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## 5 HOT WATER STORAGE

### 5.1 GENERAL

#### 5.1.1 Scope

- 1 This Part specifies the requirements for hot water storage systems.
- 2 Related Sections and Parts are as follows:

This Section:

Part 1 General  
Part 2 Water Distribution  
Part 3 Commissioning of Systems

Section 1 General

#### 5.1.2 References

- 1 The following standards are referred to in this Part:

- BS 21.....Specification for pipe threads for tubes and fittings where pressure-tight joints are made on the threads (metric dimensions); (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; 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; EN 10226-3 Pipes threads where pressure-tight joints are made on the threads - Verification by means of limit gauges)
- BS 417.....Specification for galvanized low carbon steel cisterns, cistern lids, tanks and cylinders.
- BS 699.....Specification for copper direct cylinders for domestic purposes
- BS 759.....Valves, gauges and other safety fittings for application to boilers and to piping installations for and in connection with boilers; (BS 759-1 Valves, gauges and other safety fittings for application to boilers and to piping installations for and in connection with boilers - Specification for valves, mountings and fittings; BS 759-2 Valves, gauges and other safety fittings for application to boilers and to piping installations for and in connection with boilers. - Specification for safety valves; ISO 4126-1 Safety devices for protection against excessive pressure - Safety valves).
- BS 853.....Specification for vessels for use in heating systems
- BS 1566.....Copper indirect cylinders for domestic purposes
- BS 1780.....Specification for bourdon tube pressure and vacuum gauges
- BS 1894.....Specification for design and manufacture of electric boilers of welded construction

- BS 2871.....Specification for copper and copper alloys; (BS 2871-1 Specification for copper and copper alloys. Tubes - Copper tubes for water, gas and sanitation; EN 1057 Copper and copper alloys. Seamless, round copper tubes for water and gas in sanitary and heating applications; BS 2871-2 Specification for copper and copper alloys. Tubes - Tubes for general purposes; EN 12449 Copper and copper alloys. Seamless, round tubes for general purposes; BS 2871-3 Specification for copper and copper alloys. Tubes - Tubes for heat exchangers; EN 12451 Copper and copper alloys. Seamless, round tubes for heat exchangers).
- BS 3198.....Specification for copper hot water storage combination units for domestic purposes
- BS 3274.....Specification for tubular heat exchangers for general purposes
- BS 3456.....Specification for safety of household and similar electrical appliances; (EN 60335 Household and similar electrical appliances; IEC 60335 Household and similar electrical appliances.)
- BS 3955.....Specification for electrical controls for domestic appliances.
- BS 4213.....Cisterns for domestic use. Cold water storage and combined feed and expansion (thermoplastic) cisterns up to 500 l. Specification
- BS 4504.....Circular flanges for pipes, valves and fittings (PN designated); (EN 1092 Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated)
- BS 4814.....Specification for expansion vessels using an internal diaphragm, for sealed hot water heating systems;
- BS 6144.....Specification for expansion vessels using an internal diaphragm, for unvented hot water supply systems.
- BS 6282.....Devices with moving parts for the prevention of contamination of water by backflow; (BS 6282-3 Devices with moving parts for the prevention of contamination of water by backflow - Specification for in-line anti-vacuum valves of nominal size up to and including DN 42; EN 14451 Devices to prevent pollution by backflow of potable water. In-line anti-vacuum valves DN 10 to DN 50 inclusive. Family D, type A).
- BS 6283.....Safety and control devices for use in hot water systems; (BS 6283-1 Safety and control devices for use in hot water systems - Specification for expansion valves for pressures up to and including 10 bar; EN 1491 Building valves. Expansion valves. Tests and requirements; BS 6283-2 Safety and control devices for use in hot water systems - Specifications for temperature relief valves for pressures from 1 bar to 10 bar; BS 6283-3 Safety and control devices for use in hot water systems - Specification for combined temperature and pressure relief valves for pressures from 1 bar to 10 bar; EN 1490 Building valves. Combined temperature and pressure relief valves. Tests and requirements; BS 6283-4 Safety devices for use in hot water systems - Specification for drop-tight pressure reducing valves of nominal size up to and including DN 54 for supply pressures up to and including 12 bar).

### 5.1.3 System Description

- 1 Storage-type water heaters shall be used for the provision of hot water services.

- 2 The hot water storage tank shall be constructed so that water delivered is not liable to become contaminated to the extent that it is hazardous to health or unfit for its intended use.
- 3 The capacity of the storage tank shall be as stated in the Project Documentation.

#### 5.1.4 Identification Plate

- 1 All hot water storage tanks shall have an engraved or cast-metal identification plate clearly showing the following:
  - (a) manufacturer's name and address
  - (b) date of manufacture
  - (c) hydraulic test pressures
  - (d) maximum working pressure
  - (e) rated capacity and output

#### 5.1.5 Submittals

- 1 The Contractor shall provide manufacturers' specifications for all items to be supplied under this Part.
- 2 The Contractor shall provide design calculations and shop drawings for the fabrication and erection of tank support assemblies (free standing or wall mounted), unless otherwise detailed in manufacturer's data sheets.
- 3 The submittal shall include catalogue pages, erection descriptions and manufacturer's data.

#### 5.1.6 Safety

- 1 All safety requirements specified by the Qatar General Electricity & Water Corporation, the standard to which the hot water storage tank is constructed and the manufacturer shall be strictly adhered to. If the requirements specified by any of these three parties differ or conflict in any respect, the most stringent requirement, as defined by the Engineer, shall be followed.

#### 5.1.7 Quality Assurance

- 1 Fabricated hot water storage tanks and associated equipment shall be provided by experienced and approved manufacturers and fabricators as designated in the Project Documentation and to the written approval of the Engineer.

## 5.2 HOT WATER STORAGE TANKS

### 5.2.1 Tank Construction

- 1 Hot water storage tanks constructed of copper shall comply with the relevant provisions of BS 699, BS 853, BS 1566 and BS 3198, as applicable.
- 2 Hot water storage tanks may be constructed of materials other than copper provided that they are corrosion resistant, glass lined or porcelain lined and provided that they are approved by the Qatar General Electricity & Water Corporation. Appropriate British Standards, or equivalent, specifying the construction of storage tanks covered in this paragraph shall be supplied by the Contractor to support the required approval.
- 3 Tanks shall incorporate replaceable, sacrificial magnesium anodes for cathodic protection if directed in the Project Documentation.

### 5.2.2 Pressure and Non-Pressure Hot Water Storage Tanks

- 1 The hot water tanks shall be non-pressure or pressure as directed in the Project Documentation.
- 2 Non-pressure hot water storage tanks shall have ventilation systems as described in Clause 5.7 of this Part.
- 3 For non-pressure hot water storage tanks, no hose or other connection shall be made to the outlet of a non-pressure, storage type, water heater and under no circumstances shall the outlet be controlled by a tap or valve.
- 4 For pressure systems it shall be verified that the heater is suitable for the proposed supply pressure.
- 5 Suitable arrangements to accommodate expansion of the heated water shall be made for pressure hot water storage tanks. See Clause 5.8.

## 5.3 LOW CAPACITY ELECTRIC IMMERSION HEATER SYSTEMS

### 5.3.1 System Description

- 1 A low capacity (domestic) electrical immersion heater system involves an electric heating element placed within a hot water storage tank. Such heaters shall be used for the provision of hot water services for applications where the demand for hot water is small (i.e. kitchens and bathrooms, etc.).
- 2 Electric immersion heaters shall be of the vented or unvented type, as directed in the Project Documentation.
- 3 Tank construction shall be in accordance with Clause 5.2 of this Part.

### 5.3.2 Immersion Heaters

- 1 Electric immersion heaters shall comply with the relevant provision of BS 3456.

### 5.3.3 Heating Element

- 1 The material of the heating element shall be a high-grade stainless steel. Other materials with high corrosion resistance may be used if approved by the Engineer.

### 5.3.4 Pressure Relief

- 1 An expansion relief valve shall be fitted in the cold feed to the hot water storage tank and no valves (other than a drainage tap) shall be fitted between the expansion relief valve and the storage tank. The expansion or pressure relief valve setting shall be the maximum working pressure plus 0.5 to 1.5 bar.

### 5.3.5 Pipework

- 1 For tanks with a capacity of 25 litres or greater, the size of the hot water outlet pipe shall be smaller than the cold water inlet pipe.

### 5.3.6 Temperature and Temperature Control

- 1 Unless otherwise detailed in the Project Specification, the temperature of the stored water shall never exceed 65°C.

- 2 Every hot water storage tank shall be fitted with a thermostat acting on the heat input. In addition, every hot water storage tank of capacity greater than 150 litres shall be fitted with an automatic control capable of stopping and starting the heat input to the stored water at pre-set times.

#### 5.3.7 Electric Control

- 1 All electrical controls, including thermostats, cut-outs and switches, shall comply with the relevant provisions of BS 3955.

#### 5.3.8 Pilot Light

- 1 The heater shall incorporate a clearly visible pilot light.

### 5.4 CALORIFIER SYSTEMS

#### 5.4.1 System Description

- 1 Calorifier systems shall be used for hot water applications with a high hot water demand (hospitals, schools, etc.).
- 2 Calorifier systems shall be storage type systems and shall be the direct or indirect type.
- 3 Direct systems involve directly heating the water that will enter the hot water distribution system. This is done by circulating the water in the hot water storage tank through a heat transfer system (boiler). When inside the boiler, the water is directly exposed to the heat source.
- 4 Direct type systems shall be designed for gravity circulation. Flow and return pipes between the boiler and the storage tank shall run as directly as possible and shall be not less than 25 mm diameter. The storage tank shall be located at a sufficient height above the boiler to give adequate circulation.
- 5 Indirect systems involve heating water by means of routing steam or hot water through the hot water storage tank via a tube battery. A heat transfer system (boiler) heats up the water or generates the steam that is conveyed through the tube battery that runs through the water storage tank. On exiting the hot water storage tank, the tube returns to the boiler. The hot water/steam does not come into contact with the water that will enter the hot water distribution system.
- 6 Indirect systems shall incorporate a sealed or vented primary circuit as directed in the Project Documentation. Primary circuits comprise the boiler, the primary heat exchanger in the hot water storage tank and the interconnecting and associated pipework.
- 7 Calorifiers shall incorporate electrical immersion heaters if required by the Project Documentation.

#### 5.4.2 Storage Tank Construction

- 1 Storage tank construction shall be in accordance with Clause 5.2 of this Part and shall be horizontal or vertical type.
- 2 The storage tanks shall comply with the relevant provisions of BS 853 Grade B for shell operating pressures not exceeding 4.5 bar and temperatures not exceeding 90 oC.
- 3 They shall be supported on fabricated feet attached to the shell or on separate cradles or frames. Sheet lead pads shall be fitted between shell bearing surfaces and any separate supports.

4 They shall have screwed and/or flanged connections complying with the relevant provisions of BS 21 and BS 4504.

5 They shall be delivered with all connections capped or blanked-off.

#### **5.4.3 Heat transfer System**

1 Boilers shall comply with the relevant provisions of BS 1894 unless otherwise specified in the Project Documentation.

#### **5.4.4 Tube Batteries**

1 Tube battery shall be design shall comply with the relevant provisions of BS 3274 Type 2.

2 Tubes batteries shall be of solid drawn copper to BS 2871 Part 3.

3 Tube batteries shall be fixed or removable, as stated in the Project Documentation. If fixed type tube batteries are to be used, the storage tank shall include an access opening for battery maintenance purposes.

#### **5.4.5 Electric Heating Elements**

1 Electric immersion heaters shall be complete with an integral thermostatic controller.

2 A minimum of two heating elements shall be provided in each calorifier. The first shall be at low level and the second one approximately two thirds from the base. The ratings of the elements shall be such that the lower heating element shall provide a minimum heat-up time of two (2) hours. The higher heating element shall be equivalently rated for a heat up time of four (4) hours.

3 The material of the heating element shall be a high-grade stainless steel. Other materials with high corrosion resistance may be used if approved by the Engineer.

#### **5.4.6 Calorifier Mountings**

1 The calorifiers shall have connections for hot water system controls and for open systems, a vent pipe connection.

2 The calorifiers shall also have an emptying/drain cock of the bronze gland pattern with hose union connection and malleable iron lever handle. The cock shall be fitted to the calorifier shell lowest point to ensure complete removal of water content and shall be of adequate size (25 mm diameter minimum).

#### **5.4.7 Thermometers**

1 The calorifier shall incorporate a stainless steel dial type mercury thermometer. The dial shall be 100 mm diameter (minimum), white faced with a black figured scale calibrated from 0 oC to 120 oC with divisions at 1 oC intervals and numbered at 10 oC intervals with bold figures. The thermometer shall be complete with an integral vertical or centre stem and separate pocket to suit the immersion position.

#### **5.4.8 Altitude or Pressure Gauges**

1 The calorifier shall incorporate a stainless steel dial type altitude or pressure gauges. The dial shall be 100 mm diameter (minimum), white faced with a black figured scale, calibrated both in bar and metre head, to approximately twice the working pressure, complete with lever handle gauge cock and adjustable red dial pointer set at normal working pressure or head of the system. The gauge shall generally to comply with the relevant provisions of BS 1780 Part 2.



#### 5.4.9 Pressure Relief Valve

- 1 The calorifier shall incorporate an enclosed spring loaded pattern pressure relief valve fitted with a padlock. The valve shall incorporate a copper discharge pipe running clear of any insulation and terminating 150 mm from floor level adjacent to a drain gully position. The pressure relief valve shall comply with the relevant provisions of BS 759.

#### 5.4.10 Combined Pressure and Vacuum Gauges

- 1 The calorifier shall incorporate a stainless steel dial type combined pressure and vacuum gauge. The dial shall be 100 mm diameter (minimum), white faced with a black figure scale, calibrated to suit steam chest pressure, complete with U pattern siphon and lever handle gauge cock. The gauge shall generally to comply with the relevant provisions of BS 1780 Part 2.

#### 5.4.11 Vacuum Breaker

- 1 Vacuum breakers shall comply with the relevant provisions of BS 6282 Part 2 or 3.
- 2 Every vacuum breaker valve shall be of the same nominal size as the pipe on which it is connected.
- 3 Each vacuum breaker shall be installed at a height of not less than 150 mm above the overflowing level of the receiving cistern tank or appliance, when the later is fixed or not less than 300 mm above the outlet of the fitting in all other cases.

### 5.5 CISTERN TYPE WATER HEATERS

#### 5.5.1 General Requirements

- 1 Cistern type water heaters shall comply with BS 417, BS 4213 and BS 4814, as appropriate.
- 2 The cistern shall comply with all the requirements for a cold water storage cistern.
- 3 The feed cisterns shall have a capacity at least equal to that of the hot water storage tank.
- 4 The feed cistern shall be situated at a height that will ensure a satisfactory flow of water at the highest point of discharge.

### 5.6 PRESSURE CONTROL

#### 5.6.1 General Requirements

- 1 Whether hot or cold water is involved, it shall be ensured that no part of the system bursts due to the hydraulic pressures to which it is subjected. The pressures in the system shall never exceed the safe working pressures of the component parts. The maximum working pressure in a sealed primary circuit shall not exceed 3 bar but it shall be capable of passing a test at 1.5 times the working pressure at the working temperature. The maximum working pressure in an unvented hot water storage tank or secondary circuit shall not exceed 6 bar.
- 2 Where necessary the supply pressure shall be controlled by using break cisterns or by pressure reducing valves. If the supply to a storage type water heater is through a pressure reducing a valve of the type that permits backflow, the working pressure in the system shall be assumed to be the maximum pressure upstream of the valve. Where reliance is placed on pressure reducing valves to limit the maximum working pressure, these shall comply with BS 6283, Part 4.



- 3 Where unvented storage type water heaters are used, an expansion relief valve shall be fitted in the cold feed to the heater or hot water cylinder and no valves (other than a draining tap) shall be fitted between the expansion relief valve and the heater or hot water cylinder.
- 4 In every case, including sealed primary circuits, the expansion or pressure relief valve setting shall be maximum working pressure plus 0.5 bar to 1.5 bar. This also applies to combined temperature and pressure relief valves.

## 5.7 VENTILATION

### 5.7.1 Storage Tanks

- 1 With ventilated hot water storage tanks, an open vent pipe shall run from the top of the hot water storage tank to a point above the cold water storage tank, into which it shall discharge. No valves shall be fitted to any vent pipe. The vent pipe shall rise continuously from its point of connection to the hot water storage tank to its point of discharge. The vent pipe shall be 19mm diameter or greater.

### 5.7.2 Indirect Calorifier Systems

- 1 Indirect calorifier systems incorporating vented primary circuits shall have vent route connecting the flow connection on the calorifier to the vent pipe above the expansion cistern and a feed water route from a point near the bottom of the expansion cistern to the return connection on the calorifier. These routes shall be independent.

## 5.8 EXPANSION VESSEL

### 5.8.1 General Requirements

- 1 An expansion vessel shall be connected to the cold feed supply pipe to unvented hot water storage vessels. There shall be no valve on the pipe between the expansion vessel and the storage vessel.
- 2 On indirect systems incorporating sealed primary circuits, an expansion vessel shall be connected to the section of pipework routing the water from the storage tank and boiler.
- 3 Provision shall be made to accommodate expansion water by one of the following alternative methods.
  - (a) allow the expansion water to travel back along cold feed pipe, provided that heated water cannot reach any communication pipe or branch feeding a cold water outlet.
  - (b) where reverse flow along the cold feed is prevented by a stopvalve with a loose jumper, replace this valve by one with a fixed jumper.
  - (c) where reverse flow along the cold feed is prevented, e.g. by a check valve, some types of pressure reducing valve or a stopvalve with a loose jumper, provide an expansion vessel in accordance with BS 6144 to accommodate expansion water. This vessel shall be sized in accordance with the volume of water heated and the water temperature rise so as to limit the pressure to the maximum working pressure for the system. The expansion vessel shall accommodate expansion equal to 4% of the total volume of water heated. Any discharge from relief valves shall be readily visible and disposed of safely.

## **5.9      INSULATION**

### **5.9.1    General**

- 1      The storage tank shall be supplied complete with a factory applied layer of high density, CFC free polyurethane foam insulation. The dimensions and properties of the polyurethane insulation shall be sufficient to ensure that heat loss under normal operating conditions does not exceed 90 watts per square metre of surface area.
- 2      The polyurethane shall be protected against mechanical damage and moist atmosphere by an outer shell.

END OF PART