भारतीय मानक
Indian Standard

IS 19315 : 2025

जलकल के लिए बॉल वॉल्व — विशिष्टि

Ball Valves for Water Works Purposes — Specification

ICS 91.140.60

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Sanitary Appliances and Water Fittings Sectional Committee, CED 03

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Sanitary Appliances and Water Fittings Sectional Committee had been approved by the Civil Engineering Divisional Council.

Ball valves are commonly used mechanical devices in water works to permit or prevent the flow of water through pipelines. These valves use a hollow/solid spherical closure member with a straight circular flow passageway in the centre, which supported between two seats, connected by a shaft to the operating mechanism, rotated to turn on-off the flow of water. One of the main advantages of ball valves is their ability to provide tight shutoff, which helps prevent leaks and ensures reliable operation. Additionally, ball valves are robust, easy to operate, maintain and have a low-pressure drop and high flow capacity. In water works, ball valves are often used to isolate sections of the pipeline for maintenance or repair. They are also used to turn on-off the flow of water through treatment facilities and distribution systems.

This standard aims to consider the UN SDG 6: 'Clean water and sanitation' which is one of the 17 sustainable development goals adopted by the United Nations in 2015. The use of ball valves in water works is related to SDG 6, because SDG 6 aims to ensure the availability and sustainable management of water and sanitation for all. The use of ball valves in water works helps to achieve this goal by allowing for efficient control and management of water flow, thereby ensuring safe and reliable water supply to communities.

Information to be provided by the purchaser is given in Annex B.

The composition of the Committee responsible for the formulation of this standard is given in Annex D.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’. The number of significant places retained in the rounded off value should be same as that of the specified value in this standard.

Indian Standard

BALL VALVES FOR WATER WORKS PURPOSES — SPECIFICATION

1 SCOPE

This standard lays down the requirements for material, shape, dimensions, and performance requirements of floating type ball valves for applications in water works purposes. This standard covers the ball valves manufactured from copper alloys (brass, bronze), cast steel, and stainless steel and sizes ranging from DN8 to DN150.

2 REFERENCES

The standards listed in Annex A contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of these standards.

3 TERMS AND DEFINITION

3.1 Ambient Temperature — Temperature between 10 °C to 50 °C is considered as ambient temperature.

3.2 Cold Working Pressure (CWP) — The cold working pressure rating of the valve shell and components is the maximum allowable non-shock pressure at ambient temperature. The maximum working pressure at any other temperature shall not exceed this rated pressure.

3.3 DN — An alphanumeric designation of size that is common for components used in piping system, used for reference purposes, comprising the letter DN followed by a dimensionless number indirectly related to the physical size of the bore or outside diameter of the end connection, as appropriate. For example, a valve with nominal flow bore of 100 mm shall be specified as DN100.

3.4 End-to-End Dimension — Distance between the two planes, perpendicular to the valve axis, located at the external face of the body end ports of straight type screwed end, socket end, soldering end and crimping end valves.

3.5 Face-to-Face Dimension — Distance between the two planes perpendicular to the valve axis located at the external face of the body end ports of straight type flanged end valves.

3.6 Full Bore Valve — The valve with an unobstructed opening, not smaller than the internal bore of the end connection. (*see* Fig. 4 and Fig. 5).

3.7 Operator — The device (or assembly) for opening and closing of a valve. Operator can be:

a) manual lever (*see* Fig. 1A);

b) gear box (*see* Fig. 1B); and

c) actuator (pneumatic and electric, *see* Fig. 2 and Fig. 3 respectively).

3.8 PN or Class — An alphanumeric designation for pressure-temperature rating that is common for components used in a piping system, used for reference purposes, comprising the letters 'PN' or 'Class' followed by a dimensionless whole number indirectly related to the pressure retaining capability as a function of the temperature of the component. For example, for PN rated valves, pressure rating of PN16 shall have a maximum working pressure of 1.6 MPa at ambient temperature. For Class rated valves, specified as Class 150, shall have a maximum working pressure of 1.96 MPa at ambient temperatures.

3.9 Reduce Bore Valve — The valve with a bore one size lower than the internal bore of the end connection. *See* Fig. 5A for reduced bore type valve. For example, for reduced bore DN50 the bore dimension is equal to that of full bore DN40.

3.10 Trim — The internal operating parts of the valve which are normally in contact with the service fluid (*see* Fig. 1A). The trim comprises the following:

a) Stem; and

b) Ball.

4 DESIGN

4.1 Ball Valve Construction

Ball valves shall be of full bore or reduced bore (*see* Fig. 5A) pattern and either of one piece or split construction (two piece/three piece, *see* Fig. 4) with flanged end or screwed end or socket weld end or soldering end or crimping end. (*see* Fig. 5).

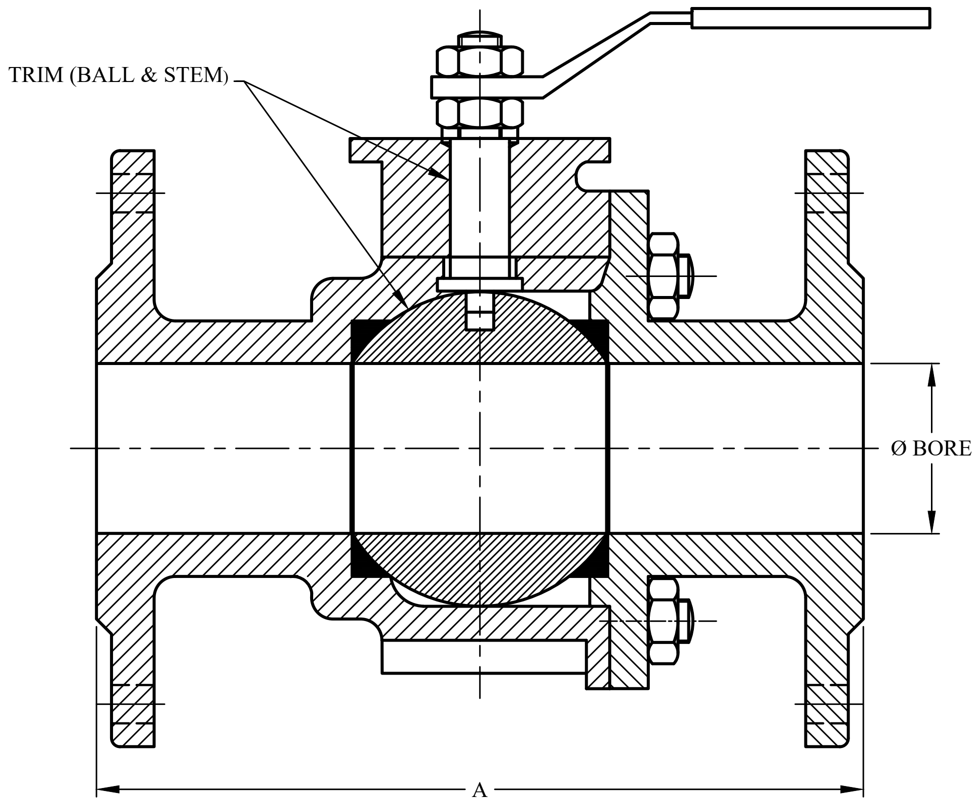


FIG. 1A MANUAL LEVER OPERATED VALVE

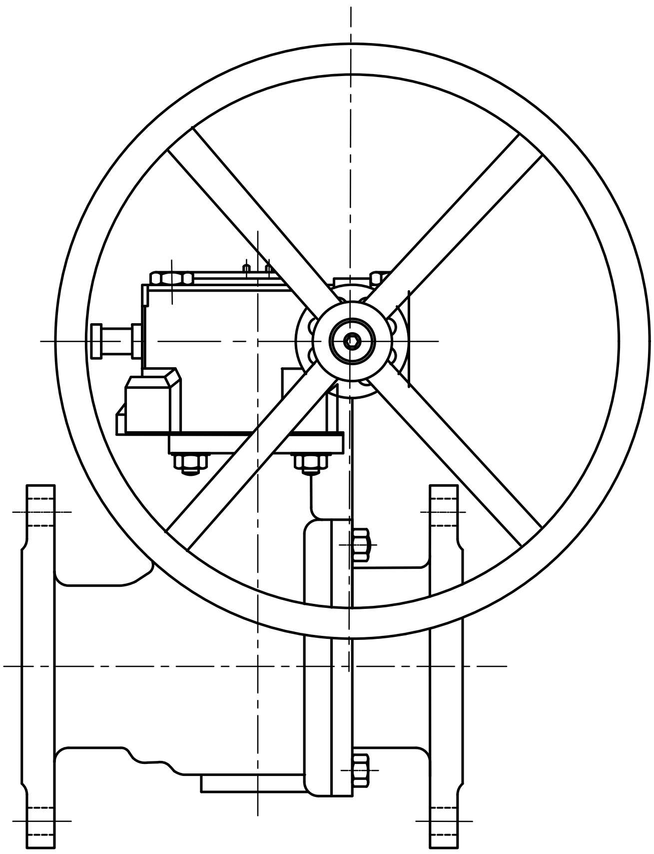


FIG. 1B GEAR OPERATED VALVE

FIG. 1 MANUAL AND GEAR OPERATED VALVE

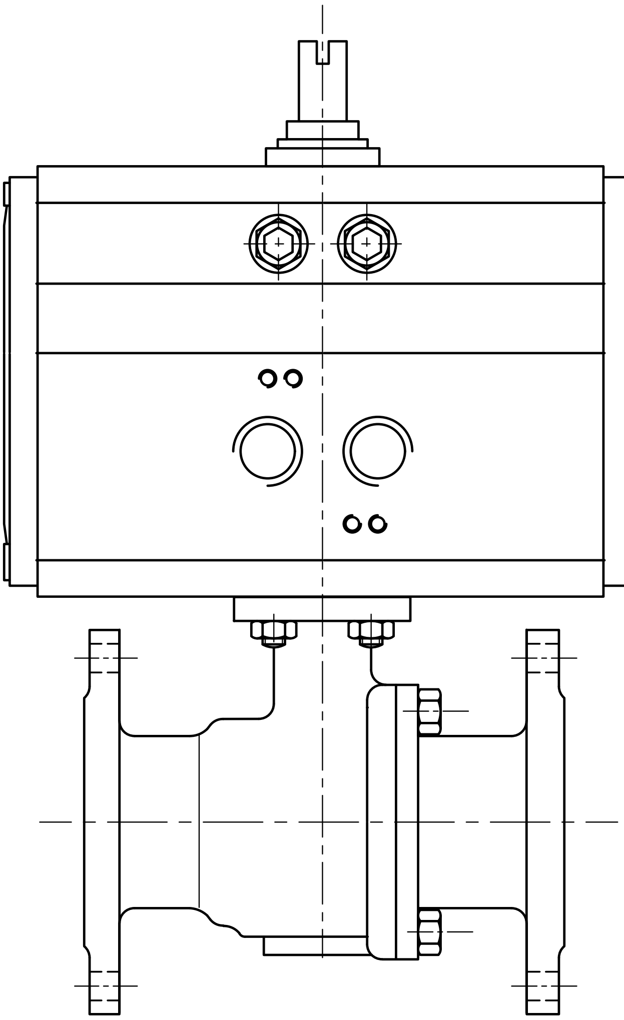


FIG. 2 PNEUMATIC ACTUATOR OPERATED VALVE

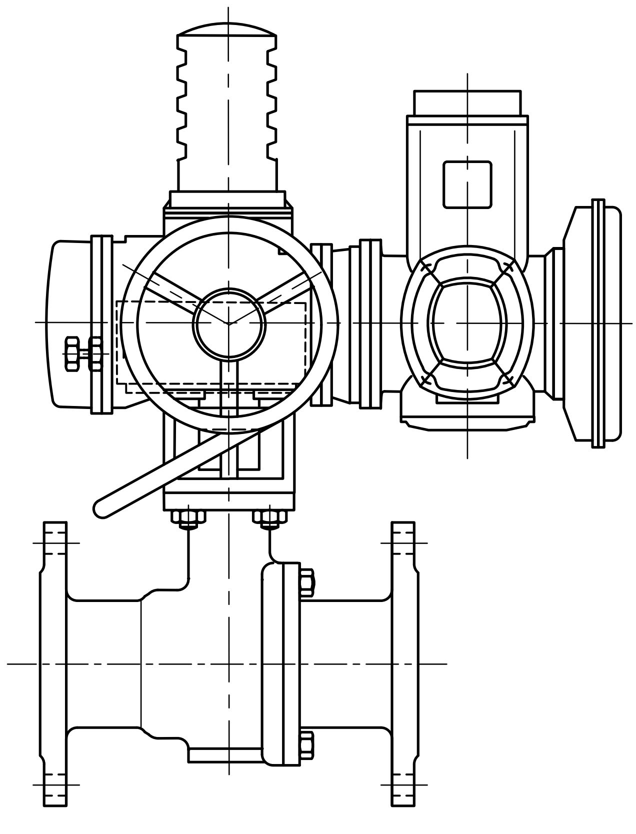


FIG. 3 ELECTRICAL ACTUATOR OPERATED VALVE

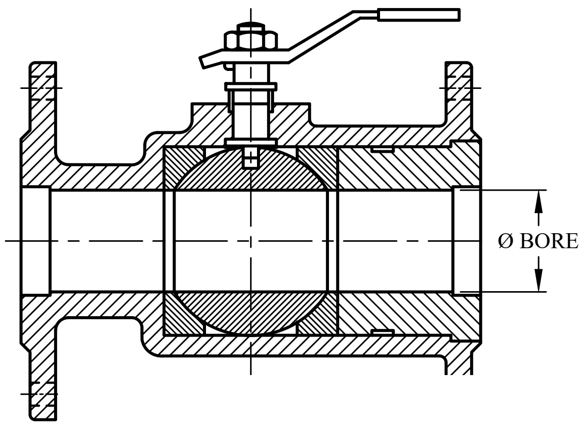


FIG. 4A ONE PIECE FLANGED ENDS CONSTRUCTION

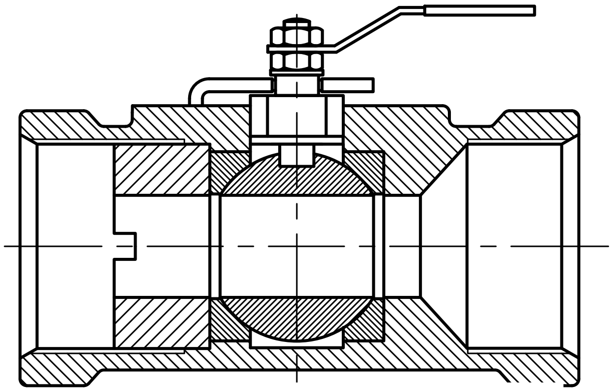


FIG. 4D ONE PIECE CONSTRUCTION

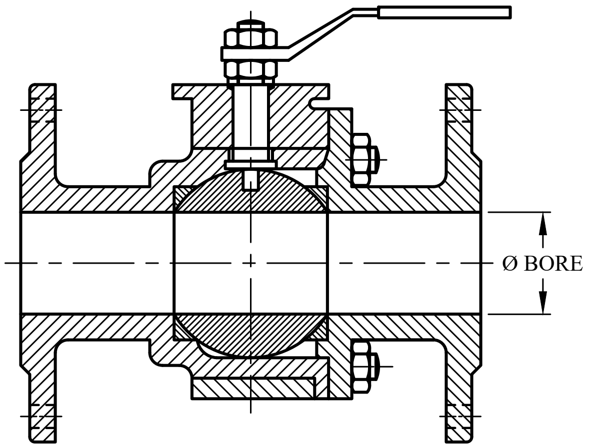


FIG. 4B TWO PIECE FLANGED ENDS CONSTRUCTION

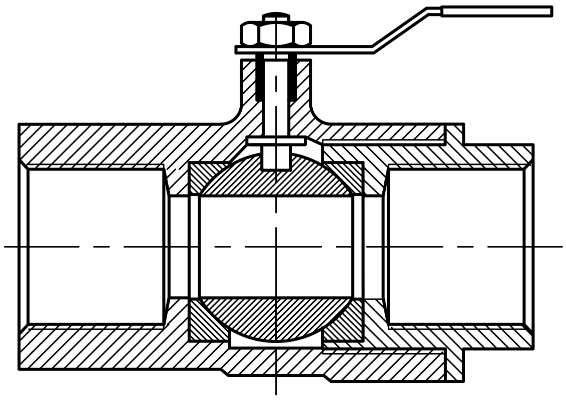


FIG. 4E TWO PIECE CONSTRUCTION

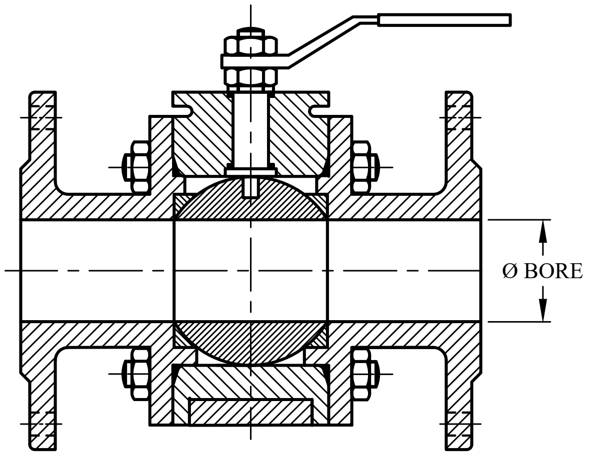


FIG. 4C THREE PIECE FLANGED ENDS CONSTRUCTION

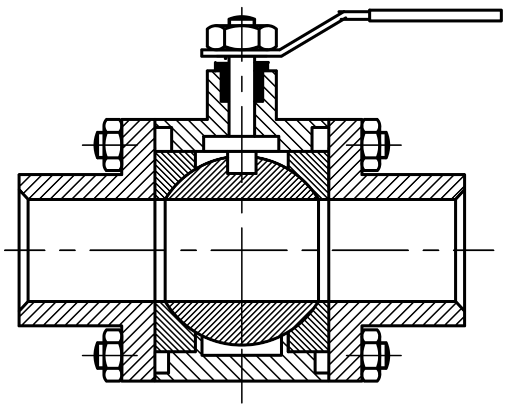


FIG. 4F THREE PIECE CONSTRUCTION

NOTE — Design details are not shown. These illustrations are not intended to limit design, or to indicate any preferred design.

FIG. 4 EXAMPLES OF VALVE CONSTRUCTION TYPES

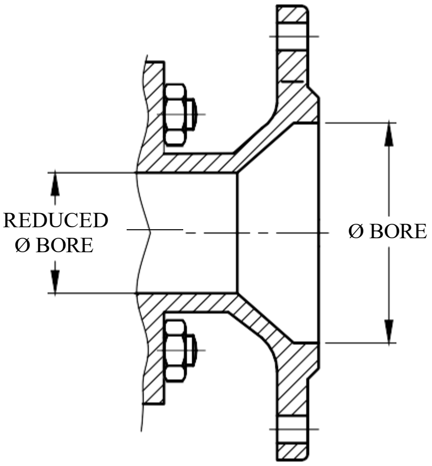


FIG. 5A REDUCED BORE, FLANGED END

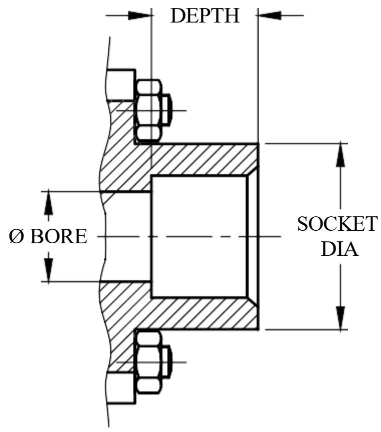


FIG. 5B SOCKET WELD END

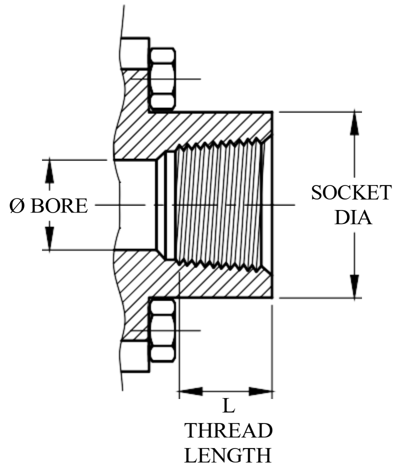
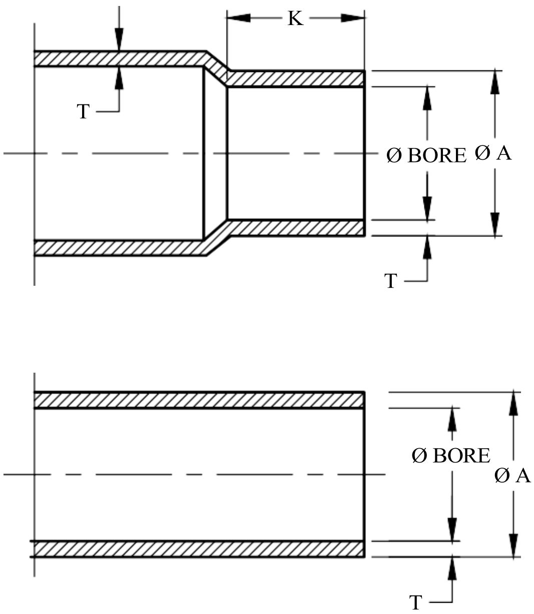
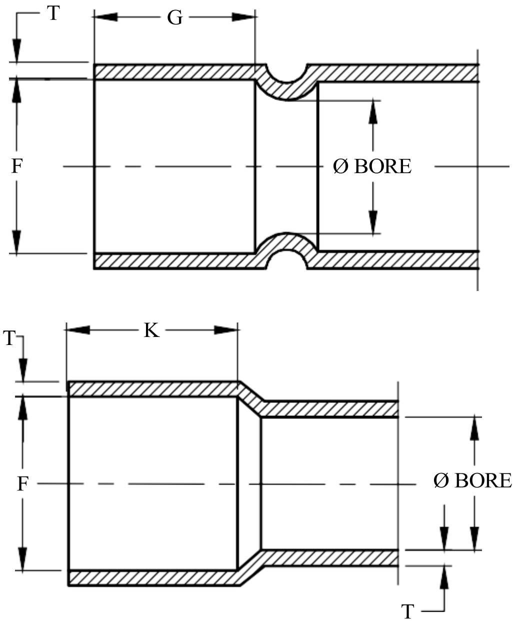


FIG. 5C SCREWED END



TYPE 1 MALE END



TYPE 2 FEMALE END

FIG. 5D SOLDER END

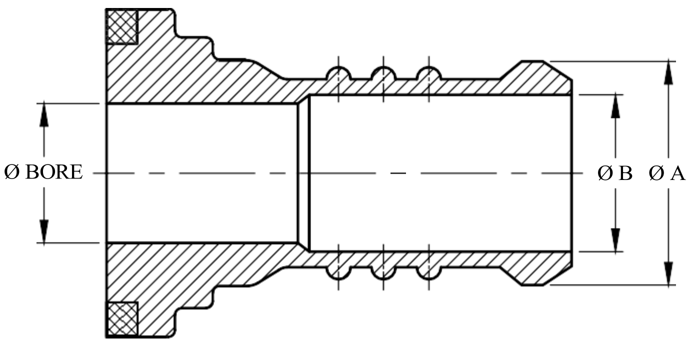


FIG. 5E CRIMPING END CONFIGURATION (TYPE 1)

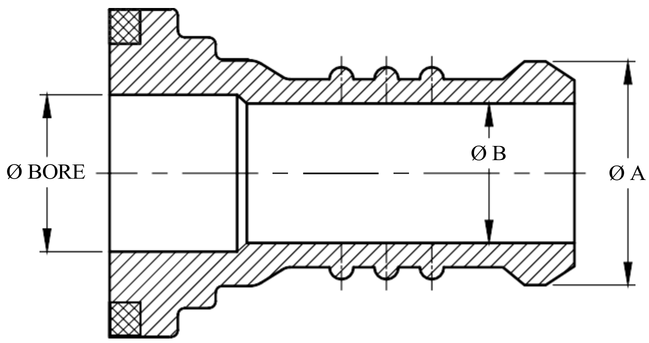


FIG. 5F CRIMPING END CONFIGURATION (TYPE 2)

FIG. 5 EXAMPLES OF VALVE END TYPES

4.2 Nominal Sizes

4.2.1 The nominal size (DN) for flanged end valve shall be 15 mm, 20 mm, 25 mm, 32 mm, 40 mm, 50 mm, 65 mm, 80 mm, 100 mm, or 150 mm.

4.2.2 The nominal size (DN) for screwed end/socket weld end/soldering end/crimping end valves shall be 8 mm, 10 mm, 15 mm, 20 mm, 25 mm, 32 mm, 40 mm, 50 mm, 65 mm, 80 mm, or 100 mm.

4.3 Rating

The ball valves covered by this standard shall be furnished in nominal pressure (PN) or classes as given in Table 1 and Table 2 respectively, at ambient temperature.

4.4 Valve Bore Dimensions

Valve bore dimensions for full bore and reduced bore shall be as given in Table 3, for different sizes of the valve.

4.5 Face-to-Face and End-to-End Dimensions

4.5.1 Unless otherwise agreed between manufacturer and purchaser face-to-face (A) dimensions of flanged end valves shall be in accordance with Table 4.

4.5.2 Tolerances on face-to-face (A) dimensions shall be ± 1.5 mm for sizes up to DN150.

4.5.3 The end-to-end dimension for screwed end, socket weld end, soldering end, and crimping end valves shall be as declared by the manufacturer.

4.6 Valve Ends

4.6.1 *Flanged End*

The flanges of valve shall be integral/welded with the body. The flanges shall be machined flat or with raised face. The dimensions of flanges shall be as per IS 6392 or IS 9523 or as agreed between manufacturer and purchaser.

4.6.2 *Socket Weld Ends for Stainless Steel Materials*

The socket bore axis shall coincide with the end entry axis. The socket end faces shall be perpendicular to the socket bore axis. The socket bore diameter and the minimum depth of socket weld ends shall be as specified in Fig. 5B and Table 5.

4.6.3 *Solder Ends for Copper Alloy Materials*

It shall be the responsibility of the user to select a solder composition as per IS 193 that is compatible with the service conditions. Inside diameter and outside diameter of the solder ends shall be as agreed between manufacturer and purchaser (*see* Fig. 5D and Table 6).

4.6.4 *Screwed Ends*

4.6.4.1 *Screwed end for copper alloy materials*

The threaded end axis shall coincide with the end entry axis. The minimum wall thickness at the threaded end and the minimum thread length shall be as specified in Table 7.

4.6.4.2 *Screwed end for stainless steel materials*

The threaded end axis shall coincide with the end entry axis. The minimum wall thickness at the threaded end shall be as specified in Table 8.

An approximate 45 degree lead in chamfer having an approximate depth of one half of the thread pitch shall be applied at each threaded end. The ends with parallel pipe threads shall meet the requirements of IS 2643. The ends with taper pipe threads shall meet the requirements of IS 554. The ends with any other pipe thread requirements shall be as agreed between the manufacturer and the purchaser.

4.6.5 *Crimping Ends for Copper Alloy materials*

The pressing together of a flexible ring to secure a watertight seal between pipe and a fitting. It shall be the responsibility of the manufacturer to size the crimping ends which is compatible with the service conditions on mutual agreement with the purchaser (*see* Fig. 5E, Fig. 5F and Table 9).

4.7 Design

4.7.1 *General*

4.7.1.1 The valve design and materials of construction shall be structurally suitable for their stated pressure ratings and temperature limits. Any additional metal thickness above the thickness necessary to contain pressure such as may be needed for assembly stresses, valve closing stresses, shapes other than circular, stress concentrations, and corrosion allowances, shall be determined by the manufacturer.

Table 1 Maximum Working Pressure for Different Pressure Ratings

(*Clause* 4.3)

Sl No.	Pressure Rating	Maximum Working Pressure MPa
(1)	(2)	(3)
i)	PN6	0.6
ii)	PN10	1.0
iii)	PN16	1.6
iv)	PN20	2.0
v)	PN25	2.5
vi)	PN30	3.0
vii)	PN40	4.0

Table 2 Maximum Working Pressure for Different Class Ratings

(*Clause* 4.3)

Sl No.	Class Rating	Maximum Working Pressure MPa
(1)	(2)	(3)
i)	Class 150	1.96
ii)	Class 300	5.17

Table 3 Minimum Bore Diameter for Valves

(*Clause* 4.4, *Table* 6 *and Table* 9)

Sl No.	DN	Minimum Bore Diameter mm	
		Full Bore	Reduced Bore
(1)	(2)	(3)	(4)
i)	8	5.0	N.A.
ii)	10	8.0	5.0
iii)	15	12.7	8.0
iv)	20	19.0	12.7
v)	25	24.0	19.0
vi)	32	30.0	24.0
vii)	40	37.0	30.0
viii)	50	44.0	37.0
ix)	65	62.0	44.0
x)	80	74.0	62.0
xi)	100	96.0	74.0
xii)	150	148.0	96.0

Table 4 Face-to-Face Dimension of Flanged End Valves

(*Clause* 4.5.1)

Sl No.	**DN, *Min*** mm	**A** mm	
		PN6-PN16/ Class 150	PN 25-PN40/ Class 300
(1)	(2)	(3)	(4)
i)	15	108	140
ii)	20	117	152
iii)	25	127	165
iv)	32	140	178
v)	40	165	190
vi)	50	178	216
vii)	65	191	241
viii)	80	203	283
ix)	100	229	305
x)	150	394	403

Table 5 Bore Diameter and Depth for Socket Weld Ends

(*Clause* 4.6.2)

Sl No.	**DN** mm	**Socket Diameter*** mm	**Depth, *Min*** mm
(1)	(2)	(3)	(4)
i)	8	14.1	9.5
ii)	10	17.5	9.5
iii)	15	21.7	10
iv)	20	27.0	13
v)	25	33.8	13
vi)	32	42.5	13
vii)	40	48.6	13
viii)	50	61.1	16

Table 6 Solder End Dimensions in mm

(*Clause* 4.6.3)

Sl No.	**Valve Size**	**Male End (Type 1)**			**Female End (Type 2)**			**Minimum Wall Thickness** T	**Inside Diameter** Ø Bore
		Outside Diameter ØA		Length K	Inside Diameter ØF		Length G		
		Min	*Max*[1)]		*Min*	*Max*[1)]			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
i)	DN8	9.47	9.55	7.0	9.58	9.68	5.5	0.58	As per Table 3 of full-bore diameter
ii)	DN10	12.62	12.73	7.0	12.75	12.85	5.5	0.66	

*The applicable diametric tolerance is 0 mm to + 0.5 mm.

[1)]Ovality of the diameter shall not exceed 1 percent of the maximum diameter.

Table 6 (*Concluded*)

Sl No.	Valve Size	Male End (Type 1)			Female End (Type 2)			Minimum Wall Thickness T	Inside Diameter Ø Bore
		Outside Diameter ØA		Length K	Inside Diameter ØF		Length G		
		Min	*Max*[1)]		*Min*	*Max*[1)]			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
iii)	DN15	15.80	15.90	9.0	15.93	16.03	7.5	0.74	As per Table 3 of full-bore diameter
iv)	DN20	22.15	22.25	10.5	22.28	22.38	9.0	0.84	
v)	DN25	28.50	28.63	13.5	28.65	28.75	12.0	1.02	
vi)	DN32	34.85	34.98	16.5	35.00	35.10	15.0	1.12	
vii)	DN40	41.17	41.33	19.5	41.35	41.48	18.0	1.30	
viii)	DN50	53.87	54.03	20.6	54.05	54.18	19.1	1.50	
ix)	DN65	66.57	66.73	21.5	66.75	66.88	20.0	1.70	
x)	DN80	79.27	79.43	21.5	79.45	79.58	20.0	1.91	
xi)	DN100	104.67	104.83	22.5	104.85	104.93	21.0	2.44	

Abbreviations:

a) Type 1 – Solder joint fitting end made to receive copper tube diameter (Male); and

b) Type 2 – Solder joint fitting end made to receive copper tube diameter (Female).

Table 7 Minimum Wall Thickness and Minimum Thread Length for Screwed Ends of Copper Alloy Materials

(*Clause* 4.6.4.1)

Sl No.	DN mm	PN16, PN20, PN30, and PN40 Class 150 and Class 300 Wall Thickness, *Min* mm	Thread Length, *Min* mm
(1)	(2)	(3)	(4)
i)	8	1.5	5.5
ii)	10	1.6	5.5
iii)	15	1.7	7.5
iv)	20	1.8	9.0
v)	25	1.9	12.0
vi)	32	2.2	15.0
vii)	40	2.5	18.0
viii)	50	3.1	19.1
ix)	80	4.0	20.0
x)	100	5.0	21.0

[1)] Ovality of the diameter shall not exceed 1 percent of the maximum diameter.

Table 8 Minimum Wall Thickness and Minimum Thread Length for Screwed Ends of Stainless Steel Materials

(*Clause* 4.6.4.2)

Sl No.	DN mm	PN6, PN10, PN16, PN25, and PN40 Class 150 and Class 300	
		Wall Thickness, *Min* mm	Thread Length, L, *Min* mm
(1)	(2)	(3)	(4)
i)	8	3.0	10.2
ii)	10	3.0	10.4
iii)	15	3.3	13.6
iv)	20	3.6	13.9
v)	25	3.8	17.3
vi)	32	3.8	18.0
vii)	40	4.1	18.4
viii)	50	4.6	19.2

Table 9 Crimping End Dimensions in mm

(*Clause* 4.6.5)

Sl No.	Valve Size	Outside Diameter, Average		Maximum Crimping End Diameter	Figure 6 Type	Valve Bore
		ØA	Tolerance (±)	ØB		Ø Bore
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	DN8	9.52	0.08	6.38	E-1	As per Table 3 of full-bore diameter
ii)	DN10	12.70	0.08	9.14	E-1	
iii)	DN15	15.88	0.10	12.32	E-2	
iv)	DN20	22.22	0.10	17.28	E-2	
v)	DN25	25.58	0.12	19.22	E-2	
vi)	DN32	34.92	0.12	27.16	E-2	
vii)	DN40	41.28	0.16	32.14	E-2	
viii)	DN50	53.98	0.16	41.98	E-2	
ix)	DN65	66.68	0.18	51.86	E-2	
x)	DN80	79.38	0.20	61.74	E-2	
xi)	DN100	104.78	0.23	81.50	E-2	

4.7.1.2 *Body shell thickness for copper alloy materials*

The minimum wall thickness of forged copper alloys is the manufacturer's design which shall bestructurally suitable for their pressure and temperature limits.

4.7.1.3 Joints

The design of the valve shall be such as to provide against detrimental distortion under hydrostatic test conditions, assembly stresses, closing stresses, pipe reaction stresses, or when rated pressure is applied across a closed valve.

4.7.1.4 Bolting shall be threaded in accordance with the design calculations.

4.7.1.5 End connections

a) Flanged ends shall be in accordance with IS 6392 for steel or as agreed between the manufacturer and purchaser;
b) Threaded pipe ends shall have taper pipe threads in accordance with IS 554 or as agreed between the manufacturer and purchaser;
c) Socket dimensions of socket welding ends shall be in accordance with IS 1239 (Part 2) or as agreed between the manufacturer and purchaser;
d) Solder end dimensions of solder joint ends shall be made by agreement between manufacturer and purchaser; and
e) Crimping end dimensions shall be made by agreement between manufacturer and purchaser.

4.7.1.6 Stems

To prevent removal of the stem while the valve is pressurized, the valve shall be designed so that the stem seal retainer assembly (gland) alone does not retain the stem.

4.7.1.7In those cases where service conditions requireelectrical continuity between the ball and stem and stem and body, the purchaser shall so specify.

4.7.1.8 Stem packing

The valve shall have provisions for the adjustment of a gland or packing nut in order to obtain a seal at the stem packing. The exception is for valves with elastomeric stem seals, where adjustment is not possible.

4.7.1.9 Corrosion resistant coating

On manufacturer and purchaser agreement based on the application requirements.

4.7.2Body Shell Thickness for Steel Valves

Theminimum body wall thickness for cast steel valves; t_m shall be as specified in Table 10. Local areashaving less than minimum wall thickness are acceptable provided that all the following conditions are satisfied:

a) The area sub-minimum thickness can be enclosed by a circle, the diameter of which is not greater than $0.35\sqrt{dt_m}$, where d is the minimum bore diameter and t_m is the minimum thickness;
b) The measured thickness is not less than $0.75t_m$; and
c) Enclosed circles are separated from each other by an ~~edge~~-to-edge distance not less than $1.75\sqrt{dt_m}$.

Table 10 Minimum Body Wall Thickness for Steel Valve, t_m, mm

(***Clause*** 4.7.2)

Sl No.	*DN*	*Up to PN16 Class 150*		*PN25 and PN40 Class 300*	
		Full Bore	Reduced Bore	Full Bore	Reduced Bore
(1)	(2)	(3)	(4)	(5)	(6)
i)	8	3.1	N.A.	3.3	N.A.
ii)	10	3.2	3.1	3.3	3.3
iii)	15	3.2	3.2	3.5	3.4
iv)	20	3.3	3.3	3.7	3.6
v)	25	4.4	3.9	4.8	4.2
vi)	32	4.5	4.5	5.1	4.9
vii)	40	4.7	4.6	5.3	5.2

Table 10 (*Concluded*)

Sl No.	DN	Up to PN16 Class 150		PN25 and PN40 Class 300	
		Full Bore	Reduced Bore	Full Bore	Reduced Bore
(1)	(2)	(3)	(4)	(5)	(6)
viii)	50	5.3	5.0	6.0	5.7
ix)	65	5.6	5.4	6.5	6.3
x)	80	5.8	5.7	7.0	6.8
xi)	100	6.3	6.1	7.7	7.4
xii)	150	7.1	6.9	9.3	8.9

4.7.3 *Body Shell Thickness*

4.7.3.1 The minimum body wall thickness for cast steel valves; t_m shall be as per below formula:

$$t_m = \frac{1.5P_cD_i}{(2S) - (1.2P_c)} + c$$

where

t_m = minimum, in mm, wall thickness;

P_c = design, in MPa, pressure;

D_i = inside, in mm, diameter;

S = stress factor, in MPa, (S = 120.7 MPa for cast steel);
Refer Table 12 for other applicable materials.

c = a constant, in mm, to compensate for corrosion.

4.7.3.2 The values of the design pressure, P_c shall be as follows:

Sl No.	*Designation*	*Pressure, P_c* MPa
(1)	(2)	(3)
i)	PN6	0.76
ii)	PN10	1.21
iii)	PN16	1.93
iv)	PN25	3.02
v)	PN40	4.83
vi)	Class 150	2.59
vii)	Class 300	5.17

4.7.3.3 The values of constant, c (in mm), used to calculate tabulated minimal thickness, shall be as follows:

Sl No.	*Designation*	*PN6*	*PN10*	*PN16*	*PN25*	*PN40*	*Class* 150	*Class* 300
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
i)	c for D_i 3 mm to 24 mm	3	3	3	3	3	3	3
ii)	c for D_i 25 mm to 49 mm	4	4	4	4	4	4	4
iii)	c for D_i 50 mm to 100 mm	4.5	4.5	4.5	4.4	4.4	4.5	4.4
iv)	c for D_i 101 mm to 1 300 mm	4.7	4.7	4.7	4.4	4.4	4.7	4.4

4.7.4 *Bolted Body Joint*

The minimum body joint bolt load shall be as per below formula:

$$P_c \frac{A_g}{A_b} \leq K_2 S_a \leq 7\,000$$

where

- P_c = pressure rating class designation;
- A_g = area bounded by the effective outside periphery of a body gasket;
- K_2 = 50.76 /MPa;
- S_a = expressed in MPa, when greater than 137.9 MPa, use 137.9 MPa; and
- A_b = total effective bolt tensile stress area.

4.7.5 *Bolted Bonnet or Cover Joint*

The minimum body joint bolt load shall be as per below formula:

$$P_c \frac{A_g}{A_b} \leq K_1 S_a \leq 9\,000$$

where

- P_c = pressure rating class designation;
- A_g = area bounded by the effective outside periphery of a body gasket;
- K_1 = 65.26/MPa; and
- S_a = expressed, in MPa, when greater than 137.9 MPa, use 137.9 MPa; and
- A_b = total effective bolt tensile stress area.

5 VALVE OPERATION

5.1 The ball valves shall be designed for direct operation by lever or wrench or by gear box, and actuator.

5.2 The maximum force required at the handle wheel or wrench to apply the breakaway torque or thrust shall not exceed 360 N.

5.3 Wrenches that are integral design shall not be longer than twice the face-to-face dimensions for flanged end valves.

5.4 Manually operated valves shall close by turning the lever or wrench in a clockwise direction when viewed from top of the operating shaft. Lever shall mark 'CLOSE' or 'OPEN' with an arrow to indicate the direction (*see* Fig. 6). Alternatively, this marking may be shown on a plate secured below the lever nut.

5.5 Wrenches shall be designed so that they are parallel to the flow passage of ball. These shall be supplied as separate items and only when specified by the customer. When wrench is used it shall be marked with direction of shut and open on the wrench. The wrench shall be covered with sleeve of poly vinyl chloride (PVC). In any case the sleeve shall be marked with shut and open and arrow showing the direction for the position and wrench shall be fitted in such a way that it held securely, they may be removed and replaced when necessary.

5.6 Suitable stops shall be provided for both fully open and fully closed positions of valves.

5.7 If chains wheel or gear operation is required, it shall be specified in order, which shall also specify any chain to be supplied or type of gearing.

5.8 If actuators are used for the operation of valves, the details of the valve operating the actuator, its power supply together with the design pressure, and the pressure differential across the valve shall be specified in the purchase order.

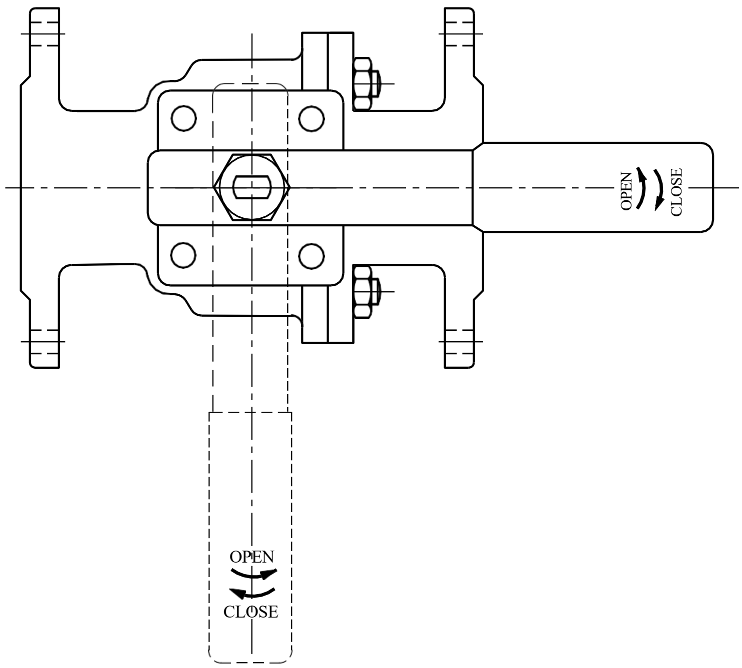


FIG. 6 HAND LEVER OPEN-CLOSE DIRECTION MARKING

6 MATERIALS OF CONSTRUCTION

Different materials used in the manufacturing of ball valves shall conform to the requirements as given in Table 11.

The manufacturer shall procure and maintain records of the certificate for the raw material testing from the raw material supplier.

Table 11 Requirements for Material of Construction of Ball Valves

(*Clause* 6)

Sl No.	Component	Material	Referred IS Grade
(1)	(2)	(3)	(4)
i)	Body and connectors	Forged brass – Low lead	IS 6912 FLB IS 6912 FMnB IS 6912 FHTB1 IS 6912 FHTB2 IS 6912 FNS
		Forged brass – Lead free	IS 6912 FNB IS 6912 FHTB3 IS 6912 FHTB4 IS 6912 FHTB5
		Brass – Gravity die casing	IS 1264 DCB-2
		Leaded tin bronze casting	IS 318 LTB-2
		Stainless steel bars	IS 6603 X12Cr12 Grade SS-304,316
		Cast steel	IS 1030
		Spheroidal graphite iron casting	IS 1865
ii)	Ball	Stainless steel or brass	12 Cr 12 of IS 6603 IS 6912 FLB IS 6912 FMnB IS 6912 FHTB1 IS 6912 FHTB1 IS 6912 FNS IS 319 Grade 1 IS 6912 FNB IS 6912 FHTB3 IS 6912 FHTB4 IS 6912 FHTB5 SS304/SS316 equivalent bar form
iii)	Stem	Stainless steel or brass	12 Cr 12 of IS 6603 304/316 or FLB of IS 6912
		Forged brass	IS 1264 DCB-2 IS 6912 FLB IS 6912 FMnB IS 6912 FHTB1 IS 6912 FHTB1 IS 6912 FNS IS 319 Grade 1 IS 6912 FNB IS 6912 FHTB3 IS 6912 FHTB4 IS 6912 FHTB5
		Extruded brass	IS 319 Grade-I or Grade-II (half hard)
iv)	Seat	PTFE/GFT/CFT	—
v)	Gland nut	Carbon steel	C-45 of IS 1570

Table 11 (*Concluded*)

Sl No.	Component	Material	Referred IS Grade
(1)	(2)	(3)	(4)
		Leaded-tin bronze	LTB-2 of IS 318
		Brass	IS 6912 FLB IS 6912 FMnB IS 6912 FHTB1 IS 6912 FHTB1 IS 6912 FNS IS 319 Grade 1 IS 6912 FNB IS 6912 FHTB3 IS 6912 FHTB4 IS 6912 FHTB5
		Stainless steel	12Cr12 IS 6603
vi)	Gland packing	PTFE/graphite	–
vii)	Thrust washer	GFT	–
		PTFE	–
viii)	Bolting nut	Carbon steel	IS 1570 (Part 2) C45 or SS 304
ix)	'O' ring	Viton/EPDM/Nitrile	
x)	Handle	Carbon steel (with suitable corrosion preventive coatings)	IS 2062 Grade B SS304 IS 513 (Part 2)
		Aluminium	IS 617
xi)	Handle sleeve	PVC	–
xii)	Stem nut	Carbon steel	IS1570 C-45
		Stainless steel	12Cr12 of IS 6603
		Leaded-tin bronze	LTB-2 of IS 318
		Brass	FLB of IS 6912

Table 12 Stress Factors for Body Shell Materials

(*Clause* 4.7.3.1)

Sl No.	Referred IS Grade	Allowable Stress MPa	Material	Application
(1)	(2)	(3)	(4)	(5)
i)	IS 6912 FLB	62	Forged brass – low lead	Screwed ends, soldering ends, crimping ends, body shell
ii)	IS 6912 FMnB	79		
iii)	IS 6912 FHTB1	120		
iv)	IS 6912 FHTB2	120		
v)	IS 6912 FNS	92		
vi)	IS 6912 FNB	68	Forged brass – lead free	
vii)	IS 6912 FHTB3	217		
viii)	IS 6912 FHTB4	200		

Table 12 (*Concluded*)

Sl No.	Referred IS Grade	Allowable Stress MPa	Material	Application
(1)	(2)	(3)	(4)	(5)
ix)	IS 6912 FHTB5	267		
x)	IS 318 LTB-2	67	Leaded tin bronze castings	
xi)	IS 6603 X12Cr12 Grade	246	Stainless steel bars	Screwed ends, crimping ends
xii)	IS 6603 X04Cr19Ni9 (SS 304)	163		
xiii)	IS 6603 X04Cr17Ni12M02 (SS 316)	163		
xiv)	IS 1030 Gr.230-450W	153	Cast steel	Flanged ends, body shell
xv)	IS 1865 400/15	68.5	SGI casting	
xvi)	IS 1865 400/18	68.5		
xvii)	IS 1865 500/7	72.5		

NOTE — Where the requirements for the material of any component or the relevant Indian Standard designation for any material are not specified, these shall be as agreed between the manufacturer and the purchaser.

7 PERFORMANCE REQUIREMENTS

7.1 The valve shall be tested and shall meet the performance requirements as specified in 7.2 and 7.3.

7.2 Pressure Tests for Steel Valves

The pressure tests indicated in this standard shall be carried out on each valve. Each valve shall be given a shell pressure test and a seat closure test as per 7.2.1 and 7.2.2, respectively. Sealing compounds, greases, or oils shall be removed from seating surfaces prior to pressure testing. It is permissible, however, for a film of oil that is not heavier than kerosene to be applied to prevent metal-to-metal sealing surfaces from galling.

7.2.1 *Shell Test* (*HYD*)

The hydrostatic test for the shell of the valve shall be carried out at a gauge pressure not less than 1.5 times the pressure rating at ambient temperature rounded off to the next higher 1 bar increment, for the duration as mentioned in Table 13. During these tests, the ball is in the half-open position to assure full pressurization of the valve shell. Visually detectable leakage through pressure boundary walls is not acceptable. There shall be no harmful inelastic deformation during or after tests. Leakage from packing shall not be cause for rejection; it shall be demonstrated that the packing will not leak at the rated working pressure of the valve. The test fluid shall be as per 7.4.

7.2.2 *Closure Test* (*HYD*)

The closure tightness test shall be a liquid test with the test fluid at a pressure not less than 1.1 times the rated pressure at ambient temperature for the duration as mentioned in Table 13, ball to be closed for test and one end of the valve shall be opened in air. Over the duration of the closure test, the maximum permitted leakage rate past the seats shall be zero leakage. The test fluid shall be as per 7.4.

7.2.3 *Closure Test* (*Gas*)

7.2.3.1 Valves shall be subjected to an air seat test at shall be 0.6 MPa ± 0.1 MPa. Over the duration of the closure test as mentioned in Table 13, the maximum permitted leakage rate past the seats shall be zero leakage. The test fluid shall be as per 7.4.

7.2.3.2 The applicable closure test of 7.2.2 and 7.2.3 shall be applied in one flow direction at a time for each seating direction. Over the duration of the gas closure test, the maximum permitted leakage rate past the seats shall be zero leakage.

7.2.3.3 For the purposes of the closure test (gas), zero leakage is defined as 3 mm^3 (1 bubble) over the duration of the test.

7.2.4 *Test Duration*

The test duration shall confirm to the requirements given in Table 13. Test duration starts once the valve leakage rate is stabilized.

Table 13 Minimum Duration for Pressure Tests

(*Clauses* 7.2.1, 7.2.2, 7.2.3 *and* 7.2.4)

Sl No.	Valve Size	Minimum Test Duration s	
		Shell	Closure
(1)	(2)	(3)	(4)
i)	DN ≤ 50	15	15
ii)	65 ≤ DN ≤ 150	60	60

7.3 Pressure Tests for Copper Alloy Valves

7.3.1 *Shell Test*

7.3.1.1 Each valve, except as noted in **7.3.1.2** and **7.3.1.3**, shall be given a shell test, at a pressure of 1.5 times the CWP, and rounded off to the next higher 0.1 MPa. The test fluid shall be air, gas, water, or liquids with a viscosity no greater than that of water. The test fluid temperature shall be at ambient temperature. The duration of the test shall be as given in Table 14.

7.3.1.2 For valves having CWP no greater than 6.9 MPa, the manufacturer may, as a substitute for the test specified in **7.3.1.1** test each valve using gas at a minimum pressure of 0.6 MPa for a duration of not less than as given in Table 14. In order to exercise this option, the manufacturer must be able to certify that a production sample of the valve model so tested has been subjected to a hydrostatic shell test of at least 2.5 times CWP with no detrimental distortion as evidenced by a subsequent seat test.

The manufacturer shall sample production lots as per Annex C.

7.3.1.3 The ball shall be in such a position during the shell test as to assure full pressurization of the valve shell.

7.3.1.4 When tested with a liquid, the valve exterior shall show no visible leakage. When tested with gas, the valve shall show no visible leakage when immersed in water or any other non-corrosive solution.

7.3.1.5 Visually detectable leakage through pressure boundary walls is not acceptable. Leakage through adjustable stem packing during testing shall not be the cause for rejection. The stem packing or stem seals shall be capable of retaining pressure at least equal to the rated cold working pressure of the valve without visible leakage.

7.3.1.6 When volumetric loss testing devices are used the valve manufacturer shall be able to demonstrate that the leakage sensitivity of the device produces results that are equivalent to those which are acceptable when visual examination methods are employed.

7.3.2 *Closure Test*

7.3.2.1 Following the shell test, each valve shall be given a closure seat test. At the manufacturer's option, this test may be either a hydrostatic closure test at a pressure no less than 1.1 times of the closure pressure rating or an air closure test at a minimum pressure of 0.6 MPa. The duration of the test shall be as set forth in Table 14.

Table 14 Seat/Shell Test Duration (Visual Test Methods)

(*Clauses* 7.3.1.1, 7.3.1.2 *and* 7.3.2.1)

Sl No.	Seat/Shell Test Duration[a)] (*Min*) s		
	Air	Hydrostatic	
	Valve Size (DN)	Valve Size (DN)	
	8 to150	8 to 50	5 to 100
(1)	(2)	(3)	(4)
i)	5	15	60

[a)] Time duration is period of inspection after valve is fully prepared and under shell test pressure.

7.3.2.2 The test pressure shall be applied successively on each side of the closed valve. As an alternate method for the 0.6 MPa minimum air test, the pressure may be applied inside the body cavity with the ball closed and both sides open for inspection. The method of seat leakage testing on each seat shall result in a filled or pressurized cavity between the seats to assure that no seat leakage can escape detection because of gradual and incomplete pressurization or filling of the cavity during the test duration.

7.3.2.3 Valves marked as one-way valves require a closure test only in the direction of the flow.

7.3.2.4 There shall be no visible leakage past the seat for the duration of the test for valves with resilient (polymeric or elastomeric) seats.

7.3.2.5 The term 'no visible leakage' applied to a hydrostatic test liquid is defined as a leak rate that will produce no visible weeping or formation of drops at the test pressure and for the duration of the test.

7.3.2.6 The term 'no visible leakage' applied to air or gas testing is defined as a leak rate that will produce no visible formation of bubbles in a water immersion test or after the application of a leak detection fluid at the test pressure and for the duration of the test. (This is equivalent to term 'zero leakage' specified in **7.2.3.3**).

7.3.2.7 For automatic leak detection methods, this definition shall be considered equivalent to a leak rate no greater than 6.7×10^{-4} ml/s with a pressure differential of 0.6 MPa to 0.7 MPa (5.5 to 6.9 bar) for application to valves DN150 and smaller.

7.3.2.8 The maximum allowable leakage rate on each seat of non-resilient seated, except metal-seated, valves for the duration of the test shall be 2.23×10^{-3} of a standard cubic meter of air per hour per mm of nominal valve size, or a maximum of 7.87×10^{-6} cubic meters of hydrostatic media per hour per mm of nominal valve size, at the test pressure specified in **7.2.1**.

7.3.2.9 When volumetric loss testing devices are used, the valve manufacturer shall demonstrate that the leakage sensitivity of the device produces results that are equivalent to or better than those which are acceptable when visual examination methods showing no leakage are employed.

7.4 Test Fluid

7.4.1 Hydrostatic tests shall be carried out with water at ambient temperature containing water soluble oil or suitable rust inhibitor. The use of any other liquid is subject to agreement between the manufacturer and purchaser. And the viscosity of the same shall in no case be greater than that of water.

7.4.2 The fluid for pneumatic tests shall be either air or inert gas. Air when used shall be free from oil as much as possible.

7.5 Test Gauges

7.5.1 The gauges used for pressure testing shall be calibrated at intervals not exceeding six months by an independent competent authority if the manufacturer does not have such facilities. The results shall be recorded and shall be liable to inspection and verification by the purchaser's representative for acceptance as and when required.

7.5.2 In all the pressure tests, the test pressure shall be measured for the stated duration without continuous use of any input to pressure build-up by mechanical or other means.

8 SAMPLING AND TESTING

8.1 The sampling procedure and criteria for conformity of a lot to the requirements of this specification shall be as specified in Annex C.

8.2 Factory Production Control

8.2.1 The manufacturer shall establish and document a factory production control system consisting of procedures for the internal control of production to ensure that the final products comply with the requirements of the present standard.

8.2.2 The manufacturer shall verify the specifications of incoming raw materials and components.

8.2.3 The relevant features of the ball valve and production process shall be defined by giving the frequency of the inspection checks and tests, together with the criteria required for the controlling and manufacturing processes in accordance with the requirements of this standard. The factory production control system shall specify the action to be taken when the control values or criteria specified are not met. Measuring equipment shall be verified and the procedure, frequency and criteria documented.

8.2.4 The stock control of finished products, together with procedures for dealing with non-conforming products, shall be documented.

9 PACKAGING

9.1 After inspection and before dispatch, valves shall be thoroughly dried and cleaned.

9.2 The painting/plating of the finished valves shall be at the option of the manufacturer, unless otherwise specified by the purchaser.

9.3 Valves shall be prepared for dispatch in such a way as to minimize the possibility of damage to inside or outside parts during storage or in transit. Openings shall be closed by suitable means to exclude dirt and other foreign matter from the interior of the valves.

9.4 Lever or wrench of valves above 50 mm size may be removed from the valves and packed along with the valve secured by cord or wire.

10 MARKING

10.1 Legibility

Each valve manufactured in accordance with this Indian Standard shall be clearly marked in accordance with IS 9866 except that the requirements of the 10.2 and 10.3 shall apply.

10.2 Body Marking

10.2.1 The mandatory valve body markings subject to the provisions shall be as follows:

a) Manufacturer's name or trademark;

b) Body material;

c) Pressure rating as PN followed by the appropriate pressure number (for example, PN 16 for PN-designated valves) or pressure Class number (for example, Class 150 for Class designated valves); and

d) Nominal size, as either DN, followed by the appropriate size number (for example, DN 100).

10.2.2 For valves smaller than DN 50, if the size or shape of the valve body precludes the inclusion of all the required markings, one or more may be omitted provided that they are shown on the name plate. The sequence of omission shall be as follows:

a) Nominal size;

b) PN designation or Class number; and

c) Body material.

10.3 Identification Plate

10.3.1 Each valve shall have an identification plate with the following marking, if the information cannot be accommodated on the valve body:

a) Manufacturer's name;

b) pressure rating designation, PN or Class;

c) Manufacturer's identification number;

d) Maximum pressure at 38 °C;

e) Limiting temperature and associated pressure, if applicable;

f) Limiting differential pressure and associated temperature, if applicable;

g) Trim identification (for example, 316SS);

h) Seat and seal material (for example, PTFE/graphite); and

j) Pipe thread identification, NPT, or Rc.

10.3.2 The material of the identification plate(s) shall be austenitic stainless steel or nickel alloy. Identification plate shall be attached to the valve body by welding or by pins made from the same materials allowed for the name plate. Other methods of attachment are acceptable only by agreement with the purchaser.

10.3.3 Any additional marking required may be as agreed to between the purchaser and the manufacturer.

10.4 BIS Certification Marking

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed thereunder, and the products may be marked with the Standard Mark.

ANNEX A

(*Clause* 2)

LIST OF REFERRED STANDARDS

IS No.	*Title*
IS 193 : 2024/ ISO 9453 : 2020	Soft solder alloys — Chemical compositions and forms — Specification (*sixth revision*)
IS 318 : 1981	Specification for leaded tin bronze ingots and castings (*second revision*)
IS 319 : 2007	Free cutting brass bars, rods, and section — Specification (*fifth revision*)
IS 513 (Part 2) : 2016	Cold reduced carbon steel sheet and strip: Part 2 High tensile and multi-phase steel (*sixth revision*)
IS 554 : 1999/ ISO 7-1 : 1994	Pipe threads where pressure — Tight joints are made on the threads — Dimensions, tolerances and designation (*fourth revision*)
IS 1030 : 1998	Carbon steel castings for general engineering purposes — Specification (*fifth revision*)
IS 1239 (Part 2) : 2011	Steel tubes, tubulars and other steel fittings — Specification: Part 2 steel pipe fittings (*fifth revision*)
IS 1264 : 1997	Brass gravity die castings — Specification (*fourth revision*)
IS 1570 (Part 2) : 1979	Schedules for wrought steels: Part 2 Carbon steels (unalloyed steels) (*first revision*)
IS 1865 : 1991	Iron castings with spheroidal or nodular graphite — Specification (*third revision*)
IS 2062 : 2011	Hot rolled medium and high tensile structural steel — Specification (*seventh revision*)
IS 2643 : 2005	Pipe threads where pressure — Tight joints are not made on the threads — Dimensions, tolerances and designation (*third revision*)
IS 6392 : 2020	Steel pipe flanges — Specification (*fifth revision*)
IS 6603 : 2024	Stainless steel semi-finished products, bars, wire rods and bright bars — Specification (*second revision*)
IS 6912 : 2005	Copper and copper alloys forging stock and forging — Specification (*second revision*)
IS 9523 : 2000	Ductile iron fittings for pressure pipes for water, gas and sewage — Specification (*first revision*)
IS 9866 : 2025	Marking system for valves (*first revision*)

ANNEX B

(*Foreword*)

INFORMATION TO BE GIVEN BY PURCHASER

B-1 The following information is to be given by the purchaser in an enquiry or order:

a) Pattern of the valve;

b) Nominal size DN (**3.3**);

c) Reduced bore or full-bore type;

d) Nominal pressure-class designation (**3.8**), and service temp;

e) Flanged ends, including facing;

f) Screwed ends, state whether a specified thread form is required (taper or parallel);

g) Gear operation, if required, including type and arrangement;

h) Power operation, if required, Including power supply and maximum design differential pressure across the valve ;

j) Any preference for materials; and

k) State whether any of the following is required:

i) Drain connection;

ii) Inspection is required by buyer;

iii) Test certificate and number of copies; and

iv) Painting.

m) Any other test as specified in **7**, if required, specify the requirements, and also specify if the inspection required would be done by the purchaser or his representative.

ANNEX C

(*Clauses* 7.3.1.2 *and* 8.1)

SAMPLING AND CRITERIA FOR CONFORMITY

C-1 SCALE OF SAMPLING

C-1.1 Lot

In any consignment, all the ball valves made of the same material of the same nominal size, of the same type and class and from the same batch of manufacture shall be grouped together to constitute a lot.

C-1.2 For ascertaining the conformity of material in the lot to the requirements of this specification, samples shall be tested from each lot separately.

C-1.3 The number of valves to be selected from the lot shall depend on the size of the lot and shall be according to Table 15.

These valves shall be selected at random from the lot. In order to ensure the randomness of the selection, procedures given in IS 4905 may be followed.

C-2 NUMBER OF TESTS AND CRITERIA FOR CONFORMITY

C-2.1 All the valves selected according to **C-1.3** shall be examined for material, design and manufacture and dimensions. Sample valves failing to satisfy one or more of these requirements shall be considered as defective.

C-2.1.1 The lot shall be considered to have satisfied these requirements if the number of the defective valves found in the sample is less than or equal to the corresponding acceptance number given in col (4) of Table 15.

C-3 TEST CERTIFICATES

If specified by the purchaser, test certificate confirming that the valves have been tested in accordance with the standard and stating the actual pressure and medium used in the tests shall be furnished by the manufacturer.

Table 15 Scales of Sampling and Criteria for Conformity

(*Clauses* C-1.3 *and* C-2.1.1)

Sl No.	No. of Valves in the Lot	Sample Size	Acceptance Number	Sub-Sample Size
(1)	(2)	(3)	(4)	(5)
i)	Up to 150	8	0	3
ii)	151 to 300	13	0	5
iii)	301 to 500	20	1	8
iv)	501 to 1 000	32	2	13
v)	1 001 to 3 000	50	3	20
vi)	3 001 and above	80	5	32

ANNEX D

(*Foreword*)

COMMITTEE COMPOSITION

Sanitary Appliances and Water Fittings Sectional Committee, CED 03

Organization	*Representative(s)*
In Personal Capacity (*96/1, Tyagi Road, Dehradun - 248001*)	SHRI SUNEEL KUMAR ARORA (***Chairperson***)
Bathline India Private Limited, New Delhi	SHRI VINAY GUPTA
Bengal Iron Corporation, Kolkata	SHRI SIDDHANT AGARWAL
Brihan Mumbai Licensed Plumbers' Association, Mumbai	SHRI KISHOR V. MERCHANT SHRI BIJAL M. SHAH (*Alternate*)
Central Public Works Department, New Delhi	SHRI PREM MOHAN SHRI DINESH K UJJAINIA (*Alternate*)
CSIR - Central Building Research Institute, Roorkee	SHRI AJAY CHAURASIA SHRI RAJIV (*Alternate*)
Fluid Control Research Institute, Palakkad	SHRI GOPAN C. K.
Hindware Limited, Gurugram	SHRI R. B. KABRA
Kejriwal Castings Limited, Kolkata	SHRI SANDIP KEJRIWAL DR SABARNA ROY (*Alternate* I) SHRIMATI RUPA CHAUDHURI (*Alternate* II)
Kohler India Corporation Private Limited, New Delhi	SHRI PARVESH KUMAR SHRI ANSHUMAN GUPTA (*Alternate*)
Military Engineer Services, Engineer-in- Chief's Branch, Integrated HQ of MoD (Army), New Delhi	SHRI PRAMOD KUMAR SINGH SHRI M. K. DEEPAK (*Alternate*)
Ministry of Jal Shakti, Department of Drinking Water and Sanitation, New Delhi	SHRI SUMIT PRIYADARSHI
Municipal Corporation of Greater Mumbai	DEPUTY HYDRAULIC ENGINEER EXECUTIVE ENGINEER (PLANNING) (*Alternate*)
National Test House, Kolkata	SHRI S. MURALI DR SUJOY KUMAR MANNA (*Alternate*)
NBCC (India) Limited, New Delhi	SHRI H. S. YADAV SHRIMATI ANNU GARG (*Alternate*)
Roca Bathroom Products Private Limited, Chennai	SHRI MUKESH KUMAR JAIN SHRI ANTARSINGH RAJPUT (*Alternate* I) SHRI TARUN PRAJAPATI (*Alternate* II)

Organization	*Representative*(*s*)
In Personal Capacity (*Flat No. 1507*, *B wing, 15th floor*, *Dosti Blossom CHS*, *Dosti Acres*, *Antop Hill*, *Wadala East*, *Mumbai - 400037*)	S. V. HULYALKAR
In Personal Capacity (*A-1202, Marvel Azure Sade Satrah Nali Road, Pune - 411028*)	SHRI R. P. SRIVASTAVA
BIS Directorate General	SHRI DWAIPAYAN BHADRA, SCIENTIST 'E'/DIRECTOR AND HEAD (CIVIL ENGINEERING) [REPRESENTING DIRECTOR GENERAL (*Ex-officio*)]

Member Secretary
SHRI RAJESH CHOUDHARY
SCIENTIST 'C'/DEPUTY DIRECTOR
(CIVIL ENGINEERING), BIS

Panel for Valves and Gates, CED 03: P5

Organization	*Representative*(*s*)
In Personal Capacity (*96/1*, *Tyagi Road, Dehradun - 248001*)	SHRI SUNEEL KUMAR ARORA **(*Convener*)**
Bangalore Water Supply and Sewerage Board, Bengaluru	SHRI S. R. ROOPKUMAR SHRI H. M. RAVINDRA (*Alternate*)
Building Materials and Technology Promotion Council, New Delhi	SHRI D. P. SINGH SHRI C. N. JHA (*Alternate*)
Central Public Works Department, New Delhi	SHRI PREM MOHAN SHRI DINESH K. UJJAINIA (*Alternate*)
Delhi Jal Board, New Delhi	CHIEF ENGINEER W. W. SUPERINTENDING ENGINEER N. W. (*Alternate*)
Government e Market Place, New Delhi	SHRI B. S. RANA SHRI P. K. MAHANA (*Alternate*)
Gujarat Water Supply and Sewerage Board, Gandhinagar	SHRI B. K. SINGHALA SHRI D. K. MEHTA (*Alternate*)
Indian Valves Private Limited, Nashik	SHRI TARUN MUKHERJEE SHRI SUDIP GHOSH (*Alternate*)
Jash Engineering Limited, Indore	SHRI PRATIK N. PATEL SHRI CHANDRESH PAREEK (*Alternate*)
Jayaswal Neco Industires Limited, Nagpur	SHRI PRAVEEN BHALMEY SHRI SANDESH DUWAWALE (*Alternate*)
Kriloskar Brothers Limited, Pune	SHRI OMKAR KONDEDESHMUKH SHRI ANIKET PRABHAKAR BARGE (*Alternate*)

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Municipal Corporation of Greater Mumbai	DEPUTY HYDRAULIC ENGINEER
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In Personal Capacity (*Flat No. 1507*, *B wing*, *15th floor*, *Dosti Blossom CHS*, *Dosti Acres*, *Antop Hill*, *Wadala East*, *Mumbai - 400037*)	SHRI S. V. HULYALKAR

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