
T90 MECHANICAL SERVICES – SELF-CONTAINED SPECIFICATION

Audit sheet

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100 INTRODUCTION

This Specification confirms the requirements for the Sainsburys staff accommodation relocation works associated with Victoria Square project, Woking. The Contractor shall provide new mechanical systems to suit the new 'temporary' Sainsburys accommodation and final fit-out of the existing Sainsburys demise.

This scope includes installing new systems inside an existing building and making necessary connections to existing systems within the building. The Contractor shall survey and verify those connections prior to confirming their installation drawings.

110 Detail Coordination

Agree all proposed methods of fixing the system(s) to structure, roof, cladding, chimneys, equipment, etc with the Contract Administrator.

Agree the colours and finishes of all exposed materials of the system(s) with the Contract Administrator.

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, replacements and associated normative references) of each of the following, current at the time of tender:

HM Government	Local Water Byelaws/Regulations (where applicable in Scotland and Northern Ireland)
HM Government	The Building Regulations, Approved Documents and associated second tier documentation including both the Domestic and Non-Domestic Building Services Compliance Guide as applicable
HM Government	The Construction (Design and Management) Regulations
HM Government	The Control of Asbestos at Work Regulations
HM Government	The Control of Asbestos Regulations
HM Government	The Control of Substances Hazardous to Health Regulations (COSHH)
HM Government	The Electrical Equipment (Safety) Regulations
HM Government	The Electricity at Work Regulations
HM Government	The Electromagnetic Compatibility Regulations
HM Government	Health and Safety at Work etc Act
HM Government	The Low Voltage Electrical Equipment (Safety) Regulations
HM Government	The Management of Health and Safety at Work Regulations (MHSWR)
HM Government	The Health and Safety (Safety Signs and Signals) Regulations
HM Government	The Water Supply (Water Fittings) Regulations
HM Government	The Water Supply (Water Quality) Regulations
HM Government	The Workplace (Health Safety and Welfare) Regulations
HM Government	General Data Protection Regulations, the Data Protection Act 1998, and any replacement legislation.
EC Directive	Low Voltage Directive (LVD)

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EC Directive	Construction Products Directive
EC Directive	General Product Safety Directive (GPSD)
EC Directive	Electromagnetic Compatibility (EMC) Directive
EC Directive	The Ecodesign of Energy Related Products Directive
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 1306	Specification for copper and copper alloy pressure piping systems
BS 143 AND 1256	Threaded pipe fittings in malleable cast iron and cast copper alloy
BS 1710	Specification for identification of pipelines and services
BS 2633	Specification for Class I arc welding of ferritic steel pipework for carrying fluids
BS 2767	Specification for manually operated copper alloy valves for radiators
BS 2879	Specification for draining taps (screw-down pattern)
BS 2971	Specification for class II arc welding of carbon steel pipework for carrying fluids
BS 3505	Specification for unplasticized polyvinyl chloride (PVC-U) pressure pipes for cold potable water
BS 3533	Glossary of thermal insulation terms
BS 4078-1	Powder actuated fixing systems. Code of practice for safe use
BS 4346-1	Joints and fittings for use with unplasticized PVC pressure pipes. Injection moulded unplasticized PVC fittings for solvent welding for use with pressure pipes, including potable water supply
BS 4652	Specification for zinc-rich priming paint (organic media)
BS 476-20	Fire tests on building materials and structures. Method for determination of the fire resistance of elements of construction (general principles)
BS 4800	Schedule of paint colours for building purposes
BS 5080-1	Structural fixings in concrete and masonry. Method of test for tensile loading
BS 5080-2	Structural fixings in concrete and masonry. Method for determination of resistance to loading in shear
BS 5158	Specification for cast iron plug valves
BS 5163-1	Valves for waterworks purposes. Predominantly key-operated cast iron gate valves. Code of practice
BS 5163-2	Valves for waterworks purposes. Stem caps for use on isolating valves and associated water control apparatus. Specification
BS 5353	Specification for steel plug valves
BS 5839-1	Fire detection and fire alarm systems for buildings. Code of practice for design, installation, commissioning and maintenance of systems in non-domestic premises
BS 5839-3	Fire detection and alarm systems for buildings. Specification for automatic release mechanisms for certain fire protection equipment
BS 5839-6	Fire detection and fire alarm systems for buildings. Code of practice for the design, installation, commissioning and maintenance of fire detection and fire alarm systems in domestic premises

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BS 5839-9	Fire detection and fire alarm systems for buildings. Code of practice for the design, installation, commissioning and maintenance of emergency voice communication systems
BS 5925	Code of practice for ventilation principles and designing for natural ventilation
BS 5992-4	Electrical relays. Specification for contact loads of preferred values used in endurance tests for electrical relay contacts
BS 5992-5	Electrical relays. Specification for test equipment used in endurance tests for electrical relay contacts
BS 5992-6	Electrical relays. Specification for the basic modules for the dimensions of general purpose all-or-nothing relays
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 6920-1	Suitability of non-metallic materials and products for use in contact with water intended for human consumption with regard to their effect on the quality of the water. Specification
BS 6920-2.1	Suitability of non-metallic materials and products for use in contact with water intended for human consumption with regard to their effect on the quality of the water. Methods of test. Samples for testing
BS 6920-2.2.1	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. Methods of test. Odour and flavour of water. General method of test
BS 6920-2.2.2	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. Methods of test. Odour and flavour of water. Method of testing odours and flavours imparted to water by multi-layered hoses and pipes
BS 6920-2.2.3	Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of water. Methods of test. Odour and flavour of water. Method of testing tastes imparted to water by hoses for conveying water for food and drink preparation
BS 6920-2.3	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. Methods of test. Appearance of water
BS 6920-2.4	Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of water. Methods of test. Growth of aquatic micro-organisms test
BS 6920-2.5	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. Methods of test. The extraction of substances that may be of concern to public health
BS 6920-2.6	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. Methods of test. The extraction of metals
BS 6920-3	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. High temperature tests
BS 6956-1	Jointing materials and compounds. Specification for corrugated metal joint rings

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BS 6956-5	Jointing materials and compounds. Specification for jointing compounds for use with water, low pressure saturated steam, 1st family gases (excluding coal gas) and 2nd family gases
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 7430	Code of practice for protective earthing of electrical installations
BS 7592	Sampling for Legionella bacteria in water systems. Code of practice
BS 7671	Requirements for Electrical Installations. IET Wiring Regulations
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 8000-0	Workmanship on construction sites. Introduction and general principles
BS 8000-13	Workmanship on building sites. Code of practice for above ground drainage and sanitary appliances
BS 8000-15	Workmanship on building sites. Code of practice for hot and cold water services (domestic scale)
BS 8000-16	Workmanship on building sites. Code of practice for sealing joints in buildings using sealants
BS 8000-4	Workmanship on building sites. Code of practice for waterproofing
BS 8233	Guidance on sound insulation and noise reduction for buildings
BS 848-9	Fans for general purposes. Tolerances, methods of conversion and technical data presentation
BS 8537	Copper and copper alloys. Plumbing fittings. Specification for press ends of plumbing fittings for use with metallic tubes
BS 8539	Code of practice for the selection and installation of post-installed anchors in concrete and masonry
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	Water quality. Risk assessments for Legionella control. Code of practice
BS 9999	Fire safety in the design, management and use of buildings. Code of practice
BS EN 10224	Non-alloy steel tubes and fittings for the conveyance of water and other aqueous liquids. Technical delivery conditions

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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 10241	Steel threaded pipe fittings
BS EN 10242	Threaded pipe fittings in malleable cast iron
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 10244-3	Steel wire and wire products. Non-ferrous metallic coatings on steel wire. Aluminium coatings
BS EN 10244-4	Steel wire and wire products. Non-ferrous metallic coatings on steel wire. Tin coatings
BS EN 10244-5	Steel wire and wire products. Non-ferrous metallic coatings on steel wire. Nickel coatings
BS EN 10244-6	Steel wire and wire products. Non-ferrous metallic coatings on steel wire. Copper, bronze or brass coatings
BS EN 10250-4	Open steel die forgings for general engineering purposes. Stainless steels
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 10273	Hot rolled weldable steel bars for pressure purposes with specified elevated temperature properties
BS EN 10283	Corrosion resistant steel castings
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 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 12056-2	Gravity drainage systems inside buildings. Sanitary pipework, layout and calculation
BS EN 12097	Ventilation for buildings. Requirements for ductwork components to facilitate maintenance of ductwork systems

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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 12201-1	Plastics piping systems for water supply, and for drainage and sewerage under pressure. Polyethylene (PE). General
BS EN 12201-2	Plastics piping systems for water supply, and for drainage and sewerage under pressure. Polyethylene (PE). Pipes
BS EN 12201-3	Plastics piping systems for water supply, and for drainage and sewerage under pressure. Polyethylene (PE). Fittings
BS EN 12201-4	Plastics piping systems for water supply, and for drainage and sewerage under pressure. Polyethylene (PE). Valves
BS EN 12201-5	Plastics piping systems for water supply, and for drainage and sewerage under pressure. Polyethylene (PE). Fitness for purpose of the system
BS EN 12236	Ventilation for buildings. Ductwork hangers and supports. Requirements for strength
BS EN 12237	Ventilation for buildings. Ductwork. Strength and leakage of circular sheet metal ducts
BS EN 12238	Ventilation for buildings. Air terminal devices. Aerodynamic testing and rating for mixed flow application
BS EN 12239	Ventilation for buildings. Air terminal devices. Aerodynamic testing and rating for displacement flow applications
BS EN 12449	Copper and copper alloys. Seamless, round tubes for general purposes
BS EN 1254-1	Copper and copper alloys. Plumbing fittings. Fittings with ends for capillary soldering or capillary brazing to copper tubes
BS EN 1254-2	Copper and copper alloys. Plumbing fittings. Fittings with compression ends for use with copper tubes
BS EN 1254-3	Copper and copper alloys. Plumbing fittings. Fittings with compression ends for use with plastics pipes
BS EN 1254-4	Copper and copper alloys. Plumbing fittings. Fittings combining other end connections with capillary or compression ends
BS EN 1254-5	Copper and copper alloys. Plumbing fittings. Fittings with short ends for capillary brazing to copper tubes
BS EN 1254-6	Copper and copper alloys. Plumbing fittings. Fittings with push-fit ends
BS EN 1254-8	Copper and copper alloys. Plumbing fittings. Fittings with press ends for use with plastics and multilayer pipes
BS EN 12589	Ventilation for buildings. Air terminal units. Aerodynamic testing and rating of constant and variable rate terminal units
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 12797	Brazing. Destructive tests of brazed joints
BS EN 12799	Brazing. Non-destructive examination of brazed joints
BS EN 1287	Sanitary tapware. Low pressure thermostatic mixing valves. General technical specifications
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

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BS EN 13030	Ventilation for buildings. Terminals. Performance testing of louvres subjected to simulated rain
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 13166	Thermal insulation products for buildings. Factory made phenolic foam (PF) products. Specification
BS EN 13180	Ventilation for buildings. Ductwork. Dimensions and mechanical requirements for flexible ducts
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 13403	Ventilation for buildings. Non metallic ducts. Ductwork made from insulation ductboards
BS EN 13831	Closed expansion vessels with built-in diaphragm for installation in water
BS EN 1412	Copper and copper alloys. European numbering system
BS EN 14154-4	Water meters. Additional functionalities
BS EN 14303	Thermal insulation products for building equipment and industrial installations. Factory made mineral wool (MW) products. Specification
BS EN 14304	Thermal insulation products for building equipment and industrial installations. Factory made flexible elastomeric foam (FEF) products. Specification
BS EN 14306	Thermal insulation products for building equipment and industrial installations. Factory made calcium silicate (CS) products. Specification
BS EN 14314	Thermal insulation products for building equipment and industrial installations. Factory made phenolic foam (PF) products. Specification
BS EN 14324	Brazing. Guidance on the application of brazed joints
BS EN 14451	Devices to prevent pollution by backflow of potable water. In-line anti-vacuum valves DN 8 to DN 80. Family D, type A
BS EN 14453	Devices to prevent pollution by backflow of potable water. Pipe interrupter with permanent atmospheric vent DN 10 to DN 20. Family D, type C
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 14814	Adhesives for thermoplastic piping systems for fluids under pressure. Specifications
BS EN 1505	Ventilation for buildings. Sheet metal air ducts and fittings with rectangular cross-section. Dimensions
BS EN 1506	Ventilation for buildings. Sheet metal air ducts and fittings with circular cross-section. Dimensions
BS EN 1507	Ventilation for buildings. Sheet metal air ducts with rectangular section. Requirements for strength and leakage
BS EN 15450	Heating systems in buildings. Design of heat pump heating systems

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BS EN 15650	Ventilation for buildings. Fire dampers
BS EN 1567	Building valves. Water pressure reducing valves and combination water reducing valves. Requirements and tests.
BS EN 15780	Ventilation for buildings. Ductwork. Cleanliness of ventilation systems
BS EN 1717	Protection against pollution of potable water in water installations and general requirements of devices to prevent pollution by backflow
BS EN 1751	Ventilation for buildings. Air terminal devices. Aerodynamic testing of damper and valves
BS EN 378-1	Refrigerating systems and heat pumps. Safety and environmental requirements. Basic requirements, definitions, classification and selection criteria
BS EN 378-2	Refrigerating systems and heat pumps. Safety and environmental requirements. Design, construction, testing, marking and documentation
BS EN 378-3	Refrigerating systems and heat pumps. Safety and environmental requirements. Installation site and personal protection
BS EN 378-4	Refrigerating systems and heat pumps. Safety and environmental requirements. Operation, maintenance, repair and recovery
BS EN 50160	Voltage characteristics of electricity supplied by public electricity networks
BS EN 50174-1	Information technology. Cabling installation. Installation specification and quality assurance
BS EN 50174-2	Information technology. Cabling installation. Installation planning and practices inside buildings
BS EN 50174-3	Information technology. Cabling installation. Installation planning and practices outside buildings
BS EN 545	Ductile iron pipes, fittings, accessories and their joints for water pipelines. Requirements and test methods
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 60085	Electrical insulation. Thermal evaluation and designation
BS EN 60204-1	Safety of machinery. Electrical equipment of machines. General requirements
BS EN 60252-1	AC motor capacitors. General. Performance, testing and rating. Safety requirements. Guidance for installation and operation
BS EN 60252-2	AC motor capacitors. Motor start capacitors
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 60335-2-51	Household and similar electrical appliances. Safety. Particular requirements for stationary circulation pumps for heating and service water installations
BS EN 60335-2-73	Household and similar electrical appliances. Safety. Particular requirements for fixed immersion heaters
BS EN 60529	Degrees of protection provided by enclosures (IP code)
BS EN 60730-2-9	Automatic electrical controls for household and similar use. Particular requirements for temperature sensing controls

T90 MECHANICAL SERVICES – SELF-CONTAINED SPECIFICATION

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 thermal protection (PTC) for rotating electrical machines
BS EN 61000-5-7	Electromagnetic compatibility (EMC). Installation and mitigation guidelines. Installation and mitigation guidelines. Degrees of protection by enclosures against electromagnetic disturbances (EM code). Degrees of protection against electromagnetic disturbances provided by enclosures (EM code)
BS EN 61000-6-1	Electromagnetic compatibility (EMC). Generic standards. Immunity for residential, commercial and light-industrial environments
BS EN 61000-6-2	Electromagnetic compatibility (EMC). Generic standards. Immunity for industrial environments
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 614-1	Safety of machinery. Ergonomic design principles. Terminology and general principles
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 speed a.c. power drive systems
BS EN 61800-3	Adjustable speed electrical power drive systems. EMC requirements and specific test methods
BS EN 61800-5-1	Adjustable speed electrical power drive systems. Safety requirements. Electrical, thermal and energy
BS EN 61800-5-2	Adjustable speed electrical power drive systems. Safety requirements. Functional
BS EN 61810-1	Electromechanical elementary relays. General and safety 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)
BS EN 681-1	Elastomeric seals. Material requirements for pipe joint seals used in water and drainage applications. Vulcanized rubber

T90 MECHANICAL SERVICES – SELF-CONTAINED SPECIFICATION

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 755-3	Aluminium and aluminium alloys. Extruded rod/bar, tube and profiles. Round bars, tolerances on dimensions and form
BS EN 755-6	Aluminium and aluminium alloys. Extruded rod/bar, tube and profiles. Hexagonal bars, tolerances on dimensions and form
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 806-3	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 969	Ductile iron pipes, fittings, accessories and their joints for gas pipelines. Requirements and test methods
BS EN ISO 10675-1	Non-destructive testing of welds. Acceptance levels for radiographic testing. Steel, nickel, titanium and their alloys
BS EN ISO 1127	Stainless steel tubes. Dimensions, tolerances and conventional masses per unit length
BS EN ISO 11666	Non-destructive testing of welds. Ultrasonic testing. Acceptance levels
BS EN ISO 12944-1	Paints and varnishes. Corrosion protection of steel structures by protective paint systems. General introduction
BS EN ISO 12944-2	Paints and varnishes. Corrosion protection of steel structures by protective paint systems. Classification of environments
BS EN ISO 12944-3	Paints and varnishes. Corrosion protection of steel structures by protective paint systems. Design considerations
BS EN ISO 12944-4	Paints and varnishes. Corrosion protection of steel structures by protective paint systems. Types of surface and surface preparation
BS EN ISO 12944-5	Paints and varnishes. Corrosion protection of steel structures by protective paint systems. Protective paint systems
BS EN ISO 12944-6	Paints and varnishes. Corrosion protection of steel structures by protective paint systems. Laboratory performance test methods
BS EN ISO 12944-7	Paints and varnishes. Corrosion protection of steel structures by protective paint systems. Execution and supervision of paintwork

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BS EN ISO 12944-8	Paints and varnishes. Corrosion protection of steel structures by protective paint systems. Development of specifications for new work and maintenance
BS EN ISO 13485	Medical devices. Quality management systems. Requirements for regulatory purposes
BS EN ISO 13585	Brazing. Qualification test of brazers and brazing operators
BS EN ISO 1452-1	Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure. Unplasticized poly(vinyl chloride) (PVC U). General
BS EN ISO 1452-2	Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure. Unplasticized poly(vinyl chloride) (PVC U). Pipes
BS EN ISO 1452-3	Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure. Unplasticized poly(vinyl chloride) (PVC-U). Fittings
BS EN ISO 1452-4	Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure. Unplasticized poly(vinyl chloride) (PVC U). Valves
BS EN ISO 1452-5	Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure. Unplasticized poly(vinyl chloride) (PVC U). Fitness for purpose of the system
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 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 17668	Zinc diffusion coatings on ferrous products. Sherardizing. Specification
BS EN ISO 17672	Brazing. Filler metals
BS EN ISO 17834	Thermal spraying. Coatings for protection against corrosion and oxidation at elevated temperatures
BS EN ISO	Anaesthetic and respiratory equipment. Dimensions of non-interchangeable screw-threaded (NIST) low-pressure connectors for medical gases
BS EN ISO 2063	Thermal spraying. Metallic and other inorganic coatings. Zinc, aluminium and their alloys
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 coatings. Electroplated coatings of cadmium with supplementary treatments on iron or steel
BS EN ISO 228-1	Pipe threads where pressure-tight joints are not made on the threads. Dimensions, tolerances and designation

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BS EN ISO 27830	Metallic and other inorganic coatings. Guidelines for specifying metallic and inorganic coatings
BS EN ISO 354	Acoustics. Measurement of sound absorption in a reverberation room
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 coatings
BS EN ISO 4064-1	Water meters for cold potable water and hot water. Metrological and technical requirements
BS EN ISO 4064-2	Water meters for cold potable water and hot water. Test methods
BS EN ISO 4064-3	Water meters for cold potable water and hot water. Test report format
BS EN ISO 4064-4	Water meters for cold potable water and hot water. Non-metrological requirements not covered in ISO 4064-1
BS EN ISO 4064-5	Water meters for cold potable water and hot water. Installation requirements
BS EN ISO 4126-1	Safety devices for protection against excessive pressure. Safety valves
BS EN ISO 5817	Welding. Fusion-welded joints in steel, nickel, 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	Graphical symbols. Safety colours and safety signs. Registered safety signs
BS EN ISO 7438	Metallic materials. Bend test
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 8990	Thermal insulation. Determination of steady-state thermal transmission properties. Calibrated and guarded hot box
BS EN ISO 9000	Quality management systems. Fundamentals and vocabulary
BS EN ISO 9001	Quality management systems. Requirements
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/IEC 27001	Information technology. Security techniques. Information security management systems. Requirements
BS EN ISO/IEC 27002	Information technology. Security techniques. Code of practice for information security controls
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 K

T90 MECHANICAL SERVICES – SELF-CONTAINED SPECIFICATION

BS HD 60269-3	Low-voltage fuses. Supplementary requirements for fuses for use by unskilled persons (fuses mainly for household and similar applications). Examples of standardized systems of fuses A to F
BS ISO 10294-1	Fire resistance tests. Fire dampers for air distribution systems. Test method
BS ISO 10294-2	Fire-resistance tests. Fire dampers for air distribution systems. Classification, criteria and field of application of test results
BS ISO 10294-3	Fire-resistance tests. Fire dampers for air distribution systems. Guidance on the test method
BS ISO 10294-4	Fire resistance tests. Fire dampers for air distribution systems. Test of thermal release mechanism
BS ISO 10294-5	Fire-resistance tests. Fire dampers for air distribution systems. Intumescent fire dampers
BS ISO 11922-1	Thermoplastics pipes for the conveyance of fluids. Dimensions and tolerances. Metric series
BS ISO 20816-1	Mechanical vibration. Measurement and evaluation of machine vibration. General guidelines
BS ISO 21940-11	Mechanical vibration. Rotor balancing. Procedures and tolerances for rotors with rigid behaviour
BS ISO 21940-21	Mechanical vibration. Rotor balancing. Description and evaluation of balancing machines
BS ISO 4065	Thermoplastics pipes. Universal wall thickness table
BS ISO 7121	Steel ball valves for general-purpose industrial applications
BS ISO 727-1	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. Metric series
BS ISO 727-2	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. Inch-based series
BS ISO 8992	Fasteners. General requirements for bolts, screws, studs and nuts
ISO 17893	Steel wire ropes. Vocabulary, designation and classifications
ISO/IEC 11801	Information technology. generic cabling for customer premises
ADCAS	An ADCAS guide to the specification of flexible ductwork
ASFP	Fire rated and smoke outlet ductwork (Blue book)
ASHRAE	ASHRAE Handbook, HVAC Applications
BCO	Guide to specification
BESA DW/143	Guide to good practice - ductwork air leakage testing
BESA DW/144	Specification for sheet metal ductwork
BESA TR/19	Guide to good practice - internal cleanliness of ventilation systems
BESA SUS/01	Guide to Good Practice: Heat Metering
BESA TR/20	Installation and testing of pipework systems
BESA TR/3	Guide to Good Practice: Jointing of copper and its alloys
BESA TR/5	Welding of carbon steel pipework
BESA TR/6	Guide to good practice - Site pressure testing of pipework

SAINSBURY RELOCATION, VICTORIA SQUARE WOKING

MEP ENGINEERING SYSTEMS

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BSRIA AG 16/2002	Variable-flow water systems. Design, installation and commissioning guidance
BSRIA AG 20/95	Commissioning of pipework systems
BSRIA BG 1/2009	Building services job book – a project framework for engineering services
BSRIA BG 10/2010	BSRIA Structural Fixings for Ductwork Systems
BSRIA BG 11/2010	Commissioning job book
BSRIA BG 2/2010	Commissioning water systems
BSRIA BG 29/2012	Pre-commission cleaning of pipework systems
BSRIA BG 43/2013	Flexible ductwork: a guide to specification, procurement, installation and maintenance
BSRIA BG 46/2015	Domestic ventilation systems – a guide to measuring air flow rates
BSRIA BG 49/2015	Commissioning air systems.
BSRIA BG 50/2013	Water treatment for closed heating and cooling systems
BSRIA BG 51/2014	Selection of control valves in variable flow systems
BSRIA BG 57/2015	Legionnaires' disease – risk assessment
BSRIA BG 58/2015	Legionnaires' disease – operation and maintenance log book
BSRIA BG 6/2014	Design framework for building services
BSRIA BG 8/2009	Model commissioning plan
BSRIA COP 22/2002	Wire Rope Suspension Systems
BSRIA FMS 1/97	Standard specification for ventilation hygiene
BSRIA TM1/88.1	Commissioning of HVAC Systems: Guidance on the division of responsibilities
CFA GN	Construction Fixings Association (CFA) Guidance Note: Procedure for site testing construction fixings
CIBSE	Technical Memoranda
CIBSE Commissioning Code A	Air distribution systems
CIBSE Commissioning Code R	Refrigeration systems
CIBSE Commissioning Code W	Water distribution systems
CIBSE Guides	
CIBSE Knowledge Series KS09	Commissioning variable flow pipework systems
DIN 50961	Electroplated coatings – zinc coatings on iron and steel – terms, testing and corrosion resistance
DIN 740	Power transmission engineering. Flexible shaft couplings
DIN 8063	Pipe joint assemblies and fittings for unplasticized polyvinyl chloride (U-PVC) pressure pipelines
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
HSE L24	Workplace (Health and Safety and Welfare) Regulations
HSE L64	Safety signs and signals. The Health and Safety (Safety Signs and Signals) Regulations. Guidance on Regulations
HSE L8	Legionnaires' disease – The control of Legionella bacteria in water systems

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HSE GS4	Safety requirements for pressure testing
HSE HSG 253	HSE guidance note. The safe isolation of plant and equipment
HSE HSG 274	Legionnaires' disease: Technical Guidance. Parts 1, 2 and 3
HSE INDG 436	Safe Management of industrial steam and hot water boilers
DD IEC/TS 60034-17	Rotating electrical machines. Part 17: Cage induction motors when fed from converters — Application guide
Institute of Refrigeration	Code of practice for the minimisation of refrigerant emissions from refrigerating systems
Institute of Refrigeration	Safety code of refrigerating systems utilising A1 refrigerants
Institute of Refrigeration	Safety code of refrigerating systems utilising A2 & A3 refrigerants
IOP / CIPHE	Plumbing engineering services design guide
PD 5304	Guidance on safe use of machinery
PD 5500	Specification for unfired fusion welded pressure vessels
Water UK	Water Industry Standards
WRAS	Products and Materials Directory
WRAS	Water Regulations Guide
WRAS AIM 08 01	Approved Installation Method Type BA device – verifiable backflow preventer with reduced pressure zone (RPZ valve)
WRAS IGN 9-02-05	WRAS information and guidance note - Marking and identification of pipework for water reuse systems

T90 MECHANICAL SERVICES – SELF-CONTAINED SPECIFICATION

300 FOUL DRAINAGE (R11)

310 PERFORMANCE OBJECTIVES

Provide all foul drainage above ground pipework to serve the new sanitary appliances with the shower cores and other drainage outlets at mezzanine level, for connection to the existing above ground drainage pipework.

Base the above ground foul drainage design on System III as defined in BS EN 12056-2 and using the tabulated discharge units as shown in Table 2 within this BS EN document.

Design and install the foul drainage installation to meet the performance objectives stated in BS EN 12056, the Building Regulations and all other technical manuals and guides applicable. Install the system using the minimum pipework and fittings necessary to carry away all foul discharges from the building to the below ground drainage system, quickly, quietly and with freedom from nuisance or risk of injury to health. Prevent air from the discharge pipes from entering the building. Clearly identify all pipelines in accordance with BS 1710.

Install all drainage pipework to convey discharges without cross-flow, back-fall, leakage or blockage. Adequately test, clean and maintain the system at all times throughout the construction process.

Ensure the design of the foul drainage above ground systems meets the requirements of BS EN 12056 and is based on the discharge unit method (DU). The frequency factor used in the flow calculations is taken from BS EN 12056-2 Table 3, but specifically as follows:

Usage of appliances frequency factor *K*

~ intermittent use for office 0.5

320 SYSTEM DESCRIPTION

Base the design of the foul drainage above ground system on the primary ventilated stack / modified primary ventilated stack principles as defined in BS EN 12056-2 with additional relief ventilation pipework provided as necessary. Convey all effluent from various sanitary appliances, drainage outlets, etc by gravity to the connection to the existing above ground drainage system.

Provide adequate drainage facilities for the mechanical services equipment and plant.

Do not use short radius bends in the foul drainage above ground system.

Make all branches to horizontal discharge pipework at high level on any floor using 45° branches swept in the direction of flow where possible. Opposed connection branches within the horizontal plane are not permitted.

Install access doors or caps on sanitary pipework to facilitate rodding and maintenance access to installed pipework. Co-ordinate access through architectural casings, with pipe accessories.

Provide access doors to all main discharge pipes in accordance with the Building Regulations and BS EN 12056, as follows:

Vertically

- 1 located at floor level plus 1200mm at each installed position, to the centreline of the access fitting
- 2 on stub stack connections at floor level plus 1200mm to the centre-line of the access fitting or above the fitting's spill-over level
- 3 as required to facilitate access for testing
- 4 on vertical pipework above and below any offset

T90 MECHANICAL SERVICES – SELF-CONTAINED SPECIFICATION

Horizontally

- 1 where shown on the public health systems drawings
- 2 all changes in direction
- 3 on all horizontal floats

Ensure all traps to appliances have deep seals in compliance with BS EN 12056 and the Building Regulations.

Where ventilating pipework is necessary to suit either the below or the above ground drainage systems, terminate through the roof to meet architectural and technical requirements.

321 General

Fully design, supply, install, test and commission the whole foul drainage above ground system, based on the requirements and parameters outlined within this specification and on the accompanying drawings.

The contractor is responsible for reviewing and surveying the existing drainage system and determining a suitable location for the new vent pipework to connect onto.

The contractor is responsible for detailing the connection to the existing above ground drainage system.

The contractor is responsible for determining the high-level drainage routes and confirming whether package pump units are required.

322 Fire safety

Provide and install protection of openings and fire stopping in accordance with the Building Regulations, Part B.

Provide and install an intumescent fire-sleeve on all plastic pipework exceeding 40mm internal diameter passing through fire compartment floors or walls. Ensure that the fire-sleeve has an appropriate Agreement Certificate. Ensure that the fire-sleeve has a fire rating compatible with the wall, floor or cavity barrier to which it is fitted.

330 SYSTEM COMPONENTS

Unless detailed or specified otherwise:

- 1 ensure main large diameter discharge and ventilation pipework and fittings for pipework of 50mm dia and above are uPVC to BS EN 1329, BS 4514 and BS EN 1566.
- 2 Lightweight cast iron to BS 416 is to be provided in the floor trench – refer to drawings for locations;
- 3 ensure all small diameter discharge and ventilation pipework and fittings for pipework less than 50mm dia are muPVC to BS EN 1329, BS 5255 and BS EN 1566.

331 Gradients

Install discharge pipes and ventilating pipework to gradients strictly in accordance with BS EN 12056 to provide self-cleansing velocities. Agree minor adjustments of gradient required by practical on site fixing, size of fittings or through co-ordination with other services with the engineer prior to installation.

332 Open ends

Where open ends of pipe, fittings etc are left exposed during the progress of the work and prior to completion, temporarily but firmly fix a suitable proprietary plug or cap to such open ends so as to prevent the ingress of any foreign matter. Ensure that the aforementioned plug or cap also prevents the egress of liquid from within the system.

T90 MECHANICAL SERVICES – SELF-CONTAINED SPECIFICATION

333 Damage

Provide suitable approved protection to afford protection to pipe, fittings or other equipment whether required on a temporary or permanent nature and where any parts or part are liable to be exposed to damage from other trades or any causes whatsoever.

Immediately replace, at your own expense, any pipework fittings, valves and sanitary fittings unduly marked by tools or otherwise damaged or distorted and rejected by the engineer.

334 Cast iron pipes and fittings

Install the discharge pipes in the positions indicated on the engineer's drawings.

Ensure that the pipes and fittings are lightweight cast iron manufactured in accordance with BS EN 877 and BS 416 suitable for being installed in the floor void. Ensure that they are straight, smooth, of true cylindrical bore, free from lamination flaws and other imperfections. Make good defects to coatings prior to installation. Ensure that the pipes and fittings bear the relevant BS EN marking.

335 UPVC pipes and fittings

Install the discharge pipes in the positions indicated on the drawings.

Use only grey coloured (10A 07 BS 4800) un-plasticised PVC pipework and fittings, manufactured in accordance with BS EN 1329 and BS 4514. Ensure that the pipework and fittings, where appropriate, bear the British Standard Kitemark and that they are straight, smooth, of true cylindrical bore and free from all flaws and imperfections.

Joint the pipework and fittings using solvent welding, using the manufacturer's approved cement.

Use seal ring fittings where necessary to accommodate thermal movement or where the manufacturer recommends. Convert the sockets of standard fittings to seal ring joints by the addition of a seal ring adaptor. Ensure the rubber seals for seal ring joints are of a section that gives more than one point of contact with the pipe. Include thermal temperature limiters on horizontal pipework spaced at a distance greater than 300mm from the structure and where the length of horizontal pipework exceeds 3000mm. Anchor all expansion units.

Provide access either by means of an integrally moulded door in an access fitting with an externally fitted rubber seal and secured with two galvanised bolts and nuts, or alternatively by a two-piece clamp type door fitted into the pipe run.

Install an expansion/movement coupling either side of the joint where a pipe crosses a building expansion joint. Where differential settlement may be expected provide the "rocker" pipe with increased fall to prevent a back-fall occurring.

Install all uPVC pipework strictly in accordance with the manufacturer's installation instructions.

336 MUPVC discharge pipework

Install the discharge pipes in the positions indicated on the drawings.

Ensure that the pipe and fittings are grey modified un-plasticised PVC manufactured in accordance with BS EN 1329 and BS 5255 and that they comply with the BS EN 12056 clear bore recommendations.

Joint the pipework and fittings using solvent welding, using the manufacturer's approved cement. Install seal ring joints where it is necessary to accommodate expansion.

T90 MECHANICAL SERVICES – SELF-CONTAINED SPECIFICATION

400 COLD WATER (S10)

410 PERFORMANCE OBJECTIVES

To receive and convey cold wholesome water to all water fittings in the premises, without waste, misuse, undue consumption or contamination (including degradation of the 'fluid category' as defined by the Water Regulations Guide) of the water supply or the cold water system all in accordance with applicable regulations and standards and other design parameters.

To limit the cold water temperature to a maximum of 20°C.

To install the system such that it can be fully drained down for frost protection purposes or maintenance whilst ensuring that air can freely enter.

411 Pipework velocity

On mains pressure systems, limit pipework velocities to maximum values of:

- ~ 2.0 m/sec in plant areas, service ducts and riser shafts
- ~ 1.5 m/sec in service enclosures and ceiling voids within non-noise-sensitive areas
- ~ 1.5 m/sec in circulation areas and entrance corridors

On gravity based systems, limit pipework velocities to a maximum of 0.8 m/sec or lower depending on pressure available and location of the point of draw off within the system.

420 SYSTEM DESCRIPTION

The cold-water supply for the new staffroom is to be connected off the existing water network in the services zone in the adjacent WCs to supply the kitchen sink, dishwasher and the coffee vending machine.

430 SYSTEM COMPONENTS

431 General

Only install WRAS approved water fittings and materials.

Form a goose-neck or sweeping bend at the connection to the water main to relieve stresses.

432 Pipework, fittings and ancillaries

Fit check valves to both hot and cold supplies where a shut off valve is fitted to the outlet nozzle of a mixing appliance.

Where copper and galvanized steel are both used in the same system ensure that the water flows from the galvanized steel to the copper not vice versa. Join the two with a gunmetal component.

Do not use copper and galvanized steel together in a drinking water installation.

Where backflow prevention devices have a relief outlet port (e.g. an 'RPZ valve assembly'), agree their installation in advance with the water supply company/authority. .

Do not use flexible hose connections

433 Backflow protection

Ensure all pipework systems and associated appliances are protected against backflow or back syphonage in accordance with the requirements of The Water Supply (Water Fittings) Regulations, WRAS guidance and applicable standards.

T90 MECHANICAL SERVICES – SELF-CONTAINED SPECIFICATION

440 EQUIPMENT

441 Pressure reducing valves (PRVs)

Supply and install pressure reducing valves (PRVs) and associated pressure relief safety valves (PRSVs) where shown on the drawings.

Ensure that they are of bronze, copper alloy or stainless steel with screwed connections up to 50 mm pipe size and flanged connections above this size.

Use only drop tight valves which comply with BS EN 1567 acoustic class 1. Select all PRVs to give a stable outlet pressure across the full range of flow rates and inlet pressures that they will be subjected to in practice, including the 'closed-head' pressure of the boost pump set. Ensure that all PRVs are sized by the manufacturer and not assumed to be line-sized.

Prior to ordering, submit all PRV technical details to the Contract Administrator.

Install all PRVs in accordance with the manufacturer's recommendations. Ensure there are at least five pipe diameters of straight pipe after a PRV before any other fitting (another PRV, elbow, restriction, valve, etc).

Protect every PRV by installing a strainer upstream of it.

500 HOT WATER (S11)

510 PERFORMANCE OBJECTIVES

To provide a complete hot water installation to serve the domestic hot water requirements of the building in compliance with all applicable regulations, standards and other design parameters.

To control the risks of legionella by storing water at and above 60°C and distributing it at not less than 55°C for primary distribution. Also, by ensuring that the minimum temperature anywhere within the circulation system (primary or secondary) does not fall below 50°C under prolonged maximum draw off conditions, and that a temperature of 50°C is reached at the furthest outlet within one minute of demand.

To enable the system to be thermally sterilised by arranging the hot water generation plant to be capable of heating the system to 70°C on required occasions.

To install the system such that it can be fully drained down for frost protection purposes or maintenance whilst ensuring that air can freely enter to prevent risk of collapse.

520 DESIGN PARAMETERS

Ensure hot water systems are capable of being maintained at designated temperatures on a constant 24 hour basis.

Provide a single pipe distribution system with no trace heating or recirculation.

Ensure that blended water pipework is no longer than 2 metres from blending device to point of discharge and is within the 3 metre overall length from trace heated or circulation mains connection.

Refer to section S10, above, for design parameters relating to pipe sizing and velocity.

Provide a 230-V, 1-phase, 50-Hz primary heating source.

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530 SYSTEM DESCRIPTION

531 Type of system

Provide a decentralised unitary unvented hot water heater installation with unheated distribution.

532 Hot water generating plant

Provide decentralised hot water generating plant comprising point of use electric storage heaters with unvented kit.

540 CONTROL REQUIREMENTS

541 Control of hot water temperature

Control the hot water storage temperature at 60°C for 24 hours per day, 365 days per year.

Provide each hot water storage vessel immersion heater with its own on-board thermostat control to maintain the set point temperature.

Ensure that each high temperature cut out device is independent of the normal temperature control system, will fail safe and is only able to be manually reset.

Provide suitable safety devices to comply with Building Regulations Approved Document G3.

550 SYSTEM COMPONENTS

551 General

Only install WRAS approved water fittings and materials.

552 Pipework, fittings and ancillaries

Install hot water distribution pipework, fittings and ancillaries in accordance with specification sections Y10, Y11, Y23, Y51 and Y90.

Where stainless steel pipework is used for domestic hot water service, wrap it in aluminium foil in accordance with the requirements of BS 5970 prior to the application of any insulation.

Where copper and galvanized steel are both used in the same system ensure that the water flows from the galvanized steel to the copper not vice versa. Join the two with a gunmetal component.

Fit check valves to both hot and cold supplies where a shut off valve is fitted to the outlet nozzle of a mixing appliance or where the hot and cold supply pressures are unbalanced and where the water mixes within the body of the appliance.

Where there is a fluid category 3 backflow risk, fit double check valves on the hot and cold supplies to any tap or mixing device whose outlet is below the spillover level of the sanitary appliance it serves or where a flexible hose is used which can reach below the spillover level or into an adjacent bath, basin or shower tray.

Do not use flexible hose connections.

600 LOCAL HEATING/COOLING UNITS

610 PERFORMANCE OBJECTIVES

To provide, install, test and commission comfort heating or cooling to control temperature in the areas indicated on the drawings, within this specification and schedules.

620 DESIGN PARAMETERS

Indoor temperature:

Winter: 21°C db (+/- 1°C)/uncontrolled wb

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Summer: 24°C db (+/- 1°C)/18°C wb (+/- 1.5°C)
Outdoor temperature:
Winter: -3°C db/-3°C wb
Summer: 30°C db/23°C wb
Refrigerant: R32
Refrigerant charge: Manufacturer to advise
Type of system: Single-split
Indoor unit cooling duty: Staff Room – 5.0kW, Office – 2.0kW
Total number of independent air conditioning systems: 2No.
Ambient dry bulb: 35 °C
Maximum condensing temperature: 50 °C
Room temperature setpoint: 24 °C
Room humidity control setpoint: 50%
Control band: +/- 1.0 °C
Outdoor unit maximum noise rating: 50 dB(A)
Outdoor unit type: Floor Mount
Indoor unit maximum noise rating: 45 dB(A)
Indoor unit type: Wall mount
Pipe run length: Manufacturer to confirm

630 SYSTEM DESCRIPTION

631 General

Provide local heating/cooling unit comprising a direct expansion (DX) cooling unit with supply air into the conditioned space and an externally mounted condenser.

Provide a condensate drainage system to serve all cooling units as indicated on drawings.

Provide systems consisting of the following components. Supply and install these system components in accordance with manufacturer's installation guidelines.

- ~ heat recovery air cooled condensing units
- ~ heat recovery indoor units
- ~ interconnecting control and power wiring from outdoor unit/s to indoor unit/s
- ~ interconnecting refrigerant pipe work from outdoor units to indoor units

Ensure that all cooling units are installed and commissioned to the manufacturer's requirements.

Ensure the installation provides energy efficient cooling/heating to the designated areas.

Provide equipment which is suitable for operating on a 230-volt, single-phase, 50-Hz supply for indoor units and a 400-volt, three-phase, 50 Hz supply for the outdoor units.

Comply with the requirements of the design drawings, technical specification, equipment schedules and relevant Y clauses.

T90 MECHANICAL SERVICES – SELF-CONTAINED SPECIFICATION

632 Condensate drainage system

Install a condensate drainage system in accordance with specification section R11.

Install pipework and supports in accordance with the relevant clauses in specification section Y10.

Insulate condensate pipework with 10 mm closed-cell elastomeric nitrile rubber insulation having a BL-s3,d0/formerly Class 0 fire rating.

633 Using condensate pumps

Where shown on the drawings, whenever an indoor evaporator unit's condensate tray does not drain adequately, and in other circumstances where agreed with the Contract Administrator, provide pumped condensate drainage for those fan-coil units where gravity drainage alone is not possible. Where pumped condensate drainage is required, provide a dedicated pump to each fan-coil unit requiring pumped condensate drainage and make the ongoing connection to a gravity system at the earliest opportunity.

Install condensate pumps that are self-priming, quiet-running, maintenance-free, capable of operating dry without an overheating failure, and tolerant to pumping suspended solids. Use positive displacement pumps without check valves or syphon, based on rotary-diaphragm technology or an equal alternative method accepted by the Contract Administrator.

Equip each pump with a reservoir containing a solid-state level sensor and incorporate electronic controls to ensure the pump only operates when condensate is present. Provide a high-level alarm that closes the valve to the evaporator coil in the indoor unit in the event of an alarm.

Power the condensate pump using an electrical supply taken from the indoor unit and install all necessary wiring.

Route individual condensate drainage tubing from each pump to a common tundish connected to the building's foul drainage system through a waterless drain trap. Provide sufficient air gap between the ends of each pump's discharge tubing and the tundish to provide a type-A air gap as defined in BS EN 13076.

640 CONTROL REQUIREMENTS

Install system timer control clock to enable operating times to be programmed.

Control the condenser fans by speed control to maintain the required condensing pressure.

Prevent the compressor motor from being re-started within 10 minutes (or the time recommended by the manufacturer) of a previous start.

Provide high-pressure and low-pressure cut-outs to each refrigerant circuit.

Provide each local cooling unit with its own stand-alone controller, complete with temperature sensor.

Install pressure relief devices to protect the refrigerant circuit from over pressure in accordance with BS EN 378. Select all system components and pipework to withstand the design pressure as per clause 210 'Design parameters' and to be protected by the pressure relief devices. Install the devices to enable servicing without the loss of refrigerant.

650 SYSTEM COMPONENTS

651 Pipework

Ensure all pipework is manufactured using de-oxidised, refrigerant quality copper to BS EN 1057, and is heat-treated as follows:

6.4mm (1/4") OD to 15.9mm (5/8") OD - Soft, Half Hard or Hard Tempered

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19.1mm (3/4") OD to 41.3mm (1 5/8") OD - Half Hard or Hard Tempered

When 1 5/8" tube is used, ensure it is 16 gauge.

Purge all pipework with oxygen-free nitrogen when brazing and keep capped at all other times.

Leak test the system with oxygen-free nitrogen at a pressure of between 34 and 37 bar for a period of at least 8 hours. Apply pressure progressively in small increments until the required outlet pressure is reached.

De-hydrate the system by creating a vacuum deeper than 0.005 bar before the vacuum pump is isolated for a period of no less than 30 minutes. If the vacuum falls during this time, add oxygen-free nitrogen and repeat the dehydration process until the vacuum is maintained for 30 minutes. Use only virgin refrigerant (R410A) in liquid form.

On all interconnecting refrigerant pipework between outdoor units and indoor units, utilise manufacturer's joint kits.

Use brackets of the Hydrozorb assembly type brass finished, fitted in either purpose made aluminium Hydrozorb channel or hot dip galvanized Unistrut, with all cut ends treated with cold galvanized paint. Fix a return flange cable tray of a suitable size, and where the possibility of mechanical damage is evident, a secondary cable tray, over the pipe work to provide protection against damage.

Install closed cell nitrile rubber insulation, BL-s3,d0 (formerly Class 0) fire rated and vapour sealed. Provide insulation thicknesses in accordance with BS 5422, but not less than 15 mm. For applications where the suction temperature is -5°C or below provide insulation of minimum thickness of 25mm.

Cap all pipework for refrigeration purposes at all times other than when actually being installed. Keep the inside of the tube free from dust and moisture at all times.

Do not cut copper tube for refrigeration purposes using a tool which creates filings that will contaminate the system. Remove any work carried out in this way.

Braze all joints. Do not use flared connectors, soft soldering, etc.

Ensure brazing is carried out by a skilled operative in accordance with the Institute of Refrigeration Codes of practice. Carry out all brazing work outside the building or internally under strict hot work permit procedures.

At the end of the installation and following the successful completion of the pressure test, examine all joints. Remove any oxidation found, check all pipework and reinstall using the brazing techniques previously described.

Support pipework by clipping to light weight cable basket or similar, avoiding movement or distortion of the pipework. Install supports to every 2 m for soft tempered 15-22 mm diameter pipework, 3 m for half hard 22-54 mm diameter pipework and 4 m for half hard 54-67 mm diameter pipework.

Install additional brackets as necessary at weak points such as bends to prevent vibration.

Where the insulation interfaces with a component, ie Hydrozorb type clip, butt it up against the clip and glue it to the pipe at this point to form a continuous and effective thermal and vapour seal.

Supply and install all components in the system necessary to provide a safe and energy efficient system. Install all components required to prevent 'migration'. Incorporate head pressure control.

Install the entire installation in a neat and tidy manner, keeping all pipework straight where possible.

Thermally insulate all external pipework and paint with two coats chlorinated rubber paint with colour ID banding (hot gas, liquid, etc). Mount pipework on heavy duty cable tray/basket and fit with mechanical and UV protective aluminium or galvanized sheet covers, secured in place.

T90 MECHANICAL SERVICES – SELF-CONTAINED SPECIFICATION

652 Outdoor unit

Provide a condenser unit, constructed having air-cooled coils mounted in the unit frame in a manner to minimise the size of unit. Construct coils from seamless copper tubes mechanically expanded/bonded into aluminium fins. Provide outdoor unit factory assembled, pre-wired, works tested, supplied with a refrigerant pre-charge and complete with fully sealed pipe work connections.

Provide high efficiency direct drive condenser fans to achieve the design airflow against the total resistance of the condenser together with fan guards and any supplementary attenuators required to conform to this specification. Condenser fans may be propeller type, axial flow or sickle bladed type as required.

Configure condenser assemblies to provide sufficient heat rejection surface area to affect the design condensing temperature at the design ambient air condition set out in the performance parameters.

Ensure the access panel is easily removable for servicing. Fit the condensing unit with its own electrical compartment with all necessary electrical and control components.

Arrange oil management to allow oil transfer between connected indoor and outdoor unit ensuring that adequate lubrication is provided to compressor/s. Make provision to facilitate piping connections to the front or bottom of the unit.

Provide condensing pressure control for stable operating at low cooling load and ambient temperature and during the night time to reduce the generated noise.

Provide a compressor of the rotary type, and with inverter capacity control to match the connected indoor cooling or heating demand. Do not use fixed speed compressors. Mount the compressor on springs and shock-absorbing rubber to minimise vibration.

Protect the compressor from liquid carryover by means of a suction accumulator, or other measure to prevent liquid carryover to the compressor.

Install the condensing unit in accordance with manufacturer's recommendations and ensure that the condenser air intake receives a direct supply of air at ambient temperature. Ensure that the condenser does not suffer any air re-circulation or increased air intake temperature due to other equipment located nearby.

653 Expansion device

Select expansion device to meet the design cooling duty under low ambient conditions. Ensure the expansion device closes when the system shuts down to prevent transfer of liquid from the high pressure side to the low pressure side of the system.

Supply battery backed power supply to drive motor to the closed position in the event of a power failure.

654 Indoor unit

Ensure each indoor unit operates on a 230-volt, single-phase, 50-Hz supply, and is fully compatible with a self-diagnostic controller with liquid crystal display of operational mode, room temperature, timer, fan speed and on/off functions. In the event of a fault ensure a malfunction code is displayed.

Supply the evaporator mounted within the indoor unit in a suitable galvanized steel frame. Construct the evaporator using seamless copper tubes mechanically expanded/bonded into aluminium fins. Design the evaporator for use in a DX cooling system.

Supply propeller or centrifugal design evaporator fans in accordance with the manufacturer's recommendations.

Design the evaporator to minimise transmission of noise and vibration.

Design the evaporator to prevent condensation on external surfaces of its casing.

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Supply the evaporator with a drip tray and provide a condensate pump to transfer any accumulated condensate water to a suitable drainage point. Include for all condensate pipework. Where condense pumps are essential for the discharge of latent cooling run off interlock condense lifter/pump fault with the outdoor unit to prevent overflow and flooding of drain tray.

Supply the indoor unit with a replaceable/washable air inlet filter.

Install the following types of indoor units.

- high wall

655 Wall-mounted controller

Install the following types of wall mounted controller.

Hard wired controller with ability to operate weekly timer schedule with maximum of six schedules per day, 100hr battery backup and included holiday program.

656 Low temperature insulation

Apply insulation complete with vapour seal and mechanical protection to low temperature refrigerant pipework and vessels generally as clause 610 above, and in accordance with specification section Y50.

Treat all low temperature surfaces to prevent corrosion. Fit drip trays to catch any condensate. Insulate liquid lines high temperature areas or where exposed to direct sunlight.

T90 MECHANICAL SERVICES – SELF-CONTAINED SPECIFICATION

700 GENERAL SUPPLY AND EXTRACT VENTILATION

710 PERFORMANCE OBJECTIVES

To provide, install and commission a complete supply and extract ventilation installation to serve the building in compliance with all applicable regulations, standards and other design parameters.

To provide, coordinate, install, test and commission:

- a reliable mechanical ventilation system that supplies filtered outside air to and extracts vitiated air from the staff room and office.

720 DESIGN PARAMETERS

The system achieves the following criteria in the locations listed:

General office supply air temperature 18°C

Area	Supply	Extract
Staff Room	10 litres/second/person	10litres/second/person
Office	10 litres/second/person	10litres/second/person

Ensure that the MVHR heat exchanger achieves a minimum efficiency of 80%.

Ensure that the design and selection of each MVHR system complies with the noise levels in the equipment schedules.

Design ventilation rates in accordance with Approved Document F for boost and background ventilation.

Floor plenum airtightness:

- Air leakage (for both plenum leakage and raised access floor leakage) <0.7l/m²/s @ reference pressure of: 50Pa

730 SYSTEM DESCRIPTION

A packaged mechanical ventilation heat recovery unit (MVHR) with heat recovery, located within the ceiling void above the staff room shall provide filtered supply air to the staff room and office. Stale air will return to the MVHR for heat recovery and will be discharged to the roof.

The MVHR will intake air from atmosphere via a roof cowl on the roof.

Install in-line attenuators on all MVHR ducts of sufficient size and attenuation material to ensure noise levels within the staff room, office and externally comply with the noise criteria as stated within this specification and the acoustic specification/report.

No humidification will be provided within the MVHR.

Intake air ductwork, supply and extract air ductwork within the risers and ceiling voids will be suitably insulated.

740 CONTROL REQUIREMENTS

Operate the ventilation systems automatically under the control of manufacturer own control system.

SAINSBURY RELOCATION, VICTORIA SQUARE WOKING

MEP ENGINEERING SYSTEMS

T90 MECHANICAL SERVICES – SELF-CONTAINED SPECIFICATION

741 Fan speed control

Provide all fans with inverter drives, to afford variable flow systems as describe herein. Control each system fan inverter via pressure sensors strategically located within the ductwork arrangement to afford the optimum control.

742 Alarms

Provide the following alarms at the local control panel:

- air flow failure alarms generated via a differential pressure switches across each fan
- filter dirty alarm generated via a differential pressure sensor across each filter

743 Fire detection mode

Ensure that activation of the fire detection system specified in specification section W50 causes all fans to stop.

750 SCOPE OF WORKS

The scope of works for the supply and extract ventilation systems are as shown on the drawings, schedules, this specification and other documentation used to describe the ventilation systems. Perform and deliver the scope of works to conform to the relevant A sections.

Include as part of the tender all specialist design, plant and equipment necessary to deliver a fully compliant installation.

760 SYSTEM COMPONENTS

761 Zinc-coated steel ductwork

Install all ductwork in accordance with specification sections Y30 and Y31.

762 Domestic plastic ductwork (DPD)

Install supply and extract domestic plastic ductwork of the sizes and in the locations shown on the drawings and as specified herein.

Install all domestic plastic ductwork in accordance with BSRIA BG 46/2013, the manufacturer's recommendations, and specification sections Y30 and Y31. The requirement in Y30 not to use flexible ductwork in lieu of bends and transformation pieces takes precedence over any recommendation to the contrary from the DPD manufacturer.

763 Flexible ducting and flexible joints

Install flexible ducting at final connections to all grilles and plenum boxes. Ensure all flexible ductwork is installed in accordance with specification section Y30. Fully coordinate ductwork arrangements with the final grille layouts to minimize offsets.

764 Air ductline ancillaries

Install and provide all exposed ductwork, components and ancillaries in accordance with specification sections Y30 and Y31 except where stated otherwise below

765 Access openings

Install access openings in accordance with specification section Y31, additionally where shown on the drawings, and additionally as necessary to internally clean all sections of the supply and extract ductwork and air handling units.

766 Volume control dampers

Install VCDs where shown on the drawings and as noted below:

Provide balancing dampers at terminals of the opposed-blade multi-leaf type designed to give close control of airflow evenly across the face of the terminal with minimum noise regeneration.

T90 MECHANICAL SERVICES – SELF-CONTAINED SPECIFICATION

767 Ductwork penetrations through non-fire-rated walls, floors and partitions

Where ductwork penetrates non-fire-rated walls, floors and partitions use the following method of installation:

Ensure that the closure of the space around the ductwork is made with due care and attention not to damage the ductwork or insulation.

768 Vibration isolation mountings

Install vibration isolation mountings in accordance with specification section Y52 and additionally where shown on the drawings, except as noted below:

769 Grilles and diffusers

Install grilles, diffusers and associated plenum boxes as scheduled in locations shown on the design drawings and in accordance with specification section Y46. Refer to the supply diffuser and extract grille schedule for further details.

Use concealed fixing wherever possible for neatness.

Provide all grilles and diffusers with a polyester powder-coated finish in a colour agreed by the Architect.

Select the grilles and diffusers such that noise levels due to regenerated noise do not exceed those specified in clause 200, or in specification section Y45. Note that where more than one grille is present in the room, the combined total of regenerative noise from each grille should not exceed that value stated.

Include for any changes in section between the ductwork sizes on the drawing and the final connection sizes of the grilles and diffusers.

Support plenum boxes separately from the structure and not from the ceiling grid. Internally paint all plenum boxes with a matt black finish.

Note that the index pressure drop on which the fan units have been selected, is based on the scheduled grilles. Check the fan pressure drop(s) based on the selected grilles and diffusers and re-select the fan unit(s) as necessary.

Before placing any order for grilles, diffusers and plenums, obtain details of the ceiling construction and ensure that each proposed selection is compatible with the ceiling.

Co-ordinate grille and diffuser finishes with the other associated trades to avoid creating an airflow restriction.

770 EQUIPMENT

771 MVHR units

Install MVHR unit in locations shown on the drawings, and in accordance with specification section Y40 and the relevant equipment schedules, except as noted below:

772 Silencers and acoustic treatment

Install silencers and acoustic treatment in accordance with specification section Y45 and additionally where shown on the drawings, except as noted below:

Allow a margin of 5 dB across the whole acoustic spectrum when selecting the required attenuators.

Include for acoustic insulation as detailed in specification section Y45 on all sections of ductwork between attenuators and plant room walls, both internally and externally of plant room walls to minimize noise transfer from these areas.

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773 Wall-mounted PIR

Contractor to install a PIR sensor at high level with trickle/boost operation.

800 PIPELINES (Y10)

810 Domestic cold mains and hot water

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.

811 Copper

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.

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

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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.

For soldered joints up to and including 54 mm size, use capillary type, non-dezincifiable, copper or 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, non-dezincifiable, 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. Alternative acceptable brazing alloys are: AG140, and where nickel is not present: CuP179, CuP182, CuP279, CuP281 and CuP284.

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.

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.

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.

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.

812 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.

T90 MECHANICAL SERVICES – SELF-CONTAINED SPECIFICATION

820 Feeds, open and closed vents and drains

821 Galvanised steel

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.

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

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.

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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.

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.

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.

Use flange gaskets as specification for particular systems.

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.

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 110°C. 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.

822 Copper

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.

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,

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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

Use capillary type, non-dezincifiable, copper or 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, non-dezincifiable, 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. Alternative acceptable brazing alloys are: AG140, and where nickel is not present: CuP179, CuP182, CuP279, CuP281 and CuP284.

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.

Use flange gaskets as specification for particular system.

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.

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.

830 Overflow and warning pipes (uPVC)

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.

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840 Pipelines installation

841 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.

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 Contractor 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.

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.

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 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 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.

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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.

842 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:

- ~ Liquids: 1 in 400 fall in direction of flow
- ~ Gas: 1 in 100 fall in direction of flow

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.

843 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.

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.

844 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.

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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.

845 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.

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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

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.

846 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 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, BL-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 BL-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

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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

Support external pipes from below to remove the risk of rain etc penetrating the insulation/cladding via drop rods.

Provide supports, at the base of vertical pipes and at appropriate intermediate positions, 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.

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.

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 ie 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	Maximum support spacing (m)
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pipe size (mm)	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		

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

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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						

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.

847 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.

848 Pipeline assembly

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, or uPVC plastic pipe fittings

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- ~ 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, domestic hot and cold water and gas. Install strictly in accordance with its manufacturer's instructions

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.

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.

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 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.

850 Venting and draining

851 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.

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852 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.

860 Welding and brazing

861 Welding carbon steels

Carry out welding and weld testing of low carbon 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.

All 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.

Competence standards:

For welds of 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.

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.

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Documentation:

Provide welding and weld testing documentation, including interpretation of test results, as detailed in BS EN 13480 part 5.

862 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 welded joints more than 600 mm from an anchor point or guide.

863 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.

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864 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.

900 PIPELINE ANCILLARIES (Y11)

910 Mains and pumped potable cold water

911 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.

912 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

913 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

T90 MECHANICAL SERVICES – SELF-CONTAINED SPECIFICATION

- ~ 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

920 Hot and cold water, internal domestic

921 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.

922 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

923 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

924 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

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- ~ Connections: Taper thread to BS EN 10226-1

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

925 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

926 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

927 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°C
- ~ Pressure rating: PN10

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- ~ 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 @ 38°C
- ~ Pressure rating: PN10
- ~ Material: DZR brass BS EN 12165 CW602N chromium or nickel plated
- ~ Connections: Compression ends to BS EN 1254-2

930 Venting and draining equipment

931 Automatic air vents

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.

932 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.

933 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.

934 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

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940 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 indicators 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.

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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.

950 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 manufacture with, as appropriate, the manufacturer's identification, pressure rating, size, and direction of flow.

1000 SILENCERS / ACOUSTIC TREATMENT (Y45)

1010 General requirements

Employ the services of a specialist manufacturer or acoustic consultant to provide the acoustic materials detailed herein.

Ensure that all noise and vibration levels specified for internal and external areas are not exceeded due to the operation of the engineering services installation. Give particular consideration to the following, as applicable:

- ~ Plant noise transmission to the conditioned space via the distribution ductwork
- ~ Plant noise breakout from ductwork distribution systems
- ~ Plant airborne noise transmission through the plant room structures
- ~ Plant structure borne noise and vibration transmission
- ~ Plant noise transmission to exterior positions
- ~ Velocity generated noise within the ductwork distribution system
- ~ Noise from terminal fittings such as grilles, diffusers, etc
- ~ Acoustic crosstalk between separate areas
- ~ Maintaining sound insulation between rooms using crosstalk attenuation
- ~ Pipe borne noise
- ~ Noise from boilers and flues

Where noise and vibration control equipment is scheduled it is the minimum required to meet the specified noise and vibration levels and it will have been selected to suit the equipment on which the designs have been based. Irrespective of what has been drawn or scheduled, meet the acoustic requirements based on the final equipment selected. Provide details of the plant to be installed to the

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specialist manufacturer/acoustic consultant of acoustic products to ensure that the specified noise and vibration levels are achieved. Provide, at no extra cost to the Contract, sufficient noise and vibration control equipment to meet all specified noise and vibration criteria.

Provide a fully documented set of the specialist manufacturer's/acoustic consultants 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.

Demonstrate all specified noise and vibration levels are satisfied. Carry out acoustic commissioning tests with all plant and machinery running normally and delivering the design conditions of ventilation, temperature and humidity.

In the case of contractual deficiency, and if requested by the Contract Administrator, return at any time during the Contract to take additional readings at no additional cost to the Contract in order to demonstrate the satisfaction of all specified noise and vibration criteria.

1020 Penetrations in building fabric

Where ductwork passes through an acoustic barrier in the form of a wall or a floor, the make an airtight seal to the ductwork by densely packing mineral wool between the ductwork and the building fabric. Line the building fabric with a galvanized sheet metal sleeve of one gauge heavier sheet than the duct passing through the opening. Hold the mineral wool in place by large galvanized steel angle sections riveted to the ductwork but not fixed to the building structure. Push the angle tight against the mineral wool packing and the building fabric with an unbroken seal of flexible mastic between to prevent the direct transmission of duct borne vibration into the building structure. Overlap the hole with the angle by 10 mm minimum all round. In exposed areas, if requested by the Contract Administrator, provide a plywood frame as an alternative to the angle flange.

Where pipework penetrates the building fabric, suitably sleeve and seal the pipes with a dense flexible mastic.

1100 VIBRATION ISOLATION MOUNTINGS (Y52)

1110 General

1111 Specialist manufacturer

Employ the services of a specialist manufacturer or acoustic 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.

1112 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.

1113 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, do not exceed the relevant maximum vibration amplitudes specified in BS 6472.

Provide a fully documented set of the specialist manufacturer's/acoustic consultants calculations to the Contract Administrator, with sufficient time for comment prior to ordering plant and noise and

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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.

1114 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 which will prevail. Pay special attention to vibration isolators which will be exposed to atmospheric or adverse interior conditions, and apply appropriate finishes to prevent excessive corrosion.

1115 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. 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 which are 'bottomed out', or where the springs have deformed from a cylindrical shape, at no additional cost to the contract.

1116 Colour coding

Colour code or otherwise clearly mark all vibration isolators to indicate the rated load and deflection capacity to facilitate identification during installation.

1117 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.

1118 Isolation of pipework and ductwork

As a minimum requirement, resiliently isolate from the building structure all pipework of 50 mm diameter and above and all ductwork within plant rooms for a minimum of 15 metres from the motor driven plant. This requirement will vary by application, and sensitive applications may require all pipework to be isolated.

1119 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.

Avoid the mounting of 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.

1120 Products/materials

1121 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 which also incorporate rubber or neoprene elements in-series with the springs to prevent the transmission of high frequency vibration.

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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.

1122 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.

1123 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.

1124 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.

1125 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/m³, is equal to a least twice the total weight supported. 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 red oxide primer unless otherwise specified.

1126 Neoprene 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/m³, is equal to a least twice the total weight supported. 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.

1127 Flexible connectors

Select all flexible connectors to achieve the specified noise and vibration criteria.

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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. 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.

1200 WIRING FOR MECHANICAL SYSTEMS (W63)

1210 Scope of work

Provide the complete wiring installation for mechanical systems, comprising all controlled plant, power and control wiring and dedicated carrier/containment systems to that plant and all control system components and sensors.

Design, supply, install and commission the entire mechanical systems wiring installation fully in accordance with the requirements of this specification and the scheme drawings.

Ensure that critical circuit lengths for successful operation (control and inverter power circuits in particular) are not exceeded.

Ensure the mechanical systems wiring containment system is completely segregated from other building electrical systems. Do not use the same containment or carrier system for both systems.

1220 Responsibilities

1221 Division of responsibilities

Electrical installer:

- Supply and install all main power cables serving major plant. The point of termination is the panel main isolator in each case.
- All main earth connections to service carriers

Mechanical installer:

- All other wiring relating to mechanical systems.

Each installer is responsible for installing carrier/containment systems for their own wiring and for ensuring the electrical continuity of such systems.

Ensure the electrical continuity of all service carriers/containment installed (including pumps, pipework, ductwork and AHUs, etc.) and provide earth connection points on each for the electrical installer to connect earth bonds.

Liaise with the electrical installer to agree the location of all earth connection points on the mechanical services systems.

Use cables which are fully suitable for their intended use and which comply with appropriate British Standards.

Provide Test and Completion certificates for all installations.

Refer to the scheme drawings and schedules (if provided) for design information relating to the mechanical systems wiring package.

Produce schematic installation drawings to suit the drives selected by the mechanical installer to meet the performance requirements of the scheme design and specification.

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1222 Co-ordination and spatial requirements

Install conduit/trunking/cable tray or cable ladder systems in the plant rooms at high level fixed by brackets from structural ceiling over. Drop services to plant vertically from high level and ensure that they are adequately supported and rigidly fixed (by 'Unistrut' channel) from floor to ceiling or alternatively to an adjacent wall. Avoid the installation of low level horizontal conduits or cables which block or restrict access or will be liable to be damaged by people standing on or climbing over those conduits.

Identify on installation drawings all major cable highways and trunkings in plant rooms - both section/elevation and plan layout.

Ensure that there is sufficient height and space to enable large multicore or single core cables to turn and be terminated into control panels and equipment.

Position wiring routes away from sources of heat and vibration. Maintain a minimum 500mm clearance from heat sources. Where necessary utilise heat resisting cables.

Allow access space for installing cables on trays/ladders and in trunkings;

- ~ minimum 300mm above trays supporting large cables
- ~ 150mm above trunkings installed with lid up

Where a large quantity of cables connect to a control panel terminate the incoming cable tray at high level above the panel coincident with the edge of the panel. Install a ladder rack arrangement above the panel to support cables from the tray and to allow them to drop neatly to their termination point on the top of the panel.

Ensure that adequate clearance is allowed between containment and panels to satisfy the bending radius of the cables terminating onto the equipment.

Ensure that containment and support systems are sized to provide specified spare capacity for future installations.

Prepare co-ordinated design and installation drawings showing all carrier/containment routes and sizes and demonstrate that the systems are co-ordinated with other installations.

1230 Segregation and separation

Ensure that power wiring is segregated from analogue control wiring and communication (bus) wiring by installing a separate carrier system of earthed metallic conduit and trunking for the analogue and bus wiring.

Provide a minimum separation of 150mm between different metallic systems which run in parallel. Metallic system in this case is defined as all cabled and metal piped and ducted systems.

Maintain a minimum 50mm separation at all crossovers of any metallic systems.

Arrange all metal system crossovers at right angles to each other. Bring to the attention of the Contract Administrator any areas of non-compliance with the above clauses at installation drawing production stage.

1240 Equipment

1241 Support systems

Install dedicated conduit/trunking/tray/ladder systems to carry/support the mechanical systems wiring. Sharing of the electrical Installers support systems is not permitted.

Segregate analogue control wiring and communications wiring from other mechanical systems wiring in a dedicated carrier system.

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Size all carrier/containment systems in accordance with the requirements of BS 7671 taking due regard of cable grouping requirements and installation methods.

Terminate conduits at field mounted devices via appropriately sized adaptable boxes/conduit boxes (sited adjacent to the devices) with flexible conduits of no more than 450mm in length fixed to each box. Fix and connect the free end in accordance with the device manufacturer's recommendation. Supply each length of flexible conduit with glands fixed at both ends.

Ensure that adequate clearance is allowed between containment and panels to satisfy the bending radius of the cables terminating onto the equipment.

Ensure that containment and support systems are sized to provide specified spare capacity for future installations. Contain all mechanical systems wiring, with the exception of flexible connections, within or fixed to, a rigid support system unless specified otherwise in the particular specification.

1242 Local isolation and auxiliary controls

General

Provide local isolation for all items of plant equipment and low voltage control components.

Unless the Electricity at Work Act and/or BS 7671 state otherwise, plant and equipment which is within 2 metres of its controlling control panel and where the panel face is clearly visible to the operator need not be provided with local isolation.

Ensure that all local isolation arrangements comply with BS EN 60947-3.

- 1 Phase and neutral (SP&N), single and three phase or TP&N supplies. Conventional isolating switch or switchfuse/fuseswitch fitted with solid neutral links. Switchfuse up to 100A TPN. Fuseswitch from 63A TPN up to 1200A TPN. (Number of poles dependent upon supply arrangement). Neutrals need not be switched. Trilink boxes may not be used.
- 2 All assisted start machines (including Star-delta) 6 pole isolator as 1 above with additional auxiliary early break contact pair (control voltage) for resetting SD starter into avoid restarting in delta.
- 3 Packaged equipment fitted with integral isolator. Ensure that the isolator is an on-load device suitable for switching motor and the inductive loads and is interlocked with the enclosure doors or access panels. Shroud all live terminals in packaged equipment.
- 4 Packaged equipment not fitted with integral isolator Install an in-line isolator local to the equipment it isolates. Each isolator to be an on-load device suitable for switching motor and other high inductive loads.
- 5 Domestic appliances/heat emitters, water heaters etc. fan coil or other terminal devices Install fused connection units, fitted with correct rated fuse, as local isolators. Do not use DP switches as the principal means of isolation for maintenance.
- 6 Low voltage items, ie damper/valve actuators, solenoid valves and any low voltage stats or switches.

Do not attach any equipment enclosure or supporting steelwork to air handling units etc., without the written permission of the Contract Administrator.

Provide lockable isolators with IP ratings appropriate for their location, environment and intended use.

Emergency stop buttons

As a minimum, install large mushroom headed type emergency stop buttons to BS EN 418 (push to lock, twist to release type) in double insulated standard IP rating, polycarbonate enclosures at each

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plant room exit door and in areas of high risk. Ensure that the operation of the emergency stop button de-energises the stop circuit via opening contacts.

Use emergency stop buttons that are coloured red with a contrasting yellow background and are labelled in accordance with the requirements of BS 7671.

Utilise PVC LSZH insulated single core cables run in fixed metallic conduit terminated directly into the stop button enclosure for wiring to the emergency stop button circuits - unless specified otherwise in the particular specification.

Arrange the emergency stop circuit such that operation of the emergency stop button de-energises the circuit contactor in such a way that the circuit contactor cannot re-energise and automatically restart the plant, when the button is released. Design this circuit in accordance with BS EN 418 categories 0-1-2 and ensure that the control circuit must be reset at the origin of the supply before the contactors can be re-energised (no volt release).

Ensure that the safe operation of each button is demonstrated.

1243 Termination methods

Where plant or control equipment is supplied with flying leads that are not long enough to be wired directly to the local isolators, install suitably IP rated and glanded, terminal boxes complete with fixed base and insulated connector block adjacent to the equipment item. Wire both flying lead and mechanical systems field wiring to the terminals in the boxes.

Unless specified otherwise elsewhere, make fused connections via PVC sheathed flexible armoured conduits with captive gland terminations. Ensure length of flexible conduit does not exceed 450mm.

Allow tails at each of the connection points as follows:

- 1 3.0m within the controls section of the mechanical control panels
- 2 300mm beyond the flexible conduit allowed for sensors and other monitoring points
- 3 300mm beyond the fixed adaptable box into which pre-wired tails for sensors are to be connected

The lengths indicated above are for tendering purposes only. Confirm actual lengths in individual cases during installation.

Terminate each armoured multicore cable serving a motor directly into its local isolator or into an adaptable box after the isolator, containing a fixed base connector suitably insulated from the box sides. Use 85°C butyl or silicone rubber insulated, stranded copper cables for the tails between the isolator/adaptable box and motor terminals. Install these tails within flexible armoured conduit as defined earlier.

Terminate inverter motor feed cables using 360-degree connection of braided screen (e.g. cable clamp over bare screen against grounding surface) unless otherwise specified by inverter manufacturer. Terminate screen directly to inverter decoupling plate at feed end and directly to metal cabinet/casing at motor end unless otherwise specified by inverter manufacturer.

Ensure that all cable cores are robust enough suitably constructed to make satisfactorily strong terminations, without the danger of stress fracture when the terminations are disturbed by installation of adjacent cores, or when terminations are made/unmade.

Terminate armoured power cables at the control panels in the following manner:

- 1 terminate armoured power cables at control panels on the appropriate gland plate at the top of the panel as applicable and earth each gland accordingly. Pass the unarmoured cable tail complete with bedding through the segregated power wiring section of the cable chamber beneath the gland plate, via a bushed entry into the wardrobe type panel/respective compartment. Remove the cable bedding to allow the individual cores to

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be connected into the respective terminals. Loosely loom all tails in the cable chambers.
Label all cables in accordance with specification, Critchley 'K'-type system or equivalent.

1244 Earthing, bonding and continuity

Provide equipotential bonding as required by BS 7671 and other applicable British Standards.

Ensure that earth continuity is maintained throughout the installation and from each item of equipment, to an earthing point in each control panel where connection shall be made to the main earth terminal.

Earth and bond the metalwork of the complete mechanical systems installation in accordance with the requirements of BS 7671

Effectively bond mechanical systems switchgear to maintain earth continuity from the main earth terminal.

Install bonding connection points on all metallic systems. As appropriate these will comprise:

- ~ cistern fed cold water supply pipes
- ~ heating flow and return main pipework
- ~ domestic hot water main pipework flow and return
- ~ pressurised mains water and associated sub-systems
- ~ ductwork
- ~ drainage pipework (if part of the mechanical works)
- ~ gas supply pipework, (Note also requirements of BS6891, and IGEN/G/5 Edition 2 for multi-tenant buildings)
- ~ packaged plant
- ~ metal staircases, platforms and handrails, supplied as part of the mechanical installation
- ~ any other metallic system or component not specifically mentioned but falling within the scope of BS 7671 and the mechanical installation work package

Ensure that all service carriers which are conductive are electrically continuous throughout their length, including the plant to which they connect. Ensure that the electrical continuity does not depend on the section to section fixings such as bolts, screws etc., but have earth links, copper braided straps and the like fitted to ensure continuity.

Each service carrier shall then be bonded by the electrical installer to the main earth system at one point in its length (main bond) and have supplementary equipotential bonding conductors installed where it is remote from the main bond and exposed to a source touch simultaneously with other extraneous or exposed conductive parts, one of which is connected to a source of electrical energy. Electrical and mechanical installers to discuss and agree all such instances and provide the necessary bonds and connections.

A service carrier is a pipe, a duct, a trunking, a tray, a conduit of any sort. Beware of particular problem areas such as pipework/ductwork with rubber seals, flexible joints, loose flanges resin coated etc.

1250 Identification and labelling

Fit coded markers at each end of all conductors and record the conductor references on the 'As Fitted' drawings.

Use distinct and different colours for ELV and LV cable systems.

Loosely loom and identify all cables prior to termination.

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Identify both ends of each control cable by means of slip on cable markers suitable for the overall diameter of the cable concerned. Arrange the markers to indicate the alphanumeric references shown on the wiring connection diagrams. Use a maximum of five character markers for each reference.

Label armoured power cables or multicore cables using Critchley 'K'-type system or equivalent.

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1300 PAINTING AND THERMAL INSULATION (Y50)

1310 Performance requirements

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, (ie 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. 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.

1320 Scope of works

1321 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.

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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 (eg 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 (eg cisterns, overflows, warning pipes, tanks, buffer vessels, calorifiers, cylinders, heat exchangers, unguarded blow down vessels, condensate receivers, pressure driven condensate pumps, relief steam 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.

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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 2014 MAT 03 methodology, an Environmental Management System (EMS) in accordance with the latest edition of ISO 14001.

1322 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 B₁ (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.

1330 Cleaning and painting

1331 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.

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

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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 (eg 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 (eg 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.

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1332 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.

1333 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.

1334 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 | |

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- ~ 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 (ie 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 (eg 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.

1335 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.

1340 Thermal insulation – materials

1341 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 isocyanurate, polystyrene or polyurethane thermal insulation materials.

Ensure that all materials are completely free of chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs) and asbestos of any type.

Ensure that all insulation products have a Declaration of Performance (DoP) certificate and are CE 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

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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, BL-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 BL-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.

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When selecting phenolic foam insulation thicknesses use the aged conductivity value not the initial conductivity.

1350 Workmanship

1351 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 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.

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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 (eg 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 (eg 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.

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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.

1352 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.

1353 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 B₁ (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.

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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 (eg for large diameter steam piping), supply insulation sections that are inherently water repelling.

1354 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.

1355 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.

1356 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 (eg 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.

Insulate anti-vibration couplings on DHW and LTHW pipework using removable covers.

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Where allowance has to be made for the vibration movement of equipment connected to insulated ductwork (eg 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.

1360 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 (eg 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 (eg 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.

1361 Cold water installations including mains, tank and boosted water

Painting not applicable to the pipework materials specified.

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For external pipework ensure that the need for trace heating is considered and where required has been installed and tested.

To 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 (eg 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

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.

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1362 Hot water service installations

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.

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 (eg those under or adjacent to sanitary fittings, dead legs and room heating coils) 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	Produced without CFCs or HCFCs Produced without CFCs or HCFCs
2	Rigid rock/stone mineral wool	120 kg/m ³	
3	Bore-coated/lined phenolic foam	35 or 40 kg/m ³	
4	Closed cell, flexible, elastomeric, nitrile-rubber-based foam	65 kg/m ³	

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 Table 17 of BS 5422:2009. 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	14	30	19	42	25	58	33	78	43	-	55	-
20	7.83	15	30	21	42	27	58	35	78	45	-	57	
25	8.62	17	21	22	28	29	38	37	49	47	64	58	
32	9.72	18	22	23	30	30	39	38	51	47	64	57	
40	10.21	19	23	25	31	32	41	40	52	49	65	60	
50	11.57	20	25	26	33	33	42	41	53	50	65	60	
65	13.09	22	28	28	35	35	44	43	55	52	66	61	
80	14.58	22	31	28	37	35	46	43	56	51	66	60	
100	17.20	23	33	29	40	36	48	43	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.

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1363 Refrigerant installations

Where condensation can occur provide load-bearing insulation rings at support positions.

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

For factory-made packaged equipment (eg 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 +10°C)	
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

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Note: In this table “liquid” pipe includes ‘the pipe downstream of the refrigerant expansion valve and upstream of the refrigerant evaporator’.

1370 Valves, pipe joints and other equipment of pipework systems

1371 General

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.

1372 Hot fluid installations

The term ‘hot fluid’ here means ‘steam (S51), condensate (S51), HTHW (T20), MTHW (T30), LTHW (T31), solar and heat recovery’ systems but not ‘HWS (S11)’ systems.

Do not insulate (a) drain valves and drain cocks on condensate, LTHW and heat recovery systems, and (b) valves and union joints on uninsulated LTHW 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/m³ 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/m² 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.

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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.

1373 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 (eg 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

1374 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.

1380 Protection of thermal insulation

1381 Protection of pipework 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 areas, including external areas and installations (eg rooftops, compounds and exposed distribution)
- ~ places where the insulation is near equipment that requires routine attendance for its operation and/ or maintenance

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- ~ 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.

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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 (eg 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.

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1382 Cladding systems

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.

System reference 2 for internal plant and equipment: 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.

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

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

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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.

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.

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.

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.

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.

1383 Protection of insulation - general

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

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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 (eg 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 (eg 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 (eg 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 (eg 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 (eg 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 (eg 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.

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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.

1400 FIXING TO BUILDING 'FABRIC' (Y90)

1410 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.

1420 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.

1430 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

1440 Holes for fixings

Drill all holes required for fixings.

1450 Testing of fixings

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.

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1500 SERVICES SUPPORT AND SUSPENSION SYSTEMS (Y93)

1510 General

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 (eg cable tray, ductwork hanger, pipework clamp)
- ~ (B.) To and via the support or suspension component (eg 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, 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.

1520 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.

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:

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- ~ 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 eg 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.

1530 Support & 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 eg 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 eg anchor or clamp
- ~ Suspension element such as wire or threaded rod
- ~ Attachment to or around service such as ductwork support eg 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.

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.

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 corners with corner saddles.

1540 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 (eg main structural columns and beams)
- ~ Exposed secondary steelwork (eg light gauge steel such as roof purlins, facade side rails)
- ~ Profiled/composite decking

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- ~ 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

1550 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.

1560 Attachment to structure

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 beams
- ~ Expansion anchors and screw fixing to concrete
- ~ Adhesive bonding anchors
- ~ Holorib or composite system eg 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.

Ensure that no cutting, digging in, or other deformation to either wire loop or item being looped occurs.

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Use manufacturers recommended corner saddles, preformed eyes or other recommended corner protection.

1570 Application specifics

1571 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.

1572 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 Parts 3 & 4
- ~ Fire Resisting Ductwork: tested to BS 476 Parts 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.

1573 Corrosion resistance

Provide details of proposed materials and corrosion performance of suspension components at tender stage to Contract Administrator for comment.

All suspension components in zones to be galvanised / hot dipped galvanised / grade A2 Stainless Steel / grade A4 Stainless Steel / special alloy of Stainless steel for use in swimming pools.

1600 IDENTIFICATION OF MECHANICAL SERVICES (Y54)

1610 Identification of services

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.

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1620 Pipework and ancillaries

1621 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 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.

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.

1622 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.

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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.

1623 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.

1630 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").

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

1640 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.

1650 Wall charts

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

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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.

1660 Hazard warning signs

Provide and install, in accordance with applicable Health and Safety Regulations, the following hazard warning signs:

Hazard markings

- ~ 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 45° stripes, either painted or using proprietary tape. Refer to the Contractor \Administrator for final agreement for positioning of markings.

Warning Signs

- ~ 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

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format and material of construction of the label with the Contract Administrator. Agree the final positioning of the labels with the Contract Administrator.

1700 CLEANING AND CHEMICAL TREATMENT (Y25)

1710 General

1711 General

Design, provide and carry out appropriate flushing, chemical cleaning and water treatment procedures, including all necessary equipment, to comply with the above reference documents to prevent, during the Works and to enable control of risks during the lifetime operation, contamination, scale build up, corrosion, erosion, general fouling, and to maintain the design engineering specification and the safe operation of the systems.

1712 Cleaning and water treatment specialist

At an early stage of the detailed design appoint a suitably qualified 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.
- ~ 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 the water quality Employers Requirement for all water and other fluid systems.
- ~ Programme 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 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.
- ~ Completion of flushing, chemical cleaning and water treatment in accordance with the method statements, the above reference documents and the particular requirements of the building.
- ~ Demonstration of the Works to the Contract Administrator.
- ~ Produce detailed records of the complete flushing, chemical cleaning and water treatment procedure, for inclusion in the O&M manuals.

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- ~ Produce written procedures and method statements for ongoing water treatment to comply with the above reference documents.

1713 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 and the particular requirements of the building. As a minimum in the strategy include a method statement which 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 procedure for achieving and demonstrating flushing and cleaning velocities, and includes each of the following requirements:

- ~ static flushing
- ~ 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

1714 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.

1715 Pipework distribution

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 allow for low flow, high resistance regulating valves to be bypassed, if necessary, to ensure that the minimum flushing velocities/flow rates are achieved.

Ensure that all pipework systems are designed to eliminate dead legs. In the situations where this is 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 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 in full compliance with BSRIA BG 29/2012.

Ensure that all strainers have a basket capable of withstanding the maximum pump head without distortion. Provide pressure test points on both sides of all strainers so that the pressure drop can be monitored. Provide drain valves on the flanges and/or end caps of all strainers 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 mesh gauge to suit flushing and cleaning. Inspect the condition of, and clean, all strainer baskets at each stage of flushing and cleaning.

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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.

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.

Only carry out flushing or cleaning of sensitive plant items with the approval of the cleaning/water treatment specialist and the plant manufacturer.

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.

Ensure that there are adequate drain points, of either full-bore capacity or of sufficient dimension to achieve flushing velocity and 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.

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

1716 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.

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.

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1720 Scope of works

1721 General

The following systems are included in the scope of this specification:

- ~ low temperature hot water (LTHW)
- ~ domestic cold water
- ~ domestic hot water

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 29/2012, 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.

1722 Hot and cold water systems

Engage a competent person with the necessary understanding of the particular systems and of the ecology of legionella to, on all new or existing systems that are considered during the design stage as part of the Works, carry out a detailed risk assessment.

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 which 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

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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

1723 Control of legionella bacteria/ environmental precautions

Ensure all water services are fully in compliance with HSE ACoP L8, associated guidance HSE HSG274 Part 2 and CIBSE TM13.

Minimise pipework dead-legs.

Avoid long runs of pipework to points with very little or infrequent usage by arranging pipework serving such points as minimum length dead-leg spurs from a pipeline that has regular use.

Install a check valve on any branch likely to be infrequently used.

Protect pipework from hot sources and freezing conditions.

Provide cisterns with close fitting covers. Fit insect screens to all overflows, warning pipes and vents. Install inlet and outlet connections at opposite ends of the cistern to prevent areas of stale/stagnant water. Protect cisterns from hot sources and freezing conditions.

Ensure that connections from cisterns dedicated to serving hot water apparatus are located 25 mm above connections serving cold apparatus.

For cisterns with a capacity greater than 1000 litres and no delayed action float valve, fit a circulation pump apparatus to minimise occurrences of thermal column formation which can allow the cold inlet to track directly to the outlet so causing stagnation elsewhere in the cistern.

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To maximise turnover in variable occupancy or phased occupancy buildings install a variable height float valve in each cistern.

Install a cistern washout valve as close as possible to the cistern and ensure that the inlet is as close as possible to the bottom. Cap/flange the open end. Terminate over a drain but achieving appropriate air gap.

Do not install spray taps or aerators where there is the likelihood of heavy fouling by grease and dirt.

Ensure that potable water points are not installed at the end of long pipe runs from which the draw off is infrequent or low in volume.

Obtain written authorisation from the local water supply company/authority prior to filling the system for bringing it into operation.

Upon filling and following sterilisation, ensure that the system is flushed using chlorinated mains water in accordance with BS 8558 and that suitable records are kept. Maintain the system at design conditions until handover to the Employer.

Carry out temperature recording in accordance with BSRIA BG 58/2015.

1730 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 37°C at 48 hours, TVC at 22°C at 72 hours, iron bacteria, identifying bacteria pseudomonads, sulphate-reducing bacteria and nitrate-oxidising bacteria, plus any criteria that do not comply with the EEC 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 to satisfy Table 10 and Table 11 of BSRIA BG 29/2012.

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

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- ~ clarity
- ~ odour
- ~ solids-visual
- ~ pH at 20°C
- ~ electrical conductivity at 20°C
- ~ total dissolved solids at 105°C
- ~ 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 37°C/24 hours
- ~ TVC at 22°C/72 hours
- ~ microfungi
- ~ coliform bacteria including E.coli
- ~ pseudomonads species at 30°C 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.

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1740 Filling and flushing

1741 General

Check content of strainers on a regular basis during these procedures for potential microbiological activity. 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 provide at practical completion, systems which are not conducive to microbiological growth, to the satisfaction of the Contract Administrator.

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, biological fouling, and the system continues to operate safely.

1742 Filling and flushing - static and dynamic

Carry out all filling, flushing and cleaning of each closed system and any non-domestic open system in accordance with BSRIA BG 29/2012.

Assemble each pipework system from pipework and ancillaries which 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 water tight.

Programme the Works to ensure that, once filled, the system clean (dynamic flushing) commences within 48 hours, to minimise the risk of biofilm development.

Ensure that all equipment which is sensitive to sediment remains valved off and bypassed throughout the flushing procedure.

During the flushing out process remove any pipeline components likely to restrict flow or suffer damage.

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 inclusions 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.

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 2°C).

Carry out dynamic flushing at the velocities identified in Table 9 of BSRIA BG 29/2012 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.

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 witness to the Contract Administrator.

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1750 Final flushing and passivation

1751 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 29/2012, taking particular care to ensure that there are no dead legs.

Forward and backward flush all plant, chillers, boilers, fan coils, radiators, etc.

1752 Overall success of benchmark 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 29/2012, Section 3. 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.

Achieve all of the following requirements from BSRIA BG 29/2012 with results treated, where relevant, in accordance with Appendix B of BSRIA BG 29/2012.

- ~ The criteria for physical and chemical parameters, and "The water quality is acceptable" interpretation for bacteria levels, in Table 4 at seven days after completion of pre-commission cleaning.
- ~ The criteria in Table 5 and Table 6 at times between pre-commission cleaning and practical completion.
- ~ The "Condition acceptable" interpretation in Table 7 at practical completion.

1753 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.

1760 Chemical cleaning

1761 General

Carry out a soluble iron test to ensure that the concentration of the system does not exceed 5 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.

1762 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.

1763 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.

1764 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.

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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.

1765 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.

1770 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.

1780 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 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.

T90 MECHANICAL SERVICES – SELF-CONTAINED SPECIFICATION

1800 TESTING AND COMMISSIONING (Y51)

1810 General

1811 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.

1812 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

1813 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.

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.

1814 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.

1815 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.

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1816 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.

1817 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.

1818 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 (i.e. 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.

1819 Schedule of commissioning deliverables

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
- ~ 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
- ~ 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
- ~ 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.

Demonstration / witnessing

The Contract Administrator or their appointed representative may require to witness, or have demonstrated, any or all of the following:

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- ~ 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 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
- ~ partial load testing of plant
- ~ functional testing of all safety interlocks
- ~ the operation of plant and systems for specified periods of time to prove plant reliability

1820 General - continued

1821 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

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- ~ 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 tapplings 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

1822 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
- ~ 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

1830 Testing

1831 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.

1832 Static testing – general

Carry out satisfactory pressure, air leakage and thermal expansion tests before the application of paint, insulation or other cladding, as appropriate.

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1833 Concealed sections of work

Individually test while still visible, any sections of a system that are to be permanently buried or concealed.

1834 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.

1835 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.

1836 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.

1837 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:

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

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

1838 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.

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Unless otherwise agreed, inspect fans for balance under supervision of the manufacturer's representative.

Keep a systematic record of all tests.

1839 Proof testing of fixings

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.

1840 Commissioning

1841 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.

1842 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.

1850 Particular test procedures

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

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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.

1851 Cold water

Pressure test and prove the function of all overflow and warning pipes.

Record system temperatures in accordance with BS 8558, BS EN 806, BSRIA BG 58/2015, HSE ACoP L8 and CIBSE TM13.

Fully vent all air from the system.

Prove the function of all cistern water level controls and BMS alarms.

Carry out performance tests to verify that the flow rate achieved at each float valve, draw off tap, shower and any specialist item meets the specification requirements. Record the results in the commissioning report and include it as part of the handover documentation building water log book.

After 1 hour of non-operation/draw off, check the water temperature at all outlets and tabulate the results.

Produce reports and water management log book(s) in accordance with BS 8558 and BS EN 806, BSRIA BG 58/2015 and CIBSE TM13.

1852 Hot water

Pressure test and prove the function of all discharge pipework from pressure/temperature relief devices, and other overflow and warning pipes.

Record system temperatures in accordance with BS 8558, BS EN 806, BSRIA BG 58/2015, HSE ACoP L8 and CIBSE TM13.

Fully vent all air from the system.

Carry out performance tests to verify that the flow rate achieved at each draw off tap, shower and any specialist item meets the specification requirements. Record the results in the commissioning report and include it as part of the handover documentation building water log book.

Commission and set to work each hot water heating device in accordance with the requirements of the Building Regulations Approved Document G and the manufacturer's written instructions. Record the process and its outcomes and place a copy of the commissioning report in the operation and maintenance manual.

Issue a suitable notice of completion of commissioning to the Building Control Body for the project.

In accordance with the requirements of HSE ACoP L8, following commissioning, continuously measure the water temperature at the bottom and outlet from each calorifier over a typical day of usage. If the outlet temperature falls below the design set point take remedial action and retest over another typical day. Ensure that records of all such tests, results and any remedial actions are added to the commissioning report.

On satisfactory completion of the commissioning of the hot water system(s) and all associated equipment, operate the completed systems at design temperatures and pressures for a period of at least 8 hours. Allow the system to cool down and examine for any defects. Rectify any defects and retest the system until satisfactory. On completion reset all gauges, controls and thermostats to the agreed specified normal operating values.

1853 Local heating/cooling units

Visually examine the installation including the following:

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- ~ all components, including safety devices, are as specified
- ~ the refrigeration pipework is supported and protected adequately
- ~ check quality of welding and other joints;
- ~ the pipework is arranged and labelled correctly, including accessibility for maintenance or repair and for inspection of piping
- ~ all pressure/temperature gauges are reading correct values/calibrated and that pointers are all set.
- ~ check vibrations and movements caused by temperature and pressure under operation conditions;
- ~ external condensers are adequately supported

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.

1860 Commissioning and testing report

1861 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

1862 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).

1863 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

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- ~ type of outlet - manufacturer's model designation
- ~ manufacturer of outlet
- ~ manufacturer's effective area for each size
- ~ required air flow rate (m³/s) at each outlet
- ~ initial air flow rate (m³/s) at each outlet
- ~ final air flow rate (m³/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.

1864 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.

1870 Performance and acceptance testing

1871 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.

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1872 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.

1873 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.

1874 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.

1900 SCHEDULE OF INSTALLER'S SUBMISSIONS

Submit the following for the Contract Administrator's comment:

- method statements
- wiring diagrams
- equipment samples

1910 Cold water system

- ~ PRV set details, including anticipated criteria ranges (maximum/minimum flow rates, upstream/downstream pressures) and mounting orientations
- ~ method statements

1920 Hot water system

- ~ full technical details of each selected hot water storage vessel; together with drawings including all pipework connection sizes, etc.

1930 Local cooling units

- ~ local cooling unit general arrangement and manufacturer's drawings
- ~ schedule of local cooling units with duties and selected sizes with calculations

1940 Pipelines and ancillaries

1941 Pipelines

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

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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.

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

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.

1942 Pipeline ancillaries

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.

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

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- ~ 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

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.

1950 Painting and thermal Insulation

Y50clause3090.1 Y50clause3090.2 Y50clause3090.3 Y50clause3090.4

1960 Services support and suspension systems

- ~ full technical details of each selected cold water storage cistern; together with drawings including all pipework connection sizes, delayed action ball valves, etc.
- ~ drawings of the structural support needed for the cistern(s)
- ~ full technical details including drawings of transfer set(s) including duties, closed valve head pressure, kW rating of individual pump motors, starting and running currents, material specifications, etc.
- ~ PRV set details, including anticipated criteria ranges (maximum/minimum flow rates, upstream/downstream pressures) and mounting orientations
- ~ all local water authority certifications
- ~ method statements
- ~ approved plumber's certification and if appropriate approved RPZ valve tester certification

2000 OPERATING AND MAINTENANCE MANUALS

In addition to the general requirements in section A37 of this specification, provide the following:

2010 Cold water system

Provide as part of the handover documentation and water log book the flushing and disinfection records as required by BS 8558, HSE ACoP L8 and HSE HSG274 Part 2, BSRIA BG 58/2015 and CIBSE TM13.

Include within the O&M manual pertinent guidance from BS 8558 on maintenance regimes including where and how frequently to make temperature measurements and for the taking of water samples.

Include within the O&M manual a clause to the effect that cisterns storing drinking water should be cleaned and disinfected at least annually but more frequently if determined by the monitoring regime.

Include within the O&M manual a clause to the effect that infrequently used float valves should be checked annually and exercised.

Include within the O&M manual a clause to the effect that the maximum time a water fitting may be disconnected (e.g. for repair) without its feed pipework also being disconnected at the live tee is 60 days.

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Include within the O&M manual a clause to the effect that any RPZ valve must be inspected/serviced/tested annually by someone from the WRAS list of approved RPZ valve testers.

Where any of the proposed work associated with this specification includes the erection or creation of one or more dwellings submit to the project Building Control Body, within 5 days of completion, a notice which specifies the potential consumption of wholesome water per person per day calculated in accordance with The Water Efficiency Calculator for New Dwellings as published in Building Regulations Approved Document G.

Issue a suitable notice of completion of commissioning to the Building Control Body for the project.

END OF SECTION T90