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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

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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*.

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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.

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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

— ¼; ⅜; ½; ¾; 1; 1¼; 1½; 2; 2½; 3; 4; 6; 8; 10; 12; 14; 16; 18; 20;

and applies for pressure designations

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— 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.

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

— flanged and butt-welded ends, in sizes $15 \leqslant DN \leqslant 500$ ($½ \leqslant NPS \leqslant 20$);

— socket welding and threaded ends, in sizes $8 \leqslant DN \leqslant 50$ ($¼ \leqslant NPS \leqslant 2$);

— 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 welding*[1)]

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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*

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

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*

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

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

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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]

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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.

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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 = 10^5 Pa; 1 MPa = 1 N/mm^2)

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.

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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.

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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 mm				NPS
	Full bore		Reduced bore	Double reduced bore	
	PN 10, 16, 25 and 40	—	PN: All	PN: All	
	Class 150 and 300	Class 600	Class: All	Class: All	
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.

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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 $0{,}35\sqrt{dt_\mathrm{m}}$; 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 $1{,}75\sqrt{dt_\mathrm{m}}$.

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 $\leqslant$ 250 of $\pm$ 2 mm and for DN $\geqslant$ 300 of $\pm$ 4 mm.

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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.

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