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## Bolted bonnet steel gate valves for the petroleum, petrochemical and allied industries

*Robinets-vannes en acier à chapeau boulonné 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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html) (standards.iteh.ai)

This document was prepared by Technical Committee ISO/TC 153, *Valves*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 69, *Industrial valves*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 10434:2004), which has been technically revised.

The main changes compared to the previous edition are as follows:

- [Clause 2](#) “Normative references” was updated;
- higher PN and Class designations have been added, including PN 63, 160, 250 and 400;
- design and manufacturing requirements for the stem to wedge connection have been added.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

## Introduction

The purpose of this document is to establish the basic requirements and practices for flanged and butt-welding end steel gate valves of bolted bonnet construction that is parallel to those given in American Petroleum Institute API Standard 600, eleventh edition.

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# Bolted bonnet steel gate valves for the petroleum, petrochemical and allied industries

## 1 Scope

This document specifies the requirements for a heavy-duty series of bolted bonnet steel gate valves for petroleum refinery and related applications where corrosion, erosion and other service conditions can indicate a need for full port openings, heavy wall sections and large stem diameters.

This document sets forth the requirements for the following gate valve features:

- bolted bonnet;
- outside screw and yoke;
- rising stems;
- non-rising handwheels;
- single or double gate;
- wedge or parallel seating;
- metallic seating surfaces;
- flanged or butt-welding ends.

It covers valves of the nominal sizes DN:

- 25; 32; 40; 50; 65; 80; 100; 150; 200; 250; 300; 350; 400; 450; 500; 600;

corresponding to nominal pipe sizes NPS:

- 1; 1¼; 1½; 2; 2½; 3; 4; 6; 8; 10; 12; 14; 16; 18; 20; 24;

applies for pressure Class designations:

- 150; 300; 600; 900; 1 500; 2 500;

and applies for pressure PN designations:

- 16, 25, 40, 63, 100, 160, 250 and 400.

## 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 amendments) applies.

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

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

ISO 5209, *General purpose industrial valves — Marking*

ISO 5210, *Industrial valves — Multi-turn valve actuator attachments*

## ISO 10434:2020(E)

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

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

ISO 15848-1, *Industrial valves — Measurement, test and qualification procedures for fugitive emissions — Part 1: Classification system and qualification procedures for type testing of valves*

ISO 15848-2, *Industrial valves — Measurement, test and qualification procedures for fugitive emissions — Part 2: Production acceptance test of valves*

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

ASME B1.5, *Acme Screw Threads*

ASME B1.8, *Stub Acme Screw Threads*

ASME B1.12, *Class 5 Interference-Fit Thread*

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

ASME B16.5, *Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 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 B16.25, *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 BPVC-IX, *Boiler and Pressure Vessel Code — Section IX — Welding, Brazing, and Fusing Qualifications*

ASTM A307, *Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength*

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

EN 12516-1:2014+A1:2018, *Industrial valves — Shell design strength — Part 1: Tabulation method for steel valve shells*

MSS-SP-55, *Quality Standard for Steel Castings for Valves, Flanges and Fittings, and Other Piping Components — Visual Method for Evaluation of Surface Irregularities*

### 3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>



**3.1****PN****Class**

alphanumeric designation for pressure-temperature rating that is common for components used in a piping system, used for reference purposes, comprising the letters “PN” or “Class” followed by a dimensionless number indirectly related to the pressure retaining capability as a function of temperature of the component

Note 1 to entry: The number following the letters PN or Class does not represent a measurable value and is not used for calculation purposes except where specified in the relevant standard. There is no definitive correlation that links PN designations to Class designations.

Note 2 to entry: The allowable pressure for a valve having a PN or Class number depends on the valve material and its application temperature and is to be found in tables of pressure/temperature ratings. PN or Class usage is applicable to steel valves bearing DN or NPS *nominal size* (3.2) designations.

Note 3 to entry: See ISO 7268 and ASME B16.34.

**3.2****nominal size****DN****NPS**

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

Note 1 to entry: The number following the letters DN or NPS does not represent a measurable value and is not used for calculation purposes except where specified in the relevant standard. Prefix DN or NPS usage is applicable to steel valves bearing *PN or Class* (3.1) designations.

Note 2 to entry: See ISO 6708 and ASME B16.34.

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**4 Pressure/temperature ratings**

**4.1** For Class designated valves the applicable pressure/temperature ratings shall be in accordance with those specified in the tables of ASME B16.34 for standard Class for the applicable material specification and the applicable Class.

**4.2** For PN designated valves the applicable pressure/temperature ratings shall be in accordance with those specified in the tables of EN 12516-1:2014+A1:2018 for the applicable material specification and the applicable PN number.

**4.3** Restrictions of temperature or pressure, for example those imposed by valve special soft seals or special trim materials, shall be marked on the valve identification plate, see 8.4.

**4.4** The temperature for a corresponding pressure rating is the maximum temperature of the pressure-containing shell of the valve. In general, this temperature is the same as 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.

**4.5** For temperatures below the lowest temperature listed in the pressure/temperature tables (see 4.1, 4.2 and 4.3), the service pressure shall be no greater than the pressure for the lowest listed temperature. The use of valves at lower temperatures is the responsibility of the user. Consideration should be given to the loss of ductility and impact strength of many materials at low temperature.

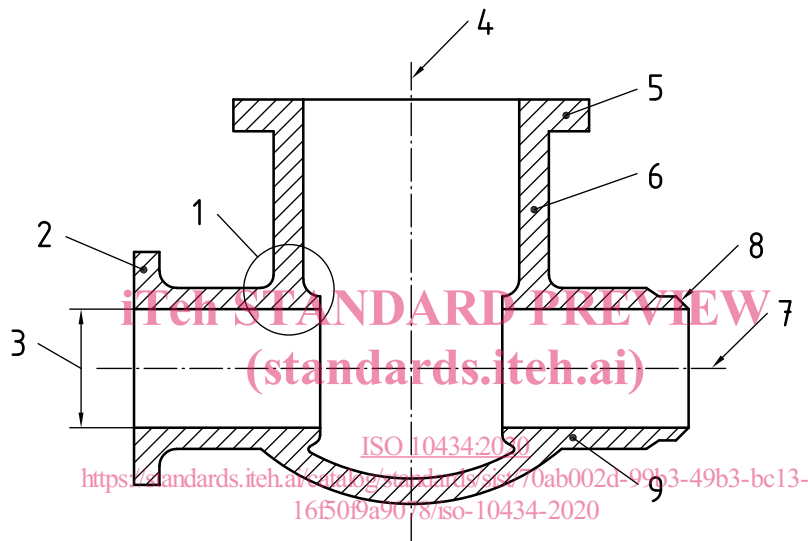
**4.6** Double seated valves, in some design configurations, may be capable of trapping liquid in the centre cavity of the valve when in the closed position. If subjected to an increase in temperature, an excessive build-up of pressure may occur leading to a pressure boundary failure. Where such condition is possible,

it is the responsibility of the user to provide, or require to be provided, means in design, installation or operating procedure to ensure that the pressure in the valve does not exceed that allowed by this document for the resultant temperature.

## 5 Design

### 5.1 Body wall thickness

5.1.1 A valve body schematic is shown in Figure 1. The minimum body wall thickness,  $T_m$ , at the time of manufacture shall be as given in Table 1, except as indicated in 5.1.2 for butt-welding valve ends. Additional metal thickness needed for assembly stresses, stress concentrations, and shapes other than circular shall be determined by individual manufacturers, since these factors vary widely. The body inside diameter (Figure 1, key 3) shall not be less than that specified in Table 6 for the body seat.



**Key**

- |   |                                    |   |                  |
|---|------------------------------------|---|------------------|
| 1 | junction of body run and body neck | 6 | body neck        |
| 2 | body end flange                    | 7 | axis of body run |
| 3 | body port inside diameter          | 8 | butt-welding end |
| 4 | axis of body neck                  | 9 | body run         |
| 5 | body/bonnet flange                 |   |                  |

Figure 1 — Identification of terms

Table 1 — Minimum wall thickness for body and bonnet

PN designation	16	25 and 40	63 and 100	—	160	—	250	—	400	Nominal size NPS
Class designation	150	300	600	900	—	1 500	—	2 500	—	
Nominal size DN	Minimum wall thickness $T_m$ (mm)									
25	6,4	6,4	7,9	12,7	7,7	12,7	8,1	15,0	12,4	1
32	6,4	6,4	8,6	14,2	8,5	14,2	9,4	17,5	14,8	1¼
40	6,4	7,9	9,4	15,0	9,7	15,0	11,4	19,1	18,3	1½
50	8,6	9,7	11,2	19,1	9,2	19,1	13,6	22,4	22,3	2
65	9,7	11,2	11,9	22,4	11,2	22,4	16,9	25,4	28,2	2½
80	10,4	11,9	12,7	19,1	13,2	23,9	20,2	30,2	34,1	3
100	11,2	12,7	16,0	21,3	15,8	28,7	42,0	35,8	42,0	4
150	11,9	16,0	19,1	26,2	22,5	38,1	61,8	48,5	61,8	6
200	12,7	17,5	25,4	31,8	29,1	47,8	81,5	62,0	81,5	8
250	14,2	19,1	28,7	36,6	35,7	57,2	101,2	67,6	101,2	10
300	16,0	20,6	31,8	42,2	42,4	66,8	121,0	86,6	121,0	12
350	16,8	22,4	35,1	46,0	49,0	69,9	140,7	—	—	14
400	17,5	23,9	38,1	52,3	55,6	79,5	160,4	—	—	16
450	18,3	25,4	41,4	57,2	62,3	88,9	180,2	—	—	18
500	19,1	26,9	44,5	63,5	68,9	98,6	199,9	—	—	20
600	20,6	30,2	50,8	73,2	82,2	114,3	239,4	—	—	24

The wall thicknesses for PN 160, PN 250 and PN 400 have been taken directly from EN 12516-1.

**5.1.2** The weld end preparation in butt-welding end valves (see 5.3.2) shall not reduce the body wall thickness to less than the values specified in 5.1.1 within a region closer than  $T_m$  to the outside surface of the body neck, measured along the run direction.

The transition to the weld preparation shall be gradual and the section shall be essentially circular through the entire length of the transition. Sharp discontinuities or abrupt changes in section in areas that infringe into the transition shall be avoided, except that test collars or bands, either welded or integral, are allowed.

In no case shall the thickness be less than  $0,77 T_m$  at a distance of  $2 T_m$  from the weld end.

## 5.2 Bonnet wall thickness

The minimum bonnet wall thickness at the time of manufacture, except for the neck extension that contains the packing, shall be  $T_m$  as given in Table 1. For the neck extension, the local minimum wall thickness shall be based on the local diameter, e.g. the inside diameter of the stem bore or packing box bore, and shall be in accordance with Table 2.

5.3 Body dimensions

5.3.1 Flanged ends

5.3.1.1 Body-end flanges for PN designated valves shall comply with the dimensional requirements of EN 1092-1 and body-end flanges for Class designated valves shall comply with the dimensional requirements of ASME B16.5.

If valve-end flange bolt holes are specified by the purchaser to be other than those of the respective PN or Class flange standard, the manufacturer shall ensure that the resultant total flange bolting cross sectional area is at least as great as that of the bolting being replaced.

Table 2 — Minimum wall thickness for bonnet neck extension

PN designation	16	25 and 40	63 and 100	160	250	400
Class designation	150	300	600	900	1 500	2 500
Bonnet neck extension inside diameter (mm)	Minimum wall thickness <sup>a</sup> (mm)					
15	2,8	3,0	3,6	4,2	5,3	7,6
16	2,8	3,1	3,6	4,4	5,6	7,9
17	2,8	3,2	3,7	4,5	5,8	8,2
18	2,9	3,5	3,9	4,7	5,9	8,5
19	3,0	3,8	4,1	5,1	6,1	8,9
20	3,3	4,0	4,2	5,2	6,3	9,2
25	4,0	4,8	4,8	6,3	7,1	11,0
30	4,6	4,8	4,8	6,5	8,2	13,1
35	4,8	4,8	5,1	7,1	9,7	14,6
40	4,9	5,0	5,7	7,5	10,2	16,4
50	5,5	6,2	6,3	7,9	11,6	19,8
60	5,6	6,4	6,8	8,9	13,4	23,2
70	5,6	6,9	7,4	9,9	15,8	26,5
80	5,8	7,2	8,1	11,0	17,4	30,1
90	6,4	7,4	8,8	12,0	19,1	33,2
100	6,4	7,7	9,5	12,8	20,8	36,7
110	6,4	8,1	10,3	14,1	22,9	40,1
120	6,6	8,6	10,9	14,9	24,8	43,5
130	7,1	8,8	11,3	16,2	26,5	46,9
140	7,1	9,2	12,0	17,3	28,3	50,2

<sup>a</sup> See 5.2.

5.3.1.2 Face-to-face dimensions for flanged end valves shall be as follows:

- for PN designated valves, in accordance with ISO 5752, basic series 3, 4 and 5;
- for Class designated valves, in accordance with ASME B16.10;
- the tolerances for all face-to-face dimensions shall be in accordance with the note in Table 5.

**5.3.1.3** Body-end flanges and bonnet flanges shall be cast or forged integral with the body. However, when specified by the purchaser, forged flanges may be attached by welding.

Welding a flange to a valve body shall be by full penetration butt-welding. The welding operator and welding procedure shall be qualified in accordance with the rules of ISO 9606-1 or the rules of ASME BPVC-IX.

Integral or other types of alignment rings (centering backing rings) used to facilitate welding shall be removed after the weld is completed.

The body to flange weld shall be given a post-weld heat treatment in accordance with [Table 3](#). HBN is the Brinell Hardness number.

**Table 3 — Post weld heat treatment**

Material	Thickness <sup>a</sup> <i>T</i> (mm)	Temperature range (°C)	Holding time (s/mm)	Weld hardness HBN maximum
Carbon steels	$T > 19$	593–649	144	—
Alloy steels:	All	704–746	144	225
½ % < Cr ≤ 2 %	All	704–760	144	241
2¼ % ≤ Cr ≤ 10 %				
Nickel alloy steels	$T > 19$	593–635	72	—
Austenitic steels <sup>b</sup>	All	solution anneal per the material specification		
Other materials	All	per the material specification		

<sup>a</sup> Thickness, *T*, is the greater thickness of the pieces being joined by welding.

<sup>b</sup> Except when materials being welded are L-Grades or stabilized grades.

### 5.3.2 Butt-welding ends

**5.3.2.1** Butt-welding ends for PN designated valves shall be in accordance with [Figure 2](#) and [Table 4](#) and butt-welding ends for Class designated valves shall be in accordance with ASME B16.25 unless otherwise specified by the purchaser.