

KINGDOM OF BAHRAIN



STANDARD SPECIFICATIONS FOR CONSTRUCTION WORKS 2008

Module – 14 – Plumbing and Sanitary

Introduction

The Standard Specification is published in a series of 21 stand-alone modules each addressing single distinct areas of the construction process. This stand-alone module 14 addresses the main aspects of plumbing and sanitary in general.

The purpose of the MoW STANDARD SPECIFICATIONS FOR CONSTRUCTION is to provide the design professional with a guide for accepted construction practices for Ministry of Works projects. As an aid to the designer, these Standard Specifications are provided for the inclusion in proposed development projects for ease, efficiency and cost savings.

The Standard Specifications are not intended to limit the design responsibility of the design professional. However, they establish a minimum acceptable criterion and/or quality for use within Ministry of Works projects.

The design professional may increase the requirements of an item contained in the Standard Specifications to meet job requirements, but when this is done, there should be no reference for that item on the drawings to the Ministry of Works Standard Specifications and a new specification should be included with the drawings or project contract documents.

The design professional must review all Standard Specifications to be sure that they are adequate for the proposed project based on the job site conditions; the design professional is solely responsible for the designs submitted under his seal.

In order to keep design standards current with changing regulations and improved construction materials and practices this section will be updated and maintained by the concerned authorities of the Ministry of Works. Prior to starting a new project, the design professional should contact the concerned Directorate of the Ministry of Works to verify that he/she has the latest document revisions.

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Foreword

This specification provides the basis for Plumbing and Sanitary. It covers the main requirements for all materials, components, installation, testing and commissioning of equipments for plumbing and sanitary.

This specification must be read in its entirety, as it is structured in order of work-flow, which means that items or activities appear in several places in the specification corresponding to the progression of the construction process.

For larger or more complex or specialist projects, a project-specific Particular Specification for Plumbing and Sanitary may also be provided.

Absence of clauses for materials and methods does not necessarily signify that they can not be used. Proposals for use of innovative methods and materials are encouraged and are subject to review and approval by the Client.

Where the word approved is used in this specification, this means that the Client or Engineer has been consulted and has confirmed that the item or procedure is acceptable in the specific context for which approval has been requested.

1. PART 1 MATERIALS

1.1 Source of Approval

Materials and components shall comply with the relevant standards and code of practice described in the latest edition of Plumbing Engineering Services Design Guide, published by the Institute of Plumbing and Heating Engineering (IPHE), or with the standards listed in the following sections with all amendments in force at time of tender.

1.1.1 Liquid / Water Disposal

1.1.1.1 Sanitary Plumbing, Drainage, Rainwater, Pipework and Ancillaries

BS EN 198 - Sanitary appliances. Baths made from crosslinked cast acrylic sheets. Requirements and test methods

BS EN 274 – Waste fittings for sanitary appliances

BS EN 295 – Vitrified clay pipes and fittings and pipe joints for drains and sewers

Part 1 – Requirements

Part 2 – Quality control and sampling

Part 3 – Test methods

Part 4 – Requirements for special fittings, adaptors and compatible accessories

Part 5 – Requirements for perforated vitrified clay pipes and fittings

Part 6 – Requirements for vitrified clay manholes

Part 7 – Requirements for vitrified clay pipes and joints for pipe jacking

Part 10 – Performance requirements

BS 460 – Cast iron rainwater goods. Specification

BS 569 – Specification for asbestos-cement rainwater goods

A written approval is required from Directorate of Environmental Assessment and Planning for use of this standard.

BS EN 588 – Fibre-cement pipes for sewers and drains

Part 1 – Pipes, joints and fittings for gravity systems

Part 2 – Manholes and inspection chambers

BS EN 598 – Ductile iron pipes, fittings, accessories and their joints for sewerage applications. Requirements and test methods

BS EN 607 – Eaves gutters and fittings made of PVC-u. Definitions, requirements and testing

BS EN 612 – Eaves gutters with bead stiffened fronts and rainwater pipes with seamed joints made of metal sheet

BS EN 752 – Drain and sewer systems outside buildings

BS EN 1253 – Gullies for buildings

Part 1 – Requirements

Part 2 – Test methods

Part 3 – Quality control

Part 4 – Access covers

Part 5 – Gullies with light liquids closure

BS EN 1462 - Brackets for eaves gutters. Requirements and testing

BS 1876 – Specification for automatic flushing cisterns for urinals

BS 3868 – Specification for prefabricated drainage stack units in galvanized steel

BS 4514 – Unplasticized PVC soil and ventilating pipes of 82.4 mm minimum mean outside diameter, and fittings and accessories of 82.4 mm and of other sizes. Specification

BS 5255 – Specification for thermoplastics waste pipe and fittings

BS 5911 – Pre-cast concrete pipes, and ancillary concrete products

Part 1 – Specification for un-reinforced and reinforced concrete pipes (including jacking pipes) and fittings with flexible joints

Part 3 – Specification for un-reinforced and reinforced concrete manholes and soakaways

Part 4 – Specification for un-reinforced and reinforced concrete inspection chambers
Part 5 – Specification for pre-stressed non-pressure pipes and fittings with flexible joints
Part 6 – Specification for road gullies and gully cover slabs
BS 6465 – Sanitary installations
Part 1 – Code of practice for the design of sanitary facilities and scales of provision of sanitary and associated appliances
Part 3 – Code of practice for the selection, installation and maintenance of sanitary and associated appliances
BS 7158 – Plastic inspection chambers for drains and sewers. Specification
BS EN 12200 - Plastics rainwater piping systems for above ground external use. Unplasticized polyvinylchloride (PVC-u)
BS EN 13476 – Specification for plastics piping systems for non-pressure underground drainage and sewerage
BS EN 14364 - Plastic piping systems for drainage and sewerage with or without pressure. Glass reinforced thermosetting plastics (GRP) based on unsaturated polyester resin (UP). Specifications for pipes, fittings and joints

1.1.1.2 Sanitary Fixtures and Accessories

BS EN 31 – Pedestal wash basins. Connecting dimensions
BS EN 32 - Wall-hung wash basins. Connecting dimensions
BS EN 35 - Pedestal bidets with over-rim supply. Connecting dimensions
BS EN 36 - Wall-hung bidets with over-rim supply. Connecting dimensions
BS EN 198 - Sanitary appliances. Baths made from crosslinked cast acrylic sheets. Requirements and test methods
BS EN 997 – WC pans and WC suites with integral trap
BS EN 1036 – Glass in building. Mirrors from silver-coated float glass for internal use
BS 1125 – WC flushing cisterns (including dual flush cisterns and flush pipes)
BS 1188 – Ceramic wash basins and pedestals
BS 1189 – Baths made from porcelain enamelled cast iron
BS 1876 – Specification for automatic flushing cisterns for urinals
BS 5504 – Wall hung WC pan
BS 6340 – Shower units
BS 6465 – Sanitary installations
BS EN 13310 – Kitchen sinks. Functional requirements and test methods

1.1.2 Liquid Systems

1.1.2.1 Pipework, Valves and Ancillaries

BS EN 806: Part 2. Specification for installations inside buildings conveying water for human consumption. Design
BS EN 1057 – Copper and copper alloys. Seamless, round copper tubes for water and gas in sanitary and heating applications
BS EN 1092 – Flanges and their joints
BS EN 1254 – Copper and copper alloys. Plumbing fittings
BS 6700 – Design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages. Specification
BS 7291 – Thermoplastics pipes and associated fittings for hot and cold water for domestic purposes and heating installations in buildings
Part 1 – General requirements
Part 2 – Specification for polybutylene (PB) pipes and associated fittings
Part 3 – Specification for cross-linked polyethylene (PE-X) pipes and associated fittings
Part 4 – Specification for chlorinated polyvinyl chloride (PVC-C) pipes and associated fittings and solvent cement
CIBSE, Guide G: Public Health Engineering. CIBSE 2004. ISBN 1 903287 42 1

CIBSE, Guide C: Reference Data. CIBSE 2001. ISBN 0750653604

1.1.2.2 Cold Water Storage and Distribution

BS EN 806: Part 2 – Specification for installations inside buildings conveying water for human consumption. Design

BS 5257 – Specification for horizontal end-suction centrifugal pumps (16 bar)

BS 6700 – Design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages. Specification

BS EN 13121 – GRP tanks and vessels for use above ground

BS EN 60730 – Automatic electrical controls for household and similar use

CIBSE, Guide G: Public Health Engineering. CIBSE 2004. ISBN 1 903287 42 1

The Institute of Plumbing. Plumbing Engineering Services Design Guide. The Institute of Plumbing 2002. ISBN 1 871956 40 4. (Now Institute of Plumbing and Heating Engineering.)

NHS Estates. HTM2027. Hot and Cold Water Supply Storage and Mains Services. 1995

1.1.2.3 Hot Water Storage and Distribution

BS EN 806: Part 2 – Specification for installations inside buildings conveying water for human consumption. Design

BS 853 – Specification for vessels for use in heating systems

BS EN 1151: Part 1 – Pumps. Rotodynamic pumps. Circulation pumps having a rated power input not exceeding 200 W for heating installations and domestic hot water installations. Non-automatic circulation pumps, requirements, testing, marking

BS 6700 – Design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages. Specification

BS EN 12897 – Water supply. Specification for indirectly heated unvented (closed) storage water heaters

BS EN 60335 - Household and similar electrical appliances. Safety. General requirements

BS EN 60730 – Automatic electrical controls for household and similar use

CIBSE, Guide G: Public Health Engineering. CIBSE 2004. ISBN 1 903287 42 1

The Institute of Plumbing. Plumbing Engineering Services Design Guide. The Institute of Plumbing 2002. ISBN 1 871956 40 4. (Now Institute of Plumbing and Heating Engineering.)

NHS Estates. HTM2027. Hot and Cold Water Supply Storage and Mains Services. 1995

Water Regulation Advisory Scheme. Water Fittings and Materials Directory

1.1.2.4 References Specific to Legionnaires Disease – Hot & Cold Water Services

BSRIA AG 19/00. Guide to Legionellosis – Operation and Maintenance. 2000. ISBN 0 86022 547 X

BSRIA AG 21/00. Legionellosis Control Log Book. 2000. ISBN 0 86022 562 3

BSRIA AG 20/00. Guide to Legionellosis – Risk Assessment. 2000. ISBN 0 86022 561 5

BSRIA AG 4/94. Guide to Legionellosis – Temperature Measurements for Hot and Cold Water Services. 1994. ISBN 0 86022 366 3

BSRIA TN 6/96. Ionisation Water Treatment for Hot and Cold Water Services. 1996. ISBN 0 86022 438 4

CIBSE, TM 13: Minimising the Risk of Legionnaires' Disease – Section 5: Hot and Cold Water Services. CIBSE 2002. ISBN 1 903287 23 5

HSC, L8: The Control of Legionella Bacteria in Water Systems. Approved Code of Practice and Guidance. HSE 2000. ISBN 0 7176 1772 6

1.1.3 Water Treatment

BS EN 806: Part 2 – Specification for installations inside buildings conveying water for human consumption. Design

BS 6700 – Design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages. Specification

BS 8300 – Design of buildings and their approaches to meet the needs of disabled people. Code of practice.

BS EN 13451: Part 3 – Swimming pool equipment. Additional specific safety requirements and test methods for pool fittings for water treatment purposes.

CIBSE. Guide G: Public Health Engineering. CIBSE 2004. ISBN 1 903287 42 1

HSC. L8: The Control of Legionella Bacteria in Water System. Approved Code of Practice and Guidance. HSE 2000. ISBN 0 7176 1772 6

Pool Water Treatment Advisory Group (PWTAG). Swimming Pool Water Treatment and Quality Standards. 1999

Water Regulations Advisory Scheme. Water Regulations Guide. WRAS. 2000. ISBN 09539708-0-9

1.1.4 Fire Protection Services

Refer to clause “Section 4” of Module 15 Mechanical Installation for Buildings

BS EN 671 – Fixed fire fighting systems. Hose systems

BS 750 – Specification for underground fire hydrants and surface box frames and covers

BS 5306 – Code of practice for fire extinguishing installations and equipment on premises

Part 1 – Hose reels and foam inlets

Part 2 – Specification for sprinkler systems

Part 4 – Specification for carbon dioxide systems

Part 6.1 – Code of practice for fire extinguishing installations and equipment on premises.

Hose reels and foam inlets

Part 6.2 – Fire extinguishing installations and equipment on premises. Specification for sprinkler systems

Part 8 – Selection and installation of portable fire extinguishers. Code of practice

BS 6391 – Specification for non-percolating layflat delivery hoses and hose assemblies for fire fighting purposes

BS 9251 – Sprinkler systems for residential and domestic occupancies. Code of practice

BS 9990 – Code of practice for non-automatic fire-fighting systems in buildings

BS EN 12094 – Fixed firefighting systems. Components for gas extinguishing systems

BS EN 12416 – Fixed firefighting systems. Powder systems

BS EN 12845 – Fixed firefighting systems. Automatic sprinkler systems. Design, installation and maintenance

1.2 Delivery Control, Handling, Storage and Protection

1.2.1 Delivery

Delivery of all materials brought to the Site shall be recorded by means of delivery sheets.

These records shall be maintained on the Site and may be available for review by the engineer if requested. Items of equipment will not be considered completely on the Site unless all accompanying installation documentation and ancillaries are included within the delivery.

Large plant items and items of large monetary value shall be delivered by the manufacturer supplier in proprietary crates/packaging using vehicles intended for the purchase.

The Engineer will be notified in advance of such large plant items arriving at the Site to review the status of equipment and packaging at time of receipt.

All relevant accompanying documentation shall be included with the equipment at the time of delivery and appropriate checks will be made ensuring the documentation and delivered items are in accordance with each other.

Where the contractor obtains material early, for example for financial benefits of early purchasing, but chooses to store the items off the Site in his own premises the above statements remain applicable.

1.2.2 Handling

All materials entering the Site shall be handled at all times in a safe manner between delivery to the Site stores or from stores to location of final installation.

Handling of all material shall in all instances be in accordance with the manufacturers recommendations. All material delivered to the Site should be accompanied by the relevant manufacturers data referring to the handling of the item.

Particular importance shall be given to the handling of large plant items and large monetary value items. Any damage caused during to handling of material and plant on the Site shall be reported to the engineer at the earliest possible time.

The contractor shall ensure that all plant required moving material and equipment is available on the Site at the time needed.

1.2.3 Storage and Protection

Agreement for location and size of site stores shall be agreed in advance of mobilising the Site.

Storage of material shall be in accordance with the requirements of the manufacturer.

Particular importance shall be given to items requiring stable climatic conditions (temperature, humidity and sunlight) to ensure that they are not damaged between time of supply from the manufacturer and the time at which they are to be installed.

Where required certain parts of equipment may have to be installed at a later date than the bulk of the equipment, for example UPS batteries may be installed later than the cabinet ensuring that air conditioning is working prior to there installation.

Storage of material will be in 3 categories which shall include:

- Internal storage
- Internal storage in climatic controlled environment
- External storage

Whilst in storage the contractor is obliged to ensure the protection of material. This includes security of such material and also the physical protection.

Any such items of equipment delivered to the Site in crates or containers should remain in its packaging until the time of installation, the crates or containers should be opened to

check the equipment upon arrival at the Site but then re-sealed to prevent damage from occurring whilst in storage.

24-hour security shall be provided to guard stores of equipment containing high value items.

2. PART 2 METHODOLOGY AND WORKMANSHIP

2.1 General

The installation(s) shall comply with all relevant legislative requirements of the Kingdom of Bahrain.

The installation shall comply with any special regulations issued by any relevant authority of the Kingdom of Bahrain.

Unless specified to the contrary by any special requirements of the Electricity Directorate or National Oil and Gas Authority, electrical works shall comply with BS 7671 (Requirements for electrical installations, The IEE Wiring Regulations. (Seventeenth Edition)), and gas installations shall comply with the requirements of The Institution of Gas Engineers Utilization Procedures (IGE/UP).

2.2 Off-site Testing of Components

Where British Standards stipulate testing of items of equipment to demonstrate compliance, these shall be carried out at the manufacturer's works or elsewhere as appropriate. In all cases, test certificates shall be submitted in duplicate to the Engineer and be included in the Record Documents. In certain cases, where appropriate, type test certificates will be accepted as indicated.

Test certificates shall serve as a record that the item referred to has been shown under test to meet the requirements of this Specification and/or British Standards as applicable and shall be dated, numbered and clearly referenced to the item tested by means of serial, chassis, or other manufacturer's reference number permanently marked in a conspicuous position.

Where an individual inspection or test takes place at the manufacturer's works, a representative of the Engineer shall normally be required to be present.

Tests shall be made at the Contractor's or supplier's premises, on samples of materials and components to be installed in the Works in any manner deemed necessary by the Engineer to ensure conformity with this Specification. The results of such tests shall in no way relieve the Contractor of his responsibilities to ensure that all materials and components used in the Works are entirely suitable for the applications and conditions of operation.

All control panels shall be checked at the manufacturer's works and certified to comply with the particular specification prior to despatch. Functional checks shall also be carried out at the manufacturer's works to ensure that all inter-locking and sequencing is in accordance with the performance requirements. Test jumpers, where fitted, shall be removed at the end of the checking. Documentary evidence of compliance with short circuit ratings shall also be provided.

Refer to Module 01 of this document with regard to standard items applicable to all packages.

Where a discrepancy arises between the information provided in the Module 1 and this works Module, the information contained herein will take precedence.

2.2.1 Earth Bonding

Bonding of all extraneous conductive parts of the installation (including metallic pipework, ductwork, insulation cladding, and so on) shall be carried out in accordance with BS 7671 and BS 7430: "Code of practice for earthing".

2.2.2 'As Built' Drawings

The Contractor shall provide 'As Built' drawings in the number, format and media specified in the Particular Specification.

Unless otherwise indicated, the drawings shall show the following:

- The complete installation including the sizes and routes of all ductwork and pipework,
- The location and identification number of all dampers,
- The location and identification number of all terminal units, fan coil units, grilles, registers and diffusers,
- The location and identification number of each pipework isolating, regulating and control valve according to the labelling and circuit control diagram(s) required by the Specification,
- The location and identification of services buried within the structure or underground,
- The manufacturer's name, model and type number and full details of duty and rating for all items of plant including control equipment.

Each drawing shall include the name of the Site, section of the Works, the title of the installation, the date of completion of the Works, the contract number and the name of the Contractor, and shall clearly show the words 'AS BUILT'.

During the course of the Works the Contractor shall maintain a fully detailed record of all changes from the tender drawings to facilitate easy and accurate preparation of the 'As Built' drawings and to ensure that these drawings are in all respects a true record of the installation. The symbols used for individual 'As Built' drawings shall be identified on each drawing.

2.2.3 Identification of Services

Pipework shall be identified by colour band code and/or symbols in accordance with BS 1710.

All pipework shall be identified by colour bands at least 25 mm wide. The bands shall be spaced and located to permit ready identification of the services, particularly adjacent to equipment positions, at all valves, at service junctions, at wall penetrations and at all changes of direction.

In addition, all pipework in plant rooms and service areas shall be indelibly and legibly marked with black or white letters and arrows, to show the type of service and the direction of fluid flow. Lettering shall be 50 mm in height or of pipe nominal bore where this is smaller. All water storage vessels shall be properly labelled in accordance with the requirements of the Particular Specification.

The letters F and R shall be added to pumped distribution to show flow and return respectively. All symbols shall conform to the legend on the 'As Built' drawings and plant room valve charts.

2.2.4 Installation

The installation of all material and equipment shall be in accordance with the requirements of the manufactures in all instances.

The contractor shall ensure that all equipment is supplied complete with all requisite components to provide a completed system and shall also ensure that any plant, material, fixings, fuel, and so on, required to complete the installation is obtained to facilitate the relevant installation.

Prior to installing plant and equipment the contractor is to satisfy themselves that the location is suitable for the installation, free from water and dust and sealed from the external climatic conditions as required.

Any conditions that may jeopardise the installation shall be brought to the attention of the contract administrator at the earliest possible time.

Ensure that the installation meets the design intention and is in accordance with the approved shop drawings. Pay particular attention to large plant items where space provision may be allocated for future use/extensions and where services have been coordinated on the design drawings so that any deviation from the design may impact other services.

2.2.4.1 Installation Issues for Liquid Systems

All pipework/appliances and controls shall be installed so as not to obstruct users.

Pipework and fixings shall be enclosed to deter vandalism and avoid accidental damage. Services shall be colour banded in accordance with BS 1710.

BS 1710 – Specification for identification of pipelines and services

2.2.4.2 Prevention of Backflow and Contamination in Liquid Systems

Appropriate backflow prevention arrangements and devices shall be selected in relation to the fluid category, appliance and system design as in Table 1 below (refer also to the Water Regulations Guide). Water delivered shall not be liable to become contaminated and contamination of the water undertaker's supply shall not occur. Related to this, the following issues need to be addressed in the installation requirements:

- No cross-connection shall occur between pipes conveying water supplied by the water undertaker with pipes conveying water from another supplier.
- Stagnation, particularly at high temperatures, shall not occur.
- Pipes and cisterns containing non-wholesome water shall be marked or colour coded in accordance with BS 1710.
- Colour identification will be placed at all junctions, inlets/outlets of valves and appliances, and where pipes pass through walls at points adjacent to both wall surfaces.
- An appropriate backflow prevention device shall be installed where pipe carrying non-wholesome water is to be connected to one carrying wholesome water.

Table 1: Requirements for Backflow Prevention

Type	Backflow Prevention Device	Requirement
BA	Verifiable backflow preventer with reduced pressure zone (RPZ)	Check that a Type AA air gap will be provided between the relief outlet port and the top of the tundish.
CA	Non-verifiable disconnecter with different pressure zones	Check that a Type AA air gap will be provided between the relief outlet port and the top of the tundish.
DA	Anti-vacuum valve	Check that the device will be fitted on a Type A up stand with the outlet not less than 300 mm above the discharge point or spill-over level. Check that no valve, flow restrictor, or tap will be fitted on the outlet of the device.
DB	Pipe interrupter with vent and moving element	Check that the device will be fitted with the lowest point of the air aperture not less than 300 mm above the discharge point or spill-over level. Check that no valve, flow restrictor, or tap will be fitted on the outlet of the device.
DC	Pipe interrupter with permanent atmospheric vent	With the exception of urinals, check that the device will be fitted with the lowest point of the air aperture not less than 300 mm above the discharge point or spill-over level. Check that no valve, flow restrictor, or tap will be fitted on the outlet of the device. For urinals check that the device will be fitted not less than 150 mm above the sparge outlet.
DUK1	Anti-vacuum valve combined with verifiable check valve	Check that the device will be fitted on a Type B up stand with the outlet not less than 300 mm above the discharge point or spill-over level. Check that no valve, flow restrictor, or tap will be fitted on the outlet of the device.
LA	Pressure air inlet valve	Check that use will be limited to locations where operational waste is acceptable, such as gardens or similar.
LB	Pressurised air inlet valve combined with check valve downstream	Check that use will be limited to locations where operational waste is acceptable, such as gardens or similar.

Appropriate backflow prevention arrangements or devices shall be fitted for any appliance, fitting or process. This is with the exception of water heaters that allow expanded water to flow back into the supply pipe; vented water storage vessels (supplied from a storage system) or where the water temperature in the cistern or supply pipe does not exceed 25°C.

Adequate air gaps shall be provided where required, such as for cisterns, basins and baths.

Backflow prevention devices shall not normally be located outside premises – with the exception of types HA and HUK1 for protection against fluid categories 2 and 3.

Vented or verifiable devices or a device with relief outlets shall not be installed in chambers below ground level or where flooding is possible.

Backflow prevention devices, such as an RPZ valve (see Table 1 above) for fluid category 4 shall be provided with line strainers immediately upstream.

Servicing valves shall be fitted upstream of line strainers and immediately downstream of the backflow prevention device.

Where a reduced pressure zone valve is fitted, the relief outlet shall terminate with a Type AA air gap located a minimum of 300 mm above the ground or floor level.

Requirements in Table 1 for backflow prevention devices shall be met.

2.2.4.3 Installation Precautions to Prevent Legionella

The storage temperature, controlled from a thermostat, should be 60 °C.

Thermometer or immersion pockets shall be fitted on the flow and return to the calorifier and in the base of the calorifier in addition to those required for control.

Notices warning of possible high temperature may be required.

Water temperatures should not exceed 55 °C at taps (lower temperatures are applicable for applications such as health care and schools where occupants are vulnerable to scalding).

Where a recirculation/shunt pump is used in conjunction with a calorifier in order to avoid temperature differences (stratification) ensure that the pump is only switched on during periods of no demand. The pump should not run during water draw-off as temperature stratification will help to maintain the design supply temperature.

The hot water circuit(s) shall be correctly balanced, if necessary using double regulating valves and thermal balancing valves.

2.2.4.4 Access and Maintenance to Backflow and Contamination Prevention Devices

Backflow devices shall be accessible for inspection, testing, maintenance and renewal. Backflow prevention devices shall not be buried in the ground.

2.2.4.5 Installation Issues for Water Softeners

Water softeners should be installed near the incoming supply pipe near to drain access.

Where ion exchange water softeners are installed this should be downstream of the supply to drinking water points or other equipment or processes which do not require softened water.

For water softeners installed in dwellings, a single check-valve shall be installed to protect the water supply from backflow. For buildings other than dwellings, the appropriate backflow protection should be provided in accordance with the appropriate fluid category as stated in the local utility requirements.

A sampling point or tap shall be provided on the softened supply from the water softener.

2.2.4.6 Access and Maintenance of Water Softeners

Pipework shall be provided to bypass the method of water treatment for use in the event of a failure or during maintenance.

Sufficient space shall be provided for access for maintenance.

2.2.4.7 Access and Maintenance for Cold Water Systems

Sufficient access shall be provided to cisterns for installation, commissioning, testing and maintenance.

Cisterns shall have reasonable access to the inside so that it may be easily inspected and cleaned, and so that the float operated valve (or other comparable device) may be easily adjusted, repaired or renewed.

Cisterns shall be fitted with a rigid, close fitting and securely fixed cover that is not airtight but excludes light and insects.

All valves, including any backflow prevention devices, shall be readily accessible for examination, commissioning, testing and maintenance.

Large storage cisterns shall have internal/external access ladders provided where necessary. Hand railing shall be provided around tops of tall cisterns where there is a danger of falling from height.

Requirements for access for future pipe repainting shall be considered (ideally in the method statements).

2.2.4.8 Access and Maintenance for Hot Water Systems

In addition to the measures for cold water systems, pipework to the services shall be sited where possible to enable inspection and repair.

Sufficient flushing and chemical cleaning supply points and drains shall be provided.

Drain points shall be installed at low points.

2.2.4.9 Access and Maintenance Issues for Prevention of Legionella

Small cisterns shall be provided with a removable cover for inspection of the cistern and maintenance of the float-operated valve.

Provision shall be made for cleaning internal surfaces of cisterns without major interruption. Where continuous cold-water service is required a small break-tank sized for the maximum draw-off rate may be required. This will allow the supply to be taken temporarily from the break tank whenever maintenance is needed on the main storage cistern.

Internally-flanged sectional cisterns shall not be used, as they are difficult to clean.

Adequate access to strainers, water softeners and filters shall be provided.

Accumulator vessels on hot and cold-water services shall be fitted with diaphragms that are accessible for cleaning. Two pipe models are preferable as they provide a through-flow.

Pipework shall be installed to permit inspection so that the thermal insulation can be checked to confirm that it is in position and undisturbed.

Calorifiers should have easy access for inspection, draining, dismantling and cleaning. A large drain or dump valve at the lowest point is required to allow rapid draining and removal of sludge. Calorifier designs that minimise the scope for the entrapment of sludge should be specified.

Accumulator vessels on pressurised systems should be fitted with diaphragms that are accessible for cleaning. Two-pipe models are preferable to ensure through flow.

2.3 Site Inspections

Site inspections shall be carried out as required by the particular specification.

2.3.1 Staff Training

Following satisfactory testing and commissioning of the installation and prior to the occupation of the building, maintenance staff will be trained in the use of the equipment.

This training may be performed on the Site or at manufacturer's premises and shall form practical and theory based training as appropriate.

Adequate notification shall be given to the client to ensure the most suitable persons are available for the training.

2.3.2 Commissioning

2.3.2.1 Overall Requirement

All plumbing and sanitary services shall be commissioned in accordance with the procedures set out in CIBSE Commissioning Codes, BSRIA Commissioning Guides, Commissioning Specialists Association Guidance or other such equivalent references, and the various supporting codes and guidance documents specified therein.

A Commissioning Management plan shall be prepared and submitted as one of the scheduled method statements required by Module 01. The Commissioning Management plan shall include a commissioning specification which describes the detailed requirements with which the various commissioning services have to comply (the commissioning work), and specific requirements for system testing. The commissioning specification should refer to drawings, schedules and the relevant parts of the Commissioning Codes, guides and other standards. If necessary, specialist commissioning advice shall be obtained on the commissioning plan.

Commissioning is defined as "The advancement of an installation from the state of static completion to full working order to the specified requirements. It includes the setting-to-work of an installation, the regulation of the system and the fine tuning of the system."

Commissioning Management is defined as "the planning, organisation, co-ordination and control of commissioning activities".

For the purposes of commissioning activity Testing is defined as the measurement and recording of system parameters to assess specification compliance.

The Contractor shall be responsible for fully commissioning each system.

The entire commissioning procedure shall be performed to the satisfaction of the Engineer and the Contractor shall demonstrate that the installation of any portion thereof, which has been set to work, complies with the requirements of this Specification.

A Legionella Risk Assessment shall be made on completion of the installation.

2.3.2.2 Distribution Systems – Water Piping

Prior to regulation, pipe systems shall be modified as necessary and in accordance with good pipework practice, so that flow rates with all valves fully open are within 50% above the design values.

After all water systems have been regulated, the final settings are to be recorded on the Commissioning Certificates provided.

Building services plant and control systems should be inherently commissionable and the commissioning requirements shall be identified in the detailed design. Manufacturers shall provide commissioning information as part of the delivery documentation supplied with any component or system.

The contractor shall allow sufficient time for the complete commissioning process and ensure integration of the commissioning process into the overall programme.

All instruments shall be provided by the Contractor or his Commissioning Specialist, and evidence of the accuracy of the test instruments shall be provided. Test methods shall be demonstrated to the Engineer where required.

The Contractor shall submit to the Engineer a schedule detailing the equipment which he or his Commissioning Specialist proposes to use in the testing and commissioning of the services and the test methods to be employed. This shall form part of the commissioning plan.

Testing and commissioning of major items of proprietary plant or specialist equipment shall be carried out by the manufacturer's personnel and witnessed by the Commissioning Specialist. The Engineer shall be advised of such activities.

2.3.2.3 Commissioning of Specialist Equipment

All instruments shall be provided by the Contractor or his Commissioning Specialist, and evidence of the accuracy of the test instruments shall be provided. Test methods shall be demonstrated to the Engineer where required.

The Contractor shall ensure that all commissioning work carried out on specialist equipment by the manufacturer's personnel is completed to his satisfaction, to the satisfaction of the Commissioning Specialist and to the satisfaction of the Engineer.

Testing and commissioning of major items of proprietary plant or specialist equipment shall be carried out by the manufacturer's personnel and witnessed by the Commissioning Specialist. The Engineer shall be advised of such activities.

The Contractor shall submit to the Engineer a schedule detailing the equipment which he or his Commissioning Specialist proposes to use in the testing and commissioning of the services and the test methods to be employed.

2.3.2.4 Cleaning

Pre-operational chemical cleaning of water systems shall be carried out by a specialized agent. For chemical cleaning requirements see BSRIA Application Guide AG8/91.

2.3.2.5 Commissioning of Cold Water Systems

The system shall be disinfected in accordance with BS 6700.

The system shall be commissioned in accordance with CIBSE Commissioning Code W and BSRIA AG 2/89.3 where relevant.

CIBSE, Commissioning Code W. Water Distribution Systems. 2003. ISBN 1903287391
BSRIA AG 2/89.3. Commissioning Water Systems in Buildings. 2002. ISBN 086022 584 4

Information shall be included in the operating and maintenance manual and water quality monitoring log book, including an indication of factors that will influence the frequency of maintenance actions.

2.3.2.6 Additional Commissioning Requirements for Hot Water Systems

There needs to be sufficient space for safe installation and maintenance of the calorifier and associated plant and equipment. There is a Defence Estates standard: MOD, DEO (W), Space Requirements for Plant Access, Operation and Maintenance, Defence Works Functional Standards, design & maintenance guide 08, HMSO 1996. ISBN 0 11 772785 7
The normal operating storage water temperature will not exceed 65 °C.

Levels of chlorine (for sterilisation purposes) shall not exceed that specified in HSE ACOP L8.

Adequately-sized expansion vessels shall be provided for unvented hot water storage systems when required.

Thermostatic mixer valves shall be fitted to outlets. If they are not, a permanent warning sign stating 'Very Hot Water' shall be fitted on the wall by the outlet of the appliance. Outlet temperatures shall meet the occupant's needs. Lower and higher temperatures are required in hospitals, schools, and homes for the elderly. For hospitals and other healthcare buildings the requirements of HTM 2027 shall be met.

2.3.2.7 Commissioning Records

The results of all checks and measurements shall be recorded in writing by the commissioning engineer as commissioning proceeds, together with any appropriate commentary. Records of all commissioning activities shall include details of tests undertaken and results achieved. Records shall include calibration certificates for all instruments used during the commissioning process.

Test results shall be recorded on Commissioning Certificates provided and countersigned by the Engineer.

It is recommended that the format of record sheets should be agreed before testing and commissioning commences. A pro forma for these records may be compiled from the relevant Commissioning Code for each particular installation.

Record sheets should be completed once only (i.e. not subsequently transcribed by typing since this can lead to errors being introduced). Where hand written records are subsequently transcribed into typed format there shall be a formal checking process carried out to validate their accuracy.

On completion of commissioning the contractor shall provide to the Engineer a commissioning report containing documentary evidence that the requirements of the commissioning specification have been met. This shall accompany the complete set of record sheets for the commissioning process and specific requirements, for incorporation into the O&M manuals.

2.3.2.8 Legionella Risk Assessment

A Legionella Risk Assessment shall be made on completion of the installation, based on CIBSE TM13, "Minimising the risk of Legionnaires' disease".

The entire commissioning procedure shall be performed to the satisfaction of the Engineer and the Contractor shall demonstrate that the installation of any portion thereof, which has been set to work, complies with the requirements of this Specification.

Note: The commissioning report should indicate that the requirements of the commissioning specification have been met. A properly annotated copy of the commissioning specification, developed contemporaneously with the commissioning works and referring to the commissioning records should be accepted as a commissioning report.

2.4 Completion and Handover

Irrespective of the time of initial testing and commissioning the contractor shall ensure that within the defects liability period he returns to the Site and undertakes re-testing of the identified equipment during peak (winter or summer, whichever is applicable) load conditions.

For all major equipments, such as central water heaters, boilers and large equipments, the simulated performance test shall be carried out at the factory and passed. Testing figures shall be submitted along with the unit.

Major equipments proposed by the Contractor shall be of a reputable manufacturer, having a good service and after-sale set-up.

The proposed make and type shall have been used in the Kingdom of Bahrain for at least seven years with a good performance record.

Throughout the defects liability period the contractor may receive notification by the client that various faults have arisen in the system. These shall be attended to within the minimum amount of time.

The Contractor shall carry out a thorough detailed examination of the installations during the eleventh and twelfth month of the defects liability period and shall put right any outstanding works or defects that might have occurred under the Defects Liability Period in the Conditions of Contract.

On completion of such works, and agreement that the requirements of the Conditions of Contract and Specification have been met, the Engineer will authorize a Certificate of Making Good Defects.

To facilitate the final handover the client must be in complete possession of all record information and the O&M manuals.

When the Contractor has demonstrated to the Engineer and to their complete satisfaction that the works are operating as intended within the design limits and tolerances of the manufactured items, then the Engineer will issue a certificate of taking over, subject to the clearance of any outstanding items or defects within 14 days of the date of the Certificate. At this time the responsibility for the operation of the plant will pass from the Contractor to the Client or as otherwise agreed with the Engineer.

3. PART 3 SUMMARY

3.1 Submittals

3.1.1 Type Approval

The following types of information are required for approvals, as shown in Table 2:

- Adequate information of the supplier's organization to allow pre-qualification.
- Adequate information of the Specialist Contractor organization to allow pre-qualification.
- Statement or checklist confirming compliance with the Contract.
- Manufacturer's certified type tested data for specific items of equipment or components.
- Country of origin where item of equipment or component is manufactured.
- Dimensioned drawings of the item of equipment indicating all critical or major dimensions.
- Shop drawings showing connecting or interfacing services or equipment demonstrating correct location, positioning and adequate provision for maintenance access, operational needs and service connections.
- Performance data certified by the manufacturer's R & D section and is not catalogue data.
- Any necessary applicable third party approval documentation such as independent testing organizations. For example Fire and Life Safety testing, Underwriters Laboratories (UL), Factory Mutual (FM), Loss Prevention Council, British Board of Agreement.
- Where applicable those items of equipment to be factory tested are to be programmed with agreed dates and suit the construction program.
- A list of projects of similar nature on which the item has been successfully installed.
- An offer by the Contractor for a visit, to similar installations, to allow inspection of the item in operation.
- Sample Warranty.
- Adequate information of the detailed warranty that will be offered in order to ensure all contractual obligations are met.
- Lead time and delivery program.
- Full and detailed lead time for an item of equipment showing all time periods within the delivery period, including all necessary transportation times, customs clearance along with approval periods, manufacturing times testing and acceptance.
- Adequate data of installation requirements. This could include handling and protection requirements and assembly of major components.
- Samples of specific items as directed.

- Data confirming special finishes on items of plant and equipment such as protective coatings for saline atmospheres, corrosive atmospheres or specific colours to suit interior design.

Table 2: Requirements for Type Approval

	Suppliers Pre-qualification documentation	Specialist Contractor Pre-Qualification	Compliance Statements	Certified Type Tested Data	Country of Origin	Dimensioned Manufacturers Drawings	Associated Shop Drawings	Manufacturers Certified Performance Data	Copy of 3 rd Party Approvals	Program of Factory tests and proposed dates	Provide Detailed List of Projects on Which Equipment Has Been Used	Offer to engineer to visit similar installation or factory to witness operation	Provide Sample Warranty	Lead Time and Delivery Programme	General Installation Data	Provide Sample of Item or Component	Special Finishes
Liquid / Water Disposal	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	
Solid Waste Disposal	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	
Liquid Systems	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	
Water Treatment	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	
Borehole / Well Water	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	
Fountains and Water Features	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	
Swimming Pools	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	
Fuel Systems	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	
Fire Fighting Systems	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	
Supports and Brackets	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	
Thermal Insulation	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	
Identification	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	
Sound and Vibration Control	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	

Table 2: Requirements for Type Approval (Cont'd)

	Suppliers Pre-qualification documentation	Specialist Contractor Pre-Qualification	Compliance Statements	Certified Type Tested Data	Country of Origin	Dimensioned Manufacturers Drawings	Associated Shop Drawings	Manufacturers Certified Performance Data	Copy of 3 rd Party Approvals	Program of Factory tests and proposed dates	Provide Detailed List of Projects on Which Equipment Has Been Used	Offer to engineer to visit similar installation or factory to witness operation	Provide Sample Warranty	Lead Time and Delivery Programme	General Installation Data	Provide Sample of Item or Component	Special Finishes
Water Treatment	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	
Borehole / Well Water	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	
Fountains and Water Features	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	
Swimming Pools	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	
Fuel Systems	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	
Fire Fighting Systems	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	
Supports and Brackets	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	
Thermal Insulation	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	
Identification	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	
Sound and Vibration Control	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	

3.1.2 Delivery Control, Storage, Handling and Protection

The following requirements shall be submitted as in Table 3.

- All necessary data shall be provided to demonstrate the correct delivery control, storage, handling and protection.
- Any necessary documentation shall be provided including custom clearances, inspection reports, prior to shipping, after shipping and transport company paperwork, and so on.
- Adequate hazard and risk data shall be provided that identifies any physical, chemical, and biological or other such hazards associated with the item being delivered. This should include all necessary procedures for eliminating hazard or reducing risk.
- Inspection shall be made when item first delivered to the Site or at agreed storage facility.
- Full documentation shall be provided in the form of a report on the condition of the delivered item. This could include photography.
- An itemised list shall be provided of any ancillaries, spare parts, components, tools, and so on, delivered with the item required for assembly or installation for example temperature sensors and energy meter.
- Internal, external, air-conditioned or secure storage, or a combination thereof, for the delivered item shall be provided.
- All necessary documentation shall be provided at the time of delivery. Original copies to be provided and to be issued to the Engineer. These documents shall form the basis of the overall record documentation.

Table 3: Requirements for Delivery Control, Handling, Storage and Protection

	Delivery Control, Handling, Storage and Protection Method Statement	Delivery Documentation	Hazard / Risk Data Sheet	Request for Inspection	Delivery Inspection / Condition Inspection Report	Ancillaries Included	Internal Storage	External Storage	Air Conditioned Storage	Secured Storage	Factory Inspection and Testing Reports	Setting to Work Procedure	O&M Instructions	Warranty
Liquid / Water Disposal	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Solid Waste Disposal	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Liquid Systems	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Water Treatment	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Borehole / Well Water	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Fountains and Water Features	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Swimming Pools	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Fuel Systems	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Fire Fighting Systems	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Supports and Brackets	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Thermal Insulation	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Identification	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Sound and Vibration Control	√	√	√	√	√	√	√	√	√	√	√	√	√	√

3.1.3 Requirements for Methodology and Workmanship

The following requirements shall be submitted as in Table 4.

- Acceptance shall be confirmed with Engineer of the use of specialist installation contractors, e.g. fire and life safety installations.
- All necessary builders works drawings shall be provided to enable routing of services, installation of plant, and so on.
- Drawings shall be provided on adequate detail to ensure installation can be made allowing for coordination with other services, structure and architecture.
- Details shall be provided, discussed and agreed with site Safety Officer all potential risk for site installation, working and storage areas.
- Site supervisor staff shall be informed by use of a schedule of when progress inspections are to be made.
- A programme shall be provided detailing all site tests for applicable items of equipment, sub-systems, complete systems and whole building to demonstrate completeness of installation and operation of installations.
- Prior to completion of static installation, procedures shall be prepared and agreed for setting to work of all items of equipment and systems, taking into account any phasing of works.
- Procedures shall be provided as how equipment and systems are to be regulated to achieve or operate to design condition. Regulation is to follow setting to work and to be on adherence/compliance to design parameters.
- Commissioning procedures shall be provided refining the regulation procedure in order to optimize equipment and system operation for efficiency and energy consumption to meet actual conditions within the building.
- All commissioning measurements shall be provided for all equipment and systems on approved standard forms/commissioning manual.
- Testing equipment calibration certificates shall be provided as directed.
- Lifting and access equipment test certificates shall be provided as directed.
- The List of headings and contents list for the O&M Manuals shall be provided for agreement.
- Full statement shall be provided on the status of the practical completion of the installations for agreement. The statement is to include a schedule of any outstanding works.

Table 4: Requirements for Methodology – Installation and Workmanship

	Specialist Installations Contractor Confirmation	Method Statement for Installation and Quality of Workmanship	Builders work Drawings	Shop Drawings	Site Installation Risk Assessment	Schedule of Progress Inspections	Programme of Site Tests with Proposed Action Dates	Setting to Work Procedure	Regulation Procedure (Using Design Parameters)	Commissioning Procedure	Record / Document Final Commissioning Measurements	Testing Equipment Calibration Certificates	Lifting and Access Equipment Test Certificates	List of Headings for O&M Manuals	Practical Completion Statement	Schedule of Outstanding Works
Liquid / Water Disposal	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Solid Waste Disposal	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Liquid Systems	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Water Treatment	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Borehole / Well Water	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Fountains and Water Features	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Swimming Pools	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Fuel Systems	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Fire Fighting Systems	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Supports and Brackets	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Thermal Insulation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Identification	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Sound and Vibration Control	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

3.1.4 Completion and Handover

All record documentation shall be provided, as collected throughout the contract duration. The records are to be indexed and collated. The records shall include the following, as scheduled in Table 5 below:

- Final commissioning measurement data
- Test reports
- Inspection reports
- All Method Statements and Installation procedures
- Final /last material and shop drawing submittals
- Final originals of standard 1 year and extended warranties
- Record drawings
- Operating and Maintenance instructions
- Planned preventive maintenance schedules
- Emergency contact details / telephone numbers
- Service contracts
- Staff training schedule
- Final handover statement

During and at the end of the defects liability period, the following shall also be provided:

- Recommissioning schedule. All equipment and systems are to be recommissioned during the defects liability period. A project finishes at any time in the calendar year and the commissioning may not be optimal conditions as either peak or minimum part load conditions are truly experienced or full occupancy achieved.
- Final handover report. This is any amendment to the initial handover report and shall include the results of any re-commissioning, completion and rectification of any defects, status of the condition and maintenance of the systems at the end of the defects liability period.

Table 5: Requirements for Completion and Handover

	Final Commissioning Measurements and Data	Test Reports	Inspection Reports	All Method Statements and Installation Procedures	(Final) Material and Shop Drawing Submittals	Final Copies of Warranties (Standard 1 year)	Final Copies of Warranties (Extended)	Record Drawings	Operating and Maintenance Instructions	Planned Preventative Maintenance Schedules	Emergency Contact Details Telephone Numbers	Service Contracts	Staff Training Schedule	Initial Handover Statement	Mid-Liability Period Re-Commissioning Schedule	Final Handover Report
Liquid / Water Disposal	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Solid Waste Disposal	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Liquid Systems	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Water Treatment	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Borehole / Well Water	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Fountains and Water Features	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Swimming Pools	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Fuel Systems	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Fire Fighting Systems	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Supports and Brackets	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Thermal Insulation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Identification	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Sound and Vibration Control	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

3.2 References

Reference	Title
BS EN 31	Pedestal wash basins. Connecting dimensions
BS EN 32	Wall-hung wash basins. Connecting dimensions
BS EN 35	Pedestal bidets with over-rim supply. Connecting dimensions
BS EN 36	Wall-hung bidets with over-rim supply. Connecting dimensions
BS EN 198	Sanitary appliances. Baths made from crosslinked cast acrylic sheets. Requirements and test methods
BS EN 274	Waste fittings for sanitary appliances
BS EN 295	Vitrified clay pipes and fittings and pipe joints for drains and sewers
Part 1	Requirements
Part 2	Quality control and sampling
Part 3	Test methods
Part 4	Requirements for special fittings, adaptors and compatible accessories
Part 5	Requirements for perforated vitrified clay pipes and fittings
Part 6	Requirements for vitrified clay manholes
Part 7	Requirements for vitrified clay pipes and joints for pipe jacking
Part 10	Performance requirements
BS 460	Cast iron rainwater goods. Specification
BS 569	Specification for asbestos-cement rainwater goods
BS EN 588	Fibre-cement pipes for sewers and drains
Part 1	Pipes, joints and fittings for gravity systems
Part 2	Manholes and inspection chambers
BS EN 598	Ductile iron pipes, fittings, accessories and their joints for sewerage applications. Requirements and test methods
BS EN 607	Eaves gutters and fittings made of PVC-u. Definitions, requirements and testing
BS EN 612	Eaves gutters with bead stiffened fronts and rainwater pipes with seamed joints made of metal sheet
BS EN 671	Fixed fire fighting systems. Hose systems
BS 750	Specification for underground fire hydrants and surface box frames and covers
BS EN 752	Drain and sewer systems outside buildings
BS EN 806: Part 2	Specification for installations inside buildings conveying water for human consumption. Design
BS 853	Specification for vessels for use in heating systems
BS EN 1253	Gullies for buildings
Part 1	Requirements
Part 2	Test methods
Part 3	Quality control
Part 4	Access covers
Part 5	Gullies with light liquids closure

BS EN 997	WC pans and WC suites with integral trap
BS EN 1036	Glass in building. Mirrors from silver-coated float glass for internal use
BS EN 1057	Copper and copper alloys. Seamless, round copper tubes for water and gas in sanitary and heating applications
BS EN 1092	Flanges and their joints
BS 1125	WC flushing cisterns (including dual flush cisterns and flush pipes)
BS EN 1151: Part 1	Pumps. Rotodynamic pumps. Circulation pumps having a rated power input not exceeding 200 W for heating installations and domestic hot water installations. Non-automatic circulation pumps, requirements, testing, marking
BS 1188	Ceramic wash basins and pedestals
BS 1189	Baths made from porcelain enamelled cast iron
BS EN 1254	Copper and copper alloys. Plumbing fittings
BS EN 1329	Specification for plastic piping systems for soil and waste discharge (low and high temperature) within the building structure
BS EN 1462	Brackets for eaves gutters. Requirements and testing
BS EN 1710	Specification for identification of pipelines and services
BS 1876	Specification for automatic flushing cisterns for urinals
BS 3868	Specification for prefabricated drainage stack units in galvanized steel
BS 4514	Unplasticized PVC soil and ventilating pipes of 82.4 mm minimum mean outside diameter, and fittings and accessories of 82.4 mm and of other sizes. Specification
BS 5255	Specification for thermoplastics waste pipe and fittings
BS 5257	Specification for horizontal end-suction centrifugal pumps (16 bar)
BS 5306	Code of practice for fire extinguishing installations and equipment on premises
Part 1	Hose reels and foam inlets
Part 2	Specification for sprinkler systems
Part 4	Specification for carbon dioxide systems
Part 6.1	Fire extinguishing installations and equipment on premises. Foam systems. Specification for low expansion foam systems
Part 6.2	Fire extinguishing installations and equipment on premises. Foam systems. Specification for medium and high expansion foam systems
Part 8	Selection and installation of portable fire extinguishers. Code of practice
BS 5504	Wall hung WC pan
BS 5911	Precast concrete pipes, and ancillary concrete products
Part 1	Specification for unreinforced and reinforced concrete pipes (including jacking pipes) and fittings with flexible joints
Part 3	Specification for unreinforced and reinforced concrete manholes and soakaways
Part 4	Specification for unreinforced and reinforced concrete inspection chambers
Part 5	Specification for prestressed non pressure pipes and fittings with flexible joints

Part 6	Specification for road gullies and gully cover slabs
BS 6340	Shower units
BS 6391	Specification for non-percolating layflat delivery hoses and hose assemblies for fire fighting purposes
BS 6465	Sanitary installations
Part 1	Code of practice for the design of sanitary facilities and scales of provision of sanitary and associated appliances
Part 3	Code of practice for the selection, installation and maintenance of sanitary and associated appliances
BS 6700	Design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages. Specification.
BS 7158	Plastic inspection chambers for drains and sewers. Specification
BS 7291	Thermoplastics pipes and associated fittings for hot and cold water for domestic purposes and heating installations in buildings
BS 7430	Code of practice for earthing
Part 1	General requirements
Part 2	Specification for polybutylene (PB) pipes and associated fittings
Part 3	Specification for cross-linked polyethylene (PE-X) pipes and associated fittings
Part 4	Specification for chlorinated polyvinyl chloride (PVC-C) pipes and associated fittings and solvent cement
BS 7671	Requirements for electrical installations. IEE Wiring Regulations. Seventeenth edition
BS 8300	Design of buildings and their approaches to meet the needs of disabled people – Code of practice.
BS 9251	Sprinkler systems for residential and domestic occupancies. Code of practice
BS 9990	Code of practice for non-automatic fire-fighting systems in buildings
BS EN 12094	Fixed firefighting systems. Components for gas extinguishing systems
BS EN 12200	Plastics rainwater piping systems for above ground external use. Unplasticized poly (vinyl chloride) (PVC-U)
BS EN 12416	Fixed firefighting systems. Powder systems
BS EN 12845	Fixed firefighting systems. Automatic sprinkler systems. Design, installation and maintenance
BS EN 12897	Water supply. Specification for indirectly heated unvented (closed) storage water heaters
BS EN 13121	GRP tanks and vessels for use above ground
BS EN 13310	Kitchen sinks. Functional requirements and test methods
BS EN 13364	Natural stone test methods. Determination of the breaking load at dowel hole
BS EN 13451	Swimming pool equipment
Part 3	Additional specific safety requirements and test methods for pool fittings for water treatment purposes
BS EN 13476	Specification for plastics piping systems for non-pressure underground drainage and sewerage
BS EN 60730	Automatic electrical controls for household and similar use

BS EN 60335: Part 1 Household and similar electrical appliances. Safety. General requirements

Other references

BSRIA AG 4/94. Guide to Legionellosis – Temperature Measurements for Hot and Cold Water Services. 1994. ISBN 0 86022 366 3

BSRIA TN 6/96. Ionisation Water Treatment for Hot and Cold Water Services. 1996. ISBN 0 86022 438 4

BSRIA AG 19/00. Guide to Legionellosis – Operation and Maintenance. 2000. ISBN 0 86022 547 X

BSRIA AG 20/00. Guide to Legionellosis – Risk Assessment. 2000. ISBN 0 86022 561 5

BSRIA AG 21/00. Legionellosis Control Log Book. 2000. ISBN 0 86022 562 3

CIBSE, Guide C: Reference Data. CIBSE 2001. ISBN 0750653604

CIBSE, Guide G: Public Health Engineering. CIBSE 2004. ISBN 1 903287 42 1

CIBSE, TM 13: Minimising the Risk of Legionnaires' Disease – Section 5: Hot and Cold Water Services. CIBSE 2002. ISBN 1 903287 23 5

HSC, L8: The Control of Legionella Bacteria in Water Systems. Approved Code of Practice and Guidance. HSE 2000. ISBN 0 7176 1772 6

The Institute of Plumbing. Plumbing Engineering Services Design Guide. The Institute of Plumbing 2002. ISBN 1 871956 40 4. (Now Institute of Plumbing and Heating Engineering.)

NHS Estates. HTM2027. Hot and Cold Water Supply Storage and Mains Services. 1995
Water Regulation Advisory Scheme. Water Fittings and Materials Directory

Commissioning References

Automatic control systems: CIBSE Commissioning Code C

Bacteria Within Closed Circuit/Pipework Systems Guidance Note: Commissioning Specialists Association GN/4

Dicks M Commissioning Management: How to achieve a fully functioning building BSRIA AG 5/2002

Commissioning of water systems in buildings: BSRIA Commissioning Guide AG 2/89.2

Commissioning of pipework systems – design considerations: BSRIA Commissioning Guide AG 20/95

Health and Safety Legislation Affecting Commissioning: Commissioning Specialists Association TM/5

Pre-commissioning cleaning of water systems: BSRIA Commissioning Guide AG 8/91

Standard specification for the commissioning of mechanical engineering services installations for buildings: Commissioning Specialists Association T/M 1

Water Distribution Systems: CIBSE Commissioning Code W

Water Treatment and the Commissioning Engineer: Commissioning Specialists Association TM/9
CIBSE TM13, "Minimising the risk of Legionnaires' disease"

Abbreviations

ACB	Air Circuit Breakers	EMC	Electromagnetic Compatibility
ACOP	Approved Code of Practice	EPDM	Ethylene-propylene-diene-monomer copolymer
ACRIB	Air Conditioning and Refrigeration Industry Board	FA	Fresh Air
ADCM	Acoustic Doppler Current Meters	FBA	Factory Built Assembly
AFMA	Australian Fisheries Management Authority	FRP	Fibre Reinforced Polymer
AGMA	American Gear Manufacturers' Association	FSC	Forest Stewardship Council
AISI	American Iron and Steel Institute	GANA	Glass Association of North America
AS	Acceptance Strength	GGBS	Ground Granulated Blast-furnace Slag
ASTA	Association of Short-circuit Testing Authorities	GMS	Galvanized Mild Steel
ASTM	American Society for Testing Materials	GRC	Glass Reinforced Cement/Glass Reinforced Concrete
ATS	Automatic Transfer Switch	GRP	Glass Reinforced Plastics
AWS	American Welding Society	HCFC	Hydrofluorocarbons
BASEC	British Approval Service for Electric Cables	HDPE	High Density Polyethylene
BOCA	Building Officials and Code Administrators	HEPA	High Efficiency Particulate Air
BRE	Building Research Establishment Ltd.	HFC	HydroFluoroCarbon
BS	British Standards	HPL	High Pressure Laminate
BSRIA	Building Service Research and Information Association	HPPE	Higher Performance Polyethylene
CBR	California Bearing Ratio	HRC	High Rupturing Capacity
CCTV	Close Circuit Television	HSE	Health and Safety Executive
CECOMAF	Comité Européen des Constructeurs de Matériel Frigorifique	HSFG	High Strength Friction Grip
GENELEC	Comité Européen de Normalisation Electrotechnique	HV	High Voltage
CFC	Chlorofluorocarbons	HVCA	Heating and Ventilating Contractors' Association
CIBSE	Chartered Institution of Building Services Engineers	ICBO	International Conference of Building Officials
CHW	Chilled Water	IGCC	Insulating Glass Certification Council
CI	Cast Iron	IGE/UP	Institution of Gas Engineers – Utilization Procedures
CLW	Cooling Water	IP	Ingress Protection
CM	Current Margin / Communication cable	ISAT	Initial Surface Absorption Test
CMP	Communication cable (Plenum)	ISO	International Standard Organization
CP	Code of Practice	ITP	Inspection Testing Plan
CPC	Circuit Protection Conductor	KD	Kiln Dried
CPT	Cone Penetration Testing	kVA	Kilovolt Ampere
CRS	Categorised Required Strength	LCD	Liquid Crystal Display
CRT	Cathode Ray Tube	LED	Light Emitting Diode
CRZ	Capillary Rise Zone	LPG	Liquid Petroleum Gas
CT	Current Transformer	LS0H	Low Smoke Zero Halogen
c(UL)	Underwriters Laboratories Incorporated (Canada)	LSF	Low Smoke and Fume
DEO	Defence Estate Organisation	LV	Low Voltage
DFT	Dry Film Thickness	MCB	Miniature Circuit Breaker
DI	Ductile Iron	MCC	Motor Control Centre
DIN	Deutsches Institut für Normung	MCCB	Moulded Case Circuit Breakers
DPC	Damp Proof Course	MDF	Medium Density Fireboard
DPDT	Differential Pressure, Differential Temperature	MDD	Maximum Dry Density
DS	Durability Strength	MDPE	Medium Density Polyethylene
DVR	Digital Video Recorder	MEP	Mechanical Electrical Plumbing
DW	Ductwork Specification	MICC	Mineral Insulated Copper Covered Cable
EA	Exhaust Air	MIO	Micaceous Iron Oxide
ECMA	European Computer Manufacturers Association	MMI	Man Machine Interface
EA	Exhaust Air	MOD	Ministry of Defence
ECMA	European Computer Manufacturers Association	MS	Micro-silica
ECR	Extra Chemical Resistant	MSDS	Material Safety Data Sheet
EIA	Environmental Impact Assessment/Electronic Industries Alliance	MSRPC	Moderate Sulphate Resistance Portland Cement
		N	Nitrogen
		NDFT	Nominal Dry Film Thickness
		NEMA	National Electrical Manufacturers' Association
		NFPA	National Fire Protection Association

NRC	Noise Reduction Coefficient
NS	Norwegian Standard
O/D	Outside Diameter
ODP	Ozone Depletion Potential
OFS	Oil Fired (Appliance/Equipment) Standard
OFTEC	Oil Firing Technical Association
O&M	Operation and Maintenance
OPC	Ordinary Portland Cement
PD	Published Documents
PE	Polyethylene
PFA	Pulverised Fuel Ash
PFC	Power Factor Correction
PM	Project Manager
PTFE	Polytetrafluoroethylene
PVC	Polyvinylchloride
PVC-u	Unplasticised Polyvinylchloride
PWTAG	Pool Water Treatment Advisory Group
QA/QC	Quality Assurance/Quality Control
RA	Return/Recycled Air
RCCD	Residual Current Circuit Breaker
RCD	Residual Current Device
R&D	Research and Development
REFCOM	Register of Companies Competent to handle refrigerants
RPM	Reinforced Plastic Mortar
RPZ	Reduced Pressure Zone
RTD	Resistant Temperature Detector
RTR	Reinforced Thermosetting Resin
SA	Supply Air
SBCCI	Southern Building Code Congress International (Incorporated)
SDR	Standard Dimension Ratio
SIS	Swedish Institute of Standards
SP	Super-plasticizing
SPDT	Single Pole Double Throw
SRPC	Sulphate Resistance Portland Cement
SS	Structural Strength
SSPC	Steel Structures Painting Council
TIA	Telecommunication Industry Association
TRA	Trussed Rafter Association
UL	Underwriters Laboratories Incorporated
ULPA	Ultra Low Penetration Air
UP	Unsaturated Polyester Resin
UPS	Uninterruptible Power Supply
UTP	Unshielded Twisted Pair
UV	Ultra Violet
VC	Vitrified Clay
VR	Video Recorder
WBP	Weather and Boil Proof
W/C	Water Cement Ratio
WIS	Water Industry Specification
WP	Water Proofing
WRAS	Water Regulations Advisory Scheme
XLPE	Cross Linked Polyethylene