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Metal ball valves for petroleum, petrochemical and allied industries

*Robinets à tournant sphérique pour les industries du pétrole, de la
pétrochimie et les industries connexes*



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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 17292 was prepared by Technical Committee ISO/TC 153, *Valves*, Subcommittee SC 1, *Design, manufacture, marking and testing* in collaboration with Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries*, Subcommittee SC 6, *Processing equipment and systems*.

Introduction

The purpose of this International Standard is the establishment, in ISO format, of basic requirements and practices for flanged, butt-welding, socket welding, and threaded end steel ball valves having flow passageways identified as full bore, reduced bore, and double reduced bore seat openings suitable for petroleum, petrochemical and allied industries applications that parallel those given in American Petroleum Institute Standard API 608.

It is not the purpose of this International Standard to replace ISO 7121 or any other International Standard that is not identified with petroleum refinery, petrochemical or natural gas industry applications.

In this International Standard, flanged end Class-designated valves have flanges in accordance with ASME B16.5. Flanged end PN-designated valves have flanges in accordance with EN 1092-1. Valves with ends threaded may have threads to either ISO 7-1 or ASME B1.20.1.

Metal ball valves for petroleum, petrochemical and allied industries

1 Scope

This International Standard specifies the requirements for a series of metal ball valves suitable for petroleum, petrochemical, natural gas plants, and related industrial applications.

It covers valves of the nominal sizes DN

— 8; 10; 15; 20; 25; 32; 40; 50; 65; 80; 100; 150; 200; 250; 300; 350; 400; 450; 500

corresponding to nominal pipe sizes NPS

— $\frac{1}{4}$; $\frac{3}{8}$; $\frac{1}{2}$; $\frac{3}{4}$; 1; $1\frac{1}{4}$; $1\frac{1}{2}$; 2; $2\frac{1}{2}$; 3; 4; 6; 8; 10; 12; 14; 16; 18; 20;

and applies for pressure designations

— Class 150; 300; 600; 800 (Class 800 applies only for valves with reduced bore and with threaded and socket welding end);

— PN 16; 25; 40.

It includes provisions for testing and inspection and for valve characteristics as follows:

— flanged and butt-welded ends, in sizes $15 \leq DN \leq 500$ ($\frac{1}{2} \leq NPS \leq 20$);

— socket welding and threaded ends, in sizes $8 \leq DN \leq 50$ ($\frac{1}{4} \leq NPS \leq 2$);

— body seat openings designated as full bore, reduced bore and double reduced bore;

— materials.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 7-1, *Pipe threads where pressure-tight joints are made on the threads — Part 1: Dimensions, tolerances and designation*

ISO 7-2, *Pipe threads where pressure-tight joints are made on the threads — Part 2: Verification by means of limit gauges*

ISO 261, *ISO general-purpose metric screw threads — General plan*

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ISO 965-2, *ISO general purpose metric screw threads — Tolerances — Part 2: Limits of sizes for general purpose external and internal screw threads — Medium quality*

ISO 4032, *Hexagon nuts, style 1 — Product grades A and B*

ISO 4033, *Hexagon nuts, style 2 — Product grades A and B*

ISO 4034, *Hexagon nuts — Product grade C*

ISO 5208, *Industrial valves — Pressure testing of valves*

ISO 5209, *General purpose industrial valves — Marking*

ISO 5752, *Metal valves for use in flanged pipe systems — Face-to-face and centre-to-face dimensions*

ISO 6708:1995, *Pipework components — Definition and selection of DN (nominal size)*

ISO 9606-1, *Approval testing of welders — Fusion welding — Part 1: Steels*

ISO 10497, *Testing of valves — Fire type-testing requirements*

ISO 15607, *Specification and qualification of welding procedures for metallic materials — General rules*

ISO 15609-1, *Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 1: Arc welding¹⁾*

ISO 15610, *Specification and qualification of welding procedures for metallic materials — Qualification based on tested welding consumables*

ISO 15614-1, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys*

ISO 15614-2, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 2: Arc welding of aluminium and its alloys²⁾*

EN 1092-1, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, PN-designated — Part 1: Steel flanges*

EN 1333, *Pipework components — Definition and selection of PN*

EN 10269, *Steels and nickel alloys for fasteners with specified elevated and/or low temperature properties*

EN 12982, *Industrial valves — End-to-end and centre-to-end dimensions for butt welding end valves*

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*

ASME B16.10, *Face to face and end to end dimensions of valves*

ASME B16.20, *Metallic gaskets for pipe flanges: Ring joint spiral wound and jacketed*

1) To be published. (Replaces ISO 9956-2:1995)

2) To be published. (Replaces ISO 9956-4:1995)

ASME B16.34:1996, *Valves flanged threaded and welding end*

ASME B18.2.2, *Square and hex nuts*

ASME BPVC-IX, *BPVC Section IX — Welding and brazing qualifications*

ASTM A193, *Standard specification for alloy-steel and stainless steel bolting materials for high temperature service*

ASTM A194, *Standard specification for carbon and alloy steel nuts for bolts for high pressure and high temperature service, or both*

ASTM A307, *Standard specification for carbon steel bolts and studs, 60 000 psi tensile strength*

MSS-SP-55, *Quality standard for steel castings for valves, flanges and fittings and other piping components — Visual method*

3 Terms and definitions

For the purposes of this document, the definitions for pressure designation, Class, and nominal valve size NPS given in ASME B16.34, the definition of pressure designation PN given in EN 1333, and the following terms and definitions apply.

3.1

DN

alphanumeric designation of size for components of a pipework system, which is used for reference purposes, comprising the letters DN followed by a dimensionless whole number which is indirectly related to the physical size, in millimetres, of the bore or outside diameter of the end connections

[ISO 6708:1995, definition 2.1]

3.2

anti-static design

design that provides for electrical continuity between the body, ball and stem of the valve

4 Pressure/temperature ratings

4.1 Valve rating

The service pressure/temperature rating applicable to valves specified in this International Standard shall be the lesser of the shell rating (see 4.2) or the seat rating (see 4.3).

4.2 Shell rating

4.2.1 The pressure/temperature ratings applicable to the valve pressure containing shell (the pressure boundary elements — e.g. body, body cap, trunnion cap, cover, body inserts) shall be in accordance with those specified in the pressure/temperature tables of either ASME B16.34, Standard Class for Class-designated valves, or EN 1092-1 for PN-designated valves.

4.2.2 The temperature for a corresponding shell pressure rating is the maximum temperature that is permitted for the pressure containing shell of the valve. In general, this maximum temperature is that of the contained fluid. The use of a pressure rating corresponding to a temperature other than that of the contained fluid is the responsibility of the user. For temperatures below the lowest temperature listed in the pressure/temperature tables (see 4.2.1), the service pressure shall be no greater than the pressure for the lowest listed temperature. Consideration should be given to the loss of ductility and impact strength of many materials at low temperature.

4.3 Seat and seal rating

4.3.1 Non-metallic elements, e.g. seats, seals, or stem seals may impose restrictions on the applied pressure/temperature rating. Any such restriction shall be shown on the valve identification plate in accordance with 7.4.

4.3.2 The design shall be such that, when either polytetrafluoroethylene (PTFE) or reinforced PTFE is used for seats, the minimum valve pressure/temperature rating shall as specified in Table 1.

4.3.3 Seat ratings for other seat materials shall be the manufacturer's standard; however, the assigned valve service pressure/temperature rating shall not exceed that of the valve shell.

Table 1 — Minimum seat pressure/temperature rating

Pressure in bar (1 bar = 0,1 MPa = 10⁵ Pa; 1 MPa = 1 N/mm²)

Temperature ^b °C	PTFE seats ^a				Reinforced PTFE seats ^a			
	Floating ball			Trunnion	Floating ball			Trunnion
	DN ≤ 50	50 < DN ≤ 100	DN > 100	DN > 50	DN ≤ 50	50 < DN ≤ 100	DN > 100	DN > 50
	NPS ≤ 2	2 < NPS ≤ 4	NPS > 4	NPS > 2	NPS ≤ 2	2 < NPS ≤ 4	NPS > 4	NPS > 2
-29 to 38	69,0	51,0	19,7	51,0	75,9	51,0	19,7	51,0
50	63,6	47,1	18,2	47,1	70,4	47,8	18,4	47,8
75	53,3	39,2	15,2	39,2	59,9	40,4	15,6	40,4
100	43,0	31,3	12,1	31,3	49,4	33,1	12,8	33,1
125	32,7	23,3	9,1	23,3	38,9	25,8	10,0	25,8
150	22,4	15,4	6,1	15,4	28,3	18,4	7,2	18,4
175	12,1	7,5	3,0	7,5	17,8	11,1	4,4	11,1
200	—	—	—	—	7,3	3,7	1,6	3,7
205	—	—	—	—	5,2	2,3	1,0	2,3

For a given PN or Class designation, the assigned valve pressure/temperature ratings shall not exceed the shell ratings, (see 4.2).

^a Polytetrafluoroethylene seats.

^b Consult the manufacturer for maximum design temperature rating of the valve seats.

5 Design

5.1 Flow passageway

The flow passageway includes the circular seat opening in the ball and the body runs leading thereto. The body runs are the intervening elements that link the seat opening to the end connection, e.g. to the thread end, weld end or socket end or to the end-flange. Collectively, the flow passageway through the ball and body runs is referred to as the flow passageway. The bore is categorized in this International Standard as full bore, reduced bore and double reduced bore. The minimum bore for each category shall be such that a hypothetical cylinder having a diameter in accordance with Table 2 can be passed through.

5.2 Body

5.2.1 Body wall thickness

5.2.1.1 The minimum valve body wall thickness, t_m , shall be as specified in Table 3, except that for butt-welding end valves the welding ends for connection to pipe shall be in accordance with Figure 1.

5.2.1.2 The minimum thickness requirements are applicable to and are measured from internally wetted surfaces, i.e. up to the point where body seals are effective.

Table 2 — Cylinder diameter for categorizing bore size

DN	Minimum bore diameter				NPS
	mm				
	Full bore	Reduced bore	Double reduced bore		
	PN 10, 16, 25 and 40	PN: All	PN: All		
	—	Class: All	Class: All		
	Class 150 and 300	Class 600			
8	6	6	6	N/A	¼
10	9	9	6	N/A	⅜
15	11	11	8	N/A	½
20	17	17	11	N/A	¾
25	23	24	17	14	1
32	30	30	23	18	1¼
40	37	37	27	23	1½
50	49	49	36	30	2
65	62	62	49	41	2½
80	74	75	55	49	3
100	98	98	74	62	4
150	148	148	98	74	6
200	198	194	144	100	8
250	245	241	186	151	10
300	295	291	227	202	12
350	325	318	266	230	14
400	375	365	305	250	16
450	430	421	335	305	18
500	475	453	375	335	20

NOTE 1 N/A signifies that valves having this configuration are not within the scope of this International Standard.

NOTE 2 For Class 800, only valves having reduced port are within the scope of this International Standard.

5.2.1.3 Local areas having less than minimum wall thickness are acceptable provided that all of the following conditions are satisfied:

- the area of 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 given in Table 2 and t_m is the minimum wall thickness given in Table 3;
- the measured thickness is not less than $0,75 t_m$;
- enclosed circles are separated from each other by an edge-to-edge distance of not less than $1,75 \sqrt{dt_m}$.

5.2.1.4 The manufacturer, taking into account such factors as component bolting or thread assembly loads, rigidity needed for component alignment, other valve design details and the specified operating conditions, is responsible for determining if larger wall thickness is required.

5.2.2 Flanged ends

5.2.2.1 Body end flanges shall comply with the requirements of ASME B16.5 for Class-designated valves and EN 1092-1 for PN-designated valves. Raised face end flanges shall be provided unless otherwise specified by the purchaser.

5.2.2.2 Face-to-face dimensions for flanged end valves shall be in accordance with ASME B16.10 for Class-designated valves or ISO 5752, Basic Series 1, 14, and 27 for PN-designated valves, with an appropriate tolerance: for $DN \leq 250$ of ± 2 mm and for $DN \geq 300$ of ± 4 mm.

5.2.2.3 Body or body cap end flanges shall be either cast or forged integral with the body or cap or cast or forged flanges attached by full penetration butt-welding. A purchaser requiring integral flange construction shall so specify. When a flange is attached by welding, it is required that the welding operator and welding procedure be qualified in accordance with the rules of ASME-BPVC, Section IX or the rules of ISO 9606-1 and ISO 15607, ISO 15609-1, ISO 15614-1, ISO 15614-2 and ISO 15610. Alignment rings, either integral or loose, used as a welding aid shall be completely removed following welding, with care being taken that the minimum wall thickness is maintained. Heat treatment, following welding, to ensure that the valve body and flange materials are suitable for the full range of service conditions, shall be performed as required by the material specification.

5.2.2.4 End flange facing finish shall be in accordance with ASME B16.5 for Class-designated valves or EN 1092-1 for PN-designated valves, unless otherwise specified by the purchaser.

5.2.3 Butt-welding ends

5.2.3.1 Butt-welding ends shall be in accordance with Figure 1 and Table 4, unless otherwise specified by the purchaser.

5.2.3.2 End-to-end dimensions for Class-designated valves shall be in accordance with ASME B16.10 for either the long or short pattern, or in accordance with EN 12982 for PN-designated valves.

Table 3 — Valve body wall thickness

PN	16			25 and 40			—			—			PN
Class	150			300			600			800 ^a			Class
DN	Minimum valve body wall thickness, t_m mm										NPS		
	Full bore	Reduced bore	Double reduced bore	Full bore	Reduced bore	Double reduced bore	Full bore	Reduced bore	Double reduced bore	Reduced bore			
8	2,7	2,7	N/A	2,9	2,9	N/A	3,1	3,1	N/A	3,3	¼		
10	2,9	2,9	N/A	3,0	2,9	N/A	3,4	3,3	N/A	3,6	⅜		
15	3,1	3,1	N/A	3,2	3,2	N/A	3,6	3,6	N/A	3,9	½		
20	3,4	3,4	N/A	3,7	3,7	N/A	4,1	4,1	N/A	5,2	¾		
25	3,9	3,8	3,8	4,1	4,1	4,1	4,7	4,6	4,6	6,0	1		
32	4,3	4,2	4,2	4,7	4,6	4,6	5,1	5,0	5,0	6,4	1¼		
40	4,7	4,5	4,5	5,2	5,0	5,0	5,5	5,4	5,4	5,8	1½		
50	5,5	5,3	5,3	6,2	5,9	5,9	6,3	6,0	6,0	7,0	2		
65	5,7	5,6	5,6	6,7	6,5	6,5	6,7	6,4	6,4	N/A	2½		
80	6	5,9	5,9	7,1	6,9	6,9	7,6	7,2	7,2	N/A	3		
100	6,3	6,3	6,3	7,6	7,6	7,6	9,2	8,7	8,7	N/A	4		
150	7,1	6,9	6,9	9,3	8,9	8,9	12,6	11,8	11,8	N/A	6		
200	7,9	7,7	7,7	10,9	10,4	10,4	15,7	14,7	14,7	N/A	8		
250	8,7	8,4	8,4	12,5	12,0	12,0	18,9	17,6	17,6	N/A	10		
300	9,5	9,2	9,2	14,2	13,5	13,5	22,3	20,7	20,7	N/A	12		
350	10	9,6	9,6	15,2	14,4	14,4	24,1	22,5	22,5	N/A	14		
400	10,8	10,4	10,4	16,8	16	16	27,3	25,4	25,4	N/A	16		
450	11,7	11,1	11,1	18,7	17,3	17,3	31,1	28,9	28,9	N/A	18		
500	12,4	11,9	11,9	20,2	18,8	18,8	33,2	30,8	30,8	N/A	20		

NOTE N/A signifies that valves having this configuration are not within the scope of this International Standard.

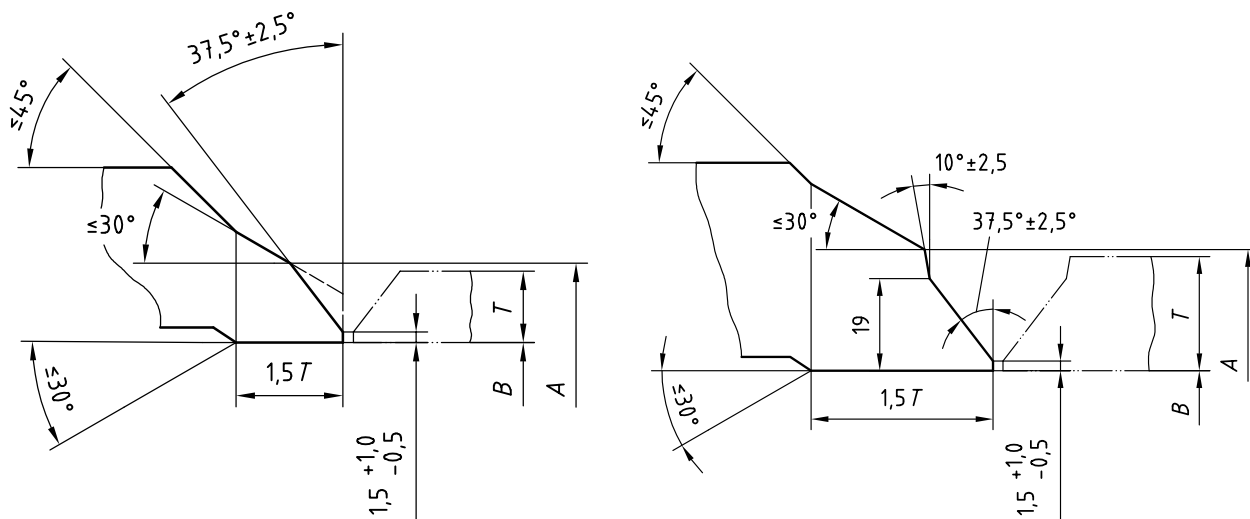
^a For Class 800, only valves having reduced ball ports are within the scope of this International Standard.

5.2.4 Socket welding ends

5.2.4.1 The socket bore axis shall coincide with the end entry axis. Socket end faces shall be perpendicular to the socket bore axis. The socket bore diameter and its depth shall be as specified in Table 5.

5.2.4.2 The minimum socket wall thickness extending over the full socket depth shall be as specified in Table 6.

5.2.4.3 End-to-end dimensions for socket welding end valves shall be established by the manufacturer.



a) Welding end for connection to pipe of wall thickness $T \leq 22$ mm

b) Welding end for connection to pipe of wall thickness $T > 22$ mm

Key

- A nominal outside diameter of welding end
- B nominal inside diameter of pipe
- T nominal wall thickness of pipe

The inside and outside surfaces of valve welding ends are machine finished overall. The contour within the envelope is at the option of the manufacturer unless specifically ordered otherwise.

Intersections should be slightly rounded.

Valves minimum wall thickness equal to 3 mm or less may have ends cut square or slightly chamfered.

NOTE 1 For nominal outside diameters and wall thickness of standard steel pipe, see ISO 4200 or ASME B36.10.

NOTE 2 Linear dimensions and tolerances shown are in millimetres.

Figure 1 — Welding ends

Table 4 — Welding ends

DN		15	20	25	32	40	50	65	80	100	150	200	250	300	350	400	450	500
NPS		½	¾	1	1¼	1½	2	2½	3	4	6	8	10	12	14	16	18	20
A mm	diameter	22	28	35	44	50	62	78	91	117	172	223	278	329	362	413	464	516
	tolerance	+2,5 -1,0										+4,0 -1,0						
B mm	tolerance	+1,0 -1,0										+2,0 -2,0						+3,0 -2,0

Table 5 — Socket diameter and depth

DN	Diameter ^a	Depth ^b	NPS
	mm		
8	14,1	9,5	¼
10	17,5	9,5	⅜
15	21,7	10	½
20	27,0	13	¾
25	33,8	13	1
32	42,5	13	1¼
40	48,6	13	1½
50	61,1	16	2

^a The applicable diametral tolerance is + 0,5 mm / 0.

^b The depth dimension is a minimum value.

Table 6 — Socket and threaded end wall thickness

PN	16, 25 and 40	—	—	PN
Class	150 and 300	600	800	Class
DN	Minimum wall thickness mm			NPS
8	3,0	3,3	3,3	¼
10	3,0	3,6	3,6	⅜
15	3,3	4,1	4,1	½
20	3,6	4,3	4,3	¾
25	3,8	5,1	5,1	1
32	3,8	5,3	5,3	1¼
40	4,1	5,6	5,8	1½
50	4,6	6,1	6,9	2

5.2.5 Threaded ends

5.2.5.1 The threaded end thread axis shall coincide with the end entry axis. The minimum wall thickness at the threaded end shall be as specified in Table 6. An approximate 45° lead-in chamfer, having an approximate depth of one-half the thread pitch, shall be applied at each threaded end.

5.2.5.2 The end threads for PN-designated valves shall be taper pipe threads meeting the requirements of ISO 7-1, or, for Class-designated valves, shall be taper pipe threads meeting the requirements of ASME B1.20.1. Pipe threads shall be gauged in accordance with ISO 7-2 or ASME B1.20.1, as applicable.

5.2.5.3 End-to-end dimensions for threaded end valves shall be established by the manufacturer.

5.2.6 Body openings

Trunnion-mounted valves that employ upstream sealing seats shall be fitted with a DN 15 (NPS ½) test plug having threads in accordance with 5.2.5.2 in order to complete the closure tightness test. Other tapped openings, for any purpose, are permitted only when specified by the purchaser.

5.2.7 Anti-static design

Valves shall incorporate an anti-static feature that ensures electrical continuity between the stem and body of valves $DN \leq 50$, and between the ball, stem and body of larger valves. The anti-static feature shall have electrical continuity across the discharge path with a resistance not exceeding 10Ω from a power source not exceeding 12 V d.c. when type tested on a new, dry, as-built valve after pressure testing and cycling of the valve at least five times.

5.2.8 Anti-blow-out stem

The valve design shall be such that the stem seal retaining device is not the sole means used to retain the stem. The design shall ensure that, while under pressure, the stem is not ejected from the valve by the disassembly of valve external parts, e.g. gland and gland flange bolting. See Annex B.

5.2.9 Ball-stem construction

5.2.9.1 The valve design shall be such that if a failure occurs either at the stem-to-ball connection or any part of the stem within the pressure boundary, no portion of the stem is ejected when the valve is under pressure.

5.2.9.2 Both the stem-to-ball connection and all of that part of the stem within the pressure boundary, shall be designed to exceed the torsional strength of the stem external to the packing by at least 10 %.

5.2.9.3 The stem and the connection between the stem and the ball shall be designed to preclude permanent deformation or failure of any part when a force applied to the direct operating lever or the operational means of a manual gear operator, whichever is furnished with the valve, transmits a torque to the valve stem equal to the greater of either

- a) 20 N·m, or
- b) twice the manufacturer's recommended torque.

5.2.9.4 The manufacturer's recommended torque shall be based on clean, dry air or nitrogen at a differential pressure equal to the maximum differential service pressure rating of the valve.

5.2.10 Ball construction

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

5.2.11 Operating means

5.2.11.1 Valves that are solely manually operated, i.e. without an attached gear or power assist device, shall be fitted with lever-type handles unless otherwise specified by the purchaser.

5.2.11.2 Gear operators, when specified or required to meet the operating force requirements of 5.2.11.3, shall be provided with handwheels for actuation.

5.2.11.3 Unless otherwise specified by the purchaser, the length of the lever type handle or the diameter of the manual gear handwheel shall be sized so that the applied input force to open or close the valve does not exceed 360 N at the torque value specified in 5.2.9.3.

5.2.11.4 For lever-operated valves, position stops shall be provided at both the full open and full closed positions.

5.2.11.5 Valves shall be designed to close when the lever or handwheel is turned in a clockwise direction.

5.2.11.6 Handwheels on manual gear operators shall be marked to indicate either the direction of opening or closing.

5.2.11.7 Lever-type handles shall be mounted with the handle parallel to the ball bore. If the purchaser specifies round or oval direct operating handwheels, a permanent means of indicating the open and closed positions shall be provided.

5.2.11.8 Lever or manual gear box handwheel design shall be such that the lever or gearbox indicating means do not assemble in other than the correct configuration for indicating the open and closed positions.

5.2.11.9 An indication of the position of the flow passageway through the ball shall be integral with the valve stem. This indication may be by a permanent marking on the stem or by a shaping of the stem.

5.2.11.10 Levers, handwheels, and other operating mechanisms shall be fitted to the valve such that they can be removed and replaced without affecting the integrity of the stem or body seal or retention of the stem.

5.2.12 Glands

5.2.12.1 Adjustable packing glands shall be accessible for tightening stem seals without the disassembly of either the valve or operator parts.

5.2.12.2 Packing glands that are threaded into bodies or covers (see Annex B) shall not be used.

5.2.12.3 Vertically split glands shall not be used.

5.2.12.4 Position stops integral with the gland, gland flange or gland bolting shall not be used.

5.2.13 End flange facing interruptions

5.2.13.1 Ring-shaped radial gaps, located in what would be the seating face area of a centred ASME B16.20-style spiral wound gasket on the flange facing area of end flanges, shall not exceed 1,5 mm. The gap is shown as dimension *b* in Figure 2. An example of the occurrence of this type of gap is one that can exist between the outer periphery of a body insert and the inner bore of the body end flange of the valve. This is illustrated in Figure 2.

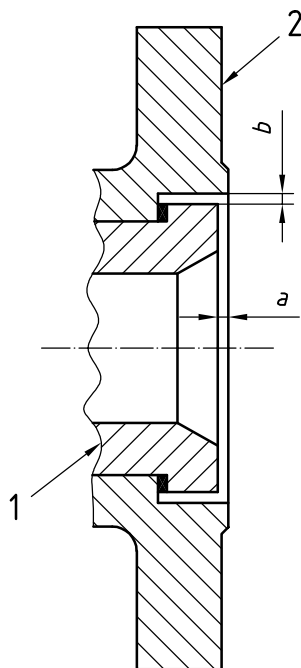
5.2.13.2 For ball valves designed with a body insert (see Annex B) with a gasket seating face outer diameter located within the seating area of a centred ASME B16.20-style spiral wound gasket, the body insert flange face shall not protrude beyond the valve body end flange face. The body insert flange face shall not be recessed below the body end flange face by more than 0,25 mm. The recess is shown as dimension *a* in Figure 2.

5.2.13.3 Threads for body inserts shall have a thread shear area such that the resultant thread shear stress is ≤ 70 MPa at an internal pressure equal to the 38 °C pressure rating.

5.2.14 Shell joints

5.2.14.1 Shell joints are characterized as bolted body-to-cap joints, threaded body-to-cap joints, bolted cover joints and threaded cover joints. Body-to-cap joints are those that could be subject to piping mechanical loads; cover joints, those that are not. See Annex B for part name identification.

5.2.14.2 Bolting used for assembly of shell joints shall be studs or continuously threaded stud bolts with nuts or cap screws. Nuts shall be semi-finished hexagons conforming to ASME B18.2.2, ISO 4032, ISO 4033 or ISO 4034. ASME specified bolting 25 mm diameter and smaller shall have coarse (UNC) threads. ASME specified bolting larger than 25 mm diameter shall be 8 thread series (8UN). ASME specified bolt threads shall be Class 2A and nut threads shall be Class 2B, conforming to ASME B1.1. Metric specified bolting M30 and smaller shall have coarse threads. Metric specified bolting larger than M30 shall be fine threads with 3 mm pitch. Metric specified threads shall be in accordance with ISO 261 and ISO 965-2 tolerance class 6g.



Key

- 1 body insert
- 2 valve body end flange

Figure 2 — Flange face interruption limits

5.2.14.3 Nut and bolt head bearing surfaces in shell joints assembled by bolting shall be perpendicular to the centreline of the tapped or clearance hole for the fastener with a tolerance of $\pm 1^\circ$.

5.2.14.4 A bolted body-to-body cap joint shall be secured by a minimum of four bolts. The minimum bolt size shall be as follows:

- M10 or 3/8 for sizes $25 \leq DN \leq 65$;
- M12 or 1/2 for sizes $80 \leq DN \leq 200$;
- M16 or 5/8 for sizes $250 \leq DN$.

5.2.14.5 At assembly, gasket contact surfaces shall be free of heavy oils, grease and sealing compounds. A light coating of a lubricant, no heavier than kerosene, may be applied if needed to assist in proper gasket assembly.

5.2.14.6 Each bolted or threaded shell joint included in the valve design shall meet one of the following applicable minimum bolting area requirements, which are the minimum requirements of this International Standard and as such do not relieve the valve manufacturer from responsibility to provide additional design basis bolting for specific valve designs.

- Bolted body-to-cap: $P_c \frac{A_g}{A_b} \leq 50,76 \quad S_b \leq 7\,000$
- Threaded body-to-cap: $P_c \frac{A_g}{A_s} \leq 3\,300$
- Bolted cover: $P_c \frac{A_g}{A_b} \leq 65,26 \quad S_b \leq 9\,000$

— Threaded cover:
$$P_c \frac{A_g}{A_s} \leq 4\,200$$

where

S_b is the allowable bolt stress at 38 °C, expressed in megapascals: when its value is > 138 MPa, use 138 MPa;

P_c is the Class designation number for Class-designated valves (e.g. 600), or the PN designation number for PN-designated valves (e.g. 40), multiplied by 6;

A_g is the area bounded by the effective outside periphery of the gasket, expressed in square millimetres;

A_b is the total effective bolt tensile stress area, expressed in square millimetres;

A_s is the total effective thread shear stress area, expressed in square millimetres.

5.2.15 Packing gland bolting

5.2.15.1 When a packing gland is included, the packing gland bolting shall pass through holes in the gland. Open slots for bolting are not permitted in the cover flange, cover or gland.

5.2.15.2 Packing gland bolts shall be sized so that the bolt tensile stress does not exceed one-quarter of the ultimate tensile strength of the bolting material for a compressive packing stress of 38 MPa.

6 Materials

6.1 Shell

The shell, which comprises, as applicable, the body, body insert, body cap, cover and trunnion cap, shall be of a material specified in ASME B16.34 for Class-designated valves or in EN 1092-1 for PN-designated valves. These shell parts are identified in Annex B.

6.2 Shell material repair

Defects in cast or forged valve pressure shell materials that are revealed during manufacturing operations or testing may be repaired as permitted by the most nearly applicable material specification for forgings or castings.

6.3 Trim

The internal metal parts of the valve, such as the ball, stem, metal seats or seat retainers, shall have corrosion-resistant properties equivalent to, or better than, those of the shell. The purchaser may specify materials having greater corrosion resistance or higher strength for these parts.

6.4 Identification plate

The material used for the identification plate shall be an austenitic stainless steel or a nickel alloy. The identification plate shall be attached to the valve by corrosion-resistant fasteners or by welding.

6.5 Bolting

6.5.1 Unless otherwise specified by the purchaser, bolts for assembling shell pressure retaining components shall be in accordance with ASTM A193-B7 or EN 10269, material grade number 1.7225,

42CrMo4 and nuts shall be in accordance with ASTM A194-2H or EN 10269, material grade number 1.1191, C45E. For service temperatures below – 29 °C, the purchase order shall specify the bolting material.

6.5.2 Unless otherwise specified by the purchaser, packing gland bolting material shall have mechanical properties at least equal to either ASTM A307 Grade B, or EN 10269 Grade C35E (1.1181).

6.6 Seals

Material for stem seals, body seals, cover seals and gaskets shall be suitable for use at the maximum allowable temperature and its corresponding pressure rating applied to the valve by the manufacturer. Metallic parts used in seals shall have corrosion-resistant properties equivalent to or better than those of the shell material.

6.7 Threaded plugs

Threaded plugs used for sealing tapped openings shall have corrosion-resistant properties equivalent to, or better than, those of the shell. Malleable, grey or any other form of cast iron shall not be used for plugs.

6.8 Low temperature service

For service at temperatures – 29 °C and lower, materials shall be specified by the purchaser.

7 Marking

7.1 Legibility

Each valve manufactured in accordance with this International Standard shall be clearly marked in accordance with ISO 5209, except that the requirements of this clause shall apply.

7.2 Body marking

7.2.1 The mandatory valve body markings, subject to the provisions of 7.2.2, shall be as follows:

- manufacturer's name or trade mark;
- body material;
- pressure rating as PN followed by the appropriate pressure number, e.g. PN 16, for PN-designated valves, or pressure Class number, e.g. 150, for Class-designated valves;
- nominal size, as either DN followed by the appropriate size number, e.g. DN 500, or the NPS number, e.g. 20.

7.2.2 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 identification plate. The sequence of omission shall be as follows:

- nominal size;
- PN designation or Class number;
- body material.

7.3 Ring joint marking

Body end flanges require marking only when the end flanges are grooved for a ring type end flange gasket. When so grooved, the ring joint gasket number (e.g. R25) shall be marked on the rim of both end flanges. For ring joint gasket numbers, see ASME B16.5.

7.4 Identification plate

Each valve shall have an identification plate with the following marking:

- the manufacturer's name;
- pressure rating designation, PN or Class;
- manufacturer's identification number;
- maximum pressure at 38 °C;
- limiting temperature and associated pressure, if applicable;
- limiting differential pressure and associated temperature, if applicable;
- trim identification, e.g. PTFE;
- pipe thread identification, NPT or Rc.

The number of this International Standard may be included, provided that all of its applicable requirements have been met.

7.5 Special marking for unidirectional valves

Valves designed for, or modified to only have, unidirectional capability, i.e. capability to block flow in only one direction, shall have a separate identification plate attached to the valve body to identify the unidirectional seat. The unidirectional seat shall be shown on the identification plate as shown in Figure 3.

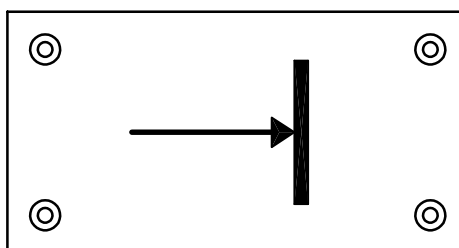


Figure 3 — Typical unidirectional valve identification plate symbol

8 Testing and inspection

8.1 Pressure tests

8.1.1 General

Each valve shall be given a shell pressure test, and a seat closure test in accordance with the requirements of ISO 5208 except as modified herein. 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.

8.1.2 Shell test

8.1.2.1 The shell test shall be at a pressure no less than 1,5 times the pressure corresponding to the valve 38 °C pressure rating. If the valve design includes an adjustable stem seal, it shall be adjusted so as to maintain the shell test pressure.

8.1.2.2 The duration of the shell test — the minimum period of time that the shell test pressure is to be sustained — shall be in accordance with Table 7.

8.1.2.3 Over the duration of the shell test, there shall be no visually detectable leakage through either the shell wall or any of the gasket seals.

Table 7 — Test duration

Valve size range	Minimum test duration	
	Shell test	Seat test
DN ≤ 50	15	15
65 ≤ DN ≤ 150	60	60
200 ≤ DN ≤ 300	120	120
350 ≤ DN ≤ 500	300	120

8.1.3 Closure tightness test

8.1.3.1 For valve designs having resilient seats, the closure tightness test shall be a gas test with the test gas at a pressure between 400 kPa (4 bar) and 700 kPa (7 bar). For floating ball designs, the test method shall be one that fills the body cavity between the seats and the body ball chamber with test gas so as to ensure that no seat leakage can escape detection. For trunnion-mounted valves of upstream sealing design, the test method shall be one that measures leakage across the upstream seat. For trunnion-mounted valves of downstream sealing design, the test method shall be one that measures leakage across the downstream seat.

8.1.3.2 For valve designs having metal or ceramic seats, 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 38 °C (100 °F). For floating ball designs, the test method shall be one that fills the body cavity between the seats and the body ball chamber with test liquid so as to ensure that no seat leakage can escape detection. For trunnion-mounted valves of upstream sealing design, the test method shall be one that measures leakage across the upstream seat. For trunnion-mounted valves of downstream sealing design, the test method shall be one that measures leakage across the downstream seat.

8.1.3.3 The applicable closure test of 8.1.3.1 and 8.1.3.2 shall be applied one flow direction at a time for each seating direction.

8.1.3.4 The duration of the closure test — the minimum period of time that the test pressure is to be sustained for the purpose of obtaining a closure leakage measurement — shall be in accordance with Table 7.

8.1.3.5 Over the duration of the gas closure test, the maximum permitted leakage rate past the seats shall be in accordance with Table 8.

Table 8 — Maximum allowable seat leakage

Valve size range	Maximum allowable seat leakage rate		
	Gas test, resilient seats	Liquid test, metal or ceramic seats ^a	
		mm ³ /s	drops/s
DN ≤ 50	0	6,3	0,1
65 ≤ DN ≤ 150	0	12,5	0,2
200 ≤ DN ≤ 300	0	20,8	0,4
350 ≤ DN ≤ 500	0	29,2	0,5

^a The manufacturer may choose either method of quantifying liquid leakage. It is recognized that the unit conversions are inexact.

8.1.3.6 Visual evidence of leakage through the ball, behind the seats or past shaft seals is not permitted. There shall be no structural damage as a result of the closure test. Plastic deformation of resilient seats or seals is not considered to be structural damage.

8.1.3.7 For the purposes of the gas closure test, zero leakage is defined as 3 mm³ (1 bubble) over the duration of the test.

NOTE It is recognized that the unit conversions are inexact.

8.2 Inspection

8.2.1 Extent of inspection

Inspection by the purchaser may be specified in the purchase order. If not otherwise specified, inspection shall be limited to the following:

- inspection of the valve assembly to ensure compliance with the specifications of the purchase order, which may include specified non-destructive methods of examination;
- witnessing of the required pressure tests and examinations;
- review of mill test reports and, if specified, non-destructive examination records and radiographs.

8.2.2 Site inspection

8.2.2.1 When a purchaser specifies that the purchaser witness tests and examinations at the valve manufacturer's factory, the purchaser's inspector shall have free access to those parts of the factory concerned with the manufacture of the valves when work on the order is under way.

8.2.2.2 When a purchaser specifies examinations that include valve pressure boundary parts manufactured at locations other than the valve manufacturer's factory, these components shall be available for inspection at the location where they are being manufactured.

8.3 Examination

8.3.1 For each valve, the items listed in Annex A shall be checked by the manufacturer before release for shipment.

8.3.2 Castings of pressure boundary parts and closure elements (balls) shall be visually examined by the manufacturer during the course of manufacture so as to ensure conformance with the surface condition requirements of MSS-SP-55.

8.3.3 The valve manufacturer shall examine each valve to assure compliance with this International Standard.

8.3.4 Examinations shall be performed in accordance with written procedures that are in accord with the applicable standards.

8.4 Supplementary examination

8.4.1 Supplementary types of examination are required only if specified in the purchase order.

8.4.2 Magnetic particle, radiographic, liquid penetrant and ultrasonic examination of castings or forgings may be specified as either the purchaser's own procedures and acceptance standards or those standardized in ASME B16.34:1996, Clause 8.

8.4.3 When service conditions require that a fire type-test be conducted, it is recommended that this test be in accordance with ISO 10497.

9 Preparation for despatch

9.1 After testing, each valve shall be drained and prepared for despatch. Special care shall be taken to drain test fluid from the body chamber surrounding the ball.

9.2 Except for austenitic stainless steel valves, unmachined exterior valve body surfaces shall have a rust preventative coating in accordance with the manufacturer's standard. Such coatings shall not contain lead.

9.3 Except for austenitic stainless steel valves, machined or threaded surfaces that are not resistant to atmospheric corrosion shall be coated with an easily removed rust inhibitor. Such coatings shall not contain lead.

9.4 Protective covers of wood, wood fibre, plastic or metal shall be securely affixed to valve ends of flanged and butt-welding end valves in order to safeguard the gasket surfaces and weld end preparations. The cover design shall be such that the valve cannot be installed in a pipeline with the protective cover in place.

9.5 Protective end plugs of wood, wood fibre, plastic or metal shall be securely inserted into the valve ends of socket welding and threaded end valves. The protective plug design shall be such that the valve cannot be installed in a pipeline with the plug in place.

9.6 At the time of shipment, unless precluded by design, the ball shall be in the open position.

9.7 When special packaging is necessary, the purchaser shall specify the requirements in the purchase order.

Annex A (informative)

Information to be specified by the purchaser

NOTE References in square brackets are to clauses or subclauses of this International Standard.

Nominal valve size [1] (DN or NPS)³⁾ :

Nominal pressure [1] (PN or Class):

Seat materials [4.3]:

Body ends [5.2]

Threaded (pipe threads ISO 7-1 or ASME B1.20.1) [5.2.2.2]:

Flanges — if integral flanges are required, it should be so specified [5.2.2.3]:

Flange facing

Raised face, ring joint or other [5.2.2.1]:

Facing finish if other than standard [5.2.2.4]:

Butt-welding end details if other than standard is needed [5.2.3.1]:

Tapped openings required [5.2.6]:

Ball construction other than solid [5.2.10]

Levers — other than standard levers [5.2.11.1 and 5.2.11.7]:

Gear actuators [5.2.11.1]:

Operating force if other than standard [5.2.11.2]:

Material [6]

Pressure-containing shell [6.1]:

Trim, metal other than standard [6.3]:

Bolting — special for low temperature [6.5.1]:

Seals — temperature-rated [6.6]:

Site inspection [8.2]:

Supplementary non-destructive examinations [8.4.2]:

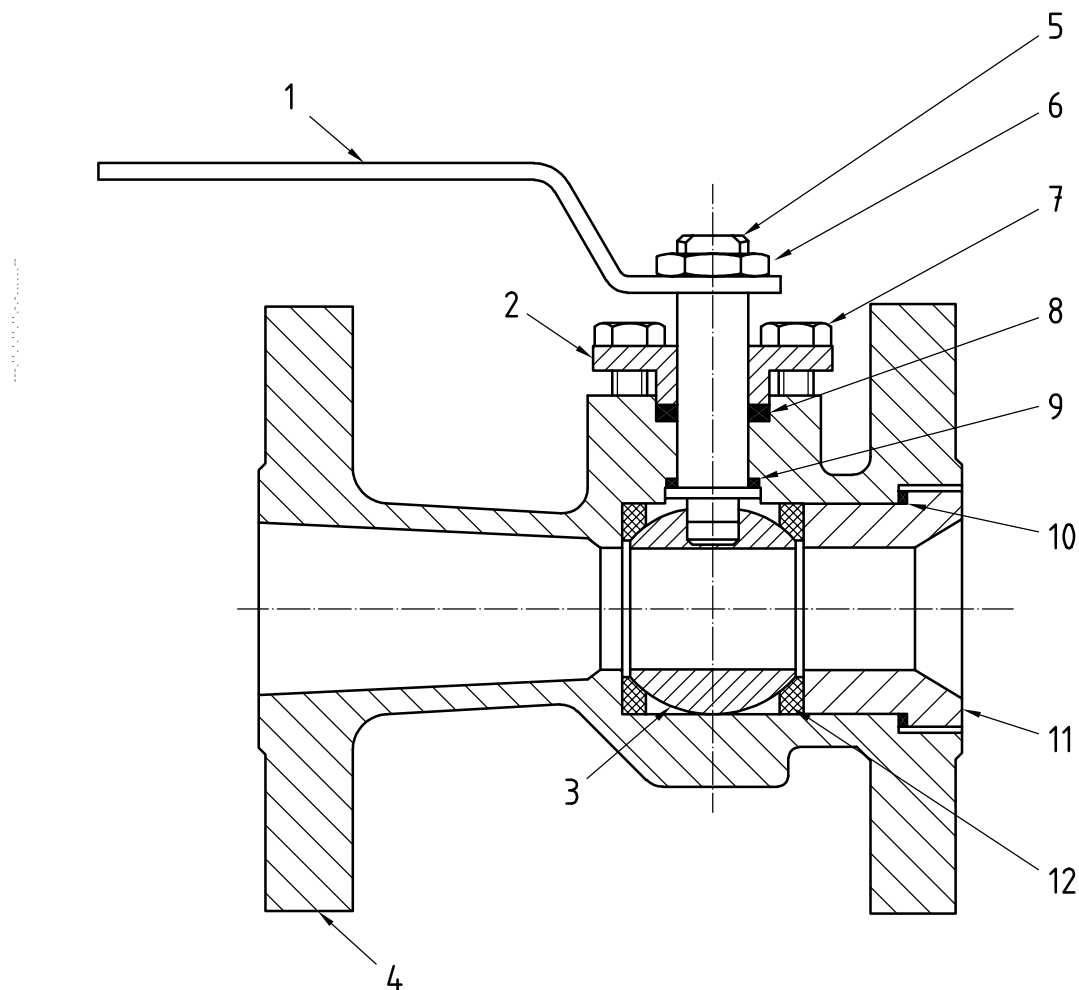
Supplementary fire type-test [8.4.3]:

3) Essential information to be provided by the purchaser.

Annex B (informative)

Identification of valve parts

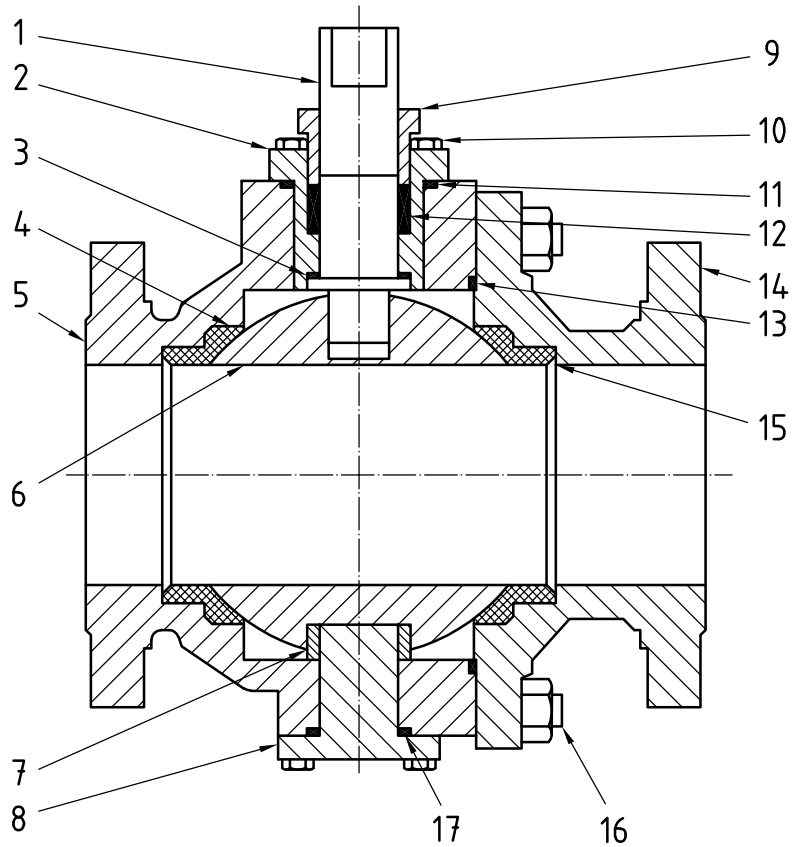
The purpose of these figures is only to identify part names. The construction of a valve is acceptable according to this International Standard only when it complies with the standard in all respects.



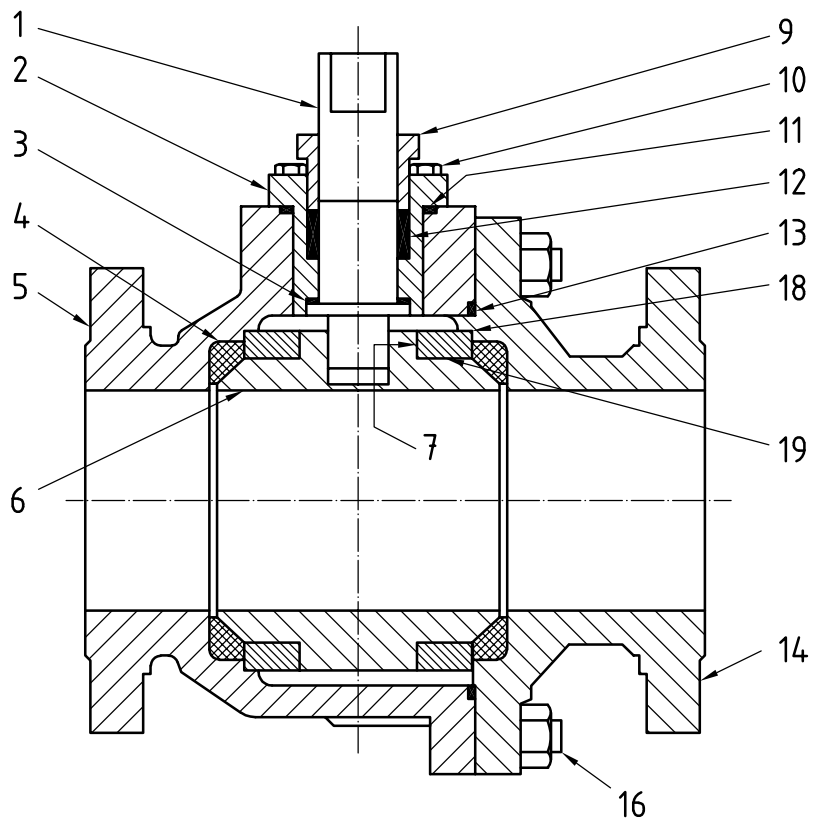
Key

- 1 handle (lever type)
- 2 gland
- 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 B.1 — Typical floating ball valve components (one-piece 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 B.2 — Typical trunnion-mounted ball valve components (split-body valve illustrated) — Nomenclature

Bibliography

- [1] ISO 4200, *Plain end steel tubes, welded and seamless — General tables of dimensions and masses per unit length*
- [2] ISO 5211, *Industrial valves — Part-turn actuator attachments*
- [3] ISO 7121, *Metal ball valves for general-purpose industrial applications*
- [4] ISO 10434, *Bolted bonnet steel gate valves for the petroleum, petrochemical and allied industries*
- [5] ISO 14313, *Petroleum and natural gas industries — Pipeline transportation systems — Pipeline valves*
- [6] ISO 15761, *Steel gate, globe and check valves for sizes DN 100 and smaller, for the petroleum and natural gas industries*
- [7] API Standard 608, *Metal ball valves — Flanged, threaded and welding end*
- [8] ASME B16.11, *Forged fittings, socket-welding and threaded*
- [9] ASME B16.25, *Buttwelding ends*
- [10] ASME B36.10, *Welded and seamless wrought steel pipe*

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ICS 23.060.20; 75.200

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