Table 12)

Minimum insulation thickness for still air with ambient at 25°C, 80% relative humidity. Thermal conductivity at insulation mean temperature (W/mK); and low (0.05), medium (0.44) and high (0.90) emissivity facing												
Minimum air temp inside duct	**0.02**			**0.025**			**0.03**			**0.035**		
	low	**mid**	**high**	**low**	**mid**	**high**	**low**	**mid**	**high**	**low**	**mid**	**high**
	0.05	**0.44**	**0.9**	**0.05**	**0.44**	**0.9**	**0.05**	**0.44**	**0.9**	**0.05**	**0.44**	**0.9**
15°C	15	8	5	18	9	6	22	11	7	25	13	8
10°C	26	10	9	32	17	11	39	20	13	45	23	15
5°C	37	19	12	47	24	15	56	28	18	64	33	21

0°C	48	25	16	60	31	20	72	37	24	84	43	27

Minimum air temp inside duct	**0.04**			**0.045**			**0.05**		
	low	**mid**	**high**	**low**	**mid**	**high**	**low**	**mid**	**high**
	0.05	**0.44**	**0.9**	**0.05**	**0.44**	**0.9**	**0.05**	**0.44**	**0.9**
15°C	29	15	10	32	17	11	36	18	12
10°C	52	26	17	58	29	19	64	33	21
5°C	75	38	24	83	42	27	92	47	30
0°C	96	49	31	108	56	35	120	61	39

1360 Access doors and panels

Ensure that all access doors and access panels in insulated ductwork and equipment, are of the proprietary sheet galvanized steel, double skin, internally insulated type.

1370 Fire-resisting ductwork

Where required/specified install fire-resisting ductwork system(s) complying with the requirements of Building Regulations Part B and the ASFP Blue Book latest edition.

Install fire-resisting ductwork systems strictly in accordance with the ASFP Blue Book and chosen manufacturer's instructions.

Where pins are used to support insulation as part of the fire resisting duct system use only welded pins not self-drill type.

Refer to specification section Y30.

1400 MEASURES TO ACCOMMODATE EXPANSION, CONTRACTION AND VIBRATION

Insulate all pipework expansion loops as for the pipe service.

Provide all pipework thermal expansion bellows and compensators with removable insulation as specified for valves. Where the adjoining pipework is clad, encase every such insulated bellows and compensator with a box as specified for valves. Ensure that every such box incorporates the means for expansion and contraction to be taken up without hindrance to the action of the bellows or compensator.

When applying insulation to pipework thermal expansion bellows of corrugated tube construction, fit a curved sheet metal cover to support the insulation material and prevent its fibres from dropping into the convolutions of the bellows.

Where allowance has to be made for the vibration movement of equipment connected to insulated pipework (e.g. at pump connections) finish the edge of the insulation on the adjoining rigid pipework in a neat and approved manner and enclose the anti-vibration pipe coupling in flexible insulation material. Where the pipework system requires a vapour barrier, seal the foil facing of the flexible insulation to that of the adjoining insulation using self-adhesive glass-reinforced aluminium foil tape of 75mm minimum width, rated at B-s1,d0 (formerly Class 0) surface spread of flame, to maintain the continuity of the vapour barrier. Fit over the insulated anti-vibration pipe coupling and its joints, a removable insulated box that permits ready access for the inspection, removal and reinstallation of the anti-vibration pipe coupling without disturbing the adjoining rigid pipework insulation. Where appropriate make the box of sufficient size to enclose adjacent components, e.g. valves.

Do not insulate anti-vibration pipe couplings on condenser water pipework.

Insulate anti-vibration couplings on DHW and LTHW pipework using removable covers.

Where flexible hoses are installed (except on chilled water operating at 14°C or above) between equipment and insulated pipework (e.g. at fan coil connections, if permitted) use a proprietary pre-insulated flexible hose. Finish the end of the insulation on the adjoining rigid pipework neatly with insulation cut squarely and, on chilled water systems, fit a removable insulated jacket over the joint of the flexible hose and associated isolating valve, that permits access for the inspection, removal and reinstallation of the flexible hose without disturbing the adjoining rigid pipework insulation.

Where allowance has to be made for the vibration movement of equipment connected to insulated ductwork (e.g. at axial fan connections), leave the flexible duct connection uninsulated but finish the insulation on the adjoining rigid ductwork by (except for nitrile rubber insulation material) fixing to the duct an 'end-cap' for the perimeter of the duct insulation. Make it of sheet cladding material folded in 'angle' or 'Z bar' form ('crocodile-cut' to fit curved surfaces), to provide a means for protecting the exposed edge of the insulation and to provide a surface for the fixing of self-adhesive glass-reinforced aluminium foil tape, rated at B-s1,d0 (formerly Class 0) surface spread of flame, to effectively seal the aluminium foil facing of the duct insulation by 'dressing' it to the duct surface.

1500 TEST POINTS

At every 'test measurement' hole in insulated ducting ensure that the hole is fitted with a grommet before applying the insulation.

At every such location arrange a piece of the insulation (and cladding where applicable) to be readily removable and re-fittable to facilitate the use of measuring instruments. Where such holes are arranged in a row (e.g. for air flow measurement), arrange a single piece of insulation (and cladding where applicable) to cover the entire row of holes.

Fix to the duct, for the perimeter of the duct insulation surrounding the removable piece, a 'frame' to provide a means for protecting the exposed edge of the insulation and to provide a surface for (except for nitrile rubber insulation material) fixing self-adhesive glass-reinforced aluminium foil tape, rated at B-s1,d0 (formerly Class 0) surface spread of flame, to effectively seal the aluminium foil facing of the duct insulation by 'dressing' it to the duct surface. Make the frame of sheet metal cladding material folded in 'angle' or 'Z bar' form ('crocodile-cut' to fit curved surfaces).

Make a removable 'access panel' of sheet metal cladding material, secured to the adjoining 'frame' with PK screws. Fix insulation with adhesive to the inner face of the removable 'access panel' and, where the insulation has an aluminium foil facing, seal all cut edges of it with self-adhesive glass-reinforced aluminium foil tape, rated at B-s1,d0 (formerly Class 0) surface spread of flame.

Where the test point is in a wet area seal the 'access panel' to the adjoining cladding with suitable flexible sealant to produce a completely watertight installation.

1600 PROTECTION OF THERMAL INSULATION

1610 Protection of pipework, ductwork and plant and equipment generally

Fit protection against physical damage to pipework, ductwork and plant and equipment insulation and any associated vapour barrier, in accordance with the following clauses, in the following locations:

- plant rooms up to a minimum height of 2100mm AFFL
- external plant areas and installations (e.g. rooftops, compounds and exposed distribution).
- places where the insulation is near equipment that requires routine attendance for its operation and/ or maintenance

~ areas where the insulation is vulnerable to mechanical damage from moving vehicles, items being transported or items being manhandled, including: car parks, commercial and institutional kitchens, laundries, loading bays, materials stores, test laboratories, warehouses and workshops
~ wet areas
~ places where the insulation is vulnerable to damage by personnel movement including where it is unavoidably installed below normal head clearance height, is liable to be climbed over, etc

For the purpose of this clause ‘plant areas’ means ‘any area or room or part thereof containing any of the following’:

~ heat transfer equipment
~ fans, air handling units
~ pumps, boosters, pressurisation equipment
~ cisterns, tanks, cylinders

For the purpose of this specification ‘wet areas’ are:

~ rooms in which the insulation is vulnerable to spillages of water
~ places where the insulation is occasionally vulnerable to rainwater if temporarily uncovered

Examples of such ‘wet areas’ are:

~ kitchens, including covered services trenches in kitchen floors
~ sluice rooms
~ swimming pool halls
~ communal shower rooms
~ car parks, unless fully enclosed, e.g. underground or in basements
~ workshops where washing down processes take place
~ fully covered external underground service trenches (but not those covered by open steel-grid flooring, nor underground walkway service ducts that are constructed to be dry)

For the purposes of this cladding and protection specification ‘external areas’ are those outside the building envelope and include:

~ underground service trenches covered by open steel-grid flooring
~ plant areas and services at ground level
~ services mounted on high level gantries
~ services mounted externally on the walls and under soffits of buildings
~ rooftop-mounted installations

Use one of the following types of cladding system in the circumstances described below unless directed otherwise by Equipment Schedule Y50. Later clauses describe the requirements for each system in more detail.

Permissible cladding systems and circumstances of use for each

Reference	Description	Applicable Internal areas			Applicable Internal wet areas			External areas		
		Pipes	Ducts	Plant and equipment	Pipes	Ducts	Plant and equipment	Pipes	Ducts	Plant and equipment
1	Stucco aluminium 0.7 - 0.9mm	✓								
2	Stucco aluminium 0.9mm		✓	✓						
3	Stucco Aluzinc corrugated							✓	✓	✓
4	Standard polyester aluminium laminate	✓	✓		✓	✓		✓	✓	
5	Heavy grade polyester aluminium laminate			✓			✓			✓
6	Proprietary cladding for elastomeric nitrile insulation	✓	✓		✓	✓		✓	✓	✓
7	PVC sheet cladding	✓	✓		✓	✓	✓			

Ensure that accessories (e.g. temperature sensors, trace heating cable terminations, manometer tubing, etc) are completely installed before the protection is added, and are not damaged by the protection.

Arrange all horizontal cladding joints so that the higher piece overlaps the lower piece and stagger longitudinal joints on adjoining sheets, to assist in shedding water and preventing moisture ingress.

Use cladding material fabricated and installed strictly in accordance with the manufacturer’s instructions. Ensure that the completed cladding system in external areas and wet areas provides a completely weatherproof installation and in internal areas a complete protective cover.

Ensure that the installed cladding system does not damage the insulation nor compromise its vapour barrier.

Ensure that all multi-layer laminated composite aluminium polyester cladding products comply with class B surface spread of flame to BS EN 13501 Part 1 (previous applicable standard was BS 476 class 0)

Do not use factory-made composite insulation/cladding products on ductwork installations or where pipework insulation is required to have a vapour barrier.

Only install multi-layer laminated composite aluminium polyester cladding products when ambient conditions and surfaces are dry.

Ensure that multi-layer laminated composite aluminium polyester cladding products are installed strictly in accordance with the manufacturer’s recommendations and that minimum 150 mm wide sealing tape is used ensuring 75 mm overlapping seals in all cases.

Where multi-layer laminated composite aluminium polyester cladding products are installed, hand over one full roll of sealing tape to the Contract Administrator for the client to use for repairs to the cladding system.

1620 Cladding systems

1621 System reference 1 for pipework: stucco aluminium 0.7 to 0.9mm thickness

Use stucco embossed aluminium cladding, of minimum sheet thickness 0.7 mm for insulation of less than 150 mm outside diameter and of minimum thickness 0.9 mm for insulation of 150 mm outside diameter or greater.

Roll or press all aluminium cladding sheets to the required diameters. Provide a slip joint, of 500 mm overlap, at every 3600 mm.

Secure the aluminium cladding at both ends of every sheet and at 300 mm centres maximum, using aluminium bands arranged to mask circumferential joints, and having reusable fasteners. Pop rivets or PK screws may be used as an alternative, except on cold water service and chilled water service, to ensure, as far as practically possible, that the vapour barrier is continuous and undamaged.

Cut and segment as necessary to fit bends and junctions. 'Ball-swage' all circumferential joints at bends.

1622 System reference 2 for internal plant, equipment and ductwork: stucco aluminium 0.9mm thickness

Use stucco embossed aluminium cladding of minimum sheet thickness 0.9 mm.

Overlap all longitudinal and circumferential sheeting joints by a minimum of 50 mm and secure with pop rivets at 150 mm pitch.

Neatly manufacture all joints by overlapping adjacent sheets and securing with pop rivets, except that on cold water service or chilled water service use spring clip fasteners.

1623 System reference 3 for external locations: corrugated stucco aluzinc coated steel sheet

Use factory-fabricated cladding of stucco embossed finish, shallow corrugated profile, hot-dip zinc-aluminium coated steel sheet, having 'self-healing' anti-corrosion characteristic at cut edges, and manufactured to BS EN 10346 or equivalent.

Use material of the following thicknesses:

~ Pipework where insulated OD. is less than 150 mm	0.4 mm
~ Pipework where insulated OD. is 150 mm or more	0.5 mm
~ Valve and pipe ancillary boxes	0.5 mm
~ Ductwork	0.6mm

Fabricate and install in accordance with the manufacturer's instructions, to provide a completely weatherproof installation that does not damage the insulation nor its vapour barrier and to achieve a 25 year maintenance-free life.

Arrange the line of corrugations of the material perpendicular to the axis of piping.

Use roll-formed, lock-formed, swaged or jointed joints, mitred at bends and tees. Where the piping has an insulated outside diameter of 200 mm or more, form 'lobster-back' cladding at bends.

Use overlapped swaged joints at the junction of adjoining sheets sealed by a 'gasket' bead of silicone sealant.

Arrange the longitudinal joints along the lowest part of the underside of horizontal piping. Form such joints with a minimum 50 mm overlap sealed by a 'gasket' bead of silicone sealant.

Secure all cladding sheets by fitting at both ends of every sheet and at intervals of 400 mm, a 19 mm wide, 0.4 mm thick band of plain zinc-aluminium coated steel with a banding clip. Where such bands are impractical secure such longitudinal laps with self-sealing stainless steel pop rivets dipped in mastic prior to fitting. Install such rivets at regular intervals of 150 mm maximum.

Arrange the line of corrugations of the material perpendicular to the axis of circular ducting, flat oval ducting and rectangular ducting.

Use roll-formed, lock-formed, swaged or jointed joints.

On circular ducting or flat-oval ducting use mitred joints at bends and tees except that where it has an insulated outside diameter of 200 mm or more, form ‘lobster-back’ cladding at bends. Use overlapped swaged joints at the junction of adjoining sheets sealed by a ‘gasket’ bead of silicone sealant.

Arrange the longitudinal joints along the lowest part of the underside of horizontal circular ducting. Form such joints with a minimum 50 mm overlap sealed by a ‘gasket’ bead of silicone sealant. Stagger longitudinal joints on adjacent sheets. Secure such sheets by 19 mm wide, 0.4 mm thick bands of plain zinc-aluminium coated steel, fitted at both ends of every sheet and at intervals of 400 mm, with banding clips. Where such bands are impractical secure such longitudinal laps with self-sealing stainless steel pop rivets dipped in mastic prior to fitting. Install such rivets at regular intervals of 150 mm maximum.

On horizontal rectangular ductwork fix a plain zinc-aluminium coated steel ‘Z’ section continuously along the centre of its underside before its insulation is applied. Make the bottom cladding in the form of a tray with upturned sides and secure it to the ‘Z’ section with self-sealing stainless steel pop rivets dipped in mastic prior to fitting. Make the top cladding in the form of an inverted tray with its downturned sides overlapping the cladding sheets fitted to the sides of the insulated duct. Arrange the side sheets to overlap the upstands of the bottom sheet. Stagger the end joints of side sheets, top sheets and bottom sheets. Seal all overlapped joints by a ‘gasket’ bead of silicone sealant and secure such joints with self-sealing stainless steel pop rivets dipped in mastic prior to fitting. Install such rivets at regular intervals of 150 mm maximum.

On vertical rectangular ductwork arrange cladding sheets with ‘tray’ formed sheets overlapping flat sheets and with upper sheets overlapping lower sheets. Seal all overlapped joints by a ‘gasket’ bead of silicone sealant and secure such joints with self-sealing stainless steel pop rivets dipped in mastic prior to fitting. Install such rivets at regular intervals of 150 mm maximum.

Arrange the line of corrugations of the material perpendicular to the axis of horizontal cylindrical vessels. Arrange the line of corrugations vertically on vertical cylindrical vessels and ‘rectangular’ cisterns and tanks.

1624 System reference 4: standard polyester aluminium self-adhesive laminate

Use stucco embossed aluminium finish/matt-black finish/white finish as appropriate multi-layer laminated aluminium polyester composite self-adhesive cladding product.

Provide a manufacturer’s 10-year guarantee.

Install metal corners under the cladding to ensure a neat finish.

For all parts of the cladding installation capable of being attacked by fauna (particularly birds) install a minimum 0.5 mm thick aluminium sheet between the cladding and insulation over the top half of the insulation section to provide enhanced mechanical protection. Alternatively install the heavy grade product, as system reference 5, in such situations.

Where installed on rectangular ductwork and other flat top system parts ensure that the heavy duty cap sheet/aluminium reinforcing sheets used are large enough to turn down the duct sides by at least 75 mm so ensuring the entire top of the duct is fully protected and the cladding is not compromised at the corners.

1625 System reference 5: heavy grade polyester aluminium self-adhesive laminate

Use heavy duty stucco embossed aluminium finish/white finish 13-layer laminated aluminium polyester composite self-adhesive cladding product.

Provide a manufacturer’s 10-year guarantee.

Where the insulation cladding is in an area where it may be walked/stepped on install a 1 mm thick aluminium sheet under the cladding to provide enhanced mechanical protection.

Install metal corners as necessary under the cladding to ensure a neat finish.

1626 System reference 6: elastomeric nitrile insulation manufacturer proprietary cladding system

Where nitrile rubber insulation has been installed and a factory-made proprietary cladding product made by the insulation manufacturer is available, install this strictly in accordance with the manufacturer’s instructions. Where a proprietary product is not available install one of the alternative cladding systems detailed in the table.

1627 System reference 7: PVC sheet cladding

Use rigid PVC sheeting of 0.35mm thickness for insulation of less than 150mm outside diameter and of 0.5mm thickness for insulation of 150mm outside diameter or greater.

Secure the PVC sheeting at both ends of every sheet and at 300mm centres maximum, with aluminium bands arranged to mask circumferential joints, and having reusable fasteners. Draw tight the cladding over the insulation of all fittings and pipework prior to fitting bands, to ensure all laps are snug fitting. Pop rivets may be used as an alternative to bands, except on cold water service and chilled water service to ensure, as far as practically possible, that the vapour barrier is continuous and undamaged.

Ensure that PVC material is not in contact with hot surfaces.

To all bends and tees fit pre-formed fittings-cladding of 0.5mm PVC sheet thickness, but applied prior to the cladding of adjoining pipework.

Where suitable pre-formed bends are not available cut the sheeting to form 'lobster-back' bends secured by suitable adhesive. Where suitable pre-formed tees are not available mitre the sheeting of the branch pipe with that of the main pipe.

Overlap all longitudinal and circumferential sheeting joints by a minimum of 50mm.

Ensure that the termination of the insulation and cladding adjacent to uninsulated pipeline equipment (eg sight glasses) is capped with aluminium terminals to the same thickness as the cladding.

Cover all corners with matching PVC corner angles secured with adhesive.

At ductwork bends and transformation pieces, shape the PVC sheeting to follow the contours of the ductwork insulation surface.\

1630 Ensure that the termination of ductwork insulation and cladding adjacent to uninsulated ductwork or equipment is capped with cladding.Protection of insulation general

Protect insulation on pipework and ductwork, and plant and equipment where it has not been fitted with protective cladding at the manufacturer’s works, in the locations and using a protection system as detailed above and the subsequent cladding system clauses.

For plant and equipment not fitted with insulation at the manufacturer’s works, insulate it using insulation materials described in the appropriate table for the service concerned and to thicknesses noted for ‘other surfaces’ in the appropriate table.

Secure the insulation to the plant and equipment with adhesive and by encompassing it with aluminium bands of 12 mm minimum width, at 300 mm intervals, or other suitable fixing arrangement, all of which will be unaffected either by chemical reaction with the plant surface and the surrounding environment, or by the heat generated by the plant.

Apply the insulation cut in segments and suitably shaped to fit domed and other non-flat surfaces. Seal all joints (except for nitrile rubber insulation material) with self-adhesive glass-reinforced aluminium foil tape of 75 mm minimum width, rated at B-s1,d0 (formerly Class 0) surface spread of flame. Seal joints in elastomeric nitrile insulation using adhesive applied strictly in accordance with the insulation manufacturer's instructions.

Unless specified in the system sections of this specification, do not protect from physical damage pipe or duct insulation installed greater than 3000 mm above finished floor level within buildings.

For internal locations where the cladding is penetrated (e.g. by damper handles, instrument probes) form a piece of cladding material cut to fit closely around the penetration and fit to effectively and neatly cover around the penetration. Secure such aluminium covers with PK screws and any PVC or multi-layer laminated aluminium polyester composite material covers with adhesive.

For all penetrations of the cladding in external and wet locations fit a purpose-made cover plate or collar of the same material as the cladding (e.g. at pipe support drop rods, damper spindles, instrument mountings and wherever a pipe, conduit or similar connection passes through the cladding). Secure each cover with self-sealing stainless steel pop rivets dipped in mastic prior to fitting for alu-zinc steel cladding and using adhesive for the other cladding systems. Seal each cover with suitable flexible sealant to produce a completely weatherproof installation.

Where access is required (e.g. to fire dampers) form an opening in the cladding to suit the opening in the insulation, and neatly finish the cladding with a collar of the same material and thickness as the cladding, leaving no edges of insulation exposed. Wherever a pipe, conduit or similar connection passes through the cladding in areas that are neither wet nor external, fit a purpose-made cover plate or collar of the same material as the cladding, secured with PK screws for aluminium and adhesive for other cladding products.

Ensure that plant and equipment manufacturers' labels are readily observable and covered neither by insulation nor by cladding.

Where access is required (e.g. to bursting discs) form an opening in the cladding to suit the opening in the insulation, and neatly finish the cladding with a collar of the same material and thickness as the cladding, leaving no edges of insulation exposed. In wet and external areas secure the collar with adhesive and seal its edges with suitable flexible sealant, and where necessary glass-fibre reinforced aluminium tape, to produce a completely watertight installation.

Where components need to be removed for routine maintenance (e.g. at the flanged joints of heater battery chests and manholes), completely encase each of them with a removable insulated box of the same material as the cladding where alu-zinc sheet has been used, and otherwise using 0.9 mm stucco embossed aluminium. Arrange such boxes to overlap the adjoining cladding and seal the junctions. For wet and external areas seal all joints of the box with suitable flexible sealant to produce a completely watertight installation.

In wet areas fit protection against physical damage and to render watertight the pipework and ductwork insulation and plant and equipment.

Where possible ensure that installations vulnerable to wetting and in external locations are arranged without penetrations of the insulation by valve spindles, damper spindles, instrument mountings, brackets, etc. Where such penetrations are unavoidable, minimise their vulnerability to water ingress by arranging them to be downward facing, or in vertical surfaces.

Seal all penetrations of PVC sheeting or self-adhesive laminate (e.g. at valve spindles, pipe support drop rods, damper handles, instrument mountings), with suitable flexible sealant to produce a completely watertight installation.

Where possible arrange that all external ductwork is circular in cross section. Where horizontal ductwork is rectangular or flat-oval type, arrange where possible, that the ductwork is fitted with a slight gradient to assist in shedding rain. Where zinc-aluminium coated steel sheet is used for cladding external services, ensure that all cladding of external pipework, ductwork and plant is of the same material throughout the project.

Where the installation is within 2 km of the sea and is clad with zinc-aluminium coated steel sheet, consult the cladding material manufacturer regarding its susceptibility to corrosion and obtain the agreement of the Contract Administrator before ordering the cladding materials.

1640 Boiler flue-pipe (T10)

Where not pre-insulated twin-wall or concentric type, insulate single-skin flues within buildings up to their junction with the associated chimney, with mineral wool mat of thickness advised by the flue manufacturer to limit the surface touch-temperature and heat gain within the space according to the equipment served. Protect the resins within the thermal insulation from deterioration through high temperature by facing on both sides with galvanized steel wire mesh supported on an expanded metal concentric ‘tube’ held off the flue by 25 mm steel spacer pieces welded to the flue at 300 mm pitch. Secure the insulation with 25 mm steel bands at 200 mm intervals.

Protect the insulation with stucco embossed aluminium cladding of 1.2 mm thickness within buildings and 1.9 mm thickness where external. Where other external services are clad with zinc-aluminium coated steel sheet, use the same material for cladding external boiler.

Ensure that all longitudinal joints and joints between sheets of cladding have an overlap of 50 mm and are secured with pop rivets at 150 mm centres.

Arrange all horizontal cladding joints so that the higher piece overlaps the lower piece to assist in preventing moisture ingress.

Where access is required (e.g. to ‘clean out’ covers) completely encase each of them with a removable insulated box of the same material as the cladding.

Do not insulate the air intake, header and discharge ducts of flue dilution systems.

1700 MATERIALS CONTAINING ASBESTOS

1710 Asbestos removal

No asbestos removal work is required as part of the works relating to this specification.

All asbestos removal necessary to facilitate the works relating to this specification will have been arranged and carried out by others and clearance certificates issued, prior to the need for the works to commence in any affected area on site.

1720 Action in the event that asbestos is discovered or suspected during the works

Stop work immediately in the affected area.

All personnel vacate the affected area, closing off the area on the way out if this is possible or, as a minimum, posting signage warning others not to enter.

As soon as possible explain the issue to the Principal Contractor and Contract Administrator and await further instruction.

Contact your organisation's Health and Safety team for advice on any personal decontamination or other measures felt necessary or appropriate.

1800 SCHEDULE OF INSTALLER'S SUBMITTALS

1810 At tender submission

Submit the following documentation to the Contract Administrator at the time of tender:

- ~ confirmation of the insulation materials and cladding materials proposed for each pipework service

Include sufficient detail for indicating how compliance with each of the following specification requirements (where relevant) will be achieved:

- ~ a protective coating to insulated copper pipework conveying cold services
- ~ a protective coating to insulated copper fittings conveying cold services
- ~ a protective coating to stainless steel pipework conveying hot services
- ~ a protective coating to stainless steel fittings conveying hot services
- ~ full compatibility between pipework materials and insulation materials (including pipework support blocks)
- ~ methodology for insulating flanges and fittings to maintain vapour barrier integrity
- ~ methodology for achieving electrical bonding where fabrication techniques do not otherwise assure this through metallic contact alone

Alternative materials to those indicated in the specification may not be considered unless such alternative proposals are notified with the tender return.

There is however, no obligation by the Contract Administrator to consider any such alternative materials either at the time of tender or post-tender.

1820 Post tender acceptance

Submit the following documentation to the Contract Administrator in good time for comment prior to ordering components or commencing any installation works:

- full submission details confirming technical and declared performance of all proposed insulation materials
- full submission details confirming technical and declared performance of all support blocks proposed including demonstration of the closed-cell content where the material is phenolic foam
- full submission details confirming sealants and tapes proposed for vapour barriers or other protection
- full submission details confirming performance details for proposed finishes and protective cladding
- full submission details confirming proposed hot and cold valve/flange insulation boxes or jackets
- full submission details demonstrating compliance with required system maximum W/m heat gains/losses
- full submission details confirming proposals for sealing brass items and fittings on plastic coated pipe installations on cold fluid installations

- where ABS and elastomeric nitrile materials are used in combination, a warranty covering their combined use from both the insulation manufacturer and pipework manufacturer

1830 Samples of insulation materials, vapour barriers and cladding

If requested by the Contract Administrator, submit samples of any insulated pipe supports, insulation materials, vapour barriers, sealants and tapes, jackets and valve boxes, and cladding offered for incorporating into the Works, in the specific sizes requested or a range of representative sizes. Submit samples in good time for comment prior to commencing any installation works.

1840 Site-fabricated samples of insulation, vapour barriers and cladding

Produce site-fabricated samples of all types of insulated pipe supports, insulation materials, vapour barriers and cladding intended for incorporating into the Works. Ensure that samples are sufficiently complete to form representative mock-ups that fully demonstrate the intended site fabrication techniques and full compliance with the specification requirements. Submit site-fabricated samples to the Contract Administrator in good time for comment prior to commencing any installation works.

END OF SECTION Y50

Y51 TESTING AND COMMISSIONING OF MECHANICAL SYSTEMS

CONTENTS

Y51 TESTING AND COMMISSIONING OF MECHANICAL SYSTEMS

100 REFERENCE DOCUMENTS

This specification is written based on legislation, standards and guidance in force in the UK generally, and within England by default. For projects in Scotland, Wales, Northern Ireland, the Channel Islands and the Isle of Man, give appropriate consideration to any locally applicable legislation, standards and guidance that deviates from or is additional to those in force within England. Similarly for projects outside the UK comply with the corresponding national legislation, standards and guidance.

Comply fully with the edition (including amendments, replacements and associated normative references) of each of the following, current at the time of tender, in addition to those standards specified in the individual system specification sections.

Where a standard referred to in this section conflicts with a standard referred to in an associated ‘engineering system’ section (e.g. S10, T31, U10, etc) of this specification, the standard referred to in the engineering system section prevails.

ASHRAE	ASHRAE Handbook, HVAC Applications
BCGA CP4	British Compressed Gas Association Code of Practice 4 - Gas supply and distribution systems (excluding acetylene)
BSRIA TM1/88.1	Commissioning of HVAC Systems: Guidance on the division of responsibilities
BSRIA AG 9/2001	Standard specification for BMS
BSRIA AG 16/2002	Variable flow water systems. Design, installation and commissioning guidance
BSRIA AG 20/95	Commissioning of pipework systems. Design considerations
BSRIA BG 1/2009	Building services job book – a project framework for engineering services
BSRIA BG 2/2010	Commissioning water systems
BSRIA BG 6/2018	Design framework for building services
BSRIA BG 8/2009	Model commissioning plan
BSRIA BG 11/2010	Commissioning job book. A framework for managing the commissioning process
BSRIA BG 44/2013	Seasonal Commissioning
BSRIA BG 46/2015	Domestic ventilation systems – a guide to measuring air flow rates
BSRIA BG 49/2015	Commissioning air systems
BSRIA BG 57/2015	Legionnaires’ disease. Risk Assessment
BSRIA BG 58/2015	Legionnaires’ disease. Operation and maintenance log book
BESA DW/143	Guide to good practice. Ductwork air leakage testing
BESA TR/6	Guide to good practice. Site pressure testing of pipework
BESA TR/20	Installation and testing of pipework systems
BRA / IoR	Guide to good commercial refrigeration practice: Part 5 – commissioning
CIBSE Guide H	Building control systems
CIBSE Commissioning Code A	Air distribution systems
CIBSE Commissioning Code B	Boilers
CIBSE Commissioning Code C	Automatic controls
CIBSE Commissioning Code M	Commissioning management
CIBSE Commissioning Code R	Refrigerating Systems

CIBSE Commissioning Code W	Water distribution systems
CIBSE Knowledge Series KS09	Commissioning variable flow pipework systems
CIBSE CP1	Heat networks code of practice for the UK
Good Practice Guide 347: Installation and commissioning of refrigeration systems. Carbon Trust, 2003	
HM Government	Building Regulations Approved Documents
HM Government	Domestic building services compliance guide
HM Government	Domestic ventilation compliance guide
HM Government	Non-domestic building services compliance guide
HSE GS4	Safety requirements for pressure testing
IGE/UP/1	Strength testing, tightness testing and direct purging of industrial and commercial gas installations
IGE/UP/1A	Strength testing, tightness testing and direct purging of small, low pressure industrial and commercial natural gas installations
IGEM/UP/1B	Tightness testing and direct purging of small Liquefied Petroleum Gas/Air, NG and LPG installations
IGEM/UP/4	Commissioning of gas-fired plant on industrial and commercial premises
UKLPG CoP 17	Purging LPG vessels and systems
UKLPG Cop 22	Design, installation and testing of LPG piping systems
BS EN 14175-2	Fume cupboards – Part 2: Safety and performance criteria
DD CEN/TS 14175-5:2006. Fume cupboards. Recommendations for installation and maintenance	
BS EN 12469	Biotechnology – Performance criteria for microbiological safety cabinets.
Labs21	Commissioning section: http://www.labs21.org.uk/commissioning.htm

200 SYSTEMS TO BE COMMISSIONED

For details of the systems to be commissioned, refer to specification section B4.

300 GENERAL

310 Roles and responsibilities

Follow the defined position of the various parties in the commissioning process as set out in BSRIA TM 1/88.

311 Specialist commissioning engineer

Directly employ a “specialist commissioning engineer” to undertake commissioning of the mechanical engineering systems. Appoint the specialist commissioning engineer at the most appropriate time in the pre-construction period to ensure the necessary involvement and site visits for examination of drawings and exchange of information. Ensure that the specialist commissioning engineer undertakes a review of the installation drawings and include any additional components deemed by the specialist commissioning engineer to be required to ensure all systems are fully commissionable. Identify those systems that must also be commissioned and operational (eg electrical power systems, etc) in order that successful commissioning of the mechanical systems may occur. Advise the Contract Administrator, well in advance of the start of testing and commissioning, of any issues identified by the specialist commissioning engineer as being likely to affect the successful outcome of the commissioning.

Y51 TESTING AND COMMISSIONING OF MECHANICAL SYSTEMS

These clauses relate to commissioning of the mechanical engineering systems. The commissioning of other engineering systems, or items of plant, may be undertaken by the installer or the manufacturer but commissioning of interfaces between systems is to be witnessed by all parties concerned and proven to operate to the satisfaction of all parties concerned.

312 Witnessing agent

Appoint a "witnessing agent" to undertake the duties detailed in CIBSE Commissioning Codes. These duties are separate from and are not to be confused with the witnessing carried out by the Contract Administrator or his representative.

320 Commissioning periods

Identify clearly, as an integral part of the construction programme, the periods representing the testing and commissioning of the engineering works and separately identify all associated costs in the tender make-up sheet.

330 Labour, materials and other provisions

Provide all labour, materials, equipment and plant necessary to achieve the standards and performance specified for testing and commissioning.

Provide all test equipment necessary for testing and commissioning and on request demonstrate that the instruments used are accurate within the permitted tolerances when compared with recognised standards, and that they have been calibrated within the last 12 months.

Provide adequate specialist staff to operate and maintain the systems throughout the testing and commissioning procedures.

Where required by specification section A42, provide fuel, water and electricity, as necessary, for the execution of the specified works:

- ~ for testing of sections of work, items of plant and each completed system
- ~ for commissioning, performance and acceptance testing and demonstration of all systems

340 Commissioning method statement

Submit, well in advance of the programmed commissioning stage, a method statement showing a full understanding of the testing and commissioning requirements. Set out in the statement the methods and resources to be employed at each stage of the process, and a programme to identify all the systems involved, their dependency on the operation of other mechanical and electrical systems and on the availability of water, electricity, gas, energy sources, and drainage.

350 Rectification of defects

Repeat as necessary, until satisfactory, any testing and commissioning and/or re-commissioning arising from rectification, at any stage, of defects in workmanship, materials, performance, maladjustments and other irregularities.

360 Reports and records

Submit throughout the commissioning period, on a weekly basis, commissioning progress reports.

Keep progressive records of testing and commissioning results and other "as installed" information for completion of record drawings and operation and maintenance instruction manuals.

370 Witnessing and notification

Allow a minimum of seven working days' notice, in writing, for appropriate persons to attend inspections and witness tests or demonstrations at works or on site.

Provide all necessary facilities and assistance for the employer's insurance company representative to attend inspections or witness tests, as required.

All client costs associated with abortive witnessing (ie where the system(s) being demonstrated fail to achieve the specified performance, and the demonstration has to be repeated at a later date) may be deducted from monies owing to the installer.

380 Definitions

The definitions apply as listed in BSRIA publications BG 2/2010 and BG 49/2015, for commissioning of air and water systems in buildings.

390 General

Follow the recommendations, on planning, installation, inspection, reporting and documentation of the BSRIA publications BG 2/2010 and BG 49/2015, the CIBSE Commissioning Codes and BESA DW Ductwork Specifications.

Pay particular attention to the following:

~ protect sensitive or fragile items of plant and electrical equipment from dirt, damp and other damage

~ observe manufacturers’ setting-to-work procedures and recommendations

~ determine and record the correct operation and sequence of automatic- or manually-operated fire control, alternative working selection, or duplicate plant changeover controls

~ ensure safety in the event of failure of, and following sudden resumption of, electricity supply by the correct operation of safety interlocks and equipment protection devices designed to protect personnel, such as those associated with the high voltage side of electrostatic filters and with remote electrically operated plant

~ lock in their finally commissioned positions all regulating valves, dampers and similar devices, or where locking is not possible, permanently mark the final agreed setting positions

~ ensure grease or lubricant is applied as required for working parts at all times and prior to handover, and fit extended grease nipple points to all inaccessible positions

~ after completion and acceptance of commissioning, return all systems and consumables to an ‘as new’ condition

~ ensure sufficient tappings for pressure measurement are installed adjacent to differential pressure control valves and flow limiting valves to enable these valves to be properly commissioned

~ check the selections for commissioning sets or other flow measurement devices are as specified in specification section Y11, in respect of the signal pressure generated at the specified water flow rate, and the pressure loss imposed on the system

~ check that the minimum straight upstream and downstream pipe lengths recommended by the manufacturer are present for each commissioning set or other flow measurement device

400 TESTING AT WORKS

Ensure inspecting and testing at manufacturer’s works, where specified in the ‘engineering system’ specification sections, comply with standards and codes of practice, and, if specified, are witnessed by the appropriate parties.

Include in the operation and maintenance instruction manuals duplicate test certificates for works tests.

500 STATIC TESTING

510 General

Carry out satisfactory pressure, air leakage and thermal expansion tests before the application of paint, insulation or other cladding, as appropriate.

520 Pre-commissioning checks for pipework and ductwork systems

Visually examine the installation to ensure the following:

- the piping/ductwork is supported adequately
- piping/ductwork is arranged, insulated, painted, identified and labelled correctly, as applicable
- hand wheels or levers are fitted to valves/dampers with clear indication of open/closed position and the direction to open or close
- grub screws on all motorised valves/dampers fixings have been correctly tightened
- electrical bonding is complete
- before soundness testing, all joints on underground piping are exposed and provided with adequate temporary support
- all valves, dampers, actuators, sensors and test locations have been suitably labelled
- test and purge points are fitted where appropriate and are accessible by test equipment
- warning notices are correctly installed
- installation drawings and line diagrams have been prepared and fitted at the primary gas meter and/or elsewhere as appropriate

530 Concealed sections of work

Individually test while still visible, any sections of a system that are to be permanently buried or concealed.

540 Pressure and leakage testing

Carry out pressure and air leakage testing in sections as the work proceeds and to suit the construction programme.

Carry out pressure and air leakage testing on complete systems, following any cleaning or scavenging, but before any disinfection or fumigation specified.

Carry out pressure testing after a preliminary inspection for leakage with the pipework full of water at nominal pressure.

Fill each system with the appropriate hydraulic or pneumatic test medium at normal pressure and inspect for leakages.

Apply the full pressure tests specified and with the pressurising equipment disconnected, hold these pressures for the period specified, without signs of leakage or distress to the system.

550 Thermal expansion tests

In conjunction with programme requirements, bring steam, condensate or high temperature hot water (HTHW) systems up to operating conditions, allow the system to cool and then check for leakages.

Where early concealment of a system is dictated by the particular nature of the programme for the works, make allowance for temporary provision of heating or cooling equipment.

Y51 TESTING AND COMMISSIONING OF MECHANICAL SYSTEMS

560 Protection of system equipment

When pressure testing, remove or isolate items of equipment set to operate below the test pressure. If not removed, limit expansion joint movement using bolts.

570 Draining after testing

Drain pipework systems following testing and refill with clean water, treated water, preserving solution, inert gas or low pressure air as appropriate to suit the stage of the programme for the works and as recommended in section 4 of BSRIA BG 2/2010.

580 Pipework distribution systems

Comply with the procedures in BESA TR/6, where applicable the water authority's requirements, and the precautions in HSE Guidance Note GS4.

Test concealed or buried pipework before any permanent covering is applied and advise appropriate personnel, in advance, of the time pressure tests may be witnessed.

Hydraulically pressure test for one hour's duration as follows:

581 Steam, condensate, HTHW and MTHW pipework

Steam: test pressure = 1.5 x boiler maximum safety valve release pressure

Condensate: test pressure upstream of trap set = 1.5 x maximum working pressure of pressurised steam main

Condensate: test pressure downstream of trap set = 7 bar gauge

HTHW: test pressure = 1.5 x maximum working pressure of system ie safety valve setting, or 40 bar gauge whichever is greater

MTHW: test pressure = 1.5 x maximum working pressure of system ie safety valve setting, or 10 bar gauge for 6 bar gauge operating systems and 25 bar gauge for 16 bar gauge operating systems whichever is greater

Visually re-check the system when the working fluid is applied and the system is at working pressure and temperature and again after the system has been allowed to cool and the working fluid is again introduced.

582 LTHW, chilled water and condenser cooling water pipework

- operating gauge pressure less than 3.5 bar: test gauge pressure = 7.0 bar
- operating gauge pressure 3.5 to 7.0 bar: test gauge pressure = 2 x operating pressure
- operating gauge pressure 7.0 to 16.0 bar: test gauge pressure = 1.5 x operating pressure

583 Hot and cold water pipework, internal domestic, not buried

- operating gauge pressure less than 3.5 bar: test gauge pressure = 7.0 bar
- operating gauge pressure 3.5 to 7.0 bar: test gauge pressure = 2 x operating pressure
- operating gauge pressure 7.0 to 16.0 bar: test gauge pressure = 1.5 x operating pressure

584 Fire mains

- operating gauge pressure less than 3.5 bar: test gauge pressure = 7.0 bar
- operating gauge pressure 3.5 to 7.0 bar: test gauge pressure = 2 x operating pressure
- operating gauge pressure greater than 7.0 bar: test gauge pressure = 14 bar or 1.5 x operating pressure, whichever is the greater

585 Feeds, open and closed vents, drains, overflow and warning pipes

- ~ operating gauge pressure less than 3.5 bar: test gauge pressure = 7.0 bar
- ~ operating gauge pressure 3.5 to 7.0 bar: test gauge pressure = 2 x operating pressure
- ~ unpressurised gravity drain pipework: air test equal to 38 mm water gauge

586 Mains and pressurised cold water, external buried

- ~ operating gauge pressure less than 7.0 bar: test gauge pressure 10 bar or 1.5 x operating pressure, whichever is the greater
- ~ operating gauge pressure greater than 7.0 bar: test gauge pressure 14 bar or 1.5 x operating pressure, whichever is the greater

Where MDPE or similar non-metallic pipework is used, obtain the manufacturer’s assistance to ensure correct procedures for the pressure testing. Prior to commencement of pressure testing, provide a certified manufacturer's drawing showing all restraint and provisions for expansion and demonstrate that such requirements have been met.

587 Plastic pipework

For plastic pipework systems within the scope of BS EN 806 (those conveying water for human consumption), hydraulically pressure test in accordance with BS EN 806-4, interpreting “Maximum Design Pressure” to mean 1.5 times the maximum operating pressure of the system, and using method C in preference to method B where this choice is applicable.

For other plastic pipework systems, hydraulically pressure test in accordance with the procedure for plastic pipework in BESA TR/6, using a test pressure of 1.5 times the maximum working pressure, or the maximum working pressure plus 5 bar, whichever is the greater, or as specified in the system specification section.

590 Plant and equipment testing

For tanks and cylinders operating at atmospheric pressure, test the structural soundness and water tightness under ‘tank full’ conditions. Ensure that there are no resulting distortions or leakages.

Hydraulically test calorifiers and heat exchangers in accordance with specification section Y23.

Pressure test boilers to twice the operating pressure or to the manufacturer’s safety limit, whichever is the lower pressure.

Unless otherwise agreed, inspect fans for balance under supervision of the manufacturer’s representative.

Keep a systematic record of all tests.

600 COMMISSIONING

610 Commissioning codes

Commission installations in accordance with current best practice, the current Building Regulations, and with the procedures, checks and suggested tolerances provided in the CIBSE Commissioning Codes, BSRIA Guides and other documents as listed in clause 100.

620 Installation (static completion)

Achieve a state of readiness to commence commissioning when each commissionable system has been successfully completed as follows:

- installed in accordance with the specification and drawings with all outstanding remedial works completed
- final installation inspection carried out, all mechanical and electrical inspection and pre-commissioning check lists completed
- successfully pressure and leakage tested as specified
- flushed and cleaned and refilled or protected, all in accordance with specification section Y25 and BSRIA BG 2/2010, as specified
- all test certificates, reports and manufacturers' information collated
- surrounding areas clean, and free from obstruction for access to commissionable equipment
- identification and labelling complete
- with all dampers, valves, control devices, test points, gauges, thermometers and other specified items adjusted and in good working order
- with the installation checked mechanically and electrically for safe operation and ready for commissioning

Do not commence commissioning until the building is in a condition suitable for commissioning works to commence.

700 PARTICULAR TEST PROCEDURES

710 General

Refer to the "Testing and commissioning" clauses in each of the applicable 'engineering system' specification sections.

Where a system is not covered in the following sub-clauses or in the "Testing and commissioning" clauses in the applicable 'engineering system' specification section, carry out test procedures in accordance with the manufacturer's written instructions, the relevant British or other Standards and, if appropriate, the relevant Hospital Technical Memoranda (HTM).

Obtain system design performance, flow rates and velocities from the drawings, specifications and schedules. Where there is conflict between the drawings, specifications and schedules, draw this to the attention of the Contract Administrator and seek clarification on the values to be used for commissioning.

Verify that the values for system design performance, flow rates and velocities still remain valid for the equipment selected for use within the works and make any adjustments necessary to the installation schematic drawings and summation of flow rates to account for the actual configuration of the installation.

In the commissioning method statement, record the design information to be used for commissioning, or make reference to the other specific documents in which it is contained.

720 Commissioning and balancing of low temperature hot water heating and chilled water systems

Carry out checks and procedures in accordance with CIBSE Commissioning Code W and check lists in BSRIA BG 2/2010. Prior to commissioning, clean water systems as detailed in BSRIA BG 29/2012.

Apply tolerances defined in CIBSE Commissioning Code W.

Use instruments for measurement detailed in BSRIA BG 2/2010, section 5.

Allow for one change of pulley and/or belts for each belt-driven pump drive, as necessary, when operating the pump and measuring the actual system characteristics, to achieve the specified performance.

721 Constant volume water distribution systems

Set to work and regulate constant volume water distribution systems in accordance with CIBSE Commissioning Code W and procedures in BSRIA BG 2/2010.

Proportionally balance the sub-circuit downstream of each branch valve, and similarly proportionally balance all branches within the system.

Commission constant speed pumps in accordance with CIBSE Commissioning Code W and BSRIA BG 2/2010, including recording pump performance at the design condition.

Demonstrate the proportional balance of the system with all control valves fully open.

722 Variable volume water distribution systems

Set to work and regulate variable volume water distribution systems in accordance with CIBSE Commissioning Code W and procedures in BSRIA BG 2/2010. Where necessary refer also to BSRIA AG 16/2002, section C and CIBSE KS9.

Proportionally balance the sub-circuit downstream of each differential pressure control valve or flow limiting valve.

Set up and adjust all differential pressure control valves and flow limiting valves (including bypass differential pressure control valves), in accordance with CIBSE Commissioning Code W and with the valve manufacturer's instructions. Where specified, employ the valve manufacturer to undertake the setting up and adjustment of these valves.

Commission variable speed pumps and their variable speed drives in accordance with CIBSE Commissioning Code W and BSRIA BG 2/2010, including recording pump performance at a minimum of four load conditions. Set differential pressure set points for pump speed control in accordance with CIBSE KS9. Ensure that all inverters and their controls are adjusted and commissioned by the inverter manufacturer in conjunction with the commissioning engineer responsible for commissioning the system served by the pump. Ensure that the specified minimum and maximum speeds are set.

Demonstrate the proportional balance of the system with all control valves fully open. Demonstrate that all differential pressure control valves and flow limiting valves (including bypass differential pressure control valves) are correctly adjusted. Also demonstrate the operation of the system in a number of simulated part load conditions. Include in the commissioning method statement proposals for the number of part load conditions to be simulated, the means of simulating them, and the method of proving successful system operation. Obtain the Contract Administrator's agreement to the methodology prior to the start of commissioning.

Monitor the pump speeds during the environmental testing period to demonstrate that the speed changes as the load changes.

730 Commissioning of Heat Networks

Carry out commissioning following the procedures in CIBSE Commissioning Code M: Commissioning Management, Code B: Boilers, Code C: Automatic Controls, Code W: Water Distributions Systems and an energy balance to ensure the metering is working correctly.

731 Documentation of procedure

Establish a commissioning and testing procedure based on the design specification description of operation and the BMS & Controls specification section W60. Ensure that the procedure involves proving and testing during day and night operation and at various times during the first year in service, when suitable system loads are available. Where necessary, arrange for artificially induced loads by changing set points or using load banks.

Arrange that on completion of commissioning a written handover process is followed to enable the operating organisation to take full control.

732 Energy centre plant

Ensure that each item of plant in the energy centre is commissioned and that the commissioning procedure incorporates the integrated operation of the entire plant to deliver the required levels of service at the expected levels of operation and efficiency.

Arrange that the stable and efficient operation of the plant is demonstrated at all expected load conditions and in particular at low load conditions.

733 Low-carbon heat source

Arrange a specific demonstration to show that the low-carbon heat source is controlled to operate as the lead unit and to maintain its output as secondary heat sources are brought into line.

734 Sensor points

Arrange that each sensor point connected to the BMS or SCADA system is checked to prove it is correctly addressed and providing a consistent and correct signal.

735 Low flow conditions

Arrange for specific checks to be carried out at times of minimum demand to verify that bypass flows have been correctly set up and controlled and that the required pressure differences are achieved at all points of the network and that excessive pressure differences are not found at periods of low flow.

736 On-site acceptance testing

Appoint an appropriately qualified heat network specialist to carry out on-site acceptance tests, including;

~ energy centre heat efficiency (%)

~ average CO_2 content of heat produced at the energy centre over an agreed period of time ($kgCO_2/kWh$)

~ heat network loss per dwelling or thermal substation (kWh)

~ average flow and return temperatures at energy centre boundary (°C)

~ district heating network loss per linear metre

~ average return temperature from each building or block and a selection of HIUs while domestic hot water is being drawn off (°C)

~ seven day ‘’reliability run’’ to show that the plant runs as required

Where practical, begin acceptance testing at the energy centre and move progressively to the heat consumers and subsequently proceed to demonstrate that the integrated operation of the entire heat network will deliver the required levels of service and expected levels of operation and efficiency.

On completion of the testing provide a written Acceptance test summary report produced by the heat network specialist summarising the acceptance testing, including any problem encountered and fault mitigation measures taken. Where tests have failed, provide a failure log detailing the mitigation carried out to achieve full acceptance in order that performance guarantees can be met.

In residential developments, carry out an initial set of tests on a small number of dwellings to establish common criteria that can be followed before testing the remainder of the estate.

Following commissioning of all the HIUs and secondary/tertiary circuits within the building/s, carry out independently inspected acceptance tests on a sample (in increments of 10%) of the circuits until it can be established that the service levels and design return temperatures have been achieved.

Assess and adjust the operation and control of the main system circulating pumps and differential pressure sensors to ensure they comply with the design description of operation, especially when newly built-out phases are brought on line.

737 Post-handover support

Arrange to provide supporting attendance for a minimum of 12 months after handover of the completed installation to carry out seasonal checks and to fine-tune the control system.

740 Commissioning of refrigeration systems

Follow the procedures given in CIBSE Commissioning Code R for use and handling of refrigerants, pressure and leak testing, evacuation and dehydration, charging and lubrication of refrigeration systems. Also follow the manufacturer's written instructions.

Carry out checks and procedures for preliminary checks, testing, setting to work and adjusting detailed in CIBSE Commissioning Code R and the manufacturer’s written instructions. Use instruments and apparatus detailed in CIBSE Commissioning Code R. Apply tolerances defined in CIBSE Commissioning Code R.

750 Commissioning and balancing of air distribution systems

Carry out checks and procedures in accordance with CIBSE Commissioning Code A, section A1 and check lists in BSRIA BG 49/2013, section 9. Prior to commissioning, clean air ductwork systems and remove all debris.

Air leakage test all air ductwork including associated equipment in accordance with BESA DW ductwork specifications (refer to specification section Y30).

Apply tolerances defined in CIBSE Commissioning Code A.

Use instruments and methods of measurement detailed in CIBSE Commissioning Code A, Appendix AA3.1 and in BSRIA BG 49/2015, sections 5 and 6.

Set to work and regulate air distribution systems in accordance with CIBSE Commissioning Code A, and procedures detailed in BSRIA BG 49/2015, section 7.

For domestic ventilation systems follow the testing procedures and use instruments in accordance with BSRIA BG 46/2015, as appropriate to the type of ventilation system.

Determine the air quantities by the velocity pressure method, using a pitot tube and inclined gauge manometer or electronic manometer.

Where, due to space limitations or air turbulence within the ductwork, the total air quantity cannot be determined by the velocity head method, calculate volume flow rates using a manometer at the main outlet or discharge louvres. Likewise, for the same conditions, the air quantities at the inlets or outlets or branch ducts may be added to provide a result for the branch duct connection.

Adjust ductwork dampers, diffusers and grilles to provide specified air movement, without draughts and free from excessive air turbulence or unacceptable noise.

Locate test points at appropriate positions in the ductwork where air turbulence is minimal.

Allow for one change of pulley and/or belts for each belt-driven fan drive, as necessary, when operating the fan units and measuring the actual system characteristics, to achieve the specified performance.

For twin-fan units, provide full commissioning data for fan 1 with check figures on all main branches for fan 2. Test and prove the auto-changeover functionality on twin-fan units.

760 Commissioning of thermal energy meters

Carry out testing, verification and commissioning of thermal energy meter equipment in accordance with specification section W66.

770 Specialised equipment

Commission specialist equipment at a suitable stage in the program such that the equipment can be put into storage or operated continuously, to avoid re-contamination.

780 Thermal imaging

Where specified, carry out a survey using a thermal imaging camera capable of producing a digital image that can be downloaded and viewed on a computer, incorporated into reports and printed.

Arrange for the survey to be carried out by a specialist company or for the camera to be operated by a person specifically trained in its use.

790 Ultra-sonic flow measurement

Where water flow rate measurement by conventional means is problematical, eg on existing systems with inadequate or inoperative orifice plates, the installer may, with the written permission of the Contract Administrator, use a portable clamp-on ultra-sonic flow meter, utilising transit time flow measurement technology.

Take measurements in accordance with the instrument manufacturer’s instructions, with regard to the setting-up and operation of the instrument, and the selection of the measuring position (distance from bends, etc).

Ensure that the instrument is suitable for the fluid, temperature, pipework material and anticipated flow rate to be measured. Ensure that the instrument has a stated accuracy on flow rate measurement of ±3% or better. Ensure that the instrument has a current calibration certificate and include a copy of the calibration certificate in the commissioning report.

800 COMMISSIONING AND TESTING REPORT

810 Content

Prepare and supply two copies of the typed commissioning report, each bound, or presented in a ring binder folder sectioned with index to cover each engineering service. Base the commissioning report on the information required by the CIBSE Commissioning Codes, and include the following topics:

- works test certificates
- site test certificates
- commissioning inspection reports
- commissioning results and final settings
- performance and acceptance test reports
- pressure vessel certificates and electrical certificates as required by the employer's insurers

820 Air handling equipment commissioning sheets

Ensure air handling equipment commissioning sheets include all the design information and measured data in the pro-forma air distribution system fan performance test sheet in BSRIA BG 49/2015, but also the following items:

- for units containing mixing chambers, the total air volume, return air volume and outside air volume (m^3/s)

- ~ air-side and water-side coil pressure drops
- ~ filter pressure drops
- ~ fan curves with the measured operating points and design operating points marked on (multiple points for variable speed fans)

830 Exhaust/extract fan commissioning sheets

Ensure fan commissioning sheets include all the design information and measured data in the pro-forma air distribution system fan performance test sheet in BSRIA BG 49/2015. Include fan curves with the measured operating points and design operating points marked on (multiple points for variable speed fans).

840 Diffusers, grilles and registers, commissioning sheets

Ensure diffusers, grilles and registers commissioning sheets include results/information for the following items:

- ~ fan systems and/or zone number
- ~ room number or area designation
- ~ outlet code number, corresponding to outlet code number on air balance code drawing
- ~ size of outlet - manufacturer's listed size
- ~ type of outlet - manufacturer's model designation
- ~ manufacturer of outlet
- ~ manufacturer's effective area for each size
- ~ required air flow rate (m^3/s) at each outlet
- ~ initial air flow rate (m^3/s) at each outlet
- ~ final air flow rate (m^3/s) at each outlet
- ~ setting of regulating device
- ~ all relevant measuring device calibration charts
- ~ percentage of design volume achieved

Provide line drawings of each air distribution system (including fans, supply, recirculation and extract air terminals, and volume control devices) indicating zone numbers with all components identified using alpha-numeric references that correspond to the commissioning sheets.

850 Water system commissioning sheets

Ensure the water system proportional balance commissioning sheets include all the design information and measured data in the pro-forma water balance test sheet in BSRIA BG 2/2010. Include all relevant calibration charts for flow measurement devices.

Ensure that the pump commissioning sheets include all the design information and measured data in the appropriate pro-forma plant performance test sheet in BSRIA BG 2/2010. Include pump curves with the measured operating points and design operating points marked on (multiple points for variable speed pumps).

For all plant items record the following:

- ~ inlet water temperature (where appropriate)
- ~ leaving water temperature (where appropriate)

~ pressure drop across item of plant (kPa)

Provide line drawings of each water distribution system (including pumps, strainers, check valves, regulating valves, commissioning sets and terminals units) indicating zone numbers with all components identified using alpha-numeric references that correspond to the commissioning sheets.

860 Heating coil and cooling coil commissioning sheets

Ensure the commissioning sheets for heating and cooling coils include the following design information and measured data:

~ manufacturer, model, serial number and rated capacity

~ pressure drop across control valves (for 3-port valves, measure in full flow and bypass)

~ bypass DRV setting (where appropriate)

~ air flow rate

~ air temperature (dry bulb and wet bulb) on-coil

~ air temperature (dry bulb and wet bulb) off-coil

~ water temperature on-coil

~ water temperature off-coil

~ water pressure drop across coil

~ air pressure drop across coil

870 Ventilation heat recovery device commissioning sheets

Ensure the commissioning sheets for heat recovery devices include the following design information and measured data (as appropriate to the device):

~ manufacturer, model, serial number and rated capacity

~ donor airstream air flow rate

~ donor air temperature (dry bulb and wet bulb) on-coil

~ donor air temperature (dry bulb and wet bulb) off-coil

~ receiving airstream air flow rate

~ receiving air temperature (dry bulb and wet bulb) on-coil

~ receiving air temperature (dry bulb and wet bulb) off-coil

~ donor air pressure drop across device

~ receiving air pressure drop across device

~ flow rate of the associated hydronic circuit (where relevant to run-around coils)

~ pressure drop of the associated hydronic circuit (where relevant to run-around coils)

~ flow and return fluid temperatures of the associated hydronic circuit (where relevant to run-around coils)

900 PERFORMANCE AND ACCEPTANCE TESTING

910 General

Commission all systems and plant, to the design performance specified, and obtain satisfactory results prior to making arrangements for performance demonstration and acceptance.

Use record sheets as detailed in BSRIA publications BG 2/2010, BG 46/2015 and BG 49/2015 and in the clauses above, to establish results, actual and design, for the final acceptance of the commissioning and performance testing stages.

Ensure all necessary calibration data, pump and fan characteristic curves, and details of plant duty are readily available on site, together with copies of all commissioning results and a set of ‘as-installed’ record drawings of the installation, showing all plant settings, air volumes, temperatures, water flow rates, pump heads and noise level readings as measured in the final commissioned state. Include these in the commissioning and testing report.

920 Demonstration

Demonstrate, for each commissioned system or item of plant, in a manner appropriate to the function and performance requirement, that each system installation performs correctly, provides the duties required and maintains conditions within the specified limits under varying plant loading.

930 Controls

Include the proper functioning of automatic controls, protective and alarm devices during acceptance tests, as well as demonstrating that the commissioning results are acceptable and within tolerances previously agreed with the Contract Administrator. Where unacceptable results are obtained, re-commission the system after any necessary adjustments or modifications.

940 BMS soak test and environmental tests

Following completion of all testing and commissioning, witnessing, demonstrations, and rectification of any outstanding items, carry out a BMS soak test and environmental tests in accordance with specification section W60. Refer to specification section W60 for the duration of these tests, which is usually not less than seven days.

Arrange the necessary attendance from all personnel, sub-traders and specialists to successfully complete the tests.

950 Approvals

Once the installations are in a suitable condition, arrange for inspections to take place by statutory bodies and others who are required to give approval to any of the engineering systems. These include the following, as applicable:

- ~ local water authority
- ~ local gas authority
- ~ employer’s insurance company

Obtain approvals in writing and include copies of the approvals in the operating and maintenance instruction manuals.

1000 SEASONAL COMMISSIONING

1010 Scope

Seasonal commissioning constitutes the validation of building performance under full-load operating conditions during the peak heating and peak cooling seasons, as well as under part-load conditions.

Y51 TESTING AND COMMISSIONING OF MECHANICAL SYSTEMS

During the 18 months after handover, seasonally commission the building's environmental systems as part of this contract. Include the engineering service systems detailed in specification section B4 in this seasonal commissioning exercise.

Prior to the start of seasonal commissioning, confirm that:

- ~ all meters are reading correctly
- ~ all BMS graphics are reading correctly
- ~ the BMS graphics are a reasonable representation of the system schematics
- ~ the automatic meter-reading system (if applicable) is connected and recording data from all relevant meters over a suitable time period
- ~ all remote monitoring has been established and is operational
- ~ all systems have been commissioned at maximum and minimum loads

Visit, and arrange for the BMS installer and the specialist commissioning engineer to visit the building on a quarterly basis during the 18 months after practical completion on a quarterly basis in order to carry out adjustments/fine tuning of the mechanical services installations throughout the building.

1020 Quarterly report

Produce, and submit no later than one week prior to each quarterly seasonal commissioning review meeting, a quarterly report on the operation of the mechanical services installations.

Include in the quarterly report an assessment of the overall consumption of electricity, gas, other fuels where applicable, and water, of the building and compare this with the design data. Also assess the performance against design of all major systems and sub systems. Identify, as applicable, daily and monthly:

- ~ building cooling consumption
- ~ building heating consumption
- ~ provision of cooling by different devices, the seasonal performance of those devices (for example, chillers, heat pumps, dry air coolers etc), and the hourly performance cross-referenced to outside air temperature
- ~ provision of heating and hot water by different devices, the seasonal performance of those devices (for example, boilers, combined heat and power devices, solar thermal panels, biomass boilers, heat pumps, etc), and the hourly performance cross-referenced to outside air temperature
- ~ provision of water from any rainwater harvesting systems and compare to relevant rain water levels
- ~ electricity generated by different devices and the performance of those devices (for example CHP, solar PV panels, fuel cells, etc)

1030 Seasonal commissioning activities

Carry out the following seasonal commissioning activities as a minimum:

- ~ comparison of meter data with predicted performance
- ~ review of set points and dead bands
- ~ review of real occupancy hours and level (with the building FM manager)
- ~ discussion of perceived performance / comfort levels

~ review of sensor and driver plots and compare with actual occupancy

~ detailed performance review of weather compensation

~ detailed performance review of night set back

~ detailed performance review of night purging

~ detailed performance review of heat reclaim devices

Agree working periods for carrying out seasonal commissioning activities with the client's facilities management personnel and ensure that these working periods fit in with the client's business operations. Arrange for facilities management or maintenance staff to be available to assist with plant operation / switching, shut-downs, access arrangements etc. It may be necessary for certain tasks to be carried out when the building is heavily, or conversely lightly, populated. Agree with the facilities management staff when these conditions occur and programme seasonal commissioning activities accordingly.

Advise the Contract Administrator at least two weeks in advance of when seasonal commissioning will be taking place. Allow facilities management personnel and / or the Contract Administrator's appointed representative to observe the seasonal commissioning work.

Be responsible for executing all seasonal commissioning work, including the provision of appropriately qualified personnel and all necessary equipment and materials. Organise all input required from plant and equipment suppliers and sub-contractors.

Correct any performance deficiencies found during seasonal commissioning.

Carry out all seasonal commissioning work in accordance with the project commissioning specification, an approved commissioning method statement, manufacturers' guidelines and the day-to-day operational requirements of the people using the building.

Ensure that seasonal commissioning works are fully recorded, signed off by the commissioning team representative and retained in the building documentation. Following seasonal commissioning works, make any required changes to building documentation such as Record Drawings, Operating and Maintenance Instruction Manuals, the Building Manual, the Building Log Book or the Building User Guide. Also properly inform facilities management personnel, end-users and the Contract Administrator, about any changes that have been made during seasonal commissioning works.

As the seasonal commissioning activities are part of the works under the contract, ensure that they are carried out by the same organisation or team as the pre-handover commissioning works. Assume roles and responsibilities as described in BSRIA BG 1/2009, BG 11/2010, BG 6/2014 and the CIBSE Commissioning Codes apply.

For phased handovers, the principles of seasonal commissioning still apply. Repeat the seasonal commissioning activities for each phase or handover. Seasonally commission any plant or systems that are affected by work in a particular phase, as the works may have an impact on the performance of plant at full load, or design, conditions.

With phased handovers, take account of those already using the building from earlier occupations, particularly where central plant and systems are concerned. Give careful thought to programming the seasonal commissioning works to cause as little disruption as possible, to maintain any essential services where necessary, and to keep occupants informed of planned works to enable them to make suitable arrangements where the works may affect their business activities.

As the building may be occupied during seasonal commissioning, comply with all health and safety requirements and carry out any commissioning works in accordance with the necessary statutory and good practice requirements.

1100 SCHEDULE OF COMMISSIONING DELIVERABLES

1110 Documentation

Issue the following documents for comment by the Contract Administrator:

~ commissioning method statement

~ commissioning logic diagram and programme for integration into the construction and finishes programmes

~ ductwork leakage testing method statement with acceptance criteria and proposed sectional testing drawings

~ static pressure testing method statement with acceptance criteria and proposed sectional testing drawings

~ flushing, chemical cleaning and water treatment method statement with acceptance criteria

~ flushing, chemical cleaning and water treatment logic diagram and programme for integration into the construction, commissioning and finishes programmes

~ integrated performance testing method statement with acceptance criteria

~ calibration certificates for all instrumentation used during testing and commissioning

~ ductwork leakage testing report and certificates

~ static pressure testing report and certificates

~ commissioning report and certificates, detailing the commissioning results and commenting on the performance of systems

~ schedule recording all plant settings including appropriate references to plant items

~ environmental testing report

~ acoustic testing report

~ disinfection certificates for mains and potable water systems and water treatment certificates for all water systems

~ a “Written Scheme of Examination” where appropriate

Incorporate these documents within the operating and maintenance instruction manuals. Modify and update operating details to reflect commissioning results.

1120 Demonstration/witnessing

The Contract Administrator or their appointed representative may require to witness, or have demonstrated, any or all of the following:

~ the flushing, cleaning, water treatment and disinfection of all water systems

~ the pre-commissioning activities in accordance with the commissioning specification

~ normal emergency, shutdown and standby mode operation of plant and systems

~ that the equipment is capable of the performance and method of operation specified

~ that the overall and complete systems perform correctly in the required manner and as intended by the specification, including return visits for seasonal tests

~ leakage testing of ductwork

~ preliminary static pressure testing of pipework

~ final static pressure testing of pipework

~ ventilation system commissioning results

~ water systems commissioning results, including, for variable volume water distribution systems, demonstration of setting of differential pressure control valves, and demonstration of part-load operation

~ operation and resetting of fire dampers (in presence of District Surveyor/Building Control Body if required)

~ performance testing of life safety ventilation systems (in presence of District Surveyor/Building Control Body if required)

~ operation of all hot and cold water outlets and authentic equal pressures at hot and cold water system outlet points

~ measurement of domestic hot water temperature at each outlet

~ operation of all drainage outlets, including condensate drainage systems

~ operation of principal plant items in accordance with the specification

~ demonstration of electrical testing/commissioning, cable insulation testing, cable continuity testing, earth fault loop impedance testing, prospective short circuit current testing, circuit labelling

~ controls/BMS testing and commissioning to demonstrate that the BMS equipment and systems supplied function and operate in accordance with the specification and drawings

~ partial load testing of plant

~ functional testing of all safety interlocks

~ acoustic tests, including full octave spectrum measurements in each internal space and externally at each site boundary

~ the operation of plant and systems for specified periods of time to prove plant reliability

END OF SECTION Y51

Y52 VIBRATION ISOLATION MOUNTINGS

CONTENTS

Y52 VIBRATION ISOLATION MOUNTINGS

100 REFERENCE DOCUMENTS

This specification is written based on legislation, standards and guidance in force in the UK generally, and within England by default. For projects in Scotland, Wales, Northern Ireland, the Channel Islands and the Isle of Man, give appropriate consideration to any locally applicable legislation, standards and guidance that deviates from or is additional to those in force within England. Similarly for projects outside the UK comply with the corresponding national legislation, standards and guidance.

Comply fully with the edition (including amendments, replacements and associated normative references) of each of the following, current at the time of tender.

Where a standard referred to in this section conflicts with a standard referred to in an associated ‘engineering system’ section (e.g. S10, T31, V21, etc.) of this specification, the standard referred to in the engineering system section prevails.

BS 6472	Guide to evaluation of human exposure to vibration in buildings
HTM 08-01	Health Technical Memorandum: Acoustics

200 GENERAL

210 Specialist manufacturer

Employ the services of a specialist manufacturer or acoustic/vibration consultant to provide the acoustic materials detailed herein.

Ensure that all noise and vibration limits specified are not exceeded due to the operation of the engineering services installation.

220 Design parameters

Achieve the design parameters stated in BS 6472 and the structure-borne radiated noise at least 10 NR below the required room internal noise levels. Meet NR curves without any tonal content from 31.5 Hz to 8 kHz. Special vibration criteria for sensitive spaces are required to be achieved as set out below.

For healthcare facilities: achieve the design parameters as stated in HTM 08-01 for sensitive wards, operating theatres, laboratories and offices.

For science and research facilities, confirm criteria from the acoustic consultant, the vibration consultant or laboratory equipment manufacturer.

230 Vibration criteria

Supply and install vibration isolators where specified, and also wherever otherwise required, such that vibration generated by the engineering services installation including plant, pipework, ductwork and all ancillary items of equipment installed as part of the Works, does not cause any specified noise and vibration criteria to be exceeded. Where no noise and vibration criteria are specified, seek confirmation from the acoustic/vibration consultant and/or Client on targets. If none are provided, do not exceed the relevant maximum vibration amplitudes specified in BS 6472 or HTM 08-01 (for healthcare facilities). Ensure the requirements are also met for horizontal (parallel to surface) vibrations. For healthcare and science and research faciliites, note that there may be bespoke project-specific requirements as stated in the previous section.

Provide a fully documented set of the specialist manufacturer's/acoustic or vibration consultant’s calculations to the Contract Administrator, with sufficient time for comment prior to ordering plant and noise and vibration control equipment, to demonstrate that the selected plant and the selected noise and vibration control equipment enable all specified noise and vibration criteria to be achieved.

240 Durability of vibration isolators

Mount all mechanical plant likely to produce vibration that results in the specified noise and vibration criteria being exceeded on durable vibration isolators, with adequate lateral restraint. Select vibration isolators suitable for the loading, operating and environmental conditions that will prevail. Pay special attention to vibration isolators that will be exposed to atmospheric or adverse interior conditions, and apply appropriate finishes to prevent excessive corrosion. Ensure isolators have sufficient life cycle without adverse creep or performance reduction over the period of proposed equipment operational life.

250 Static deflection

Select the static deflection of vibration isolators to give the necessary degree of isolation efficiency under the lowest normal operating speed of the isolated plant. For plant mounted on suspended slabs, select static deflection of vibration isolators as ten times the slab deflection under total equipment loads. If the slab deflection under equipment loads is not known, refer to CIBSE guide B4 for minimum static deflection values depending on floor spans. In any case appoint an acoustic/vibration consultant to confirm such static deflection calculations and submit the calculations to the Contract Administrator for comment. Allow for asymmetric load distribution such that the minimum static deflection is achieved on all vibration isolators under normal operating conditions. Carefully level machines and bases. Replace any vibration isolators that are 'bottomed out', or where the springs have deformed from a cylindrical shape, at no additional cost to the contract. For sensitive applications such as lightweight, thin suspended, CLT slab types, where the static deflection requirements may be in excess of 100mm, utilise an air spring system meeting <2Hz natural frequency under equipment weight. Seek confirmation from an acoustic/vibration consultant.

260 Colour coding

Colour code or otherwise clearly mark all vibration isolators to indicate the rated load and deflection capacity to facilitate identification during installation.

270 Flexible connections

Make all external connections to vibration-isolated plant using flexible connections. Take particular care to ensure that the connection of pipes, ducts, shafts, electrical conduit etc, to vibration-isolated plant neither short-circuits the plant vibration isolation, nor impedes the free movement of the vibration-isolated plant. Select the vibration isolation system to support the operating weight of the plant and equipment to be isolated only. Support all associated pipework, valves, filters, ductwork etc., and their contents independently so as not to impose additional forces on the isolator system. Select and arrange all flexible connections to accommodate this requirement.

When selecting flexible connectors, ensure these purely act as a vibration impedance break and no amplification effects from connection's natural frequency are encountered. Otherwise, ensure the natural frequency of the connector is lower than the natural frequency of the supported pipe/duct and plant RPM. Select connectors that will also smooth fluid flow to reduce flow-induced vibration. If seismic effects are present, ensure such connectors allow for required movement tolerances (translational and rotational). For large ductwork, where flexible connection may not be possible, isolate along the body of ductwork (see below).

280 Isolation of pipework and ductwork

As a minimum requirement, isolate from the building structure all pipework of 50 mm diameter and above (including drainage pipework) and all ductwork within plant rooms for a minimum of 15 metres from the motor driven plant. This may be either through a ceiling-mounted hanger or base isolators or a combination, depending on the closest mounting surface. The requirement will vary by application, and sensitive applications (as defined in clause 220) may require all pipework to be isolated. For any wall and floor penetrations, use a resilient seal around the circumferential mating surface.

Y52 VIBRATION ISOLATION MOUNTINGS

290 Vibration isolation and structure borne noise

Resiliently isolate from any part of the building structure all plant, pipework and ductwork as specified, and also wherever otherwise required, to achieve the specified noise and vibration criteria. Pay particular attention to areas where low noise levels are specified and seek advice from an acoustic/vibration consultant.

Avoid mounting any item of plant, pipework or ductwork from lightweight (stud) partitions. If unavoidable, notify the Contract Administrator of all such instances. Provide the Contract Administrator with full details of the resilient mounting arrangements between the service item and the partition.

300 PRODUCTS/MATERIALS

310 Vibration isolators

311 Helical spring vibration isolators

Use helical spring isolators manufactured from sheet steel and springs of substantial thickness, and treated with a rust-resistant protective coating. Use isolators with the necessary damping and load adjustment devices and that also incorporate rubber or neoprene elements in series with the springs to prevent the transmission of high frequency vibration.

Use springs with an outside diameter of not less than 75% of their operating height. Select spring mounts to have at least 50% overload capacity before becoming coil bound.

Ensure vibration isolators incorporating snubbers or restraining devices are designed so that these devices have no significant effect during the normal operation of the isolated plant.

312 Rubber or neoprene vibration isolators

Use rubber or neoprene vibration isolators consisting of a steel top plate and base plate completely embedded in oil-resistant neoprene. Use isolators that include a tapping through the top plate and bolt holes in the base plate so they can be bolted to the supporting structure and the isolated equipment as required.

313 Air springs

Use Air Springs for sensitive applications where static deflection requirements are in excess of 100mm. Use an air spring design with a valve controlling the internal air pressure of the air bellows, giving variation of the load-carrying capacity and natural frequency. Provide a continuous air supply to the air springs in accordance with the manufacturer’s recommendations. Include in the operating and maintenance manual details of the recommended inspection and maintenance requirements of the air springs. Ensure spatial provisions for compressed air cylinders close to the air springs.

320 Vibration isolation hangers

321 Helical spring vibration isolation hangers

Use helical spring hangers incorporating a helical steel spring of suitable thickness together with one or more rubber, neoprene or glass fibre elements in-series with the spring to prevent the transmission of high frequency vibration.

Use spring hangers that allow the lower hanger rod to move laterally at least 15° before a vibration short circuit occurs.

Use springs with an outside diameter of not less than 75% of their operating height. Select spring mounts to have at least 50% overload capacity before becoming coil bound.

322 Rubber, neoprene or glass fibre vibration isolation hangers

Use rubber, neoprene or glass fibre hangers that incorporate a rubber, neoprene or glass fibre vibration isolation element housed in a steel cage.

Use hangers that allow the lower hanger rod to move laterally at least 15° before a vibration short circuit occurs.

330 Inertia bases

331 Spring isolated inertia bases

Use spring isolated inertia bases of a fully welded steel construction. Ensure the depth of the frame is not be less than one-twelfth of the largest dimension, or 100 mm, whichever is the greater. Include in the frame an appropriate quantity and distribution of height-reducing spring fixing brackets. Provide spring fixing brackets that are either mounted external to the frame, or recessed into the frame, as specified.

Ensure that the weight of the inertia base, including concrete at approximately 2300 kg/m^3, is equal to at least 1.5 times the total weight of supported equipment. Arrange the supported equipment and ancillary weights on the inertia base so as to distribute the load as evenly as possible over the mounting positions. Ensure that the inertia base is sufficiently large to provide support for all parts of the equipment, including any parts that overhang the equipment base.

Use frames finished with long life red oxide primer unless otherwise specified. If the primer or coating is damaged during installation, apply a new coat post-installation.

332 Elastomeric pad isolated inertia bases

Use neoprene pad isolated inertia bases comprising a concrete base cast onto permanent shuttering, supported on neoprene pad(s) to give the required minimum static deflection, the whole resting on a plinth as required.

Ensure that the weight of the inertia base, including concrete at approximately 2300 kg/m^3, is equal to at least 1.5 times the total weight of supported equipment. Arrange the supported equipment and ancillary weights on the inertia base so as to distribute the load as evenly as possible over the mounting positions. Ensure that the inertia base is sufficiently large to provide support for all parts of the equipment, including any parts that overhang the equipment base.

340 Flexible connectors

Select all flexible connectors to achieve the specified noise and vibration criteria.

Provide flexible connections on ductwork and pipework as specified elsewhere. Ensure that the aggregate stiffness of all flexible connections fixed to any one item of isolated plant is insignificant in relation to the stiffness of the supporting vibration isolators and the supported pipework/ductwork. Make due allowance for the stiffening effect produced by the internal pressure, both negative and positive, of the system.

Fit flexible connections for all fans between their inlets and outlets and the associated system ductwork. Use acoustic flexible connections having a mean sound reduction index of not less than 22 dB. Ensure that the material used complies with those requirements of flexible connections specified elsewhere.

END OF SECTION Y52

Y54 IDENTIFICATION OF MECHANICAL SYSTEMS

CONTENTS

Y54 IDENTIFICATION OF MECHANICAL SYSTEMS

100 REFERENCE DOCUMENTS

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Comply fully with the edition (including amendments, replacements and associated normative references) of each of the following, current at the time of tender.

Where a standard referred to in this section conflicts with a standard referred to in an associated 'engineering system' section (e.g. S10, T31, V21, etc.) of this specification, the standard referred to in the engineering system section prevails.

The Construction (Design and Management) Regulations

The Health and Safety (Safety Signs and Signals) Regulations

The Workplace (Health Safety and Welfare) Regulations

The Safety Signs and Signals Regulations

The Water Supply (Water Fittings) Regulations

BS 1710	Specification for identification of pipelines and services
BS 4781	Specification for pressure-sensitive adhesive plastics labels for permanent use
BS 4800	Schedule of paint colours for building purposes
BS 8525	Greywater systems. Domestic greywater treatment equipment. Requirements and test methods
BS 8558	Guide to the design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages. Complementary guidance to BS EN 806
BS EN 806-2	Specifications for installations inside buildings conveying water for human consumption. Design
BS EN 806-4	Specifications for installations inside buildings conveying water for human consumption. Installation
BS EN 16941-1	On-site non-potable water systems. Systems for the use of rainwater
BS EN ISO 7010	Graphic symbols. Safety colours and safety signs. Registered safety signs
CIBSE Guide G	Public health and plumbing engineering
BESA DW/144	Specification for sheet metal ductwork
HTM 02-01	Medical gases. Medical pipeline systems
HTM 04-01	The control of legionella, hygiene, "safe" hot water, cold water and drinking water systems
WRAS IGN 9-02-05	WRAS information and guidance note - Marking and identification of pipework for water reuse systems
HSE L64	Safety signs and signals. The Health and Safety (Safety Signs and Signals) Regulations. Guidance on Regulations
Street Works UK	Street Works UK Publication: Volume 1. NJUG Guidelines on the positioning and colour coding of underground utilities' apparatus

200 IDENTIFICATION OF SERVICES

210 General

Install warning, caution and instruction notices where indicated in the relevant ‘engineering system’ sections of this specification or on the drawings, or where otherwise required, to ensure safe operation and maintenance of mechanical systems and of the items to which they connect.

Install identification labels to all items of mechanical equipment and ancillary components, pipework systems and ductwork systems in accordance with the requirements of this specification section.

Apply identification labels directly to the service, e.g. pipe. duct, fitting, etc., before the application of thermal insulation or other covering. Where identification labels become obscured by thermal insulation or other covering, apply additional identification labels to the thermal insulation or covering.

Ensure that all identification labels and notices are installed in a visible position, without interference to the operation and maintenance of equipment.

Ensure that identification labels and notices are sized in proportion to the equipment on which they are mounted and that they are securely fixed.

Obtain agreement from the Contract Administrator, with regard to style, colour, lettering, size and position of all labels and notices. Provide samples, at no cost to the contract, for the Contract Administrator’s acceptance.

220 Materials and marking

Ensure that materials used for labels and notices have a predicted lifespan equal to or greater than the lifespan of the installation to which they refer.

Ensure that labels and notices which are fitted outside buildings use the appropriate material and marking method from the following list:

- rigid, laminated, ABS substrate material, of three or five layers of different colours, machine engraved in a contrasting colour [e.g. Traffolyte]
- rigid plastic, hot press printed
- pressure sensitive labels to BS 4781, printed
- brass, engraved
- stainless steel, engraved

Ensure that labels and notices which are fitted within buildings use the appropriate material and marking method from the following list.

- rigid, laminated, ABS substrate material, of three or five layers of different colours, machine engraved in a contrasting colour [e.g. Traffolyte]
- thermosetting rigid plastic, screen printed
- flexible plastic, screen printed or manuscript lettering
- rigid plastic, hot press printed
- pressure sensitive adhesive labels to BS 4781, printed
- aluminium or aluminium alloy, letter pressed, letter engraved or letter embossed
- stainless steel, engraved

230 Fixing

Ensure that fixing methods and materials have a predicted lifespan equal to or greater than the lifespan of the installation to which they are applied.

Fix every label and notice using materials compatible with it and with the surface to which it is being fixed. Use only non-corrodible fixings for external labels and notices. Thoroughly clean surfaces of dust, loose materials and protective/oily films before fixing labels and notices to them. Fix labels and notices to a surface only after all finishing to that surface is complete.

240 Asset register and record documents

Provide an asset register of all plant and equipment supplied under the contract, in a format agreed with the Contract Administrator. Provide and permanently fix an indelible asset label to all plant and equipment listed in the asset register. Ensure that each label is located in an accessible position on the asset and it is of a design, size and format accepted by the facilities manager.

Correlate record documents so that the terminology and the references used are consistent with those used in the physical identification of the component parts of the installations.

Correlate the As-built Model so that the terminology and the references used are consistent with those used in the physical identification of the component parts of the installations.

300 PIPEWORK SYSTEMS AND ANCILLARIES

310 Pipework above ground

Provide all above ground piped services with colour coded identification bands in accordance with BS 1710, BS 8525, BS EN 16941-1, HTM 02-01, WRAS IGN 9-02-05 and CIBSE Guide G as appropriate.

In industrial gas applications, use proprietary bandings incorporating pressure details, source and destination of the service. Identify gas at a pressure exceeding 75 mbar with the normal operating pressure stencilled into the colour band.

Where applicable ensure the method of identification is consistent with the Client’s particular colour coding scheme.

Ensure that the colour coding scheme enables each installed service to be separately identifiable. Where this cannot be achieved by colour coding alone use text-based wording to identify separate services.

Provide with each section of banding the service description and direction of flow. Use a single arrow where fluids flow predominantly in one direction; and a double-arrow where unidirectional flow may prevail, e.g. ring main systems, In the case of fluid circulation systems, indicate the flow and return with the letters ‘F’ and ‘R’, or the words ‘FLOW’ and ‘RETURN. Where the pressure or temperature of the fluid conveyed exceeds 3 bar gauge or 95°C respectively, include information the within the label or immediately adjacent to it indicating the pressure or temperature. Extend the colour coding scheme to incorporate any installed services not named specifically in BS 1710.

Provide self-adhesive identification bands or use heat-proof paint. Where adhesive banding is applied to external services, employ a method to suit the environment to ensure banding remains intact for the life of the service.

Provide identification bands so they are visible at all junctions, at both upstream and downstream sides of each valve or other pipeline ancillary, at service appliances, at bulkheads, at wall penetrations, at service duct openings and at intervals of 12 m maximum, along with any other places where identification is considered necessary by the Contract Administrator.

Provide identification to medical gas pipeline systems adhering to the specific requirements and pipeline identification colours given in HTM 02-01. Use identification bands applied every 3 m and bearing 6 mm size letters to identify each medical gas.

Identify pipework within natural gas systems with the application of painted yellow ochre wherever feasible, colour reference to BS 4800 08 C 35. Where painting gas pipework is not feasible (e.g. long runs of pipework within risers), use adhesive identification labels. Submit to the Contract Administrator for agreement any proposals to use labels in place of painting the pipe.

Provide identification to grey water and rain water pipework in accordance with the WRAS information and guidance note 9-02-05.

Provide identification to rain water pipework also in accordance with BS EN 16941-1 and BS 8525 Annex B.

Ensure through the colour coding scheme that mains cold water supply pipework and pipework for supplying water solely for firefighting purposes are clearly and indelibly marked to distinguish them from each other and all other pipework, in accordance with BS 8558.

Ensure through the colour coding scheme that pipework containing potable and non-potable water are adequately and permanently marked to facilitate identification and avoid operating errors in accordance with BS EN 806-2 and BS EN 806-4.

320 Valves

With the exception of general-purpose valves exposed to view in rooms, whose circuit and use is obvious, label all valves and automatic air vents, including those in plantrooms, external plant areas, service voids, service risers and any other concealed service area. Use phenolic, multi-layered white or yellow surface laminate (Traffolyte) as standard for the label material, engraved to reveal a black core. Within plant areas use labels, with a minimum diameter of 40 mm, engraved with the valve reference number. Ensure the reference number is consistent with the valve schedule as detailed in section 800 of this specification. Outside of plant areas ensure a brief title indicating the valve system and function is detailed on the valve label in addition to the reference number.

Proposals may be submitted for use of non Traffolyte labels, such as brass or stainless steel, to the Contract Administrator for agreement.

Ensure lettering is plain black uppercase with a minimum height of 6 mm. Secure each label to its respective valve using a brass or stainless steel chain loop.

Record the position, function, size and reference number of all valves on the corresponding Record Drawings and valve charts.

Ensure that valves associated with potable and non-potable water systems are adequately and permanently marked to facilitate identification and avoid operating errors in accordance with BS EN 806-2 and BS EN 806-4.

330 Water Outlets

In non-domestic premises identify all designated potable cold water outlets as drinking water points with a label stating ‘Drinking Water’ positioned on the wall above the outlet. Use Traffolyte labels, surface colour white, with 7 mm high uppercase lettering in blue. Secure labels with non-ferrous or stainless steel screws, or alternatively by an adhesive where accepted by the Contract Administrator.

Identify taps in accordance with BS EN 806-2. If colour code is used for this purpose, use red to identify hot and blue to identify cold.

In non-domestic premises label all draw-off points for non-potable water with the words “Not drinking water” or by a prohibition sign as BS EN 806-2. Where rainwater systems are present and other non-potable systems are also available, label rainwater draw-off points with “Non-potable water: RAINWATER” in accordance with BS EN 16941-1.

400 DUCTWORK SYSTEMS AND ANCILLARIES

410 Ductwork

Provide permanent identification to ductwork in accordance with BESA DW/144.

Employ the following method of identification:

~ Use colour coded symbols comprising an equilateral triangle with one apex pointing in the direction of flow. The minimum symbol side dimension is 150 mm but use larger symbols on larger ductwork and where the viewing distance means regular symbols cannot clearly be identified.

~ Apply symbol colours as identified in Table 18 of BESA DW/144 Appendix B. Where appropriate, incorporate additional colour coding to identify the complete range of air distribution systems, i.e. fresh air, supply air, return air, etc. In the event of ductwork being painted in a decorative colour that may clash with the symbol colour, refer to the Contract Administrator for advice regarding a suitable symbol colour.

Position symbols as follows:

~ On the surfaces which face the positions of normal access to the completed installation.

~ So as not to be hidden from view by structural members, other ducts, plant or other services distribution services.

~ Placed where possible, where there is adequate natural or artificial light.

~ In all areas at intervals of not more than 12 m and also at all service and access points to the distribution system. Increase frequency of labelling in plantrooms as necessary to suit the complexity of the ductwork arrangement.

Apply symbols using self-adhesive plastics, paint or transfers with water-soluble backing.

Where adhesive materials are applied to external services, employ a method to suit the environment to ensure symbols remains intact for the life of the service.

420 Ductwork Dampers

For all ductwork distribution systems label each shut-off, regulating and fire damper with a Traffolyte label. Within plant areas use labels with a minimum diameter of 40 mm and engraved with a reference number. Ensure the reference number is consistent with the schedules detailed in section 800 of this specification. Outside plant areas include on each label a brief title indicating the damper’s system and function in addition to the reference number.

Ensure lettering is plain black uppercase with a minimum height of 6 mm. Use white or yellow surface colours and secure the label to each damper by a brass or stainless steel chain loop through the damper handle where possible. Alternatively fix the label securely to the ductwork adjacent to the damper. Position the label on the surface that faces the position of normal access to the completed installation.

Record the position, function, size and reference number of all dampers on the corresponding Record Drawings.

Y54 IDENTIFICATION OF MECHANICAL SYSTEMS

500 UNDERGROUND SERVICES

Identify underground services in accordance with the 'National Joint Utilities Group' Guidelines on the positioning and colour coding of Utilities' Apparatus. Install markers/warning systems for each service, ensuring passive electronic marker systems are laid as an aid to the location of non-metallic pipes and ducts.

Provide identification to underground grey water and rain water pipework in accordance with the WRAS information and guidance note, IGN 9-02-05.

Record the location and position of domestic water underground pipes and valves in accordance with BS 8558 and BS EN 806-4. Ensure surface boxes are marked to indicate the service below them. Set up durable markers with stamped or set in indexes to indicate pipe service, size position and depth below the surface.

600 PLANT AND EQUIPMENT

610 Plant and Equipment Identification Labels

In addition to manufacturer's labels, ensure all mechanical and associated electrical equipment is permanently, clearly and uniquely labelled with an identification name, reference number and function within a particular installation. Ensure referencing is consistent with the Record Drawings and Operating and Maintenance Instruction Manuals (e.g. "Pump No.2, Constant Temperature Heating"). Labelling for all associated electrical equipment to be in accordance with section Y82 of this specification.

Provide labels in the same way, where necessary, to identify any adjustable control components associated with mechanical systems such as thermostats etc.

Use white or yellow Traffolyte labels, sized to suit the information provided and engraved. Ensure lettering is plain black uppercase with a minimum height of 2.5 mm. Secure each label on or immediately adjacent to the equipment it refers to and in a position that is readily observable.

Ensure that cisterns associated with potable and non-potable water systems are adequately and permanently marked to facilitate identification and avoid operating errors in accordance with BS EN 806-2 and in Healthcare premises in accordance with HTM 04 01. Label any plant and equipment associated with rainwater and grey water in accordance with the WRAS information and guidance note, IGN 9-02-05.

In accordance with BS EN 806-2 install notice(s) in prominent position(s) drawing attention to maintenance requirements of any domestic water safety devices required to prevent bursting due to high temperatures and pressures. Where applicable provide warning sign(s) which state surge arresting valves or air admittance devices should not be isolated while boosted water system pumps are running. Provide warning notice(s) for these devices also in accordance with section 900 of this specification.

Ensure the direction of flow of water through mechanical water filtration plant is permanently and clearly marked.

700 ACCESS PANELS

Where access panels are installed in floors, walls and false ceilings for the commissioning and maintenance of equipment, ensure such panels are identified with a marker disc and the positions clearly indicated on the Record Drawings. Use 10 mm diameter, red, plastic marker discs, permanently secured with an appropriate adhesive in the corner of a panel. Agree the method for installation of any floor discs with the Contract Administrator.

Agree the coloured identification, means of fixing and display and charting for each individual location, and for the installation as a whole.

800 WALL CHARTS AND OPERATING & MAINTENANCE MANUALS

Provide and fix the following printed wall charts:

- In each plantroom: a schematic layout of the plantroom indicating all equipment and piped services, valves and fittings. Annotate the drawing with the valve and equipment numbers to correspond with the labels installed in the field. Detail all pipe sizes and the nature of the pipe contents. Include schedules indicating the valve/equipment reference numbers together with the valve /equipment function, size/duty and the type of service. Where applicable, detail ventilation services in the same way.
- A 'Safety Procedures' wall chart adjacent to each mechanical services control panel.
- A wall chart in tabular form relating to 'Identification of Pipelines and Services'. Ensure the chart clearly identifies the basic and code indication colours utilised throughout the installations to comply with the requirements of BS 1710 and HVCA DW/144 Appendix B.
- Any additional wall charts necessary to comply with other sections of this specification (e.g. gas line diagram where applicable).

Ensure that all references correspond with those included on the Record Drawings.

Provide drawings in an agreed Autocad format or other style accepted by the Contract Administrator, with charts in typed format using uppercase only. Encase all charts and drawings in a hardwood frame, with hard back and clear polycarbonate glazing. Laminate charts and drawings for additional durability and ensure they comprise black print on white background. Ensure final fixing positions are readily visible and agreed with the Contract Administrator.

Provide a copy of the chart relating to 'Identification of Pipelines and Services' within the Operating & Maintenance Instruction Manuals.

900 HAZARD WARNING SIGNS

Provide and install, in accordance with applicable Health and Safety Regulations, the following hazard warning signs:

<u>Hazard markings</u>

- In the horizontal plane: Any section of a pipe or duct system installed less than 2 m above the normal maintenance access or escape route level.
- In the vertical plane: Any section of a pipe or duct system installed less than 2 m above the normal access or escape route level and that protrudes into the normal maintenance access or escape route path.
- Any section of a pipe or duct system installed such that it crosses the floor of a normal maintenance access or escape route path.

Ensure the hazard marking comprises yellow and black 45º stripes, either painted or using proprietary tape. Refer to the Contractor \Administrator for final agreement for positioning of markings.

<u>Warning Signs</u>

- Install warning signs adjacent to each item of machinery which is subject to automatic stop and start control. Agree the format and material of construction of the label with the Contract

Administrator. Word the label as follows: “DANGER. THIS EQUIPMENT MAY START WITHOUT WARNING. ISOLATE THE ELECTRICAL SUPPLY BEFORE WORKING ON THE PLANT.”

~ Install warning signs adjacent to all discharge pipe outlets for steam/ hot water (hot water being >43°C) and for temperature and pressure relief valves and bursting discs. Word the label as follows: “DANGER. HOT LIQUID/STEAM MAY DISCHARGE WITHOUT WARNING”

~ Any additional warning signs necessary to identify particular project specific hazards. Agree these with the Contract Administrator.

Ensure that lettering is red, a minimum 10 mm high, bold uppercase and on a white background. Secure warning signs adjacent to or directly on the plant in a prominent visible position. Agree the format and material of construction of the label with the Contract Administrator. Agree the final positioning of the labels with the Contract Administrator.

END OF SECTION Y54

Y60 CONDUIT AND CABLE TRUNKING ENCLOSURES

CONTENTS

Y60 CONDUIT AND CABLE TRUNKING ENCLOSURES

Y60 CONDUIT AND CABLE TRUNKING ENCLOSURES

100 REFERENCE DOCUMENTS

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Comply fully with the edition (including amendments, replacements and associated normative references) of each of the following, current at the time of tender.

Where a standard referred to in this section conflicts with a standard referred to in an associated ‘engineering system’ section (eg S10, T31, V21, etc) of this specification, the standard referred to in the engineering system section prevails.

BS 4607	Non-metallic conduits and fittings for electrical installations
BS 4678-2	Cable Trunking Steel underfloor (duct) trunking
BS 4678-4	Cable Trunking. Specification for trunking made of insulating material.
BS 7671	Requirements for electrical installations. IET Wiring Regulations.
BS 8313	Code of practice for accommodation of building services in ducts
BS 8519	Selection and installation of fire-resistant power and control cable systems for life safety and fire-fighting applications. Code of practice
BS EN 1366	Fire resistance tests for service installations. Fire protective systems for cable systems and associated components.
BS EN 10088-3	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 10143	Continuously hot-dip coated steel sheet and strip. Tolerances on dimensions and shape
BS EN 10346	Continuously hot-dip coated steel flat products for cold forming. Technical delivery conditions
BS EN 10143	Continuously hot-dip coated steel sheet and strip. Tolerances on dimensions and shape
BS EN 50085-1	Cable trunking systems and cable ducting systems for electrical installations. General requirements.
BS EN 50085-2-1	Cable trunking systems and cable ducting systems for electrical installations. Cable trunking systems and cable ducting systems intended for mounting on walls and ceilings.
BS EN 50085-2-2	Cable trunking systems and cable ducting systems for electrical installations. Particular requirements for cable trunking systems and cable ducting systems intended for mounting underfloor, flushfloor, or onfloor
BS EN 50085-2-3	Cable trunking systems and cable ducting systems for electrical installations. Particular requirements for slotted cable trunking systems intended for installation in cabinets
BS EN 60423	Conduit systems for cable management. Outside diameters of conduits for electrical installations and threads for conduits and fittings
BS EN 60529	Specification for degrees of protection provided by enclosures (IP code)

BS EN 61386-1	Conduit systems for cable management. General requirements
BS EN 61386-21	Conduit systems for cable management. Particular requirements. Rigid conduit systems
BS EN 61386-22	Conduit systems for cable management. Particular requirements. Pliable conduit systems
BS EN 61386-23	Conduit systems for cable management. Particular requirements. Flexible conduit systems
BS EN 61386-24	Conduit systems for cable management. Particular requirements. Conduit systems buried underground
BS EN 61386-25	Conduit systems for cable management. Particular requirements. Conduit fixing devices
IET	Guidance Note 1: Selection and Erection

200 GENERAL REQUIREMENTS

Except where otherwise stated in this specification these general requirements will be applicable.

210 Circuit protective conductors (CPCs)

Do not use conduit or trunking as the primary means of CPC medium. Install CPCs and ensure that they are of the same voltage grade and temperature rating as the live conductors of that part of the circuit. Use green and yellow coloured insulation for CPCs as required by BS 7671.

Ensure that all CPCs are electrically continuous and bonded to earth throughout.

Ensure that each circuit has its own CPC emanating from the distribution position and installed in the same trunking/conduit as the live conductors of that circuit.

Ensure that every CPC is sized in accordance with BS 7671.

Identify the CPC clearly on all equipment by a cable marker at the earthing terminal. Fix a label adjacent to the earthing terminal of every equipment box, appliance box and the like, stating ‘PROTECTIVE CONDUCTOR – DO NOT DISCONNECT’

220 Enclosure cable capacities

Size all conduit and trunking in accordance with *IET Guidance Note 1: Selection and Erection* to provide the following space factor (sum of cross sectional area of cables / net internal area of conduit or trunking) unless otherwise specified in this section:

- Conduit – space factor not to exceed 35% of net internal cross-sectional area of conduit
- Trunking – space factor not to exceed 45% of net internal cross-sectional area of trunking

Do not use conduit less than 20mm nominal diameter.

Ensure that the internal surfaces and ends of conduit and trunking are kept clear of any protrusions, burrs, sharp edges or other foreign bodies except where allowed for as part of the respective conduit or trunking manufacturer’s recommended fittings and use. Do not restrict the cross-sectional area capacity or diminish the smoothness of the trunking and conduit internal surface.

230 Protection against corrosion

Do not place dissimilar metals liable to initiate electrolytic action, or other materials liable to cause mutual or individual deterioration, in contact with each other unless specific arrangements are made to avoid the consequences of such contact.

Ensure that all metallic conduit systems comply with BS EN 60423 and BS EN 61386 and are of the heavy gauge welded seam and screwed pattern. Ensure that all metallic conduit systems are mechanically and electrically continuous and bonded to earth throughout.

Ensure that all metallic trunking systems comply with BS EN 50085, and specifically BS 4678-2 for under-floor trunking systems. Ensure that all metallic trunking systems are mechanically and electrically continuous and bonded to earth throughout.

240 Fire resistance and reaction-to-fire performance

Support conduit and trunking such that they would not be liable to premature collapse in the event of fire.

Do not install containment that has a lesser performance with respect to fire-resistance and reaction-to-fire than the cables contained by it.

Where specified, install non-metallic conduits using conduit manufactured from low smoke zero halogen material.

Install fire barriers as required to meet the project fire strategy and the requirements of the Building Regulations.

Ensure that all containment systems (other than metallic conduit) passing through fire compartments are packed inside and outside with intumescent material, or are otherwise preventative of the passing of fire and smoke. Do not use non-metallic containment systems where passing between fire compartments.

250 Trunking performance standard

Ensure that the trunking system, unless specified otherwise in the Particular Specification, (ie trunking and trunking fittings) meets or exceeds the performance classifications shown in *Table 1 - Trunking performance and* as defined in BS EN 50085 (and cross-referenced to BS 4678 in terms of corrosion protection and impact resistance) unless an alternative performance criterion is explicitly required elsewhere in this section.

Table 1 - Trunking performance

Trunking performance property as defined in BS EN 50085	**General areas / zones where higher performance not required.** **Classification:**	**Higher performance areas / zones or specific application:** **Plant areas; kitchens… lighting.** **Classification:**
Resistance to impact	Impact of 2J (Alternatively, BS 4678-4 Class Medium mechanical stress for non-metallic trunking)	Impact of 5J (Alternatively, BS 4678-4 Class Heavy for non-metallic trunking)
Minimum and maximum temperature	-5ºC to +90ºC	-25ºC to +120ºC
IP Rating, solid object	3, (IP3X)	5, (IP5X)
IP Rating, water	2, (IPX2)	4, (IPX4, and if non-sheathed cables used) 6, (IPX5, Swimming pools)

Corrosion protection	Medium inside and outside Stove enamel/electro zinc plate/air drying paint	High inside and outside Hot-Dip Pre-Galvanised to BS EN 10346 and BS EN 10143, or stainless steel. Use in kitchens; plant rooms; tank rooms; ducts buried in ground; external and all internal areas subject to dampness

Enclose non-sheathed (single insulated) cables in conduit, ducting or trunking in accordance with BS 7671 to provide a degree of protection to IPXXD and IP4X. Ensure covers are removable only with the aid of a tool or other deliberate action.

260 Conduit performance standard

Ensure that the conduit performance classification conforms to the *Table 1 - Performance Classification as per BS EN 61386-1*

Conduit Performance Property	**Table 1: Performance Classification as per BS EN 61386-1**						
	1	2	3	4	5	6	7
Resistance to compression (N)	V. light (125N)	Light (320N)	Medium (750N)	Heavy (1250N)	V. Heavy (4000N)	-	-
Resistance to impact	V. light	Light	Medium	Heavy	V. Heavy	-	-
Lower temperature range, °C	+5	-5	-15	-25	-45	-	-
Upper temperature range, ºC	+60	+90	+105	+120	+150	+250	+400
Resistance to bending	Rigid	Pliable	Pliable / Flexible	Flexible	-	-	-
Electrical characteristics	With electrical continuity characteristics	With electrical insulating characteristics	With electrical continuity & insulating characteristics	-	-	-	-
Protection against the ingress of solid objects (IP coding as per BS EN 60529 in brackets)	-	-	> 2.5mm & greater (IP3X)	> 1.0mm & greater (IP4X)	Dust protected (IP5X)	Dust-tight (IP6X)	-
Protection to the ingress of water	Vertical falling water drops	Drops at 15º (IPX2)	Spray (IPX3)	Splashing (IPX4)	Jets (IPX5)	Powerful jets	Temporary immersion

(IP coding as per BS EN 60529 in brackets)	(IPX1)					(IPX6)	(IPX7)
Resistance to corrosion	Low inside and outside Example: priming paint (BS EN 61386-1 Class 1.)	Medium inside and outside Example: stove enamel/electro zinc plate/air drying paint (BS EN 61386-1 Class 2.)	Medium inside, high outside Example: Stove enamel inside; sherardizing outside (BS EN 61386-1 Class 3.)	High inside and outside Example: Hot dip zinc coating/ sherardizing/ stainless steel (BS EN 61386-1 Class 4.)	-	-	-
Tensile strength	V. light (100N)	Light (250N)	Medium (500N)	Heavy (1000N)	V. Heavy (2500N)	-	-
Resistance to flame propagation	Non-flame propagating	Flame propagating	-	-	-	-	-
Suspended load capacity	V. light (20N)	Light (30N)	Medium (150N)	Heavy (450N)	V. Heavy (850N)		

Ensure that the conduit system (ie conduit and conduit fittings) meets or exceeds the performance classifications shown in and as defined in BS EN 61386 unless an alternative performance criterion is specified in the Particular Specification.

Table 2 - Conduit performance

Conduit performance property to BS EN 61386	**General areas / zones where higher performance not required.** **Classification number:**	**Higher performance areas / zones or specific application:** **Plant areas; kitchens etc.** **Classification number:**
Resistance to compression and impact	2 (light)	4 (heavy)
Low and high temperature	2 (-5ºC to +90ºC)	4 (-25ºC to +120ºC)
IP Rating, solid object	3 (IP3X)	5 (IP5X)
IP Rating, water	2 (IPX2)	4 (IPX4, and if non-sheathed cables used) 6 (IPX5, Swimming pools)
Corrosion protection	2 (medium inside and outside)	4 (high inside and outside)

	Example: stove enamel / electro-zinc-plate / air drying paint. (BS EN 61386-1 Class 2)	Example: Hot dip zinc coating / sherardizing / stainless steel Use in kitchens; plant rooms; tank rooms; ducts buried in ground; external and all internal areas subject to dampness (BS EN 61386-1 Class 4)
Suspended load	2 (light)	4 (heavy)

Ensure that the protective coating on conduit and trunking fittings (including saddles, conduit boxes, adaptable boxes) are the same class as that on the conduits to which they are joined.

300 GENERAL INSTALLATION REQUIREMENTS

Except where otherwise stated in this specification comply with these general installation requirements.

310 Safety

Do not use the conduit and cable trunking installation at any time as part of a fall arrest system.

Ensure that the conduit and cable trunking installation is coordinated with any spatial requirements necessary to accommodate all installation and future access requirements.

320 Common installation practice – trunking systems

Do not use trunking in exterior locations.

Use multi-compartment trunking where segregation of cables is required. Ensure that the compartments remain fully segregated throughout the length including the bends, sets and tees.

Ensure trunking routes are mechanically continuous throughout their length. Provide all trunking that crosses a construction movement joint with a sliding coupling, for metallic systems, complete with a flexible protective conductor that ensures equipotential bonding.

Fit removable cable restraining straps into trunking at maximum intervals of 600 mm where trunking covers are fixed on the bottom or side of trunking.

Install drip-proof, close fitting trunking covers along the complete trunking length. Use trunking covers of the same material and protective finish as the trunking. Ensure that the cover is removable over the whole length of the trunking. Where trunking passes through building fabric (including walls and ceilings, etc), provide a short length of fixed cover to form a sleeve extending 25mm beyond each face of the building fabric.

Ensure that each cover is fixed throughout its length, and at each end within the last 50mm of its length.

Do not use self-tapping screws or fixed bridge pieces to hold the cover in position.

Do not use non-metallic trunking for vertical routes of 5m or more, for passing through floors or passing through fire compartment walls. In such locations use bonded metal trunking of the correct classification, with a short length of cover to form a sleeve. Install bagged intumescent material within and around the trunking where it traverses fire compartments or between floors, as required to maintain fire integrity.

Install heat barriers in vertical routes of metallic trunking of 5m or more.

Install insulated pin racks for supporting cables in vertical routes of trunking of 3m or more, and at maximum centres of 2m.

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Use the trunking manufacturer's standard fittings, of the same material and protective finish as the trunking. Ensure all changes of direction, terminations and tees, use the trunking manufacturer's fittings, suitably ‘gusseted’ where necessary, for the largest cables. Do not use site-fabricated fittings unless the situations encountered make the use of manufactured fittings impracticable. Submit sample site-fabricated trunking and obtain the Contract Administrator’s prior written agreement to any proposal to use fittings not manufactured by the trunking manufacturer.

Make connections to distribution boards, equipment, panels etc, by using manufactured flanges giving the full trunking capacity, making due allowance for the future installation of cables from spare ways. Join each such flange to its associated trunking permanently, and such that the ingress protection of the trunking system is maintained. Fit appropriate gaskets between the flange and board, etc to maintain the IP rating.

Make each connection between trunking and equipment by means of a brass male bush, a coupling and an internally serrated washer, or a standard flanged coupling.

Where multi-compartment trunking is required, do not pass conduit through one compartment in order to reach another compartment. Provide exposed conduit connections to a multi-compartment trunking via a conduit box mounted on the outside of the trunking. In concealed conduit systems, terminate the recessed conduit boxes immediately behind the appropriate compartment, and feed cables through a bushed hole.

In situations where tees and junctions are to be installed in multi-compartment trunking systems, use multi-compartment fittings of such depth as to ensure suitable pass-over connections.

Use only flush-type covers for all flush trunking. Ensure that all finished edges of the trunking are flush with the adjoining surfaces of the fabric of the building. Ensure that all flush covers are coloured to match the finish of the immediately adjacent surface.

Perform all trunking work in accordance with sound practice and in a competent manner using skilled operatives. Ensure that all trunking is installed neatly (whether directly to a surface, or via a suspension or other support system) and routed horizontally level, vertically plumb, or parallel with the features of the building. Use tools and equipment suitable for the intended purpose.

Do not allow suspensions, fixings or other foreign bodies to intrude into the internal space of any trunking. Use roundhead screws for joining to suspensions or fixings. Remove all burrs from the head of all such screws.

Prior to installing cables in trunking remove all debris and take precautions to prevent further ingress of debris.

330 Common installation practice – conduit systems

331 General

Provide each lighting point, socket outlet, equipment point, etc, with a suitable conduit box securely fixed to the building fabric, that is able to support the weight of the fittings, etc. It is only permissible to solely suspend the luminaire or wiring accessory from the conduit box where the conduit system is of rigid metallic construction, with the conduit box fixed to the conduit system using metallic couplers and bushes as appropriate.

Install conduit from trunking to directly above each luminaire position. Size the conduit for the quantity of cables installed.

Install conduit from trunking to each switch-drop back-box position. Size the conduit to include 25% spare capacity, in addition to a maximum space factor of 35% specified.

Co-ordinate trunking and conduit routes. Allow a minimum of 300mm separation between trunking and cable-basket where running in parallel, and 50mm minimum separation where trunking and cable cross. Cross over at 90 degrees

Plan and install routes so that the crossing of surface-mounted conduits is avoided.

Ensure that the mounting plate of each item of surface-mounted equipment completely covers the recessed box to which it is fitted. Ensure that any cables are correctly bushed and protected against mechanical and electrical damage.

Use countersunk screws only where a countersunk hole is also provided otherwise use roundhead screws in all other cases.

Ensure that each accessory box is securely fixed using a minimum of 2 No. fixings.

Drill and tap holes in metalwork suitable for metal thread screws of 6mm diameter, or larger as required.

332 Concealed

Fix all conduits installed above suspended ceilings to the building fabric at distances to comply with BS 7671, Guidance Note 1. Use saddles, or steel strapping suspensions, or circular steel suspension sets with saddles, or proprietary suspension clips. Do not use suspensions that permit greater than a negligible amount of sideways movement of the conduit in normal service.

Provide conduit that is concealed above plastered or rigidly-constructed false ceilings, with ceiling mounted conduit boxes flush with the finished ceiling surface using extension rings where necessary.

Fix all ceiling-mounted lighting points or pull-cord operated switches independently of the support structure of false ceilings. Provide break-joint rings at all luminaire or ceiling switch points as necessary.

Ensure that all conduits concealed in plastered walls have 12mm minimum cover along their whole length and are routed vertically, not horizontally.

Where partitions and walls are of such a construction that it is not possible to make a normal conduit entry to the flush accessory box, terminate the conduit in a box recessed deep into the wall and use an extension box to achieve a flush finish.

Provide boxes of all types (including adaptable, conduit, draw-in) with an overlapping cover flush with the finished wall or ceiling surface, and coloured to match the finish of the immediately adjacent surface.

Where containment is to be installed within and beneath the surface of a screed:

~ Do not allow an installation to proceed that may lead to the premature failure of the screed, or screed-embedded services.

~ Install containment with at least 25mm depth of cover over its entire length, increasing the burial depth as dictated by the screed manufacturer and the designer of the building fabric.

~ Ensure that the installation layout conforms to the requirements of the screed manufacturer and the designer of the building fabric, with specific attention to requirements regarding the lateral separation between buried services. Gain the specific consent and direction of the building fabric designer where conduits would be installed in parallel with other buried services (including containment), with less than 150mm clear space between each.

Where conduits are to be concealed in concrete, fix them securely to the steel reinforcement and fix conduit boxes to the shuttering.

333 Conduit layout and cable draw-in

Ensure that all conduit systems are of the surface-fixed or the concealed type as appropriate and as detailed in the system section(s) of this specification.

Ensure all lubricants and adhesives used for installation are suitable for the intended purpose and do not cause damage or other deterioration to the installation.

Lay conduits parallel and at equal distance to each other maintaining equal distance throughout all turns and bends.

Wherever possible, locate conduits in inconspicuous areas. Wherever a surface conduit turns through a wall install a back outlet box.

Install inspection boxes in accessible positions having due regard to switch and socket positions, and all aesthetic requirements.

Allow for sufficient draw-in boxes to permit ease of wiring/rewiring and comply with *Table 3 - Distance between draw-in boxes*:

Table 3 - Distance between draw-in boxes

No of right-angled bends	Maximum distance between draw-in boxes (m)
Nil	10
1	10
2	6

For the purpose of this specification, a double-set constitutes the equivalent of 1 No. right-angled bend. Do not use more than two right-angled bends or a 10m length of conduit between draw-in boxes.

Ensure that conduit installation allows for the easy pulling in of cables with minimal risk of cable damage. Rectify all causes of difficult draw-in, replacing all damaged cable as necessary.

Take special care to prevent debris and moisture entering conduit systems (conduit and all fittings). Do not leave ends of conduits or conduit boxes open during building operations; effectively plug open ends and cover conduit boxes, and coat with petroleum jelly. Use only shaped plugs or screwed caps.

Remove all swarf, assembly fluids (eg lubrication, adhesive), other debris and moisture ingress to conduit systems and take steps to prevent further ingress.

Remove all swarf, assembly fluids (eg lubrication, adhesive) and other debris from all external conduit surfaces.

Do not draw in cables until the associated section of the conduit installation is complete and free of all debris and moisture.

Arrange conduits so as to minimise the collection of water from condensation or other sources. Where necessary drill drain holes (3mm diameter) in conduit boxes located at local low points and at any other points required by the Contract Administrator.

340 Flexible conduit

Use only weatherproof flexible conduit in external or continually damp locations.

Use non-metallic flexible conduits of the heavy duty reinforced pattern, and of the same manufacturer, colour and composition as the associated rigid non-metallic conduit installation.

Except where agreed otherwise with the Contract Administrator, make all flexible conduits of a length between 300mm and 1000mm.

Ensure flexible conduits comply with BS EN 61386. Only use such conduits for final connections to equipment in the following locations:

~ all equipment subject to vibration, including all electric motors

~ all equipment subject to adjustment or that can be withdrawn for maintenance

~ thermostats, control sensors, etc not forming part of a piped or ducted system

Do not use non-metallic flexible conduit for final connections to heat-producing equipment. Use only metallic flexible conduit with suitable classification for use. Earth both ends of metallic flexible conduit.

Terminate every non-metallic flexible conduit using the coupling connection produced by, or recommended by, the flexible conduit manufacturer.

Ensure that where non-metallic flexible conduit joins rigid conduit, the rigid conduit is terminated with an appropriate box to receive the flexible conduit.

350 Conduit and trunking support

Support conduit as per *Table 4 - Conduit support spacing* and trunking as per *Table 5 – Trunking support spacing* or in accordance with the manufacturer's recommendations if such recommendations specify a lower distance between supports. Use additional supports where conduit provides support to luminaires and other electrical fixings:

Table 4 - Conduit support spacing

Nominal diameter (d) of conduit in millimetres (mm)	Maximum distance between support (m) for rigid conduit			
	Metallic conduit		Non-metallic conduit	
	Horizontal	Vertical	Horizontal	Vertical
d ≤ 25	1.75	2.0	1.5	1.75
25 < d ≤ 40	2.0	2.25	1.75	2.0
d > 40	2.25	2.5	2.0	2.0

Table 5 – Trunking support spacing

Cross sectional area (A) of trunking in square millimetres (mm^2)	Maximum distance between support (m) for trunking			
	Metallic trunking		Non-metallic trunking	
	Horizontal	Vertical	Horizontal	Vertical
300 < A ≤ 700	0.75	1.0	0.5	0.5
700 < A ≤ 1500	1.25	1.5	0.5	0.5
1500 < A ≤ 2500	1.75	2.0	1.25	1.25
2500 < A ≤ 5000	3.0	3.0	1.5	2.0
A > 5000	3.0	3.0	1.75	2.0

Support each bend, set, adaptable box, conduit box, etc, by a conduit fixing equally spaced on each side at 150mm maximum.

Use spacer bar type saddles with 3mm clearance between the conduit and fixing surface on all resistance to corrosion Class 2 installations.

Use distance spacing type saddles with 12mm clearance between the conduit and fixing surface on all resistance to corrosion Class 4 installations.

Secure saddles and boxes by screws of minimum size 30mm x No.8. Use brass or sherardized screws for Class 4 installation.

351 Services Support and Suspension Systems

Comply with section Y93 of this specification.

352 Fixing to building fabric

Comply with section Y90 of this specification.

Do not undermine the fire integrity or acoustic integrity of the building-fabric. In addition to the items of good practice described within the MEP information, also comply with any project-specific detail or requirement with respect to fire stopping and acoustics.

400 STORAGE

Where conduit and trunking is stored for any amount of time prior to installation, ensure that they are stored on racks in dry storage conditions that do not promote corrosion, staining, warping or cracking, or allow other damage and defacement to occur. Dispose of any damaged materials; do not install them.

500 METALLIC CONDUIT AND FITTINGS

510 Metallic conduit

Use only conduits and fittings that are free of mechanical defects and surface rust. Ensure that this condition is maintained on installation.

Unless permitted to remain by the Contract Administrator, replace conduits where the protective coating is damaged, or where the protective coating becomes damaged after installation. If permitted to remain by the Contract Administrator, make good the rust patches by cleaning down to bright metal, priming and re-painting to match the undamaged conduit and subject to the satisfaction of the Contract Administrator.

520 Fittings for metallic conduit

Ensure all fittings are malleable iron conforming to BS EN 60423 and BS EN 61386.

521 Conduit boxes

Use circular malleable iron draw-in boxes at all lighting points, angle boxes, tee boxes, and all junctions having up to four conduits. For all other cases use adaptable boxes of the appropriate protective finish.

Fit every conduit box with a heavy steel cover, secured with brass screws, except where covered with a directly mounted accessory or fitting. Ensure all such covers are oversized, where used as flush inspection points, and have break-joint rings at luminaire and ceiling switch positions. Use standard or deep pattern conduit boxes having spout entry, except where they are loop-in boxes.

Ensure that all loop-in boxes are of the non-screwed entry type.

Ensure that all exterior installations and wet or damp installations use hot-dipped galvanised finish conduit boxes having external fixing lugs, malleable iron covers, machined mating surfaces and, where necessary, appropriate neoprene gaskets.

522 Adaptable boxes

Use adaptable boxes complying with BS EN 61386. For areas that are considered subject to mechanical damage and/or an aggressive environment, install adaptable boxes made of malleable iron or heavy duty steel with welded joints and tapped lugs to receive the cover screws. For all other areas, heavy duty hot-dipped galvanised pressed steel adaptable boxes may be installed.

Provide Class 4 installations located in exterior locations, or in areas that are expected to be wet and/ or damp, with adaptable boxes having external lugs, a 3mm drainage hole at the lowest point, and a waterproofing seal between the box and the cover; where they are in other areas, use adaptable boxes that do not have external lugs.

Ensure adaptable boxes used as junction boxes for accommodating permissible cable joints, are of adequate size to receive a fixed porcelain or heat-resisting terminal block capable of withstanding the same temperature range as the cable insulation.

Install cable sweeps and neat connections.

Where necessary, use adaptable boxes having earthed barriers to retain segregation of cables for incompatible circuits (eg low voltage and data communications).

Provide overlap lids on flush installations, that are coloured to match the finish of the immediately adjacent surface.

523 Bushes

Use only brass, male type, long-threaded bushes where loop-in non-screwed entries are provided. Do not use lock nuts and ring bushes.

524 Couplings

Ensure that all couplings are in accordance with BS EN 61386 with protection against corrosion, where applicable.

525 Earthing terminals

Ensure that earthing terminals are provided and securely fixed to all equipment boxes, conduit accessories and adaptable boxes, to which either cables, flexible conduits, equipment or other accessories are mounted and terminated.

526 Serrated washers

Use spring metal, female-type serrated washers.

530 Installation

531 General

Cut all conduit threads ’square’ and to the correct length and properly butt. Clean existing threads using appropriate running dies before installation. Do not leave threads exposed except on running couplings. Ream all ends smooth.

Provide conduit connections to trunking, metallic boxes, panels, switchgear, or any item not having a tapped entry (or a tapped entry of 6 mm or less), using long-threaded male brass bushes with a flanged coupling and serrated spring washer. Make connections after removing the paint with a purpose-made tool.

Use locknuts with running couplings on Class 2 installations only when approved by the Contract Administrator.

Do not use running couplers with locknuts for Class 4 installations; use only manufactured conduit unions.

Form all-site manufactured bends and sets on a proprietary bending machine using the recommended former for the diameter and type of conduit. Use only proprietary fittings where tee, cross, right-angle, loop-in, thru, “U”, “H”, “Y”, terminal or inspection pieces are to be installed in the conduit system

Space conduits at least 150 mm from other services, (including gas, water and steam services), unless otherwise agreed with the Contract Administrator.

Provide all conduits which cross-construction movement joints with at least two 90-degree sets (or more to counter the offset) centred on the joint-line such that movement of the joint is taken up by lateral flexing of the conduit sets.

Ensure that the entire conduit system is electrically continuous throughout, forming a fully bonded system, the whole system being effectively earthed. Cross-bond all exposed conductive containment to any other conductive containment systems, structure and services in the locality. Where conductive containment systems extend to the wiring accessory, ensure that there is continuity between the CPC(s) and the containment system. Carry out earth continuity tests before any conduits are concealed.

532 Concealed installation

Ensure that all conduits that are to be buried in concrete or in floor screed are hot-dipped galvanised. Ensure that all exposed threads of conduit joints are completely coated with zinc-rich paint prior to concreting or screeding.

Ensure that all conduits specified for installation in the ground are of high corrosion protection inside and outside to BS EN 61386-24 (generally equivalent to Class 4 protective finish). Wrap all ground installed conduit with ‘half-lap’ wrap mastic damp-proof bond tape. Extend such wrapping at least 300 mm beyond the ground emergence point.

600 NON-METALLIC CONDUIT AND FITTINGS

610 Non-metallic conduit

Ensure that all non-metallic conduit complies with BS EN 61386, is rigid, heavy gauge, high impact, non-flame propagating, , free from imperfections, smooth inside and outside.

Ensure that all non-metallic conduits are of the same colour throughout the entire installation.

Ensure that all non-metallic conduit is UV-stable.

620 Fittings for non-metallic conduit

Ensure that all fittings are of the same specification and colour as the conduit to which they are attached and comply with BS EN 61386.

Ensure that standard boxes are circular pattern with push-fit spouts to BS EN 61386 and with lid held in place with brass screws. Ensure all conduit box lids are of the same specification and colour as the conduit system.

Ensure that all boxes used at outlet points for luminaires and ceiling-mounted switches, are heat-resistant, have factory-fitted brass earth terminals, and are reinforced with tapped metal inserts for screws used to secure the cover or the fitting.

Ensure that adaptable boxes are of the same British Standard specification as the conduit and have lids fixed by brass screws. Do not use adaptable boxes smaller than 75mm x 50mm or larger than

300mm x 300mm. Where cable joints are permitted or specified, ensure that such boxes are of adequate size to contain the terminal block with sufficient space for making neat connections.

Fix the terminal block to the adaptable box using brass or nylon screws.

Fix concealed non-metallic conduits using saddles of the single-hole, half-clip type.

630 Installation

631 General

Use proprietary conduit adhesive for jointing conduit to couplers, adaptable boxes, etc. Insert square-cut conduits to the full depth of the spout.

Provide conduits terminating in trunking, accessories, or any item not having a smooth bored spout with connections using female plain-to-threaded adaptors, secured by a male bush.

Use male plain-to-threaded adaptors where conduits terminate at tapped conduit entry boxes.

Ensure all bends made on site use only appropriate bending springs. Make the radius of such bends not less than 2.5 times the diameter of the conduit. Make bends only where the ambient temperature is above +10°C. Do not use elbows or tees.

Position expansion joints at maximum intervals of 6m. Install expansion joints in accordance with the manufacturer’s recommendations. Ensure that the conduit and expansion joint are correctly aligned and free from binding.

Do not use non-metallic conduits in situations where ambient temperatures are likely to be lower than -5°C or higher than 60°C. If temperatures are likely to be lower than -5°C but not lower than -25°C, then use non-metallic conduit of appropriate temperature rating, as described in BS EN 61386.

Use 2-No. fixings with large washers for conduit boxes supporting luminaires or ceiling-mounted pull switches.

632 Concealed installation

Do not bury non-metallic conduits in floor screed where electromagnetic screening is required.

Make fixings by means of single-hole plastic half-clips. Place these at intervals to comply with BS 7671 and at all changes of direction, to prevent displacement.

633 Surface-mounted installation

Ensure that conduit work complies with *Table 4 - Conduit support spacing* above and uses only appropriate spacer bar saddles.

700 METALLIC CABLE TRUNKING

710 General

Manufacture all metal cable trunking from sheet steel in accordance with BS EN 50085, and BS 4678-2 for under-floor systems.

Use galvanised trunking. Ensure that the trunking emanates from the distribution centres.

Ensure that the trunking is complete with earth links to bond across all joints and utilises only manufacturers’ proprietary parts.

Supply the trunking in standard lengths, free from all sharp edges and projections and with each length having a coupling sleeve.

Use stove-enamelled or electro-zinc-plated inside and outside in areas having Class 2 conduit installations, and a minimum designation of G275 (to BS EN 10143) of hot-dipped zinc coating in areas having Class 4 conduit installations.

Ensure that the entire trunking system is electrically continuous throughout, forming a fully bonded system, the whole system being effectively earthed. Fit brass continuity links to all trunking joints external to the trunking, using brass bolts and shake-proof washers. Cross-bond all exposed conductive containment to any other conductive containment systems, structure and services in the locality. Where conductive containment systems extend to the wiring accessory, ensure that there is continuity between the CPC(s) and the containment system. Carry out earth continuity tests before any containment systems are concealed.

Protect all cut edges of the trunking with a suitable material to prevent damage to the installed cables.

711 Floor trunking

Install all embedded-in-floor and all flush-in-floor trunking systems complete with segregated compartments, fixed straight and level and in accordance with the trunking manufacturer's installation instructions and with the following:

~ Install appropriate floor service outlet boxes, junction boxes, change-of-direction boxes and vertical intersection boxes, to form a complete installation.

~ Install floor boxes of the fully adjustable pattern each fitted with the required segregated compartments and with appropriate lids.

~ Install power, data and telephone outlets as required.

~ Ensure that trunking to be concealed in floor screeds complies with BS 4678-2 and BS EN 50085-2-2. Ensure that no void occurs below trunking lengths and that the routes/boxes are correctly packed. Prevent the ingress of screed or debris into the trunking system.

~ Ensure that all floor trunking level alignment is correct and that the desired level is maintained throughout any associated screed laying process.

~ Ensure that all underfloor trunking systems are fully re-wireable to all final service outlets. Where wireways only are required, install draw-in wires to suit the particular system(s).

800 NON-METALLIC CABLE TRUNKING

810 General

Ensure that all non-metallic cable trunking complies with BS 4678-4 and BS EN 50085, is of heavy gauge high impact resistance construction, non-flame propagating, is smooth inside and outside, and is fitted with drip-proof lids along the complete trunking length. Do not use plastic trunking or plastic trunking products unless they are constructed using low smoke, halogen-free material.

Ensure that the cover of non-metallic trunking is removable throughout.

Make due allowance for expansion to all fixings and connections as recommended by the trunking manufacturer.

Fix dado / skirting trunking with round head screws with oversized washers at a maximum interval distance of 500mm, and at the top and bottom of the trunking. In addition to regular fixing, install further fixings at all trunking-run ends, within the last 50mm of the trunking length. Fill irregularities between trunking and wall with silicon beading to eliminate gaps.

END OF SECTION Y60

Y61 HV / LV / ELV CABLES AND WIRING

CONTENTS

Y61 HV / LV / ELC CABLES AND WRITING

Y61 HV / LV / ELC CABLES AND WRITING

100 REFERENCE DOCUMENTS

This specification is written based on legislation, standards and guidance in force in the UK generally, and within England by default. For projects in Scotland, Wales, Northern Ireland, the Channel Islands and the Isle of Man, give appropriate consideration to any locally applicable legislation, standards and guidance that deviates from or is additional to those in force within England. Similarly for projects outside the UK comply with the corresponding national legislation, standards and guidance.

Comply fully with the edition (including amendments, replacements and associated normative references) of each of the following, current at the time of tender.

Where a standard referred to in this section conflicts with a standard referred to in an associated ‘engineering system’ section (eg S10, T31, V21, etc.) of this specification, the standard referred to in the engineering system section prevails.

The Dangerous Substances and Explosive Atmospheres Regulations

Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations

BS 2562	Specification for cable boxes for transformers and reactors
BS 5266	Emergency lighting
BS 5467	Electric cables. Thermosetting insulated, armoured cables for voltages of 600/1000 V and 1900/3300 V
BS 5839	Fire detection and fire alarm systems for buildings. Code of practice for system design, installation, commissioning and maintenance
BS 6004	Electric cables. PVC insulated, non-armoured cables for voltages up to and including 450/750 V, for electric power, lighting and internal wiring
BS 6121-1	Mechanical cable glands. Armoured glands. Requirements and test methods
BS 6121-5	Mechanical cable glands. Code of practice for selection, installation and inspection of cable glands and armour glands
BS 6231	Electric cables. Single core PVC insulated flexible cables of rated voltage 600/1000 V for switchgear and control gear wiring
BS 6387	Specification for performance requirements for cables required to maintain circuit integrity under fire conditions
BS 6622	Electric cables. Armoured cables with thermosetting insulation for rated voltages from 3.8/6.6 kV to 19/33 kV. Requirements and test methods
BS 6724	Electric cables. Thermosetting, armoured cables for voltages of 600/1000 V and 1900/3300 V, having low emission of smoke and corrosive gases when affected by fire
BS 7211	Electric cables. Thermosetting insulated, non-armoured cables for voltages up to and including 450/750 V, for electric power, lighting and internal wiring, and having low emission of smoke and corrosive gases when affected by fire
BS 7629-1	Electric cables. Specification for 300/500 V fire resistant, screened, fixed installation cables having low emission of smoke and corrosive gases when affected by fire. Multicore cables
BS 7671	Requirements for Electrical Installations. IET Wiring Regulations
BS 7835	Electric cables. Armoured cables with thermosetting insulation for rated voltages from 3.8/6.6 kV to 19/33 kV having low emission of smoke and corrosive gases when affected by fire. Requirements and test methods

BS 7846	Electric cables. 600/1000 V armoured fire resistant cables having a thermosetting insulation and low emission of smoke and corrosive gases when affected by fire
BS 7889	Electric cables. Thermosetting insulated, unarmoured cables for a voltage of 600/1000 V
BS 8434-1	Methods of test for assessment of the fire integrity of electric cables. Test for unprotected small cables for use in emergency circuits. BS EN 50200 with addition of water spray
BS 8434-2	Methods of test for assessment of the fire integrity of electric cables. Test for unprotected small cables for use in emergency circuits. BS EN 50200 with 930°C flame and with water spray
BS 8436	Electric cables. Specification for 300/500 V screened electric cables having low emission of smoke and corrosive gases when affected by fire, for use in walls, partitions and building voids. Multicore cables
BS 8488	Prefabricated wiring systems intended for permanent connection in fixed installations. Specification
BS 8491	Method for assessment of fire integrity of large diameter power cables for use as components for smoke and heat control systems and certain other active fire safety systems
BS 8519	Selection and installation of fire-resistant power and control cable systems for life safety and fire-fighting applications. Code of practice
BS EN 13501-6	Fire classification of construction products and building elements. Classification using data from reaction to fire tests on electric cables
BS EN 50085	Cable trunking systems and cable ducting systems for electrical installations
BS EN 50109	Hand crimping tools
BS EN 50200	Method of test for resistance to fire of unprotected small cables for use in emergency circuits
BS EN 50393	Test methods and requirements for accessories for use on power cables of rated voltage 0,6/1,0 (1,2) kV
BS EN 50399	Common test methods for cables under fire conditions. Heat release and smoke production measurement on cables during flame spread test. Test apparatus, procedures, results
BS EN 50525-1	Electric cables. Low voltage energy cables of rated voltages up to and including 450/750 V (U0/U). General requirements
BS EN 50525-2-31	Electric cables. Low voltage energy cables of rated voltages up to and including 450/750 V (U0/U). Cables for general applications. Single core non-sheathed cables with thermoplastic PVC insulation
BS EN 50525-2-41	Electric cables. Low voltage energy cables of rated voltages up to and including 450/750 V (U0/U). Cables for general applications. Single core cables with crosslinked silicone rubber insulation
BS EN 50525-2-42	Electric cables. Low voltage energy cables of rated voltages up to and including 450/750 V (U0/U). Cables for general applications. Single core non-sheathed cables with crosslinked EVA insulation
BS EN 50525-2-81	Electric cables. Low voltage energy cables of rated voltages up to and including 450/750 V (U0/U). Specific requirements for different types of cables

BS EN 50525-3-41	Electric cables. Low voltage energy cables of rated voltages up to and including 450/750 V (U0/U). Cables with special fire performance. Single core non-sheathed cables with halogen-free crosslinked insulation, and low emission of smoke
BS EN 50565	Electric cables. Guide to use for cables with a rated voltage not exceeding 450/750 V (U0/U). General guidance
BS EN 50575	Power, control and communication cables. Cables for general applications in construction works subject to reaction to fire requirements
BS EN 60332	Tests on electric and optical fibre cables under fire conditions
BS EN 60332-1-2	Tests on electric and optical fibre cables under fire conditions. Test for vertical flame propagation for a single insulated wire or cable. Procedure for 1 kW pre-mixed flame
BS EN 60684	Flexible insulating sleeving
BS EN 60702-1	Mineral insulated cables and their terminations with a rated voltage not exceeding 750 V. Cables
BS EN 60702-2	Mineral insulated cables and their terminations with a rated voltage not exceeding 750 V. Terminations
BS EN 60754	Test on gases evolved during combustion of materials from cables. Determination of the halogen acid gas content
BS EN 61034	Measurement of smoke density of cables burning under defined conditions
BS EN 61386	Conduit systems for cable management
BS EN 61386-24	Conduit systems for cable management. Particular requirements. Conduit systems buried underground
BS EN 61439	Low-voltage switchgear and control gear assemblies
BS EN 61442	Test methods for accessories for power cables with rated voltages from 6 kV (Um = 7,2 kV) up to 36 kV (Um = 42 kV)
BS EN 61534	Powertrack systems
BS EN 61535	Installation couplers intended for permanent connection in fixed installations
BS EN 61914	Cable cleats for electrical installations
BS EN 61984	Connectors. Safety requirements and tests
BS EN 62275	Cable management systems. Cable ties for electrical installations
BS EN 62444	Cable glands for electrical installations
BS IEC 60287-1-1	Electric cables. Calculation of the current rating. Current rating equations (100% load factor) and calculation of losses
IEC 60331-1	Tests for electric cables under fire conditions. Circuit integrity. Test method for fire with shock at a temperature of at least 830°C for cables of rated voltage up to and including 0,6/1,0 kV and with an overall diameter exceeding 20 mm
IEC 60331-2	Tests for electric cables under fire conditions. Circuit integrity. Test method for fire with shock at a temperature of at least 830°C for cables of rated voltage up to and including 0,6/1,0 kV and with an overall diameter not exceeding 20 mm
IEC 60331-3	Tests for electric cables under fire conditions. Circuit integrity. Test method for fire with shock at a temperature of at least 830°C for cables of rated voltage up to and including 0,6/1,0 kV tested in a metal enclosure

ENA TS 09-12	Impregnated paper insulated corrugated aluminium sheathed 6350/11000 volt cable
NJUG	Guidelines on the positioning and colour coding of utilities' apparatus

200 GENERAL

210 Cables

Use only cables that have received product certification from the British Approvals Service for Cables (BASEC) or equivalent third party certification.

For any cable requiring fire resistance, use only products having received certification of their compliance via the LPCB.

Supply and install all cables in compliance with the Construction Product Regulations. Ensure that all cables are compliance marked for the appropriate market; are marked with the appropriate Euroclass code and labelling; and have a suitable Declaration of Performance (DoP) based upon testing and verification by BASEC or another equal and accepted notified body. Provide the DoP to the Contract Administrator for comment in advance of cable procurement.

For all power-system cables (including for small power), installed within buildings, install only cables with a Euroclass of D_{ca}, s1b, d2, a2 or better.

For all telecoms-system cables within the scope of BS 6701 and installed within buildings, install only cables with a Euroclass of C_{ca}, s1b, d2, a2 or better.

Where installed outside of buildings, install only cables with a Euroclass of Eca or better.

Where the term “low smoke zero halogen” (LSZH) or “low smoke and fume”’ (LSF) is included in the project specifications, this means cables with such performance that when affected by fire, they emit only limited smoke and negligible amounts of corrosive gases. Ensure that any cable specified to have “LSZH” or “LSF” sheath and or insulation, meets the Euroclass minimum performance sub-classes of s1b and a2 for smoke density and corrosive gas emission respectively.

Ensure that all containment and fixings of LSZH cabling is of a type producing low levels of smoke and negligible halogens, such that a coordinated strategy for LSZH materials in the cabling and containment systems is achieved.

Ensure that the neutral conductor of a 4-wire three-phase final or distribution circuit is of equal cross-sectional area to a phase conductor.

For recessed tungsten and fluorescent luminaires or for heat-producing or heat-emitting equipment that have final connections using flexible cables, make the final connections using heat-resisting flexible cables. Where heat-producing/emitting equipment is directly wired, fit heat-resisting sleeving, of temperature rating not less than 185°C, over conductors within electrical equipment.

Determine the appropriate value of current carrying capacity for cables in accordance with BS 7671 and BS IEC 60287-1-1, based on a maximum permissible conductor temperature of 70°C in normal service.

Where a conductor operates at a temperature exceeding 70°C ascertain from the manufacturer that the switchgear, protective devices, accessories, other types of equipment connected to the conductor, and the fabric of the building or other material the cable is touching, is suitable for the resulting temperature at the point of contact.

Do not use any current carrying conductor less than:

- 2.5 mm^2 for general power applications
- 1.5 mm^2 for general lighting and fire alarm applications

~ 0.75 mm² for ELV control and signalling applications

Do not use thermoplastic insulated (PVC) cables if the expected ambient temperature exceeds 50°C. Do not use thermosetting insulated (XLPE) cables if the expected ambient temperature exceeds 70°C. In applications where the ambient temperature exceeds these limits, install heat-resisting cables back to the first switch or distribution board or a termination box that is not in an area with elevated temperature.

Where it is permissible for cables to traverse channel-ways or similar on continuously mounted fluorescent luminaires, ensure that the cable rating is appropriate for the temperature inside the channel or duct by applying the appropriate de-rating factor. Do not use thermoplastic insulated (PVC) cables if the expected temperature exceeds 50°C. Do not use thermosetting insulated (XLPE) cables if the expected temperature exceeds 70°C.

Do not use thermoplastic insulated (PVC) cables for final connections to any appliances containing a heating element or any appliance emitting heat. Wherever a final connection is within flexible conduit, make it using heat-resisting cables. Ensure that the full length of cable installed in flexible conduit is heat resistant from the point of connection of the appliance to that with the fixed wiring system contained by rigid containment.

Ensure cables are not in direct contact with any form of polystyrene used in the building.

Ensure that all cables are installed, straightened, dressed and supported to give a neat and workmanlike installation in accordance with BS 7671.

Ensure wherever practicable, low voltage and extra low voltage cables cross at ninety degrees to each other and such that they do not cause interference or mutual detriment.

Do not install cabling in thermal insulation wherever practicable. Ensure cable routes and fixings are selected to prevent mechanical damage or overheating of the cable during installation or during their use.

Wherever cores less than 4 mm² are terminated in tunnel and similar terminations, double them back on themselves to ensure a good level of contact is achieved. Whenever preparing a cable for connection by stripping insulation from it, ensure that the stripping tool does not damage the conductor. Strip back only so much of the insulation that none of the conductor beyond its termination is exposed, and ensure that the termination compresses only its conductor and not its insulation. Do not use soldered connections or lugs.

Terminate all conductors requiring bolted connections with compression lugs using an automatic compression crimp tool that releases only after obtaining the correct crimp depth. Ensure that the cable, the compression lug, the die used and the crimping tool are all compatible. For small compression lugs, use an appropriate hand-crimping tool to BS EN 50109. Test every crimped termination and every mechanical termination for mechanical soundness immediately after making.

Make all bolted terminations using suitable bolts, nuts and shake-proof washers. Tighten connections to the torque recommended by the equipment manufacturer.

Ensure that all cable joints and connections are electrically and mechanically sound.

For low-voltage cables identify conductors using colours and cable markers in accordance with BS 7671.

Identify all cables using a proprietary alphanumeric marker system manufactured by 'Critchley' or an equal alternative supplier accepted by the Contract Administrator. Identify cable references at both ends of the cable, including individual conductors within the distribution boards and at every floor within risers, and allow for up to fourteen alphanumeric characters. When cable markers with a limited fire hazard (LFH) rating are required, use zero-halogen markers made from self-extinguishing material.

Arrange cable routes so that cables, hangers, cleats, and the like, do not come into contact with, or in close proximity to, pipe services.

Where cables rise from below the floor, protect them by metal conduit to a height of 300 mm above the floor surface. Increase the height of such protection to 2 m where the cables are exposed to potential mechanical damage.

Ensure that all installation work results in a workmanlike installation consistent with recognised ‘good practice’ in the industry.

220 Cable ties

Where cable ties are used, comply with BS EN 62275, and use the following minimum classification for cable ties:

~ 6.1 according to material: may be metallic, non-metallic or composite depending on the location of the installation

~ 6.2 according to minimum loop tensile strength: sufficient to support the mass of the cables and any loads that may be imposed during the installation or any subsequent alteration of the installation and not less than 180 N

~ 6.3 according to temperature: maximum temperature not less than 85°C; minimum temperature not higher than -5°C for indoor application and not higher than -15°C for outdoor application

~ 6.4 according to the flame application time: not less than 30°seconds

~ 6.5 according to environmental influence: for outdoor application, declared by the manufacturer as resistant to UV and, for any metallic component, resistant to atmospheric corrosion

Use cable fixings that, when affected by fire, emit levels of smoke and corrosive gases no greater than the cable that they support.

Support wiring systems such that they will not prematurely collapse in the event of a fire, use only metal cable fixings.

Where final-circuit and other minor-gauge cabling is laid in and is supported by incombustible support components, secure them with zero halogen, self-extinguishing, ultra-violet resistant ties. For all other cabling, use plastic coated metallic cable ties or metallic cable cleats. Do not use wire or similar material for cable ties.

Where a cable is fire resisting, select its fixings to maintain the overall fire performance of the cable installation.

230 Cable cleats

Select cleats of duty to suit the application with the following BS EN 61914 requirements:

~ capable of accommodating the size or range of cable bundle diameter without cracking or breaking, or stripping screw threads

~ resistant to impact at the minimum declared temperature

~ capable of withstanding the lateral load at the maximum declared temperature

~ capable of withstanding the axial load at the maximum declared temperature

~ resistant to electromechanical forces

Ensure each cleat is to be marked with the manufacturer’s logo or trademark and the identification or type.

Ensure that surfaces of cleats are free from sharp edges and burrs that are likely to damage cables or cause possible injury to the installer.

Avoid excess pressure of cleats and other fixings on cables to prevent deformation of the plastic sheathing. Ensure that non-metallic and composite cable cleats and intermediate restraints have adequate resistance to flame propagation and are able to withstand a 30-second period of exposure to a needle flame in accordance with BS EN 61914.

Where a cable is fire resisting, select its fixings to maintain the overall fire performance of the cable installation.

For single-core SWA cables, use aluminium (non-ferrous) or proprietary plastic cleats / brackets for restraints, as opposed to steel, to reduce the effect of eddy current heating within the cleats / brackets.

240 Cable glands

Select cable glands according to the size, type and profile of the cable. Select cable glands complying with the following standards:

~ for non-armoured cable: BS EN 62444. Ensure that the classification of the gland as detailed in 6 Classification is compatible with the cable, the installation, and the intended purpose

~ for armoured cable: BS 6121-1 with the gland selection compliant with BS 6121-5. Ensure that the protective connection to earth for the gland is certified to a current at least equal to the maximum expected for the installation

~ for mineral insulated cables: BS EN 60702-2

~ for high voltage cables: a cable entry as described in BS 2562 fitted with a preparatory gland arrangement that provides the performance of a cable gland detailed in BS EN 62444, but not necessarily including the threaded entry. Ensure that the protective connection to earth for the gland is certified to a current at least equal to the maximum expected for the installation.

Use metallic glands where electrical continuity or high impact resistance is required.

Use non-metallic glands where a lightweight gland is required or to be used with a non-metallic enclosure to avoid the need for a separate earth connection to the part of a metal gland.

Use composite glands where it is necessary to guard against electrolytic and / or chemical attack.

For single-core cables, use non-ferrous glands, as opposed to steel glands, in order to reduce the effect of eddy currents which may cause heat and therefore possible thermal damage to the installation.

Fit cable glands with shrouds. Ensure that glands for flexible cables include an effective cable guard.

Use cable glands, shrouds and all associated components that, when affected by fire, emit levels of smoke and corrosive gases no greater than the associated cable they support.

Where a cable is fire resisting, select the gland to maintain the overall fire performance of the cable installation.

Use a cable gland with inner and outer seals where ingress protection is to be maintained at the point of cable termination.

300 LV CABLES IN CONDUIT AND TRUNKING

310 Cables

Select cable for the method of installation that meets the requirements of the relevant standard referred to in clause Y61.100 or in the relevant ‘system’ section of this specification. This clause applies primarily to the following:

- ~ thermosetting insulated non-sheathed single-core cable to BS EN 50525-2-31, harmonised code H07Z-R, cable code 6491B (low smoke zero halogen cable)
- ~ PVC insulated non-sheathed single-core cable to BS EN 50525-2–31, harmonised code H07V-R, cable code 6491X
- ~ heat-resisting rubber insulated non-sheathed single-core cable to BS EN 50525-2-42, harmonised code H07G-R
- ~ heat-resisting silicone-rubber insulated non-sheathed single-core cable to BS EN 50525-2-41, harmonised code H05SJ-K

This clause also applies to insulated and sheathed single-core cables or insulated and sheathed multi-core cables with or without a circuit protective conductor described below when installed in conduit or trunking:

- ~ thermosetting insulated sheathed single-core or multi-core cable to BS 7211, table 3, cable code 6181B, or table 5 cable code 624#B. Use class 2 multi-stranded conductors for cables of 4.0 mm^2 and above. Use class 1 single-stranded conductors for cables below 4.0 mm^2 (low smoke zero halogen cable)
- ~ PVC insulated and sheathed single-core or multi-core cable to BS 6004, table 3 or 5, cable code 618#Y or table 4 or 5, cable code 624#Y. Use class 2 multi-stranded conductors for cables of 4.0 mm^2 and above. Use class 1 single-stranded conductors for cables below 4.0 mm^2
- ~ thermosetting insulated PVC sheathed single-core cable to BS 7889, table 3, cable code 6181X
- ~ [In the descriptions above # denotes number of cores.]

This clause also applies to cables of other types where installed in trunking or conduit for support or mechanical protection.

When installing cables within a building or occupied space use only cables that, when affected by fire, emit low levels of smoke and zero halogens (LSZH sheathed multicore and LSZH insulated single core cables), unless specified otherwise in the relevant ‘system’ section of this specification or on the drawings.

Select cables according to external influences not only for proper functioning, but also to ensure the reliability of the measures of protection for safety in accordance with BS 7671 and BS EN 50565.

Use only new cables with each coil having its manufacturer's seal intact giving the size, classification and the like.

Ensure that the sizes of all cables including circuit protective conductors (CPCs) are in accordance with BS 7671. Design the cable sizing with a grouping correction factor for the actual circuits within the same containment, plus a further factor for not less than 25% additional future circuits.

Where an installation includes an extension or alteration to a pre-existing installation, do not add cables where their installation would result in the grouping correction factor for the total number of circuits reducing the current carrying capacity of the cables below that required by BS 7671.

Where cables are routed outside of their associated trunking for making the final connection to an energy meter, use sheathed and insulated single cables. Ensure that such cables where outside the trunking, are as short as practicable and meet the metering requirements of the supply company. This method of connection is generally applicable only for directly metered supplies of 100 A or less.

320 Installation

Install and fix all cables in accordance with BS EN 50565.

Install cables only of the same voltage band within the same conduit and trunking system. Do not install cables forming part of a fire alarm and detection system in the same cable containment as other circuits. Install a dedicated cable containment system exclusive to the wiring system serving a Group 2 medical location (as defined in chapter 9 of Guidance Note 7 ‘Special Locations’ published by the IET) where electrical equipment is supplied through a safety-isolating transformer.

Ensure the electromagnetic compatibility of equipment connected with wiring routed within the same conduits and trunking.

Ensure that all conduit and trunking is de-burred and free from sharp edges, water, chemicals, building debris, dust and other contaminants before cables are installed, and throughout the period of the installation works.

Where tungsten luminaires are ceiling-mounted direct to conduit boxes, use heat-resisting cables from the luminaire to its lighting switch and respective neutral conductor.

Carry out all wiring of multi-point circuits in a ‘loop-in' system, and do not use joints or connections, other than those required for the connection of switches, fuses, socket outlets, motors and the like.

Do not make cable joints within trunking.

Do not allow cables to exceed the capacity of the conduit and/or trunking as defined in Guidance Note 1 ‘Selection and Erection of Equipment’ published by the IET.

Ensure that the sheathing and insulating materials of cables are not damaged while drawing cables into conduit.

Do not install cables when the temperature is below the minimum installation and handling temperature given in BS EN 50565. If the cables have been exposed to such temperature, allow a warming up time before the cables are handled.

In the event of any insulation being damaged, eg while cables are being drawn or laid in, remove and replace the whole length of cable. Damage includes any instance of bending to a radius less than the normal-use minimum bending radius given in BS EN 50565 or specified by the cable manufacturer.

Do not bend cables during installation to a smaller radius than the normal-use minimum bending radius specified by the cable manufacturer or BS EN 50565 where the manufacturer data does not exist. Take into account that the minimum bending radius allowed for installation work is within a limited range of ambient temperatures.

Do not draw cables into conduit occupied by cables. If conduits occupied by cables have to be used for additional circuits or alterations, then isolate, identify, label, disconnect and withdraw all wiring from the conduit. Replace the wiring by drawing it back into the conduit with the new wiring.

Do not draw cables into trunking but lay them in, irrespective of whether the trunking is installed ‘lid-up’, ‘lid-down’, or ‘lid-on-side’. ‘Comb’ cables as laying-in proceeds and lay the neutral and circuit protective conductor of each circuit with each phase cable of that circuit. Where trunking is installed lid-down, support the cables with proprietary cable retainers at intervals not exceeding 1 m. Ensure that cables are not trapped between the trunking body and its lid or fastening.

Ensure that the respective neutral or switched live conductor and the circuit’s permanent live conductor are contained in the same containment section to prevent eddy current heating of the containment.

Where cables of several circuits occupy the same trunking, bind the cables of each individual circuit together at intervals not exceeding 5 m, by labelling ties or other similar means. As a minimum ensure that the ties at each end of the circuit clearly show the circuit reference number.

Leave sufficient slack in the cables at conduit and trunking expansion joints.

Where cables are left unattended before installing them in conduits or trunking, temporarily form them into coils, bind them and securely support the resulting coils at high level.

330 Circuit protective conductors (CPCs)

Do not use conduit or trunking as a CPC medium. Install CPCs and ensure that they are of the same grade and temperature rating as the live conductors of that part of the circuit. Use green/yellow coloured insulation for CPCs in accordance with BS 7671.

Ensure that each circuit has its own CPC emanating from the distribution position and installed in the same trunking/conduit as the live conductors of that circuit.

Ensure that every CPC is sized in accordance with BS 7671.

Identify the CPC on all equipment clearly, by a cable marker at the earthing terminal. Permanently fix in a visible position adjacent to the earthing terminal of every equipment box, appliance box and the like, a durable label to BS 951 indelibly marked with the words “SAFETY ELECTRICAL CONNECTION – DO NOT REMOVE".

400 INSULATED AND SHEATHED CABLES

410 Cables

Select cable for the method of installation that meets the requirements of the relevant standard referred to in clause Y61.100 or in the relevant ‘system’ section of this specification. This clause applies primarily to the following:

~ thermosetting insulated sheathed single-core or multi-core cable to BS 7211, table 3, cable code 6181B, or table 5 cable code 624#B. Use class 2 multi-stranded conductors for cables of 4.0 mm^2 and above. Use class 1 single-stranded conductors for cables below 4.0 mm^2 (low smoke zero halogen cable)

~ PVC insulated and sheathed single-core or multi-core cable to BS 6004, table 3 or 5, cable code 618#Y or table 4 or 5, cable code 624#Y. Use class 2 multi-stranded conductors for cables of 4.0 mm^2 and above. Use class 1 single-stranded conductors for cables below 4.0 mm^2

~ thermosetting insulated PVC sheathed single-core cable to BS 7889, table 3, cable code 6181X

~ [In the descriptions above # denotes number of cores.]

Ensure that the cross-sectional area of the integral circuit protective conductor complies with BS 7671.

Identify conductors using colours in accordance with BS 7671. Fit coloured sleeves over bare copper CPCs, where stripping-back the sheath has exposed them. Fit coloured sleeves to BS EN 60684 where the standard colour of the phase or neutral conductor is at variance with the identification colour given in BS 7671 (for example, when the blue conductor in a two-core cable is used as a switch wire).

420 Installation

421 General installation requirements

Do not install cables when the temperature is below the minimum installation and handling temperature given in BS EN 50565. If the cables have been exposed to such temperature, allow a warming up time before the cables are handled.

In the event of any cable being damaged, remove and replace the whole length of cable. Damage includes any instance of bending to a radius less than the normal-use minimum bending radius given in BS EN 50565 or specified by the cable manufacturer.

Do not bend cables during installation to a smaller radius than the normal-use minimum bending radius specified by the cable manufacturer or BS EN 50565 where the manufacturer data does not exist. Take into account that the minimum bending radius allowed for installation work is within a limited range of ambient temperatures.

Ensure compliance with the requirements of BS EN 50565 in respect of instances where the sheath temperature may exceed 50°C by ensuring that:

- ~ either the cable is located so that persons or animals will not touch it, or
- ~ the cable is de-rated to prevent its temperature from rising above 50°C

Do not bury these cables underground. Only install these cables in external locations if contained within conduits or trunking.

Do not install these cables in locations classified as hazardous areas.

Install and fix all cables in accordance with BS EN 50565 using single-pin or saddle clips. Use clips that, when affected by fire, emit levels of smoke and corrosive gases no greater than the cable that they support. Where cables are supported on cable tray, or supported in other similar ways, fixing of the cables using cable ties is acceptable. Where cables are fixed using cable ties ensure that the rating of the cables is not affected beyond that allowed for by the grouping factors applied.

Support wiring systems such that they will not prematurely collapse in the event of a fire, use only metal cable fixings.

Where final-circuit and other minor-gauge cabling is laid in and is supported by incombustible support components, secure them with zero halogen, self-extinguishing, ultra-violet resistant ties. For all other cabling, use plastic coated metallic cable ties or metallic cable cleats. Do not use wire or similar material for cable ties.

Where cables are supported from a catenary system use only proprietary catenary fixing clips suitable for the environment they are installed in and in accordance with BS 7671.

Where the final circuit cable installation is intended to be installed without containment as in domestic installations using multicore cabling, fix these cables to maximise their capacity by installing multiple bunches of no more than ten cables in any one bunch with heavy loads separated. Install accessory boxes for all terminations and accessories.

Where cables enter boxes ensure that all cable sheaths pass fully into the box via a rubber insert bush and web. In areas where class 4 conduit or trunking is installed (eg in kitchens, plantrooms and areas subject to dampness), use packed glands with neoprene washers in lieu of rubber insert bushes. Within every box ensure that the CPC has sleeving coloured green/yellow in accordance with BS 7671, where connecting to the earthing terminal. Install a separate green/yellow sleeved CPC from the earthing terminal of the box to the earthing terminal of the accessory or appliance.

Do not use these cables for final connections to any heat-emitting appliance nor to any appliance containing any heating element.

Fit heat-resisting sleeving of temperature rating not less than 185ºC, over conductors within electrical equipment, including tungsten luminaires where the temperature at the termination may exceed the temperature rating of the cable.

422 Installation requirements for surface installations

Comply fully with clause Y61.421 of this specification.

Install cables as inconspicuously as possible, taking advantage of the features of the building by fixing in corners, along skirting boards, mouldings and the like, and around fitments and the like while maintaining the appropriate bending radius of the cable.

Where cables are installed in roof spaces or lofts, clip them to the side of joists and rafters. Where traversing between adjacent joists or rafters, install a 'binder-joist' or suitable batten and clip the cable to its side.

423 Installation requirements for concealed installations

Comply fully with clause Y61.421 of this specification.

Protect cables by means of galvanized metal capping where concealed in solid masonry walls.

Where cables are installed in a wall or partition at a depth of less than 50 mm from a surface of the wall or partition, ensure that the cable:

- (i) Is installed in a zone within 150 mm from the top of the wall or partition or within 150 mm of the vertical junction of two adjoining walls. Where a cable is connected to an electrical point, accessory or switchgear on any surface of the wall or partition, install the cable in a zone either horizontally or vertically to the point, accessory or switchgear
- (ii) Incorporates an earthed metallic covering which complies with the requirements for a protective conductor of the circuit, complying with BS 5467, BS 6724, BS 7846, BS 8436 or BS EN 60702, or
- (iii) Is installed in earthed trunking or ducting complying with BS EN 61386 and satisfying the requirements for a protective conductor, or
- (iv) Is enclosed in earthed trunking or ducting complying with BS EN 50085 and satisfying the requirements for a protective conductor, or
- (v) Is provided with mechanical protection against damage sufficient to prevent penetration of the cable, or
- (vi) Forms part of a Separated Extra-Low Voltage (SELV) or Protective Extra-Low Voltage (PELV) circuit complying with BS 7671

Where clause (i) has been met but neither of the clauses (ii) to (vi) apply to the installation, provide the cable with additional protection by means of a residual current device (RCD) with the characteristics specified within BS 7671.

Ensure that, irrespective of its buried depth, a cable in a wall or partition with metallic parts, other than fixings such as nails, screws and the like (for example, a metal stud frame):

- is provided with additional protection by means of an RCD, or
- complies with the requirements within BS 7671 for a cable installed at a depth of less than 50 mm

Where cables are routed through joists, drill through the neutral axis of each joist perpendicular to its surface, ensuring that there is at least 50 mm of joist above and below the hole. Do not notch joists.

Terminate all lighting points in a ceiling rose box mounted flush to the ceiling. Ensure that every such box is of heavy-gauge, self-extinguishing PVC to the relevant British Standard, reinforced with tapped metal inserts.

Do not lay cables directly on suspended ceilings. Where groups of cables are routed above suspended ceilings, clip them directly to the soffit or secure them to cable trays (or similar containment). Where single cables are routed above suspended ceilings, secure them to a catenary wire or route them through a length of rigid suspended conduit bushed at both ends. Secure sheathed multi-core flexible cables connecting electrical equipment fixed in the ceiling void (eg fan-coil units) or recessed into the suspended ceiling (eg luminaires), in a similar manner.

Where sheathed multi-core flexible cables are used to make final connections to electrical equipment and luminaires, ensure that cord-grips are used at both ends to secure the sheath of the cable in order to prevent strain on the conductors.

500 FIRE-RESISTING CABLES FOR VOICE ALARM AND FIRE ALARM SYSTEMS

510 Cables and cable systems

For public address systems that are used for announcing the evacuation of a building (including voice alarm systems), emergency voice communication (EVC) systems and for fire detection and alarm systems, use fire-resisting cable systems of ‘standard fire resistance’ (PH30) or ‘enhanced fire resistance’ (PH120) as required by the appropriate part(s) of BS 5839 and as defined by the testing regimes of BS 8434 and BS EN 50200.

Use one or more of the following wiring systems:

~ mineral insulated cable systems complying with BS EN 60702-1 and BS EN 60702-2 and BS EN 60332-1-2

~ fire-resistant cables complying with IEC 60331-1 or IEC 60331-2 or IEC 60331-3 and with BS EN 60332-1-2

~ fire-resistant cables complying with test requirements of BS EN 50200 or BS 8434 or BS 8491, appropriate for the cable size and with BS EN 60332-1-2

~ a wiring system maintaining the necessary fire and mechanical protection

Select the wiring system to meet the requirements of the appropriate part(s) of BS 5839 relative to the application, and install in such a way that the circuit integrity will not be impaired during a fire.

Install cabling of minimum fire survival time as required by BS 8519 and to the requirements of the specific system for which the cable is being used. Mechanically protect the cabling either by the cable’s own armoring or additional enclosures.

Use clips that emit levels of smoke and corrosive gases when affected by fire no greater than the cable that they support.

Ensure that all accessories, including, but not limited to fixings, supports, terminations, terminals and glands are compatible with the cable selected, and together with the cable containment and supports form a cabling system that meets the required integrity standard. Produce documentary evidence and technical information that demonstrates that the cable system as a whole is consistent in its fire-resistance rating. Ensure that such documentation is incorporated in the building health and safety file and forms part of the relevant operation and maintenance instruction manuals.

Other than for instances prohibited in clause Y61.520 or otherwise specified in the relevant ‘system’ section of this specification, or otherwise shown on the drawings, flexible soft-skin cables are acceptable.

Obtain written assurance from the manufacturer of the fire alarm, voice alarm and EVC systems installed, that the proposed cabling system is compatible with the fire alarm, voice alarm or EVC system. Ensure that the assurance documentation is incorporated in the building health and safety file and forms part of the relevant operation and maintenance instruction manuals.

520 Installation

Install fire-resisting cables in accordance with BS EN50565, BS 5839 and the cable manufacturer's guidance. Fix fire-resisting cables to fire-resisting structure and secure with fire-resisting fixings.

Where there is risk of damage by rodents, use armoured cable or install the cable within steel conduit.

Do not install cables when the temperature is below the minimum installation and handling temperature given in BS EN 50565. If the cables have been exposed to such temperature, allow a warming up time before the cables are handled.

In the event of any cable being damaged, remove and replace the whole length of cable. Damage includes any instance of bending to a radius less than the normal-use minimum bending radius given in BS EN 50565 or specified by the cable manufacturer.

Do not bend cables during installation to a smaller radius than the normal-use minimum bending radius specified by the cable manufacturer or BS EN 50565 where the manufacturer data does not exist. Take into account that the minimum bending radius allowed for installation work is within a limited range of ambient temperatures.

Do not bury flexible soft-skin cables underground.

Do not install flexible soft-skin cables in locations classified as hazardous areas unless appropriate certification exists for the cable and installation.

For surface installations install cables as inconspicuously as possible, taking advantage of the features of the building by fixing in corners, along skirting boards, mouldings and the like, and around fitments and the like while maintaining the appropriate bending radius of the cable.

Protect cables by means of galvanized metal capping where concealed in solid masonry walls. Where cables are routed in hollow partitions ensure they are mechanically protected by virtue of their position or otherwise by metallic conduit. Ensure that cables installed in hollow partitions are arranged in such a way that they are effectively supported.

Where cables are concealed within solid walls or partitions, route them vertically in the zone directly above or below the accessory they serve. Do not install horizontal cabling to or from accessories.

Where cables are routed through joists, drill through the neutral axis of each joist perpendicular to its surface, ensuring that there is at least 50 mm of joist above and below the hole. Do not notch joists.

Do not lay cables directly on suspended ceilings. Where groups of cables are routed above suspended ceilings, clip them directly to the soffit or secure them to cable trays (or similar containment). Where single cables are routed above suspended ceilings, secure them to a catenary wire or route them through a length of rigid suspended conduit bushed at both ends.

600 FIRE-RESISTING CABLES FOR GENERAL APPLICATIONS

610 Cables and cable systems

Where wiring and interconnection is required to maintain circuit integrity under fire conditions for longer periods than can be achieved with cables of conventional construction, use one or more of the following wiring systems:

- ~ mineral insulated cable systems complying with BS EN 60702-1 and BS EN 60702-2 and BS EN 60332-1-2
- ~ fire-resistant cables complying with IEC 60331-1 or IEC 60331-2 or IEC 60331-3 and with BS EN 60332-1-2
- ~ fire-resistant cables complying with test requirements of BS EN 50200 or BS 8434 or BS 8491, appropriate for the cable size and with BS EN 60332-1-2
- ~ a wiring system maintaining the necessary fire and mechanical protection

Select the wiring system to meet the requirements of the appropriate part(s) of BS 5266 or BS 8519 relative to the application, and install in such a way that the circuit integrity will not be impaired during a fire, with the cable support system achieving a level of fire resistance via suitably sized suspension rods as calculable according to Annex E of BS 8519.

Install cabling of minimum fire survival time as required by BS 8519 and to the requirements of the specific system for which the cable is being used. Mechanically protect the cabling either by the cable's own armoring or additional enclosures.

Where the cable itself cannot achieve the required fire rating such as for high and medium voltage distribution, it is acceptable to install non-fire resistant cabling within fire resistant enclosure(s) meeting the minimum fire survival time published in BS 8519.

For control and bus systems of safety services, use wiring meeting the same requirements as the wiring used for the safety services in question, except for circuits thereof that do not adversely affect the operation of the safety equipment.

Use clips that emit levels of smoke and corrosive gases when affected by fire no greater than the cable that they support.

620 Installation

Install fire-resisting cables in accordance with BS EN 50565, BS 8519 and the cable manufacturer's guidance. Fix fire-resisting cables to fire-resisting structure and secure with fire-resisting fixings.

Where there is risk of damage by rodents, use armoured cable or install the cable within steel conduit.

Do not install cables when the temperature is below the minimum installation and handling temperature given in BS EN 50565. If the cables have been exposed to such temperature, allow a warming up time before the cables are handled.

In the event of any cable being damaged, remove and replace the whole length of cable. Damage includes any instance of bending to a radius less than the normal-use minimum bending radius given in BS EN 50565 or specified by the cable manufacturer.

Do not bend cables during installation to a smaller radius than the normal-use minimum bending radius specified by the cable manufacturer or BS EN 50565 where the manufacturer data does not exist. Take into account that the minimum bending radius allowed for installation work is within a limited range of ambient temperatures.

Do not bury flexible soft-skin cables underground.

Do not install flexible soft-skin cables in locations classified as hazardous areas unless appropriate certification exists for the cable and installation.

For surface installations install cables as inconspicuously as possible, taking advantage of the features of the building by fixing in corners, along skirting boards, mouldings and the like, and around fitments and the like while maintaining the appropriate bending radius of the cable.

Protect cables by means of galvanized metal capping where concealed in solid masonry walls. Where cables are routed in hollow partitions ensure they are mechanically protected by virtue of their position or otherwise by metallic conduit. Ensure that cables installed in hollow partitions are arranged in such a way that they are effectively supported.

Where cables are concealed within solid walls or partitions, route them vertically in the zone directly above or below the accessory they serve. Do not install horizontal cabling to or from accessories.

Where cables are routed through joists, drill through the neutral axis of each joist perpendicular to its surface, ensuring that there is at least 50 mm of joist above and below the hole. Do not notch joists.

Do not lay cables directly on suspended ceilings. Where groups of cables are routed above suspended ceilings, clip them directly to the soffit or secure them to cable trays (or similar containment). Where single cables are routed above suspended ceilings, secure them to a catenary wire or route them through a length of rigid suspended conduit bushed at both ends.

700 MINERAL INSULATED, COPPER COVERED (MICC) CABLES

710 Cables

Use only cables that comply with BS EN 60702-1.

Use mineral insulated cables with copper conductors, mineral insulation (inorganic type), copper sheaths and a halogen free outer covering, unless specified otherwise in the relevant ‘system’ section of this specification or on the drawings.

Do not use cables of less than 1.5 mm^2.

For MICC cables within fire detection and alarm systems, use a red coloured outer sheath and ensure that this colour of sheath is not used for any other application in the same building.

Use 300/500-V or greater grade for:

- ~ socket outlet circuits
- ~ lighting circuits except discharge lighting
- ~ fire alarm systems
- ~ call systems
- ~ reduced low voltage systems

Unless otherwise specified in the relevant ‘system’ section of this specification, use 750-V grade for:

- ~ motor wiring
- ~ 400 V 3- or 4-wire circuits
- ~ discharge lighting circuits

720 Terminations

Ensure the equipment for terminating MICC cables complies fully with BS EN 60702-2 and is of the same manufacture as the cable.

Select cables seals complying with the following:

- ~ installations up to 105°C - cold screw-on pot type, sealed with plastic compound or alternatively, ‘shrink-on’ type sealed by the application of heat
- ~ installations between 105°C and 185°C - cold screw-on pot type, sealed with suitable plastic compound and bonded glass-fibre caps or, alternatively, ‘shrink-on’ type sealed by the application of heat

Within 24 hours after sealing both ends of each MICC cable make a 500-V dc (Megger) insulation resistance test of each seal to prove an infinity reading.

Ensure that all terminations on surface installations have brass compression glands conforming to BS EN 60702 and are fitted with shrouds. In areas where installations are concealed within the fabric of walls and the like, use proprietary MICC clamps to the conduits and adaptable boxes.

Use proprietary male/female cable gland arrangements where cables terminate in plain-hole boxes.

Where glands are omitted or, where the termination is made into a non-metallic enclosure, provide patent CPC tails with the protective conductor brazed to each pot by the manufacturer and suitably sleeved.

Insulate cable tails with sleeving to suit the prevailing temperature conditions. Use sleeving for tungsten luminaires of the medium temperature range for use up to 185°C.

Apply colour-coded markers to the sleeving of phase and neutral conductors in accordance with BS 7671. Ensure that CPC tails have green/yellow striped sleeving. Ensure that all such sleeving is anchored and sealed to the pot.

Where MICC cables are used in hazardous areas (ie where gases, vapours or dust present a risk of explosion), terminate them with glands and seals that have been certified for use in the hazardous area. Use a type of termination that is compatible with the electrical installation in the hazardous area (eg flameproof, intrinsically safe, etc). Ensure that the certification meets the current ATEX standards, eg ATEX 95 (Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations) and ATEX 137 (Dangerous Substances and Explosive Atmospheres Regulations), and include a copy of the certification in the operating and maintenance instruction manuals.

Ensure the environmental conditions when making terminations are such that the work can be carried out without detriment to the completed termination.

730 Conduit boxes and adaptable boxes

Use conduit boxes for terminating or jointing MICC cables with a class 4 protective finish to BS EN 61386. Install conduit boxes of the 'terminal', 'through', 'tee', or 'crossing' circular patterns for all lighting points. Use steel boxes with lugs suitably tapped to receive brass cover fixing screws (not self-tapping). Fit a heavy steel cover to each box, unless an accessory or fitting is mounted.

Where boxes are in exterior locations or in areas of continual dampness, use conduit boxes or adaptable boxes having external lugs and a waterproofing seal between the box and the cover; and where they are in other areas, use adaptable boxes that do not have external lugs.

Where used as junction boxes for permissible cable joints, use conduit boxes and adaptable boxes having terminal blocks supplied and fixed. Ensure terminal blocks have brass connectors shrouded in porcelain or heat-resisting material capable of withstanding, without deterioration, the same temperatures as the pots, insulation and sleeving. Size boxes to allow for the terminal block and to facilitate neat connections.

Ensure all conduits, accessories, or adaptable boxes, to which flexible cables, or flexible conduits are fitted, or upon which accessories or equipment are mounted, have earthing terminals that are securely fixed to the box.

740 Installation

Install all MICC cables in accordance with BS EN 50565.

Ensure that MICC cables are installed only by experienced installers who have received a course of instruction on the handling, jointing and termination of MICC cables, and in the use of the specialist tools recommended by the cable manufacturer.

Where MICC cables are buried underground, comply with the requirements of the relevant clause of the Y61 specification.

Secure MICC cables using copper saddles with a halogen-free covering, meeting the same performance requirements as the cable outer covering, using 30 mm x 4 mm diameter, roundhead brass fixing screws. Use multiple saddles where several cables are installed together. Where cables are specified with no outer covering, use copper saddles with no covering.

Ensure the maximum spacing of supports for MICC cables in accessible positions complies with the recommendations of the manufacturer and in any case do not exceed the following:

Overall diameter of MICC cable	Maximum horizontal spacing	Maximum vertical spacing
below 9 mm	600 mm	800 mm
9 mm to15 mm	900 mm	1200 mm
over 15 mm	1500 mm	2000 mm

Where MICC cables are concealed in masonry walls, fix them securely in position before the wall is plastered or rendered. Where cables are routed in hollow partitions, ensure they are mechanically protected by virtue of their position or otherwise by metallic conduit. Ensure that cables installed in hollow partitions are installed in such a way that they are effectively supported.

Where MICC cables are concealed within solid walls or partitions, route them vertically in the zone directly above or below the accessory they serve. Do not install horizontal cabling to or from accessories.

Where surface-mounted equipment is installed within a concealed MICC installation, terminate cables in a flush-mounted box, drill and bush the back of the equipment for back entry, and install the equipment over the box to conceal it.

For surface installations, install MICC cables neatly on the surface and route cables truly horizontal, vertical or parallel with the features of the building.

Where MICC cables are laid in floor screeds, plan routes to avoid areas where there is a possibility of floor fixings. Avoid centres and edges of doorways to allow for fixing closure bolts and the like. Keep cable crossovers within floor screeds to a minimum and maintain a screed cover of 25 mm above cables.

Ensure that MICC cables fixed to galvanized cable tray have an outer covering. Fix saddles using brass roundhead screws, washers and nuts.

Make connections to items of equipment subject to vibration, adjustment or withdrawal, by terminating MICC cables in an appropriate adaptable box, sited adjacent to the item being connected. Enclose the final connection from the box in metallic flexible conduit or install a 360° loop not less than 150 mm diameter immediately adjacent to the cable entry to the equipment. Allow a clear space of not less than 10 mm at the point where the cable crosses itself.

Ensure all cables are installed, straightened and suitably dressed with rollers and the like, to give a neat and workmanlike installation. Ensure that there is no damage to the cable sheath or outer covering. In the event of any cable being damaged, remove and replace the whole length of cable. Damage includes any instance of bending to a radius less than the normal-use minimum bending radius given in BS EN 50565 or specified by the cable manufacturer.

At termination positions, arrange cable conductors to minimize crossing.

Fit surge suppressors to all cable ends connected to motors with star connection up to and including 2 kW size.

Segregate MICC cables used for a fire alarm installation, from all other cable categories, by providing separate containment.

800 ARMOURED CABLES – LOW VOLTAGE

810 Cables

Use cables having class 2 stranded copper conductors, unless specified otherwise in the relevant ‘system’ section of this specification or on the drawings.

The following abbreviations apply:

- ~ “XLPE/SWA/LSZH” indicates; XLPE compound insulation, polymeric material bedding, single steel-wire armouring, black low smoke zero halogen sheath overall, 600/1000-V grade in accordance with BS 6724
- ~ “XLPE/AWA/LSZH” indicates; XLPE compound insulation, polymeric material bedding, single aluminium-wire armouring, black low smoke zero halogen sheath overall, 600/1000-V grade in accordance with BS 6724
- ~ “XLPE/SWA/LSZH/FR/F#” where # is either 2, 30, 60 or 120 indicates; XLPE compound insulation, polymeric material bedding, single steel-wire armouring, black low smoke zero halogen sheath overall, 600/1000-V grade fire-resisting cable in accordance with BS 7846. F# indicates the category of fire resistance as given in BS 7846 and in the absence of the inclusion of this designation use F120 cable.
- ~ “XLPE/SWA/PVC” indicates; XLPE compound insulation, polymeric material bedding, single steel-wire armouring, black PVC sheath overall, 600/1000-V grade in accordance with BS 5467
- ~ “XLPE/AWA/PVC” indicates; XLPE compound insulation, polymeric material bedding, single aluminium-wire armouring, black PVC sheath overall, 600/1000-V grade in accordance with BS 5467

Use only cables that, when affected by fire, emit low levels of smoke and zero halogens (LSZH sheathed multicore and LSZH insulated single core cables), unless specified otherwise in the relevant ‘system’ section of this specification or on the drawings.

Where cable sizes are not detailed then size these in accordance with BS 7671 and in addition, those standards pertinent to the installation and load supplied.

Ensure all cables are of the same manufacture and delivered to site in continuous lengths, complete with end caps.

At the manufacturer’s works, subject all cables to the routine tests detailed in the relevant British Standards. Submit duplicate copies of test certificates to the Contract Administrator.

For every single-core cable operating on ac systems, use armouring that is non-magnetic (ie is not steel).

820 Terminations, straight joints, tees and branches

Make all cable joints using a proprietary cast-resin kit system, cold-shrink system or heat-shrink joint system supplied by one manufacturer and install strictly in accordance with its instructions. Prior to selecting heat-shrink technology, demonstrate that the installation practices to be adopted make the potential risks associated with hazards negligible (eg applied heat, fire hazards, escaping flammable gas and exposure to fumes).

Install mechanical protection for the cable joint (in the case of a cast-resin joint kit the encapsulation is considered to provide this). For shrink joints, use a further encapsulation where buried or on cable tray or similar arrangement, and cover the joint with a metal tray or equivalent.

Make connections at joints using connectors designed for LV applications, and correctly sized for the type and size of conductor. Connections may use either compression tooling or be of the shear-bolt type. For compression connectors use a compression tool that does not release until the correct compression has been achieved, and ensure compatibility between the tool, die and connector. Verify that the continuity resistance of the jointed conductors is no greater than that of the equivalent length of a conductor without a joint, and that the insulation resistance between cores, and between cores and earth, is no less than that of the original cable.

At joints use solder-less earthing connections comprising a constant-force spring and earthing connection for the armour connections. Ensure that the conductivity and fault current capability of the earth connection across the joint is at least equal to that of the cable without the joint.

Fit cable glands complying with BS 6121-1 at all terminations. Select glands in accordance with BS 6121-5. Use brass compression glands for steel-wire armoured cables and aluminium alloy glands suitable for accepting an insulated insert for single-core aluminium-wire armoured cables. Use non-ferrous gland plates for single-core cables. Ensure that all glands have cone grip armour clamps with suitable provision for cross-joint bonding.

Where armoured cables are used in hazardous areas (ie where gases, vapours or dust present a risk of explosion), terminate them with glands and seals that have been certified for use in the hazardous area. Use a type of termination that is compatible with the electrical installation in the hazardous area (eg flameproof, intrinsically safe, etc). Ensure that the certification meets the current ATEX standards, eg ATEX 95 (Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations) and ATEX 137 (Dangerous Substances and Explosive Atmospheres Regulations), and include a copy of the certification in the operating and maintenance instruction manuals.

Ensure the environmental conditions when jointing or terminating cables are such that the work can be carried out without detriment to the completed joint or termination.

830 Installation

Where cables are buried underground, comply with the requirements of the relevant clause of the Y61 specification.

Do not install cables when the temperature is below the higher of:

~ the minimum installation and handling temperature specified in the installation recommendations appendix of the appropriate cable standard, or

~ the minimum installation and handling temperature given by the cable manufacturer

If the cables have been exposed to such temperature, allow a warming up time before the cables are handled.

Do not bend cables to a radius smaller than the larger of:

~ the minimum installation radius specified in the installation recommendations appendix of the appropriate cable standard

~ the minimum installation radius given by the cable manufacturer

Where cables need to be pulled by winches or use similar mechanical aids, use them fully in accordance with the cable manufacturer’s instructions. Record the pulling tension and do not exceed the allowable maximum for the method by which the winch is attached to the cable.

Ensure cables, wherever installed including those fixed on walls or installed in accessible ducts, are fixed at intervals to prevent sag, in accordance with the manufacturer's recommendations. Ensure bends are fully supported.

Fix cables, including those in building engineering services ducts, using cable cleats complying with clause Y61.240 of this specification and galvanized bolts where:

- the cable is rated as clipped direct (Reference method C (20) of BS 7671)
- the cable is rated as on perforated trays with the cables in a group spaced (Reference method E or F (31) of BS 7671)
- the cable is rated as in trenches (Reference method B (54 or 56) of BS 7671)

Note that the rating of cables is based on cables in a group being spaced, unless otherwise specifically indicated.

Fix cleats so that the maximum spacing between supports does not exceed the lower spacing of those recommended by the manufacturer of the cable and the cleat. In selecting the cleat and fixing, take into account the full details of the installation including the static load of the cable and any load imposed by, but not limited to, wind, icing and the load for wind including icing.

Ensure the maximum spacing of supports for armoured cables in accessible positions complies with the recommendations of the manufacturer and in any case do not exceed the following:

Overall diameter of the cable	Maximum horizontal spacing	Maximum vertical spacing
9 mm to15 mm	350 mm	450 mm
15 mm to 20 mm	400 mm	550 mm
20 mm to 40 mm	450 mm	600 mm

When the selection takes into account the full details of the installation including the static load of the cable and any load imposed as described above, the fixing may use plastic covered, galvanized, perforated steel strip and galvanized bolts where:

- the cable is rated as clipped direct with the cables in a group touching (Reference method C (20) of BS 7671)
- the cable is rated as on perforated trays with the cables in a group touching (Reference method E or F (31) of BS 7671)

Ensure the material used for cleats, any covering on a metal cleat and the plastic covering of any strip fixing has properties in a fire condition at least equal to that of the cable.

Where the cable is fire resisting, select the fixing so that the overall fire performance of the cable installation is maintained.

Avoid excess pressure of cleats and other fixings on cables to prevent deformation of the plastic sheathing. Install suitable supporting steelwork and/or galvanized cable tray where cables cross open spaces. Protect such steelwork by a rust-inhibiting paint.

Unless specified otherwise in the relevant ‘system’ section or Y63 of this specification or on the drawings, arrange the installation of single core cables neatly in close trefoil using cable cleats and intermediate restraints complying with clause Y61.230 of this specification.

Install fixings at intervals compliant with the cleating system certification for a maximum fault current at least equal to that of the installation. Install the neutral conductor adjacent to the group and fix in a similar manner. When approaching terminations, ensure the cores remain in close trefoil for as long a distance as possible, keeping the splayed length to the minimum that practical considerations will permit, having regard to minimum bending radii. Where single-core cables are installed with more than one cable per phase, cleat the cables in three-phase groups with the neutral alongside each group using cleats as described above.

Where single-core cables are specifically detailed to have a flat spaced installation, arrange them neatly at the required spacing fixed to a non-magnetic cleating system otherwise as described above for cables in trefoil. Install fixings at intervals compliant with the cleating system certification for a maximum fault current at least equal to that of the installation. Install the neutral conductor adjacent to the group fixed in a similar manner. Where single core cables are installed with more than one cable per phase, cleat the cables in three-phase groups as described in Y63, using cleats as described above.

Fix cables laid in racks, hangers or on steelwork at intervals to prevent sag, in accordance with BS 7671.

Ensure the armouring is independently bonded to the switchgear and at termination points, using the brass earth “banjo” tag of the gland and single green/yellow cable. Ensure the armouring is bonded for continuity at all points. Use copper conductors of the correct size in accordance with BS 7671.

Where cables pass through walls and floors fit them with permanently fixed oversized sleeves each packed with fire resisting infill. Ensure where cables rise or fall on walls they are protected to a height of 2 m with a sheet steel guard where prone to mechanical damage.

Ensure all cables are installed, straightened and dressed to give a neat and workmanlike installation.

Where armoured cables are installed or terminated into electrical equipment in hazardous areas ensure that a sealed gland with ATEX certification is used of the correct size and type for the cable and the equipment into which it is installed. Ensure that the gland is correctly rated for the gas group of the particular gas or vapour. Where solvent vapours are present ensure that the sheath of the cable and the gland material will not be degraded.

900 CABLES FOR HIGH VOLTAGE APPLICATIONS

For single-core and three-core cables with system nominal voltages from 3.8/6.6 kV up to 19/33 kV inclusive, use cables with:

~ stranded copper, stranded aluminium or solid aluminium conductor(s)

~ cross-linked polyethylene or cross-linked ethylene-propylene rubber insulation

~ metallic armour of aluminium or galvanized steel wire

~ thermoplastic over sheath

910 Cables

Ensure that the external surface of each cable is marked with the following elements in accordance with BS 5467, BS 6724, BS 6622 and BS 7835:

~ cable manufacturer – manufacturer’s name and unique factory identifier

~ electric cable – marked ‘ELECTRIC CABLE’

~ voltage designation, eg 6600 V, 11000 V, 33000 V

~ manufacturing standard number, eg BS 5467

~ number of cores, type, and nominal cross-sectional area of the conductors

~ year of manufacture

~ mark of a third-party approval organisation, eg BASEC

~ standard core colour identifier, ie H

Ensure that the marking of the above elements is by embossing or indenting on the sheath.

Use low-smoke zero-halogen (LSZH) sheaths for cables in enclosed areas and in public spaces.

Use cables as indicated in the relevant ‘system’ section of this specification or on the drawings.

The following abbreviations apply:

- “Cu/XLPE/SWA/LSZH” indicates; copper conductors, XLPE compound insulation, single steel-wire armouring, red LSZH compound sheath overall, 3.8/6.6 kV to 19/33 kV voltage designation in accordance with BS 7835
- “Cu/XLPE/AWA/LSZH” indicates; copper conductors, XLPE compound insulation, single aluminium-wire armouring, red LSZH compound sheath overall, 3.8/6.6 kV to 19/33 kV voltage designation in accordance with BS 7835
- “Cu/XLPE/SWA/PVC” indicates; copper conductors, XLPE compound insulation, single steel-wire armouring, red PVC sheath overall, 3.8/6.6 kV to 19/33 kV voltage designation in accordance with BS 6622
- “Cu/XLPE/AWA/PVC” indicates; copper conductors, XLPE compound insulation, single aluminium-wire armouring, red PVC sheath overall, 3.8/6.6 kV to 19/33 kV voltage designation in accordance with BS 6622
- “Cu/XLPE/SWA/PE” indicates; copper conductors, XLPE compound insulation, single steel-wire armouring, red MDPE sheath overall, 3.8/6.6 kV to 19/33 kV voltage designation in accordance with BS 6622
- “Cu/XLPE/AWA/PE” indicates; copper conductors, XLPE compound insulation, single-aluminium wire armouring, red MDPE sheath overall, 3.8/6.6 kV to 19/33 kV voltage designation in accordance with BS 6622
- “PICAS” indicates a three-core utility cable with stranded aluminium conductors, belted paper insulation, corrugated aluminium sheath, red PVC sheath overall, 6.35/11 kV voltage designation in accordance with the Energy Networks Association specification ENA TS 09-12

When installing cables within a building or occupied space use only cables that, when affected by fire, emit low levels of smoke and zero halogens (LSZH sheathed multicore and LSZH insulated single core cables), unless specified otherwise in the relevant ‘system’ section of this specification or on the drawings.

Ensure all cables are of the same manufacture and delivered to site in continuous lengths, complete with end caps.

At the manufacturer’s works, subject cables to the routine tests detailed in the relevant British Standards. Submit duplicate copies of test certificates to the Contract Administrator.

920 Jointing and terminations

Use cable accessories (terminations and joints) complying with, or that have been tested in accordance with BS EN 61442. Select accessories that are compatible with the cables with which they are used.

Make connections and terminations using lugs and connectors designed for HV applications, and correctly sized for the type and size of conductor. Ensure that all connections and terminations include a moisture block, and for terminations ensure compatibility with the equipment terminals. Connections and terminations may use either compression tooling or be of the shear-bolt type. For compression connectors use a compression tool that does not release until the correct compression has been achieved, and ensure compatibility between the tool, die and connector.

At joints, use solder-less earthing connections comprising a constant-force spring and earthing connection to bond conductor screens. Also use solder-less connection arrangements for the overall screen and armour connections. Ensure that the conductivity and fault current capability of the earth connection across the joint is at least equal to that of the cable without the joint.

At terminations, ensure that all screens and armour is earthed at both ends of the cable unless specifically detailed otherwise in the relevant 'system' section of this specification or on the drawings. Use glands that are compatible with the cable and the type of termination selected.

The use of cold-shrink, cold-applied or heat-shrink technology for stress control and insulation at terminations is acceptable. Prior to selecting heat-shrink technology, demonstrate that the installation practices to be adopted make the potential risks associated with hazards negligible (eg applied heat, fire hazards, escaping flammable gas and exposure to fumes).

Install overall protection for the cable joint by means of an outer case filled with resin compound or equivalent additional mechanical protection. Where joints are directly buried, ensure that the joint is supported by means of paving flags laid immediately below the bedding sand on which the finished joint rests. Extend the paving flags for a distance of 700 mm beyond each end of the joint. Where joints are installed in locations other than buried, for example in buildings, cable ducts or other similar instances, support the cable joint by means of a cable tray or ladder rack.

Make HV cable terminations at equipment cable boxes. Include a terminal boot to insulate the equipment terminal cable lug connection. Use non-ferrous gland plates for single-core cables. Make the termination straight, without a cross or significant roll of the cores in the cable box, and achieve this requirement using one of the following methods:

~ make the final connection to equipment using three single-core cables at each end of the circuit, and install a trifurcating joint within 10 m of the final termination at each end to make a transition to the three-core cable PREFERRED SOLUTION

~ install any circuit of less than 50 m in length in single-core cables PREFERRED SOLUTION

~ make the final connection to equipment at one end using a three-core termination made straight and, at the other end of the circuit, using three single-core cables with a trifurcating joint installed within 10 m of the final termination, to make a transition to the three-core cable

~ make the final connection to equipment at both ends of the circuit using a three-core termination made straight, and install a cross joint within the circuit route to restore correct phasing

~ make the final connection to equipment at one end using a three-core termination made straight and, at the other end of the circuit, at a cast resin transformer, power factor correction cubicle or similar equipment that does not include a cable box and where the space for cable termination is unrestricted, make the final connection using a cross joint to restore correct phasing

When terminating cables at equipment with cable boxes designed for compound filling, ensure that the finished clearances in the box are sufficient for the installed cable and termination type. Acceptable works to ensure compatibility are extending the box by lowering the gland plate or replacing the cable box with a newly fabricated steel box. Do not reuse cast iron cable boxes; replace them with fabricated steel boxes.

Other than at terminations as detailed above, join cables only when they cannot be supplied or installed as a continuous single length. Obtain the written acceptance of the Contract Administrator if cables have to be joined inside buildings.

Use only suitably qualified and experienced persons for the jointing and termination of HV cables who have received a course of instruction on the proposed cable joint and in the use of the specialist tools recommended by the cable joint manufacturer. Ensure that a copy of the training certificate is included in the operating and maintenance instruction manuals and the joints and terminations are traceable to the individual concerned.

Ensure the environmental conditions when jointing or terminating cables are such that the work can be carried out without detriment to the completed joint. Once the cable seal has been broken, ensure that the jointing work on the cable end is undertaken continuously until completed and the cable sealed against the ingress of moisture.

930 Installation

Where cables are buried underground, comply with clause Y61.1000 of this specification.

Do not install cables when the temperature is below the higher of:

~ the minimum installation and handling temperature specified in the installation recommendations appendix of the appropriate cable standard, or

~ the minimum installation and handling temperature given by the cable manufacturer

If the cables have been exposed to such temperature, allow a warming up time before the cables are handled.

Do not bend cables to a radius smaller than the larger of:

~ the minimum installation radius specified in the installation recommendations appendix of the appropriate cable standard

~ the minimum installation radius given by the cable manufacturer

Arrange single-core cables neatly in close trefoil fixed with cable cleats and intermediate restraints complying with clause Y61.230 of this specification. Fix at intervals compliant with the cleating system certification. When approaching terminations, ensure the cores remain in close trefoil for as long as possible, keeping the splayed length to the minimum that practical considerations will permit, having regard to minimum bending radii.

Arrange cable routes so that cables, hangers, cleats, and the like, do not come into contact with, or in close proximity to, piped services. Ensure a separation of not less than 600 mm from other building engineering services.

Where HV cables are routed within buildings or externally and not underground, install them on continuous ladder rack, heavy duty cable tray or in accessible service ducts. Fix the cables at intervals, in accordance with the manufacturer's recommendations using cleats complying with clause Y61.230 of this specification. Secure each cleat to the ladder rack, cable tray or service duct using bolts. Ensure that the cleat and fixing selection takes into account the full details of the installation including the static load of the cable and any load imposed by, but not limited to, wind, icing and the load for wind including icing. Install suitable supporting steelwork and/ or galvanized cable tray where cables cross open spaces. Protect such steelwork by a rust-inhibiting paint.

Where cables need to be pulled by winches or similar mechanical aids, use such aids fully in accordance with the cable manufacturer’s instructions. Record the pulling tension and do not exceed the allowable maximum for the method by which the winch is attached to the cable.

Where cables pass through walls and floors fit them with oversized sleeves permanently fixed, packed with fire resisting infill. Where cables rise or fall on walls, ensure they are protected to a height of 2 m with a sheet steel guard where prone to mechanical damage.

Ensure all cables are installed, straightened and dressed to give a neat and workmanlike installation. Ensure that there is no damage to the cable sheath or outer covering. In the event of any cable being damaged, remove and replace the whole length of cable. Damage includes any instance of bending to a radius less than the normal-use minimum bending radius given in BS EN 50565 or specified by the cable manufacturer.

Perform tests after installation of cables in accordance with the requirements of the installation appendix of the particular Standard to which the cable was manufactured.

1000 INSTALLATION OF CABLES UNDERGROUND

1010 General

Install only MICC and armoured cable types (HV and LV) underground.

For each respective cable type, comply with the general requirements (including but not limited to installation temperatures, pulling tension, bending radius, etc) specified in the relevant clauses of this section of the specification.

Install underground cables in accordance with the National Joint Utilities Group (NJUG) publication 'Guidelines on the positioning and colour coding of utilities' apparatus'.

Where appropriate install underground cables in accordance with chapter 13 (Gardens) or chapter 5 (Agricultural and horticultural premises) of Guidance Note 7 'Special Locations' published by the IET.

Ensure cables installed direct in ground have a minimum spacing of:

~ 300 mm from HV/ EHV cables

~ 600 mm from communication cables, alarm cables and gas services

~ 800 mm from heating services

Where single-core cables are laid direct in the ground to form a three-phase circuit, lay them in touching trefoil unless specifically detailed otherwise in the relevant 'system' section of this specification or on the drawings. Bind the trefoil group together using heavy-duty cable ties at intervals of one metre, and install the neutral conductor adjacent to the group. Do not energise cables until the cables are buried, as the support in the event of a fault condition is by means of the surrounding ground. Where single-core cables are installed with more than one cable per phase, install the cables in three-phase groups with the neutral conductor alongside each group as described above. If the cables are to be energised prior to being buried use cleats and intermediate restraints as detailed in clause Y61.230 of this specification, to secure the cables.

1020 Burial depths

Bury LV cables to a minimum depth of:

~ 600 mm to the top of the cable in unmade ground

~ 800 mm in made-up ground, ie roadways, and the like

For HV cables increase these depths respectively to 800 mm and 1000 mm.

Where it is not possible to comply with the depths specified above, install additional protection for the cable so that the overall protection is equivalent to being buried at the normal depth specified. For additional protection, install overlapping stainless steel plates of 8 mm minimum thickness permanently marked to indicate cables are buried below the plate.

1030 Bedding, backfill and marker tape/tiles

Rest cables on a 100 mm deep bed of sifted sand and riddled earth, then cover with a further depth of 100 mm of the same material. Ensure that the selected sand and backfill material are such that the design thermal resistivity of the ground in which the cable is buried does not exceed 1.2 K.m/W (ie the thermal resistivity upon which the cable rating is based).

Use only excavated material for backfill in areas that will remain unmade ground, for example grass verges; in other areas use crushed stone fill that will ensure the bearing capacity of the final surface is achieved.

Install two layers of marker tape along the entire length of each cable. Place the lower layer 50 mm above the cable and the higher layer 300 mm above. Use durable heavy-duty (0.1 mm thick) yellow-coloured marker tape, 150 mm wide, manufactured from recycled polyethylene polymers, and marked "ELECTRIC CABLE BELOW – CAUTION" in permanent black lettering printed continuously along its length. For HV cables, substitute the lower layer of tape with cable tiles. Use durable heavy-duty (minimum 12 mm thick) cables tiles, manufactured from high-impact recycled polyethylene sheet, and having the words “HV ELECTRICAL CABLE BELOW – CAUTION” cast in them.

Ensure that backfill does not contain stone, brick, or any sharp material and is fully consolidated by means of a rammer to the 300 mm level before the second tape is laid. Only then carry out the final backfill to ground level and suitably consolidate.

1040 Cable conduits

Protect cables passing under roadways and at all other areas of vehicular traffic, using circular conduits encased in concrete.

Ensure cable conduits for cables underground are circular non-metallic and comply with BS EN 61386-24. Use conduit system type 450 or 750, resistance to impact ‘normal’. Do not use conduits smaller than nominal size 50 mm (37 mm internal diameter.) Select a non-threaded entry system (socket and spigot type). For conduits installed straight between points select a rigid system; for conduits that require deviation from a straight route, select pliable conduits.

For cables installed in conduits seal around the cables at all ends of conduits (including where they enter a building), by a waterproof and gas-proof seal of self-extinguishing plastic foam of a type approved by the Energy Networks Association. Fit suitable end caps to all unused spare conduits.

1050 Cable route markers

Install cable route markers where cables are laid in grass verges, paved areas and the like. Space the cable route markers at 45 m intervals on straight routes. Also place markers over all tee-joints, at changes of direction, where cables cross roads, and at building entries. Ensure that all markers are of a proprietary type, 200 mm square 50 mm deep, concrete with plastic inserts indicating the depth and voltage of the cable(s), and are laid level with the finished surface.

1060 Location plans

Produce accurate plans with dimensions and GPS coordinates so that the location of any cable can be determined with a maximum uncertainty of 100 mm from local fixed features. Where multiple cables follow a route, record the relative positions of the cables and indicate the locations of any cables that cross, and the relationship with key features of any other buried service. Accurately record the location of cable joints using GPS coordinates.

1100 MODULAR WIRING

Use a modular wiring system that complies with BS 8488.

Forward fully dimensioned manufacturing and installation drawings of the entire modular wiring system to the Contract Administrator for comment prior to installation.

Unless indicated otherwise by the relevant ‘system’ section of this specification or the drawings, provide 5% as spares for all connectors and provide ordering details for replacement parts.

Ensure that the system components provide separated systems for lighting, power, clean earth power, IT earthing systems, data and communications, bus systems and other ELV controls. Ensure that connections/connectors for these types of components cannot be interchanged.

Ensure that the distribution units are secured to surfaces in concealed locations (eg to cable tray where in a void beneath a raised access floor or, where in a ceiling void, to the soffit of the floor or roof above).

Ensure that the interconnecting cables are of a type producing low levels of smoke and zero halogens (LSZH sheathed multicore and LSZH insulated single core cables) when affected by fire, and are compliant with BS EN 50525-3-41.

Ensure that all containment of the modular wiring system is of a type producing low levels of smoke and zero halogens such that a coordinated strategy for LSZH materials in the cabling and containment systems is achieved.

Ensure that the system incorporates installation couplers complying with BS EN 61535.

Ensure that all interconnecting cables are mechanically protected by flexible metallic conduits and suitable for the environment in which they are installed. Ensure that plug-in connections are mechanically and electrically secure and that they cannot be inadvertently dislodged. Make sure that all connections are shrouded and are of the male/female type to ensure that no live parts can be exposed to touch when a component is unplugged. Ensure that the components containing the interconnecting cables are selected, manufactured and installed so that they are routed orthogonally, ie at right angles.

Ensure that the cables and connectors are sized to have current ratings not less than the circuit protective device at the origin with any grouping de-rating factor applied. When calculating cable sizes, ensure that the orthogonal routing of conductors is accounted for in the design cable lengths.

Ensure where the wiring system comprises a number of circuits connected to separate overcurrent protection that they emanate from LV switchgear and control gear assembly, which conforms to the relevant part of BS EN 61439 or BS EN 61534.

Where the LV switchgear and control gear assembly contains the wiring system overcurrent protection, ensure that connector to the LV switchgear and control gear assembly conforms to BS EN 61984 and the installation coupler to the LV switchgear and control gear assembly conforms to BS EN 61535.

Ensure earth continuity and continuity of the circuit protective conductor throughout, which may be specified as a dedicated clean electrical earth.

Ensure that the flexible conduit wiring sections are routed orthogonally (ie at right angles to each other) and are secured to the sub-floor slab or soffit.

Ensure that each individual section of the installation is distinctly and durably marked with the following information:

~ the origin (trade mark / manufacturers identification mark / name of responsible vendor)

~ rated current and reference installation method from BS 7671 Table 4A2

~ rated voltage

~ IP code if higher than IP20

~ manufacturers model number or type reference

~ unique manufacturing batch reference for traceability

~ electrical test status in line with BS 8488

Ensure that the complete assembled system is designed, installed, tested and commissioned to BS 7671, and ensure that the specialist manufacturer / supplier provides all relevant system design information validating conformity with BS 7671.

END OF SECTION Y61

Y63 SUPPORT COMPONENTS CABLES

CONTENTS

Y63 SUPPORT COMPONENTS CABLES

100 REFERENCE DOCUMENTS

This specification is written based on legislation, standards and guidance in force in the UK generally, and within England by default. For projects in Scotland, Wales, Northern Ireland, the Channel Islands and the Isle of Man, give appropriate consideration to any locally applicable legislation, standards and guidance that deviates from or is additional to those in force within England. Similarly for projects outside the UK comply with the corresponding national legislation, standards and guidance.

Comply fully with the edition (including amendments, replacements and associated normative references) of each of the following, current at the time of tender.

Where a standard referred to in this section conflicts with a standard referred to in an associated ‘engineering system’ section (eg S10, T31, V21, etc) of this specification, the standard referred to in the engineering system section prevails.

BS 476-6	Fire tests on building materials and structures. Method of test for fire propagation for products
BS 476-7	Fire tests on building materials and structures. Method of test to determine the classification of the surface spread of flame of products
BS 1449-1.1	Steel plate, sheet and strip. Carbon and carbon-manganese plate, sheet and strip. General specification
BS 6946	Specification for metal channel cable support systems for electrical installations
BS 7671	Requirements for electrical installations. IET Wiring Regulations
BS 8313	Code of practice for accommodation of building services in ducts
BS 8519	Selection and installation of fire-resistant power and control cable systems for life safety and fire-fighting applications. Code of practice
BS EN 10088-3	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 10143	Continuously hot-dip coated steel sheet and strip. Tolerances on dimensions and shape
BS EN 10244-1	Steel wire and wire products. Non-ferrous metallic coatings on steel wire. General principles
BS EN 10244-2	Steel wire and wire products. Non-ferrous metallic coatings on steel wire. Zinc or zinc alloy coatings
BS EN 10346	Continuously hot-dip coated steel flat products for cold forming. Technical delivery conditions
BS EN 50174-2	Information technology. Cabling installation. Installation planning and practices inside buildings
BS EN 61914	Cable cleats for electrical installations
BS EN 61537	Cable management. Cable tray systems and cable ladder systems
BS EN 62275	Cable management systems. Cable ties for electrical installations
BS EN ISO 1461	Hot dip galvanized coatings on fabricated iron and steel articles. Specifications and test methods
BS EN ISO 2081	Metallic and other inorganic coatings. Electroplated coatings of zinc with supplementary treatments on iron or steel

BS EN ISO 14713-1	Zinc coatings. Guidelines and recommendations for the protection against corrosion of iron and steel in structures. General principles of design and corrosion resistance
BS EN ISO 17668	Zinc diffusion coatings on ferrous products. Sherardizing. Specification
BS EN ISO 12683	Mechanically deposited coatings of zinc. Specification and test methods

200 GENERAL REQUIREMENTS

210 General

This specification applies to cable tray systems, wire tray, cable ladder systems and cable matting systems for cable management. The specification is also applicable for metal channel cable support systems for electrical installations where they are used as support devices for cable tray systems, cable ladder systems or independently for cable management. Note the term ‘manufacturer’ used in this specification includes the term responsible vendor as used in BS EN 61537.

Obtain all cable system components and fixings from a single manufacturer.

Size and select the containment system to be fit for purpose, to include a spare capacity of 30% and to withstand the effects of cable weight and the forces during a cable fault. Where appropriate, make further allowance in the selection of the containment system to take account of other loads such as those due to wind, snow and ice.

Allow 30% of the base area of the cable containment length and of the safe working load (SWL) as spare capacity for future cables when sizing and placing support components. Make allowance within the support components and system selection, where appropriate, for the additional load that could be placed upon the system due to wind, snow, ice, etc.

Ensure that all ferrous metal for cable tray, cable ladder, and wire cable tray lengths, their fixings and suspension components have a resistance against corrosion classification to BS EN 61537 as follows:

- Class 2 minimum for all indoor heated spaces
- Class 3 or Class 4 for all indoor heated spaces containing mission critical IT (eg datacentres)
- Class 5 minimum for all external areas, plant rooms and risers
- Class 5 minimum for all indoor unheated spaces subject to high moisture levels and/or condensation

Use metal channel support systems that comply with BS 6946 or support devices that are part of the cable tray system or cable ladder system to support cable runway.

Ensure that all surfaces, which are likely to come into contact with cables during installation or use, do not cause damage to the cables.

Ensure that all surfaces are safe for handling and that sharp edges and burrs are removed.

Do not place dissimilar metals liable to initiate electrolytic action, or other materials liable to cause mutual or individual deterioration, in contact with each other unless specific arrangements are made to avoid the consequences of such contact.

Never allow any copper cable or fitting to be in contact with the galvanising. Generally ensure that cables have an outer covering of polymeric material that prevents contact between the metal parts of the cable and the supports. Where cables have no outer covering then lay them on a layer of polymeric material securely fixed to the support components. Ensure that any additional polymeric material does not add to the spread of fire, smoke or the generation of corrosive gases in the event of a fire.

Use standard fittings that are supplied as part of the cable tray system or cable ladder systems; if local situations make it impracticable, fabricated fittings are acceptable provided they are of the same quality and the same protective finish as the standard fittings.

Ensure that sets and bends are sized to allow for the minimum permissible radius of the largest cable and that cables retain their relative positions on all bends and sweeps.

Fit grommets to all holes cut into the support components.

Maintain electrical continuity at all joints with suitable earthing links. Ensure that joints have all burrs removed and are made by fishplates and screws.

Ensure that the weight of cables is uniformly distributed on the cable tray system or cable ladder system with the exception of cable management systems supported via cantilevered support arrangement. Where cantilever supports are provided, align the heavier cabling closest to the vertical support surface. Ensure that the weight imposed onto the cable support system does not exceed the SWL specified by the manufacturer (including future allowance).

Where cables of fire resisting construction are carried on the containment system, provide a cable support system achieving a level of fire resistance as calculable according to Annex E of BS 8519.

Ensure that mitigation of building expansion is incorporated in the installation of the cable support components.

220 Installation

Provide all fixings in compliance with Y90.

Provide all suspension systems used for support in compliance with Y93.

Comply with the written installation instructions of the cable tray, cable ladder or wire cable tray system manufacturer.

Use butt joints to connect adjacent cable tray or ladder lengths or to connect to fittings. Do not weld any joints. Ensure that every connection is mechanically strong, allowing no relative movement between the two components.

Install the cable runway on mild steel support devices having suitable protective coating, fixed to the structure at not more than 1 metre intervals, or at such spacing as to ensure the SWL of the system is not exceeded. For sides, bends and intersections provide supports at a distance not exceeding 300 mm. Use external fixing devices of expanding masonry bolts or equal. Alternatively, use proprietary steel channel permitting easy adjustment and modification. Proprietary clamp fixings onto the flanges of structural beams are also permitted.

Allow 75mm minimum space between any part of the cable tray or cable ladder system and structure to give ease for securing the cable fixings and general maintenance. Comply with the minimum spacing between services as set out in BS 8313.

Avoid any obstruction and all other services to ensure that the installation can be properly installed and maintained.

Check and agree with the engineer and architect the final positioning and routing of all exposed containment systems. Provide detailed and dimensioned coordinated construction drawings for this purpose.

Provide and install proprietary plastic caps to the ends of threaded rod. Cap the ends of channel support systems using proprietary caps.

Ensure that internal fixing devices and external fixing devices do not come into contact with cables in a way that may give rise to damage of the cables.

Prime and paint all metalwork, exposed cut ends, fixing bolts, mild steel supports, brackets, etc., where the manufacturer's galvanised coating is damaged, or where no galvanised coating has been applied, with two coats of zinc-enriched paint.

230 Safety

Do not use any part of the cable support installation at any time as part of a fall arrest system.

Ensure that the cable support installation is coordinated with any spatial requirements necessary to accommodate all installation and future access requirements.

300 PRODUCTS AND MATERIALS

310 Cable tray systems

311 General

Ensure that cable tray lengths and fittings that form the cable runway comply with BS EN 61537 are of perforated sheet steel meeting classification D in accordance with BS EN 61537 and are formed with a return flange. Ensure steel complies with BS 1449-1.

Ensure that cable tray systems have electrical continuity characteristics in accordance with BS EN 61537, can fulfil a protective earth (PE) function, and are bonded and earthed throughout. Fix copper connectors with tinned connections across all joints of the cable trays in order to maintain the earth continuity. Ensure that the length of the copper connector is slightly longer than the distance of its attachment points to allow for movement or expansion of the joint.

As a minimum use medium-duty trays internally, heavy-duty trays for external work, or as appropriate to the installation conditions and manufacturers guidance.

Use a dropout plate of the same width as the cable tray or other proprietary cable guide product as the cables exit the cable tray.

Select the size and type of cable tray bends according to the most onerous bending radii requirements.

312 Installation

Cut cable trays along a line of plain metal only; do not cut through the perforations. Remove all burrs from cut edges so that surfaces are smooth and clean before painting. Treat all cut edges with a zinc enriched paint.

Achieve the jointing of cable tray lengths and the fixing of the cable runway tray to support devices, by means of sherardized steel mushroom headed bolts and nuts with the threaded portion away from the cables.

Where cable tray systems are installed across building expansion joints fit a proprietary slip connector fixed at one end only.

320 Cable ladder systems

321 General

Ensure that cable ladder lengths and fittings that form the cable runway, comply with BS EN 61537 meeting classification Z in accordance with BS EN 61537. Ensure steel complies with BS 1449-1. Select a type that has slotted side sections and rungs, and has side sections that are profiled for rigidity.

Ensure that cable ladder systems have electrical continuity characteristics in accordance with BS EN 61537, can fulfil a PE function, and are bonded and earthed throughout. Fix copper connectors with tinned connections across all joints of the cable ladder in order to maintain the earth continuity. Ensure that the length of the copper connector is slightly longer than the distance of its attachment points to allow for movement or expansion of the joint.

As a minimum use medium-duty cable ladder internally, heavy-duty or extra-heavy-duty cable ladder for external work, or as appropriate to the installation conditions and manufacturers guidance.

Use a dropout plate of the same width as the cable ladder to support the cables as they exit the ladder.

Ensure that the inside radius of all bends in the cable runway is greater than 300mm and large enough to accommodate the minimum bending radius allowed for any cable installed on the ladder.

322 Installation

Use flexible couplers to joint cable ladder systems across expansion joints of the building structure. Do not use rigid fittings across expansion joints.

Treat all cut edges with a zinc enriched paint.

Fit ladder covers, where specified, in accordance with the manufacturer’s instructions.

330 Wire cable tray systems

331 General

Ensure that wire cable tray (cable basket) lengths and fittings that form the cable runway comply with BS EN 61537, are made of high strength steel wires formed into wire mesh pattern with intersecting wires welded together. Use wire cable tray lengths and fittings from lateral and longitudinal sidewall steel wires with minimum diameters of: 4mm for wire cable tray widths up to 100mm, 5mm for wire cable tray widths of 150mm and 200mm, and 6mm for wire cable tray widths of 300mm or greater.

Ensure that wire cable tray systems have electrical continuity characteristics in accordance with BS EN 61537, can fulfil a PE function, and are bonded and earthed throughout. Fix copper connectors with tinned connections across all joints of wire cable trays to maintain earth continuity. Ensure that the length of each such copper connector is slightly longer than the distance of its attachment points, to allow for movement or expansion of the joint.

Use a dropout plate of the same width as the wire cable tray or other proprietary cable guide product where more than two cables exit the tray, in all other cases provide suitable cable support to prevent physical stress on the cable(s). Where cables exit the wire cable tray within conduit, provide a proprietary conduit take off bracket to secure the conduit to the tray.

Check that all wire ends along the basket’s sides are rounded during manufacturing, to ensure the safety of cables and installers.

Use only centre support hangers, trapeze hangers or wall brackets, to support the wire cable tray system.

332 Installation

Use side action bolt cutters with offset jaws to cut mesh wires; do not use saws, nor cutters with centre cut jaws. Make cuts at the intersection of longitudinal and lateral wires. Treat all cut edges with a zinc enriched paint.

Use serrated flange locknuts and bolts for all splicing assemblies.

Use flexible couplers to joint cable basket systems across expansion joints of the building structure. Do not use rigid fittings across expansion joints.

Y63 SUPPORT COMPONENTS CABLES

340 Cable matting

Use cable matting manufactured from flexible, elastomeric, moisture resistant, closed cell, foam rubber.

Ensure that the cable matting system complies with BS 476 parts 6 and 7, is resistant to flame spread and is certified to be of fire rating class 1.

Ensure that all parts of the cable matting system are constructed from low smoke and zero halogen (LSZH) material.

Where matting is applied directly to the sub floor in areas with an accessible floor system, provide matting of minimum 13mm thickness. Where applied to cable tray, apply matting of minimum thickness of 6mm.

Cut the cable matting using a proprietary tool as recommended by the manufacturer and join lengths of cable matting using a proprietary tape that maintains the fire resistant properties of the mat.

Where required to traverse obstructions, apply the cable matting to proprietary bridging pieces constructed of LSZH material.

350 Cable cleats

Use cable cleats that are made from materials that are resistant to corrosion without the need for any treatment. Ensure that plastic materials are non-brittle down to -20°C. For cables having low emission of smoke and zero halogens (LSZH) when exposed to high levels of heat, use non-metallic or aluminium cleats made from LSZH material. Use trefoil cleats for single core cables.

Ensure that cleats are of such a size that they can be tightened down to grip the cables without exerting undue pressure or strain and allows for longitudinal expansion of the cable. For vertical cables, use two-bolt cleats which grip the cables firmly enough to prevent them from slipping.

Space cable cleats in accordance with the minimum spacings in accordance with the manufacturer’s recommendations. Locate cleats immediately before and after any bends in the cable. Ensure that cleats and other cable support systems are adequately supported themselves by fixing into a suitable substrate, and that the fixing to the substrate will maintain its integrity in fire conditions to an equal degree of performance as the cable support system.

360 Cable installation

Provide cable cleats and cable ties to BS EN 61914 and BS EN 62275 respectively. Use only proprietary cable support systems and fixings.

Support wiring systems such that they will not prematurely collapse in the event of a fire, use only metal cable fixings.

Where final-circuit or other minor-gauge cabling is laid in and is supported by incombustible support components, secure them with zero halogen, self-extinguishing, ultra-violet resistant ties. For all other cabling, use plastic coated metallic cable ties or metallic cable cleats. Do not use wire or similar material for cable ties.

Install cables individually and lay the cables in or on support components.

Where single core conductors are arranged in three phase parallel configuration, ensure equal current sharing between the parallel conductors via a suitable arrangement of the conductors, ensure that conductors of the same phase are not grouped together. Where parallels of no more than two conductors per phase are to be installed, install these on ladder rack and according to the following arrangements:

Y63 SUPPORT COMPONENTS CABLES

- ~ Three phase (no neutral), arranged as trefoil sub-groups spaced from one another by twice the cable diameter.
- ~ Three phase and neutral, arranged as quadrofoil sub-groups, with L3 and L2 arranged adjacent to L1 with the neutral conductor opposite L1, with each group spaced from one another by twice the cable diameter.

Where parallel single core conductors are installed, verify that the load current is shared evenly at varying load conditions and phase imbalance.

Ensure that cables are protected from damage during installation. Replace all damaged cable immediately on discovery.

Fix cables to support components at minimum spacing in accordance with the manufacturer's recommendations. Do not allow any cable to be used to support the weight of any item other than its own self weight.

Where the final circuit cable installation is intended to be installed without containment as in clipped direct installations using multicore cabling, fix these cables to maximise their capacity by installing multiple bunches of no more than ten cables in any one bunch with heavy loads separated.

Where cables are fitted to support components that are:

- ~ mounted in the horizontal plane running horizontally but with cables fitted to the underside, or
- ~ mounted in the vertical plane running horizontally, or
- ~ mounted in the vertical plane running vertically

Secure cables using plastic coated metal straps or proprietary cleats of a pattern recommended by the cable manufacturer.

Secure HV cables in accordance with the requirements of section Y61 of this specification.

Ensure that all fixing bolts/studs are sherardized and where necessary of sufficient length to allow stacking of cables.

END OF SECTION Y63

Y71 LV SWITCHGEAR AND DISTRIBUTION BOARDS

CONTENTS

Y71 LV SWITCHGEAR AND DISTRIBUTION BOARDS

100 REFERENCE DOCUMENTS

This specification is written based on legislation, standards and guidance in force in the UK generally, and within England by default. For projects in Scotland, Wales, Northern Ireland, the Channel Islands and the Isle of Man, give appropriate consideration to any locally applicable legislation, standards and guidance that deviates from or is additional to those in force within England. Similarly for projects outside the UK comply with the corresponding national legislation, standards and guidance.

Comply fully with the edition (including amendments, replacements and associated normative references) of each of the following, current at the time of tender.

Where a Standard referred to in this section conflicts with a Standard referred to in an associated 'engineering system' section (eg S10, T31, V21, etc) of this specification, the Standard referred to in the engineering system section prevails.

BS 88	Low-voltage fuses
BS 89	Direct acting indicating analogue electrical measuring instruments and their accessories
BS 90	Specification for direct-acting electrical recording instruments and their accessories
BS 159	Specification for high-voltage busbars and busbar connections
BS 842	Specification for a.c. voltage-operated earth-leakage circuit breakers
BS 3036	Specification. Semi-enclosed electric fuses. (Ratings up to 100 amperes and 240 volts to earth)
BS 4293	Specification for residual current-operated circuit-breakers
BS 5424-2	LV controlgear. Specification for semiconductor contractors (solid state contactors)
BS 5424-3	Specification for controlgear for voltages up to and including 1000 V a.c. and 1200 V d.c.
BS 5472	Specification for low voltage switchgear and controlgear for industrial use. Terminal marking and distinctive number. General rules
BS 6231	Electric cables. Single core PVC insulated flexible cables of rated voltage 600/1000 V for switchgear and controlgear wiring
BS 6272	Specification for low voltage switchgear and controlgear for industrial use. Terminal marking. Terminals for external associated electronic circuit components and contacts
BS 6423	Code of practice for maintenance of electrical switchgear and controlgear for voltages up to and including 1 kV
BS 7194	Specification for direct-current and low-frequency electronic measuring instruments with a digital display
BS 7211	Electric cables. Thermosetting insulated and thermoplastic sheathed cables for voltages up to and including 450/750 V for electric power and lighting and having low emission of smoke and corrosive gases when affected by fire
BS 7264-2	Shut capacitors for a.c. power systems having a rated voltage above 1000 V
BS 7288	Specification for socket outlets incorporating residual current devices (S.R.C.D.s)
BS 7671	Requirements for Electrical Installations. IET Wiring Regulations

BS 8431	Electrical static meters for secondary metering and sub-metering. Specification
BS EN 13601	Copper and copper alloys. Copper rod, bar and wire for general electrical purposes
BS EN 13602	Copper and copper alloys. Drawn, round copper wire for the manufacture of electrical conductors
BS EN 60044	Instrument transformers
BS EN 60076-1	Power transformers. General
BS EN 60076-6	Power transformers. Reactors
BS EN 60079	Explosive atmospheres relay
BS EN 60255	Measuring relays and protection equipment
BS EN 60269-1	Low-voltage fuses. General requirements
BS EN 60269-4	Low-voltage fuses. Supplementary requirements for fuse-links for the protection of semiconductor devices
BS EN 60439	Low-voltage switchgear and controlgear assemblies
BS EN 60445	Basic and safety principles for man-machine interface, marking and identification. Identification of equipment terminals, conductor terminations and conductors
BS EN 60521	Class 0.5, 1 and 2 alternating-current watthour meters
BS EN 60529	Specification for degrees of protection provided by enclosures (IP Code)
BS EN 60831	Shunt capacitors of the self-healing type for a.c. power systems having a rated voltage up to and including 1000 V
BS EN 60898	Specification for circuit-breakers for overcurrent protection for household and similar installations
BS EN 60947-1	Low-voltage switchgear and controlgear. General rules
BS EN 60947-2	Low-voltage switchgear and controlgear. Circuit breakers
BS EN 60947-3	Low-voltage switchgear and controlgear. Switches, disconnectors, switch-disconnectors and fuse-combination units
BS EN 60947-4-1	Low-voltage switchgear and controlgear. Contactors and motor-starters. Electromagnetic contractors and motor-starters
BS EN 60947-4-3	Low-voltage switchgear and controlgear. Contactors and motor-starters. AC semiconductor controllers and contractors for non-motor loads
BS EN 61008-1	Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCB's). General rules
BS EN 61009	Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs)
BS EN 61439	Low-voltage switchgear and controlgear assemblies
BS EN 61642	Industrial a.c. networks affected by harmonics. Application of filters and shunt capacitors
BS EN 61869-2	Instrument transformers. Additional requirements for current transformers
BS EN 61921	Power capacitors. Low-voltage power factor correction banks
BS EN 62053-21	Electricity metering equipment (a.c.). Particular requirements. Static meters for active energy (classes 1 and 2)

BS EN 62053-23	Electricity metering equipment (a.c.). Particular requirements. Static meters for reactive energy (classes 2 and 3)

200 PRODUCTS AND MATERIALS

210 Assemblies

Ensure all LV switchgear and controlgear assemblies have verification by either testing, calculation or design rules, to BS EN 61439. Ensure that the assembly maintains BS EN 61439 verification after integration into the on-site electrical systems.

Ensure all individual devices and self-contained components within assemblies conform to relevant product standards.

Ensure all equipment is free of damage and any deterioration from the manufacturer's intended standard before incorporation into the on-site electrical system.

220 Switchgear

221 Switchgear: 500 V

This clause covers circuit breakers, switches, disconnectors, switch-disconnectors and fuse-combination units and their associated controlgear.

Ensure that all switchgear and controlgear complies with BS EN 60947-1, BS EN 60947-2 and BS EN 60947-3.

Handle and mount all loose switchgear and assemblies in accordance with manufacturer's instructions at locations defined by the drawings or the relevant 'system' sections of this specification.

Ensure that all short circuit ratings, current ratings, number of poles and fusing arrangements are as indicated by the drawings or the relevant 'system' sections of this specification.

Contain the neutral connection/link of each circuit breaker, switch, disconnector, switch-disconnector, and fuse-combination unit within its respective enclosure/moulding.

Ensure that all multi-pole isolators conform to BS EN 60947-3 and are of Utilisation Category AC-23A. Provide high breaking capacity fuses to Class 'gG' to BS EN 60269-1 unless stated otherwise in the relevant 'system' sections of this specification. Ensure that they are of the make and ratings indicated by the drawings or the relevant 'system' sections of this specification. Fit fuse carriers rated at 200 A and over, with wedge or bolted contacts. Provide spare fuses of the number and sizes indicated by the relevant 'system' sections of this specification.

Ensure that all isolators and fuse-switches, are suitable for padlocking in the OFF position. Where isolators and fuse-switches are used for fire alarm, intruder alarm, UPS supplies, etc, ensure that they are also suitable for padlocking in the ON position.

Ensure that each type of switchgear classified as either circuit breakers, switches, disconnectors, switch-disconnectors and fuse-combination units under BS EN 60947 is of the same manufacture as all other switchgear of that type.

Provide sufficient space in all enclosures to accommodate external conductors from point of entry to terminal in accordance with BS EN 60947.

222 Switchgear: 250 V

Ensure that where 250 V rated switchgear (eg a consumer unit) is used it is not within 2.0 m of any other phase within the same room. Where multiple phases are within 2.0 m of each other use 500 V rated switchgear.

230 Consumer units

Use consumer units (eg a distribution board intended to be operated by ordinary persons) to BS EN 61439-3 rated for 250 V where no other phase is within 2.0 m, otherwise use a 500 V distribution board.

Ensure that all consumer units are either manufactured from non-combustible material or located within an enclosure constructed of non-combustible material in accordance with IET regulation 421.1.201.

Ensure that outgoing circuit protection is afforded by BS EN 60269 cartridge fuse links appropriate to the circuit rating, unless miniature circuit breaker (MCB) units are indicated by the drawings or the relevant ‘system’ sections of this specification.

Ensure that all consumer units are complete with a suitably sized integral double-pole isolator.

Ensure that all consumer units are fitted with multi-connection earth and neutral terminal bars to provide a separate connection for each conductor connecting to the terminal bars.

Make neutral and earthing connections to the terminal bars so that the respective circuit neutral and earth cables follow the same pattern and direction as those of the phase conductors.

240 Residual current-operated circuit breakers (RCCBs)

Unless otherwise specified use RCCBs having a sensitivity of 30 mA.

Ensure that all RCCB units without integral overcurrent protection conform fully to BS EN 61008 and are of the sensitivities, load ratings and pole configurations indicated by the drawings or the relevant ‘system’ sections of this specification.

Ensure that all RCCB units with integral overcurrent protection conform fully to BS EN 61009 and are of the sensitivities, load ratings and pole configurations indicated by the drawings or the relevant ‘system’ sections of this specification.

Adhere to the selected RCCB manufacturer's installation requirements. Ensure that the respective breaker trips lie within the time limits recommended for the category of breaker.

250 Distribution boards

251 General

Ensure that adequate provision is made within every distribution board to receive the specified cabling and that it is physically sized to suit the proposed installation location.

Ensure within TP&N distribution boards that the earth and neutral terminal bars have sufficient terminations for the maximum number of single phase circuits that the board can accommodate.

Ensure that insulated barriers and phase segregation barriers are properly fitted in every distribution board to prevent accidental contact.

Ensure that all cable entries into every distribution board are made to uphold the ingress protection rating of the associated distribution board and be a minimum of IP31 to BS EN 60529.

Mount distribution boards so that they are readily accessible and fixed firmly to masonry by plated anchors, each having a loose bolt and washer or by other approved fixing, or by nuts, bolts and washers to a painted mild steel framework.

252 HBC distribution boards

Ensure that all distribution boards have a minimum rating of 400 V with the number of ways and fuse ratings as indicated by the drawings or the relevant ‘system’ sections of this specification. Ensure they conform to BS EN 60947-3 and are of the same finish and manufacture as the main switchgear/panels selected for the works.

Supply all distribution boards complete with cartridge type fuses conforming to BS EN 60269-1. Ensure that every distribution board is complete with multi-connection earth and neutral terminal bars having a separate connection for each conductor.

253 Miniature circuit breaker (MCB) distribution boards

Ensure that all MCB distribution boards have a minimum rating of 400 V with the number of ways and MCB of the sizes indicated by the drawings or the relevant 'system' sections of this specification. Ensure they conform to BS EN 60947-3 and are of the same finish and manufacture as the main switchgear/panels selected for the works.

Ensure that every MCB conforms to BS EN 60898-1, Type C (instantaneous trip current range)with 10 kA short-circuit capacity rating unless indicated otherwise by the drawings or the relevant 'system' sections of this specification.

Securely clamp every MCB to its busbars, or properly install the plug-in type.

Use combined MCB/RCCB units where indicated by the drawings.

Ensure that where the selected manufacturer's RCCD unit(s) takes up more than one way on a board, a larger board is provided so as not to compromise the number of spare ways required by the drawings or the relevant 'system' sections of this specification.

260 Power factor correction equipment

Ensure that all power factor correction equipment is of the ratings indicated by the drawings or the relevant 'system' sections of this specification.

Provide for all necessary space, electrical switchgear and controlgear required for any future fit of PFC identified by the drawings or the relevant 'system' sections of this specification.

Use power factor correction equipment compliant to BS EN 61439 and BS EN 61921.

Include detuning reactors within power factor correction equipment in accordance with the manufacturer's recommendations.

Ensure that all capacitors are of the self-healing type conforming to BS EN 60831.

Provide rating markings to power factor correction equipment as per BS EN 60831-1.

Use capacitors banks consisting of individual capacitors wound from a metallized polypropylene film dielectric hermetically encapsulated. Mount capacitor banks in a sheet steel tank. Alternative forms of construction may be offered for consideration by the Contract Administrator.

Ensure that capacitor dielectric losses are less than 1.0 W/kVAr

Fit capacitors with an automatic discharge device to achieve full discharge of capacitors within one minute after disconnection. Ensure that there are no devices capable of isolating the capacitors from the discharge device during the discharge period.

Install suitable current limiting devices to capacitor banks to limit inrush currents on capacitor switching. Ensure that power factor correction control equipment has the following functionality:

~ user interface

~ automatic disconnection of all capacitors in the event of mains failure, with a two-minute delay before re-connection

~ adjustable target power factor setting

~ optimization of capacitor switching to minimise inrush currents, minimal switching of capacitors to achieve target power factor, minimise the propagation of voltage transients to the LV supply, and controlled discharge of capacitor before reconnection to supply

- push-button operated manual override incorporating controlled discharge as above
- adjustable switching programmes
- visible indication of capacitor stages
- metering parameters voltage, current, kvar, power factor

Protect each capacitor stage with HBC fuses of current rating no less than 1.5 times its rated capacity current.

Ensure that every capacitor control contactor is rated for its switching duty.

Ensure that all power factor equipment is automatically disconnected prior to the operation of any standby generator(s).

Fit rating plates to each capacitor assembly as per BS EN 61921 to include, but not limited to, date of manufacture, rated reactive power, rated voltage, frequency, short circuit withstand and IP rating.

270 Harmonic filtering equipment

Ensure that all harmonic filtering equipment is of the ratings indicated by the drawings or the relevant 'system' sections of this specification.

Allow for all necessary space and electrical switchgear and controlgear required for any future fit of harmonic filtering equipment identified by the drawings or the relevant 'system' sections of this specification.

Install and commission all harmonic filtering equipment as per the manufacturer's recommendations.

Provide all harmonic filtering equipment with spares as per the manufacturer's recommendations.

Undertake a field survey for harmonic analysis of all n^{th} harmonics up to and including the 50^{th}. Submit the field survey report to the Contract Administrator within two weeks' of undertaking the survey.

The field survey must be representative of the normal site operations and be of sufficient duration to capture a representative sample of plant and equipment duty cycles.

Install passive harmonic filtering assemblies conforming to BS EN 61439 as indicated by the drawings or the relevant 'system' sections of this specification.

Size and tune passive filters to provide optimum attenuation of harmonics identified for reduction during the field survey.

Install active harmonic filtering equipment conforming to BS EN 61439 as indicated by the drawings or the relevant 'system' sections of this specification.

Ensure that the active harmonic filtering equipment comprises all necessary current transformers, closed loop control technology, and semiconductor power injection devices necessary to deliver the performance identified by the field survey report.

Provide active harmonic filter equipment with a user interface to allow access to:

- stop and start filter
- switch between automatic and manual selection of targeted harmonic frequencies
- set operating parameters
- read operating parameters such as total harmonic distortion, injected harmonic currents
- view waveforms and graphs
- set Modbus/BMS output

280 Switchboards

281 Cubicle type switchboards

Ensure that all cubicle type switchboards (cubicle panels) are manufactured in accordance with BS EN 61439. Ensure that the cubicle panel maintains BS EN 61439 verification after site assembly and integration into the on-site electrical systems.

Size all cubicle to accommodate the switchgear and to the form indicated by the drawings or the relevant ‘system’ sections of this specification.

Ensure that all cubicle panels are manufactured with a minimum thickness of 16-gauge zintec-coated braced sheet steel finished with epoxy-based paint on all surfaces and support frames.

Ensure that all cubicle panels are protected to a minimum of IP31 to BS EN 60529.

Ensure that all cubicle panels are fully fault-rated as detailed by the drawings or, if not indicated by drawings, to a minimum level of 50 kA for one second duration.

Ensure that all cubicle panels are of the front-access type unless otherwise indicated by the drawings or the relevant ‘system’ sections of this specification.

Ensure that all cubicle panels are complete with a 100 mm high metal plinth.

Ensure that all cubicle panels are readily extendible.

Install spare cubicle panels as indicated by the drawings or the relevant ‘system’ sections of this specification to accommodate the metering equipment etc for the electricity companies.

Provide cubicle panel sections with removable eye bolts in each corner for lifting purposes.

Ensure that all connections between busbars and associated switchgear are adequately rated for load and fault currents.

Enclose cubicle panel busbars in an earthed metal chamber. Ensure that a removable metal cover provides an earthed barrier between the operator and the live connections.

Ensure that all penetrations of live busbars into outgoing circuit compartments or cable chambers are fully shrouded. Ensure that all busbars have a minimum current rating of that of the switchgear controlling the incoming supply to the cubicle panel.

Install a full length and suitably sized earth bar to each panel. Provide bonding connections to each item of switchgear and cable plates.

Control all outgoing circuits using fuse switches, MCCBs or ACBs as indicated by the drawings or the relevant ‘system’ sections of this specification. To permit the renewal of fuses, ensure that their fuse carrier assemblies are fully isolated when the associated fuse switch is in the OFF position. Ensure that all fuse switches have double-break, silver or electro-tinned contacts, safety interlocks, and ON/OFF indication.

Ensure that all ACBs and MCCBs installed in cubicle panels are I_{cs} (rated service short-circuit breaking capacity) duty as defined in BS EN 60947, and tested within a minimum switchboard enclosure.

Use ACBs conforming to BS EN 60947-3 Utilisation Category AC-23. Use moulded-case circuit breakers conforming to BS EN 60947-2, with the voltage and current ratings, rated duty and rated short-circuit breaking capacity indicated, and a rated short-time withstand time of one second unless otherwise indicated.

Ensure that all ACBs are of the withdrawable pattern each complete with control/ switching devices, interlocks, locks, etc, and safety shutters which completely shroud the main fixed isolating contacts automatically when the breaker section is withdrawn.

Ensure that all operating handles for switchgear are of the rotary, toggle or retractable types and are manufactured such that the cover cannot be removed while the switch is in the ON position.

Fuse switch units fitted with solid copper links appropriately rated may be used as isolators for circuits up to 1600 A provided they are suitable for the fault duty.

Fit labels to all switchgear, cable chamber covers and busbar covers with the appropriate designations or warning notices as necessary. Issue label schedules to the Contract Administrator for agreement of designation.

282 Unit type switchboards

Ensure that all unit type switchboards consist of switchgear units and fusegear in accordance with this specification section Y71, together with all matching cable boxes, terminations, conduits and wiring interconnections, as indicated by the drawings or the relevant ‘system’ sections of this specification.

For each unit type switchboard, mount all switchgear and fusegear on a painted mild steel angle frame within the dimensions of the space indicated on the drawings.

Where unit type switchboards are sited over formed floor trenches, supply and fix all necessary support steelwork to span the trenches.

Make all required floor/wall fixings by using plated anchors each having a loose bolt and washer.

Ensure that each busbar chamber spans the whole length of the associated switchboard and is readily extendible. Ensure that all copper busbars are of the minimum rating of the main incoming switch, and suitably colour coded both on the bars and on the chamber cover.

Ensure that all connections between busbars and their respective switchgear and distribution gear are by copper bars, copper rods or copper cables, suitably fixed with clamps and bolts.

Mount suitable cable trunking and matching steel cabinet(s) on the frame to accommodate metering, CTs and other equipment of the local electricity companies where required.

Incorporate instrumentation in accordance with section Y71and the relevant ‘system’ sections of this specification, and as indicated by the drawings.

Ensure that each unit type switchboard is complete with protective conductors bonding all components fully in accordance with BS 7671. Provide a main earth terminal. Do not carry out through wiring.

Assemble all unit type switchboards from one manufacturer's equipment with a common finish.

300 SWITCHGEAR AND LV PANELS - GENERAL

310 Drawings

Before manufacture commences submit drawings to the Contract Administrator for comment showing the proposed switchboards, including dimensions, construction details, layout, internal connections and identification markings.

320 Terminations and switchboard connections

Provide the selected manufacturers of LV panels with details of all cable sizes, cable types, switchgear and panel locations, both during tender enquiry and post-tender periods, so that if necessary, panels, switch unit sizes, terminations, etc are properly adjusted to suit the particular project requirements. Include all costs associated with such adjustments in the tender.

Provide all switchgear with suitable means of accepting the types and sizes of connected cables.

Provide connection rail enclosures and cable gland plates for cubicle boards.

Ensure that all small wiring within every panel complies with BS 6231 using type 'B', PVC insulated 600V grade stranded copper conductors having a cross section of not less than 1.5 mm^2.

Terminate wiring on readily accessible fully shrouded terminal rails adjacent to the instruments.

Ensure that terminal markings and conductor identification fully comply with section Y82 of this specification and BS 5472.

Ensure that terminations of voltages in close proximity are segregated by insulated barrier plates.

Ensure that terminal rails are of the appropriate current rating, of sufficient size to suit the cable conductors being installed, are fitted with purpose-made supports, are of robust construction, and further comply with the following:

- ~ the voltage rating is 500 V
- ~ DIN rail mounted
- ~ the terminal fixing to rails has spring-loaded fronts, ie retention is not dependent only on the terminal mouldings
- ~ terminals are locked to the terminal rail
- ~ clamping screws are captive of high-tensile steel and operate against a plate to prevent damage to the conductor. Do not use pinch screws or push-on terminals
- ~ insulation materials are carbon-free non-hygroscopic and suitable for continuous operation at temperatures of -5°C to 130°C
- ~ contain safety features to eliminate accidental contact by any operator

Do not route outgoing cables through the busbar chamber.

Ensure that suitable cable gland plates are fitted to receive the respective cables where vertical cable chambers form part of the panel construction.

Wire to terminal rails all relays, multi-pole contactors, instruments and other components accommodated within panel compartments.

330 Safety and maintenance

Ensure that all remote switch devices used for local isolation have facilities for padlocking the device in the ON or OFF position as appropriate. Ensure that all switches conform to tables I and II of the relevant British Standards.

Ensure that all switchgear specified with Castell interlocks are sequenced correctly and that the correct number of keys is supplied.

340 Identification and notices

Ensure that all identifications and notices comply with section Y82 of this specification and BS 7671.

Fix identification and warning labels of minimum size 75 mm X 25 mm to each item of equipment. Fix all labels with plated screws.

Ensure that all identification labels are white with in-filled black letters 6 mm high.

Ensure that warning labels are white with in-filled red letters 20 mm minimum high.

Ensure that the basic circuit chart for distribution boards is in accordance with BS 7671.

350 Phase colouring

Clearly mark all switchgear and distribution boards on the external vertical face by discs showing the phase. Mark busbars with a coloured tape band.

Ensure that the phase sequence is maintained along the entire length of each busbar trunking system and is identical in all systems in the installation. Permanently mark phase colours clearly and in each trunking unit.

360 Current transformers

Use current transformers (CT) conforming to BS EN 61869-2.

Use CTs with a 5 A secondary unless otherwise indicated by the drawings or the relevant ‘system’ sections of this specification.

Ensure that each CT has a rated VA output suitable for the type and magnitude of the connected burden.

Ensure that all CTs for metering and control purposes are of accuracy Class 3 minimum.

Match protection CT secondary excitation characteristics, secondary winding resistance and secondary burden resistance to the protective relay system with which it is used to ensure correct operation of protection relay.

Ensure that the Accuracy Limit Factor (ALF) for 5P and 10P protective CTs is appropriate for the protection scheme, and greater than the highest available setting of any instantaneous element. Ensure that the 'knee' point voltage of Class PX CTs is sufficient for correct operation of the protection scheme and can maintain stability for 'through fault' conditions.

Use current transformers of the 'bar' primary type unless otherwise approved accepted by the Contract Administrator. Match sets of CTs.

Terminate all connections from secondary windings at terminals integral with or adjacent to the CTs. Lace secondary windings and arrange to prevent contact with the 'main' circuit. Earth one terminal of the CT secondary circuit.

Do not insert isolating contacts in circuits between CTs and protective devices.

Ensure that the removal of the protection relay from its case will 'short circuit' the connected CT.

Provide all protection relays with facilities for testing:

~ preferred method - direct secondary injection at the relay

~ alternative method - a CT with a test winding, and terminals brought out to convenient locations. Arrange every such test winding so that injection of 10 A represents the full load current in the main circuit

All protection relays or electronic protection devices and metering shall be resistant to mains-borne harmonics such that their operation or accuracy is not affected.

All protection relays shall be electronic, programmable protection devices with self-illuminating electronic displays.

Each relay shall have short-circuit and earth fault (both residual and restricted) protection with selective inverse, very inverse, definite time, and instantaneous short circuit tripping facilities.

All protection relays shall be capable of recording and storing a date and time stamped event log.

370 Instruments and metering

Provide all instrumentation and metering as identified by the drawings or the relevant ‘system’ sections of this specification.

Provide dedicated metering for the measurement of kWh at the locations identified by the drawings.

Ensure that all combined performance measuring and monitoring devices that measure and monitor the electrical parameters within electrical distribution systems conform to BS EN 61557-12. Ensure that all energy meters are of the static type, minimum Class 2 accuracy with digital display, and conform to BS 8431 and/or BS EN 62053-21 and/or BS EN 62053-23.

Use meters that operate with a meter supply of 230 V ac at 50 Hz.

Ensure all instruments are:

~ flush mounted

~ back connected

~ provided with means for zero adjustment

~ minimum size DIN 72 x 72 panel mounted

~ minimal terminal size of M4

Provide multi-function meters with the following functions:

~ voltage phase-to-phase

~ voltage phase-to-neutral

~ voltage total harmonic distortion

~ current

~ kW

~ kVA

~ kVAR

~ power factor

~ frequency

Provide all multi-function meters with pulse output.

Provide all networked meters with Modbus communication output.

Provide HBC fuses to each voltmeter. Provide double insulated cables between the busbars and the meter fuses. Provide single insulated cables between the meter fuses and the meter.

Submit drawings of the location and general arrangement of meters to the Contract Administrator for comment before manufacture commences.

Fit all incoming supply compartments with voltmeters, ammeters or multi-function meters.

Fit all outgoing circuits with ammeters and selector switches as detailed by the drawings.

380 Testing

Submit verification documentation in accordance with BS EN 61439 for all switchgear and controlgear assemblies to the Contract Administrator when the panel and assembly drawings are submitted for comment.

Clearly mark all equipment with the standard to which it complies. Provide type test certificates, for the class of switchgear to be supplied.

Ensure type testing is in accordance with BS EN 60439.

Include in the tender all costs for inspection visits to the manufacturer’s works by the Contract Administrator. Give the Contract Administrator two weeks’ notice of each test.

END OF SECTION Y71

Y72 CONTROL PANELS, MOTOR STARTERS AND CONTROLLERS

CONTENTS

Y72 CONTROL PANELS, MOTOR STARTERS AND CONTROLLERS

100 REFERENCE DOCUMENTS

This specification is written based on legislation, standards and guidance in force in the UK generally, and within England by default. For projects in Scotland, Wales, Northern Ireland, the Channel Islands and the Isle of Man, give appropriate consideration to any locally applicable legislation, standards and guidance that deviates from or is additional to those in force within England. Similarly for projects outside the UK comply with the corresponding national legislation, standards and guidance.

Comply fully with the edition (including replacement, amendments and normative references) of each of the following, current at the time of tender.

Where a standard referred to in this section conflicts with a standard referred to in an associated 'engineering system' section (eg S10, T31, V21, etc.) of this specification, the standard referred to in the engineering system section prevails.

The Electricity (Factories Act) Special Regulations

The Health and Safety at Work etc. Act

The Electricity at Work Regulations

The Electrical Equipment (Safety) Regulations

The Supply of Machinery (Safety) Regulations

BS 88	Low-voltage fuses (Cited in BS 7671 but withdrawn and replaced by BS EN 60269)
BS 89	Direct acting indicating analogue electrical measuring instruments and their accessories.
BS 5992	Electrical relays
BS 7671	Requirements for electrical installations. IET Wiring Regulations
BS EN 55014-1	Electromagnetic compatibility. Requirements for household appliances, electric tools and similar apparatus. Emission
BS EN 60051-1	Direct acting indicating analogue electrical measuring instruments and their accessories. Definitions and general requirements common to all parts
BS EN 60073	Basic and safety principles for man-machine interface, marking and identification. Coding principles for indicators and actuators
BS EN 60204-1	Safety of machinery. Electrical equipment of machines. General requirements
BS EN 60255	Measuring relays and protection equipment
BS EN 60269-1	Low-voltage fuses. General requirements
BS EN 60269-4	Low-voltage fuses. Supplementary requirements for fuse-links for the protection of semiconductor devices
BS HD 60269-2	Low-voltage fuses. Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application). Examples of standardized systems of fuses A to J
BS EN 60529	Degrees of protection provided by enclosures (IP code)
BS EN 60947-1	Low-voltage switchgear and controlgear. General rules
BS EN 60947-2	Low-voltage switchgear and controlgear, Circuit breakers
BS EN 60947-3	Low-voltage switchgear and controlgear. Switches, disconnectors, switch-disconnectors and fuse-combination units

BS EN 60947-4-1	Low-voltage switchgear and controlgear. Contactors and motor-starters. Electromechanical contactors and motor-starters
BS EN 60947-4-2	Low-voltage switchgear and controlgear. Contactors and motor-starters. AC semiconductor motor controllers and starters
BS EN 60947-8	Low-voltage switchgear and controlgear. Control units for built-in protection for rotating machines
BS EN 61000-5-7	Electromagnetic compatibility (EMC). Installation and mitigation guidelines. Degrees of protection by enclosures against electromagnetic disturbances (EM code)
BS EN 61000-6-3	Electromagnetic compatibility (EMC). Generic standards. Emission standard for residential, commercial and light-industrial environments
BS EN 61000-6-4	Electromagnetic compatibility (EMC). Generic standards. Emission standard for industrial environments
BS EN 61439-1	Low-voltage switchgear and controlgear assemblies. General rules
BS EN 61439-2	Low-voltage switchgear and controlgear assemblies. Power switchgear and controlgear assemblies
BS EN 61439-6	Low-voltage switchgear and controlgear assemblies. Busbar trunking systems (busways)
BS EN 61800-2	Adjustable speed electrical power drive systems. General requirements. Rating specifications for low voltage adjustable frequency a.c. power drive systems
BS EN 61800-3	Adjustable speed electrical power drive systems. EMC requirements and specific test methods
BS EN 61810-1	Electromechanical elementary relays. General requirements
BS EN 62208	Empty enclosures for low-voltage switchgear and controlgear assemblies. General requirements
BS EN 62262	Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)
ENA ER G5/4	Planning Levels for harmonic Voltage Distortion and the Connection of Non-Linear Equipment to Transmission Systems and Distribution Networks in the United Kingdom

200 GENERAL

This specification applies to:

~ motor starters and controllers

~ all control panels and / or enclosures housing electrical switchgear and controlgear used with all forms of mechanical plant

Ensure that all cable terminals are correctly sized to accommodate the tails of cables specified. Ensure there is ample space within panels, isolators, etc to accept the cables specified.

Protect equipment against physical damage and from ingress of water, dust and other contaminants during delivery, storage and installation.

Install the motor starters, motor controllers, control panels and all interconnected equipment to form a complete and working system. Co-ordinate the designs of all interconnected units, their wiring and terminal connections so that they are mutually compatible and function as a whole in accordance with the design intent.

Ensure that the cable access systems required are adequately sized, supported and spatially co-ordinated with other equipment and the building structure.

Design and manufacture all purpose-built assemblies incorporating motor control gear and associated equipment and components to comply with the standards referred to in this specification and with the component manufacturers' recommendations.

300 PRODUCTS AND MATERIALS

310 Control panels

311 General

Comply with the motor control centres / control panels requirement of W60.

Design, construct and install control panels, associated switchgear and controlgear assemblies in accordance with BS EN 61439. Submit BS EN 61439 verification documentation to the Contract Administrator when the panel and assembly drawings are submitted for comment.

Fit each assembly with a durable legible label located in a clearly visible place. Provide the following information:

~ manufacturer's name or trade mark

~ type designation or identification number or other means of identification

~ date of manufacture

~ IEC 61439-X (the specific part “X” shall be identified)

Prepare schematic, wiring and general arrangement drawings of the control panels and all equipment connected and submit the drawings to the Contract Administrator for comment at least four weeks before manufacture is required to begin. Include details of the motor drives finally ordered. Ensure drawings are A3 size or larger.

Ensure that it is possible, without taking off covers or disturbing the wiring, to safely measure motor current for commissioning purposes with a suitable clip-on ammeter.

Equip the spare compartments with switch/fuses sized for each compartment's maximum capacity. Provide a distribution of spare compartment sizes to match that of the installed drives and packaged plant.

312 Construction

Construct the motor control panels with rigid framed enclosures and with panels in zinc-coated mild steel at least 1.6mm thick for panels up to 600mm x 600mm and at least 2mm thick for larger panels. Round all edges and corners to a minimum radius of 3mm. Passivate the panels and finish all surfaces with a wear resistant paint system in the maker's standard colour.

Provide details of the proposed panel construction and paint system with the drawings submitted to the Contract Administrator for comment.

Design and construct the panels containing motor starters and controllers with protection to IP54 where mounted internally and with protection to IP65 where mounted externally. Design the panels for continuous operation. Size and/or ventilate all panels to maintain all internal components within their maker's specified temperature limits in local ambient temperatures up to 40°C.

Mount proprietary equipment such as inverters and motor soft starters in accordance with their manufacturers’ recommendations. Ensure that heat generated can be safely dissipated.

Fit control panels containing inverters or motor soft starters with temperature detectors to warn when the panel limiting temperature is reached.

For panels weighing more than 40kg provide four removable lifting eye bolts on the top of each panel. Provide blanking plugs to seal the holes when the lifting eyes are removed.

Assemble floor-mounted units on a plinth at least 100mm deep made of channel iron or zinc-coated sheet steel, with holes provided to bolt the complete assembly to the floor. Provide all necessary packing and / or grouting to ensure the plinth is fixed on a firm level surface. Limit the maximum height of floor-standing units to 2m above the plinth.

Ensure that the panel dimensions, particularly the height, do not prevent proper installation of the panel and of the cables and cable access systems associated with it.

Do not mount any live panel components on the floor, roof or sides of the panel, or less than 150mm from the bottom of the panel.

Provide panel doors with lockable hand-operated fastenings and a minimum of three keys per fastening.

Fit appropriately rated anti-condensation heaters which are automatically energised when the panel is switched off. Fit clearly legible warning label in prominent position near each anti-condensation heater with the following warning: “Power to anti-condensation heater is supplied from a separate source. Ensure that power is isolated and locked off before servicing.”

313 Wardrobe-type control panels

Construct wardrobe type control panels to BS EN 61439-2 with separation as per National Annex NA to the Form Types specified in specification section W63.

Mount all main components on a back plate. Mount switches, instrumentation and indicator lamps on the front panel doors. Ensure that all live parts are efficiently shrouded against accidental contact during maintenance or inspection.

Supply power to all motor drives and packaged plant via fuses to BS 88 / BS EN 60269.

314 Compartmented control panels

Equip each compartment with the following equipment and controls as appropriate:

~ ~ fuse/switch isolator

~ ~ ammeter

~ ~ control switches and indicator lamps

~ ~ motor starters

~ ~ sub-fuses for the low speed windings of motors with separate windings

~ ~ door lock

~ ~ labels and warning notices

315 Electrical requirements

Design the internal busbar system, including its fixings within the assembled panel, to carry the full load current scheduled in the particular specification and a 3-phase symmetrical short-circuit current of 30kA for 1 second.

Design all equipment and wiring for 50Hz electrical supplies of 400V (3 ph) or 230V (1 ph) plus 10% or minus 6%.

Design and construct all electrical equipment to be suitable for use in local ambient temperatures up to 40°C and with relative humidities up to 90% with occasional occurrences of moderate condensation, unless specified otherwise in specification section V20. Proof all equipment against moderate amounts of dust and, where required, against corrosion by salt laden air. Use only materials resistant to mould growth and attack by vermin.

Protect all connecting cables against overload and short-circuit faults by appropriately sized fuses to BS 88 / BS EN 60269. Select fuses protecting motor circuits to suit the motors to be finally installed according to the fuse manufacturer's recommendations for the type of motor starting employed.

Ensure that all cable glands and conduit entries maintain the integrity of the IP protection rating specified. Ensure that all cables entries from trunking are made via a purpose made watertight upstand of sufficient height to form a water resistant junction between the panel and the cable trunking.

Terminate all incoming and outgoing cables in terminal blocks close to the cable entry positions. Terminate control cables carrying voltages of 110V and above in disconnectable terminal blocks for essential working without isolating the main supplies, using appropriate safety procedures.

Ensure all fuses installed in the motor control panel provide satisfactory discrimination with sub-circuit fuses within the panel and with the panel's main supply fuse. Submit discrimination study to the Contract Administrator for comment.

Shroud all cable terminals, live parts of the switchgear and other components, including live parts to the rear of switchgear, against accidental direct contact when testing and inspecting the panel. Install fuses either as part of fuse/switches or in shrouded fuse holders.

Identify and mark all cables, cable terminals, fuses, switchgear and other components with permanent labels using the circuit references used in the installation and on Record Drawings.

Connect all motor control panels to a main low voltage switch board as per the Electrical Distribution Schematic.

Ensure that all internal cableways and terminal blocks are sized to accept the input and output cables specified. Submit details of the maximum proposed incoming and outgoing cable termination capacities in conjunction with their panel drawings for comment by the Contract Administrator prior to panel manufacture.

Loosely loom all internal wiring in slotted plastic trunking. Ensure all wiring is free from mechanical strain and protected from abrasion or other mechanical damage. Size all wiring to be protected against both overload and short circuits by the fuses installed. Incorporate extra space in the panels for terminals, fuseways and starters up to one-quarter of the installed capacity.

316 Monitoring instrumentation

Equip each panel with the following instrumentation:

- a fuse protected incoming supply voltmeter of 0-500V range with a line and phase voltage selector switch
- an incoming ammeter with phase selector switch. The full scale reading of the meter shall be the rating of the fuses protecting the panel
- an ammeter for each motor drive and packaged plant unit of 15kW and above

Ensure all instruments are at least 70mm square, with scales over a 90° arc and conforming to BS 89. Provide motor and packaged plant ammeters with full scale readings twice the full load current of the equipment served. Ensure ammeters are capable of passing starting currents without damage.

317 Earthing

Install an earthing bar of 25 x 3mm copper along the whole length of each panel.

Connect each panel section, including the panel doors and circuit protective conductors to the earthing bar via connections sized to comply with BS 7671.

318 Panel isolation

Route the incoming supply via a separate full-load rated three-pole isolator mounted so that it can be operated with the panel doors open or closed.

Take the building management system from the live side of the panel isolator via separately mounted fuse/switches, or from a separate secure supply.

320 Motor starters and controllers

321 General

Provide motor starters of the type specified in this specification to start and accelerate motors to normal speed and to ensure continuous operation of motor. Ensure motor starters can switch off the supply from the motor and also provide protection of motors and associated circuits against operating overloads.

Ensure that the levels of harmonic emissions from soft-starters, inverters and other non-linear loads do not exceed the planning levels specified in ENA ER G5/4. Provide, install and commission all passive and / or active filters as necessary to reduce all excessive harmonic emissions to a level in compliance with G5/4.

Prepare schematic, wiring and general arrangement drawings of the motor starters, controllers and all equipment connected and submit the drawings to the Contract Administrator for comment at least four weeks before manufacture is required to begin. Produce the drawings at A3 size and include final details of all the motors ordered.

Schedule the details of all motors and packaged plant ordered and ensure that the wiring, fuse protection, starter contactors, overload relays and all other circuit elements are correctly selected according to the requirements of this specification, the documents referred to above and the component manufacturer's published application data.

Apply the following starting methods for all IE3 rated motors:

- ~ Direct-on-line is permissible for motor drives below 5.5kW
- ~ Fit motor drives of 5.5kW output and above with Star/Delta starters, or with such other form of assisted starting as is scheduled in the particular specification
- ~ Fit motor drives with outputs above 22kW, if suitable for star/delta starting, with closed-transition Star/Delta starting, Electronic Soft Start or Variable Speed Drive Controllers as specified in the equipment schedules

Apply the following starting methods for all IE2 rated motors installed before 1 January 2017:

- ~ Direct-on-line is permissible for motor drives below 5.5kW
- ~ Fit motor drives between 5.5kW and 7.5kW output with Star/Delta starters, or with such other form of assisted starting as is scheduled in the particular specification
- ~ Fit motor drives with outputs above 7.5kW with Variable Speed Drive Controllers

Apply the following starting methods for all IE2 rated motors for all motors installed on or after 1 January 2017:

- ~ Direct-on-line is permissible for motor drives below 0.75kW
- ~ Fit motor drives with outputs above 0.75kW with Variable Speed Drive Controllers

Arrange for motor starters and drives to open in the event of power interruption and to remain open until deliberately restarted in the normal manner.

Ensure that motor drives with hand controls only can be restarted by hand. Fit motor drives subject to automatic control with automatic sequencing arranged to ensure that the drives are restarted in correct sequence and without overloading the main supply system.

Design automatic controls so as not to allow motor drives to be started more frequently than once every ten minutes unless a lesser interval between motor starts is allowed by the particular specification.

Where Duty 1 and Duty 2 motors are provided for the same item of plant, hard-wire interlock the associated starters to prevent simultaneous operation.

Where two-speed motors are fitted with separate windings for each speed provide a separate starter for each speed. Hard-wire interlock the starters to prevent simultaneous operation, with a time delay relay fitted to provide an adjustable pre-set delay of up to 10 seconds when switching from High to Low speed.

322 Contactors and overload protection

Install motor starters which comply with appropriate parts of BS EN 60947 and include the following features:

~ contactors rated for continuous duty, Category AC-3 and sized to carry at least the maximum continuous current they are required to carry with the motor or other equipment served at full load plus 10%

~ thermal-magnetic overloads chosen to suit the motors and starter connections finally selected, compensated for ambient temperature and with loss-of-phase protection. Ensure the units incorporate manual reset, local visual fault indication and auxiliary contacts for remote fault indication

~ individual protection against short circuits by fuses to BS 88 / BS EN 60269. Select the contactor and fuse combination to provide Type 'C' protection co-ordination to BS EN 60947-1. Ensure that a short-circuit fault downstream of the motor starter causes no damage to starter

~ thermistor protection units for those motors for which thermistor protection is specified eleswhere. Ensure the units comply with BS EN 60947-8 and incorporate manual reset, LED fault signalling and a test button to check correct operation

~ auxiliary contacts for the control and signalling functions specified elsewhere

323 Direct-on-line (DOL) motor starters

Install direct-on-line motor starters embodying the following features:

~ a single contactor

~ thermal-magnetic overload set for the motor rated full load current

324 Star/delta (S/D) motor starters

Install star/delta motor starters embodying the following features:

~ three contactors: line, delta and star

~ mechanical interlock between the delta and star contactors to prevent simultaneous operation

~ variable time delay for change from star to delta of 5 to 20 seconds. Set the delay time so that the change from star to delta takes place after the motor current has fallen to a value less than rated full load

~ ensure that the time delay to making of the delta contactor allows sufficient time for the star contactor to break

- ~ thermal-magnetic overload set for the motor rated full load current
- ~ auxiliary contact signal from motor local isolator switch to signal that motor starter should be switched off when switch is open

325 Closed-transition star/delta motor starters

Install closed-transition star/delta motor starters embodying the following features:

- ~ four contactors: line, delta, star and resistance, all sized for the load current carried plus 10%
- ~ a resistor in series with each winding, rated for up to 5 seconds on load
- ~ mechanical interlock between the delta and star conductors to prevent simultaneous operation
- ~ variable time delay for the time in star connection of 5 to 20 seconds. Set the delay time so that the change from star to resistance takes place after the motor current has fallen to a value less than rated full load
- ~ variable time delay for the time with the resistors in series with the windings of 0.5 to 1.5 seconds. Set the delay time so that the resistors remain in series with the motor windings until the motor current has fallen to a value less than rated full load
- ~ short out then disconnect the resistors at the expiration of the 0.5 to 1.5 seconds time delay
- ~ thermal-magnetic overload set for the motor rated full load current
- ~ auxiliary contact signal from motor local isolator switch to signal that motor starter should be switched off when switch is open

326 Electronic soft starters

Provide electronic soft-starters sized by their manufacturer to suit the motors finally ordered. Allow for the motors to operate continuously at their maximum continuous rating (Duty S1).

Fit input/output filters if required to reduce mains harmonic distortion or to keep electromagnetic radiation within acceptable limits. Fit varistors or equivalent input device to prevent damage to the unit by mains over-voltage spikes.

Mount the soft starters as detailed in specification section W63, and provide the following control facilities:

- ~ adjustable acceleration ramp up to 30 seconds
- ~ adjustable current limit from 2 to 5 times full load current
- ~ combined acceleration ramp and current limit to control starting torque
- ~ motor thermal overload protection and early warning indication
- ~ fault detection, diagnostic facilities and alarm signalling to the BMS
- ~ shorting / bypass contactor for use with motor drives where energy saving is ineffective
- ~ starter trip and reset to OFF on loss of power supplies

Submit the following details of the proposed soft-starter to the Contract Administrator for comment before ordering:

- ~ maker's specification and literature
- ~ proposed starter mounting details

- ~ proposed wiring and connection details, including control connections
- ~ proposed commissioning and adjustment procedure

330 Motor drives

331 Variable frequency inverter drives

Provide stand-alone (ie separate from motor) inverter drives or combined (close coupled) or separate inverter and motor drives, as specified in specification section W63, sized by the inverter manufacturer to match the motors finally ordered.

Install inverter and combined inverter and motor drives in accordance with manufacturer's recommendations. Ensure that the installation meets the manufacturer's cooling and vibration recommendations.

Ensure inverter drives for fans and pumps maintain a constant voltage / frequency ratio at frequencies below 50Hz. Provide confirmation that the motors and inverter units finally selected are suitable for the required duty, including any allowance for motor de-rating specified by the motor manufacturer.

Select the motor drive pulley sizes so that the motors deliver their selected maximum output with the inverter output at 50Hz. Provide inverters whose minimum inverter frequency is 10Hz and the maximum 57.5Hz, or the frequency at which the motor is delivering full power, whichever is the lesser.

Ensure that the inverter drive starts the motor and its load within the time constraints recommended by the motor / equipment manufacturer.

Provide the following inverter control facilities:

- ~ power supply via BS 88 / BS EN 60269 fuses of a size specified by the inverter manufacturer and a local isolating switch to disconnect all power from the inverter and motor when required
- ~ inverter power input circuits protected against mains voltage short duration spikes of up to 2 kilovolts
- ~ initiate drive start by signal from the building management system or locally by a panel mounted Hand/Off/Auto switch or otherwise
- ~ drive frequency controlled by a 0-10V signal from the building management system, or by local panel mounted inverter frequency control
- ~ a frequency display, either digital or analogue scaled 0-60Hz
- ~ protection against inverter overheating, motor over current, external short circuits, motor single phasing and earth faults
- ~ simple fault diagnosis facilities and a common fault signal to the building management system
- ~ where the inverter is mounted remotely from the motor drive provide a local steel cased isolator with early-break contact to shut down the inverter, for motor maintenance
- ~ user programmable functionality

Provide for the following relay outputs rated at 240V AC, 2A from the inverter:

- ~ inverter running
- ~ inverter alarm

Where specified in system specifications provide for the following digital outputs rated at 24V DC, 40mA from the inverter:

~ inverter running

~ inverter fault

~ inverter ready

~ motor current outside specified range

~ motor speed outside specified range

~ thermal warning

~ drive in hand mode

~ drive in auto mode

~ inverter operating in fire/smoke mode (inverter will keep running irrespective of its normal protective functions)

Where specified in system specifications provide for the following digital inputs rated at 24V DC, at the inverter:

~ go to preset speed 1

~ go to preset speed 2

~ go to preset speed 3

~ fire / smoke mode enable

~ drive start

Where specified in system specifications provide for the following analogue inputs rated at 0-10V DC or 0/4-20mA selectable:

~ variable frequency / motor speed reference

Where specified in system specifications provide for the following analogue outputs rated at 0-10V DC or 0/4-20mA selectable:

~ inverter frequency / motor speed

Where required in W66 provide energy consumption data in kWh to metering, monitoring and management systems.

Where communication with the inverters is specified in system specifications or noted on drawing provide RS 485 datalink communication interface suitable for communication using BACnet, Modbus, Lonworks, Ethernet/IP or other protocol as specified.

Where the inverter/motor system is not provided as an integrated and matched system ensure that the inverter and the motor are compatible over the full range of design operating conditions.

Install an electromagnetic interference (EMI) filter in the supply line to the inverter and in the output terminals from the inverter to manage the effects of harmonic distortion on the mains supply within acceptable limits in accordance with the manufacturer's recommendation. Check with the inverter and motor manufacturers as to whether a surge suppressor is required to be installed between the inverter drive and the motor and install one if required.

Use only 12-pulse rectifiers for inverter drives serving motors of 132kW or more to reduce generation of low frequency harmonics.

Submit the following details of the proposed variable frequency inverter drive to the Contract Administrator for comment before ordering:

~ maker's specification and literature

~ proposed drive, starter and controller mounting details

~ proposed wiring and connection details, including control connections

~ proposed commissioning and adjustment procedure

340 Motor control panels

Ensure that motor control panels comply with all the requirements specified in clause 310 except where modified or added to by the requirements specified under clause 330.

341 Motor circuit wiring

Unless specified differently elsewhere, install wiring types as scheduled below:

Wiring Type	Application
PVC/SWA/XLPE, 600/1000V grade, insulated and sheathed, with stranded copper conductors, run on cable tray or clipped direct.	Connections to main LV switchboard, motor drives, control devices operating at 230V.
PVC insulated, 600/1000V grade, stranded copper conductors.	Control panel internal power wiring.
Screened and sheathed twisted pairs with stranded copper conductors as specified by controls specialist.	Connections to sensors, instrumentation and motorised valves operating at voltages less than 230V.
Inverter manufacturer specified motor feed cable where specified OR multicore, XLPE insulated, symmetrical with full size ground, braided / foil screened and suitable for inverter motor feed cable.	Motor feed cable.

Ensure that all wiring, except that specified by controls specialist, meets the requirements of BS 7671 and is of a minimum size of 1.5mm2.

Submit full cable sizing calculations to meet BS 7671 for all plant supply cabling for the Contract Administrator's comment.

Use crimped lugs by AMP or equivalent for all minor cable terminations, with the cable insulation secured at the termination by a crimped plastic skirt. Prepare cable terminations in accordance with the crimp manufacturer's instructions and using the tools specified. Leave sufficient lengths on cables to ensure there is no tension on any connection.

342 Control circuits

Design control circuits for operation of contactors at 230V. SIze control circuit wiring to be at least 1.5mm² and so that voltage drop even during motor starting is never great enough to prevent correct operation of all devices served.

343 3Control relays

Install control relays of the plug-in type which shall conform to BS EN 55014-1 and BS 5992 with contacts rated for operation up to 230V, 5A, 50Hz.

Enclose control relays in dust proof covers.

Y72 CONTROL PANELS, MOTOR STARTERS AND CONTROLLERS

344 Control switches

Provide front panel rotary switches for the following duties:

- single speed, single motor drives: HAND/OFF/AUTO.
- two-speed motor drives: HIGH SPEED/LOW SPEED/OFF/AUTO
- motor drives with Duty 1 and Duty 2 motors: DUTY 1/DUTY 2 selector switch for use when the motors are in hand control with HAND/OFF/AUTO selector switches for each drive

Arrange for all selector switches serving plant subject to AUTO control to have auxiliary contacts to signal to the building management system when the drives are in auto control.

345 Lamp indications

Provide indicator lamps of uniform luminance and a viewing angle in excess of 120 degrees for the following functions for each drive served:

- RUN: Green Lamp
- TRIPPED: Red Lamp
- PANEL LIVE (EACH SECTION): White Lamp
- SUPPLY ON (PACKAGED PLANT): White Lamp

Install LED indicator lamps powered by extra low voltage drivers with integral current limiting functionality and reverse polarity protection. Provide a push-to-test facility. Ensure LEDs are replaceable without the use of special tools and are of an industry standard size and fitting.

346 Panel labels for information and warning

Fix permanent engraved labels to all panels to provide information and warning to suitably qualified persons carrying out operation and maintenance:

- a label indicating the function of each switch and lamp indication
- a label on each openable panel door reading: "WARNING - ISOLATE PANEL BEFORE MAINTENANCE". In addition, a self-adhesive warning label is to be fixed to each door giving access to 400 volt circuits
- a key diagram showing the source and identification of all power supplies entering a panel, their function and means of isolation

347 Motor isolation

Provide all motor drives with local isolators for safe mechanical and electrical maintenance of the drives served, including motor drives within packaged plant.

Install isolators with metal cases, protected to IP54 and with early-break contacts to trip the drive starters where assisted start is provided.

Fit a permanent engraved label near each motor drive to read: "ISOLATE MOTOR BEFORE MAINTENANCE".

348 Stand-alone motor starters

Mount stand-alone motor starters in type-tested steel enclosures protected to IP54.

Equip the starters with the following equipment and controls as appropriate:

- panel isolating switch
- ammeter

- ~ HAND/ OFF/ AUTO and SPEED control switch
- ~ Motor Run (Green) and Trip (Red) indicating lamps
- ~ motor starter
- ~ labels and warning notices

Ensure that it is possible to measure motor current safely with a suitable clip-on ammeter for commissioning purposes.

349 Electromagnetic interference

Install measures to prevent electromagnetic interference with control panel operation and to prevent electromagnetic interference from control panels affecting other electrical equipment. Measures likely to be required include:

- ~ supply motor control panels direct from the main LV switchboard
- ~ wire control systems in twisted pair cable. Segregate control cables from mains cables in accordance with BS 7671
- ~ use armoured cables for power circuits and full-size neutral conductors
- ~ fit voltage surge suppression devices to mineral insulated cables, relay and contactor operating coils and vulnerable electronic equipment
- ~ fit input and output harmonic filters to electronic inverters and motor soft starters
- ~ use of manufacturer’s recommended cable for inverter motor feed cable

400 FIXING TO BUILDING ‘FABRIC’

Comply with section Y90 of this specification.

500 IDENTIFICATION OF ELECTRICAL SERVICES

Comply with section Y82 of this specification.

600 INSPECTION, TESTING AND COMMISSIONING

Comply with specification section Y81.

Before dispatch undertake verification by testing to BS EN 61439. Provide documentation of all verification undertaken to BS EN 61439to the Contract Administrator.

Allow time in the programme and attendance for the Contract Administrator to inspect the control panels, before delivery, at the maker's works on completion of manufacture and test. Give ten working days’ notice of readiness for inspection.

Ensure that the panels are clean of debris and that all holes are properly sealed.

Check the functioning of all components and controls for correct operation including the correct functioning of all interfaces with associated equipment. Immediately rectify all mal-function and re-check to confirm correct operation. Measure and record power wiring insulation and earth fault loop impedance.

Following installation on site and completion of all site tests, allow programme time and provide attendance for the Contract Administrator to inspect the installation and to verify test results.

Arrange for special units, such as variable frequency inverters, to be checked and commissioned by the manufacturers, or according to the makers' specific instructions for the units fitted.

Measure and record all motor currents. Set motor overloads to motor nameplate full load currents. Note that star/delta starters normally have overloads installed in the delta load and set to full load current x 0.58

Ensure that during commissioning and testing, no motor that has reached normal operating temperature is started more frequently than twice in one hour, or according to motor manufacturer's recommendations if different.

700 RECORD DRAWINGS, OPERATION AND MAINTENANCE MANUALS

Provide three copies of the following documents bound into durable hardback folders:

- ~ description of equipment operation
- ~ schematic and wiring diagrams and panel general arrangement drawings
- ~ inspection and test certificates
- ~ data sheets and manufacturers' addresses for all panel components
- ~ recommended spares list
- ~ schedule of recommended periodic inspection and maintenance, including safety precautions

800 SCHEDULE OF INSTALLER'S SUBMISSIONS

Submit the following drawings and documents in connection with the motor starters and controllers specified above.

- ~ control panel and assemblies verification documentation to BS EN 61439
- ~ details of discrimination studies and cable sizing calculations
- ~ control panel schematic and general arrangement drawings
- ~ details of control panel construction and finish
- ~ details of control panel labels and key diagrams
- ~ control panel works test certificates
- ~ control panel site testing and commissioning results
- ~ control panel record drawings and operation & maintenance manuals
- ~ details of proposed soft starter, and variable frequency drive

END OF SECTION Y72

Y73 LUMINAIRES AND LAMPS

CONTENTS

Y73 LUMINAIRES AND LAMPS

IMPORTANT NOTICE

Not all of the lamp types included in this reference specification may be appropriate to the project. Refer to the individual system specifications and the luminaire schedule for particular project requirements.

100 REFERENCE DOCUMENTS

This specification is written based on legislation, standards and guidance in force in the UK generally, and within England by default. For projects in Scotland, Wales, Northern Ireland, the Channel Islands and the Isle of Man, give appropriate consideration to any locally applicable legislation, standards and guidance that deviates from or is additional to those in force within England. Similarly for projects outside the UK comply with the corresponding national legislation, standards and guidance.

Comply fully with the edition (including amendments, replacements and associated normative references) of each of the following, current at the time of tender.

Where a standard referred to in this section conflicts with a standard referred to in an associated 'engineering system' section (eg S10, T31, V21, etc) of this specification, the standard referred to in the engineering system section prevails.

BS 67	Specification for ceiling roses
BS 476-20	Fire tests on building materials and structures. Method for determination of the fire resistance of elements of construction (general principles)
BS 559	Specification for the design and construction of signs for publicity, decorative and general purposes
BS 1362	Specification for general purpose fuse links for domestic and similar purposes (primarily for use in plugs)
BS 1363	13 A fused plugs, socket-outlets, adaptors and connection units
BS 1853-2	Tubular fluorescent lamps for general lighting service. Specification for lamps used in the United Kingdom not included in BS EN 60081, BS EN 60901, BS EN 61195 and BS EN 61199
BS 4533-102.19	Luminaires. Particular requirements. Specification for air-handling luminaires (safety requirements)
BS 5266-1	Emergency lighting. Code of practice for the emergency lighting of premises
BS 5499-4	Safety signs. Code of practice for escape route signing
BS 5733	General requirements for electrical accessories. Specification.
BS 6972	Specification for general requirements for luminaire supporting couplers for domestic, light industrial and commercial use
BS 7211	Electric cables. Thermosetting insulated and thermoplastic sheathed cables for voltages up to and including 450/750 V, for electric power and lighting and having low emission of smoke and corrosive gases when affected by fire
BS 7629-1.	Electric cables. Specification for 300/500 V fire resistant, screened, fixed installation cables having low emission of smoke and corrosive gases when affected by fire. Multicore cables
BS 7671	Requirements for Electrical Installations. IET Wiring Regulations
BS 7693	Guide to uses of infra-red transmission and the prevention or control of interference between systems
BS 7895	Specification for bayonet lamp holders with enhanced safety

BS 8519	Selection and installation of fire-resistant power and control cable systems for life safety and fire-fighting applications
BS 9999	Fire safety in the design, management and use of buildings
BS EN 40-1	Lighting columns. Definitions and terms
BS EN 40-2	Lighting columns. General requirements and dimensions
BS EN 40-3-1	Lighting columns. Design and verification. Specification for characteristic loads
BS EN 40-3-2	Lighting columns. Design and verification. Verification by testing
BS EN 40-3-3	Lighting columns. Design and verification. Verification by calculation
BS EN 40-4	Lighting columns. Requirements for reinforced and prestressed concrete lighting columns
BS EN 40-5	Lighting columns. Requirements for steel lighting columns
BS EN 40-6	Lighting columns. Requirements for aluminium lighting columns
BS EN 40-7	Lighting columns. Requirements for fibre reinforced polymer composite lighting columns
BS EN 81-71	Safety rules for the construction and installation of lifts. Particular applications to passenger lifts and goods passenger lifts. Vandal resistant lifts
BS EN 12193	Light and lighting. Sports lighting
BS EN 12464-1	Light and lighting. Lighting of work places. Indoor work places
BS EN 12464-2	Light and lighting. Lighting of work places. Outdoor work places
BS EN 13032-1	Light and lighting. Measurement and presentation of photometric data of lamps and luminaires. Measurement and file format
BS EN 13032-2	Light and lighting. Measurement and presentation of photometric data of lamps and luminaires. Presentation of data for indoor and outdoor work places
BS EN 13032-3	Measurement and presentation of photometric data of lamps and luminaires. Presentation of data for emergency lighting of work places
BS EN 13032-4	Light and lighting. Measurement and presentation of photometric data of lamps and luminaires. LED lamps, modules and luminaires
BS EN 50107-1	Signs and luminous-discharge-tube installations operating from a no-load rated output voltage exceeding 1 kV but not exceeding 10 kV. General requirements
BS EN 50107-2	Signs and luminous-discharge-tube installations operating from a no-load rated output voltage exceeding 1 kV but not exceeding 10 kV. Requirements for earth-leakage and open-circuit protective devices
BS EN 50107-3	Product standard covering luminous signs with discharge lamps and/or LED (light emitting diodes) and/or EL (electroluminescent) lightsources with a nominal voltage not exceeding 1000 V, with the exclusion of general lighting, traffic- or emergency related purpose.
BS EN 50525 (All Parts)	Electric cables - Low voltage energy cables of rated voltages up to and including 450/750 V
BS EN 62931:	GX16t-5 capped tubular ledLED lamp. Safety specifications
BS EN 55014-1	Electromagnetic compatibility. Requirements for household appliances, electric tools and similar apparatus. Emission

BS EN 55014-2	Electromagnetic compatibility. Requirements for household appliances, electric tools and similar apparatus. Immunity. Product family standard
BS EN 55015	Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment
BS EN 60061-1	Lamp caps and holders together with gauges for the control of interchangeability and safety. Lamp caps
BS EN 60061-2	Lamp caps and holders together with gauges for the control of interchangeability and safety. Lampholders
BS EN 60061-3	Lamp caps and holders together with gauges for the control of interchangeability and safety. Gauges
BS EN 60061-4	Lamp caps and holders together with gauges for the control of interchangeability and safety. Guidelines and general information
BS EN 60064	Tungsten filament lamps for domestic and similar general lighting purposes. Performance requirements
BS EN 60079-0	Explosive atmospheres. Equipment. General requirements
BS EN 60079-1	Explosive atmospheres. Equipment protection by flameproof enclosures "d"
BS EN 60079-2	Explosive atmospheres. Equipment protection by pressurized enclosure "p"
BS EN 60079-5	Explosive atmospheres. Equipment protection by powder filling "q"
BS EN 60079-6	Explosive atmospheres. Equipment protection by liquid immersion "o"
BS EN 60079-7	Explosive atmospheres. Equipment protection by increased safety "e"
BS EN 60079-10-1	Explosive atmospheres. Classification of areas. Explosive gas atmospheres
BS EN 60079-10-2	Explosive atmospheres. Classification of areas. Explosive dust atmospheres
BS EN 60079-11	Explosive atmospheres. Equipment protection by intrinsic safety "i"
BS EN 60079-13	Explosive atmospheres. Equipment protection by pressurized room "p" and artificially ventilated room “v”
BS EN 60079-14	Explosive atmospheres. Electrical installations design, selection and erection
BS EN 60079-15	Explosive atmospheres. Equipment protection by type of protection "n"
BS EN 60079-17	Explosive atmospheres. Electrical installations inspection and maintenance
BS EN 60079-18	Explosive atmospheres. Equipment protection by encapsulation "m"
BS EN 60079-20-1	Explosive atmospheres. Material characteristics for gas and vapour classification. Test methods and data
BS EN 60079-25	Explosive atmospheres. Intrinsically safe electrical systems
BS EN 60079-26	Explosive atmospheres. Equipment with Equipment Protection Level (EPL) Ga
BS EN 60079-28	Explosive atmospheres. Protection of equipment and transmission systems using optical radiation
BS EN 60079-31	Explosive atmospheres. Equipment dust ignition protection by enclosure "t"
BS EN 60079-32-2	Explosive atmospheres. Electrostatics hazards. Tests
BS EN 60081	Double-capped fluorescent lamps. Performance specifications
BS EN 60188	High-pressure mercury vapour lamps. Performance specifications
BS EN 60192	Low pressure sodium vapour lamps. Performance specification
BS EN IEC 60238	Edison screw lampholders

BS EN 60357	Tungsten halogen lamps (non-vehicle). Performance specifications
BS EN 60400	Lampholders for tubular fluorescent lamps and starterholders
BS EN 60529	Degrees of protection provided by enclosures (IP code)
BS EN 60570	Electrical supply track systems for luminaires
BS EN 60598-1	Luminaires. General requirements and tests
BS EN 60598-2-2	Luminaires. Particular requirements. Recessed luminaires
BS EN 60598-2-3	Luminaires. Particular requirements. Luminaires for road and street lighting
BS EN 60598-2-5	Luminaires. Particular requirements. Floodlights
BS EN 60598-2-6	Luminaires. Particular requirements. Luminaires with built-in transformers for filament lamps
BS EN 60598-2-11	Luminaires. Particular requirements. Aquarium luminaires
BS EN 60598-2-13	Luminaires. Particular requirements. Ground recessed luminaires
BS EN 60598-2-14	Luminaires. Particular requirements. Luminaires for cold cathode tubular discharge lamps (neon tubes) and similar equipment
BS EN 60598-2-18	Luminaires. Particular requirements. Luminaires for swimming pools and similar applications
BS EN 60598-2-20	Luminaires. Particular requirements. Lighting chains
BS EN 60598-2-21	Luminaires. Particular requirements. Rope lights
BS EN 60598-2-22	Luminaires. Particular requirements. Luminaires for emergency lighting
BS EN 60598-2-23	Luminaires. Particular requirements. Extra low voltage lighting systems for filament lamps
BS EN 60598-2-24	Luminaires. Particular requirements. Luminaires with limited surface temperatures
BS EN 60598-2-25	Luminaires. Particular requirements. Luminaires for use in clinical areas of hospitals and health care buildings
BS EN 60630	Maximum lamp outliners for incandescent lamps
BS EN 60730-2-3	Automatic electrical controls for household and similar use. Particular requirements for thermal protectors for ballasts for tubular fluorescent lamps
BS EN 60838-1	Miscellaneous lamp holders. General requirements and tests
BS EN 60838-2-1	Miscellaneous lampholders. Particular requirements. Lampholders S14
BS EN 60838-2-2	Miscellaneous lampholders. Particular requirements. Connectors for LED-modules
BS EN 60838-2-3	Miscellaneous lampholders. Particular requirements. Lampholders for double-capped linear LED lamps
BS EN 60901	Single-capped fluorescent lamps. Performance specifications
BS EN 60921	Ballasts for tubular fluorescent lamps. Performance requirements
BS EN 60923	Auxiliaries for lamps. Ballasts for discharge lamps (excluding tubular fluorescent lamps). Performance requirements
BS EN 60927	Auxiliaries for lamps. Starting devices (other than glow starters). Performance requirements
BS EN 60929	AC and/or DC-supplied electronic control gear for tubular fluorescent lamps. Performance requirements

BS EN 60947 (All Parts)	Low-voltage switchgear and control gear
BS EN 60968	Self-ballasted lamps for general lighting services. Safety requirements
BS EN 60969	Self-ballasted lamps for general lighting services. Performance requirements
BS EN 61000-3-2	Electromagnetic compatibility (EMC). Limits. Limits for harmonic current emissions (equipment input current up to and including 16 A per phase)
BS EN 61000-4-5	Electromagnetic compatibility (EMC): Testing and measurement techniques – Surge immunity test
BS EN 61047	D.C. or A.C. supplied electronic step-down convertors for filament lamps. Performance requirements
BS EN 61048	Auxiliaries for lamps. Capacitors for use in tubular fluorescent and other discharge lamp circuits. General and safety requirements
BS EN 61049	Specification for capacitors for use in tubular fluorescent and other discharge lamp circuits. Performance requirements
BS EN 61050	Specification for transformers for tubular discharge lamps having a no-load output voltage exceeding 1000 V (generally called neon-transformers). General and safety requirements
BS EN 61184	Bayonet lampholders
BS EN 61195	Double-capped fluorescent lamps. Safety specifications
BS EN 61199	Single-capped fluorescent lamps. Safety specifications
BS EN 61347-1	Lamp controlgear. General and safety requirements
BS EN 61347-2-1	Lamp controlgear. Particular requirements for starting devices (other than glow starters)
BS EN 61347-2-2	Lamp controlgear. Particular requirements for d.c. or a.c. supplied electronic step-down convertors for filament lamps
BS EN 61347-2-3	Lamp control gear. Particular requirements for a.c. and/or d.c. supplied electronic control gear for fluorescent lamps
BS EN 61347-2-7	Lamp controlgear. Particular requirements for battery supplied electronic controlgear for emergency lighting (self-contained)
BS EN 61347-2-8	Lamp controlgear. Particular requirements for ballasts for fluorescent lamps
BS EN 61347-2-9	Lamp controlgear. Particular requirements for electromagnetic controlgear for discharge lamps (excluding fluorescent lamps)
BS EN 61347-2-10	Lamp controlgear. Particular requirements for electronic invertors and convertors for high-frequency operation of cold tubular discharge lamps (neon tubes)
BS EN 61347-2-11	Lamp controlgear. Particular requirements for miscellaneous electronic circuits used with luminaires
BS EN 61347-2-12	Lamp controlgear. Particular requirements for d.c. or a.c. supplied electronic ballasts for discharge lamps (excluding fluorescent lamps)
BS EN 61347-2-13	Lamp controlgear. Particular requirements for d.c. or a.c. supplied electronic controlgear for LED modules
BS EN 61535	Installation couplers intended for permanent connection in fixed installations
BS EN 61547	Equipment for general lighting purposes. EMC immunity requirements

BS EN 61558-1	Safety of power transformers, power supplies, reactors and similar products. General requirements and tests
BS EN 61558-2-1	Safety of power transformers, power supplies, reactors and similar products. Particular requirements and tests for separating transformers and power supplies incorporating separating transformers for general applications
BS EN 61558-2-6	Safety of transformers, reactors, power supply units and similar products for supply voltages up to 1100 V. Particular requirements and tests for safety isolating transformers and power supply units incorporating safety isolating transformers
BS EN 62031	LED modules for general lighting. Safety specifications
BS EN 62035	Discharge lamps (excluding fluorescent lamps). Safety specifications
BS EN 62262	Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)
BS EN 62384	DC or AC supplied electronic control gear for LED modules. Performance requirements
BS EN IEC 62386-207	Digital addressable lighting interface. Particular requirements for control gear. LED modules (device type 6)
BS EN IEC 62442-3	Energy performance of lamp controlgear. Controlgear for tungsten-halogen lamps and LED light sources. Method of measurement to determine the efficiency of controlgear
BS EN 62471	Photobiological safety of lamps and lamp systems
BS EN 62504	General lighting. Light emitting diode (LED) products and related equipment. Terms and definitions
BS EN 62560	Self-ballasted LED-lamps for general lighting services by voltage > 50V. Safety specifications
BS EN 62612	Self-ballasted LED lamps for general lighting services with supply voltages > 50V. Performance requirements
BS EN 62707-1	LED-binning. General requirements and white colour grid
BS EN 62717	LED modules for general lighting. Performance requirements.
BS EN 62722-1	Luminaire performance. General requirements
BS EN 62722-2-1	Luminaire performance. Particular requirements for LED luminaires
BS EN 62776	Double-capped LED lamps designed to retrofit linear fluorescent lamps. Safety specifications.
BS EN ISO 7010	Graphical symbols. Safety colours and safety signs. Registered safety signs.
BS EN ISO 9241	Ergonomics of human-system interaction
BS ISO 3864-1	Graphical symbols. Safety colours and safety signs. Design principles for safety signs and safety markings
ICEL 1001	Scheme of product and authenticated photometric data registration for emergency lighting luminaires and conversion modules
ICEL 1004	The requirements for the re-engineering of luminaires for emergency lighting use
IEC 62717	LED Modules for general lighting. Performance Requirements
IESNA LM-79-08	Approved Method: Electrical and Photometric Measurement of Solid-State Lighting Products

IESNA LM-80-15	Approved Method: Measuring Luminous Flux and Colour Maintenance of LED Packages, Arrays and Modules
IESNA TM-21-11	Projecting Long Term Lumen Maintenance of LED Light Sources

200 PRODUCTS AND MATERIALS

210 Luminaires

211 General

Ensure that all luminaires comply with all relevant British Standards.

Ensure that all luminaires are suitable for the location and environment in which they are to be installed.

Supply, erect, and connect all luminaires complete with all associated components including glassware, diffusers, lamps, appropriate control-gear and gasket seals, in the positions shown on the drawings and/or described in sections V21, V40, V41 and V42 of this specification.

Supply operating manuals, maintenance instructions and parts manuals for all luminaires. Ensure that these documents provide maintenance and care data including periodic and preventative maintenance procedures and intervals, expected lifetime, diagnostic procedures and complete ordering information and sources for all parts provided.

Fit luminaires with cover glass to protect against ultra-violet emissions and risk of explosion from lamps where appropriate.

Provide, where appropriate, secondary support for translucent covers, diffusers and gear trays to prevent them from falling when the primary fixing is released.

Ensure that, for each luminaire type supplied, the manufacturer confirms that their published photometric performance data is within the tolerances defined by BS EN 13032.

Provide only luminaires that comply with BS EN 61547 for EMC immunity.

Ensure that luminaires have sufficient physical protection to satisfy BS EN 60529 and BS EN 62262.

Where luminaires are supported directly from the ceiling T-bar grid, ensure adequate additional fixings are provided by the ceiling installer to support the entire weight of every such luminaire and its attachments, without causing any distortion to the ceiling line or level. In addition, provide a direct single fixing from the body of every such luminaire to the structure, using galvanised steel chain and hook backplates.

Ensure that ceiling- and wall-mounted luminaires, where installed to plasterboard surfaces, are fixed via conduit boxes installed flush with the ceiling/wall face, with the conduit boxes supported directly from the conduit/trunking system or structure.

Liaise as necessary with the luminaire and ceiling tile manufacturer, together with the ceiling installer, to ensure compatibility between the luminaire and the ceiling systems for proper installation.

Ensure all recessed luminaires maintain the ceiling fire barrier rating and integrity of the respective fire compartment or area. Provide proprietary fire rated canopies for recessed luminaires where necessary.

Ensure luminaires specified with thermoplastic diffusers comply with Category TP(a), as defined in the Building Regulations. Provide copies of manufacturer’s test certificates to verify compliance.

Ensure that all suspended luminaires utilise proprietary ‘cable drop’ accessories for final connection.

Ensure that all flexible cords are effectively secured at each termination point by the use of proprietary cord anchors on the outer sheath.

Ensure that every luminaire is accurately aligned, to fit flush and square against adjacent/abutting structures or surfaces, to provide a neat straight and true appearance in their relation to the building structure.

Set out the lighting system installation in accordance with the co-ordinated reflected ceiling plan drawings and the Architect's detailed room loaded layout drawings. Check the positions of all windows, door swings, roof lights and fitments etc., before commencing the installation of the lighting system.

Ensure luminaires fully comply with the following:

~ manufactured to meet the requirements of BS EN 60598

~ manufactured to provide Class 1 protection against electric shock

~ protected to an ingress class, as referred to in BS EN 60598, of IP 20 minimum

~ suitable for operation at 230V, 50Hz, SP&N

~ manufactured to meet the requirements of the appropriate electromagnetic compatibility (EMC) Directive of the European Council and appropriately CE marked

Supply all luminaires complete with a fused terminal block to BS 1363.

Ensure all low voltage tungsten halogen or LED luminaires are each provided with an individual 230/12V transformer/driver as appropriate. Secure every such transformer/driver to the building structure; do not allow them to rest on false ceilings.

Provide all luminaires with high frequency (HF) control gear unless stated otherwise on the drawings or in this specification.

Do not permit luminaires that are fixed to, or recessed into, suspended ceilings, to have their weight borne by the ceiling unless written acceptance is obtained from the Contract Administrator.

Suspend luminaires from the structure or from false ceiling support beams using steel strapping, circular steel suspension, or proprietary fixing methods. Use at least two fixings for luminaires up to 300 mm wide and four fixings for sizes over 300 mm wide.

Supply and fix all materials for fixing and suspending the luminaires, from the building structure, building fabric, or system of beams provided by others for the support of false ceilings and/or other services or equipment, unless specified otherwise.

Ensure that the luminaire backplate fully covers the conduit box in concealed installations. Use white break joint rings where the conduit boxes cannot be concealed by the luminaire backplate.

Do not use luminaires for through-wiring unless the luminaire is specifically designed for that purpose and incorporates a segregated wiring channel.

Ensure there is suitable strain relief via clamping of the supply wiring's sheath or strain relief lugs, for every luminaire.

Ensure that the lighting and lighting control system does not undermine the sound pressure levels set by the acoustic brief, the architectural specification, and the project design criteria. Additionally, ensure that the sound power levels associated with any luminaire or luminaire control device located within areas other than equipment spaces, are not of a magnitude such that they cause any noise perceptible against the ambient conditions. Ensure no lighting or lighting control device emits a sound power level of greater than 10dB below the room sound pressure level stated in the design criteria.

Ensure that all luminaires are individually power factor corrected. Use shunt connected capacitors to achieve a power factor greater than 0.95 for fluorescent luminaires, and greater than 0.85 for other discharge luminaires. Ensure LED luminaires' power factor (including both driver and light source) is greater than 0.9.

Before installing any luminaire ensure that it is appropriately selected for all aspects including: the type of installation, the location in which it is installed, the ceiling void size, the ceiling type (including tee section size) and the lamp voltage.

Provide an assembly of luminaire and exhaust air device or luminaire and supply air device to meet the design requirements for illumination and air flow. Ensure that every such assembly can be integrated and flush-mounted into the associated false ceiling. Ensure that the fixing is capable of carrying the weight of the whole assembly.

Where specified, incorporate a path for exhaust air in the diffuser. Provide an outlet for the air either by a series of circular openings in the top of the assembly or by a circular spigot for direct connection to extract or exhaust ducting.

Ensure that the acrylic diffusers are 100 percent virgin acrylic plastic and have a high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation. The lens thickness to be a minimum of 3mm

Ensure that the glass diffusers are annealed crystal glass unless otherwise indicated.

Ensure that the aluminium diffusers or reflectors consist of high quality aluminium with shape surface finish that is in accordance with the photometric data published for the luminaire.

212 Emergency lighting luminaires

Ensure that all emergency lighting luminaires comply with BS EN 60598, BS EN ISO 7010 and BS ISO 3864-1.

Comply with ICEL 1001. Ensure that emergency lighting luminaires are marked with the ICEL certification labels.

Ensure that luminaires comply with ICEL 1004.

213 Exit signs

Ensure that exit signs comply with BS EN ISO 7010 and BS ISO 3864-1.

214 Hazardous area luminaires

Comply with the following standards:

~ BS EN 60079

~ BS EN 60598

215 Signs and high voltage installations

Ensure that signs and high voltage installations comply with BS 559 and BS EN 50107-1.

Ensure that neon transformers comply with BS EN 61050.

220 Lampholders

221 General

Comply with the following standards:

~ lamp caps - BS EN 60061-1

~ lamp holders - BS EN 60061-2

~ lamp holders with enhanced safety features – BS 7895

~ bayonet lampholders – BS EN 61184

~ lampholders for tubular fluorescent lamps and starter holders – BS EN 60400

- ~ Edison screw lampholders – BS EN 60238

Ensure that lampholders in luminaires of similar type and rating are identical.

Ensure that metal lampholders incorporate an earthing terminal.

222 Tungsten and equivalent fittings

Provide a shade carrier ring for separately mounted lampholders for GLS tungsten filament lamps.

Ensure that the phase conductor is connected to the centre contact of Edison screw lampholders.

223 Mounting

Securely mount the lampholder in the luminaire when it is the sole support for the lamp.

Provide integral cord grips when lampholders are suspended by cord.

When mounted directly to conduit systems use a backplate lampholder for the conduit box.

230 Control-gear and components

Ensure that control-gear and components are suitable for the lamp type, wattage and starting characteristics.

Ensure that the selected control-gear has a current in-rush characteristic that both singularly and cumulatively with others, does not exceed 80% of the withstand capability of the least rated device in the circuit.

231 Fluorescent lamp ballasts and starters

Ensure that electronic control gear is used wherever possible.

Ensure that fluorescent lamp ballasts and starters comply with the following standards:

Ballasts:

- ~ BS EN 61347
- ~ BS EN 60921
- ~ BS EN 60929 for fluorescent lamps to BS EN 60081 and BS EN 60901
- ~ BS EN 60730-2-3 for ballasts for tubular fluorescent lamps

Starters:

- ~ BS EN 61347
- ~ BS EN 60927

Use low distortion ballast lumen factor 0-15 or greater.

232 Discharge lamp ballasts and starters

Ensure that discharge lamp ballasts and starters comply with the following standards:

- ~ BS EN 61347
- ~ BS EN 60923 for ballasts
- ~ BS EN 60927 for starters

233 Capacitors

Use capacitors in accordance with BS EN 61048 and BS EN 61049 in tubular fluorescent, high pressure mercury and low pressure sodium vapour discharge lamp circuits.

234 Supply terminals

Use screw terminals for supply cables and circuit protective conductors, each sized to terminate up to three 2.5mm^2 conductors. Provide separate terminal blocks for each incoming circuit, with marking to identify each circuit.

235 Fuse

Include a fuse holder and BS 1362 fuse in each incoming circuit phase connection.

236 Interference

Comply with BS EN 55015.

237 Remote gear

Locate controlgear in a separate enclosure with the same degree of protection and finish as that specified for the luminaire. Comply with the luminaire manufacturer’s recommendations for maximum cable length between gear and lamp.

240 Lamps

241 Tungsten filament and equivalent lamps

Ensure that tungsten filament lamps comply with BS EN 60064, BS EN 60432-1 and BS EN 60630.

Supply electronic step-down converters for filament lamps to BS EN 61347 and BS EN 61047.

242 Fluorescent lamps

Ensure that fluorescent lamps comply with the following standards:

- ~ BS 1853-2 for UK tubular lamps
- ~ BS EN 60901 and BS EN 61199 for single capped lamps
- ~ BS EN 60081 and BS EN 61195 for double capped lamps
- ~ BS EN 60969 and BS EN 60968 for self-ballasted lamps

243 Tungsten halogen lamps

Ensure that tungsten halogen lamps comply with BS EN 60357 and BS EN 60432-2.

244 High pressure mercury vapour lamps

Ensure that high pressure mercury vapour lamps comply with BS EN 60188 and BS EN 62035.

245 Metal halide lamps

Ensure that metal halide lamps comply with BS EN 62035.

246 High pressure sodium vapour lamps

Ensure that high pressure sodium vapour lamps comply with BS EN 62035.

247 Low pressure sodium vapour lamps

Ensure that low pressure sodium vapour lamps comply with BS EN 60192.

248 Transformers for low voltage (LV) luminaires

Ensure that transformers comply with the following standards:

- ~ BS EN 55014
- ~ BS EN 61547
- ~ BS EN 61347

~ BS EN 61047

~ BS EN 61558

Ensure that transformers are each housed in a sheet steel casing with a demountable lid. Ensure that each such unit has a primary anti-surge fuse and secondary fuse, and that each output to the luminaire is fused. Fit a thermal cut-out that has an automatic reset.

Ensure that all such transformers have soft-start characteristics (0.5 to 1.0 second ramp-up, run-in silent operation), and have an automatically regulated secondary voltage.

Locate transformers in well ventilated areas that are easily accessible.

Where dimming transformers are used, obtain the luminaire manufacturer’s written assurance that the transformer is compatible with the luminaire.

249 Lamp manufacturer

Ensure that lamps of the same type are obtained from the same manufacturer.

250 Support systems

251 Conduit

Use conduit of the same type as that used for the lighting system, and diameter no less than 20mm.

252 Rod

Use continuously threaded rods made from bright zinc-plated steel with matching washers and nuts.

253 Chain

Use bright zinc-plated steel chain with load-carrying capacity of not less than twice the weight of the complete luminaire.

254 Flexible cord

Ensure that the temperature rating of the flexible cord is suitable for the operating temperature of the luminaire or lampholder. Ensure that every such cord is adequate for the mass that it supports.

255 Wall bracket

Ensure that every wall bracket is suitable for supporting the associated luminaire.

256 Ball and socket

Provide ball and socket as the top support, complete with cover fixed to a circular conduit box.

257 Columns and bollards

Ensure that columns and bollards comply with BS EN 40.

260 Accessories

261 Lighting track

Where indicated on the drawings or in the schedules, or in section V21 or V42 of this specification, provide track for fixing luminaires in accordance with BS EN 60570.

262 Integral photo-cell

Incorporate an integral photo-cell on each luminaire where indicated on the drawings or in the schedules.

270 Light emitting diodes (LED)

271 LED luminaires

Ensure that LED luminaires comply with the general and safety requirements of BS EN 62031.

Ensure that the LED luminaire product data is presented in accordance with BS EN 62722-2-1.

Ensure that the complete LED luminaire is tested in accordance with IESNA LM-79-08 and absolute photometry is conducted in accordance with this method.

Ensure the lumen output of the luminaire complies with the requirements indicated in the luminaire schedule and the luminaire performance is rated for the ambient temperature in which it will operate.

Ensure the maintained luminous flux at 25% of lumen maintenance life up to a maximum of 6000 hours is greater than 90% of the initial lumen output.

Ensure the drive current and junction operating temperatures are in accordance with the LED manufacturer's requirements.

Ensure cooling is achieved by passive heat sinks integral to the luminaire. Do not utilise luminaires with active cooling.

For standard white light applications ensure colour variance is within a 3-step MacAdam ellipse initially and also within a 3-step MacAdam ellipse through lumen maintenance.

For wall-washers, museum lighting and other white light applications where visual appearance is critical, as specified in the luminaire schedule, ensure colour variance is within a 2-step MacAdam ellipse initially and within a 3-step MacAdam ellipse through lumen maintenance.

Ensure luminaires are CE and ENEC marked.

272 LED modules

Ensure that LED modules comply with the general and safety requirements of BS EN 62031.

Ensure that the LED module product data is presented in accordance with IEC 62717.

Ensure that the lumen maintenance of the LEDs within the luminaire is tested in accordance with IESNA LM-80-15.

Meet or exceed the lumen maintenance life specified in the luminaire schedule, ensuring that the declared lumen maintenance life of the LED package, array or module is extrapolated in accordance with IESNA TM-21-11.

Ensure that the minimum performance of the LED module complies with the following

Minimum luminaire efficacy	90 lumens/watt
Minimum colour rendering index(CRI)	65
Minimum LLD at 100 000 hours at 25ºC	0.85

273 LED lamps

Ensure that self-ballasted LED lamps with voltage >50V comply with:

- ~ Safety requirements of BS EN 62560
- ~ Performance requirements of BS EN 62612
- ~ The most recent generation of LED models available

274 Electronic control gear for LED modules

Ensure that DC or AC supplied electronic control gear for LED Modules complies with the performance requirements of BS EN 62384.

Ensure that the minimum performance of the control gear complies with the following

Total harmonic distortion	<20%
Power factor	>0.9
Operating temperature range	-40ºC to +40ºC for all electrical components in the luminaire including the LED engines/modules, drivers and surge devices
Voltage fluctuations	+/- 10%
Dimming control	Integrated capability when specified using an external 0 - 10V DC control signal
Operating lifetime	At least L80 of 50,000 hours
Efficiency	>80%

300 WORKMANSHIP

310 General

Install luminaires complete and as indicated on the drawings or in the schedules. Unless otherwise stated, install luminaires plumb, square, and level with ceilings and walls, and in alignment with adjacent lighting fixtures.

Do not use the permanent lighting installation for temporary lighting purposes during the contract period unless prior written acceptance is obtained from the Contract Administrator. Where such acceptance is given, and the luminaires are not LED, provide new lamps at the handover for the employer's use.

Fix every surface-mounted luminaire to a conduit box (or boxes) that has a porcelain screw type connector.

Fix all luminaires and pendants with brass roundhead screws.

Provide all pendant luminaires with a suspension system and an associated flexible cable to a minimum length of 600 mm unless otherwise defined in section V21, V40, V41 or V42 of this specification.

Connect all metalwork on luminaires to the circuit protective conductor with proper and approved earthing arrangements for metalwork.

Upon completion of the installation and after circuits have been energised, apply power and demonstrate to the Contract Administrator the capability and compliance with requirements of all luminaires and circuits. Correct, or remove and replace, malfunctioning units, then re-test and demonstrate to the Contract Administrator’s satisfaction. Ensure that all lamps are fully operational; replace all failed lamps at no extra cost to the contract. When directed by the Contract Administrator, remove all temporary protective covering from luminaires.

320 Orientation

Install luminaires in the positions indicated on the drawings and in the horizontal plane, unless shown otherwise on the drawings or in the schedules.

Y73 LUMINAIRES AND LAMPS

330 Cleanliness

Ensure that all luminaires are clean and grease-free on handover. Thoroughly clean all luminaires after installation, leaving the installation in a new, clean condition at handover.

340 Installation

341 Recessed fittings

Mount fully recessed luminaires within the suspended ceiling in the positions indicated on the drawings.

Install luminaires flush with the finished surface of the associated ceiling, wall or floor into which they are fitted.

Ensure the luminaire has the correct void, as specified by the manufacturer, for the dissipation of heat. Ensure the luminaire is free of thermal insulation in all directions to a minimum distance of 100mm.

Ensure that all recessed luminaires maintain the fire barrier integrity of their respective area.

342 Semi-recessed fittings

Install luminaires in accordance with the manufacturer’s instructions to achieve the extent of recessing required.

343 Wall-mounted fittings

Install luminaires at the height indicated on the drawings or in the schedules.

344 Material supportive surface

Ensure that the fire classification of luminaires is appropriate. Do not mount luminaires on flammable surfaces.

345 Potentially explosive atmospheres

Ensure that the installation complies with BS EN 60079.

346 Areas with infra-red control systems

Install luminaires in areas with infra-red control systems or data bearers, so as not to cause a loss of service, and so as to cause minimum disturbance to the infra-red transmission system in accordance with BS 7693.

347 Signs and high voltage discharge lighting

Comply with BS 559 and BS EN 50107-1.

348 Extra-low voltage tungsten halogen lamps

Use the same wattage lamp on all luminaires fed from a common transformer. Supply each such luminaire on a common transformer, by a separate cable of the same cross-sectional area.

350 Supports

Ensure that every support is adequate for the weight of the associated luminaire.

Provide the following minimum number of supports for each luminaire longer than 600mm:

Luminaire Width (mm)	Minimum number of supports
≤ 300	2
> 300	4

Y73 LUMINAIRES AND LAMPS

351 Conduit

Where luminaires are supported from conduit, provide a conduit box forming an integral part of the lighting conduit system at each point of suspension. Ensure that all such suspensions are vertical. Use tube of the same corrosion resistance as the conduit of the lighting system.

Secure the luminaire body with back-nuts and washers where the conduit enters it.

Where the temperature of the material may exceed 60°C or the mass suspended exceeds 5 kg, do not support luminaires directly from conduit boxes made from non-metallic or heat sensitive materials.

352 Trunking

Where luminaires are supported from trunking, use proprietary clamps or brackets that are compatible with both the luminaire and the trunking.

Where the temperature of the material may exceed 60°C or the mass suspended exceeds 5 kg, do not support luminaires directly from trunking made from non-metallic or heat sensitive materials.

353 Direct fixing

Install luminaires in accordance with the manufacturer’s instructions.

354 Luminaires located in suspended ceilings

Support luminaires directly from building fabric and in accordance with the manufacturer’s instructions.

Ensure that the type of fixing is suitable for the luminaire weight and ceiling system and complies with the requirements of the luminaire manufacturer.

355 Suspension

Suspend luminaires at the height indicated on the drawings or in the schedules. Ensure that all suspensions hang vertically unless otherwise indicated.

356 Rod

Use washers, nut and lock-nut at the top and bottom of the rod. Paint cut ends with zinc-rich paint.

357 Chain

Use a ‘hook cover’ for suspension from a circular conduit box. For connection to luminaires use the luminaire manufacturer’s own chain hook but, if not available, use a hook with standard screw threaded end and secure it to the luminaire body with nuts and washers. Where indicated use captive hooks.

358 Flexible cord

Suspend cord from the ceiling rose. Ensure strain relief, via the clamping of the cord sheath, is provided at both ends.

359 Ball and socket

Install cable through ball and socket connected to the conduit box.

3510 Columns and bollards

Confirm locations with the Contract Administrator before excavation.

Mount columns or bollards on a base as recommended by the manufacturer.

Ensure columns and bollards are vertical unless otherwise indicated on the drawings or in the schedules, or in section V21, V40 or V41 of this specification.

Install a circuit protective conductor to connect the luminaire to the earthing terminal in the service compartment. Make the circuit protective conductor the same size as the live conductors. Bond the accessible metal parts of the column or bollard to the earthing terminal.

360 Connections

361 Luminaires

Use the appropriate size of grommet where cables enter through the hole in the luminaire body.

Ensure that the earthing terminal of BS EN 60598 - Class 1 luminaires is connected to the circuit protective conductor of the supply circuit.

Clip, or tie back with suitable proprietary devices, loose wiring within luminaires, at 300 mm intervals.

362 Direct to conduit

Terminate circuit wiring in a terminal block within the supporting conduit box. Use flexible cord from the terminal block to the luminaire.

Terminate circuit wiring at the supply terminals of the luminaire. Take all conductors through the same cable entry into the luminaire.

363 Direct to trunking

Terminate circuit wiring in a terminal block in an adaptable box located on the side of the trunking. Use flexible cord from the terminal block to the luminaire.

Terminate circuit wiring at the supply terminals of the luminaire. Take all conductors through the same cable entry into the luminaire.

364 Suspended from trunking

Where luminaires are suspended from trunking, secure plug-in type ceiling rose to BS 6972 and BS 5733 adjacent to, or on the side of, trunking. Terminate circuit wiring at the socket of the ceiling rose. Take flexible cord from the plug of the ceiling rose to the supply terminals of the luminaire.

365 Recessed fittings

Where luminaires are recessed in a suspended ceiling, terminate the circuit wiring at a pluggable installation connector to BS EN 61535, located not more than 500 mm from the access through the ceiling. Use flexible cord complete with corresponding pluggable installation connector to supply the terminals of the luminaire.

Ensure suitable access is provided to the pluggable installation connector either by having suitable access into the void, or providing the facility to withdraw the connector.

Where luminaires are recessed in a suspended ceiling, terminate circuit wiring in a terminal block within the conduit box.

366 MICC cables

Fix a cable gland to each luminaire and continue conductors to the supply terminals of the luminaire.

END OF SECTION Y73

Y74 ACCESSORIES FOR ELECTRICAL SYSTEMS

CONTENTS

Y74 ACCESSORIES FOR ELECTRICAL SYSTEMS

100 REFERENCE DOCUMENTS

This specification is written based on legislation, standards and guidance in force in the UK generally, and within England by default. For projects in Scotland, Wales, Northern Ireland, the Channel Islands and the Isle of Man, give appropriate consideration to any locally applicable legislation, standards and guidance that deviates from or is additional to those in force within England. Similarly for projects outside the UK comply with the corresponding national legislation, standards and guidance.

Comply fully with the edition (including amendments, replacements and normative references) of each of the following, current at the time of tender.

Where a Standard referred to in this section conflicts with a Standard referred to in an associated 'engineering system' section (eg S10, T31, V21, etc) of this specification, the Standard referred to in the engineering system section prevails.

BS 88-3	Low-voltage fuses Part 3: Supplementary requirements for fuses for use by unskilled persons (fuses mainly for household or similar applications). Examples of standardized systems of fuses A to F
BS 546	Specification. Two-pole and earthing-pin plugs, socket-outlets and socket-outlet adaptors
BS 646	Specification. Cartridge fuse-links (rated up to 5 amperes) for a.c. and d.c. service
BS 1361	Specification for cartridge fuses for a.c. circuits in domestic and similar premises
BS 1362	Specification for general purpose fuse links for domestic and similar purposes (primarily for use in plugs)
BS 1363-1	13 A plugs, socket-outlets, adaptors and connection units. Specification for rewirable and non-rewirable 13 A fused plugs
BS 1363-2	13 A plugs, socket-outlets, adaptors and connection units. Specification for 13 A switched and unswitched socket-outlets.
BS 1363-4	13 A plugs, socket-outlets, adaptors and connection units. Specification for 13 A fused connection units switched and unswitched
BS 2950	Specification. Cartridge fuse-links for telecommunication and light electrical apparatus
BS 4177	Specification for cooker control units
BS 4573	Specification for 2-pin reversible plugs and shaver socket-outlets
BS 4662	Boxes for flush mounting of electrical accessories. Requirements and test methods and dimensions
BS 5733	Specification for general requirements for electrical accessories
BS 6396	Electrical systems in office furniture and educational furniture. Specification
BS 6500	Electric cables. Flexible cords rated up to 300/350 V, for use with appliances and equipment intended for domestic, office and similar environments
BS 6991	Specification for 6/10 A two-pole weather-resistant couplers for household, commercial and light industrial equipment
BS 7071	Specification for portable residual current devices
BS 7288	Specification for socket outlets incorporating residual current devices (S.R.C.D.s)

BS 7671	Requirements for Electrical Installations. IET Wiring Regulations
BS 7895	Specification for bayonet lampholders with enhanced safety
BS 8300	Design of buildings and their approaches to meet the needs of disabled people
BS EN 55014-1	Electromagnetic compatibility. Requirements for household appliances, electric tools and similar apparatus Part 1: Emission. Product family standard
BS EN 55015	Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment
BS EN 60269	Low voltage fuses (also known as BS 88-1)
BS EN 60309-1	Plugs, socket-outlets and couplers for industrial purposes Part 1: General requirements.
BS EN 60309-2	Plugs, socket-outlets and couplers for industrial purposes Part 2: Dimensional interchangeability requirements for pin and contact-tube accessories
BS EN 60320	Appliance couplers for household and similar general purposes
BS EN 60529	Specification for degrees of protection provided by enclosures (IP code)
BS EN 60598-1	Luminaires. General requirements
BS EN 60598-2	Luminaires. Particular requirements.
BS EN 60669-1	Switches for household and similar fixed-electrical installations Part 1: General requirements
BS EN 60670-22	Boxes and enclosures for electrical accessories for household and similar fixed electrical installations Part 22: Particular requirements for connecting boxes and enclosures
BS EN 60730-2	Specification for automatic electrical controls for household and similar use Part 2: Particular requirements
BS EN 60947	Low-voltage switchgear and control gear
BS EN 61058	Switches for appliances
BS EN 61009	Residual current circuit breakers with integrated overcurrent protection for household and similar uses (RCBO's)
BS EN 61184	Bayonet lampholders
BS EN 61558	Safety of power transformers, power supply units and similar devices
Building Regulations	Approved Document Part M – Access to and use of buildings

200 LIGHTING SWITCHES

Ensure local lighting switches comply with the manufacture, rating and type as indicated in the Particular Specification or on the drawings.

Ensure lighting switches comply with the relevant BS.

Ensure switches are capable of switching the full rated inductive or resistive load, and where connected to fluorescent loads in excess of 600 Watts, use minimum 15 amp rating.

Install all switches with suitable boxes of 37 mm minimum depth with adjustable lugs to ensure switch plates are true and square where required. Fit boxes flush with wall finish and make any adjustment to depth using extension rings. Install back boxes constructed from pressed steel/PVC/pressed steel and PVC as detailed in the Particular Specification.

Ensure all switch boxes are compatible with the wiring system used and are complete with CPC terminal.

Where several switches of the same phase are required in the same position, use a multi-gang switch box to accommodate all switches on a common faceplate.

Where switches are specified for installation in situations exposed to weather or continual dampness, ensure they are of the weatherproof pattern in accordance with the relevant BS and minimum IP56 rating.

Where different phases are present at one switch location, segregate each phase in a separate compartment and cover each compartment by its own internal warning plate suitably engraved, "WARNING 400 VOLTS PRESENT".

Mount switches adjacent to the closing side of doors where possible.

300 SOCKET OUTLETS

Ensure socket outlets comply with the relevant BS, are switched and shuttered, are mounted in single-gang or multi-gang assemblies, and are of the type and rating as indicated in the Particular Specification or on the drawings.

Fit plug tops to appliances with fuses of the correct rating.

Install all socket outlets with suitable boxes of not less than 35 mm depth with adjustable lugs to ensure socket plates are true and square. Where required fit boxes flush with finished surface (eg floors, skirtings or walls) and make any adjustments to depth using extension rings. Install back boxes constructed from pressed steel/PVC/pressed steel and PVC as detailed in the Particular Specification.

Ensure all socket outlet boxes are compatible with the wiring system used and are complete with CPC terminal.

Ensure all socket outlets installed within circuits likely to serve equipment having high protective conductor currents are provided with dual earth terminals compliant with the high integrity earthing requirements of BS 7671. The dual earth terminal requirement equally relates to any non-socket outlet accessories connected to the same circuit.

Ensure cover plate finishes match the lighting switches and are flush or surface to suit the mounting box.

Ensure the earth terminal(s) of each socket is connected to the box earth terminal with a green/yellow insulated protective conductor. Do not use cover screws for earth continuity.

Ensure socket outlets are complete with indicating lamps where intended for appliances with a heating element.

Where socket outlets are specified for installation in situations exposed to weather or continual dampness, ensure they are of the weatherproof pattern in accordance with the relevant BS and minimum IP56 rating.

400 FUSED CONNECTION UNITS

Ensure these are to the relevant BS and are double-pole switched or unswitched insulated patterns with plates to match the socket outlets.

Where used as a flex outlet for an appliance, ensure they are of the flex outlet pattern with cable anchoring clamp.

Fit fuses of the correct rating.

Install fused connection units with suitable boxes of not less than 35 mm depth with adjustable lugs to ensure the connection unit are true and square. Fit boxes flush with the wall finish and make any adjustment to depth using extension rings. Install back boxes constructed from pressed steel/PVC/pressed steel and PVC as detailed in the Particular Specification.

Ensure all boxes are compatible with the wiring system used and are complete with CPC terminal.

Ensure all connection units installed within circuits serving equipment likely to introduce high protective conductor currents are provided with dual earth terminals compliant with the high integrity earthing requirements of BS 7671.

Ensure the earth terminal(s) of each connection unit is connected to the box earth terminal with a green/yellow insulated protective conductor. Do not use cover screws for earth continuity.

500 LAMPHOLDERS

Provide ceramic interiors for screw type lamps and when used in areas exposed to weather or continual dampness.

Provide brass lamp holders with ceramic interiors when integral with luminaires.

Provide lamp holders with compression cord grip with integral moulded grip.

Ensure that a suitable suspension method is provided with the lamp holder so that lamps or luminaires are not supported by the cable/termination point and cables are not under stress.

Ensure batten lamp holders are heat resistant and skirted.

Ensure metal lamp holders are effectively earthed using an earth terminal fixed to the lamp holder by the manufacturer.

Ensure low energy lamp holders have a non-standard interface.

Ensure all bayonet lamp holders are safety type unless specified otherwise.

600 CEILING ROSES

Provide ceiling roses for all lighting points with a luminaire suspended by a flexible cable without an integral mounting.

Ensure ceiling roses conform to the relevant BS, of the white insulated pattern incorporating 2, 3 or 4 terminals as necessary, and complete with cord grips.

700 LAMPS

Ensure all lamps are new at handover, allowing reasonable time for testing etc.

"Break-in" fluorescent lamps used on dimming circuits for at least forty hours.

Ensure lamps comply with the relevant BS.

800 FLEXIBLE CABLES

Use flexible cables for pendant luminaires and for final connections to equipment (fixed, or portable). Ensure these are 300/500 V grade to BS 6500, Table II, PVC insulated white circular with high conductivity tinned copper conductors of minimum size 1.0 mm^2.

Ensure the maximum mass of any suspended luminaire is 5 kg unless additional support is provided.

Use heat resistant flexible cables for all non-pendant type luminaires.

Use heat resistant flexible cables for making final connections to equipment (fixed or portable) with a heating element or equipment fixed to pipework or appliance forming part of a heat distribution system. Ensure the flexible cables are 300/500 V grade complying with the relevant BS.

900 CONTROL SWITCHES

Ensure double-pole and triple-pole and neutral control switches are in accordance with relevant BS (Category AC22) respectively and are suited as other accessories defined in the Particular Specification.

Ensure each switch is of the surface or flush pattern as appropriate and install with suitable back box and flylead. Install back boxes constructed from pressed steel/PVC/pressed steel and PVC as detailed in the Particular Specification.

Ensure switch plates are complete with pilot lamp, and where defined in the Particular Specification, engraved with coloured lettering identifying the equipment being controlled.

If cable outlet plates are required for final connections to equipment, suite these to other accessories.

1000 SHAVER SOCKETS

Install shaver sockets in accordance with BS 7671, fed from a local lighting circuit, and ensure they are manufactured in accordance with BS EN 61558.

Ensure mounting back boxes are installed flush with the wall surface in concealed installations. Install back boxes constructed from pressed steel/PVC/pressed steel and PVC as detailed in the Particular Specification.

1100 COOKER CONTROL UNITS

Ensure cooker control units are manufactured to the relevant BS, and are complete with a suitably rated double-pole switch and where indicated a 13 A switched socket outlet, both with indicating lamp, and suitable back box. Install back boxes constructed from pressed steel/PVC/pressed steel and PVC as detailed in the Particular Specification.

Mount the cooker control unit alongside the cooker, not directly behind or above.

Affect final connections via a fixed cooker connection unit mounted directly behind the cooker. Where split level hobs and ovens are to be provided, see the Particular Specification for the required final connection details.

1200 FUSED CLOCK CONNECTORS

Install fused clock connectors for all mains voltage clock points. Ensure connectors are specifically designed for clock connections and are of the fused plug and socket type, complete with appropriately sized flexible cable for final connections.

Connect clock connectors to the 'local' lighting circuit feed unless otherwise stated on the drawings or in the Particular Specification.

Install all clock connectors with boxes of suitable depth with adjustable lugs to ensure outlet plates are true and square. Fit boxes flush with wall finish and make any adjustments to depth using extension rings. Install back boxes constructed from pressed steel/PVC/pressed steel and PVC as detailed in the Particular Specification.

Ensure all boxes are compatible with the wiring system used and are complete with CPC terminal.

1300 MOUNTING HEIGHTS AND VISUAL CONTRAST

Ensure all accessories are mounted in line with current best practice and at heights to meet accessibility requirements. Refer to Specification Section Y89 for further details.

Ensure that the contrast, as measured by the Light Reflectance Value (LRV), between all accessories and the background they are mounted on meet the Approved Document M requirement to contrast visually.

END OF SECTION Y74

Y80 EARTHING AND BONDING COMPONENTS

CONTENTS

Y80 EARTHING AND BONDING COMPONENTS

100 REFERENCE DOCUMENTS

This specification is written based on legislation, standards and guidance in force in the UK generally, and within England by default. For projects in Scotland, Wales, Northern Ireland, the Channel Islands and the Isle of Man, give appropriate consideration to any locally applicable legislation, standards and guidance that deviates from or is additional to those in force within England. Similarly for projects outside the UK comply with the corresponding national legislation, standards and guidance.

Comply fully with the edition (including amendments, replacements and associated normative references) of each of the following, current at the time of tender.

Where a standard referred to in this section conflicts with a standard referred to in an associated ‘engineering system’ section (eg S10, T31, V21, W51 etc) of this specification, the standard referred to in the engineering system section prevails.

The Electricity Safety, Quality and Continuity Regulations

BS 951	Electrical earthing. Clamps for earthing and bonding purposes. Specification
BS 4444	Guide to electrical earth monitoring and protective conductor proving
BS 5958	Code of practice for control of undesirable static electricity
BS 7430	Code of practice for protective earthing of electrical installations
BS 7671	Requirements for Electrical Installations. IET Wiring Regulations
BS EN 13599	Copper and copper alloys. Copper plate, sheet and strip for electrical purposes
BS EN 13601	Copper and copper alloys. Copper rod, bar and wire for general electrical purposes
BS EN 13636	Cathodic protection of buried metallic tanks and related piping
BS EN 15112	External cathodic protection of well casing
BS EN 61140	Protection against electric shock. Common aspects for installation and equipment.
BS EN 62305	Protection against lightning
ENA TS 41-42	Guidelines for the design, installation, testing and maintenance of main earthing systems in substations

200 GENERAL

Comply with section W51 of this specification.

Bond the lightning protection system, if fitted, to the main electrical electricity earthing terminal in accordance with section W52 of this specification.

Install the whole of the earthing and bonding installations in accordance with the requirements of BS 7671, the Distribution Network Operator, BS 7430, and other relevant British Standards and Codes of Practice.

Ensure all enclosures, equipment, exposed conductive parts, extraneous conductive parts, metallic trunking, metallic conduits, metallic cable trays and any other metalwork, other than any live part, forming protection or part of the electrical installation, including apparatus and appliances, are effectively bonded to earth and do not form part of the earth fault path of the protective conductor system.

Ensure all main water pipes, main gas pipes, other service pipes, ventilation ducting (including ductwork flexible connections, riser of central heating and air conditioning systems), oil pipe services, storage tank, piped gas systems, etc, and the exposed metallic parts of the building structure are effectively connected to the main earthing terminal points. Make connections using, where applicable, earthing clamps which conform to BS 951.

Fix copper tape to the building structure by means of purpose-made 'spacer bar' saddles.

Ensure bolts, nuts and washers for any fixing of the earth tape are bronze.

300 PRODUCTS AND MATERIALS

310 Earth rods and plates

Earth is normally the earth terminals or earthed cable sheath of the electricity supply installation, provided the company has given written approval for the use of their earthing system for this purpose. Forward duplicate copies of the Distribution Network Operator’s written approval to the Contract Administrator before the earth connection is made.

Install an earth electrode system to meet the site and soil condition.

Use solid drawn high-conductivity copper rods to BS EN 13601, 15 mm diameter and 1200 mm sections with internal screw and socket joints.

Use earth plates only where use of earth rods is unsuitable. Make earth plates of solid copper a minimum of 3.0 mm thickness.

Fit rod sections with hardened steel tips and driving caps. Ensure that the depth of the driver rods are a minimum of 2400 mm and the spacing between rods is at least equal to their length. Ensure that no electrode is within 3000 mm of the building foundations.

Make connections by using proprietary clamps and within a concrete inspection pit with removable covers inscribed "EARTH".

Provide earthing terminals at all main incoming supply positions and connect to earth. Ensure main and/or sub-main panels have an earthing terminal and are effectively connected to earth.

Carry out soil resistivity and other tests, as detailed in the relevant British Standard.

320 Extension and alterations to existing installations

Check existing installations which are being extended to ensure that the existing protective conductors comply with BS 7671.

Where a connection is made to another protective conductor, supply and fix a permanent label to BS 7671 and BS 951 indelibly marked with the words “SAFETY ELECTRICAL CONNECTION - DO NOT REMOVE".

330 Warning notices

Permanently fix in a visible position a durable label to BS 951 with the words “SAFETY ELECTRICAL CONNECTION – DO NOT REMOVE” at or near:

- ~ the point of connection of every earthing conductor to an earth electrode
- ~ the point of connection of every bonding conductor to an extraneous conductive part
- ~ the main earthing terminal, where separate from the main switchgear

END OF SECTION Y80

Y81 TESTING AND COMMISSIONING OF ELECTRICAL SYSTEMS

CONTENTS

Y81 TESTING AND COMMISSIONING OF ELECTRICAL SYSTEMS

100 REFERENCE DOCUMENTS

This specification is written based on legislation, standards and guidance in force in the UK generally, and within England by default. For projects in Scotland, Wales, Northern Ireland, the Channel Islands and the Isle of Man, give appropriate consideration to any locally applicable legislation, standards and guidance that deviates from or is additional to those in force within England. Similarly for projects outside the UK comply with the corresponding national legislation, standards and guidance.

Comply fully with the edition (including amendments, replacements and associated normative references) of each of the following, current at the time of tender:

Where a standard referred to in this section conflicts with a standard referred to in an associated ‘engineering system’ section (e.g. S10, T31, V21, etc.) of this specification, the standard referred to in the engineering system section prevails.

BS 4444	Guide to electrical earth monitoring and protective conductor proving
BS 4737	Intruder alarm systems (complete series)
BS 5000-3	Rotating electrical machines of particular types or for particular applications. Generators to be driven by reciprocating internal combustion engines. Requirements for resistance to vibration
BS 5000-11	Specification for rotating electrical machines of particular types or for particular applications. Small-power electric motors and generators
BS 5266-1	Emergency lighting. Code of practice for the emergency lighting of premises
BS 5306-0	Fire protection installations and equipment on premises. Guide for selection, use and application of fixed firefighting systems and other types of fire equipment
BS 5611	Application guide for on-load tap-changers
BS 5839	Fire detection and fire alarm systems for buildings (full series)
BS 6266	Fire protection for electronic equipment installations. Code of practice
BS 7430	Code of practice for protective earthing of electrical installations
BS 7671	Requirements for electrical installations. IET Wiring Regulations
BS 8243	Installation and configuration of intruder and hold up alarm systems designed to generate confirmed alarm conditions. Code of practice.
BS 8434	Methods of test for assessment of the fire integrity of electric cables
BS 8591	Remote centres receiving signals from alarm systems. Code of practice
BS EN 54	Fire detection and fire alarm systems (full series)
BS EN 1838	Lighting applications. Emergency lighting
BS EN 50147-1	Anechoic chambers. Shield attenuation measurement
BS EN 50171	Central power supply systems
BS EN 50518	Monitoring and Alarm Receiving Centre (full series)
BS EN 55011	Industrial, scientific and medical equipment. Radio-frequency disturbance characteristics Limits and methods of measurement
BS EN 55016-2	Specification for radio disturbance and immunity measuring apparatus and methods. Methods of measurement of disturbances and immunity. Measurement of disturbance power

BS EN 60034	Rotating electrical machines (full series)
BS EN 60060	High-voltage test techniques (full series)
BS EN 60076-1	Power transformers. General
BS EN 60076-2	Power transformers. Temperature rise for liquid-immersed transformers
BS EN 60076-3	Power transformers. Insulation levels, dielectric tests and external clearances in air
BS EN 60076-5	Power transformers. Ability to withstand short-circuit
BS EN 60076-10	Power transformers. Determination of sound levels
BS EN 61439	Low-voltage switchgear and controlgear assemblies (full series)
BS EN 60849	Sound systems for emergency purposes
BS EN 60896	Stationary lead-acid batteries (full series)
BS EN 60947	Low-voltage switchgear and control gear (full series)
BS EN 61180	High-voltage test techniques for low-voltage equipment. Definitions, test and procedure requirements, test equipment
BS EN 61439-1	Low-voltage switchgear and controlgear assemblies. General rules
BS EN 61439-2	Low-voltage switchgear and controlgear assemblies. Power switchgear and control assemblies
BS EN 61439-3	Low-voltage switchgear and controlgear assemblies. Distribution boards intended to be operated by ordinary persons. (DBO)
BS EN 61557	Electrical safety in low voltage distribution systems up to 1000 V a.c. and 1500 V d.c. Equipment for testing, measuring or monitoring of protective measures. (full series)
BS EN 62040-3	Uninterruptible power systems (UPS). Method of specifying the performance and test requirements
BS EN 62271-1	High-voltage switchgear and controlgear. Common specifications for alternating current switchgear and controlgear
BS EN 62271-200	AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV
BS EN 62271-202	High-voltage switchgear and control gear. High voltage/low voltage prefabricated substation
BS EN 62305	Protection against lightning. Risk management
BS EN 62676	Video surveillance systems for use in security applications. (full series)
BS EN ISO 2178	Non-magnetic coatings on magnetic substrates. Measurement of coating thickness. Magnetic method.
BS EN ISO 2409	Paints and varnishes – Cross cut test
BS EN ISO 10012	Measurement management systems. Requirements for measurement process and measuring equipment
BS ISO 8528-6	Reciprocating internal combustion engine driven alternating current generating sets. Test methods

CIBSE Commissioning Code L: *Lighting* (SLL Commissioning Code L)ENA ER 99 Requirements for the connection of generation equipment in parallel with public distribution networks on or after 27 April 2019

HTM 05-02	Firecode – Guidance in support of functional provisions (fire safety in the design of healthcare premises) HTM 05-03 Fire safety in the NHS. Operational provisions. (All parts)
HTM 06-01	Electrical services supply and distribution
HTM 06-02	Electrical safety guidance for low voltage systems
HTM 06-03	Electrical safety guidance for high voltage systems
HTM 07-02	Making energy work in healthcare. (All parts)
HTM 07-05	The treatment recovery, recycling and safe disposal of waste electrical electronic equipment (Wales)
HTM 08-02	Lifts
HTM 08-03	Bedhead services
HTM 2005	Building management systems
PSDB 14-95	Home Office - Performance testing of CCTV perimeter surveillance systems
PSDB 9-01	Home Office - Guidance notes for the procurement of CCTV for public safety at football grounds
IET	Code of Practice for Low and Extra Low Voltage Direct Current Power Distribution in Buildings
IET	Practical considerations for d.c. installations

Association of Manufacturers and suppliers of Power Systems and ancillary equipment (AMPS) standard test procedures

All data protection legislation including the General Data Protection Regulations

200 GENERAL (APPLICABLE TO ALL TESTING AND COMMISSIONING PROCEDURES)

Carry out inspection and tests to comply with any British or International standards as necessary on all equipment and installations.

Comply with all aspects of section A32 (Management of the works) of this specification.

Where a substation, HV/LV transformer, HV switchgear, LV switchgear, generator, UPS system or Motor Control Centre(s) have been completely assembled at a manufacturer's works, arrange for the employer's representative to inspect and witness tests on the completed equipment at the works. Give the employer and Contract Administrator at least 14 days' notice of the tests so that they can attend if they wish.

For on-site testing give the employer and the Contract Administrator at least 7 days' notice of the tests so that they can attend if they wish.

Whether or not this opportunity is accepted by the employer provide the complete set of test results and inspection reports to the Contract Administrator after the tests have been completed and before the equipment is installed.

Retest on site any such item of equipment that has been partially dismantled for transportation, unless otherwise agreed with the Contract Administrator.

Prepare and submit a fully detailed programme and method statement for the testing, commissioning and demonstration of each system stating exactly how these are to be carried out and whether they interface with other systems. Ensure the programme includes a schedule of tests to be applied to the system to demonstrate that the fault diagnostic routines function as required. Submit the programme and statement to the Contract Administrator for comment one month in advance of the test. Notify manufacturers or specialists of the dates as appropriate.

Arrange for the attendance of a tester to carry out all required tests. Ensure that this tester is not the same person who carried out the installation, unless agreed with the Contract Administrator.

Supply all test instruments. Ensure they are calibrated immediately prior to commencement of testing and operated by trained personnel. Arrange for all calibration certificates to be available for inspection at the time of the tests. Prior to commencement of tests ensure the Contract Administrator is asked to comment on the suitability of the proposed test equipment and methods of testing being adopted.

Provide all specialist equipment, to test and demonstrate the various systems as required.

Arrange and carry out disconnection or similar operations to satisfy the requirements for testing, etc, and the reinstatement of the installation after tests.

Carry out the test procedures in the following clauses in addition to any tests required by the particular system section, or any other ‘Y’ section, of this specification, as a minimum.

Provide certificates for all testing and commissioning carried out. Include all recorded test results in the operating and maintenance manuals as a record of commissioning prior to contract completion.

Ensure all control arrangements, settings and sequences on completion of commissioning and demonstration are recorded, added to the Record Drawings and included within the operating and maintenance manuals.

Provide two days of training (either pre- or post-contract completion, as directed by the Contract Administrator), for nominated client’s / end-user’s representatives in all aspects of the installation operation that are the user's responsibility.

300 PARTICULAR TEST PROCEDURES

Carry out the following procedures as necessary in accordance with the relevant British or other standards and, if appropriate, the relevant Health Technical Memoranda (HTM).

Ensure that the work’s test engineer controls all tests undertaken at the manufacturer’s works.

Ensure that, in the presence of the employer’s representative, all tests undertaken at site are controlled by the installer/manufacturer.

310 Substations

Test and inspect substation components at the manufacturer’s works, whether the substation is packaged or made up of discrete elements.

320 Transformers

Test and inspect power transformers fully in accordance with BS EN 60076-1.

Carry out the following routine tests for all transformers:

- ~ Measurement of winding resistance;
- ~ Measurement of voltage ratio and check of phase displacement;
- ~ Measurement of short-circuit impedance and load loss;
- ~ Measurement of no-load loss and current;
- ~ Dielectric routine tests. (BS EN 60076-3);
- ~ Tests on on-load tap-changers, where appropriate. (BS 5611);

- Leak testing with pressure for liquid-immersed transformers (tightness test);
- Tightness tests and pressure tests for tanks for gas-filled transformers (BS EN 60076-15);
- Check of the ratio and polarity of built-in current transformers;
- Check of core and frame insulation for liquid immersed transformers with core or frame insulation;
- Test and confirm measurement of the zero-phase sequence.

Carry out the following additional routine tests for transformers with U_m > 72.5 kV:

- Determination of capacitances windings-to-earth and between windings;
- Measurement of DC insulation resistance between each winding to earth and between windings;
- Measurement of dissipation factor (tan δ) of the insulation system capacitances;
- Measurement of dissolved gases in dielectric liquid from each separate oil compartment except diverter switch compartment;
- Measurement of no-load loss and current at 90% and 110% of rated voltage.

Where specified carry out the following tests:

Type tests

- Temperature-rise type test (BS EN 60076-2);
- Dielectric type tests (BS EN 60076-3);
- Determination of sound level (BS EN 60076-10) for each method of cooling for which a guaranteed sound level is specified;
- Measurement of the power taken by the fan and liquid pump motors;
- Measurement of no-load loss and current at 90% and 110% of rated voltage.

Special tests

- Dielectric special tests (BS EN 60076-3);
- Winding hot-spot temperature-rise measurements;
- Determination of capacitances windings-to-earth, and between windings;
- Measurement of dissipation factor (tan δ) of the insulation system capacitances;
- Determination of transient voltage transfer characteristics (Annex B of BS EN 60076-3:2000);
- Measurement of zero-sequence impedance(s) on three-phase transformers;
- Short-circuit withstand test (BS EN 60076-5);
- Measurement of DC insulation resistance each winding to earth and between windings;
- Vacuum deflection test on liquid immersed transformers;
- Pressure deflection test on liquid immersed transformers;
- Vacuum tightness test on site on liquid immersed transformers;
- Measurement of frequency response (frequency response analysis or FRA). Agree the test procedure between manufacturer and purchaser;

- Check of external coating (ISO 2178 and ISO 2409 or as specified);
- Measurement of dissolved gases in dielectric liquid;
- Mechanical test or assessment of tank for suitability for transport (to customer specification);
- Determination of weight with transformer arranged for transport. For transformers, up to 1.6 MVA by measurement. For larger transformers by measurement or calculation as agreed between manufacturer and purchaser.

Test and demonstrate that the transformer insulation can withstand a test voltage of the magnitude stated in BS EN 60076-3. Use a combination of the following tests depending on the requirements of table 1 in the standard and the type of winding in the transformer:

- lightning impulse test;
- switching impulse test;
- long duration ac test;
- short duration ac test;
- separate source ac test.

Test and demonstrate that the temperature rises of the active part of the transformer (oil, windings, core), do not exceed the limits agreed on or by the standards.

On every transformer test every Buchholz relay that has been installed.

Test every temperature sensor that has been installed in the oil or embedded in the windings or core, and verify its correct operation, be it alarm or shut-down.

330 Switchgear

331 HV switchgear

Test and inspect all HV switchgear fully in accordance with BS EN 62271-1.

Carry out the following routine tests for all HV switchgear:

- Visual inspection;
- Verification of conformity to the circuit and wiring diagrams;
- Functional tests of all low voltage circuits;
- Verification of protection against electric shock;
- Measurement of the resistance of the main circuit;
- Dielectric test on the main circuit;
- Gas tightness test (if applicable);
- Partial discharge measurement (if applicable).

Ensure that all switchgear has been ASTA type tested and has their approval and certification.

Where switchgear is reassembled on site, retest the switchgear and control gear in line with the standard.

Carry out the following on-site tests:

- Inspect all equipment. Check that it is installed complete according to the installation drawings and this specification, and that it is clean and free from damage. Check that all notices and labelling are correct.

- Check all connections are correct and tightly fastened.
- Test cabling, switchboard and switchgear insulation at voltages to be agreed with equipment manufacturers and the Contract Administrator in accordance with BS EN 62271-200.
- Check the operation of all switchgear, including trip testing using injection current testing where appropriate.

Adjust and test the HV/LV electrical supply protection relays as required by the protection co-ordination study referred to in section V11 of this specification.

332 LV switchgear

Inspect and test the switchgear assembly fully in accordance with BS EN 61439, and in particular BS EN 61439-1 to comply with type testing or partial type testing.

Ensure that all switchgear and the assembly has been type tested, approved and certified by a UKAS accredited test facility and provide a letter of conformity with the relevant test certificates.

Ensure that all meters fitted to any switchgear have a valid calibration certificate.

Carry out routine tests for:

- Inspection of the assembly including inspection of wiring;
- Electrical operation test;
- Dielectric test;
- Checking of protective measures and electrical continuity of the protective circuit.

Ensure that the settings of all ACBs and MCCBs are in accordance with the design settings as detailed in the schedules.

Verify the correct functioning of all residual current devices (RCD), and confirm that the surge protection devices (SPDs) and arc fault detection devices (AFDDs) are correctly installed and do not indicate any faults. Ensure the AFDDs are tested using the test button on the device, and the RCD using a RCD tester as part of the testing and commissioning.

During commissioning ensure that all switchgear and distribution boards have been correctly labelled and all distribution board schedules are correct and in place.

333 HV and LV switchgear functional tests

Carry out functional tests on switchgear to verify correct operation of the following, where applicable:

- motorised operation of any switchgear;
- contacts, whether volt-free or not;
- power factor correction including sequencer and contactors;
- G99 isolation testing of both mechanical and electrical interlocks;
- Castell key operation;
- Switch earth position if installed;
- Any other control function on the switchgear.

In carrying out the above tests ensure that interlocks and keys effectively prevent any cross phasing, paralleling or unintended action by the switchgear.

334 Protection tests

Within all switchboards, test every protective relay to ensure it functions correctly.

Check that the current transformers are correctly installed and connected.

Verify the action of all such relays by secondary injection methods.

Check that the system has been graded and that the correct settings have been set up.

Check that the grading settings have been correctly recorded in test sheets and that these settings are recorded in the operation and maintenance manual.

340 Cables

341 HV cables

Test all installed HV cables as detailed in section V11 of this specification and in accordance with the manufacturer's requirements.

Carry out all pressure tests under a 'permit to test' issued by the Authorised Person. Carry out all such tests in the presence of the Contract Administrator.

On every paper insulated cable carry out the "crackle test" on the impregnated bindings before making each joint, to ensure that they contain no water moisture.

342 LV cables

Test all installed LV cables fully in accordance with BS 7671.

Carry out the insulation, continuity and conductor resistance tests required. Be responsible for the conducting of the tests and the subsequent recording and certification of the results. Ensure that, throughout all such tests, both ends of every cable are monitored by a competent person.

When testing long cables that probably have considerable capacitance, be aware of the dangers of stored energy and the need to earth down, in a controlled manner, all cores after each test.

On every paper insulated cable carry out the "crackle test" on the impregnated bindings before making each joint, to ensure that they contain no water moisture.

For large section circuits consisting of more than one conductor per phase, verify the equality of load current sharing between the parallel conductors.

350 Standby generators

Commission and test the complete emergency generator installation in accordance with BS ISO 8528-6 and as follows:

351 Works tests prior to despatch

Carry out works tests prior to despatch as described in the Association of Manufacturers and Suppliers of Power Systems and Ancillary Equipment (AMPS) standard test procedures to demonstrate compliance with all aspects of the specification.

Carry out load tests at full output power with one hour at 10% overload. Measure fuel and lubricating oil consumption at full load.

352 Commissioning following installation

Check the complete generating set is installed as designed and specified, including all wiring connections.

Test the power and control wiring installation, including the earthing system.

Check the functioning of all switchgear, interlocks and controls.

Check the functioning of all auxiliary equipment. Set fuel pump overloads, measure running currents and fuel flow rates.

Calibrate all sensors and relays (in co-operation with others where appropriate).

Provide the first fill of fuel oil, lubricating oil and anti-freeze.

Commission, test and demonstrate the complete fuel system.

Install equipment for site tests and demonstrations.

353 Site tests and demonstrations

.1 Prior to paralleling with the local distribution network:

With the generators running off-load, demonstrate automatic starting on loss of mains, manual and automatic synchronising, returning to mains, and automatic operation of the earthing system.

Prove the critical shut-down interlocks and alarms and normal shut-down interlocks and alarms.

With a load bank connected demonstrate that the generators will deliver their full load output for 4 hours followed immediately by 1 hour at 110% of full load.

With the generators at 110% of full load, measure noise levels at 1m and 10m from the exhaust system discharge(s) and all related external louvres.

Following the test at 110% of full load demonstrate that load sharing is satisfactory between 40% and 110% of full load (where relevant).

Demonstrate the automatic fuel replenishment system from the bulk tank including testing level switches in both bulk and daily service tanks.

.2 Paralleling with the local distribution network:

Ensure that the detailed requirements for paralleling with the local distribution network have been provided in accordance with Engineering Recommendations G99 and/or G98, depending on the electrical capacity of the system.

Before connection with the mains ensure the following:

~ Agreements with the Distribution Network Operator are in place. (Connection agreement, Adoption agreement / Arrangements for operating the interface between the distribution network / generation equipment).

~ Meter operator and meter are in place for exporting to the local distribution network.

~ Supplier is in place for purchasing the electricity exported to the local distribution network.

Arrange for the generator vendor to test and commission the generator unit in conjunction with the Distribution Network Operator and the electrical and mechanical plant installers. Carry out the following tests:

.3 Operation of electrical protection devices and compliance with BS 7671

.4 Proving engine safety and emergency shut-down devices

.5 For systems installed up to and including 16A, demonstrate compliance as described within Engineering Recommendations G98.

Generally the interface protection and protection functionality are provided by type-tested equipment with protection settings that have been factory set. Providing the settings are as the type-tested figures, there is no requirement to confirm the protection settings.

.6 For systems installed greater than 16A per phase but less than 50kW (3-phase) / 17kW (1-phase) demonstrate compliance as described within Engineering Recommendations G99.

Generally (where the Distribution Network Operator has agreed) where the interface protection and protection functionality are provided by type-tested equipment with protection settings that have been factory set, there is no requirement to confirm the protection settings.

Where type-tested generating plant has not been used, test and demonstrate full interface protection and protection functionality on site in accordance with G99.

For systems installed greater than 50kW demonstrate compliance as described within Engineering Recommendations G99

Prove the installation has been installed in accordance with the agreed design with respect to:

- ~ Earthing
- ~ Synchronising
- ~ Voltage control
- ~ Frequency control (where applicable)
- ~ Interface protection
- ~ Control procedures
- ~ Interlocks
- ~ Notices and labels.

Ensure that all protection and control settings have been correctly applied and recorded.

Ensure that all metering current transformers (CTs) and voltage transformers (VTs) are of the correct type and class and are compliant with the appropriate metering code of practice and installed with the correct orientation and connections.

Ensure that the overvoltage tests are satisfactory (HV installations).

Ensure that all operational aspects have been implemented and that an agreed operating procedure is established with the Distribution Network Operator.

With the building sufficiently complete to provide at least 50% of the final loads to be connected in an emergency, including major motor drives and any UPS system fitted, demonstrate the complete generator starting sequence and mains restoration sequence, including one or more generators disconnecting as the load is reduced below 45% of full load.

354 Post commissioning

Ensure that completed commissioning form, with a written record of the protection settings and test results, is submitted to the Distribution Network Operator within 30 days of commissioning.

360 CHP generators

Commission and test the complete CHP system installation in accordance with BS ISO 8528-6 and as follows:

361 Witnessing

Ensure that the CHP vendor provides for witnessing by the Contract Administrator of works inspection and tests of the CHP unit.

362 Works tests prior to despatch

Prior to despatch, carry out works tests as described in the Association of Manufacturers and Suppliers of Power Systems and Ancillary Equipment (AMPS) standard test procedures to demonstrate compliance with all aspects of the specification.

Include load tests at full output power. Measure fuel (oil / gas) and lubricating oil consumption at full load. Give the employer and Contract Administrator at least 14 days' notice of the works tests so that they can attend if they wish.

363 Commissioning following installation

Check the complete CHP set is installed as designed and specified, including all wiring connections.

Check compliance with G98/G99 as appropriate.

Check the functioning of all switchgear, interlocks and controls.

Check the functioning of all auxiliary equipment.

Check lubricating oil and anti-freeze to the engine.

Check the fuel supply complies with current regulations.

- ~ For gas supplies, check functioning of manual shut-off valve, gas filter, gas meter, gas pressure gauge and low pressure relay. Check the CHP unit is capable of operating at the gas pressure measured at the gas connection point.
- ~ For fuel oil supplies, check functioning of fuel oil system as described in the standby generator section in this specification.

Commission, test and demonstrate the complete fuel system.

Test the power and control wiring installation, including the earthing system.

Calibrate all sensors and relays in co-operation with others where appropriate.

Install equipment for site tests and demonstrations.

364 Site Tests and Demonstrations

.1 Prior to paralleling with the local distribution network:

Electrical

With the CHP running (but not paralleled to the local distribution network) demonstrate automatic starting and stopping on loss of mains, automatic synchronising, returning to mains and automatic operation of the earthing system.

Prove the critical shut-down interlocks and alarms and normal shut-down interlocks and alarms.

Mechanical

Prove the control and monitoring system functioning, including CHP unit and boiler sequencing. Check the compatibility and accuracy of all temperature detectors and other instruments.

Carry out combustion testing including monitoring gas supply, water flow test and temperature monitoring.

Carry out continuously monitored performance checks for one week including CHP thermal and electrical outputs and fuel consumption, CHP unit and boiler operation, and water heating circuit temperatures, and CHP unit overall efficiency.

For gas engines, prove that short depressions of gas pressure less than 3 seconds in duration inhibit the low pressure relay from shutting down the CHP unit.

For oil fuelled engines prove the auto fuel replenishment system from the bulk tank including testing level switches in both bulk and daily service tanks.

Arrange for all tests to be monitored by the CHP unit vendor's service centre and by the building management system where installed.

With the CHP unit operating at 100% of full load measure noise levels at 1m and 10m from the exhaust system discharge(s) and all related external louvres.

.2 Paralleling with the local distribution network:

Ensure that the detailed requirements for paralleling with the local distribution network have been provided in accordance with Engineering Recommendations G99 and/or G98 depending on the electrical capacity of the system.

Before connection with the mains ensure the following:

~ Agreements with the Distribution Network Operator are in place. (Connection agreement, Adoption agreement / Arrangements for operating the interface between the distribution network / generation equipment).

~ Meter operator and meter are in place for exporting to the local distribution network.

~ Supplier is in place for purchasing the electricity exported to the local distribution network.

Arrange for the CHP vendor to test and commission the CHP unit in conjunction with the Distribution Network Operator and the electrical and mechanical plant installers. Carry out the following tests:

.3 Operation of electrical protection devices and compliance with the BS 7671

.4 Engine safety and emergency shutdown device proving

.5 For systems installed up to and including 16A, demonstrate compliance as described within Engineering Recommendations G98

Generally the interface protection and protection functionality are provided by type-tested equipment with protection settings that have been factory set. Providing the settings are as the type-tested figures, there is no requirement to confirm the protection settings.

.6 For systems installed greater than 16A per phase but less than 50kW (3 phase) / 17kW (1 phase) demonstrate compliance as described within Engineering Recommendations G99

Generally (where the Distribution Network Operator has agreed) where the interface protection and protection functionality are provided by type-tested equipment with protection settings that have been factory set, there is no requirement to confirm the protection settings.

Where type-tested generating plant has not been used, test and demonstrate full interface protection and protection functionality on site in accordance with G99.

.7 For systems installed greater than 50kW demonstrate compliance as described within Engineering Recommendations G99.

Prove the installation has been installed in accordance with the agreed design with respect to:

~ Earthing

~ Synchronising

~ Voltage control

~ Frequency control (where applicable)

~ Interface protection

~ Control procedures

~ Interlocks

- Notices and labels.

Ensure that all protection and control settings have been correctly applied and recorded.

Ensure that all metering CTs and VTs are of the correct type and class and are compliant with the appropriate metering code of practice.

Ensure that the overvoltage tests are satisfactory (HV installations).

Ensure that all operational aspects have been implemented and that an agreed operating procedure is established with the Distribution Network Operator.

Ensure that the noise and vibration measurements, taken with the equipment operating at full load, is within the specified values.

365 Post commissioning

Check that completed commissioning form, with a written record of the protection settings and test results, is submitted to the Distribution Network Operator within 30 days of commissioning.

Arrange for the CHP unit vendor to help the users to set up their own monitoring system to the Contract Administrator’s satisfaction.

370 UPS systems

371 Works tests prior to despatch

For type-tested units carry out routine tests at the manufacturer’s works as detailed in BS EN 62040-3 section 6.

For non-type-tested equipment, carry out all tests as detailed in BS EN 62040-3 table 3 ‘type test’ column.

In addition to the above carry out the following tests:

- Light load and functional test;
- Synchronisation test;
- Efficiency tests;
- Inspection of input and output waveforms;
- battery test;
- maintenance bypass test;
- static bypass test.

Include standby generator manufacturers in all UPS tests at the manufacturer’s premises as required. Make the generator manufacturer responsible for verifying the UPS system test results and the information issued to them at design stage and confirm that there are no issues on interfacing the generator to the UPS systems.

372 Site tests and demonstrations

Where UPS(s) comprise or are delivered as separate functional units intended for final on-site assembly and wiring, carry out final performance tests on site. The site test procedure generally consists of the manufacturer’s commissioning procedure and completion of any routine tests from Table 3 of BS62040-3 – UPS test schedule that were not completed prior to delivery. Test each UPS system under simulated full load conditions on completion of the installation works at site.

Carry out tests for total simulation of mains failure and the automatic operation of the standby generator system, together with the functional operation of all isolators / switches / by-passes and controls.

Demonstrate fully the UPS systems battery support with a total discharge at the 20 minute and 40-minute battery period, as appropriate, at specified full load condition and demonstrate the recovery time over the specified 12-hour period.

Provide a paper chart recorder for the duration of the system tests at site. The minimum demonstration period required for each of the UPS systems is 5 days on-line operation.

Include the recorded test results in the operating and maintenance manuals as a record of all 'on-line' tests and issue at contract completion.

Complete all tests in the presence of the UPS equipment manufacturer’s engineer.

380 Emergency lighting

381 General

Fully test and inspect emergency lighting installations in accordance with this specification and generally as outlined in BS 5266, BS 1838, and BS 7671, after first disconnecting all luminaires to prevent damage to the electronic circuits. Provide measured readings of all tests undertaken.

Carry out full testing and commissioning of the automatic emergency lighting testing and monitoring system where specified as set out in section V40 of this specification.

Carry out adjustments and calibration of all automatic control devices and systems to provide optimum operation.

Make available a suitable operative, familiar with lighting controls, as may be required to assist any specialist equipment supplier/manufacturer throughout the commissioning period.

Ensure that CAD record drawings of the lighting installation and associated controls are completed and available on site to specialist equipment supplier/manufacturers prior to commissioning commencement.

Replace all failed lamps of the installed luminaires during the course of the contract works.

Thoroughly clean all luminaires and ensure they are in a new clean condition at handover.

Fully demonstrate the complete operation of the emergency lighting installation to the satisfaction of the Contract Administrator and client’s representative.

Arrange a mutually agreed programme for the above demonstrations with the Contract Administrator, providing at least ten working days’ notice.

Prepare a method statement for the tests, detailing how they are to be undertaken.

Submit the programme for comment at least four weeks in advance of commencement of testing.

Arrange for all specialist equipment suppliers/manufacturers to provide a minimum of one full day’s instruction of the complete emergency lighting system for the Employer’s representative prior to the contract completion date, and ensure that the demonstration also includes the automatic testing and monitoring system where specified.

382 Tests to be conducted prior to commissioning

.1 A visual inspection of the whole installation covering equipment and cable where accessible, to verify compliance with BS 5266-1, BS EN 1838, BS 7671 and this specification.

.2 Inspect and test the electrical installation in accordance with BS 7671 and record all results on approved test record sheets

Test conductors and other circuit components prior to them being connected to electronic components in order to avoid damage during the electrical installation test procedures. Test electronic equipment in accordance with the manufacturers’ instructions.

Clearly note on the circuit charts and in operating and maintenance procedures the presence of electronic components with an indication that testing procedures may result in damage.

Where any part of the installation is to be concealed within the building fabric carry out tests to ensure that the installation is satisfactory prior to concealment.

.3 Upon completion of the works subject the whole installation to the tests detailed and note every defect, correct them and bring to the attention of the Contract Administrator.

In the event of any test indicating failure to comply, repeat that test and any preceding it whose results may have been influenced by the faults indicated, after the fault has been rectified.

383 Tests to be conducted during commissioning

.1 Carry out the following tests and inspections:

~ Test the operation of all luminaires and emergency lighting luminaires accessories and items of equipment and check for proper function.

~ Carry out functional test of all light switches, emergency lighting test switches and control devices.

~ Demonstrate the operation of each self-contained luminaire under simulated mains failure condition to prove the luminaire output for the specified time and that the battery is fully recharged within 24 hours.

~ Under emergency lighting conditions, check adequate illumination is available for safe movement on the escape / open areas and all escape route safety signs / fire-fighting equipment location signs and other safety signs identified from risk assessment are visible with the normal lighting extinguished.

~ Carry out full emergency illuminance test in accordance with Annex B of BS 5266 or submit lighting calculations for the scheme.

~ Carry out full duration test of three hours, including confirmation that adequate illumination is available for safe movement on the escape and open areas at the end of the test.

~ Carry out full functional test of the automatic test system for emergency lighting and confirmation that all inputs / outputs are fully operational.

Submit the completion certificate in Annex F of BS 5266-1 to the Building Control Officer. Where light level calculations by the designer is the chosen compliance route, submit the calculations with the completed certificate.

390 Fire alarm

Arrange for the manufacturer or their representative to test and commission the complete fire alarm system fully in accordance with BS 5839 and this specification.

391 General

Carry out, on completion of the installation works, together with the selected specialist equipment manufacturers, the complete testing, commissioning and demonstration of the system operation as detailed below.

Make available suitable operatives, familiar with the fire detection system, as may be required to assist the manufacturer throughout the commissioning period.

Ensure that CAD record drawings of fire alarm systems are completed and available on site to manufacturers prior to commissioning commencement.

Ensure that the tests are largely composed of simulated faults that are artificially imposed on the system. Check all visual units, alphanumeric displays, and printers to establish that all programmed messages are displayed correctly. Ensure all control panel switches undergo functional demonstration of correct operation.

Complete and produce the commissioning and test certificate for scrutiny before any part of the project can be handed over and accepted.

Ensure that ‘As Fitted’ drawings and manuals are available before the demonstration and instructions.

Fully demonstrate the complete operation of the system to the satisfaction of the Contract Administrator and, where appropriate, the Fire Officer.

392 Tests to be conducted prior to commissioning

Prior to commissioning carry out the following tests:

.1 Carry out a visual inspection of the whole of the installation, including equipment and cabling in subways, walkways, crawl ways, ceilings and floor voids where accessible.

.2 Check insulation resistance tests cover all circuits forming part of the system and made between phases, phase to neutral, phase to earth and neutral to earth. Ensure that the method of undertaking insulation resistance tests does not adversely affect any sensitive system components, and if required, isolate sensitive devices prior to undertaking the tests.

.3 Check correct polarity of the alarm devices, bells, sirens, klaxons, etc, and all items where correctness of polarity is essential

.4 Check the programming of the fire alarm system to ensure all detectors are in the correct zone. Base the zoning arrangement on the arrangement shown on the drawings and/or as required by the British Standard. Allow for making minor adjustments to the zoning arrangement to suit the final position of the fire doors and other zone boundaries. Agree all such adjustments with the Contract Administrator.

393 Tests to be carried out during commissioning

During commissioning carry out testing in accordance with the requirements of BS 5839 and BS EN 54, including, but not limited to, the following:

.1 Test the operation of all panels, accessories and items of equipment and check for proper function, including such items as may have been supplied by others but wired under the electrical installation. Carry out these tests under normal operating conditions, including the discharge and recharging of the ‘battery’ system, and record the results.

.2 Functional test of all manual “break glasses”

.3 Functional test of all smoke detectors by use of an approved smoke generator testing device

.4 Functional test of all “fixed temperature” or “rate of rise” heat detectors, by an approved heat source testing device

.5 Simulated tests for fire or fault alarm at detectors and manual contacts as may be instructed by the Contract Administrator, with all tests agreed and recorded on to a system checklist to be approved prior to any witness testing being carried out.

.6 Testing of all sprinkler sensors and fusible link units

.7 Testing of all visual indicators under simulated operational conditions with sounders out of circuit

.8 Testing of auxiliary signals to remote panels and via BT lines, etc

.9 Five simulated faults, at randomly chosen locations on each loop circuit and sounder interface secondary circuit, for each of the following type:

.1 open circuit

.2 short circuit

.3 sensor removal/alarm device removal

.4 earth fault

.10 Simulated charger and battery faults for all power supply units (panels, interface units, etc), followed by a battery discharge test (i.e. 24-hour quiescent detection of the full alarm system, followed by 30 minutes alarm operation)

.11 Simulated operation of mechanical plant where such faults (if any) are required to operate the fire alarm system (e.g. fire/smoke dampers).

Ensure that during routine fire alarm system testing, certain functions are inhibited, i.e. gas supply shut-off valve, smoke damper operation, etc. Provide suitable key switch facilities.

394 Audibility tests

Carry out, prior to full commissioning of the rest of the system, the following tests:

.1 Fully test the fire alarm system audible alarm facility to ensure that the correct audibility levels are achieved as required by the relevant standards.

.2 Carry out tests on completion of the installation when all mechanical plant is fully functioning to ensure that realistic results are obtained, including all normal background noise levels.

.3 Measure and record the sound pressure level in each room, area or plant space. Carry out and record the number of tests necessary to have results from the highest to lowest background noise conditions in each area to obtain average values.

.4 Inform the Contract Administrator, in writing, of any areas where the required audibility levels are not achieved.

Arrange for the manufacturer to carry out the audibility tests twice. Carry out the first test on completion of the system when all mechanical plant is fully functioning to ensure that realistic results are obtained. Carry out the second test approximately six months later when the building is operating under normal conditions. Carry out both tests in the presence of the Contract Administrator.

In the event that the required audibility levels are not achieved, provide any additional sounders and wiring required to rectify this, and repeat the audibility tests at no additional cost to the contract.

395 Documentation

.1 Provide the required fire alarm system test certificate(s), issued by the specialist manufacturer, in the forms as detailed in BS 5839 and other relevant standards.

.2 Record all audibility test results, present in tabulated form and include in the operating and maintenance manuals.

.3 Provide a full set of zoning diagrams to depict the exact zoning arrangement as required by the British Standards. Frame, glaze and mount adjacent to the main panel and repeater panel in agreed positions to facilitate clear recognition of alarm condition location.

.4 Provide full details and include within the tender for the provision of a full 12 months system maintenance contract including system inspection and test as recommended by BS 5839.

400 PARTICULAR TEST PROCEDURES - CONTINUED

410 Intruder alarm

Arrange for the specialist security Installer to carry out the testing and commissioning of the system as detailed below and in the relevant parts of the specification section W41.

411 Testing

On completion of the installation, undertake full technical and performance tests on the entire system, including, as a minimum, the following tests:

- Check all wiring is correctly terminated and labelled.
- Check all equipment is correctly labelled.
- Confirm the supply voltage is correct at all parts of the system.
- Verify that the system continues to work when the main power supply is disconnected.
- Test the correct operation of all detectors, and the elimination of false alarms.
- Test the correct operation of manually operated devices.
- Test the correct operation of annunciation devices, and measure and record sound levels.
- Test the operation of all software functions.
- Test the operation of remote monitoring and control via the LAN.
- Test the effectiveness of access level settings.
- Test the receipt of all types of alarm signals to the remote monitoring facility.
- Test tamper protection of devices, enclosures, and wiring.

Ensure that the entire system satisfies all test criteria.

Before demonstrating the system, submit to the Contract Administrator full tests results, as well as a certificate of conformity that lists details of all aspects of the system that do not conform to the intended requirements.

412 Commissioning

Demonstrate to the Contract Administrator that the system complies with all technical and functional requirements, of the specification

Demonstrate all functions of the intruder alarm system to the users and the user’s insurers, after successful demonstration to the Contract Administrator.

Ensure all control arrangements, settings and sequences on completion of commissioning and demonstration are recorded and added to the record drawings and included within the operating and maintenance manuals.

420 Access control

Carry out the testing and commissioning of the system in accordance with the requirements as detailed below, and in section W40 of the specification.

421 Testing

Obtain all permissions and consent as might be necessary to remain compliant with the requirements of the General Data Protection Regulations.

On completion of the installation, undertake full technical and performance tests on the entire system, include as a minimum the following tests:

- ~ Check all wiring is correctly terminated and labelled.
- ~ Check all equipment is correctly labelled.
- ~ Confirm the supply voltage is correct at all parts of the system.
- ~ Verify that the system continues to work when the main power supply is disconnected.
- ~ Test the correct operation of all devices.
- ~ Test the correct operation of manually operated devices.
- ~ Test the correct operation of annunciation devices, and measure and record sound levels.
- ~ Test the operation of all software functions.
- ~ Test the operation of remote monitoring and control via the LAN.
- ~ Test the effectiveness of access level settings.
- ~ Test tamper protection of devices, enclosures, and wiring.

422 Commissioning

Undertake the following commissioning procedures:

- ~ Test all reader devices and demonstrate that the system meets with the overall operation and control functional requirements detailed.
- ~ Calibrate all field devices.
- ~ Provide a hard copy print-out of the events recorded during the commissioning.
- ~ On completion of the commissioning and testing, provide a certificate of conformity.
- ~ Setup the operator and supervisor security access levels on the integrated system.
- ~ Setup the alarm annunciation on the operator computers and all remote computers.
- ~ Fully demonstrate software graphics.
- ~ Ensure that site plans used by the computer software are current.
- ~ Check release times for each door.
- ~ Check door held open signal.

423 Communication link

Where a remote monitoring centre is used, ensure that the alarm communication link to the remote centre is fully tested and commissioned as follows:

- ~ Check the link before connecting the system.
- ~ Warn the remote centre of the test.
- ~ Initiate the alarm, contact the remote control centre / station and confirm that the alarm condition has been received.
- ~ Confirm the end of testing once the system links have been fully commissioned.

424 Interfaces

Commission every system scheduled below independently and as an integrated, co-ordinated system as detailed within the specification:

- ~ Access control system

- Surveillance system
- Alarm monitoring system
- Intercom facilities
- Fire alarm system
- BMS
- Vehicle traffic light system
- Lighting control

Commission the access control system under normal power supply conditions, followed by a simulated power failure that proves that the backup UPS supports the system.

Test, prove and commission the interfaces with the following systems under normal and emergency power modes:

- Fire detection and alarm system
- BMS.

Ensure all control arrangements, settings and sequences on completion of commissioning and demonstration are recorded and added to the record drawings, and included within the operating and maintenance manuals.

430 Public address

Arrange for the specialist Installer to carry out the testing and commissioning of the system as detailed below, to the standards detailed in section W12 and to BS 7671.

Ensure that commissioning meets the requirements of BS EN 60849 with particular attention to 'RASTI measured intelligibility'.

Liaise with the manufacturers of the interfaced systems to ensure all tests and demonstrations are fully co-ordinated.

Prepare a fully detailed method statement for the test, commissioning and demonstration stating exactly how these are to be carried out including interface with the fire alarm system. Submit the statement to the Contract Administrator for comment one month in advance of the test.

431 Visual examination

Visually examine the installation, including the following:

- Check for segregation to BS 7671.
- Check that all items are correctly and safely installed
- Check that the system is correctly earthed.
- Check continuity of system.
- Check all equipment is operational.

432 Testing

Undertake the following testing and commissioning procedures:

- Test all devices and demonstrate that the system meets the overall operation and control functional requirements detailed.
- Calibrate and set all speaker outputs, microphone units, and amplifier / control units.

- Calibrate and set all amplifier outputs and adjust volume control as appropriate.
- Carry out a full speech intelligibility test using the Room Acoustic Speech Transmission Index (RASTI) method. Ensure that the emergency voice communication system EVC obtains a minimum of 0.5 in all accessible parts of the installation.
- Carry out a subjective check of the sound output in all areas using a person with normal hearing.
- Carry out a functional test of the complete system to ensure the correct operation of the system to the satisfaction of the Contract Administrator.
- Where applicable carry out a full functionality test of the voice evacuation system (VES) to demonstrate full integration with the fire alarm system (FAS) during FAS operation
- Where applicable commission the voice evacuation system under normal power supply conditions, followed by a simulated power failure that proves that the backup UPS supports the system.

Where applicable, test, prove and commission the interfaces with the following systems under normal and emergency power modes:

- Fire detection and alarm system
- BMS.

Ensure all control arrangements, settings and sequences on completion of commissioning and demonstration are recorded and added to the record drawings, and included within the operating and maintenance manuals.

440 Nurse call

Arrange for the specialist installer to carry out the testing and commissioning of the system as detailed below, in Health Technical Memorandum 08-03, in section W14 of the specification and in BS 7671.

Liaise with the manufacturers of any interfaced systems to ensure all tests and demonstrations are fully co-ordinated.

441 Visual examination

Visually examine the installation, including the following:

- Check for segregation to BS 7671.
- Check that all items are correctly and safely installed
- Check that the system is correctly earthed.
- Check the continuity of the system.
- Check all equipment is operational.

442 Testing

Undertake the following testing and commissioning procedures:

- Test all devices and demonstrate that the system meets the overall operation and control functional requirements detailed within the specification.
- Cary out a functional test of the complete system ensuring the correct operation of all devices.

443 Commissioning

- Demonstrate the complete system to the Contract.

~ Once accepted by the Contract Administrator, demonstrate the complete system to the end user.

~ Provide a hard copy print of the events recorded during the commissioning.

~ Issue a system verification certificate.

450 Vertical or horizontal busbar systems

Test all busbar systems fully in accordance with BS 7671 and to the requirements specified in section Y62 of this specification.

Carry out the following tests:

~ Visual inspection

~ Insulation tests

~ Earth bonding and continuity tests.

460 Lighting and power installations

For all lighting and power installations, inspect and test the complete installation fully in accordance with BS 7671.

Carry out the inspection and tests in the same sequence as set out in BS 7671, and in such time as to allow any remedial work to be completed within the contract period.

Prior to void-closures, carry out, as a minimum, insulation resistance testing to all mains voltage cabling, and supply the results to the Contract Administrator for comment.

Ensure tests also include any part of an existing installation related to the new work. Carry out the following BS 7671 tests before making the system live:

~ Visual inspection, including verifying that:
  - o the cable containment is supported adequately;
  - o all luminaires are complete with lamps and accessories;
  - o lamps are of the correct colour, rating and manufacturer selection;
  - o control devices have been correctly installed;
  - o all switch plates align straight and true;
  - o all required labelling has been provided;
  - o luminaires and lamps are in clean condition;
  - o SPDs are operational;

~ Continuity of protective conductors including main and supplementary equipotential bonding;

~ Continuity of ring final circuit conductors;

~ Insulation resistance, ensuring that devices such as AFDDs and SPDs are not damaged, or cause incorrect results when the test is performed;

~ Site applied insulation resistance;

~ Verification of protection by separation of circuits;

~ Verification of protection against direct contact by barrier or an enclosure provided during erection;

- ~ Electrical resistance of floors and walls that provide protection against direct contact;
- ~ Polarity;
- ~ Earth electrode resistance;

Carry out the following BS 7671 tests after making the system live:

- ~ Earth fault loop impedance;
- ~ Prospective fault current;
- ~ Functional testing (testing of RCDs, RCBs, AFDDs, interlocks, etc).

Test and commission the lighting system in accordance with CIBSE Commissioning Code L.

Engage the specialist equipment installer/manufacturer to set up, prove the operation and function and fully commission the lighting management system together with its associated control devices.

Set up, prove the operation and function and fully commission all individual control devices including switches, presence detectors, photocell sensors, and contactor/relay units, etc.

Carry out adjustments and calibration of all automatic control devices and systems to demonstrate optimum performance and operation.

Record all control arrangements, settings, sequences and functions on completion of commissioning and demonstrations.

Demonstrate the operation of all control functions to the satisfaction of the Contract Administrator and Employer’s representative after commissioning has been fully completed.

Provide out-of-hours attendance, as necessary, during periods of darkness, for the demonstration and verification of operation and function of particular lighting systems.

Make average illuminance measurements of the installed lighting system, as recommended by the CIBSE Code for Lighting, throughout all areas of the building. Incorporate the results on the lighting system ‘Record’ layout drawings.

Test the installed lighting system progressively during construction and upon final completion of the whole installation. Test the complete lighting system, including luminaires, control devices and all associated equipment in accordance with the manufacturer’s recommendations.

Measure the installed cable lengths for underwater lighting circuits and submit a report in writing to the Contract Administrator.

Verify that the control devices for underwater lighting operated correctly.

470 Electromagnetic compatibility Issues

Where section W53 of this specification requires that a specialist be employed to report on electromagnetic compatibility issues, ensure that the specialist carries out an ambient electromagnetic interference (EMI) survey of the areas of the building described in section W53, using an appropriate instrument. Make an inspection to ensure that the specialist’s recommendations have been fully implemented before making the electrical system live.

After the electrical system is live but before the protected systems and equipment are operated, arrange for the specialist to carry out EMI tests to confirm that the electric and magnetic field strengths are within the required limits.

Ensure that the EMI survey and tests are carried out in accordance with appropriate standards including BS CISPR 16, BS EN 50147-1 and BS EN 55011.

480 DC supplies and batteries

Carry out, on any dc supply installed, all relevant tests required by BS 7671. Carry out all tests as recommended by the manufacturer on any rechargeable batteries installed, in compliance with a relevant standard such as BS EN 60896–11.and the

~ IET :Code of Practice for Low and Extra Low Voltage Direct Current Power Distribution in Buildings

~ IET: Practical considerations for d.c. installations

490 Street/area/floodlighting

491 Visual inspection

Visually inspect the completed installation to verify that:

~ all cable containment is supported adequately;

~ all luminaires are complete with lamps and accessories;

~ all lamps are of the correct colour, rating and manufacturer selection;

~ all control devices have been correctly installed;

~ all switch plates align straight and true;

~ all required labelling has been provided;

~ all luminaires and lamps are in a clean condition;

Carry out a visual appraisal of the completed and energised lighting system in conjunction with the Contract Administrator.

492 Testing

Fully test the lighting system installation in accordance with BS 7671.

Test the installed lighting system progressively during construction and upon final completion of the whole installation.

Test the complete lighting system, including luminaires, control devices and all associated equipment in accordance with the manufacturer’s recommendations.

493 Commissioning

Engage the specialist equipment installer / manufacturer to set up, prove the operation and function, and fully commission the lighting control system, together with its associated control devices.

Set up, prove the operation and function and fully commission all individual control devices including switches, presence detectors, photocell sensors and contactor/relay units.

Carry out adjustments and calibration of all automatic control devices and systems to demonstrate optimum performance and operation.

Provide out-of-hours attendance as necessary during periods of darkness, for the demonstration and verification of operation and function of particular lighting systems.

After all street and road lighting has been tested and commissioned operate it for a minimum of 100 hours, then take illuminance readings. Ensure that all such readings are compliant section V41 of this specification.

After all floodlights have been tested and commissioned operate them for a minimum of 100 hours and then take illuminance readings. Ensure that all such readings are compliant with section V41 of this specification.

500 PARTICULAR TEST PROCEDURES - CONTINUED

510 Studio/auditorium/arena internal lighting

511 Compliance

Inspect, test and commission the system in accordance with CIBSE Commissioning Code L and BS 7671.

512 Visual inspection

Visually inspect the completed installation and verify that:

- ~ the cable containment is supported adequately;
- ~ all luminaires are complete with lamps and accessories and operating as expected;
- ~ lamps are of the correct colour, rating and manufacturer selection;
- ~ luminaires have been positioned correctly;
- ~ control devices have been correctly installed;
- ~ all switch plates align straight and true;
- ~ all required labelling has been provided;
- ~ luminaires and lamps are in a clean condition.

Carry out a visual appraisal of the completed and energised lighting system in conjunction with the Contract Administrator and employer's representative.

513 Testing

Test the installed lighting system progressively during construction and upon final completion of the whole installation.

Test the complete lighting system, including fixed luminaires, control devices and all associated equipment in accordance with the manufacturer's recommendations.

Test the outlets on lighting patch panels to confirm the correct operation, using a test luminaire.

Provide tabulated copies of all test result sheets

514 Commissioning

Set up, prove the operation and function and fully commission all individual control devices including switches, presence detectors, photocell sensors, and contactor/relay units, etc.

Carry out adjustments and calibration of all automatic control devices and systems to demonstrate optimum performance and operation.

Engage the specialist equipment installer/manufacturer to set-up, prove the operation and function and fully commission the lighting management system together with its associated control devices.

Record all control arrangements, settings, sequences and functions on completion of commissioning and demonstrations and include in the operating and maintenance manuals.

Provide all out-of-hours attendance necessary during periods of darkness, for the demonstration and verification of operation and function of particular lighting systems.

Make average illuminance measurements of the installed lighting system(s), as recommended by the CIBSE *Code for Interior Lighting* and BS 12464, throughout all areas of the building. Incorporate the results on the lighting system record layout drawings.

520 Miscellaneous – motors

521 Motor starters and controllers / motor control centres

Subject the panels, before dispatch, to physical inspection, insulation testing, sequence and component operation testing. Provide certificates recording the works inspections and tests.

Following installation on site, check and provide evidence that all wiring connections are correct.

Check that the functioning of all components and controls is correct, including the correct functioning of all interfaces with associated equipment. Measure power wiring insulation and earth loop impedance and record the results.

Arrange for special units such as variable frequency inverters to be checked and commissioned by their manufacturers, or according to the manufacturers' specific instructions for the units fitted.

Measure and record all motor currents. Set motor overloads to motor nameplate full load currents. Note that star/delta starters normally have overloads installed in the delta loop and set to full load current x 0.58.

Ensure that during commissioning and testing no motor that has reached normal operating temperature is started more frequently than twice in one hour, or according to the motor manufacturer's instructions if different.

Carry out, on any DC supply installed, all relevant tests required by BS 7671 and this specification.

522 Motor drives

Ensure that every belt coupling is accurately aligned and tensioned in accordance with the belt manufacturer's instructions.

Set all starter overloads to the motor nameplate full load current

Where thermistor relay operation is fitted, check it.

With the motor delivering its maximum required duty measure (with suitable true r.m.s. instruments) and record the following:

1. for 3-phase motors - each phase-to-phase voltage (400V nominal); for 1-phase motors – the phase-to-neutral voltage (230V nominal);
2. for 3-phase motors - each phase current; for 1-phase motors – the line current;
3. the motor shaft speed;
4. for belt coupled machines - the driven pulley shaft speed.

530 Earthing and bonding

Where a building is equipped with a lightning protection system, test the system in accordance with this specification, including testing its bonding to other systems, and in accordance section W51 of this specification.

Test that all earthing and bonding is fully in compliance with BS 7671 and BS 7430, and prove all protective conductors are fully in accordance with BS 4444.

Carry out full impedance/continuity testing of all service carriers prior to connecting to the earthing system, to the Contract Administrator’s satisfaction.

On completion of the contract works, carry out all necessary tests to prove the effectiveness of the complete earthing system. Ensure that the earth electrode system achieves an overall resistance as detailed in specification section W51 noting the requirement to provide additional electrodes if the systems fail to meet the specified resistance to earth.

540 Telecommunications

Where external and internal telephone wiring is installed, carry out testing fully in accordance with the telephone service provider's (TSP) specification and section W10 of this specification.

Where internal and site-wide telephone and data wiring form one integral wiring system, test it as detailed in the Data section, clause 550 of this specification section.

Carry out the following tests:

- visual inspection, verifying that:
  - the cable containment is supported adequately;
  - control devices have been correctly installed;
  - all cabling is correctly installed and secured;
  - all required labelling has been provided;
- continuity of protective conductors including main and supplementary equipotential bonding;
- verification of protection by separation of circuits;
- verification of protection against direct contact by barrier or an enclosure provided during erection.

550 Data

551 General

Thoroughly test the cabling installation to confirm that the components and installation practices meet the defined standards in W30 and any specific client specifications.

552 Testing

553 UTP cable tests

Test all UTP horizontal and riser cables, following installation, for:

- pair polarity;
- crossed pairs;
- continuity;
- short circuits;
- length;
- attenuation;
- cross talk (near and far end);
- PS-NEXT;
- EL FEXT;
- PS-ELFEX;
- propagation delay;

~ delay skew.

Check the results against declared published results for the types of cable used and notify the Contract Administrator of any variations.

Ensure each pair in each link is tested from both ends and the worst pair results used as the test result.

554 Fibre optic cable tests

Test all optical fibre cabling on the reel prior to installation using a light meter.

Do not use cables with any identified faults; remove such cables from site.

Test all fibre optic cables following installation, including the following tests:

~ visual check for damage to each terminated connector;

~ Optical time-domain reflectometer (OTDR) from both ends;

~ attenuation measurement using a light source and power meter;

~ front-lit microscope examination at 200X, for each termination connector.

Examine each optical element for the following:

~ random mated loss at connectors;

~ sudden step in attenuation coefficient or back scatter;

~ losses due to excessive bending;

~ different lengths recorded at each end of an element.

Record the following test results, for each end of each cable:

~ length;

~ random mated loss of each mated connected pair (to a resolution of 0.02db or better).

555 Test equipment

Provide a valid calibration certificate that is less than six months old for each item of test equipment brought to site to measure performance data. Make the calibration certificate available for inspection on site.

Ensure UTP test equipment can provide Level II accuracy for both channel and basic link in accordance with requirements of the American National Standards Institute (ANSI) Technical Services Bulletin EIA/TIA TSB67.

Ensure all fibre optic test equipment complies with the appropriate standards.

Ensure the light source and power meter pair provide attenuation accuracy better than 0.02db and operate at 850nm and 1310nm.

Provide microscope(s) for inspection of terminated fibre optic connectors, conforming to the following:

~ magnification of 200X minimum;

~ allow connection of SC connectors;

~ built-in front illumination;

~ built-in infra-red blocking filter.

Maintain full records of all testing carried out and the results of the tests, and include in the operating and maintenance manuals.

560 Radio and television aerial systems

With the system manufacturer, fully test, commission and demonstrate the system in accordance with the manufacturer's recommendations and those of the standards listed in section W20 of this specification, and as detailed below. Liaise with manufacturers of the interfaced systems to ensure all tests and demonstrations are fully co-ordinated.

561 Testing and commissioning

Undertake preliminary checks to ensure that the system and system components are in a satisfactory and safe condition before commencing the commissioning.

On completion of the installation undertake the complete testing, commissioning and demonstration of the system operation in accordance with the British Standards to verify the following.

- correct antenna alignment;
- correct signal strength for all digital TV channels (terrestrial and satellite);
- correct signal strength for all FM channels;
- correct signal strength at every outlet.

562 Commissioning

Undertake operational selective viewing and/or listening tests on all channels provided, at each co-axial socket outlet including any reconnected existing outlets to demonstrate the following:

- that all channels and teletext operate satisfactorily;
- there is no discernible difference in picture, sound or teletext quality of the same receiver, whether connected to the co-axial socket outlets specified or to the aerial input of the head-end equipment, using attenuators if necessary;
- measuring and recording of the signals levels throughout the system at the input and output of each amplifier and at the output of the antenna(s) head-end equipment;
- the operation of the TV sound and volume control at each outlet.

Record all signal dB losses and signal strength throughout the system on completion of the commissioning and demonstration, and include this information on the as-fitted" drawings and within the operating and maintenance manual.

Issue a system test certificate detailing compliance with all the relevant British Standards and this specification.

570 Surveillance system

Arrange for the specialist surveillance system installer to carry out the testing and commissioning of the system as detailed below and in section W42 of the specification. Comply with the requirements of BS EN 50132-1 & NACP 20

571 General

On completion of the installation and working with the specialist equipment manufacturer carry out the complete testing, commissioning and demonstration of the system operation as detailed below.

Ensure that CAD record drawings of the surveillance system are completed and available on site to the manufacturer prior to commissioning commencement.

Return to site one month after Practical Completion to prove the recording archive capacity.

572 Testing

Carry out tests according to the relevant system specification section and the following:

- Check every video cable for continuity and shorts to earth. Check through every video line to ensure that all terminations are set correctly.
- Check that the correct lens is fitted in line with the specification. Set up the lens focus and back focus of the camera. If automatic iris lenses are fitted, adjust the peak/average and level potentiometers. Check that the field of view is as required.
- Where zoom lenses are fitted, check that the scene remains in focus throughout the zoom range.
- Check the dwell time and sequencing of standard video switchers. In the case of matrix switchers set up the dwell times and sequences for each monitor. If there is a master/slave situation, ensure that the units are correctly located with the master control at the main control location.
- Check that all functions are operating correctly and that end stops are set as required. Make sure that the pan right and tilt down controls correspond to the right direction of movement. If pre-set positions are incorporated, set them up according to the manufacturers' instructions and to the specified fields of view.
- Set the time, date and camera titles. Programme the multiplexer according to the video recorder in use.

For external systems, carry out the main programming at night under the worst lighting conditions.

On completion, undertake full performance tests on the entire system. Ensure that the entire system satisfies all test criteria, and in particular ensure the system conforms to NACP 20 requirements.

Before demonstrating the system, submit to the Contract Administrator full tests results, as well as a certificate of conformity that lists details of all aspects of the system that do not conform to the intended requirements.

573 Commissioning

Obtain all permissions and consent as might be necessary to remain compliant with the requirements of the General Data Protection Regulations.

After testing has been successfully carried out, demonstrate all applicable functions to the Engineer, including but not limited to demonstrating the following:

- All wiring is correctly terminated and labelled;
- Camera and lens are fitted correctly for each position to achieve the desired field of view;
- Effective operation of all cameras in different light levels;
- Correct setting of all pan and tilt limits and associated automatic control;
- Correct supply voltage at all parts of the system;
- Effective operation of supplementary lighting;
- Operation of recording systems under alarm and steady-state conditions;
- Recording and display of the system under all alarm conditions;
- Search and retrieval of all types of recorded surveillance data;
- Operation of all software functions;
- Effective operation of video analysis software;
- Walk tests with any volumetric-device-operated cameras;

~ The system continues to work when the main power supply is disconnected.

Change lenses as required where the required field of view is not achieved.

Capture and record images of the specified targets, and of the Rotakin test described below, on the system, under both normal lighting conditions and under lowest light conditions.

Demonstrate the compliance of the surveillance system to the above requirements by performing a series of tests using a standard Rotakin® target to simulate a “person” as referred to above. Ensure that the resolution of the recorded images as viewed on screen is such that the lines at marking *reference C* on the target can be distinguished when the target occupies 100% of the vertical dimension of the screen at 25 images per second.

Export these images to a protected USB solid state drive.

Demonstrate to the Contract Administrator that the content of the USB drive can be viewed in full resolution and at full frame rate on a standard personal computer operating on a Microsoft Windows operating system, without the need for special software.

Demonstrate to the Contract Administrator that, when the content of the USB drive is viewed through a standard, non-networked personal computer, the images are of such quality that a viewer is able to achieve all of the following:

~ **monitor** the movement of a person or persons, when the figure occupies 5% of the vertical dimension of the screen;

~ **detect** a person when the figure occupies 10% of the vertical dimension of the screen;

~ **recognise** a known person when the figure occupies 50% of the vertical dimension of the screen; and

~ **identify** beyond reasonable doubt an unknown person when the figure occupies 120% of the vertical dimension of the screen.

Demonstrate all functions of the surveillance system to the user after successful demonstration to the Contract Administrator.

Test the Surveillance system of sports grounds to demonstrate compliance with the requirements of PSDB 14/95 and appendices B, C & D of PSDB 09-01.

580 Lightning protection and surge protection

Ensure that the complete lightning protection system and surge protection devices are fully tested by the specialist installer all in accordance with BS EN 62305.

Make provision for witnessing of the testing procedure by the Contract Administrator.

With its test link removed and without any bonding to other services, measure the earth resistance of every individual earth electrode. Ensure such resistance in ohms does not exceed ten times the number of down conductors on the structure.

Measure with the test links in place the resistance to earth of the complete lightning protection system at any point on the building. Ensure that all results from this test do not exceed ten ohms. Carry out this test prior to bonding to other services. If the overall resistance exceeds ten ohms provide, at no additional cost to the employer, any means (e.g. the addition of earth mats or plate electrodes) as recommended by BS EN 62305, to reduce the overall resistance.

Fully tabulate all test results and record in the operating and maintenance manuals

Y81 TESTING AND COMMISSIONING OF ELECTRICAL SYSTEMS

590 Thermal imaging/acoustic vibration testing

In locations where a thermal image survey of cable terminations, busbar field connections and general switchboard components, or an acoustic vibration test, is specified:

- Carry out the survey using a thermal imaging camera capable of producing a hard copy or of producing a digital image that can be viewed on a computer and printed therefrom.
- Arrange for the survey to be carried out by a specialist company or for the camera to be operated by a person specifically trained in its use.
- Carry out an acoustic vibration survey to ascertain the origin of any unusual or unacceptable noise.

600 PARTICULAR TEST PROCEDURES – CONTINUED

610 PHOTOVOLTAIC SYSTEMS TESTING AND COMMISSIONING

611 General

Test and commission the electrical elements of the installation in accordance with BS 7671. Follow the procedure set out in *Photovoltaics in Buildings – Testing, Commissioning and Monitoring Guide* as published by ETSU for the Department for Trade and Industry.

Ensure commissioning of the PV system is carried out by a competent person.

Provide a minimum of 15 days' notification e to the DNO for their attendance at ENA Engineering Recommendation G98 and G99 witnessing tests. Provide the DNO with all necessary protection test results as is required under ENA Engineering Recommendation G98 and G99, including those required even in the absence of DNO attendance.

612 Commissioning following installation

Conduct a thorough visual examination of the system to ensure components have not been damaged during installation. Test all AC and DC isolation devices to prove their proper function.

Verify the correct operation of any inverters and associated control and protection systems before the PV system is connected to the grid.

For electrical outputs, up to and including 16 A, comply with the relevant requirements of ENA ER G98.

For electrical outputs, greater than 16 A per phase but less than 50 kW (3 phase) / 17 kW (1 phase), comply with the relevant requirements of ENA ER G99. Provide attendance for witness testing by the DNO (at their discretion).

For electrical outputs installed greater than 50 kW comply with the relevant requirements of ENA ER G99. Provide attendance for witness testing by the DNO for HV connections, and LV connections (at their discretion).

613 Site acceptance tests and demonstrations

Perform a full system site acceptance test after commissioning during hours of daylight. Ensure that final commissioning of the PV system is undertaken with a minimum irradiation level of 600 W/m².

Once the generation system is commissioned, issue a 'G98/G99 Commissioning Confirmation' form and an operation diagram to the DNO within 28 days. Record the results of the testing and commissioning procedures and include within the operating and maintenance instruction manuals.

As part of witnessing, measure solar irradiance and demonstrate that the output of the PV systems equals or exceeds the manufacturer's declared performance for those conditions.

Demonstrate that the instantaneous efficiency of the installed solar PV system meets that specified using a calibrated reference device to measure incident irradiance falling on the PV system.

Use either a pyranometer, PV reference cell or other solar irradiance tool as the calibrated reference device and allow for any temperature-related compensation effects.

Ensure that the energy generation validation specified in V17 is undertaken and the results documented and included with the test results.

Record the testing and commissioning results and include within the operating and maintenance instruction manuals. Include full details of all protection and other settings of the system within the operating and maintenance instruction manuals.

620 Integrated system test

621 General

Carry out on completion of the installation works and after successful commissioning of all systems, the complete testing, commissioning and demonstration of the integrated systems operation as outlined below. Develop, complete and produce a comprehensive test plan for comment by the Contract Administrator at least two weeks before the test.

Ensure that critical systems included within the integrated system test include all systems interfaced with life-safety systems, including but not limited to:

- Security and access control systems;
- Lift and escalator systems;
- Safety systems;
- Warning systems (eg water leak detection);
- Building management systems;
- Systems provided for safe operation of the development (eg mechanical ventilation to enclosed space or critical equipment);
- Power distribution systems (eg HV and LV distribution, switchgear, automatic transfer switches etc);
- Fire detection and alarm systems;
- Fire suppression systems (eg sprinkler, wet riser).

Incorporate and test the monitoring of all non-critical systems status as part of the integrated system test.

Make available suitable operatives, familiar with all the relevant systems that will be affected, as required to facilitate and assist during testing. Ensure that record drawings of all relevant systems are completed and available on site prior to test commencement. Provide necessary access and communication equipment during the test to all attendees.

Carry out tests comprising simulated faults artificially imposed on the systems. Check all visual units, alphanumeric displays, and printers to establish that all programmed messages are displayed correctly. Carry out functional demonstrations of correct operation of all control panel switches.

Fully demonstrate the complete operation of the systems to the satisfaction of the Contract Administrator and, where appropriate, the Building Control Officer and the Fire Officer.

622 Activities to be conducted prior to test

Submit and gain approval for a comprehensive cause and effect schedule complete with detailed method statement for the test. Plan for and co-ordinate the test with the required parties, arranging for it to be completed "out of hours".

Carry out a visual inspection of the whole of the installations and obtain confirmation that all life-safety, critical and non-critical systems are fully functional with no errors or alarms prior to starting the test.

Confirm that the test can proceed without risk to people and property and all the necessary notifications have been issued to the affected parties.

623 System test

Complete the approved integrated system test of life-safety systems with all associated interfaced systems. Carry out tests to demonstrate that the operation, interaction and coordination of multiple individual systems perform their intended function, including but not limited to:

- ~ All life-safety and critical systems continue to operate under partial incoming power failure.
- ~ Relevant life-safety systems and critical systems continue to operate under full incoming power failure (eg fire detection and alarm system, access control outstations).
- ~ All life-safety and critical systems return to normal operation when power returns with no intervention.
- ~ Critical communication and network equipment.
- ~ Critical cooling systems.

624 Tests to be carried out

Detail tests to be carried out, including, but not be limited to, the following:

- ~ Incoming site main power failure: systems expected actions and operations;
- ~ Incoming site main power return: systems expected actions and operations;
- ~ Site secondary power failure: systems expected actions and operations;
- ~ Site secondary power return: systems expected actions and operations;
- ~ Incoming site main and secondary power failure: systems expected actions and operations;
- ~ Incoming site main and secondary power return: systems expected actions and operations.

625 Activities to be conducted on completion of the test

Repair or modify any parts of the system that failed any test, to ensure that the reason for the failure will not be repeated.

Repeat the test if deemed to be required by the Contract Administrator, performing all necessary work until the integrated test is completed to the satisfaction of the Contract Administrator with all elements fully functional as expected.

Return all systems to normal operational status and notify the affected parties that the tests are complete.

Complete all the test documentation and issue to the Contract Administrator.

626 Documentation

Document all the tests and results. Describe the sequence of any actions required to return the systems to normal operation.

Include the test plan, cause and effect schedule, method statements and test results in the operating and maintenance manual.

700 INSTRUMENTATION

Supply all test instruments for the tests required. Ensure that all such instruments are calibrated and supply the current calibration certificate for each. Ensure that all such instruments comply with BS EN ISO 10012.

800 CERTIFICATES AND SCHEDULES

Ensure that all completion certificates, test certificates, schedules and reports required by the relevant BS or International or other standards are recorded and produced before handover of the project. As a minimum, provide the following documents for each system:

- works test certificates;
- certificates for type-tested components;
- site commissioning certificates;
- record drawings;
- warranty certificates for the installation and individual components;
- operating and maintenance instruction manuals;
- records of test results, documented to confirm compliance with the design and/or specification;
- schedule of the contact details of the support and maintenance companies for each of the products.

Include copies of all completion certificates, test certificates, schedules and reports within the operating and maintenance manuals at completion of the project.

END OF SECTION Y81

Y82 IDENTIFICATION OF ELECTRICAL SYSTEMS

CONTENTS

Y82 IDENTIFICATION OF ELECTRICAL SYSTEMS

100 REFERENCE DOCUMENTS

This specification is written based on legislation, standards and guidance in force in the UK generally, and within England by default. For projects in Scotland, Wales, Northern Ireland, the Channel Islands and the Isle of Man, give appropriate consideration to any locally applicable legislation, standards and guidance that deviates from or is additional to those in force within England. Similarly for projects outside the UK comply with the corresponding national legislation, standards and guidance.

Comply fully with the edition (including amendments, replacements and normative references) of each of the following, current at the time of tender.

Where a standard referred to in this section conflicts with a standard referred to in an associated 'engineering system' section (eg S10, T31, V21, etc) of this Specification, the standard referred to in the engineering system section prevails.

The Health and Safety (Safety Signs and Signals) Regulations

BS 1710	Specification for identification of pipelines and services
BS 3858	Specification for binding and identification sleeves for use on electric cables and wires
BS 4781	Specification for pressure-sensitive adhesive plastics labels for permanent use
BS 4800	Schedule of paint colours for building purposes
BS 4999	General requirements for rotating electrical machines
BS 5070	Engineering diagram drawing practice
BS 5306	Code of practice for fire extinguishing installations and equipment on premises
BS 5472	Specification for low voltage switchgear and controlgear for industrial use. Terminal marking and distinctive number. General rules
BS 5499	Graphical symbols and signs. Safety signs including fire safety signs
BS 6272	Specification for low voltage switchgear and controlgear for industrial use. Terminal marking. Terminals for external associated electronic circuit components and contacts
BS 7671	Requirements for electrical installations. IET Wiring Regulations
BS EN 60073	Basic and safety principles for man-machine interface, marking and identification. Coding principles for indicators and actuators
BS EN 60445	Basic and safety principles for man-machine interface, marking and identification. Identification of equipment terminals, conductor terminations and conductors
BS EN 60447	Basic safety principles for man-machine interface, marking and identification. Actuating principles
BS EN 61082-1	Preparation of documents used in electrotechnology. Rules
BS EN 61439	Low-voltage switchgear and controlgear assemblies
HSE L64	Safety signs and signals. The Health and Safety (Safety Signs and Signals) Regulations 1996. Guidance on Regulations

HTM 06-01	Health Technical Memorandum 06-01: Electrical services supply and distribution
HTM 06-02	Health Technical Memorandum 06-02: Electrical safety guidance for low voltage systems
HTM 06-03	Health Technical Memorandum 06-03: Electrical safety guidance for high voltage systems

200 GENERAL

Provide all identification labels and notices in accordance with BS 7671.

Install warning, caution and instruction notices where indicated in the engineering system sections of this Specification or on the drawings, or where required, to ensure safe operation and maintenance of electrical systems and of the items to which they connect.

Fix a warning notice in all positions where there are live parts which are not capable of being isolated by a single device. Ensure that warning notices state the location of each isolator. Ensure that every such warning notice is in a prominent position and clearly visible before access to the live parts can be gained.

Ensure that, where a nominal voltage exceeding 230V exists, a warning label stating the maximum voltage is present and clearly visible.

Ensure that all identification labels and notices are installed in a visible position, without interference to the operation and maintenance of equipment.

Ensure that labels and notices are sized in proportion to the equipment on which they are mounted and that they are securely fixed.

Obtain agreement from the Contract Administrator, with regard to style, colour, lettering, size and position of all labels and notices. Provide samples, at no cost to the contract, for the Contract Administrator’s acceptance.

Identify every termination and joint box by an externally fitted label indicating the type of service contained, such as ‘bells’, ‘radio’, ‘fire alarm’.

210 Materials and marking

Ensure that materials used for labels and notices have a predicted lifespan equal to or greater than the lifespan of the installation to which they refer.

Ensure that labels and notices which are fitted outside buildings use the appropriate material and marking method from the following list:

~ rigid, laminated, ABS substrate material, of three or five layers of different colours, machine engraved in a contrasting colour [eg Traffolyte]

~ rigid plastic, hot press printed

~ pressure sensitive labels to BS 4781, printed

~ brass, engraved

~ stainless steel, engraved

Ensure that labels and notices which are fitted within buildings use the appropriate material and marking method from the following list.

~ rigid, laminated, ABS substrate material, of three or five layers of different colours, machine engraved in a contrasting colour [eg Traffolyte]

~ thermosetting rigid plastic, screen printed

~ flexible plastic, screen printed or manuscript lettering

~ rigid plastic, hot press printed

~ pressure sensitive adhesive labels to BS 4781, printed

~ aluminium or aluminium alloy, letter pressed, letter engraved or letter embossed

~ stainless steel, engraved

220 Fixing

Ensure that fixing methods and materials have a predicted lifespan equal to or greater than the lifespan of the installation to which they are applied.

Fix every label and notice using materials compatible with it and with the surface to which it is being fixed. Use only non-corrodible fixings for external labels and notices.

Thoroughly clean surfaces of dust, loose materials and protective/oily films before fixing labels and notices to them. Fix labels and notices to a surface only after all finishing to that surface is complete.

300 LABELLING OF EQUIPMENT

310 Cables

Provide all cables including those routed underground, on cable trays, on cable ladders or in wire baskets, except final sub circuit wiring enclosed in conduits or trunking, with identification labels.

Fix each underground cable with a label at each point it emerges from or enters the ground.

Identify all cables using a proprietary alphanumeric marker system similar to ‘Critchley’ manufacture or an accepted equivalent. Provide for the cable reference at both ends of the cable, at either side of wall/ floor/ roof penetrations, and at every fourth floor within the riser and include in the tender for up to fourteen (14) alphanumeric characters. When cable markers with a Limited Fire Hazard (LFH) rating are required, zero halogen markers made from self-extinguishing material shall be provided.

Ensure that all cable identification labels provide a ‘unique reference number’ to include the following information unless agreed otherwise with Contract Administrator:

~ points of termination (ie the locations where the cable starts and finishes)

~ size and number of conductors

~ type of cable (eg LSZH, XLPE, PVC)

~ operating voltage of cable

311 Cable conductor colour coding

Identify cable conductors in accordance with BS 7671; note that a lighting sub-circuit switch wire is a phase conductor in a single phase circuit.

312 Cable sheath identification

Submit for agreement by the Contract Administrator the colour and coding methods of both internal and external cable sheaths.

Ensure that fire alarm cables use red, telephone and data cables use grey, intruder alarm and nurse call cables use white, television aerial cables use brown and speaker cables use black unless otherwise stated in the system sections of this Specification.

Y82 IDENTIFICATION OF ELECTRICAL SYSTEMS

313 Terminal marking and conductor identification

Apply identification markers, in accordance with BS 7671, to all conductor termination points.

Arrange for the manufacturer of switchgear and controlgear to mark their terminals in accordance with BS 5472 and BS 6272. Use a unique reference to identify each element in the switchgear or control gear. Mark the unique reference on or adjacent to each element. Identify each terminal for connection to external wiring or cabling using a reference system complying with BS EN 60445 based on the element reference and the appropriate element terminal reference.

Use lettered or numbered ferrules or sleeves to BS 3858 to mark each core, cable, auxiliary conductor, control cable core or any other conductor not otherwise obviously identifiable. Mark all cores, cable and conductor within all switchgear, controlgear, distribution boards, and all other enclosures with the identity of the terminal to which it is connected and the reference of plant or equipment to which it is connected and the identity of the terminal at the remote end.

Identify the main circuit conductors in accordance with BS 7671.

Ensure that the material of cable markers is at least the same standard, or better, as the cables they identify, ie LSZH.

314 Underground cables

Provide cable route markers in accordance with section Y61 of this Specification, and upon each of them clearly indicate the following information:

- type of cable and date installed
- operating voltage of cable
- depth at which cable is buried

Mark and protect direct buried cables with one of the following:

- concrete cable covers
- clay ware cable covers
- recovered plastic cable tiles
- recovered plastic cable tiles with integral yellow printed black warning tape
- plastic tape yellow printed black

320 Conduit and trunking colour coding

In areas of mechanical plant or voids accommodating mechanical services, or where otherwise indicated in the ‘engineering system’ sections of this Specification or on the drawings, identify electrical conduits in accordance with BS 1710. Apply colour ‘orange’ to BS 4800, by one of the following methods:

- painting on service as a band over 150 mm
- applying an adhesive tape (of wrap-around type services) over a length of 150 mm

Place such identification colours at bulkheads, wall penetrations and any other place where identification is necessary.

330 Switchgear

Ensure that all switchgear is fitted with labels in accordance with BS 7671 and BS EN 61439 to indicate duty of unit, its voltage, phase and current rating, protective device rating, size of conductor involved, and all other necessary details.

Use an agreed serial coding system, and provide at the switch a legend of the coding system.

Identify loose switchgear such as fused switches, switch fuses, distribution boards, isolators, indicating switches, starters and control switches controlling remote equipment, by fitting an external label or engraving, indicating the equipment controlled.

340 Distribution boards

Clearly identify the circuit ways either by the miniature circuit breaker or fuse bases and carriers being indelibly numbered in an accepted manner or by a label. Use a numbered plan or a printed statement held in a pocket on the inside of the door, to the effect that the numbering of the ways is from left to right, or top to bottom.

Internally

Identify every outgoing way with a renewable circuit chart, in a transparent plastic envelope, permanently fitted inside the cover of every distribution board.

Clearly indicate for each circuit, in typed script, the following information:

- ~ circuit identification number
- ~ cable size
- ~ fuse or circuit breaker rating (including whether an RCD or not)
- ~ description of item supplied and area supplied by circuit

Label all cable connections internally with their circuit reference. Use lettered or numbered ferrules or sleeves to BS 3858.

Externally

Clearly identify each distribution board, with a label that is compatible with the schematic and wiring diagrams, and complies with BS 7671.

350 Motor and starter labels

Fit identification labels to all motors, starters and starter panels. Ensure the positive identification of respective motors and starters. Ensure that all such labelling is compatible with schematic and wiring diagrams and complies with BS 4999-103.

Check that every motor bears secure markings indicating the type of lubricant to use (if any) at its bearings and its correct direction of rotation. Where it does not, notify the Contract Administrator.

Check that every motor fitted with surge suppressors or thermistors bears secure markings indicating that insulation test voltages must not be applied. Where it does not, notify the Contract Administrator.

360 Colour corrected luminaires

Fit a warning or identification disc under the lamp(s) of luminaires containing colour corrected fluorescent tubes or other corrected light sources, to remind maintenance staff to install the correct lamps.

370 Plant and equipment labels

Label all electrical plant and equipment with the labels specified in the appropriate British Standards for that plant or equipment.

Fit labels on all items of electrical equipment, switches, etc, that include the following information:

- ~ service controlled
- ~ circuit reference

- voltage and number of phases
- circuit protection type and rating

Label all 'accessory boxes' internally with their circuit reference.

Identify externally the mid-point of each ring main circuit.

Engrave switchplates, spur units, pushes and special plates for bedhead units, call systems, fire alarms, kitchen appliances, etc, as indicated in the ‘engineering system’ sections of this Specification or on the drawings. Use 6 mm high letters with engraving (in a contrasting colour), except where otherwise stated.

Where voltage above ELV exists, label all electrical plant and associated controlling equipment, using safety signs.

380 Indicator lamps and push buttons

Use indicator lamp and push button colours in accordance with BS EN 60073.

390 Final circuit accessories

Label all electrical final circuit accessories such as socket outlets, fused connection units, cooker outlets, isolators etc., with labels that indicate the circuit reference, unless instructed by the client that the accessories must be not labelled. Label the back boxes when the client has indicated that no label must be placed on the outside surface.

Ensure that, where additional protection by RCD is not provided, socket outlets with a rated current not exceeding 20A and mobile equipment with a current rating not exceeding 32A for use outdoors are provided with a label indicating the particular item of equipment it serves.

Label all 'back boxes' internally with their circuit reference.

Identify externally the mid-point of each ring main circuit.

Use 6 mm high letters with engraving (in a contrasting colour), except where otherwise stated.

Where voltage above ELV exists, label all electrical plant and associated controlling equipment, using safety signs.

400 SIGNS NOTICES AND DIAGRAMS

410 Safety signs

Ensure that all safety signs comply with HSE L64.

Ensure that each safety sign is of the correct type and complies with BS 5499.

Provide with each safety sign supplementary or text signs complying with BS 5499.

Identify each substation and main switchroom with safety signs and supplementary signs complying with BS 5499 and, for any associated fire extinguishing system, with BS 5306. Ensure that all such notices and signs give details of:

- name of the substation or switchroom
- the presence of high and low voltages
- administrative instructions for access
- location and method of contacting controlling authority
- actions to be taken in emergency

Y82 IDENTIFICATION OF ELECTRICAL SYSTEMS

420 Additional safety signs

Provide additional safety signs at locations shown on the drawings or noted in the engineering system sections of this Specification or as appropriate, in accordance with BS 5499. Ensure that all such additional safety signs comply with HSE L64.

430 Maintenance notices

Fix notices giving warning of and instructions on, any special maintenance procedures to plant and equipment to ensure that people are informed before maintenance is carried out. An example is for a standby generator; “Do not isolate the power supply to a sprinkler water pump without first obtaining a ‘permit to work”.

Upon completion of the installation or maintenance work, ensure that notices of periodic inspection and testing are fixed in a prominent position at every installation.

440 Schematic diagrams

Permanently fix to a nearby wall of the room, a purpose made schematic diagram, showing all the electrical connections to equipment and plant served at the following locations:

- ~ at main switchgear
- ~ at sub-main switchgear

Ensure that all such diagrams and symbols comply with BS 5070 and BS EN 61082-1.

Ensure schematic is at least A3 drawing size and mounted in picture frame.

450 Earthing

Adjacent to the final connection of the electrical system of the building to the earth electrode or earthing terminal, provide a clear and permanent warning label stating “Safety Electrical Connection – do not remove”.

Fit labels describing the purpose and instructions for operation and maintenance to all special purpose earthing conductors [eg ‘clean earths’ for IT networks] and connection points.

Label main earth bonding cables in the same manner as submain cables.

460 Shock treatment card

Provide a copy of the ‘Electrical Times’ Shock Treatment Card at each main switch panel position. Ensure that the card gives the following information:

- ~ instructions for isolating a person from live conductors
- ~ artificial respiration and resuscitation methods
- ~ location of the nearest telephone and the telephone number of whom to contact for assistance

470 Periodic inspection and testing notice

Fix a periodic inspection and testing notice in accordance with BS 7671.

480 Alternative supplies

Fix warning notice for all alternative or multiple supplies in accordance with BS 7671.

490 Non-standard colours

Fix warning notices to BS 7671 where the installation contains wiring colours under different versions of BS 7671.

END OF SECTION Y82

Y89 SUNDRY COMMON ELECTRICAL ITEMS

CONTENTS

Y89 SUNDRY COMMON ELECTRICAL ITEMS

100 REFERENCE DOCUMENTS

This specification is written based on legislation, standards and guidance in force in the UK generally, and within England by default. For projects in Scotland, Wales, Northern Ireland, the Channel Islands and the Isle of Man, give appropriate consideration to any locally applicable legislation, standards and guidance that deviates from or is additional to those in force within England. Similarly for projects outside the UK comply with the corresponding national legislation, standards and guidance.

Comply fully with the edition (including amendments, replacements and normative references) of each of the following, current at the time of tender.Where a standard referred to in this section conflicts with a standard referred to in an associated ‘engineering system’ section (eg S10, T31, V21, etc) of this specification, the standard referred to in the engineering system section prevails.

Building Regulations	Approved Document M: Access to and use of buildings
	Approved Document B: Fire Safety
Disability Discrimination Act	
BS 5839	Fire detection and fire alarm systems for buildings
BS 5266	Emergency lighting
BS 7671	Requirements for electrical installations. IET Wiring regulations
BS 8300	Design of buildings and their approaches to meet the needs of disabled people
BS EN 61537	Cable management. Cable tray systems and cable ladder systems
BS IEC 60050	International Electrotechnical Vocabulary
CAE & RIBA	Designing for Accessibility

200 GENERAL

210 Definitions

Use the definitions given in BS 7671. Where a term is not defined in BS 7671, use that given in BS IEC 60050.

220 Electricity supply

Ensure that the electricity supply provided is at 400/230V, 50Hz, 3-phase, 4-wire, unless detailed otherwise in the ‘engineering system’ sections of this specification. Check that the fault level at the origin, and the earth-loop impedance external to the installation, is as given in the ‘engineering system’ sections of this specification and inform the Contract Administrator if they are not. Ensure that the size and rating of the overcurrent device at the origin, and the method of earthing used in the installation, is as given in the ‘engineering system’ sections of this specification or as indicated on the drawings.

230 Design criteria

The main distribution schematic diagram and/or the ‘engineering system’ sections of this specification, indicates the design criteria applicable at the time of tender.

Do not make any change to the installation that invalidates such design criteria without prior written agreement from the Contract Administrator.

Y89 SUNDRY COMMON ELECTRICAL ITEMS

300 PRODUCTS AND MATERIALS

310 Faulty materials and workmanship

Replace any material or installation rejected under clause A33 at no cost to the contract including all costs arising from any associated building works or the works of other trades, together with all costs arising from delay in the replacement of rejected items.

320 Supports and fixings

Comply with specification sections Y63 and Y93.

Supply and install complete all necessary support steelwork, including brackets and suspension/ threaded rods etc to support the electrical installation defined in this specification and shown on the drawings.

Provide corrosion resistance to the minimum levels appropriate to the environment as specified in relevant standards (eg BS EN 61537 minimum Class 1 (electroplated) for internal heated spaces and minimum Class 5 (post galvanised zinc costing) for external areas unless otherwise defined in the 'engineering system' sections of this specification).

Do not fix electrical services to any support steelwork that is subject to vibration or heat transfer.

Do not support electrical services from any suspended tile ceiling system but provide independent support fixings.

400 ANCILLARIES

410 Fire and smoke barriers

Fit sleeves or transit frames around cables (including those supported by trays, wire trays or cable ladders), and fire-seal the gap between them and the cable(s), as appropriate, wherever electrical installations pass through fire and smoke barriers (including compartment walls and compartment floors). Provide and fit, at all fire or smoke barriers, internal fire stopping to conduits, trunking, ducts and busbar products that have internal space that can conduct combustion products.

Carry out all such work to the requirements of Building Regulations Part B and those of BS 7671.

Arrange the integrity of the fire and smoke barriers through which such cables, conduits, trunking, busbar systems, etc, pass, by advising the Contract Administrator of the need to arrange for making good around the sleeves, transit frames and trunkings with appropriate fire stopping materials.

420 Expansion joints

Ensure that every expansion joint in conduits, trays, trunkings and busbar enclosures/trunking is of a recognised pattern supplied by the appropriate equipment manufacturer.

Loosely clamp within the adjacent fixing saddles/cleats to allow movement, and where necessary install formed loops' at each cleated cable crossing at expansion joints.

430 Enclosures

Install all site-fitted electrical components (including relays, contactors, RCDs) that are not installed within a distribution board, consumer unit or control panel, within a proprietary enclosure. Ensure that every such enclosure is ingress protected to suit its location, is manufactured from a material that resists combustion, and is equipped with DIN rails or detachable mounting frames for mounting the equipment.

440 Other sundry components

Ensure that all other sundry components used are proprietary and are of a recognised pattern, supplied by the appropriate service manufacturer.

500 WORKMANSHIP

Comply with the positions and heights given in Y89, and Approved Document M, unless otherwise agreed in writing with the Contract Administrator. Prior to installation of any sockets, switches, controls, etc, agree the positions with the building control authority responsible for the project.

510 Positioning

Comply with the requirements of specification sections A11 and A13.

Check and confirm all measurements and work to the larger scale, formally issued, detail plans in the possession of the clerk of works or main contractor to verify the positional dimensions of accessories and associated electrical equipment. Do this before commencing work. In the absence of large-scale drawings being available, agree all positions with the Architect.

Do not scale dimensions from the drawings as the symbols representing electrical accessories and equipment on drawings are not drawn to scale.

Install wall mounted socket outlets, switches, telephone outlets, TV outlets and control items (eg adjustable thermostats) with their nearest edge at least 350 mm horizontally from room ‘internal angle’ corners.

Position at least one outlet above kitchen work surfaces at the return end (work surface end abuts wall) where the work surface does not have wheelchair manoeuvring space beneath. Position the outlet with its centre no more than 150 mm horizontally from the front edge of the work surface, and no more than 100 mm above the work surface.

Install door entry phones, card readers and manual controls for powered door systems within 200 mm horizontally of the associated door frame, except that, where the door opens towards the user, set-back such items 1400 mm horizontally from the swinging stile (leading edge) of the door (so that wheelchair users do not have to move to avoid contact with the door as it opens.)

Install lighting pull cords at 150 mm maximum horizontally, from the door frame of the swinging stile (leading edge) of the associated door and as close to the wall as possible.

520 Mounting heights in walls

Locate and mount all switches, outlets and controls as shown on architectural setting out drawings, if available, and to satisfy Building Regulations Approved Document M and BS 7671. In the absence of large-scale drawings being available, all positions are to be agreed with the Contract Administrator.

Select mounting heights for landing push buttons, keypads and ‘indicator arrows’ associated with lifts, and for emergency stop buttons associated with escalators and conveyers, to satisfy relevant standards, codes and manufacturer’s recommendations.

In car parks and garages mount all socket-outlets at 1.2 m above floor level to avoid mechanical impact from the movement of motor vehicles. Confirm with building control and other relevant authorities that mounting of socket-outlets in this manner is acceptable.

Comply with the London District Surveyors Association Fire Safety Guide No 1 *Fire Safety in Section 20 Buildings*, section 3.07: Car parks, that requires:

~ 1. Electrical apparatus (including luminaires) if installed below the general car park floor level, or in other similarly hazardous positions, should be of a type suitable for use in potentially explosive atmospheres (apparatus Group 11A) Zone 1 areas in accordance with BS 5345.

~ 2. Electrical apparatus (including luminaires) if installed at floor level or within 1.2m above floor level should be of a type suitable for use in potentially explosive atmospheres (apparatus Group 11A) Zone 2 areas in accordance with BS 5345.

~ 3. All electrical apparatus in the car park shall be suitably protected from mechanical damage.

~ 4. Any electrical equipment installed within the air stream of a mechanical extract ventilation system should be of a type suitable for use in potentially explosive atmospheres (apparatus Group 11A) Zone 1 areas in accordance with BS 5345.

Mount all items of the same category and within the same room, at the same height unless otherwise agreed with the Contract Administrator.

Mount all accessories at the heights Above Finished Floor Level (AFFL) given in this clause unless otherwise detailed in the ‘engineering systems’ sections of this specification or otherwise stated.

Apply the heights given in this clause to the accessory and not to the conduit box to which it is fitted.

Ensure that the bottom edge of the accessory is no lower than the lowest AFFL in the range, and the top edge of the accessory is no higher than the highest AFFL in the range, unless stated otherwise. Apply them but make due allowance for coordinating with any building feature, eg wall tiling.

Do not mount accessories within 50 mm of the upper edge of tiling. Do not mount accessories within 100 mm of the underside of a worktop.

CAWS	CATEGORY OF ITEM/ ACCESSORY	mm AFFL	NOTES
V20	Utility meters	1200 – 1400	
	Distribution boards	400 – 1800	Dependant on size of the distribution board with meters
	Consumer units (non-domestic)	750 – 1200	As BS 8300
	Consumer units mounting height from FFL to switches (in dwellings)	1350 – 1450	Approved Document M recommends that switches sockets and other equipment should be located between 450 mm and 1200 mm from finished floor level. Approved Document P suggests one way to comply is by mounting the consumer unit so that the switches are between 1350 mm and 1450 mm from the finished floor level.
V21	Lighting switches	900 – 1200	And level with door handles
	Lighting pull cords	900 – 1100	To lower end of cord
	Access for those with reduced reach	450 - 1200	Serving habitable rooms
V22	Socket outlets and switched socket outlets	400 – 1200	
	Switches for permanently wired appliances (eg fused connection units)	400 – 1200	Higher if needed for particular appliances
	Socket outlets, switched socket outlets and switches for permanently wired appliances	100 – 200	To centre above work surfaces in kitchens and laboratories

	Isolators, push buttons, starters, cooker control units	750 – 1200	
	Cooker connection units	450 – 750	
	Shaver socket outlets, hot air hand driers	800 – 1000	To bottom edge
	Flex-outlets		To suit the circumstances
	Powered window controls	800 – 1000	
V40	Safety signs (emergency exit signs)	2000 – 2500	To bottom edge or as risk assessed under BS 5266
W10	Doorbell pushes, door entry ‘phones	400 – 1200	Depending on accessibility requirements
	Telephone outlets (non-domestic)	400 – 1200	
W11 & W14	Emergency assistance alarm pull cord	100	To lower red bangle
		800 – 1000	To upper red bangle
	Emergency assistance alarm reset button	800 – 1000	To bottom edge
W20	TV outlets (non-domestic)	400 – 1200	
W23	Clocks	2500	
W40	Manual controls (including push pads and green emergency break glass units) for powered door systems	750 – 1400	Reset back 1400 mm from leading edge of door when fully open
	Swipe card readers	950 – 1000	To centre of reader
W50	Fire alarm manual call points	900 – 1200	And level with door handles *****
	Alarm sounders	2500	To centre
	Visual alarms	2100	Minimum
W60	Room thermostats and humidistats that room occupants adjust	1400	To top of thermostat or humidistat
	Room thermostats, temperature and humidity sensors that are not adjustable by room occupants		At height recommended by manufacturer, approximately 1200 –1800 mm (with default height of 1800 mm)

X10	Lift controls (non-domestic)	900 – 1100 mm from the FFL and 500 mm from any return wall	As Approved Document M, Volume 2, 3.34.g
	Lift controls in dwellings	900 – 1200 mm and 400 mm from the front wall	As Approved Document M, Volume 1, 1.11.k

NOTE * Where fire alarm manual call points are mounted at lower than 1100 mm record this as a variation from the BS 5839 requirement of 1400 mm, (a variation of less than 300 mm need not be recorded as a variation), in the 'Design Certificate' and have it approved by the controlling fire authority.

END OF SECTION Y89

Y90 FIXING TO BUILDING FABRIC

CONTENTS

Y90 FIXING TO BUILDING FABRIC

100 REFERENCE DOCUMENTS

This specification is written based on legislation, standards and guidance in force in the UK generally, and within England by default. For projects in Scotland, Wales, Northern Ireland, the Channel Islands and the Isle of Man, give appropriate consideration to any locally applicable legislation, standards and guidance that deviates from or is additional to those in force within England. Similarly, for projects outside the UK comply with the corresponding national legislation, standards and guidance.

Comply fully with the edition (including amendments, replacements and associated normative references) of each of the following, current at the time of tender.

Where a standard referred to in this section conflicts with a standard referred to in an associated ‘engineering system’ section (e.g. S10, T31, V21, etc) of this specification, the standard referred to in the engineering system section prevails.

Construction Products Regulations

BS EN ISO 4016	Hexagon head bolts. Product grade C
BS EN ISO 4034	Hexagon regular nuts (style 1). Product grade C
BS EN ISO 898-1	Mechanical properties of fasteners made of carbon steel and alloy steel. Bolts, screws and studs with specified property classes. Coarse thread and fine pitch thread
BS EN ISO 898-2	Mechanical properties of fasteners made of carbon steel and alloy steel. Nuts with specified property classes. Coarse thread and fine pitch thread
BS EN ISO 898-5	Mechanical properties of fasteners made of carbon steel and alloy steel. Setscrews and similar threaded fasteners with specified hardness classes. Coarse thread and fine pitch thread
BS EN ISO 3506-1	Mechanical properties of corrosion-resistant stainless steel fasteners. Bolts, screws and studs
BS EN ISO 3506-1	Mechanical properties of corrosion-resistant stainless steel fasteners. Nuts
BS EN 20898-7	Mechanical properties of fasteners. Torsional test and minimum torques for bolts and screws with nominal diameters 1 mm to 10 mm
BS 1473	Specification for wrought aluminium and aluminium alloys for general engineering purposes - rivet, bolt and screw stock
BS 4078-1	Powder actuated fixing systems. Code of practice for safe use.
BS 4190	ISO metric black hexagon bolts, screws and nuts. Specification
BS 5080-1	Structural fixings in concrete and masonry. Method of test for tensile loading
BS 8000-0	Workmanship on building sites. Introduction and general principles
BS 8539	Code of practice for the selection and installation of post-installed anchors in concrete and masonry
BG 10/2010	BSRIA Structural Fixings for Ductwork Systems
CFA GN	Construction Fixings Association (CFA) Guidance Note: Procedure for site testing construction fixings

Y90 FIXING TO BUILDING FABRIC

200 PRODUCTS AND MATERIALS

210 General

Where an ‘engineering system’ specification section or a ‘service reference’ specification section specifically refers to fixings and adhesives for a particular application, comply with the requirements of that specification. Use this specification section for fixings and adhesives in other applications where the specification is otherwise silent on such matters.

Supply all necessary and appropriate fasteners, fixings, bearings, brackets, etc. necessary for the safe and proper installation plus associated flashings and closures. Carry out fixings in straight lines, or at regular centres.

Ensure all materials and components forming part of external construction are of corrosion resistant material or have a corrosion resistant finish.

Confirm that all materials have bimetallic corrosion resistance appropriate to items being fixed.

Use fixing and jointing methods and types, sizes, quantities and spacings of fasteners which are suitable having regard to:

- ~ the nature of and compatibility with product/material being fixed and fixed to, including vibrations in use
- ~ manufacturer’s instructions
- ~ materials and loads to be supported
- ~ conditions expected in use
- ~ appearance, this being subject to acceptance by the Contract Administrator

220 Methods of fixing

221 Fixing types

Where appropriate securely fix all engineering components to the building fabric using any of the following methods:

1. expanding anchors and bolts for heavy loads fixed to masonry or concrete
2. white finished metal or plastic wall plugs and screws for light loads to masonry or concrete
3. screws into wood for light fixings
4. clamps and adaptors to fix to structural steelwork, if accepted by the Contract Administrator in writing
5. proprietary adaptors for proprietary cast in fixings when provided as part of the building

Employ all fixings within the loading recommendations and substrate recommendations of the manufacturer.

222 Fixing methods not allowed

Do not use the following fixing methods:

1. drilling structural steel work
2. hanging supports with loose back plates under floor screed
3. wooden or fibre wall plugs
4. built-in fixings unless specifically detailed in the specification or on the drawings

230 Masonry fixings

Select plugs and screws for light duty applications.

Select expansion anchors or chemical anchors for heavy duty applications.

231 Plugs

Use proprietary type plugs to suit the substrate. Confirm that loads are adequately supported and that fixings are suitable for the expected conditions in use.

Locate plugs accurately in correctly sized holes in accordance with the manufacturer's instructions.

232 Anchors

Use adhesive or chemicals in substrates where the expansion of an anchor would cause fractures, or for use in irregular substrates where expansion anchors cannot transfer loads adequately.

Select the type and size of the anchor considering:

- ~ the strength of the concrete being fixed to
- ~ the loads to be applied to each anchor
- ~ the allowance to be made for bending stresses caused by packing shims; the available edge clearance from the drilled hole
- ~ and the spacing of the fixings

Install the anchor in accordance with the manufacturer's instructions. Before fitting the anchor into the drilled hole, clear all dust and fragments from hole. Insert anchor, through material to be fixed if appropriate, and tap or set in accordance with the manufacturer's instructions. Tighten to the correct torque setting in accordance with the manufacturer's instructions.

240 Powder-actuated fixing

Do not use powder-actuated (explosive) fixing systems without written acceptance from the Contract Administrator. Where their use has been accepted, only use for light fixings.

Only use fully trained and certified operators who are proven competent in the safe use of powder-actuated systems for the fixings selected.

Prior to use on site perform a site trail to determine suitability of powder fixing and the need or not for pre-drilling. Do not use powder-actuated fixing if site trial results are unsatisfactory.

Pre-drill powder-actuated fixings as required.

Select fasteners and accessories recommended for the application by the tool manufacturer.

Apply a zinc rich primer to heads of fasteners used externally, in external walls or in other locations subject to dampness.

Use top-hat section plastics washers to isolate cartridge-fired nails from stainless steel components fixed externally, in external walls or in other locations subject to dampness.

250 Composite / concrete slab embedded channel

Use only proprietary cast-in channels and other fixings if provided as part of the building specification.

Use only proprietary loose fixings such as wedge and T-nuts approved for use with cast-in channels and other fixings by cast-in channel manufacturer.

Liaise with the building contractor regarding the locations of cast-in channels prior to these being built-into the building structure.

Y90 FIXING TO BUILDING FABRIC

260 Cavity fixings

Do not use cavity wall fixings without written acceptance from the Contract Administrator.

Where possible arrange for fixings to occur directly into the main load-bearing supporting framework of the cavity construction or via suitably located secondary load-bearing supports attached to the main framework.

Select metallic spring-toggle anchors for light duty applications.

Select metallic hollow-wall anchors for medium duty applications.

Install the anchor in accordance with the manufacturer's instructions. Retain anchors in a cavity by ensuring the locking mechanism, i.e. toggles of spring-toggle anchors or expanding arms of hollow-wall anchors, are firmly engaged against the inside face of the cavity.

270 Screws

Select screws to suit the fixing requirement of the components and substrate.

Use parallel, fully-threaded shank or twin-thread type wood screws for fixings into timber.

Use self-tapping, metallic drive screws, or power-driven screws as required. Do not hammer screws unless they are specifically designed to be hammered.

Ensure all screws have clearance holes. Provide pilot holes about half the diameter of the shank for screws of 8 gauge or more, and all screws used for hardwood.

Use washers and screw cups, where required, of the same material as the screw.

280 Adhesives

Only use adhesives where dismantling is not required and where the application does not demand an alternative method of mechanical fixing, or for those applications where adhesive is fully accepted.

Select adhesive types as recommended by the component supplier and/ or manufacturer, that are compatible with the finished surfaces and preservative/ fire retardant treatments, and that will not compromise the performance requirements of the elements to be bonded.

Prepare surfaces to receive adhesive to be free from dust, grease and any other contamination likely to affect bonding. Where necessary, clean surfaces using methods and materials recommended by the adhesive manufacturer.

Adjust the regularity and texture of the surfaces as required to suit the bonding and gap filling characteristics of the adhesive. Apply adhesives using the manufacturer’s recommended spreaders/applicators to ensure correct coverage.

Bring surfaces together within the recommended time and apply pressure evenly over full area of contact to ensure full bonding. Provide supports and clamps as necessary during setting. Do not mark surfaces or distort components being fixed.

Remove surplus adhesive using methods and materials recommended by the adhesive manufacturer and without damaging surfaces.

290 Packing

Provide suitable non-compressible and corrosion proof, tight packings at fixing points to take up tolerances and prevent distortion. Do not allow packings to intrude into zones that are to be filled with sealant.

Y90 FIXING TO BUILDING FABRIC

300 WORKMANSHIP

Carry out the workmanship in compliance with the requirements of the appropriate reference documents specified in clause 100.

Observe the manufacturer's and statutory requirements for storage and safe usage of materials.

Do not use adhesives in unsuitable environmental conditions or beyond the storage period recommended by the manufacturer.

Drill all holes required for fixings.

Do not hammer screws and fixings unless they are specifically designed to be hammered.

Remove all unspent fixings and adhesives from the site when no longer required.

Avoid moisture penetration by suitably tightening screws and bolts, or using protective caps. Do not overtighten bolts in timber to avoid local compression of the timber.

400 INTERFACE WITH FIXED SERVICES

Comply with section Y93 of this specification.

500 TESTING

Undertake proof testing in accordance with BS 8539 and CFA Guidance Note: Procedure for site testing construction fixings.

Use only competent testers, assessed and certified by the CFA Approved Tester scheme for testing. Provide documentary evidence of a tester’s certification to the Contract Administrator at least 4 weeks prior to commencement of testing.

600 SCHEDULE OF INSTALLERS SUBMISSIONS

Submit to the Contract Administrator no less than 28 days prior to the date of practical completion:

- ~ all documentary evidence of proof tests, methodology and results
- ~ detailed technical specifications and record drawings
- ~ detailed installation instructions including COSHH Assessments and data sheets
- ~ detailed maintenance and operating instructions including safety requirements necessary to carry out the works
- ~ schedules of plant and materials suppliers
- ~ load tests for fixings where required
- ~ guarantees and warranties

END OF SECTION Y90

Y92 MOTOR DRIVES

CONTENTS

Y92 MOTOR DRIVES

100 REFERENCE DOCUMENTS

This specification is written based on legislation, standards and guidance in force in the UK generally, and within England by default. For projects in Scotland, Wales, Northern Ireland, the Channel Islands and the Isle of Man, give appropriate consideration to any locally applicable legislation, standards and guidance that deviates from or is additional to those in force within England. Similarly for projects outside the UK comply with the corresponding national legislation, standards and guidance.

Comply fully with the edition (including amendments, replacements and associated normative references) of each of the following, current at the time of tender.

When a standard referred to in this section conflicts with a standard referred to in an associated ‘engineering system’ section (for example S10, T31, V21, etc.) of this specification, the standard referred to in the engineering system section prevails.

EC Directive	2005/32/EC Establishing a framework for the setting of ecodesign requirements for energy-using products
EC Regulation	Commission Regulation No 640/2009 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for electric motors
BS 3790	Specification for belt drives. Endless wedge belts, endless V-belts, banded wedge belts, banded V-belts and their corresponding pulleys
BS EN 614-1	Safety of machinery. Ergonomic design principles. Terminology and general principles
BS EN 60034-1	Rotating electrical machines. Rating and performance
BS EN 60034-2-1	Rotating electrical machines. Standard methods for determining losses and efficiency from tests (excluding machines for traction vehicles)
BS EN 60034-5	Rotating electrical machines. Degrees of protection provided by integral design of rotating electrical machine (IP code)
BS EN 60034-6	Rotating electrical machines. Methods of cooling (IC code)
BS EN 60034-7	Rotating electrical machines. Classification of types of constructions and mounting arrangements (IM code)
BS EN 60034-8	Rotating electrical machines. Terminal markings and direction of rotation
BS EN 60034-9	Rotating electrical machines. Noise limits
BS EN 60034-11	Rotating electrical machines. Thermal protection
BS EN 60034-12	Rotating electrical machines. Starting performance of single-speed three-phase cage induction motors
BS EN 60034-14	Rotating electrical machines. Mechanical vibration of certain machines with shaft heights 56 mm and higher. Measurement, evaluation and limits of vibration severity
BS EN 60034-30-1	Rotating electrical machines. Efficiency classes of line operated AC motors (IE code)
BS EN 60079-1	Explosive atmospheres. Equipment protection by flameproof enclosures ‘d’
BS EN 60079-14	Explosive atmospheres. Electrical installations design, selection and erection
BS EN 60085	Electrical insulation. Thermal evaluation and designation

BS EN 60204-1	Safety of machinery. Electrical equipment of machines. General requirements
BS EN 60252	AC motor capacitors
BS EN 61800	Adjustable speed electrical power drive systems
BS EN 12101-3	Smoke and heat control systems. Specification for powered smoke and heat control ventilators (Fans)
BS ISO 10816-1	Mechanical vibration. Evaluation of machine vibration by measurements on non-rotating parts. General guidelines
DD IEC/TS 60034-17	Rotating electrical machines. Part 17: Cage induction motors when fed from converters. Application guide
DIN 740	Power transmission engineering. Flexible shaft couplings
PD 5304	Guidance on safe use of machinery

200 GENERAL

The public electricity supply voltage and tolerance is:

~ 4-wire, 3-phase, 400-V (+10%/-6%), 50-Hz

~ 2-wire, 1-phase, 230-V (+10%/-6%), 50-Hz

Ensure that all electrical equipment and wiring required in connection with the works is suitable for these supplies and for the location in which they are installed. Adjust motor supply voltages as close as reasonably possible to the nominal supply voltage, and within 400 V (±4%) 3-phase, 230 V (±4%) 1-phase as appropriate.

Ensure that all motors supplied in connection with this specification are suitable for the supply voltages and the environment in which they are installed.

When motors are installed in hazardous areas where an explosive atmosphere may exist, as defined by BS EN 60079, use motors suitably designed for use in the particular application. Motors and the associated installation may be required to be; non-sparking, increased safety, or flameproof types, complying with the respective section of BS EN 60079, dependant on the classification of the environment.

Unless otherwise indicated, ensure that all electrical equipment is suitable for use in ambient temperatures up to 40°C and relative humidities up to 90%.

Protect electrical equipment from direct sunlight.

Protect equipment from corrosion, including that of saline air when indicated and ensure that all materials used are not susceptible to either mould growth or attack by vermin.

When motors and the driven machines are obtained as factory-assembled packaged units, ensure that the packaged equipment manufacturer accepts responsibility for the adequacy and compatibility of the motor and coupling with the driven machine’s characteristics, including the starting requirements, together with the design margins specified elsewhere.

When motors and the driven machines are obtained from different suppliers, ensure that the motor and coupling is adequate for and compatible with the driven machine’s characteristics, including the starting requirements, together with the design margins specified elsewhere.

Mount motors with access to sufficient air flow to maintain motor cooling performance.

Securely mount each motor on to a rigid, firm and level foundation of sufficient substance to support the physical loads imposed by the motor and its operation. Do not impose any torsional stress on the frame of the motor by tightening it down on to an uneven foundation. If motor feet do not seat solidly against the foundation, insert shims to achieve a level firm seating before tightening the motor down.

300 PRODUCTS AND MATERIALS

310 General

For applications that require motor drives of:

- ~ 500 W or less in size, use electronically commutated direct current (EC/DC) motors
- ~ between 500 W and 2 kW in size, either use EC/DC motors or three-phase AC motors with variable frequency drives (VFDs) depending on availability and efficiency
- ~ more than 2 kW in size, use direct- and VFD-driven three-phase AC motors

Comply with EC Directive 2005/32/EC as implemented by EC Regulation No 640/2009.

Ensure that all motors with a rated output of 0.75 kW to 375 kW comply with:

- ~ IE3 as defined in BS EN 60034-30 and as measured in accordance with BS EN 60034-2-1 or
- ~ IE2 defined in BS EN 60034-30 and as measured in accordance with BS EN 60034-2-1 if combined with adjustable speed (inverter) drives

Provide extended lubrication facilities whenever needed to enable motor bearings fitted with grease nipples to be routinely greased without dismantling housings or removing guards.

Provide all motors installed within buildings with protection against water and dust to a minimum of IP55. Make all motors installed externally with protection to a minimum of IP56.

Provide appropriate power factor correction and harmonic filtering equipment to address any power quality problems.

Provide active harmonic filtration at the individual motor drive units if required.

320 Three-phase motors

Select direct- and variable frequency drive (VFD)-driven AC motors to run at their maximum loads within the speed ranges of 50 Hz to 60 Hz.

Provide four-pole motors, except if it can be demonstrated that the efficiency of a two-pole motor would be better, the noise no worse, and the life or mean time to failure (MTTF) no worse.

Provide VFDs for all motor sizes of 1.1 kW or above. AC motor speed controllers may be provided instead of VFDs for very small motor sizes less than 1.1 kW.

Make all motors Code IC411 to BS EN 60034-6 (totally enclosed fan ventilated – TEFV) except when specified otherwise. When motors are installed in circumstances where they are in danger of overheating make them Code IC416 to BS EN 60034-6 (with machine-mounted independent driven cooling fans).

Where motors are controlled by VFDs, provide motors capable of the required duty without overheating.

Provide thermal protection for all motors:

- ~ of 11 kW and above
- ~ for all motors enclosed in ductwork
- ~ for all other motors where particularly specified

Arrange thermal protection by thermistors mounted in the motor stator end windings, one in each phase, and designed to trip at 160°C.

Except when specified otherwise make motor starting performance Design H to BS EN 60034-12 for direct-on-line (DOL) starting up to and including 5.5 kW, and Design HY for assisted starting 7.5 kW and above. Ensure that the inertia of each motor and its connected load is within the capability of the motor and type of motor starting selected.

Make the minimum winding insulation Class F to BS EN 60085, for standard temperature applications and motor designed temperature rise within Class B.

Make the minimum winding insulation Class H to BS EN 60085, for high temperature applications (such as smoke extraction) and motor designed temperature rise in accordance with BS EN 60034-1, or BS EN 12101-3 in cases of emergency high temperature applications.

Ensure that all motors are designed for continuous running duty BS EN 60034-1 (S1).

Ensure that all motors are designed for safe operation at maximum continuous rating within the electrical supply parameters defined in clause 200

Make dual-speed motors with separate windings for each speed, except where specified otherwise.

Where particularly specified, make dual speed motors with Dahlander-wound windings.

Fit surge suppressors across motor windings to limit transient voltages to 1200 V peak.

For motor frame sizes up to and including D200, provide ball bearings at either end. For motor frame sizes D225 and above, provide roller bearings at the drive end and ball bearings at the non-drive end. Fit sealed-for-life bearings.

Ensure that motors are dynamically balanced to 'normal' balance standards defined by BS EN 60034-14.

Provide the motor fan and fan cowl of polypropylene-type material or equal unless all-metal construction is specified elsewhere. Provide a corrosion-resistant paint finish to all motors.

Arrange for final selection of motor sizes by the motor manufacturer, who will require the following data in addition to that specified above:

- mechanical mounting details
- direction of rotation
- details of driven load, including speed of rotation and external inertia (kg m^2)
- transmission method
- details of duty for which required, including use of inverter to control the speed

For all motors ordered submit, before delivery, their details to the Contract Administrator for comment and for checking the electrical supply arrangements.

330 Single-phase motors

Some packaged units may be fitted with single-phase motors selected and supplied by the packaged unit manufacturer. For all such units ensure that the packaged unit manufacturer specifies the starting and protection requirements that are appropriate.

Single-phase motors up to 3 kW output may, with the Contract Administrator’s agreement, be fitted to equipment. Ensure that all single-phase motors comply with the appropriate parts of this specification.

Make all single-phase motors of the capacitor-start, capacitor-run type, unless specified otherwise.

340 Electronically-commutated direct current (EC/DC) motors

Provide infinitely variable speed control.

Ensure that the building's earthing system meets the requirements of BS 7671 with respect to any earth conductor currents arising from EC/DC motors.

Provide motors with ball bearings suitable for continuous operation at their maximum operating speed with a minimum bearing life of 40,000 hours.

Provide motors that comply with the requirements of BS EN 60034-1, BS EN 60034-5 through 9, BS EN 60034-11, BS EN 60034-14 and BS ISO 10816-1.

350 Safety extra low voltage (SELV) motors

Ensure SELV motors installed in zones 0, 1 or 2 of bathrooms (defined in clause 701 of BS 7671) have a minimum ingress protection of IPX5 and are protected by a 30 mA maximum residual current device (RCD) located in a suitable area outside zones 0, 1 or 2.

Install SELV transformers in a suitable area outside zones 0, 1 or 2.

Provide motors with ball bearings suitable for continuous operation at their maximum operating speed with a minimum bearing life of 40,000 hours.

360 Motor - mechanical installation

Unless agreed otherwise with the Contract Administrator, provide every motor drive and the associated driven unit as a complete factory-built, adjusted, tested and guaranteed packaged assembly.

Provide every motor drive with a robust, rigid, accurately and easily adjusted mounting arrangement.

Ensure that the driven equipment is capable of being accelerated and driven by the motor specified, without danger to its mechanical integrity, including impellers, bearings and mechanical supports. Ensure that all mechanical resonances are well outside normal operating speeds.

370 Belt couplings

Provide belt-coupled machines with statically and dynamically balanced pulleys constructed from close-grained cast iron. Ensure that all pulleys are accurately centred and aligned with the shafts on which they are mounted.

Make pulleys on drives up to 30 kW rating of the taper-bush type and those on drives over 30 kW of the key-secured type, unless agreed otherwise with the Contract Administrator.

Ensure that the pulley ratio selected operates driven fans or pumps at their optimum speed for the required duty, whether the motor is connected to a conventional starter or controlled by a variable frequency drive (VFD).

Ensure that the pulleys selected for each motor and driven load, and the distance between shafts, are the appropriate size and type, and optimum for each application as recommended by the belt manufacturer.

Include in the tender for one pulley change on every belt coupling during commissioning.

Ensure that all belts are selected and installed strictly in accordance with the belt manufacturer's published rules.

Ensure that all belts are selected for continuous operation at full motor output or for the intended mode of operation of specific equipment, if that is more arduous.

Ensure that belt-coupled machinery is provided with endless wedge or V belts in accordance with BS 3790.

Use raw edge, moulded notch, narrow section V belts when recommended by the belt manufacturer for couplings utilising small pulleys.

Use flat belts when high drive efficiency and freedom from maintenance is required.

Submit proposed belt and pulley selections to the Contract Administrator for comment before equipment manufacture begins.

For every wedge or V belt installed, supply one spare new belt.

380 Direct couplings

When directly driven machines are fitted with shaft couplings, ensure that they are of the flexible type to DIN 740 Part 2 to prevent the transmission of excessive torsional vibrations from the motor to the driven member.

Ensure that on completion, each motor is accurately aligned in all three planes to the driven machine and the coupling secured.

390 Guards

Provide all moving items (including pulleys, belts, shafts and couplings) with suitable guards complying with PD 5304. Ensure that all guards prevent access to moving items from all directions and are rigid and firmly fixed.

When fan, coupling and motor are all mounted inside equipment, the casing of the equipment may, at the discretion of the Contract Administrator, be deemed to be a suitable guard, except where the compartment housing the moving items is large enough for personnel to access, or operation of the equipment with the compartment cover removed presents a foreseeable danger.

Provide access via pivoted covers to the ends of all shafts, for the use of a tachometer. Ensure that guards allow the adjustment of motor position for drive alignment and belt tension.

Ensure that the cooling of motors and couplings is not impaired by the guards.

Zinc-coat all guards to protect against corrosion.

400 ADJUSTABLE SPEED DRIVES

Comply with specification section Y72.

When the adjustable speed drive is not integral with the motor ensure that the two distinct elements, the adjustable speed drive and the motor, are compatible over the range of design operating conditions.

Provide all motor control gear with protection against water and dust ingress to a minimum of IP54.

410 Variable frequency drive (inverter) driven motors

Install high frequency coupling/bonding straps to earth and driven machine if recommended by either the variable frequency drive (VFD) manufacturer or the motor manufacturer.

Provide a motor type designed for operation by VFD.

On motors used with VFDs, take appropriate and adequate measures to ensure that externally sourced and internally sourced bearing currents do not lead to premature failure of the bearings of the motor or driven load. Precautions may include:

~ the use of shaft earthing brush devices

~ equipotential bonding of the motor and the load

~ the selection of appropriate switching frequencies for the drive output stage

- the correct application of high frequency earthing connections
- the application of common mode filters or chokes
- a combination of the previous measures or other proven means

Carefully follow the installation instructions given in product-specific manuals. Where earthing brushes are selected, ensure the design life of the brush is at least equal to that of the bearings and that the brush replacement can be undertaken without dismantling the motor or disconnecting the drive equipment.

Select VFD driven motors to achieve their selection duty within the speed ranges of 50 Hz to 60 Hz.

Because of the torque limitations of synchronous motors, de-rate motors running at high loads at lower speeds than 50 Hz to avoid stalling and/or overheating with a subsequent reduction in life. Oversize motors operating at high loads at speeds below 50 Hz, to maintain their rated power, accordingly, ie:

- at 40 Hz operating speed, oversize by 30%
- at 30 Hz operating speed, oversize by approximately 100%

Provide a motor type with bearings suitable for continuous operation at the design operating duty of the VFD with a minimum bearing life of 20,000 hours.

State the calculated bearing life for the design operating duty, within the technical submittal and the operation and maintenance instruction manuals, if it is less than that stated by the manufacturer’s requirements at 50 Hz.

420 AC motor speed controlled motors

Provide a motor type with bearings suitable for continuous operation at the maximum operating speed of the adjustable speed drive with a minimum bearing life of 20,000 hours.

500 COMMISSIONING AND TESTING

510 General

Ensure all commissioning operatives are suitably qualified and experienced with motor drives and controls. Provide details and qualifications of the commissioning operatives to the Contract Administrator for comment.

Comply with specification section Y81.

520 Tests

Test and commission each system in accordance with the particular system specification, eg S13 Pressurised Water, and provide suitable testing and commissioning certificates. Allow the client and the client’s representatives the opportunity to witness testing of the motor drives.

After installation of any major motor drive, check the bearing condition using an approved bearing condition monitor as an objective acceptance test.

Provide, at no additional cost to the contract, thermal imaging of any motor drives identified for this particular testing by the Contract Administrator.

END OF SECTION Y92

Y93 SERVICES SUPPORT AND SUSPENSION SYSTEMS

CONTENTS

Y93 SERVICES SUPPORT AND SUSPENSION SYSTEMS

100 REFERENCE DOCUMENTS

This specification is written based on legislation, standards and guidance in force in the UK generally, and within England by default. For projects in Scotland, Wales, Northern Ireland, the Channel Islands and the Isle of Man, give appropriate consideration to any locally applicable legislation, standards and guidance that deviates from or is additional to those in force within England. Similarly for projects outside the UK comply with the corresponding national legislation, standards and guidance.

Comply fully with the edition (including amendments, replacements and associated normative references) of each of the following, current at the time of tender:

Where a standard referred to in this section conflicts with a standard referred to in an associated ‘engineering system’ section (e.g. S10, S63, T31, V21, W63, Y10, Y30, Y52, Y60, Y62, Y63, Y89, etc.) of this specification, the standard referred to in the engineering system section prevails.

BS 476-24	Fire tests on building materials and structures. Method for determination of the fire resistance of ventilation ducts
BS 4078-1	Powder actuated fixing systems. Code of practice for safe use
BS 4078-2	Powder actuated fixing systems. Specification for tools
BS 8539	Code of practice for the selection and installation of post-installed anchors in concrete and masonry
BS EN 12236	Ventilation for buildings. Ductwork hangers and supports. Requirements for strength
BS EN 12385	Steel wire ropes. Safety
BS EN 13411	Terminations for steel wire ropes - Safety
BS EN 14713	Zinc coatings
BS EN 10210	Hot finished structural hollow sections of non-alloy and fine grain steels
BS EN 13501-3	Fire classification of construction products and building elements. Classification using data from fire resistance tests on products and elements used in building service installations: fire resisting ducts and fire dampers
BS EN ISO 1461	Hot dip galvanized coatings on fabricated iron and steel articles. Specifications and test methods
BS EN ISO 10244	Steel wire and wire products. Non-ferrous metallic coatings on steel wire. Zinc or zinc alloy coatings
BS EN ISO 27830	Metallic and other inorganic coatings. Requirements for the designation of metallic and inorganic coatings
ISO 17893	Steel wire ropes. Vocabulary, designation and classifications
BESA DW/144	Specification for sheet metal ductwork
Association for Specialist Fire Protection (ASFP) Blue Book:	
ASFP	Blue book. Fire Resisting Ductwork: classified according to BS EN 13501 Parts 3 and 4
ASFP	Blue book. Fire Resisting Ductwork: tested to BS 476 Parts 24
BSRIA BG 10/2010	Structural fixings for ductwork systems
BSRIA COP 22/2002	Wire rope suspension systems. A code of practice for service installers

HSE ACOP L113	Safe use of lifting equipment: Lifting Operations and Lifting Equipment Regulations 1998
CFA GN	Construction Fixings Association (CFA) Guidance Note: Procedure for site testing construction fixings

200 GENERAL ITEMS

Provide for the support and/or suspension of services and the safe transfer of services dead load and dynamic load to the building structure. Support means holding in place from below the horizontal under compression stress and/or bending stress. Suspension means holding in place from above the horizontal under tension stress and/or bending stress. Allow for all shear stress and lateral loadings as may occur subject to physical arrangements implemented.

The transfer of supported and suspended loads must not adversely affect either the structure or fabric to which it attaches, nor the performance of the service being supported or suspended.

All support and suspension systems must ensure both the initial and ongoing safety of the supported and/or suspended services.

The support and suspension system must not diminish the thermal, acoustic or mechanical performance of the suspended or supported service. The support and suspension system must not introduce condensation nor facilitate its formation.

Install the support and suspension system to transfer loads thus:

~ (A.) From the service or, (AA.) from associated intermediate physical support (e.g. cable tray, ductwork hanger, pipework clamp)

~ (B.) To and via the support or suspension component (e.g. threaded rod, wire rope, catenary system, channel (unistrut))

~ (C.) To the fixing with the structure/fabric

Structure includes all secondary support and access steel work designed, fabricated, supplied and installed to support the engineering services within this works package. A requirement for Installer to provide secondary steelwork, where not specifically detailed on the Structural Engineering drawings, is set out in Section A20 Preliminaries / General Conditions.

Design, configure and install the support and suspension systems in accordance with the specifications shown in the following matrix.

(C.) Fixing to structure/fabric	**(B.) Support / suspension component**	**(A.) Termination/connection to Service**	**(AA.) Intermediate support**
Comply with: Y93 A20 Preliminaries / General Conditions Y90 Fixing to building fabric	Comply with: Y93	Comply with: Y93 Where not otherwise specified under AA, Includes but not limited to: Wire rope looped over ductwork.	Comply with: Y89 Luminaires and lamps. Specifies the support of luminaires from conduit, trunking, and direct fixing. Specifies the use of rod, chain and flexible cord.
			Y63 Support Components – cables

		Wire rope connected to integral lifting eye integral to, say, fan coil unit. Direct bolting of threaded rod to say, VAV box	Specifies the SWL of cable tray and cable ladder. Specifies the support for cable runway and cable ladders. Specifies the electrical requirements integral to the use of cable support components regarding PE and bonding also specified.
			W63 Wiring for mechanical systems Cross refers to Y63 for support system details.
			S63 Sprinklers Specifies compliance with LPC rules for pipe supports. Specifies additional fixings / support to final sprinkler position.
			Y62 Busbar trunking Specifies installation of busbar as per specification and manufacturer's instructions. Specifies proprietary and non-proprietary brackets.
			Y30 Ductwork Specifies all ductwork and associated components as detailed in DW/144 and BS EN 10210

Design, specify, procure, install and test the support and suspension system and all its component parts to comply with BS 8539 as applicable. (BS 8539 is considered to be an appropriate standard because it refers to applications vulnerable to progressive collapse including suspended ceilings, and suspended services such as pipework, ductwork or cable tray.)

Ensure that the support and suspension system is designed, specified and installed to prevent progressive collapse and the potential risk to human life in the event of such collapse. Commission specialist design services from manufacturers or other competent professionals to ensure that the support and suspension system as installed eliminates all material and unmanageable risk of progressive collapse.

Design, specify, procure and install all component parts to comply fully with manufacturer's instructions for design and installation.

210 Loadings

Provide all suspension and support components with sufficient Safe Working Load (SWL), Working Load Limit (WLL), or other approved loading classification sufficient to support all design loads. These loads arise from services to include, but not limited to, the following:

- ~ Air handling units
- ~ Fan coil units
- ~ Ductwork
- ~ Heating/cooling emitters
- ~ Pipework
- ~ Cable trays, basket and ladder
- ~ Lighting
- ~ Signs
- ~ Grid support systems

Ensure that all fixings and fixing points to the building structure or fabric are approved or otherwise classified as fit for purpose and correctly installed to maintain such approval or classification.

Ensure that all suspended and supported services have sufficient strength and appropriate rigidity at each point of suspension and/or support for transfer of its loads to the suspension and/or support system.

Use suspension and support components in accordance with the manufacturer's instructions taking due account of all:

- ~ Vertical loads
- ~ Lateral loads
- ~ Dynamic loads
- ~ Tensile, compressive and shear loads

Include for loads arising from fluid content, insulation, acoustic quilt and installation, maintenance and servicing loads e.g. persons inside ductwork performing cleaning activities.

Subject to receiving normal maintenance, as recommended by the manufacturers, and in-service use in accordance with the design conditions provide all support and suspension systems to sustain their design performance properties throughout their expected service life.

220 Support and suspension elements

Support services from below and include the following main components:

- ~ Fixing to structure or fabric e.g. anchor or clamp
- ~ Support element such as Unistrut, angled bracket or threaded rod
- ~ Attachment to or around service such as ductwork support e.g. circular duct ring; profiled straight channel, cable tray profiled hanger.

Suspend services from above and include the following main components:

- ~ Fixing to structure or fabric e.g. anchor or clamp
- ~ Suspension element such as wire or threaded rod
- ~ Attachment to or around service such as ductwork support e.g. circular duct ring; profiled straight channel, cable tray profiled hanger.

Use solid wire, wire rope, threaded rod or similar products designed specifically, or otherwise approved by manufacturer, for supporting suspended loads.

Use stranded wire support systems only by prior agreement with the Contract Administrator and in applications limited to non-fire rated ductwork branches which have supplementary means of lateral support. Do not use for supporting fire rated ductwork, pipework or electrical containment services. Do not joint wire rope, or other similar continuous reel supplied suspension elements to increase their length. Use only continuous reel length suspension elements.

Joints to any non-continuous support or suspension element, such as threaded rod, must be made with products designed specifically, or otherwise approved by manufacturer, for securely jointing and holding supported or suspended load.

230 Support and suspension terminations

Provide all hooking loops within wire rope systems with a solid thimble eye.

Use closed eye fixings on suspended services. Where closed eye fixings are not practicable for application use double loop (Pigs tail) open hook fixings.

Attach a ferrule or other such means to the loose end of any wire rope to prevent fraying.

Protect all sharp edges and protrusions (including surfaces, edges, crevices, points, wire ends, screw heads, corners, brackets, braided cable, clamps, pins, drop rods etc.) by fitting suitable safety measures such as, but not limited to, corner saddles, chamfering, cutting back excess lengths as appropriate, or proving protective caps where relevant. Additionally, where sharp edges and protrusions exist, provide warning tapes (black/yellow) and soft padding to areas based on the risks posed.

240 Types of structure

Liaise with the project Structural Engineer to ensure that the structural elements to be used for supporting services loads are capable of this.

Only attach the suspension system to the following types of structure after confirming suitability:

- Exposed primary steelwork (e.g. main structural columns and beams)
- Exposed secondary steelwork (e.g. light gauge steel such as roof purlins, facade side rails)
- Profiled/composite decking
- Concrete
- Other structural elements

Do not drill any structural steel work without permission from the Structural Engineer.

Do not attach suspension system to the following:

- Any non-suitable structure or fabric
- Any structural engineer/architect barred structures

250 Catenary systems

Confirm building suitability with structural engineer before using horizontal catenary support system suspended between two building fixing points. Allow for all lateral, compressive, tension, and shear loads.

Install catenary support wires with the straight line between their two end support points within plus or minus 5 degrees of horizontal.

Ensure all items attached to catenary support wires are designed to be non-slip, self-gripping or otherwise prevented from slipping by locking devices specifically designed for prevention of slippage on catenary wires.

Use only trained competent installers experienced in the design and installation of catenary support systems.

260 Installation

Design, install and adjust the suspension system to fix services to the required design height and orientation.

Where mechanical lifting assistance is required provide, in accordance with HSE ACOP L113, all necessary temporary suspension arrangements during installation of the suspension system as required. Transfer the mechanically lifted load to the suspension system gradually and evenly.

Locate fixings directly above the suspension point. If this is not possible then check with the manufacturer the suitability of the fixings to accept lateral loads at the angle involved.

Use only parts from the same manufacturer for each independent suspension system. Only mix different manufacturer parts if all are fully compatible without degradation of performance or manufacturer warranty.

Use components from a single manufacturer.

Ensure that all suspension rods, wire ropes and other suspension components are evenly tensioned with no nicks, cuts, fraying, twisting, deformation, or deflection of wire ropes by other objects.

300 ATTACHMENT TO STRUCTURE

310 Methodology

Attach the suspension support system building structure by one or more of the following methods providing in all cases that the manufacturer's instructions, BSRIA COP and standards are adhered to:

- Direct attachment e.g. cable looped over a beam
- Expansion anchors and screw fixing to concrete
- Adhesive bonding anchors
- Holorib or composite system e.g. embedded channel in slab for use with wedge fixings, T-head bolts, or similar fixings on the underside
- Powder fixing (where such use is permitted)
- Clamps and clips
- Other

Ensure that reinforcement bars are not damaged, cut or otherwise affected as part of the attachment fixing. Report all damage to the Structural Engineer.

Comply with BS 5080 for all fixings in concrete and masonry.

Select and install fixings in accordance with BS 8539 Code of practice.

Provide slip restraints where rope wire attachment to structure is not perpendicular to structure.

320 Direct attachment

Ensure that no cutting, digging in, or other deformation to either wire loop or item being looped occurs.

Use manufacturers recommended corner saddles, preformed eyes or other recommended corner protection.

330 Expansion anchors and screw fixing

Comply with specification section Y90.

340 Composite systems

Comply with specification section Y90.

400 APPLICATION SPECIFICS

410 Safety margin and redundancy

Provide a minimum level of redundancy that will ensure the transfer of suspended load to immediately adjacent supports in the event of failure of any single system component. The immediately adjacent support must sustain the additional load.

420 Fire rating

All elements of the support and/or suspension system used for fire resisting ductwork must be capable of bearing the load of the ductwork under specified fire conditions relating to such ductwork. Guidance set out in the following Association for Specialist Fire Protection Blue Book publications show the factors relevant to supporting fire resisting ductwork:

- ~ Fire Resisting Ductwork: classified according to BS EN 13501-3
- ~ Fire Resisting Ductwork: tested to BS 476-24

All elements of the support and/or suspension system used for support and/or suspension of services must be capable of bearing the load of the service under any specified fire conditions relating to that service.

Provide all such certification and other manufacturers evidence of the fire rating for different exposure times under conditions of standard fire test procedures.

500 CORROSION RESISTANCE

Provide details of proposed materials and corrosion performance of suspension components at tender stage to Contract Administrator for comment.

600 TESTING

Use only certified competent and approved testers for testing. Provide documentary evidence of the testers' certification, competence and approval to the Contract Administrator at least four weeks prior to the commencement of testing.

Carry out all testing of fixings and anchors to concrete and masonry to BS 8539.

610 Preliminary testing

Provide details of all preliminary testing required at least four weeks before carrying out testing.

Undertake preliminary testing in accordance with CFA Guidance Note: Procedure for site testing construction fixings.

620 Proof testing

Perform proof tests on a representative sample to at least 2.5% of fixings. Provide details of the proposed proof testing with the tender submission.

In the event of any fixture failing under test, double the test sample size. Investigate and determine the cause of failure and ensure the elimination of failure cause from all other fixings of the same type. Where the cause cannot be eliminated use alternative fixings and subject those to proof tests.

Undertake proof testing in accordance with BS 8539 and CFA Guidance Note: Procedure for site testing construction fixings.

700 SCHEDULE OF INSTALLER'S SUBMISSIONS

710 Design proposals and specialist contractors

Provide to the Contract Administrator at least 4 weeks before implementation, details of all proposed support and suspension systems to include the following:

~ details of any suspension or support systems specialist to be used and the nature of their engagement

~ details of the proposed systems and how they comply with this specification

~ details of system manufacturers' certification of proposed system components

~ details of any consultation and agreement with the structural engineer where required e.g. in respect of lateral loads imposed by catenary systems

~ details of physical layout and orientation of all systems elements

720 Certificates and test results

Provide documentary evidence of tester's certification, competence and approval to the Contract Administrator at least 4 weeks prior to commencement of testing.

Provide all design assumptions, documentation of installed components and installation and maintenance guides.

Provide all documentary evidence of proof tests, methodology and results.

Provide all documentary evidence of preliminary tests, methodology and results.

Provide all tester's certificates

730 Maintenance and inspection

Provide details of all recommended inspection regimes necessary to ensure the long term integrity of the support and suspension system.

END OF SECTION Y93