BRITISH STANDARD

BS 759-1:1984
Incorporating Amendment No. 1

Valves, gauges and other safety fittings for application to boilers and to piping installations for and in connection with boilers —

Part 1: Specification for valves, mountings and fittings

UDC [621.183.3+621.646]:697.32/.33

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Pressure Vessel Standards Committee (PVE/-) to Technical Committee PVE/12 upon which the following bodies were represented:

Associated Offices Technical Committee
Association of Shell Boilermakers
British Compressed Air Society
British Compressed Gases Association
British Electrical and Allied Manufacturers' Association (BEAMA)
British Valve Manufacturers' Association Ltd.
Combustion Engineering Association
Department of Trade and Industry (Marine Division)
Electricity Supply Industry in England and Wales
Energy Industries Council
Engineering Equipment and Materials Users' Association
Gambica (BEAMA)
Health and Safety Executive
Institution of Chemical Engineers
Institution of Mechanical Engineers
Liquified Petroleum Gas Industry Technical Association (UK)
Process Plant Association
Spring Research and Manufacturers' Association
Water-tube Boilermakers' Association

This British Standard, having been prepared under the direction of the Pressure Vessel Standards Committee, was published under the authority of the Board of BSI and comes into effect on 29 February 1984

The following BSI references relate to the work on this standard:
Committee reference PVE/12
Draft for comment 80/74859 DC

ISBN 0 580 13646 9

Amendments issued since publication

Amd. No.	Date of issue	Comments
5890	July 1988	Indicated by a sideline in the margin

Contents

Foreword

This British Standard has been prepared under the direction of the Pressure Vessel Standards Committee. It is a revision of BS 759:1975 incorporating such requirements as are necessitated by technical developments.

The decision taken to align the requirements for safety valves with those of ISO 4126 "Safety valves, general requirements", published by the International Organization for Standardization, has resulted in a change of format of this revision compared with that adopted for the 1975 edition.

Part 1 of this standard deals with valves, mountings and fittings, other than safety valves, for steam and hot water installations.

Section 5 of Part 1 dealing with requirements for automatic working draws attention to the recommendations contained in the Health and Safety Executive Guidance Note PM5.

The hydraulic pressure testing requirements for components complying with Part 1 of this standard are in many cases equal to or greater than those for the boiler to which they will be fitted, but in any case it can be taken that any valve or fitting supplied to this standard will be capable of sustaining, against a closed valve where appropriate, a hydraulic test pressure equal to 1.5 times the design pressure of the valve as specified to the valve supplier by the purchaser.

Part 1 deals with the materials and construction of valves, gauges and other fittings, but is not intended to cover all details of their installation, for which reference should be made to the appropriate British Standard.

It is recognized that clauses (reproduced in Appendix A) regarding inspecting facilities and testing facilities which have traditionally been incorporated into safety valve standards are a contractual matter. Nevertheless their importance is such that the purchaser in agreeing a contract should not overlook them.

Part 2 of this standard has been created by amendments to the requirements of the 1975 edition of BS 759. This Part is declared obsolescent and will be withdrawn in December 1987. Its retention is to give manufacturers a period of grace in which to align their products with BS 6759-1.

NOTE 1 In order to ensure the correct functioning of the fittings in this standard, it is essential that suitable equipment be provided to enable the proper condition of the feedwater to the boiler and the water in the boiler to be maintained.

NOTE 2 The use of asbestos is controlled by the Asbestos Regulations 1969 S.I. No. 690 made under the Factories Act, 1961, and particular attention is drawn to the danger associated with blue asbestos (crocidolite).

Further information is available in the Health and Safety Executive Guidance Note EH/10, Environmental Hygiene, Asbestos.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 14, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

Section 1. General

1 Scope

This Part of this British Standard specifies requirements for steam and water fittings excluding safety valves for boiler installations where the steam pressure exceeds 1 bar gauge or, in the case of hot water boilers, the rating is 44 kW and above. It also specifies requirements for fittings for boilers used exclusively for the following:

a) low pressure steam heating in which the whole of the condensate is returned to the boiler on a closed circuit;

b) hot water central heating;

c) hot water supply.

It deals with valves, boiler blowdown mountings, water level gauges, high and low water level alarms, pressure gauges, test connections and fusible plugs. Where appropriate, general recommendations relating to the installation of fittings are included for the guidance of users. Additional requirements specific to steam and hot water boilers, arranged for automatic working, are given in section 5.

This Part does not cover fittings for boilers used in open vented hot water systems working at temperatures not exceeding 100 °C nor for storage water heaters of the unvented type which normally operate at temperatures not exceeding 82 °C and at pressures not exceeding 10 bar[1)]. For such boilers within the scope of BS 779 and BS 855 the requirements are incorporated in those standards.

NOTE The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definitions

For the purposes of this Part of BS 759 the following definitions apply.

2.1
blowdown

the removal of liquid and/or entrained sediment, if present, from a pressure vessel or boiler

2.2
boiler blowdown fittings

valves or cocks used for controlling blowdown

2.3
boiler feed water valve

a valve in the feed system between the discharge of the feed pump and the inlet to the boiler

2.4
boiler main stop valve

the stop valve provided for the purpose of isolating the main outlet pipe from the boiler

2.5
boiler operating pressure

in the case of fully-flooded hot water boilers, not externally pressurized, the maximum operating pressure in the hot water system, including any static head

in the case of externally pressurized fully-flooded hot water boilers, the pressure at which the boiler operates

2.6
design pressure

the pressure used in calculating the thickness of a vessel or pipe system

2.7
drain mountings

valves or cocks fitted to pressure containing parts for drainage purposes. Such valves may be used to induce flow on initial pressure raising

2.8
fusible plug

a plug containing a metal of low melting point, screwed or otherwise secured into the wall of a vessel

2.9
gauge

an indicating device, e.g. pressure or water level

2.10
high and low water level alarm

an automatic device giving audible warning of an unacceptably high water level and an unacceptably low water level

2.11
inspecting authority

the competent independent authority or association which verifies compliance with this standard

2.12
low water level alarm

an automatic device giving audible warning when the water level drops below an unacceptably low water level

2.13
nominal pressure (PN)

a numerical designation of pressure which is a convenient round number for reference purposes

[1)] 1 bar = 10^5 N/m^2 = 100 kPa.

2.14
nominal size (DN)

a numerical designation of size which is common to all components in a piping system other than components designated by outside diameter or by thread size. It is a convenient round number for reference purposes and is only loosely related to manufacturing dimensions

2.15
pressure containing components

those parts which, when assembled, form the pressure containment. Body, bonnet, stem, body bonnet fasteners, gland and gland fasteners are deemed pressure containing components

2.16
protector

a device which protects personnel from the effects of failure of tubular glass and which does not obstruct the reading of the gauge

2.17
sequencing valve

a valve which is only used in connection with float chambers of water level controls mounted external to the boiler. It is used for the testing of such controls and for blowing through separately the water connection and the float chamber of the controls. It is so arranged as to ensure that the float chamber is drained completely during the blow through sequence and that the water connection to the boiler cannot be shut off unless the drain connection to the float chamber is open

2.18
siphon pipe

in the case of a pressure gauge, a pipe fitted below the gauge shaped so as to ensure that hot fluid is never in contact with the internal fittings of the pressure gauge

2.19
water level gauge

a device permitting direct visual determination of water level in the boiler

2.20
water level gauge column

a structural support to maintain the correct distance between the top and bottom arms of the water level gauge, and on which the water level gauge or gauges are mounted

2.21
water level gauge safety devices

automatic shut-off valves which control the discharge of fluid should the transparent portion of the gauge fracture

2.22
water level indicator

a device permitting indirect determination of water level in the boiler

3 Applicability of other valve standards

Subject to the limitations specified in this standard, it is permissible for valves complying with the following British Standards to be used

BS 4312, BS 5151 BS 5152, BS 5153, BS 5154, BS 5157, BS 5160.

Section 2. Material requirements and limitations

4 Pressure containing components

4.1 Material specification. The materials used in the manufacture of bodies and bonnets and other similar pressure containing components of valves and fittings shall comply with whichever of the following is appropriate bearing in mind that fittings made of the less ductile materials are more likely to fail under shock conditions, e.g. water hammer.

a) Cast carbon steel to BS 1504-161, grade 480.

NOTE This material has a maximum carbon content of 0.30 %. For valves with butt welded ends less than 35 mm thick and intended for welding into pipelines subject to the requirements of BS 2633, the carbon content should be 0.25 % maximum. Alternatively, the material may be specified as BS 1504-161, grade 430.

b) Cast carbon $^1/_2$ % molybdenum steel to BS 1504-245.

c) Cast $1^1/_4$ % chromium $^1/_2$ % molybdenum steel to BS 1504-621.

d) Cast $2^1/_4$ % chromium 1 % molybdenum steel to BS 1504-622.

e) Cast austenitic chromium nickel steel to BS 1504-347C17 or, cast austenitic chromium nickel molybdenum steel to BS 1504-316C16.

f) Forged carbon steel to BS 970-1, 070M20.

g) Forged carbon steel to BS 1503 221-430.

h) Forged carbon $^1/_2$ % molybdenum steel to BS 1503 245-420

i) Forged 1 % chromium $^1/_2$ % molybdenum steel to BS 1503 620-440

j) Forged $1^1/_4$ % chromium $^1/_2$ % molybdenum steel to BS 1503 621-460.

k) Forged $2^1/_4$ % chromium 1 % molybdenum steel to BS 1503 622-560.

l) Forged chromium molybdenum vanadium steel to BS 1503 660-460.

m) Forged austenitic chromium nickel steel to BS 1503 321S51-490 or BS 1503 347S51 or, forged austenitic chromium nickel molybdenum steel to BS 1503 316S51.

n) Cast iron with minimum mechanical properties equal to those specified in BS 1452 grade 220.

o) Cast copper alloy with minimum mechanical properties equal to those specified in BS 1400 LG 2.

p) Other material having properties at least equal to those of the material to which it is an intended alternative, subject to the limitations given in **4.2** and to agreement between the manufacturer and the purchaser, such agreement being approved by the inspecting authority.

4.2 Pressure and/or temperature limitations

4.2.1 *Cast iron* Cast iron shall not be used for the following:

a) temperatures above 220 °C;

b) pressures exceeding 13 bar gauge;

c) valves exceeding 200 mm nominal bore which are connected directly to the boiler[2)];

d) wedge or double disk gate valves which are connected directly to the boiler[2)];

e) boiler blowdown fittings.

4.2.2 *Cast copper alloy.* Cast copper alloy shall not be used for temperatures above 260 °C.

4.2.3 ***Steel***

4.2.3.1 There are no pressure limitations on steel.

Temperature limitations are given in **4.2.3.2** to **4.2.3.7** where the letters in parentheses refer to items listed in **4.1**.

4.2.3.2 Cast carbon steel a) and forged carbon steel f) and g) shall not be used at temperatures above 480 °C.

4.2.3.3 Cast carbon molybdenum steel b) and forged carbon molybdenum steel h) shall not be used at temperatures above 540 °C.

4.2.3.4 Cast chromium molybdenum steel c) and forged chromium molybdenum steel i) shall not be used at temperatures above 565 °C.

4.2.3.5 Cast chromium molybdenum steel d) and forged chromium molybdenum steel j) and k) shall not be used at temperatures above 580 °C.

4.2.3.6 Forged chromium molybdenum vanadium steel l) shall not be used at temperatures above 580 °C

4.2.3.7 Cast austenitic chromium nickel steel and cast austenitic chromium nickel molybdenum steel e) and forged austenitic chromium nickel steel and forged austenitic chromium nickel molybdenum steel m) shall not be used at temperatures above 700 °C.

NOTE At temperatures above 680 °C it is generally accepted that the rate of oxidation or chemical attack begins to be important

5 Body seat faces and valve disk faces

Body seat faces and valve disk faces shall be made from corrosion and erosion resistant material.

6 Fusible plugs

The non-fusible portions of the plug shall be of copper alloy except where the nature of the fluid is such as to preclude its use.

NOTE In such cases the non-fusible portions of the plug should be to the satisfaction of the inspecting authority.

The fusible metal shall be an alloy melting readily at a temperature not less than 90 °C in excess of the saturated steam temperature at the design pressure of the boiler.

Section 3. Design and construction requirements

7 Locking devices

In addition to any legislative requirements for locking devices on particular valves mentioned elsewhere in this Part of BS 759, any valve, the inadvertent operation of which could constitute a hazard, shall be fitted with a suitable locking device.

8 Scantlings

Copper alloy and iron valves manufactured in accordance with the relevant British Standard shall have scantlings as specified therein. Steel valves manufactured in accordance with this Part of BS 759 or manufactured in accordance with the relevant British Standard which does not specify the thickness of pressure containing components or allowable design strength values, shall only be deemed to comply with this Part of BS 759 if the design strength value does not exceed that given in Table 2.3 of BS 5500:1982. Valves shall be designed for a life of 150 000 h except when contractual requirements, approved by the inspecting authority, specify a different design life.

[2)] The expression "connected directly to the boiler" refers to any valve which cannot itself be isolated from the boiler.

Calculations of scantlings shall be based on the design pressure as defined in BS 806 and BS 2790 or, where applicable, the calculation pressure as defined in BS 1113, of the boiler component or pipework to which the valve or fitting is connected.

The body end neck of a boiler mounting shall be of adequate strength and stiffness for its intended duty.

9 Castings and forgings

All castings shall be smooth, sound, and free from cracks, significant flaws or other injurious defect. Variations in thickness shall be gradual, and substantial fillets shall be provided.

The welding of cast iron or copper alloy pressure containing components is prohibited. The welding of pressure containing components in cast steel shall be in accordance with the procedures laid down in BS 4570-1, cognizance being taken of the requirements of clauses **18** and **19** of BS 1504:1976 dealing with rectification of castings and freedom from defects, respectively.

All forgings shall be in accordance with BS 1503.

10 Body to bonnet/cover connection for all valves and fittings

10.1 General. The following shall have bolted[3] body to bonnet/cover connections:

a) cast iron valves;

b) cast copper alloy valves of 40 mm bore and over when connected directly to the boiler[4], or of 65 mm bore or over when otherwise located.

No method of attaching body to bonnet/cover which relies solely upon the rotation of the components to effect a seal shall be used for steel valves.

Where the bonnets or covers of valves are secured by studs, the studs shall be screwed into the body with a full thread for a length at least equal to one nominal diameter of the stud. The metal thickness between the stud hole and the pressure space of a valve shall be adequate for pressure containment.

10.2 Locking of screwed bonnets. In the case of valves with screwed bonnets, connected directly to the boiler[4], means shall be provided to prevent the inadvertent unscrewing of the bonnet or cover caused by rotation of the valve stem.

11 Stems

All cast iron valves and all steel valves incorporating screwed stems shall be of the outside screw type, i.e. with the actuating thread of the stem outside the pressure containing components.

All cast copper alloy valves of 40 mm bore and over which are connected directly to the boiler[4], and other copper alloy valves of 65 mm bore and over, shall have stems of the outside screw type.

12 Direction of operation

All valves shall be arranged to close by clockwise rotation as seen when facing the handwheel, handle or key. Attention is drawn to **27.3** in relation to the marking of handwheels.

13 Indicators

Each valve connected directly to the boiler[4] shall be fitted with an indicator to show clearly whether the valve is closed or open. Where a remote control is fitted, an additional indicator shall be attached at the point of control.

14 Moving parts

Moving parts shall be guided efficiently, and shall have sufficient clearance to ensure freedom of movement under all conditions of service.

15 Body seats

Seats, other than those of an integral design, shall be secured effectively.

16 Body end connections

End connections of valves and fittings shall comply with one of the following standards:

a) flanges complying with BS 1560-2 or BS 4504;

b) screwed connections complying with BS 21;

c) weld preparation complying with an appropriate standard which has the approval of the inspecting authority.

17 Cocks

Cocks shall have provision, other than the gland, for securing the plug.

Cocks fitted with taper plugs shall be of the compound gland type with bolted cover.

NOTE Cocks, in general, are not suitable for regulating purposes.

[3] The term bolted includes studded.

[4] The expression "connected directly to the boiler" refers to any valve which cannot itself be isolated from the boiler.

18 Water level alarms

18.1 Types. Water alarms, be they low water or high and low water types shall be one of the following.

a) Float or displacer operated alarms fitted either inside the boiler or in a separate external chamber. The steam and water connections on separate chambers have an internal diameter of not less than 25 mm. Where connecting pipes are fitted between the chamber and the boiler they shall comply with the requirements of **32.1.5**. Provision shall be made for isolating the chamber from the boiler and means shall be provided to test the operation of the alarm and to blow out accumulated deposits.

b) Electrical probe or thermostatic operation.

c) Manometric operation.

d) Operated by any other principle which has the approval of the inspecting authority.

18.2 Actuation. All alarms shall be so fitted that the alarm is actuated while the water level is still visible or indicated in the water level gauges.

18.3 Isolating valves. The steam and water isolating valves fitted to the chambers of externally mounted high and lower water level alarms if of the straight pattern globe type shall be mounted with spindle horizontal. This restriction does not appertain to parallel slide type valves.

19 Water level gauges

19.1 Types. Water level gauges in which the water level can be observed shall be one of the following types.

a) Tubular glass type, the glass of which shall comply with BS 3463.

b) Through vision type, or reflex glass type. If glass is used it shall comply with BS 3463.

c) A type having circular ports, the glasses of which shall comply with BS 3463.

Tubular glass type water level gauges shall be fitted with plugs to facilitate cleaning.

Where tubular glass water level gauges are fitted, effective protection shall be provided which shall not obstruct the reading of the gauge.

Where protector glasses are used these shall comply with BS 3463.

19.2 Isolation and drains

19.2.1 Each water level gauge shall incorporate or be fitted with isolating valves or cocks and a drain valve or cock with a discharge pipe. Where cocks are used they shall have their handles so arranged as to lie parallel with the longitudinal centre line of the gauge when the cocks are in the normal working position. Valves shall have provision for indicating the open and closed positions.

19.2.2 Isolating valves or cocks, which are independent of the water level gauge, shall be not less than 20 mm nominal bore and shall have provision for indicating the open and closed positions.

NOTE In the case of cocks, this provision may take the form of the cock handle lying along the axis of the pipeline when the cock is in the open position.

19.2.3 Arrangements shall be made so that all cock handles not integral with the cock plug cannot be fitted incorrectly.

19.3 Safety devices. Each water level gauge shall be fitted with a self-closing device in its bottom arm.

NOTE A self-closing device may also be fitted in the top arm by agreement between the purchaser and the manufacturer.

19.4 Water level gauge columns. Where the water level gauges are mounted on a column, there shall be no connecting passage between the top and bottom arms of the column unless valves or cocks are fitted between the column and the boiler.

20 Bolting for pressure containing joints

The dimensions and finish of bolting shall comply with the following British Standards, as appropriate.

Metric	Inch
BS 3692	BS 1768 (below $^1/_2$ in)
BS 4190	BS 1769
BS 4439	BS 2693-1
BS 4882	BS 2708
	BS 4882

21 Pressure gauges

21.1 General. At least one pressure gauge of the Bourdon tube type shall be fitted to each boiler. It shall be of at least 150 mm nominal diameter and shall comply with all the relevant requirements for the class 1 industrial concentric scale gauge as specified in BS 1780-2. The dial shall be provided with a stop pin in the zero position.

21.2 Scale marking. The total scale of each pressure gauge shall be so chosen from BS 1780-2 that the operating pressure is between 40 % and 75 % of the scale range. The dial shall have the following information marked upon it:

a) the boiler operating pressure in red as shown at A in Figure 1;

b) the maximum permissible working pressure[5)] of the boiler in purple as shown at B in Figure 1;

c) when the gauge is compensated for a head of water between the gauge and the boiler connection, the amount of such compensation.

21.3 Connections. All pressure gauges shall be fitted with a syphon pipe and a valve or cock adjacent to the gauge in such a manner that the gauge can be shut off and removed while the boiler is under pressure. Where a cock is fitted, the handle shall be parallel to the bore of the cock when the cock is open.

21.4 Pressure gauge test connection. Every boiler shall be fitted with a valve or cock having a connection for the attachment of a test pressure gauge. This connection shall be tapped G 3/8 in accordance with BS 2779, and shall be fitted with an easily removable plug.

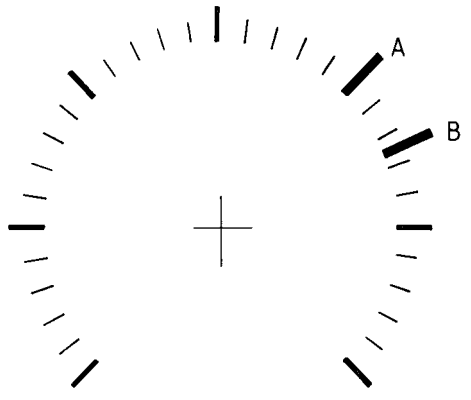

Figure 1 — Pressure gauge dial markings

22 Fusible plugs

Fusible plugs shall consist of an outer body with a central conical passage. The smallest diameter of the conical passage shall be not greater than 13 mm for plugs suitable for pressures up to 7 bar gauge, and not greater than 10 mm for plugs for pressures exceeding 7 bar gauge. The passage shall be closed with a plug secured by an annular lining of fusible alloy so that the plug can drop clear if the lining melts.

A portion of the body carrying the fusible metal shall be detachable from the base to allow easy replacement without removing the whole fitting from the boiler.

The screwed portion of the plug shall have a pipe screw thread of not more than eleven threads per inch (2.307 mm pitch). Threads shall comply with BS 21.

Section 4. Production testing, inspection and marking

23 General

All temporary pipes, connections and blanking devices shall be adequate to withstand the test pressure.

Any temporary welded-on attachments shall be carefully removed after the test and the resulting weld scars shall be ground flush with the parent metal. After grinding, all such scars shall be inspected by magnetic particle or liquid penetrant techniques in accordance with BS 4080 to ensure that no injurious defects remain.

To confirm accuracy, all Bourdon tube pressure gauges or other recognized pressure measuring devices fitted to test equipment shall be tested and calibrated at intervals of time no greater than six months.

24 Safety precautions

The valve or fitting shall be vented to remove entrapped air. No valve, fitting or part thereof undergoing pressure testing shall be subjected to any form of shock loading, e.g. hammer testing.

Under no condition shall the gland be tightened whilst the hydraulic pressure in the valve or fitting is higher than the design pressure.

[5)] Attention is drawn to the requirements regarding the marking of pressure gauges in Section 32 (2)(C) of the Factories Act, 1961, and to any subsequent legislation.

If materials that are liable to failure by brittle fracture are incorporated into that part of the valve or fitting which is to be hydraulically tested, then both the valve or part thereof and the testing medium shall be at a sufficient temperature to prevent the possibility of such failure.

25 Test media

The test media shall be water (treated with a suitable inhibiter, when necessary), or other liquid whose viscosity at ambient temperature is equal to or less than water.

NOTE Attention is drawn to the need to control the chloride content of the test water in the case of safety valves with austenitic steel components.

26 Hydraulic test

26.1 Methods

26.1.1 *General*. Hydraulic pressure tests shall be applied in accordance with **26.1.2** or **26.1.3** except that:

a) glasses of water level gauges of tubular type shall not be subjected to the test pressure;

b) sub-assemblies incorporating the glasses of water level gauges of the through vision or reflex glass type or of the type having circular ports, shall not be subjected to the test pressure.

26.1.2 *Shell test.* The shell test shall be performed by applying pressure inside the assembled valve with the ends capped or plugged, the valve partially closed and the packing gland sufficiently tight to maintain test pressure, thereby testing the packing chamber portion of the structure.

Seepage from stuffing boxes is permissible at hydraulic test pressure provided that there is no visible leakage when the hydraulic pressure is reduced to the seat test pressure.

26.1.3 *Seat test.* The seat test shall be made with seats clean and free of oil or grease.

The seat test shall be carried out by closing the valve obturator in the normal manner. The method of testing shall result in the application of the full differential pressure across the seat or seats in the direction for which they are designed. Tests for various types of valves shall be as follows.

a) *Gate valves, ball valves and plug valves.* Fill the bonnet cavity with the test fluid. Apply pressure successively to each side of the closed valve and check the opposite side for leakage. Valves with independent double seating (such as two piece obturator or double-seated valves) can be tested by applying pressure to the body cavity between the seats and checking each side of the closed valve for leakage.

b) *Globe valves (including angle and Y types) and diaphragm valves.* Apply pressure to the obturator in the direction producing the more adverse seating condition, e.g. test a globe valve with pressure in the direction likely to unseat the obturator.

c) *Butterfly valves.* Apply pressure in the more adverse direction; valves with symmetrical seating can be tested in either direction.

d) *Check valves.* Apply pressure in the direction tending to close the obturator and check the opposite side for leakage.

Unless otherwise specified, the following maximum leakage rate when testing with a liquid and when discharging to atmosphere shall be 0.01 $mm^3/s \times DN$.

All valves marked as unidirectional flow valves, with the exception of check valves, shall be tested in the specified flow direction only.

26.2 Pressure

26.2.1 *Valves and fittings*

26.2.1.1 *General.* Valves manufactured in accordance with a relevant British Standard shall be hydraulically tested in accordance with the requirements of that standard, where such requirements do not conflict with the requirements of this Part of BS 759, in which case the requirements of this Part of BS 759 shall apply.

26.2.1.2 *Flanged valves.* The hydraulic shell test on flanged valves shall be carried out on the assembled valve at a pressure equal to 1.5 times the cold rating of the valve, and the seat test shall be carried out on the closed valve at a pressure equal to 1.1 times the cold rating of the valve except when contractual requirements, approved by the inspecting authority specify different test pressures.

26.2.1.3 *Weld end valves.* The hydraulic shell test on weld end valves designed to comply with this Part of BS 759, shall be carried out on the assembled valve at a pressure in bars (rounded to the next higher bar increment) equal to:

$$1.5 \times P_a \times \frac{150}{f_t}$$

where

P_a is the maximum working pressure of the valve at the maximum allowable temperature (in bar);

f_t is the allowable design strength value for the material (in N/mm^2) at the maximum allowable temperature, corresponding to P_a, as listed in Table 2.3 of BS 5500:1982 based on a design life of 150 000 h. f_t shall not exceed a value of 150 N/mm^2.

NOTE If a design life of other than 150 000 h has been agreed as a specific contract requirement, such agreement having the acceptance of the inspecting authority, then this of itself does not invalidate compliance with this standard (see clause **8**).

If, however, the design of the valve precludes the testing of the assembled valve at the above pressure, then it is permissible to test, before assembly, the pressure containing components at this pressure, and to test the assembled valve at a pressure equal to that for the seat test as specified below.

The seat test shall be carried out on the closed valve at a pressure in bars (rounded to the next higher bar increment) equal to:

$$1.1 \times P_a \times \frac{150}{f_t}$$

For valves and fittings where critical areas of the valve body are shown to be sound by radiographic or ultrasonic testing the factor of 150 shall be reduced to 120, in which case the f_t value shall be not greater than 120.

26.3 Duration. The shell test pressure shall be applied to the valve, or fitting, and maintained at the required pressure for a sufficient length of time to permit a visual examination to be made of all surfaces and joints but in any case not less than the times detailed in Table 1.

The seat test pressure specified in **26.2.1.2** and **26.2.1.3** shall be maintained at the required pressure for a time not less than that detailed in Table 2.

NOTE The testing times listed in Table 1 and Table 2 differ from British Standards for general purpose valves in that they are expressed in minutes.

Table 1 — Minimum duration of hydraulic shell test

Nominal valve size (DN)[a]	Pressure rating		
	Up to and including 40 bar	Over 40 bar up to and including 64 bar	Over 64 bar
	Duration		
	min	min	min
Up to and including 50	2	2	3
over 50 up to and including 65	2	2	4
over 65 up to and including 80	2	3	4
over 80 up to and including 100	2	4	5
over 100 up to and including 125	2	4	6
over 125 up to and including 150	2	5	7
over 150 up to and including 200	3	5	9
over 200 up to and including 250	3	6	11
over 250 up to and including 300	4	7	13
over 300 up to and including 350	4	8	15
over 350 up to and including 400	4	9	17
over 400 up to and including 450	4	9	19
over 450 up to and including 500	5	10	22
over 500 up to and including 600	5	12	24

[a] Nominal valve sizes larger than DN 600 shall have testing times pro rata.

Table 2 — Minimum duration of hydraulic seat test

Nominal valve size (DN)[a]	Duration
	min
Up to and including 150	2
over 150 up to and including 250	3
over 250 up to and including 450	4
over 450 up to and including 600	5

[a] Nominal valve sizes larger than DN 600 shall have testing times pro rata.

27 Marking

27.1 Body marking. Each valve shall bear legible and durable marking on the body or on a plate fixed securely to the body. If a plate is used it shall be separate and distinct from the identification plate referred to in **27.2**. Body markings shall be as follows:

a) the nominal size (DN);

b) the nominal pressure (PN);

c) for all materials except copper alloy and cast iron, the material designation of the body;

d) the manufacturer's name and/or trademark;

e) an arrow for direction of flow, where applicable;

f) the ring joint number, where applicable (to be marked on the flange).

27.2 Identification plate. In addition to the markings required by **27.1**, the following markings shall be on an identification plate.

a) the limiting temperature (in °C) if this is different to that implied by the nominal pressure rating (PN) for the material;

b) the hydraulic test pressure in bar gauge if the valve does not have a nominal pressure (PN), see **26.2**;

c) the design life, if other than 150 000 h.

NOTE A manufacturer, having complied with the requirements of **27.1** and **27.2**, is not precluded from marking any item additionally in a place other than that specified, e.g. if a marking is required to appear on the body it may also be repeated on an identification plate.

Additional markings may be used at the option of the manufacturer, e.g. a serial number of catalogue number, providing they do not conflict with any of the specified markings.

27.3 Handwheel marking. There shall be marking to indicate the direction of closing, incorporating an arrow and either the word "close" or "shut". This marking shall either be on the handwheel or on a plate secured below the handwheel nut.

NOTE It is permissible to indicate also the direction for opening using an arrow and the word "open".

Section 5. Additional requirements for automatically controlled steam and hot water boilers

NOTE Every boiler which is provided with the appropriate water level and/or firing control to allow for automatic working has to comply with the requirements of the Health and Safety Executive Guidance Note PM 5 titled "Automatically controlled steam and hot water boilers" or a similar Associated Offices Technical Committee (AOTC) document "Requirements for automatically controlled steam and hot water boilers".

Boilers pressurized by steam for use in hot water systems are classified as steam boilers and therefore have to comply with the requirements for steam boilers.

28 Automatic water level controls[6)]

Automatic water level controls shall be as follows:

a) float or displacer operated, or

b) operated by electrical probe or thermostat, or

c) operated by another principle approved by the inspecting authority.

The control equipment shall regulate the feedwater supply to the boiler in order to maintain effectively the level of the water in the boiler between predetermined limits.

29 Water level controls housed in chambers external to the boiler

Where control or alarm devices are housed in chambers external to the boiler, the following requirements shall be complied with.

a) Unless a sequencing valve is fitted on the water side, provision shall be made for isolating the steam and water connections of the chambers from the boiler for testing and maintenance purposes[7)]. Such isolating valves shall be capable of being locked in the open position.

b) Steam and water isolating valves if of the straight pattern globe type shall be mounted with the spindle horizontal.

NOTE This restriction is not applicable to parallel slide type valves.

[6)] Attention is directed to the requirements of the Factories Act 1961 Section 32 "Steam boilers — attachments and construction" in which connection the Certificate of Exemption No. 27 refers to coil type steam generators and the Certification of Exception No. 29 refers to forced flow once through boilers.

[7)] Where boilers cannot be shut down to enable maintenance to be carried out to control chambers it is necessary to fit steam isolating valves.

c) The steam and water connections of the chambers shall be not less than 25 mm bore and the associated pipework shall comply with the requirements of **32.1.5**.

d) Means shall be provided to blow through the control chamber and connecting pipes in order to:

1) test the operation of the control or alarm;

2) prevent the accumulation of deposits.

e) A drain system shall be provided which gives a visual indication of flow from the chambers. If tundishes are used they shall be of adequate size and they shall be placed in a prominent and safe position.

Section 6. Installation requirements

30 Boiler main stop valves

30.1 Steam boilers. The stop valve connecting the boiler to the steam delivery pipe shall be attached directly to the boiler or as near as practicable to it. In the case of a boiler with a superheater, the stop valve shall be located as near the outlet from the superheater header as is convenient and practicable.

Where two or more boilers are connected to a common header or steam manifold, the steam connection from each boiler shall be provided with one stop valve and either one globe stop and check valve capable of being locked in the closed position or a stop valve capable of being locked in the closed position and a separate check valve.

NOTE An isolating valve is necessary as the Factories Act, 1961, requires periodic thorough examination of boiler fittings and attachments and this includes the boiler stop valve. This is not possible unless the boiler under examination can be isolated from a common header or manifold.

30.2 Hot water boilers. Each boiler shall be provided with a parallel slide valve or other form of gate valve at the flow and return connections as near as practicable to the boiler. Where two or more boilers are connected to a common header or manifold, the boiler flow and return connections shall each be fitted with an additional parallel slide valve or other form of gate valve capable of being locked in the closed position to isolate the boiler. All valves on flow and return connections shall be capable of being locked in the open position at all times while the boiler is in service.

31 Boiler feedwater valves

31.1 Valves required for a single boiler. Each boiler shall be fitted with:

a) a feed water stop valve and a check valve, or

b) a globe stop and check valve.

31.2 Valves required for two or more boilers. Further to the requirements of **31.1**, where two or more boilers are supplied from a common feedwater system, each boiler shall be provided with an additional stop valve capable of being locked in the closed position.

31.3 Boiler blowdown and drain mountings

31.3.1 Each boiler shall be fitted with suitable blowdown and drain valves or cocks. Cocks shall not be used for pressures over 13 bar.

Boiler blowdown and drain valves shall be attached to the boiler by pipes as short as practicable.

31.3.2 Each valve or cock shall be fitted with an indicator to show clearly whether the valve or cock is open or closed.

31.4 Blowdown valves or cocks. Blowdown valves or cocks for shell boilers shall be placed at or as near as practicable to the lowest point of the boiler.

Blowdown valves for water tube boilers shall be placed as near as practicable to the lowest part of the steam drum.

31.5 Continuous and automatic blowdown mountings. Valves, cocks and mountings required to control the water conditions in a boiler shall be provided at appropriate positions.

31.6 Drains. Valves or cocks shall be provided to drain all parts of boilers which are not drained by blowdowns.

31.7 Safety arrangements

31.7.1 All blowdown mountings and drain valves connected directly to the boiler and discharging into the boiler blowdown system either shall be capable of being locked in the closed position or shall be protected by a second valve at their discharge which is capable of being locked in the closed position.

31.7.2 Where manually operated blowdown valves or cocks from more than one boiler discharge into a common main or vessel when a common handle or operating/interlocking device shall be provided which shall be capable of being removed only when such valves or cocks are fully closed.

31.7.3 Where more than one boiler is equipped with a continuous or automatic blowdown system leading to a common main, this common main shall be separate from and independent of any main to which manually operated valves are connected, and the discharges from the two mains shall be led to separate disposal points such that the inadvertent pressurization of the manual blowdown main cannot occur. Each such system shall be fitted with either a stop valve capable of being locked in the closed position and a check valve or a globe stop and check valve capable of being locked in the closed position. This requirement is in addition to any regulating valves or devices required to control the blowdown flow.

NOTE Attention is drawn to Section 34 of the Factories Act, 1961.

32 Water level gauges

32.1 General

32.1.1 Except in the special case of once through boilers where the fitting of water level gauges is not mandatory[8)] each steam boiler shall have at least two independent means of indicating the water level, each capable of being isolated from the boiler and both of which shall be water level gauges in which the water level can be observed, except in the following cases.

a) For boilers with any safety valve set at or above 60 bar gauge, the use of two independent manometric remote water level indicators is permitted in place of one of the water level gauges. In such cases these remote water level indicators shall have their own independent connections to the boiler.

b) For boilers of less than 145 kg/h evaporative capacity, one water level gauge is permitted.

c) The use of alternative devices, e.g. water level indicators, which have been specifically approved by the Chief Inspector of Factories is permitted in place of water level gauges in which the water level can be observed.

32.1.2 The mandatory[8)] water level gauge in which the water level can be observed shall be mounted so that the lowest water level which can be observed is at least 50 mm above the lowest water level at which there will be no danger of overheating any part of the boiler when in operation at that level. Where this is not practicable the siting of water level gauges shall be by agreement with the inspecting authority in positions which have been found by experience to indicate satisfactorily that the water content is sufficient for safety under all service conditions.

32.1.3 At least one of the water level gauges with its isolating valves or cocks shall be connected directly to the boiler and, other than a drain, no device shall be fitted to the gauge which could cause incorrect indication of the water level in the gauge.

32.1.4 In the case of horizontal return tube boilers, such as waste heat boilers economic boilers or similar, where the water level gauge connections are taken from the sides of the boilers, the lower or water end at least shall be arranged with a tee or cross connection so as to permit cleaning and proving of the pipes.

32.1.5 Where a water level gauge, safety control or alarm device is connected to the boiler by pipes, the bore of such pipes shall be not less than 25 mm. Where the chamber of a safety control or alarm device has a water level gauge fitted to it, the connecting pipes to the boiler shall have a bore of not less than 40 mm. The ends of pipes local to the fittings shall be not less than 20 mm bore for water level gauges and 25 mm bore for separate safety control and alarm devices[9)].

In order that the true level of water in the boiler, at the point of connection, is indicated accurately in the water level gauges and the water level control chambers, the water connection of these fittings shall be mounted as close as is practicable to the boiler shell or drum.

The water connections shall be on, or as near as possible to, the same horizontal plane.

33 Stuffing boxes and glands

The extent of lagging on valves shall be such that, while the fluid containing components are efficiently insulated, stuffing boxes and glands shall be kept as near ambient temperature as possible.

34 Fusible plugs

Where fusible plugs are fitted they shall be at a sufficient height and fitted in such a position as to give an early warning in the event of shortage of water to all parts of the boiler liable to damage by the direct application of furnace heat.

NOTE In the case of oil-fired and gas-fired boilers, it is recommended that low water level alarms should be fitted in preference to fusible plugs.

Fusible plugs shall be screwed into the boiler plates from the water side.

8) Mandatory in this sense refers to the need to comply with Section 34 of the Factories Act, 1961.

9) The Factories Act, 1961 Section 32 (1) and (2) requires at least one water level gauge to be fitted directly to the boiler.

Appendix A Inspection and testing facilities

A.1 Inspection facilities. The purchaser or his representative should have access, at all reasonable times, to those portions of the manufacturer's works in which the production is being carried out and in which the testing is taking place.

A.2 Testing facilities. The manufacturers should supply labour and appliances for such testing as may be carried out on his premises in accordance with this standard. Failing facilities at his own works for making the prescribed tests, the manufacturer should make arrangements for carrying out the tests elsewhere.

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Publications referred to

BS 21, *Pipe threads for tubes and fittings where pressure-tight joints are made on the threads.*

BS 759, *Valves, gauges and other safety fittings for application to boilers and to piping installations for and in connection with boilers.*

BS 759-2, *Specification for safety valves*[10)].

BS 779, *Cast iron boilers for central heating and indirect hot water supply (44 kW rating and above).*

BS 806, *Ferrous piping systems for and in connection with land boilers.*

BS 855, *Specification for welded steel boilers for central heating and indirect hot water supply (rated output 44 kW to 3 MW).*

BS 970, *Wrought steels in the form of blooms, billets, bars and forgings.*

BS 970-1, *Carbon and carbon manganese steels including free cutting steels.*

BS 1113, *Water-tube steam generating plant (including super-heaters, reheaters and steel tube economizers).*

BS 1400, *Copper alloy ingots and castings.*

BS 1452, *Specification for grey iron castings.*

BS 1503, *Specification for steel forging (including semi-finished forged products) for pressure purposes.*

BS 1504, *Specification for steel castings for pressure purposes.*

BS 1560, *Steel pipe flanges and flanged fittings for the petroleum industry.*

BS 1560-2, *Metric dimensions.*

BS 1768, *Unified precision hexagon bolts, screws and nuts (UNC and UNF threads). Normal series.*

BS 1769, *Unified black hexagon bolts, screws and nuts (UNC and UNF threads). Heavy series.*

BS 1780, *Bourdon tube pressure and vacuum gauges.*

BS 1780-2, *Metric units.*

BS 2633, *Class 1 arc welding of ferritic steel pipework for carrying fluids.*

BS 2693, *Screwed studs.*

BS 2693-1, *General purpose studs.*

BS 2708, *Unified black square and hexagon bolts, screws and nuts (UNC and UNF threads). Normal series.*

BS 2779, *Pipe threads where pressure-tight joints are not made on the threads.*

BS 2790, *Specification for shell boilers of welded construction.*

BS 3463, *Observation and gauge glasses for pressure vessels.*

BS 3692, *ISO metric precision hexagon bolts, screws and nuts.*

BS 4080, *Methods for non-destructive testing of steel castings.*

BS 4190, *ISO metric black hexagon bolts, screws and nuts.*

BS 4312, *Flanged steel screw-down stop valves and stop and check valves for general purposes.*

BS 4439, *Screwed studs for general purposes.*

BS 4504, *Flanges and bolting for pipes, valves and fittings, Metric series.*

BS 4570, *Fusion welding of steel castings.*

BS 4570-1, *Production, rectification and repair.*

BS 4882, *Bolting for flanges and pressure containing purposes.*

BS 5151, *Cast iron gate (parallel slide) valves for general purposes.*

BS 5152, *Cast iron globe and globe stop and check valves for general purposes.*

BS 5153, *Cast iron check valves for general purposes.*

BS 5154, *Copper alloy globe, globe stop and check, check and gate valves for general purposes.*

BS 5157, *Steel gate (parallel slide) valves for general purposes.*

BS 5160, *Specification for flanged steel globe valves, globe stop and check valves and lift type check valves for general purposes.*

[10)] Referred to in the foreword only.

BS 5500, *Unfired fusion welded pressure vessels.*
BS 6759, *Safety valves*[11)].
BS 6759-1, *Specification for safety valves for steam and hot water.*
ISO 4126, *Safety valves, general requirements*[11)].

[11)] Referred to in the foreword only.

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