Metal Ball Valves—Flanged, Threaded, and Welding Ends

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Introduction

In the seventh edition, the following significant changes were made:

— Limitations on pressure classes were increased for valve sizes DN 50 (NPS 2) and smaller.

— Double reduced bore was removed, but bore sizes smaller than standard reduced bore are permitted when specified by the purchaser.

— Seat ratings for PTFE and R-PTFE in Table 1 and Table 2 were increased.

— An informative annex (Annex D) was added to provide a method for validation testing of pressure-temperature rating of non-metallic seats.

— Table 3 for bore sizes was revised to include the higher-pressure classes and remove the double reduced bore.

— Dimensional limitations were introduced for lever handle length and handwheel diameter of manually operated valves.

— Design of stem extension assemblies was addressed.

Metal Ball Valves—Flanged, Threaded, and Welding Ends

1 Scope

1.1 This standard specifies the requirements for metal ball valves suitable for petroleum, petrochemical, and industrial applications—corresponding to the nominal pipe sizes in ASME B36.10—that have:

— flanged ends in sizes DN 15 through DN 600 (NPS $^1/_2$ through NPS 24);

— butt-welding ends in sizes DN 15 through DN 600 (NPS $^1/_2$ through NPS 24);

— socket-welding ends in sizes DN 8 through DN 50 (NPS $^1/_4$ through NPS 2); and

— threaded ends in sizes DN 8 through DN 50 (NPS $^1/_4$ through NPS 2).

1.2 This standard applies to metal ball valves with pressure classes as follows:

— flanged ends in Classes 150, 300, and 600;

— flanged ends in Classes 900, 1500, and 2500 in sizes DN 15 through DN 50 (NPS $^1/_2$ through NPS 2) only;

— butt-welding ends in Classes 150, 300, and 600;

— butt-welding ends in Classes 800, 900, 1500, and 2500 in sizes DN 15 through DN 50 (NPS $^1/_2$ through NPS 2) only;

— socket-welding ends and socket-welding by threaded ends in Classes 150, 300, 600, 800, 900, 1500, and 2500;

— threaded ends in Classes 150, 300, 600, and 800.

1.3 This standard establishes requirements for bore sizes described as:

— full bore;

— reduced bore.

1.4 This standard applies to floating (seat-supported) ball (Figure C.1a and Figure C.1b) and trunnion ball valve designs (Figure C.2). These figures are to be used only for the purpose of establishing standard nomenclature for valve components; other floating and trunnion designs also exist.

1.5 This standard establishes additional requirements for ball valves that are otherwise in full conformance to the requirements of ASME B16.34 (Standard Class).

1.6 Trunnion ball valves equipped with double piston effect seats are outside of the scope of this standard.

1.7 Users of this standard should refer to API RP 615 for background and further guidance and definitions on API 608 valves.

2 Normative References

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any addenda) applies.

API Standard 598, *Valve Inspection and Testing*

API Standard 602, *Gate, Globe, and Check Valves for Sizes DN 100 (NPS 4) and Smaller for the Petroleum and Natural Gas Industries*

API Standard 607, *Fire Test for Quarter-turn Valves and Valves Equipped with Nonmetallic Seats*

API Standard 641, *Type Testing of Quarter-turn Valves for Fugitive Emissions*

ASME B1.1, *Unified Inch Screw Threads (UN and UNR Thread Form)*

ASME B1.20.1, *Pipe Threads, General Purpose (Inch)*

ASME B16.5, *Pipe Flanges and Flanged Fittings: NPS $^1/_2$ Through 24 Metric/Inch Standard*

ASME B16.10, *Face-to-Face and End-to-End Dimensions of Valves*

ASME B16.11, *Forged Fittings, Socket-welding and Threaded*

ASME B16.20, *Metallic Gaskets for Pipe Flanges*

ASME B16.25, *Buttwelding Ends*

ASME B16.34, *Valves—Flanged, Threaded, and Welding End*

ASME B18.2.2, *Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)*

ASME B36.10, *Welded and Seamless Wrought Steel Pipe*

ASME B36.19, *Welded and Seamless Wrought Stainless Steel Pipe*

NACE MR 0103/ISO 17945, *Petroleum, petrochemical and natural gas industries—Metallic materials resistant to sulfide stress cracking in corrosive petroleum refining environments*

NACE MR0175/ISO 15156, *Petroleum and natural gas industries—Materials for use in H_2S-containing environments in oil and gas production*

ISO 5211, *Industrial valves — Part-turn actuator attachments*

MSS-SP-101, *Part-Turn Valve Actuator Attachment*

3 Terms and Definitions

For the purposes of this document, the following definitions apply.

3.1
class
An alphanumeric designation (used for reference purposes) that relates to valve pressure-temperature capability and takes into account valve material mechanical properties and valve dimensional characteristics. It includes the word "Class" followed by a dimensionless whole number. The number following the word "Class" does not represent a measurable value and is not used for calculation purposes except where specified in this standard. The allowable pressure for a valve having a class number depends on the valve material and its application temperature is found in tables of pressure-temperature ratings.

3.2
DN
An alphanumeric designation of size that is common for components used in a piping system and is used for reference purposes. It includes the letters "DN" followed by a dimensionless number indirectly related to the physical size of the bore or outside diameter of the end connection as appropriate. The dimensionless number following "DN" does not represent a measurable value and is not used for calculation purposes except where specified in this standard.

3.3
handle
A manual operator of a valve. Also known as "lever" or "wrench."

3.4
NPS
An alphanumeric designation of size that is common for components used in a piping system and is used for reference purposes. It includes the letters "NPS" followed by a dimensionless number indirectly related to the physical size of the bore or outside diameter of the end connection as appropriate. The dimensionless number may be used as a valve size identifier without the prefix "NPS". The dimensionless size identification number does not represent a measurable value and is not used for calculation purposes.

3.5
reduced bore valve
A valve that has an opening through the ball that is smaller than the inside diameter of the end connections.

3.6
shell
Includes the body, cover, body insert, body cap, and trunnion that forms a part of the pressure boundary (see Annex C).

3.7
stem extension assembly
A non-pressure-containing assembly of components that effectively lengthens the valve stem.

3.8
trim
An internal wetted part of the valve, including ball, stem, trunnion (if it is not part of the pressure boundary), seats, and seat retainers (see Annex C and Figure 3).

3.9
UN
The various constant-pitch series (UN/UNR) with 4, 6, 8, 12, 16, 20, 28, and 32 threads per inch that offer a comprehensive range of diameter-pitch combinations for those purposes where the threads in the coarse-, fine-, and extra-fine-thread series do not meet the particular requirements of the design.

3.10
UNC
The coarse-thread series (UNC/UNRC) generally used for the bulk production of screws, bolts, and nuts.

3.11
valve-bidirectional
A valve designed for blocking the flow from either direction.

3.12
valve-unidirectional
A valve designed for blocking the flow in one direction only.

4 Pressure-temperature Ratings

4.1 Valve Rating

The valve pressure-temperature rating shall be the lesser of the shell rating or the seat and seal rating.

4.2 Shell Rating

The valve shell pressure-temperature rating shall be the rating for the shell material as listed for Standard Class in ASME B16.34.

The valve shell pressure/temperature ratings for intermediate Class 800 valves shall be as shown in Tables 2a–2f of API 602 (2022).

4.3 Seat and Seal Rating

4.3.1 Seat Ratings for PTFE and R-PTFE

Valves employing polytetrafluoroethylene (PTFE) or modified PTFE seats and valves employing reinforced polytetrafluoroethylene (R-PTFE) or modified R-PTFE seats shall have seat pressure-temperature ratings equal or higher than the values shown in Table 1 and Table 2.

4.3.2 Seat Ratings—Other Materials

Seat pressure-temperature ratings for seat materials other than PTFE or R-PTFE shall be the manufacturer's standard.

The published seat pressure-temperature ratings shall not exceed the manufacturer's published shell ratings.

NOTE Validation testing (as described in Annex D) of pressure-temperature rating of valve seats made of nonmetallic materials may be performed by the manufacturer or specified by the purchaser.

Table 1—Minimum Seat Pressure-Temperature Rating—bar

Temperature °C	Temperature °F	PTFE and Modified PTFE Seats				R-PTFE and Modified R-PTFE Seats			
		Floating Ball Design			Trunnion	Floating Ball Design			Trunnion
		DN ≤ 50	50 < DN ≤ 100	DN > 100	DN ≥ 50	DN ≤ 50	50 < DN ≤ 100	DN > 100	DN ≥ 50
–29 to 38	–20 to 100	69.0	51.0	21.0	51.0	75.9	51.0	26.7	51.0
66	150	60.0	44.7	19.3	44.7	66.8	46.0	23.9	46.0
93	200	50.0	37.3	16.5	37.7	56.4	39.1	20.1	39.1
122	250	39.2	29.4	13.5	29.4	45.2	31.8	16.1	31.8
149	300	29.2	22.1	10.7	22.1	34.7	25.0	12.3	25
177	350	18.8	14.5	7.8	14.5	23.9	17.8	8.4	17.8
205	400	—	—	—	—	13.1	10.9	4.8	10.9

NOTE For any given pressure class, the seat pressure-temperature rating shall not exceed the shell ratings in ASME B16.34.

Table 2—Minimum Seat Pressure-Temperature Rating—psig

Temperature °C	Temperature °F	PTFE and Modified PTFE Seats				R-PTFE and Modified R-PTFE Seats			
		Floating Ball Design			Trunnion	Floating Ball Design			Trunnion
		NPS ≤ 2	2 < NPS ≤ 4	NPS > 4	NPS ≥ 2	NPS ≤ 2	2 < NPS ≤ 4	NPS > 4	NPS ≥ 2
–29 to 38	–20 to 100	1000	740	305	740	1100	740	387	740
66	150	870	648	280	648	969	667	347	667
93	200	725	541	239	541	818	567	291	567
122	250	568	426	196	426	655	461	233	461
149	300	423	320	155	320	503	363	178	363
177	350	273	210	113	210	347	258	122	258
205	400	—	—	—	—	190	158	70	158

NOTE For any given pressure class, the seat pressure-temperature rating shall not exceed the shell ratings in ASME B16.34.

5 Design

5.1 General

Valves designed and manufactured in accordance with this standard shall meet the requirements of Standard Class valves per ASME B16.34 and additional requirements as specified in this standard.

5.2 Flow Passageway

The flow passageway is the circular opening in the ball and extends outward to both valve end connections, which can be flanged, threaded, socket-welding, or butt-welding types.

The bore of this flow passageway is categorized in this standard as either full bore or reduced bore.

Full-bore and reduced-bore valves shall have a flow passageway such that a cylinder with the diameters shown in Table 3 can be passed through when the handle or gear operator is moved to the fully open position stop.

Further reduction in bore size is allowed when specified.

5.3 Body

5.3.1 The wall thicknesses of the valve shell (see 3.6) shall be in accordance with the requirements of ASME B16.34 for the applicable Standard Class. ASME wall thicknesses are based on the Standard Class of valve and not the pressure-temperature ratings of 4.1.

5.3.2 Unless otherwise specified, face-to-face dimensions of flanged reduced-bore floating ball valves up to DN 150 (NPS 6) in Class 150 and 300 shall conform to ASME B16.10 short pattern, and all other flanged valves shall conform to ASME B16.10 long pattern.

5.3.3 End-to-end and face-to-face dimensions for valves not covered in ASME B16.10 shall be per the manufacturer's standard.

5.3.4 The dimensions and facing finish of end flanges shall conform to ASME B16.5.

5.3.5 Butt-welding ends shall conform to the requirements of ASME B16.25 for the bore specified for use without backing rings.

The inside and outside surfaces of valve welding ends shall be machine-finished. The contour within the envelope is at the option of the manufacturer unless specifically ordered otherwise. Intersections should be slightly rounded. For nominal outside diameters and wall thicknesses of standard steel pipe, see ASME B36.10 and ASME B36.19.

End-to-end dimensions for butt-welding end valves with either integral or fabricated stub ends shall be in accordance with ASME B16.10 except as permitted in 5.3.3.

Conversion of a flanged end valve to a butt-welding valve is not permitted except by agreement between the purchaser and manufacturer.

Table 3—Cylinder Diameter for Categorizing Bore Size

DN	NPS	Full Bore						Reduced Bore			
		Classes 150, 300, 600, and 800		Classes 900 and 1500		Class 2500		Classes 150 and 300 Other than One Piece (Uni-Body) and Classes 600 and 800		One Piece (Unibody) Valve, Classes 150 and 300	
		mm	in.	mm	in.	mm	in.	mm	in.	mm	in.
8	1/4	5	0.20	—	—	—	—	—	—	—	—
10	3/8	8	0.31	—	—	—	—	5	0.20	—	—
15	1/2	11	0.44	11	0.44	11	0.44	8	0.31	8	0.31
20	3/4	17	0.68	17	0.68	14.2	0.56	11	0.44	11	0.44
25	1	24	0.94	22.1	0.87	19.1	0.75	17	0.68	17	0.68
32	1 1/4	30	1.19	28.4	1.12	25.4	1.00	22	0.87	22	0.87
40	1 1/2	37	1.44	34.8	1.37	28.4	1.12	24	0.94	24	0.94
50	2	49	1.94	47.5	1.87	38.1	1.50	37	1.44	37	1.44
65	2 1/2	62	2.44	—	—	—	—	49	1.94	49	1.94
80	3	75	2.94	—	—	—	—	49	1.94	49	1.94
100	4	100	3.94	—	—	—	—	75	2.94	75	2.94
125	5	125	4.94	—	—	—	—	100	3.94	100	3.94
150	6	151	5.94	—	—	—	—	100	3.94	100	3.94
200	8	199.9	7.87	—	—	—	—	151	5.94	138	5.43
250	10	247.7	9.75	—	—	—	—	199.9	7.87	186	7.32
300	12	298.5	11.75	—	—	—	—	247.7	9.75	227	8.94
350	14	326.9	12.87	—	—	—	—	298.5	11.75	—	—
400	16	374.7	14.75	—	—	—	—	326.9	12.87	—	—
450	18	419.1	16.50	—	—	—	—	374.7	14.75	—	—
500	20	463.6	18.25	—	—	—	—	419.1	16.50	—	—
550	22	511.0	20.12	—	—	—	—	463.6	18.25	—	—
600	24	558.8	22.00	—	—	—	—	463.6	18.25	—	—

NOTE All values are minimums.

5.3.6 Socket-welding end preparation, including the internal ends of extended-body valves, shall conform to ASME B16.11.

The bottom of the socket shall be square and flat, except in the case where a threaded end valve is converted to a socket-weld end valve.

The minimum wall thickness of internal socket-welding ends shall be in accordance with ASME B16.34.

5.3.7 Threaded ends shall have taper pipe threads in accordance with ASME B1.20.1, and the minimum wall thicknesses shall conform to ASME B16.34.

5.3.8 End flanges and bonnet flanges shall be cast or forged integral with the body, except that cast or forged flanges attached by full-penetration butt-welding may be used if agreed to by the purchaser.

Valves having flanges attached by welding shall meet the requirements of ASME B16.34.

5.3.9 Upstream sealing trunnion-mounted ball valves shall have a test port into the body cavity between seats to allow seat testing as specified in API 598.

Test ports shall have taper pipe threads in accordance with ASME B1.20.1 unless otherwise specified by the purchase order.

5.3.10 If drain, bypass, or other types of auxiliary connections are specified in the purchase order, they shall comply with the requirements of ASME B16.34.

5.3.11 Valves shall be provided with a means of protection against excessive pressure within the body cavity between the seats.

5.3.12 When injection points for sealant lubrication or flushing are provided for seats and/or stem, they shall incorporate a check valve and a secondary means of isolation for each injection point.

Sealant fittings shall have a design pressure not less than the valve rated pressure and the injection pressure.

5.3.13 The chemical composition of carbon steel welding ends shall meet the following requirements, unless otherwise agreed:

— the carbon content shall not exceed 0.23 % by mass;

— the carbon equivalent, CE, shall not exceed 0.43 as determined by the following formula:

$$CE = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15}$$

where

C	is weight % carbon;
Mn	is weight % manganese;
Cr	is weight % chromium;
Mo	is weight % molybdenum;
V	is weight % vanadium;
Ni	is weight % nickel;
Cu	is weight % copper.

5.3.14 Instructions for valve welding shall be provided by the manufacturer for valves with welding ends to avoid damaging the valve parts by the heat of welding.

5.4 Antistatic Design (Electrical Continuity between Ball-Stem-Body)

Valves shall incorporate an antistatic feature that ensures electrical continuity between the stem and body of valves ≤ DN 50 (≤ NPS 2) and between the ball, stem, and body of valves > DN 50 (> NPS 2).

The antistatic feature shall have electrical continuity across the discharge path with a resistance not exceeding 10 ohms from a power source not exceeding 12-volt direct current (Vdc) when type-tested on a new, dry, as-built valve after open-close position cycling of the valve at least five times.

5.5 Ball-stem Design and Construction

5.5.1 The valve shall be designed to ensure that if a failure occurs at the stem-to-ball connection or at the stem itself within the pressure boundary, no portion of the stem is ejected by internal pressure.

5.5.2 The stem shall be of an anti-blowout design and the stem seal retaining device shall not be the sole means used for stem retention.

The design shall ensure that the stem cannot be ejected from the valve by disassembly of gland bolting or actuator mounting hardware (see 5.8.16).

5.5.3 The torsional strength of both the stem-to-ball connection and the portion of the stem within the pressure boundary (below top of packing) shall exceed the torsional strength of the stem portion above the pressure boundary (above the top of the packing) by at least 10 % at the maximum valve rated temperature.

5.5.4 The stem and the ball-to-stem connection shall be designed such that no permanent deformation occurs, and no failure of any part occurs when a force applied to the lever or gear operator handwheel produces a torque equal to the greater of:

— 20 N m (15 ft-lb); or

— twice the manufacturer's maximum published torque.

The manufacturer's maximum published torque shall be based upon clean, dry air service at the maximum differential pressure rating of the valve.

5.5.5 Tolerance classes (grades) and surface finish specifications of valve components that affect sealing performance shall be identical to the valve used for fugitive emission qualification testing in 7.5.

5.6 Ball Construction

The ball shall have a cylindrical bore and shall be of solid one-piece construction. Other constructions, such as "hollow"-type, cored cavity, or sealed cavity, may be furnished only if agreed to by the purchaser.

5.7 Packing Glands and Gland Bolting

5.7.1 Adjustable packing glands shall be accessible for resealing stem packing without the disassembly of valve parts or operator parts.

5.7.2 Packing glands that are threaded into bodies or covers, or onto stems, shall not be used for valve sizes greater than DN 80 (NPS 3) unless otherwise specified by purchase order (see Figure C.1a, Figure C.1b and Figure C.2 for parts identification).

5.7.3 Vertically split glands shall not be used.

5.7.4 When used, gland bolts shall pass through holes in the packing gland. The use of open slots is not permitted on any portion of the packing gland.

5.7.5 Packing gland bolts shall be designed so that the bolt stress shall not exceed one-third of the ultimate tensile strength of the bolting material when compressing packing material to a compressive stress of 38 MPa (5500 psi) at 38 °C (100 °F).

5.8 Operation

5.8.1 Unless otherwise specified on the purchase order, manually operated valves shall be equipped with lever-type handles.

5.8.2 Gear operators shall be fitted with handwheels and shall be sized to comply with the requirements of 5.8.3.

5.8.3 Unless otherwise specified in the purchase order, the length of the lever handle or the gear ratio, efficiency, and handwheel diameter of gear operators shall be designed so that the required input force to fully open and close the valve shall not exceed 360 N (80 lb) when operating the valve at the manufacturer's maximum published torque, as described in 5.5.4.

5.8.4 The following dimensional limitations shall apply to lever handle length and handwheel diameter for manually operated valves:

— For flanged, welded, and threaded end valves, the lever handle length shall not exceed twice the face-to-face dimension for same-size, flanged-end Class 300 long pattern per ASME B16.10.

— Lever handles longer than 610 mm (24 in.) shall be removable.

— The handwheel diameter shall not be smaller than 150 mm (6 in.) and shall not exceed the lesser of 800 mm (31.5 in.) and the face-to-face or end-to-end dimension of the valve.

— Other handle lengths and handwheel diameters are permitted by agreement between purchaser and manufacturer.

5.8.5 Valves shall be closed by rotating the closure device (lever or handwheel) in a clockwise direction.

5.8.6 Position stops shall be provided for both fully open and fully closed positions of the valve. Position stops integrated into the packing gland, gland flange, or gland bolting shall not be used.

5.8.7 Handwheels on manual gear operators shall be marked to indicate the direction of opening and/or closing. The gear operator shall have a position indicator.

5.8.8 Lever-type handles shall be parallel to the ball bore so that the lever always indicates the ball bore position. If the purchase order specifies round or oval direct-mounted handwheels, a permanent means of indicating the ball bore position shall be included in the handwheel design.

5.8.9 An indication parallel with the position of the ball bore of the valve shall be integral with the valve stem. This indication may be by permanent marking to the top of the stem, keyways, or by the shape of the exposed stem portion.

5.8.10 Levers, handwheels, and other operating mechanisms shall be fitted so that they may be removed and replaced without affecting the integrity of the stem seal(s), body seal(s), or stem retention means.

5.8.11 Lever or manual gear operators shall be designed so that the lever or gear operator cannot be assembled to the valve other than in the correct configuration to indicate open and closed positions.

5.8.12 When specified in the purchase order, valves shall be furnished with a lockable device that accepts a purchaser-supplied padlock that allows the valve to be locked in both the fully open and fully closed positions.

The lockable device shall be designed such that a lock with an 8-mm ($^{5}/_{16}$-in.) diameter shank not more than 102 mm (4.0 in.) long can be inserted directly through the hole(s) in the lockable device and locked.

Provision for the lockable device is permitted, even when not specified on the purchase order.

5.8.13 Unless otherwise specified, when a manual gear operator is provided, the output torque/thrust rating shall be at least 1.5 times the maximum required operating torque/thrust of the valve.

5.8.14 Direct-mounted gear operators, actuators, and extension-mounted operators shall be designed or provided with a means of preventing pressure buildup in the mechanism resulting from stem packing, stem seals, or bonnet seal leakage.

Such designs shall also provide self-draining capability to prevent liquid buildup onto gland seals and gland bolting.

5.8.15 Pressed steel handwheels and handwheels with external spokes on gear operators are not allowed.

5.8.16 Pressure boundary bolting shall not be used for the bolting actuator/gear operator or any mounting brackets.

5.8.17 Unless otherwise specified, gear operator or actuator mating dimensions shall be in accordance with either ISO 5211 or MSS SP-101.

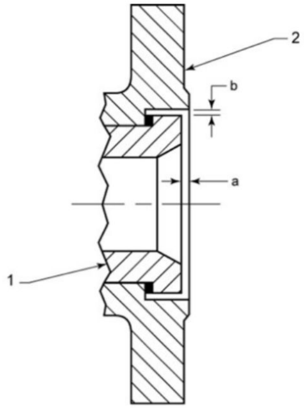
5.9 End Flange Face Interruptions

5.9.1 Ring-shaped radial gaps in the faces of end flanges of flanged ball valves, located in the sealing surface of a centered ASME B16.20 spiral-wound gasket, shall not exceed 0.75 mm (0.030 in.); see dimension "b" in Figure 1.

An example of this condition is the radial gap that exists between the outer diameter of a body insert and the inner bore of the body end flange of a valve as shown in Figure C.1a.

5.9.2 For ball valves designed with a body insert as shown in Figure C.1a, with a gasket seating face outer diameter located within the sealing area of a centered ASME B16.20 spiral-wound gasket, the body insert flange face shall not protrude beyond the valve body end flange face.

The body insert flange face shall not be recessed below the body end flange face by more than 0.25 mm (0.010 in.). See dimension "a" in Figure 1.



Key

1 body insert

2 valve body end flange

Figure 1—Flange Face Interruption Limits

5.10 Valve Shell Joints

5.10.1 Nut and bolt head bearing surfaces of shell parts assembled by bolting shall be perpendicular to the centerline of tapped or clearance holes for the fasteners within ±1.0°.

5.10.2 Bolting used for assembly of shell joints shall be studs with nuts, hex head bolts, or cap screws.

Nuts shall conform to ASME B18.2.2. Bolts and studs shall be threaded in conformance to ASME B1.1 unless the purchase order specifies metric series bolting.

Bolting 25 mm (1.0 in.) or smaller shall have coarse (UNC) threads; bolting larger than 25 mm (1.0 in.) shall be eight thread series (8 UN).

Bolt and stud threads shall be Class 2A, and nut threads shall be Class 2B per ASME B1.1.

5.10.3 The retention system of body inserts shall be designed for the full valve pressure rating and shall not rely on adjacent piping for retention. Additionally, a seal (Figure C.1a) shall be provided between the valve body and the insert to avoid leakage.

5.11 Stem Extension Assemblies

Unless otherwise specified, stem extension assemblies shall conform to the following requirements:

a) A stem within a stem extension assembly shall conform to 5.5.4.

b) Extended stem assemblies shall be provided with a non-pressure-containing extension support casing (housing). A sample stem extension is shown in Figure 2.

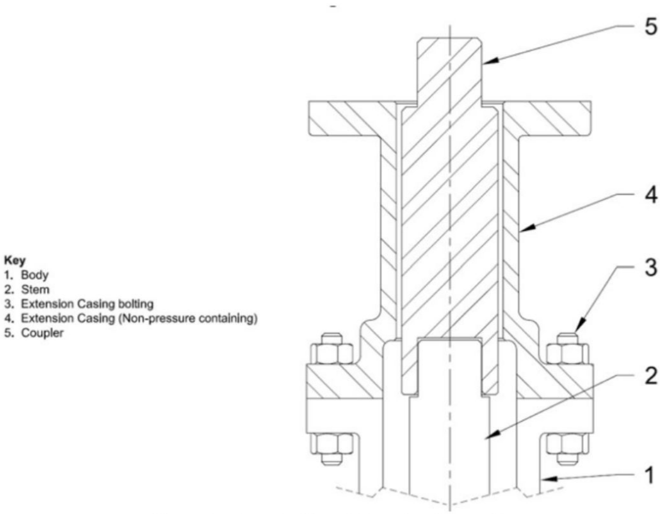


Figure 2—Sample Stem Extension Assembly

6 Materials

6.1 Shell

The shell materials shall be in accordance with ASME B16.34. See Figure C.1a, Figure C.1b, and Figure C.2.

6.2 Trim

The trim shall have corrosion-resistance properties equivalent to or better than those of the shell. See Figure C.1a, Figure C.1b, and Figure C.2.

6.3 Bolting

Body, cover, body joint, and packing gland bolting shall be as specified in ASME B16.34 (Group 4).

6.4 Stem Seals, Body Seals, and Gaskets

Materials for stem seals, body seals, and gaskets shall be suitable for use at the maximum operating temperature and corresponding maximum pressure rating of the valve as stated by the valve manufacturer.

Metallic parts of any gasket shall have corrosion-resisting properties equal to or superior to trim material, with austenitic stainless steel at a minimum.

6.5 Identification Plate(s)

The material of identification plate(s) shall be austenitic stainless steel or nickel alloy.

The identification plate(s) shall be attached to the valve body by welding or by pins made from the same materials allowed for the identification plate.

6.6 Threaded Plugs and Auxiliary Components

Threaded plugs and auxiliary components shall have the same nominal composition as the shell or trim material unless otherwise specified in the purchase order.

6.7 NACE Requirements

When NACE MR0103/ISO 17945 is specified, the purchaser shall specify either exposed bolting or non-exposed bolting as defined in NACE MR0103/ISO 17945. The purchaser may specify NACE MR0175/ISO 15156 in lieu of NACE MR0103/ISO 17945.

7 Inspection, Examination, and Testing

7.1 Inspection and Examination

7.1.1 The valve manufacturer shall examine each valve to ensure compliance to this standard.

7.1.2 If inspection is specified in the purchase order, inspection shall be in accordance with API 598. Examination by the manufacturer shall be as specified in API 598.

7.2 Assembly

7.2.1 Light oil or anti-seize compound may be applied to facilitate assembly of mating metal components.

7.2.2 Light oil, having a viscosity no greater than kerosene, may be used to assemble O-rings or other seals required to move during valve assembly.

7.2.3 No sealant or grease shall be applied to the ball-seat interface prior to testing.

7.3 Pressure Testing

Each valve shall be pressure tested in accordance with API 598.

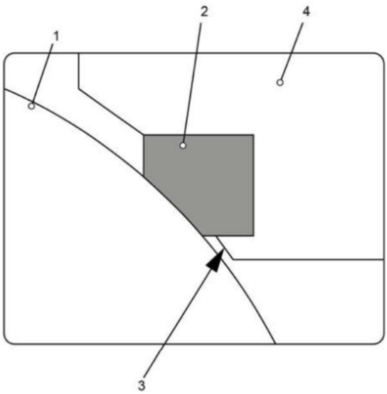
7.4 Fire Testing

When a fire-tested ball valve is specified in the purchase order, the valve design supplied shall have successfully passed API 607. See Figure 3 for two examples of a fire-resistant seat arrangement using a resilient primary non-fire-resistant seal and a secondary metal backup seat.

7.5 Fugitive Emission Testing

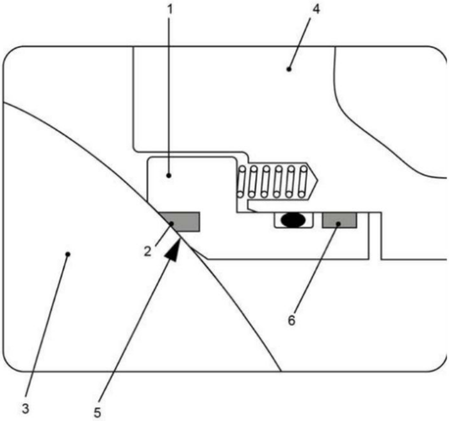
The valve design shall be qualified by type testing to meet the fugitive emissions requirements of API 641 up to Class 1500.

Valves in Class 2500 shall be qualified by fugitive emission type testing to meet the purchaser's requirements.



Key
1 ball
2 seat
3 secondary metal scaling
4 adapter or body

a) Fire-resistant Seat Arrangement—Floating Ball Valve



Key
1 seat retainer
2 seat
3 ball
4 adapter or body
5 secondary metal seat
6 backing ring

b) Fire-resistant Seat Arrangement—Trunnion Ball Valve

Figure 3—Typical Fire-resistant Seats

8 Marking

8.1 The identification plate shall be marked in accordance with ASME B16.34 and shall also be marked API 608 and API 641 (as applicable).

8.2 Body end flanges require marking when end flanges are ring type joint design. The ring joint groove number (such as R24) shall be marked on each end flange outside diameter using either a low-stress marking or a permanently attached (welded or riveted) tag. Ring joint groove numbers are as shown in ASME B16.5.

8.3 At a minimum, valve bodies shall be marked with the following information:

— manufacturer's name or trademark;

— body material identification;

— pressure class designation (e.g., Class 1500);

— nominal size, as either DN (e.g., DN 50) or NPS (e.g., NPS 2)

8.4 Markings on the body shall consist of letters or symbols cast, stamped, or otherwise integral with the valve, marked on an identification plate (see 6.5), or both.

When stamping is used on the valve body, a low-stress stamping process shall be used.

8.5 Unidirectional valves shall be marked with the designation "HP" on the high-pressure side of the valve, either by cast or stamped characters or on a permanently attached nameplate (see 6.5).

In addition, unidirectional valves shall have a warning label or tag that states "Unidirectional Valve".

8.6 Bidirectional valves with a "preferred sealing direction" shall be marked with the designation "HP" on the preferred high-pressure side of the valve, either by cast or stamped characters or on a permanently attached nameplate (see 6.5).

Bidirectional valves that do not have a "preferred sealing direction" need no additional marking.

9 Packaging and Shipping Requirements

9.1 All valves shall be drained of any test fluids and dried in conformance with the manufacturer's documented procedures prior to packaging or shipping.

9.2 Valves manufactured with shell materials shown in ASME B16.34 (Group 1) shall have lead-free rust preventative coatings on all unmachined exterior body surfaces.

9.3 Machined or threaded surfaces of ASME B16.34 (Group 1) materials that are not protected from atmospheric corrosion shall be coated with an easily removable, lead-free rust inhibitor.

9.4 Protective end plugs of wood, wood fiber, plastic, or metal shall be securely inserted into the valve end connections of socket-welding and threaded valves, or a protective cover shall be placed over the threaded ends in the case of external threaded ends.

The protective end plugs or covers shall be of a design such that the valve cannot be installed with the protective plug or cover in place.

9.5 Protective covers of wood, wood fiber, plastic, or metal shall be securely attached to the valve ends of flanged and butt-welding end valves to protect the gasket surfaces and weld end preparations.

The protective end covers shall be of a design such that the valve cannot be installed with the protective cover in place.

9.6 At the time of shipment, the ball shall be in the fully open position, unless design precludes this position, such as in the case of a spring-return-to-closed-position actuated ball valve.

9.7 Threaded auxiliary connections shall be fitted with fully tightened solid threaded plugs (see 5.3.9 and 6.6).

The thread sealant used to seal the plugs shall be suitable for the full pressure and temperature rating of the valve or as specified in the purchase order.

9.8 Valves shall be packaged to prevent damage during shipment.

9.9 When export packaging is specified in the purchase order, valves shall be shipped in wooden boxes or crates and packed to prevent individual valves from moving within the crate or box.

10 Spare Parts

When specified on the purchase order, the manufacturer shall submit a complete list of recommended spare parts. This list shall include cross-sectional assembly drawings for identification of recommended spare parts and part numbers.

Annex A

**The information in this annex has been intentionally removed.
See Annex A of API Specification Q1 or the API website for information pertaining to the API Monogram Program and use of the API Monogram on applicable products.**

Annex B
(normative)

Information to Be Specified by the Purchaser

Numbers in brackets are references to sections or subsections of this standard.

1) Supplemental requirements of this standard shall be specifically stated in the purchase order.

2) If no supplemental requirements are to be taken, the purchase order only needs to refer to API 608 and to specify the items listed below:

   a) nominal valve size [1.1];

   b) nominal pressure class [1.2];

   c) end connection type [1.2];

   d) bore size category [1.3];

   e) shell material [6.1];

   f) trim material [6.2];

   g) seat and seal material [4.3 and 6.4];

   h) operator type [5.8.1 and 5.8.13];

   i) ASME B16.10 long or short pattern [5.3.2].

3) Optional items that can be specified by the purchaser:

   a) lockable device [5.8.12];

   b) inspection by the purchaser [7.1.2];

   c) supplementary examination [7.1.2];

   d) compliance with NACE MR 0103/ISO 17945 (exposed or non-exposed bolting) or NACE MR 0175/ISO 15156 [6.7];

   e) bolting material [6.3];

   f) shell joint bolting [5.10.2];

   g) special paint or coating;

   h) export packaging [9.9];

   i) auxiliary connections [5.3.10];

   j) recommended spare parts [10];

   k) prevention of body cavity overpressure [5.3.11];

l) API 607 fire-tested design [7.4];

m) butt-welded flanges [5.3.8];

n) butt-weld end details [5.3.5];

o) sealant injection fittings [5.3.12];

p) ball construction [5.6];

q) threaded packing gland [5.7.2];

r) required input force [5.8.3];

s) threaded plug material [6.6];

t) thread sealant [9.7];

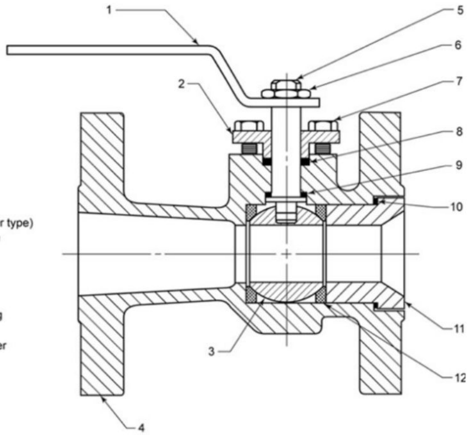
u) thread style [5.3.9];

v) additional fugitive emissions testing standard [7.5];

w) stem extension assembly [5.11].

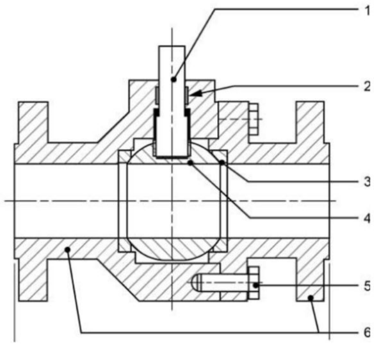
Annex C
(informative)

Typical Floating and Trunnion Ball Valve Component Nomenclature



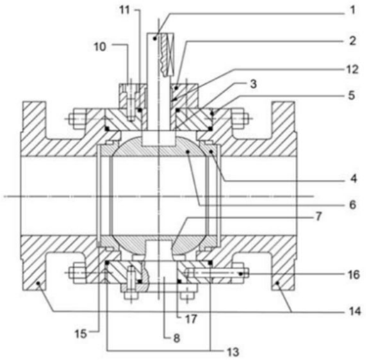
Key
1 handle (lever type)
2 gland flange
3 ball
4 body
5 stem
6 stem nut
7 gland bolting
8 stem seal
9 thrust washer
10 body seal
11 body insert
12 seat

Figure C.1a—Typical Floating Ball Valve Components (One-piece Body/Unibody Illustrated)—Nomenclature

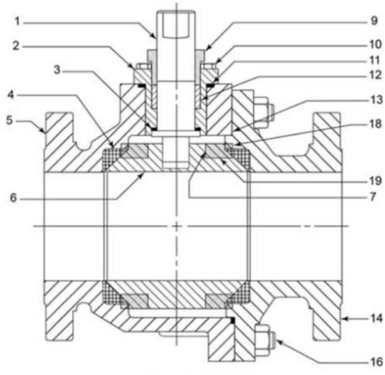


Key
1 stem
2 stem seal
3 seat ring
4 ball
5 body bolting
6 body

Figure C.1b—Typical Floating Ball Valve Components (Two-piece Body/Split-body Illustrated)—Nomenclature



a) Example 1



b) Example 2

Key

1 stem
2 cover
3 thrust washer
4 seat
5 body
6 ball
7 trunnion bearing
8 trunnion
9 gland
10 cover bolting
11 cover seal
12 stem seal
13 body seal
14 body cap
15 seat spring
16 body bolting
17 trunnion seal
18 trunnion plate
19 bearing spacer

Figure C.2—Typical Trunnion-mounted Ball Valve Components (Split-body Valve Illustrated)—Nomenclature

Annex D
(informative)

Validation Testing of Pressure-Temperature Rating of Nonmetallic Seats

D.1 Scope

This annex provides a method for the validation testing of pressure-temperature rating of valve seats made of nonmetallic materials.

WARNING — The testing facility shall be designed to ensure that all the test operations are conducted in a safe and protected environment appropriate for the test conditions. It is the responsibility of the testing facility to analyze the hazards resulting from the pressure and temperatures and take proper safety precautions. All applicable safety regulations shall be followed.

D.2 Test Fluid

The testing fluid shall be air or nitrogen.

D.3 Measuring Devices

Measuring devices shall be calibrated within the calibration period specified by the device manufacturer.

The temperature shall be monitored using thermocouples in contact with the upstream and downstream side of the valve.

A test pressure-measuring device (analog or electronic) shall be accurate to at least ±2.0 % of full scale. If an analog pressure gauge is used in lieu of a pressure transducer, it shall be selected such that the test pressure is indicated within 20 % and 80 % of the full-scale value. A displacement measuring device or volumetric device (bubbler) as per API 598 shall be used for measuring valve leakage.

D.4 Testing Temperature

Testing shall be performed at the following temperatures:

— ambient temperature [15 °C–50 °C (59 °F–122 °F)];

— maximum allowable temperature;

— at least two intermediate temperatures equally spaced between ambient and maximum allowable temperature;

— additional intermediate temperatures selected by the manufacturer.

The temperature variation during the test shall not exceed +/- 5 °C (9 °F).

D.5 Testing Procedure

D.5.1 Floating Ball Valves

A valve shall be successfully tested per API 598 prior to performing the following steps:

a) Testing shall start with the valve in the partially open position at ambient temperature and atmospheric pressure.

b) While the valve is partially open, increase the pressure until reaching the rated working pressure at the testing temperature.

c) Close the valve and vent the downstream side to atmospheric pressure.

d) Hold until the pressure and temperature are stabilized, then hold the pressure for 1 hour at the test temperature.

e) Monitor and check for seat leakage. If leakage is detected, stop the test.

f) Depressurize the valve by operating to the full open. Close the valve and apply 2 bar (30 psi) at the same test temperature; hold for 15 minutes.

g) Monitor and check for seat leakage. If leakage is detected, stop the test.

h) Heat the valve body to the next higher testing temperatures listed in D.4.

i) Repeat steps (b) through (g) until reaching the maximum allowable temperature.

j) Allow the valve temperature to drop to ambient temperature, then perform the API 598 low-pressure closure test.

k) After testing, the valve shall be disassembled, and seats and seals shall be inspected for damage.

D.5.2 Trunnion-mounted Ball Valves

A valve shall be successfully tested per API 598 prior to performing the following steps:

a) Testing shall start with the valve in the partially open position at ambient temperature and atmospheric pressure.

b) Fully close the valve and increase the pressure in the upstream side until reaching the rated working pressure at the testing temperature.

c) Hold until the pressure and temperature are stabilized, then hold the pressure for 1 hour at the test temperature.

d) Monitor and check for seat leakage from the body cavity. If leakage is detected, stop the test.

e) Depressurize the valve by operating to the full open. Close the valve and apply 2 bar (30 psi) at the same test temperature; hold for 15 minutes.

f) Monitor and check for seat leakage from the body cavity. If leakage is detected, stop the test.

g) Heat the valve body to the next higher testing temperatures listed in D.4.

h) Repeat steps b) through g) until reaching the maximum allowable temperature.

i) Allow the valve temperature to drop to ambient temperature, then perform the API 598 low-pressure closure test.

j) After testing, the valve shall be disassembled, and seats and seals shall be inspected for damage.

D.6 Acceptance Criteria

No visible leakage, as defined in API 598.

D.7 Scaling

For the same valve design, and seat design and material, the validation may be scaled by size as described below.

The validated seat shall qualify bore sizes within the following groups:

— DN 8 (NPS $^1/_4$) up to and including DN 50 (NPS 2);

— DN 65 (NPS 2 $^1/_2$) up to and including DN 100 (NPS 4);

— DN 150 (NPS 6) and above.

D.8 Documentation

D.8.1 Pressure-temperature Rating Validation Files

The manufacturer shall maintain a file on each pressure-temperature rating validation.

D.8.2 Contents of Pressure-temperature Rating Validation Files

Pressure-temperature rating validation files shall contain or reference the following information:

a) test number and test procedure;

b) complete identification of the product being tested;

c) the testing organization;

d) date and location of test completion;

e) test results and post-test examination conclusions (including photographs);

f) model numbers and other pertinent identifying data on all sizes, rated pressure-temperature;

g) size ranges and ratings of valves of the same product family that are validated by the validation of this specific product;

h) detailed dimensional drawings and material specifications applicable to the tested product;

i) a sketch of the test rig, product, and seal or sample, temperature, and pressure-measurement locations;

j) test data specified of actual test conditions (pressure, temperature, etc.);

k) observed leakages or other acceptance parameters, and identification of testing media used;

l) test equipment identification and calibration status;

m) identification of seat manufacturer.

Bibliography

[1] API Recommended Practice 615, *Valve Selection Guide*

[2] ASME B31.3, *Process Piping*

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[4] ASTM A193, *Standard Specification for Alloy-steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications*

[5] ASTM A194, *Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both*

[5] ISO 14723, *Petroleum and Natural Gas Industries—Pipeline Transportation Systems—Subsea Pipeline Valves*

[6] ISO 28921-1, *Industrial Valves—Isolating Valves for Low-temperature Applications—Part 1: Design, manufacturing and Production Testing*

[7] MSS SP-134, *Valves for Cryogenic Service, Including Requirements for Body/Bonnet Extensions*

[8] MSS SP-141, *Multi-turn and Check Valve Modifications*

[9] MSS SP-159, *Manual Actuators for Hand-Operation or Automated Input*

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