INTERNATIONAL STANDARD

**ISO 10434**

Third edition
2020-08

# 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).

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).

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.

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.

# 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.

# 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 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.

## 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.

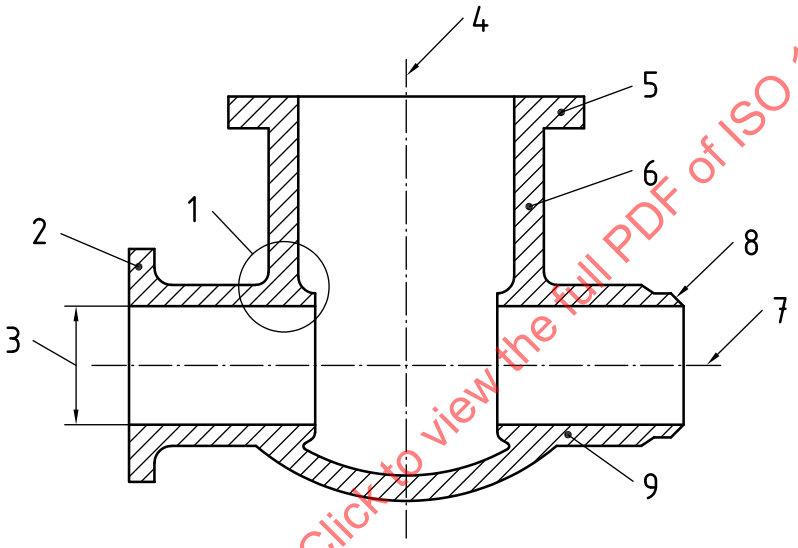
**4.6** Double seated valves, in some design configurations, may be capable of trapping liquid in the centre cavity of the valve when in the closed position. If subjected to an increase in temperature, an excessive build-up of pressure may occur leading to a pressure boundary failure. Where such condition 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 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Class designation | 150 | 300 | 600 | 900 | — | 1 500 | — | 2 500 | — | |
| Nominal size DN | | | Minimum wall thickness $T_m$ (mm) | | | | | | | Nominal size NPS |
| 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**[a] (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 |

[a] 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**

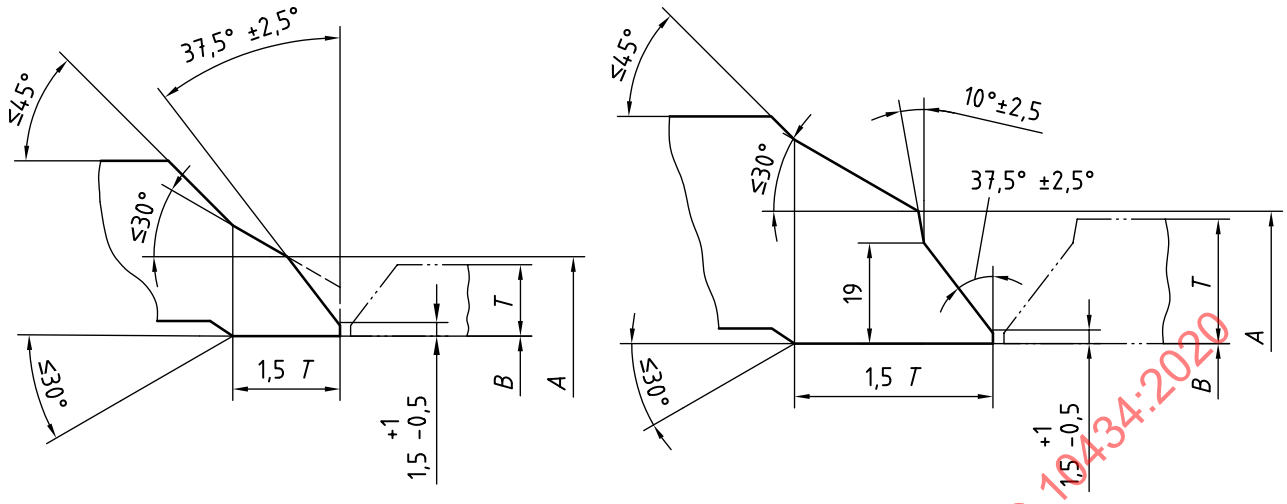
| Material | Thickness[a] $T$ (mm) | Temperature range (°C) | Holding time (s/mm) | Weld hardness HBN maximum |
|---|---|---|---|---|
| Carbon steels | $T > 19$ | 593–649 | 144 | — |
| Alloy steels: | All | 704–746 | 144 | 225 |
| ½ % < Cr ≤ 2 % | All | 704–760 | 144 | 241 |
| 2¼ % ≤ Cr ≤ 10 % | | |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

[a] Thickness, $T$, is the greater thickness of the pieces being joined by welding.

[b] 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.




**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

**Figure 2 — Welding ends**

**Table 4 — Butt-welding end diameters**

| **Nominal size, DN** | | 25 | 32 | 40 | 50 | 65 | 80 | 100 | 150 | 200 | 250 | 300 | 350 | 400 | 450 | 500 | 600 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Nominal size, NPS** | | 1 | 1¼ | 1½ | 2 | 2½ | 3 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 24 |
| **A** (mm) | **diameter** | 35 | 44 | 50 | 62 | 75 | 91 | 117 | 172 | 223 | 278 | 329 | 362 | 413 | 464 | 516 | 619 |
| | **tolerance** | +2,5 / −1,0 | | | | | | | +4 / −1 | | | | | | | | |
| **B** (mm) | **tolerance** | +1 / −1 | | | | | | | | | | +2 / −2 | | | | +3 / −2 | |

Intersections should be slightly rounded.

Valves with minimum wall thickness equal to 3 mm or less may have ends cut square or slightly chamfered. For nominal outside diameters and wall thickness of standard pipe, see ISO 4200.

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

**5.3.2.2** End-to-end dimensions for butt-welding end PN and Class designated valves shall be in accordance with Table 5, unless otherwise specified by the purchaser.

**Table 5 — End-to-end dimensions for butt-welding end valves**

| PN designation | 16 | 25 and 40 | 63 and 100 | 160 | 250 | 400 | |
|---|---|---|---|---|---|---|---|
| Class designation | 150 | 300 | 600 | 900 | 1 500 | 2 500 | |
| Nominal size DN | End-to-end dimensions (mm) | | | | | | Nominal size NPS |
| 25 | 127 | 165 | 216 | 254 | 254 | 308 | 1 |
| 32 | 140 | 178 | 229 | 279 | 279 | 349 | 1¼ |
| 40 | 165 | 190 | 241 | 305 | 305 | 384 | 1½ |
| 50 | 216 | 216 | 292 | 368 | 368 | 451 | 2 |
| 65 | 241 | 241 | 330 | 419 | 419 | 508 | 2½ |
| 80 | 283 | 283 | 356 | 381 | 470 | 578 | 3 |
| 100 | 305 | 305 | 432 | 457 | 546 | 673 | 4 |
| 150 | 403 | 403 | 559 | 610 | 705 | 914 | 6 |
| 200 | 419 | 419 | 660 | 737 | 832 | 1 022 | 8 |
| 250 | 457 | 457 | 787 | 838 | 991 | 1 270 | 10 |
| 300 | 502 | 502 | 838 | 965 | 1 130 | 1 422 | 12 |
| 350 | 572 | 762 | 889 | 1 029 | 1 257 | — | 14 |
| 400 | 610 | 838 | 991 | 1 130 | 1 384 | — | 16 |
| 450 | 660 | 914 | 1 092 | 1 219 | 1 537 | — | 18 |
| 500 | 711 | 991 | 1 194 | 1 321 | 1 664 | — | 20 |
| 600 | 813 | 1 143 | 1 397 | 1 549 | 1 943 | — | 24 |

NOTE Tolerances applicable to the dimensions:

— for DN ≤ 250: ±1,5 mm;

— for DN > 250: ±3 mm.

### 5.3.3 Body seats

**5.3.3.1** The inside diameter of the body seat, except for assembly drive lugs on threaded seat rings, shall not be less than the applicable value specified in Table 6.

**5.3.3.2** Integral body seats are permitted in austenitic stainless-steel valves. When an austenitic stainless steel or a hardfacing material is used for the body seat, this material may be weld deposited directly on the valve body. Otherwise, valve bodies shall have separate shoulder or bottom seated seat rings that are either threaded or welded in place, except that for DN ≤ 50, rolled or pressed-in seat rings may be used.

**5.3.3.3** Body seating surfaces shall have adequate seating area and not have sharp corners at either the inner or outer seat circumference in order to prevent galling or damage to the wedge or disc when operated against full differential pressure.

**5.3.3.4** Sealing compounds or greases shall not be used when assembling seat ring. However, a light lubricant having a viscosity no greater than kerosene may be used to prevent galling of mating threaded surfaces.

**Table 6 — Body seat inside diameter**

| PN designation | 16 | 25 and 40 | 63 and 100 | 160 | 250 | 400 | |
|---|---|---|---|---|---|---|---|
| Class designation | 150 | 300 | 600 | 900 | 1 500 | 2 500 | |
| Nominal size DN | Minimum body seat inside diameter (mm) | | | | | | Nominal size NPS |
| 25 | 25 | 25 | 25 | 22 | 22 | 19 | 1 |
| 32 | 31 | 31 | 31 | 28 | 28 | 25 | 1¼ |
| 40 | 38 | 38 | 38 | 34 | 34 | 28 | 1½ |
| 50 | 50 | 50 | 50 | 47 | 47 | 38 | 2 |
| 65 | 63 | 63 | 63 | 57 | 57 | 47 | 2½ |
| 80 | 76 | 76 | 76 | 72 | 69 | 57 | 3 |
| 100 | 100 | 100 | 100 | 98 | 92 | 72 | 4 |
| 150 | 150 | 150 | 150 | 146 | 136 | 111 | 6 |
| 200 | 200 | 200 | 199 | 190 | 177 | 146 | 8 |
| 250 | 250 | 250 | 247 | 238 | 222 | 184 | 10 |
| 300 | 305 | 305 | 298 | 282 | 263 | 218 | 12 |
| 350 | 336 | 336 | 326 | 311 | 288 | 241 | 14 |
| 400 | 387 | 387 | 374 | 355 | 330 | 276 | 16 |
| 450 | 438 | 431 | 419 | 400 | 371 | 311 | 18 |
| 500 | 489 | 482 | 463 | 444 | 415 | 342 | 20 |
| 600 | 590 | 584 | 558 | 533 | 498 | 412 | 24 |

## 5.4 Bonnet dimensions

**5.4.1** When designing the stem, gland, lantern ring (if supplied) and backseat the manufacturer shall take into account stem guiding and the prevention of packing extrusion.

**5.4.2** The bonnet shall include a conical stem backseat in one of the following forms:

— a bushing positively secured against coming loose, i.e. not relying on friction;

— an integral surface in the case of an austenitic stainless-steel valve;

— an austenitic stainless steel or hardfaced weld deposit that is a minimum of 1,6 mm thick.

**5.4.3** The restrictions of 5.12.3 on tapped openings also apply to the bonnet.

**5.4.4** Bonnets shall be one-piece castings or forgings subject to the same exceptions and requirements as specified in 5.3.1.3.

**5.4.5** The gland bolting shall not be anchored to the bonnet or yoke through a fillet welded attachment or stud welded pins. The gland bolt design shall be such that during repacking the gland bolts are positively retained.

## 5.5 Bonnet-to-body joint

**5.5.1** The bonnet-to-body joint shall be a flange and gasket type.

**5.5.2** For PN 16 and for Class 150 valves, the bonnet-to-body joint shall be one of the types illustrated in either EN 1092-1 or ASME B16.5:

— flat face;

— raised face;

— tongue and groove;

— spigot and recess;

— ring joint.

**5.5.3** For PN > 16 and for Class > 150 valves, the bonnet-to-body joint shall be as in 5.5.2, except that the flat face joint is not permitted.

**5.5.4** The bonnet flange gasket shall be one of the following:

— solid metal, corrugated or flat;

— filled metal jacketed, corrugated or flat;

— metal ring joint;

— spiral wound metal gasket with filler and a centring/compression ring;

— spiral wound metal gasket with filler, to be used only in a body-to-bonnet joint design that provides gasket compression control.

For PN 16 and Class 150, the following is also acceptable:

— flexible graphite sheet, reinforced with a stainless-steel flat, perforated, tanged or corrugated insert.

**5.5.5** Valves designated PN > 16 or Class > 150 in sizes DN > 50 shall have circular bonnet-to-body flanges.

**5.5.6** Bonnet and body flange nut bearing surfaces shall be parallel to the flange face within ±1°. Spot facing or back facing required to meet the parallelism requirement shall be in accordance with ASME B16.5.

**5.5.7** The bonnet-to-body joint shall be secured by a minimum of four through type stud bolts. The minimum stud bolt size for each valve size shall be as follows:

— either M10 or ⅜ when 25 ≤ DN ≤ 65;

— either M12 or ½ when 80 ≤ DN ≤ 200;

— either M16 or ⅝ when 250 ≤ DN.

**5.5.8** The valve bonnet bolting shall meet the requirements of either 5.5.8 a) or 5.5.8 b).

a) For Class designated valves, the cross-sectional area of the valve bonnet bolting shall, as a minimum, meet the requirement of Formula (1):

$$P_c \frac{A_g}{A_b} \leq 65{,}26\, S_b \leq 9\,000 \quad (1)$$

where

$P_c$ is the pressure Class designation number, e.g. 150;

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

$A_g$ is the area bounded by the effective outside periphery of the gasket — except that in the case of a ring joint the bounded area is defined by the pitch diameter of the ring, in $mm^2$;

$A_b$ is the total effective bolt tensile stress area, in $mm^2$.

b) The value of $A_b$ that satisfies Formula (1) is a minimum tensile cross-sectional area requirement for bonnet bolting. The manufacturer is responsible for providing additional bolting area as may be required for valve design details such as gasket compression essentials or special service conditions.

c) For PN designated valves, the cross-sectional area of the valve bonnet bolting shall, as a minimum, meet the requirements of 5.5.8 a) with the substitution of $P_c$ = 150 for PN 16, $P_c$ = 300 for PN 25, $P_c$ = 300 for PN 40 and $P_c$ = 600 for PN 100.

**5.5.9** 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.

## 5.6 Gate

**5.6.1** Gate configurations are categorized as illustrated in Annex B. The types of valve gates are given in Figure B.2.

a) A one-piece wedge gate — as either a solid or flexible wedge design — shall be furnished, unless otherwise specified by the purchaser.

b) A two-piece split wedge gate or parallel seat double disc gate may be furnished when specified by the purchaser. A split wedge gate consists of two independent seating parts that conform to the body seats when closed. A double disc gate has a spreading mechanism that forces the two parallel discs to the body seats when closed.

**5.6.2** Except for a double disc gate, in the open position, the gate shall completely clear the valve seat openings.

**5.6.3** The body guides shall be designed to minimize wear of the valve, to accurately position the gate throughout the travel into its seat and to ensure the alignment of the gate and stem in all orientations without the gate binding or galling.

**5.6.4** Gate seating surfaces shall be integral or faced with weld metal. Unless specified, hardfaced seating surfaces are not required. Finished thickness of any welded facing material shall be not less than 1,6 mm.

**5.6.5** Wedge gates shall be designed to account for closure position seat wear. The dimensions that fix the position of the gate seats relative to the body seats shall be such that the gate, starting from the time of manufacture, can, as a result of seat wear, move into the seats by a distance, $h$, defined as wear travel.

Wear travel is in a direction that is parallel with the valve stem. The required minimum wear travel varies with valve size in accordance with Table 7.

**Table 7 — Minimum wear travel**

| Valve size range DN | Wear travel $h$ (mm) | Valve size range NPS |
|---|---|---|
| 25 ≤ DN ≤ 50 | 2,3 | 1 ≤ NPS ≤ 2 |
| 65 ≤ DN ≤ 150 | 3,3 | 2½ ≤ NPS ≤ 6 |
| 200 ≤ DN ≤ 300 | 6,4 | 8 ≤ NPS ≤ 12 |
| 350 ≤ DN ≤ 450 | 9,7 | 14 ≤ NPS ≤ 18 |
| 500 ≤ DN ≤ 600 | 12,7 | 20 ≤ NPS ≤ 24 |

**5.6.6** The lower face of the wedge tee slot shall allow the stem to transmit a balanced force to the wedge.

## 5.7 Yoke

**5.7.1** The yoke may be either an integral part of the bonnet or a separate part. The yoke shall retain the stem nut which links the handwheel to the stem.

**5.7.2** The yoke and stem nut assembly design shall permit stem nut removal while the valve is under pressure and backseated. This is a design requirement of this document and, as such, is not meant to imply a valve manufacturer's recommendation of its use for any purpose including, for example, stem nut repair or replacement.

**5.7.3** Yokes that are not integral with the bonnet shall have the yoke-to-bonnet mating surfaces that are machined.

**5.7.4** The yoke-to-stem nut bearing surfaces shall be machined flat and parallel. A lubricating fitting shall be provided for the bearing surfaces.

**5.7.5** A design that utilizes a threaded retainer for the stem nut-to-yoke assembly shall provide a positive means, one that does not rely on friction alone, to keep the threaded retainer from disengaging.

## 5.8 Stem and stem nut

**5.8.1** The minimum stem diameter, $d_s$, shall be as given in Table 8. The minimum stem diameter applies to the stem along the surface area that comes into contact with the packing and to the major diameter of the trapezoidal stem thread. However, the major diameter of the stem thread may be reduced, at the manufacturer's option, by no more than 1,6 mm. The stem surface area in contact with the packing shall have a surface finish, $R_a$ of 0,80 µm or smoother.

**5.8.2** Stems shall have a gate attachment means at one end and an external trapezoidal style thread form at the other. Stem nuts shall be used for handwheel attachment and to drive the operating stem thread.

**5.8.3** The stem-to-stem nut threads shall be of trapezoidal form as specified in ASME B1.5 or ASME B1.8, with nominal dimensional variations allowed. Stem threads shall be left-handed so that a direct operated handwheel rotated in a clockwise direction closes the valve.

**5.8.4** The stem shall be one-piece wrought material. A stem that is a welded fabrication or a threaded assembly or both in combination is not permitted under this document.

**5.8.5** The stem end that connects to a gate shall be in the form of a "T", except that for a double disc gate, the end connection may be threaded.

**Table 8 — Minimum stem diameter**

| PN designation | 16 | 25 and 40 | 63 and 100 | 160 | 250 | 400 | |
|---|---|---|---|---|---|---|---|
| Class designation | 150 | 300 | 600 | 900 | 1 500 | 2 500 | |
| Nominal size DN | Minimum stem diameter $d_s$ (mm) | | | | | | Nominal size NPS |
| 25 | 15,59 | 15,59 | 15,59 | 18,77 | 18,77 | 18,77 | 1 |
| 32 | 15,59 | 15,59 | 15,59 | 18,77 | 18,77 | 18,77 | 1¼ |
| 40 | 17,17 | 18,77 | 18,77 | 21,87 | 21,87 | 21,87 | 1½ |
| 50 | 18,17 | 18,77 | 18,77 | 25,04 | 25,04 | 25,04 | 2 |
| 65 | 18,77 | 18,77 | 21,87 | 28,22 | 28,22 | 28,22 | 2½ |
| 80 | 21,87 | 21,87 | 25,04 | 28,22 | 31,39 | 31,69 | 3 |
| 100 | 25,04 | 25,04 | 28,22 | 31,39 | 34,47 | 34,47 | 4 |
| 150 | 28,22 | 31,39 | 37,62 | 40,77 | 43,84 | 46,94 | 6 |
| 200 | 31,39 | 34,47 | 40,77 | 46,94 | 53,24 | 59,54 | 8 |
| 250 | 34,47 | 37,62 | 46,94 | 53,24 | 62,74 | 72,24 | 10 |
| 300 | 37,62 | 40,77 | 50,14 | 56,44 | 69,14 | 81,84 | 12 |
| 350 | 40,77 | 43,84 | 56,44 | 59,54 | 75,44 | — | 14 |
| 400 | 43,84 | 46,94 | 59,54 | 62,74 | 75,44 | — | 16 |
| 450 | 46,94 | 50,14 | 62,74 | 69,14 | — | — | 18 |
| 500 | 50,14 | 53,24 | 69,14 | 75,44 | — | — | 20 |
| 600 | 56,44 | 62,74 | 75,44 | — | — | — | 24 |

**5.8.6** The stem connection shall be designed to prevent the stem from turning or from becoming disengaged from the gate while the valve is in service.

**5.8.7** The stem design shall be such that the strength of the stem to gate connection and the part of the stem within the valve pressure boundary shall, under axial load, exceed the strength of the stem at the root of the operating thread.

**5.8.8** The one-piece stem shall include a conical or spherical raised surface that seats against the bonnet backseat when the gate is at its fully open position. A stem-bonnet backseat is a requirement of this document and, as such, is not meant to imply a manufacturer's recommendation of its use for the purpose of adding or replacing packing while the valve is under pressure.

**5.8.9** The stem nut design shall allow for the removal of the handwheel while keeping the stem (and disc) in a fixed position.

**5.8.10** The stem-nut-to-handwheel attachment shall be through a hexagonal interface, a round interface having a keyway or another means of equivalent strength.

**5.8.11** When the stem nut is retained in the yoke by means of a threaded bushing, the bushing shall be secured in place using either a lock weld or a positive mechanical lock. Locking by simple metal upsetting such as peening or staking is not permitted.

**5.8.12** The closed-position stem thread projection beyond the stem nut on a new valve shall be a distance having a minimum equal to the valve wear travel and a maximum of five times the wear travel for valves DN ≤ 150 and three times the wear travel for valves DN > 150.

**5.8.13** Valves DN ≥ 150 with designations PN ≥ 100 or Class ≥ 600, shall be furnished with stem nuts having ball or roller bearings.

## 5.9 Packing and packing box

**5.9.1** The packing may be either square or rectangular in cross-section. The nominal radial width of the packing, *w*, shall be in accordance with Table 9.

**Table 9 — Nominal radial width of packing**

| Nominal stem diameter $d_n$ (mm) | Nominal radial width of the packing $w$ (mm) | Packing box clearance factor $y$ (mm) |
|---|---|---|
| $15 < d \leq 27$ | 6,4 | 0,4 |
| $27 < d \leq 37$ | 7,9 | 0,4 |
| $37 < d \leq 49$ | 9,5 | 0,4 |
| $49 < d \leq 56$ | 11,1 | 0,8 |
| $56 < d \leq 74$ | 12,7 | 0,8 |
| $74 < d$ | 14,3 | 0,8 |

**5.9.2** The nominal depth of the packing box shall accommodate a minimum of five uncompressed rings of packing. Unless otherwise specified by the purchaser, the packing box surface area in contact with the packing material shall have a surface finish, $R_a$, of 3,2 µm or smoother.

**5.9.3** The nominal bore (inside diameter) of the packing box shall be the sum of the nominal valve stem diameter, $d_n$, plus twice the nominal packing width, *w*, plus a clearance factor, *y*, i.e. $d_n + 2\,w + y$. See Table 9.

**5.9.4** A gland and a separate gland flange shall be provided for packing compression. The gland flange shall have two holes to receive the gland bolting. Slots for gland flange bolts shall not be used. The gland and gland flange shall be self-aligning. The gland shall have a shoulder at its outer edge to prevent complete entry of the gland into the packing box.

**5.9.5** A lantern ring shall be provided only if specified by the purchaser.

Holes shall be located 180° apart on each end for its removal. These holes may be either through holes for use with a hook or threaded holes using the ½-coarse thread series (No. 5-40UNC) as specified in ASME B1.1.

When a lantern ring is installed, the packing box shall be tapped opposite the centre of the installed lantern ring and shall be fitted with a threaded round or hexagon head plug size DN ≥ 8 (NPS ≥ ¼). The plug shall be in accordance with ASME B16.11.

When the threaded opening requires additional metal thickness to obtain adequate wall thickness, a boss shall be provided as specified in 5.12.4 and 5.12.5, proportioned for sizes not listed.

In order to accommodate the lantern ring, the packing box depth shall be at least equivalent to that of a minimum of three uncompressed rings of packing above the lantern ring and three uncompressed rings of packing below the lantern ring plus the length of the lantern ring.

**5.9.6** The clearance between the packing box bore (inside diameter) and the outside diameter of the gland (Figure B.1) shall be nominally less than the diametrical clearance between the inside diameter of the gland and the stem diameter.

## 5.10 Bolting

**5.10.1** Bolting for the bonnet-to-body joint shall be continuously threaded stud bolts with heavy, semi-finished hexagon nuts that are in accordance with ASME B18.2.2.

**5.10.2** Yoke-to-bonnet bolting shall be either continuously threaded stud bolts or headed bolts with hexagon nuts.

**5.10.3** Gland bolts shall be hinged eyebolts, headed bolts, stud bolts or studs. Hexagon nuts shall be used.

**5.10.4** Bolting with diameters 25 mm and smaller shall have coarse (UNC) threads or the most nearly corresponding metric threads. Bolting with diameters larger than 25 mm shall be 8 thread series (8UN) or the most nearly corresponding metric threads. Bolt threads shall be Class 2A and nut threads shall be Class 2B, in accordance with ASME B1.1. Studs used for gland bolting shall use a Class 5 interference fit conforming to ASME B1.12.

## 5.11 Operation

**5.11.1** Unless otherwise specified by the purchaser, the valve shall be supplied with a direct operated handwheel that opens the valve when turned in a counter-clockwise direction.

**5.11.2** The handwheel shall be a spoke-rim type with a maximum of six spokes and shall be free from burrs and sharp edges. Unless otherwise specified, the handwheel shall be a one-piece casting or forging or a multi-piece carbon steel fabrication that includes other carbon steel product forms. Fabricated handwheels shall have strength and toughness characteristics comparable to that of handwheels made as one-piece castings or forgings.

**5.11.3** The handwheel shall be marked with the word “OPEN” and an arrow pointing in the direction of opening, except when the handwheel size makes such marking impractical.

**5.11.4** The handwheel shall be retained on the stem nut by a threaded handwheel nut.

**5.11.5** If operation by a chain wheel, gearbox or power actuator is to be added to the valve, the purchaser shall specify the following, as applicable:

— for chainwheel operation, the dimension from the centreline of the valve stem to the bottom of the chain loop;

— spur or bevel gear and the position of gearing handwheel relative to the pipe axis;

— electric, hydraulic, pneumatic or other actuator type;

— maximum service temperature and pressure differential across the valve disc;

— power supply attributes for power actuators.

**5.11.6** Valve-to-gearbox or power actuator flange mating dimensions shall be according to ISO 5210 or shall comply with the purchaser’s specifications.

## 5.12 Auxiliary connections

**5.12.1** Auxiliary connections are not permitted, except when specified by the purchaser.

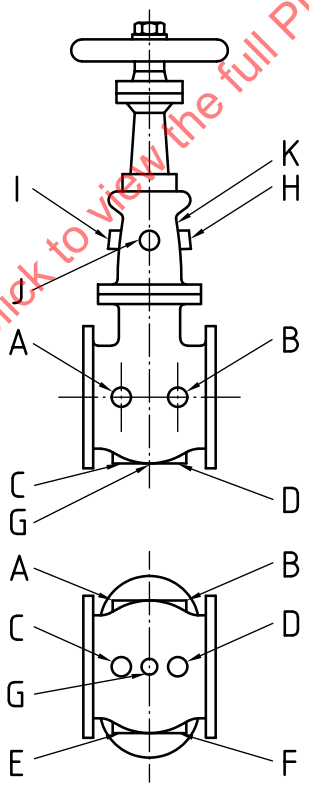
**5.12.2** Unless the purchaser specifies otherwise, the minimum nominal pipe size for auxiliary connections shall be in accordance with Table 10.

**Table 10 — Auxiliary connection size**

| Valve size range | | Auxiliary connection minimum size | |
|---|---|---|---|
| DN | NPS | DN | NPS |
| $50 \leq d \leq 100$ | $2 \leq d \leq 4$ | 15 | ½ |
| $150 \leq d \leq 200$ | $6 \leq d \leq 8$ | 20 | ¾ |
| $250 \leq d \leq 600$ | $10 \leq d \leq 24$ | 25 | 1 |

**5.12.3** Tapped opening size for testing shall be DN ≤ 15 unless the purchaser specifies otherwise.

**5.12.4** Auxiliary connections shall be identified as indicated in Figure 3. Each of the 11 locations is designated by a letter.




**Key**

| | | | |
|---|---|---|---|
| A, B | opposite side of E and F | H, I | on valve ends |
| C, D | on bottom of valve | J | on same side as A and B |
| E, F | opposite side of A and B | K | on same side as E and F |
| G | same side as C and D | | |

**Figure 3 — Location of tapped openings for auxiliary connections**

**5.12.5** When bosses require additional metal thickness to obtain adequate metal wall thickness, the minimum inscribed diameter of the boss shall be in accordance with Table 11.

**Table 11 — Minimum inscribed boss diameter**

| Auxiliary connection size | | Minimum inscribed diameter (mm) |
|---|---|---|
| DN | NPS | |
| 15 | ½ | 38 |
| 20 | ¾ | 44 |
| 25 | 1 | 54 |
| 32 | 1¼ | 64 |
| 40 | 1½ | 70 |

**5.12.6** The wall of the valve may be tapped for a pipe connection if the metal thickness is thick enough to allow the effective thread length, *L*, shown in Figure 4 and given in Table 12. Where the thread length is insufficient or the tapped hole needs reinforcement, a boss shall be added as specified in 5.12.4. Pipe threads shall be of the taper style in accordance with either ASME B1.20.1 or ISO 7-1 Rc.

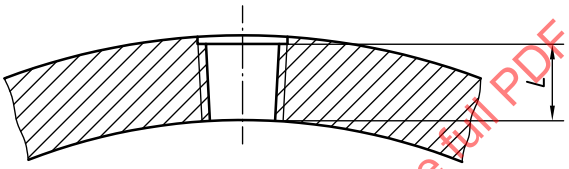
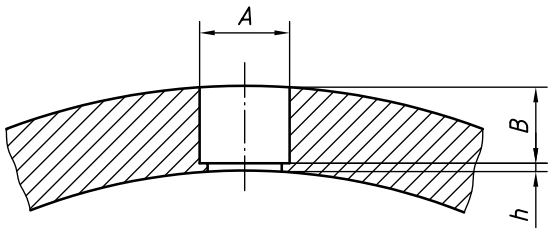



**Figure 4 — Thread length for auxiliary connections**

**Table 12 — Pipe connection thread length**

| Auxiliary connection size | | Minimum thread length *L* (mm) |
|---|---|---|
| DN | NPS | |
| 15 | ½ | 14 |
| 20 | ¾ | 14 |
| 25 | 1 | 18 |
| 32 | 1¼ | 18 |
| 40 | 1½ | 19 |

**5.12.7** Sockets for socket welding connections may be provided if the metal is thick enough to accommodate the depth of socket and remaining wall as shown in Figure 5 and given in Table 13. Where the wall thickness is insufficient for the socket welding connection, a boss shall be added as specified in 5.12.5. The length of the leg of the connection attachment weld shall be 1,09 times the nominal pipe wall thickness of the auxiliary connection or 3 mm, whichever is the greater.




**Key**

*A* minimum diameter of socket

*B* minimum depth of socket

*h* 1,5 mm minimum

**Figure 5 — Socket welding for auxiliary connections**

**Table 13 — Socket dimensions**

| Auxiliary connection size | | $A_{min}$ (mm) | $B_{min}$ (mm) | $h_{min}$ (mm) |
|---|---|---|---|---|
| DN | NPS | | | |
| 15 | ½ | 22 | 5 | 1,5 |
| 20 | ¾ | 27 | 6 | 1,5 |
| 25 | 1 | 34 | 6 | 1,5 |
| 32 | 1¼ | 43 | 6 | 1,5 |
| 40 | 1½ | 49 | 6 | 1,5 |

**5.12.8** Auxiliary connections may be attached by butt-welding directly to the wall of the valve as shown in Figure 6. Where the size of the opening is such that reinforcement is necessary, a boss shall be added as specified in 5.12.5.

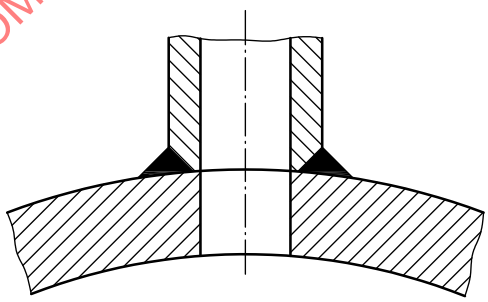


**Figure 6 — Butt-welding for auxiliary connections**



# 6 Materials

## 6.1 Materials other than trim materials

Materials for body, bonnet, and valve parts other than trim items shall be selected from Table 14.

**Table 14 — Materials for parts**

| Part | Material[a] |
|---|---|
| Body and bonnet | As selected from ASME B16.34. |
| Gate | Steel, at least equal in corrosion resistance to that of the body material. |
| Yoke, separate | Carbon steel or same material as the bonnet. |
| Bolting: body to bonnet | Unless otherwise agreed between the purchaser and manufacturer, the bolting material listed in Annex C is recommended. However, for service temperatures below –29 °C or above 454 °C, the purchase order shall specify the bolting material. |
| Bonnet gasket | The metallic portion exposed to the service environment shall be of a material that has a corrosion resistance at least equal to that of the body material. |
| Bolting: gland and yoke | Bolting material at least equal to ASTM A307-Grade B. |
| Seat ring | As in Table 15, except that when weld deposited facings are used, the base material shall be of similar corrosion resistance as the body material. |
| Gland flange | Steel |
| Gland | Material with melting point above 955 °C. |
| Packing | Suitable for steam and petroleum fluids for temperature range from –29 °C to 538 °C.<br>Shall contain a corrosion inhibitor. |
| Lantern ring | Material having corrosion resistance at least equal to that of the body material. |
| Stem nut | Austenitic ductile iron or copper alloy with melting point above 955 °C. |
| Handwheel | Malleable iron, carbon steel or ductile iron. |
| Handwheel nut (retaining) | Steel, malleable iron, ductile iron or non–ferrous copper alloy. |
| Pipe plugs | Nominal composition shall be the same as the shell material. Cast iron plugs shall not be used. |
| Bypass piping and valves | Nominal composition shall be the same as the shell material. |
| Pin, double disk stem to gate | Austenitic stainless steel |
| Identification plate | Austenitic stainless steel or nickel alloy attached to the valve by corrosion-resistant fasteners or by welding. |

[a] Metallic parts shall not be treated with zinc or cadmium coatings.



## 6.2 Trim materials

**6.2.1** Trim items include the stem, the gate seating surfaces, the backseat seating surface and the body or body seat ring seating surfaces. The trim combination number (CN) identifies both the stem material and the associated seating surface material. Except as noted in 6.2.2 and 6.2.3 or when otherwise agreed between the purchaser and manufacturer, the trim material combinations shall be in accordance with Table 15. Trim material usage is specific to the associated valve body and body to bonnet bolting material. Information is to be found in Annex C for commonly used valve materials.

**6.2.2** Trims of free machining materials, e.g. 13Cr steel grades containing additions of elements such as lead, selenium or sulfur to enhance machinability, are intentionally not listed in Table 15. They may be used only when specified by the purchaser, in which case they shall be identified by the appropriate trim number from Table 11 plus 100. The affected trim CN numbers would thus be identified as, e.g. CN101, 104, 105, 105A, 106, 107, 108 and 108A. Correspondingly, hardfacing or other material overlays shall not be applied to free machining grades of base materials unless so specified by the purchaser.

**6.2.3** Seat ring seating surfaces where the facing material is applied by plasma arc or a laser process shall have a minimum finished facing material thickness of 0,5 mm. All other weld deposited seating surfaces shall have a minimum finished facing material thickness of 1,6 mm. Mating seating surfaces shall not have sharp edges, e.g. edges positioned that may cause damage to the gate seat ring surfaces at either inner or outer seating circumferences.

**6.2.4** The trim material shall be the manufacturer's standard trim material for the combination number, CN, specified in the purchase order. For a specified CN in a purchase order an alternative CN may be furnished in accordance with Table 16. However, it is not permissible to furnish a listed specified CN when an alternative CN is specified in a purchase order without agreement from the purchaser.

**Table 15 — Basic trim materials**

| Part | Combination number CN | Material description | Brinell hardness HB |
|---|---|---|---|
| Stem[a] | 1, 4, 5, 5A, 6, 7, 8 or 8A | 13Cr | 200 min/275 max |
| | 2 or 15 | 18Cr-8Ni | [c] |
| | 3 | 25Cr-20Ni | [c] |
| | 9, 11 or 11A | NiCu alloy | [c] |
| | 10, 12, 12A, or 16 | 18Cr-8Ni-Mo | [c] |
| | 13, 14, 14A, or 18 | 19Cr-29Ni | [c] |
| | 17 | 18Cr-10Ni-Cb | [c] |

Cr = chromium; Ni = nickel; Co = cobalt; Mo = molybdenum; Cb = columbium; Cu = copper. HF = hard facing using CoCr welding alloy. HFA = hard facing using NiCr welding alloy.

Free machining grades of 13 Cr are not used.

For CN 1, a differential hardness of at least 50 Brinell points is required between mating surfaces. For seating surfaces, single material entries designate the same material for both seating surfaces. For seating surfaces, dual entries do not designate a particular seating surface.

[a] Stems are wrought material.

[b] Backseat surfaces, Figure B.1, Key 11, for CN 1 and CN 4 to CN 8, have a minimum hardness of 250 HB.

[c] Hardness is not specified.

**Table 15** *(continued)*

| Part | Combination number CN | Material description | Brinell hardness HB |
|---|---|---|---|
| Seating surfaces[b] | 1 | 13Cr | 250 min |
| | 2 | 18Cr-8Ni | [c] |
| | 3 | 25Cr-20Ni | [c] |
| | 4 | 13Cr | 750 min |
| | 5 | HF | 350 min |
| | 5A | HFA | 350 min |
| | 6 | 13Cr/CuNi | 250 min/175 min |
| | 7 | 13Cr/13Cr | 300 min/750 min |
| | 8 | 13Cr/HF | 250 min/350 min |
| | 8A | 13Cr/HFA | 250 min/350 min |
| | 9 | NiCu alloy | [c] |
| | 10 | 18Cr-8Ni-Mo | [c] |
| | 11 | NiCu alloy/HF | [c] / 350 min |
| | 11A | NiCu alloy/HFA | [c] / 350 min |
| | 12 | 18Cr-8Ni-Mo/HF | [c] / 350 min |
| | 12A | 18Cr-8Ni-Mo/HFA | [c] / 350 min |
| | 13 | 19Cr-29Ni | [c] |
| | 14 | 19Cr-29Ni/HF | [c] / 350 min |
| | 14A | 19Cr-29Ni/HFA | [c] / 350 min |
| | 15, 16 17 or 18 | HF | 350 min |

Cr = chromium; Ni = nickel; Co = cobalt; Mo = molybdenum; Cb = columbium; Cu = copper. HF = hard facing using CoCr welding alloy. HFA = hard facing using NiCr welding alloy.

Free machining grades of 13 Cr are not used.

For CN 1, a differential hardness of at least 50 Brinell points is required between mating surfaces. For seating surfaces, single material entries designate the same material for both seating surfaces. For seating surfaces, dual entries do not designate a particular seating surface.

[a] Stems are wrought material.

[b] Backseat surfaces, Figure B.1, Key 11, for CN 1 and CN 4 to CN 8, have a minimum hardness of 250 HB.

[c] Hardness is not specified.

**Table 16 — Alternative trim numbers**

| **Specified CN** | 1 | 2 | 5A | 6 | 8A | 8 | 10 | 15 | 13 |
|---|---|---|---|---|---|---|---|---|---|
| **Alternative CN** | 5, 5A, 8 or 8A | 10 | 5 | 8 | 5, 5A, 8 | 5 | 12 or 12A | 16 | 14 or 14A |

## 6.3 Welding for fabrication and repair

**6.3.1** When fabrication welds are permitted by a purchaser, the welds joining pressure shell materials forming valve bodies or bonnets shall be joined by full penetration butt-welding. For such fabrications, the welding operator and welding procedure shall be qualified in accordance with ISO 9606-1 or the rules of ASME BPVC-IX. Alignment rings, integral or loose, used as welding aids 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 or bonnet materials are suitable for the full range of service conditions, shall be performed as required by the material specification. These requirements do not apply for seal welds or attachment welds such as those for backseat bushings, seat rings, lifting lugs and auxiliary connections.

**6.3.2** Defects in the 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 specification for forgings or castings.

# 7 Testing, inspection and examination

## 7.1 Pressure tests

### 7.1.1 General

Each valve shall be given a shell pressure test, a seat closure test and a stem backseat 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 sealing surfaces from galling.

### 7.1.2 Shell test

**7.1.2.1** The shell test shall be at a pressure no less than 1,5 times the pressure corresponding to the valve 38 °C pressure rating. The packing gland shall be adjusted so as to maintain the test pressure. For this test, the valve shall be in the partly open position.

**7.1.2.2** 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 17.

**7.1.2.3** Over the duration of the shell test there shall be no visually detectable leakage through the shell wall or at the bonnet gasket.

**Table 17 — Duration of pressure tests**

| Valve size range DN | Minimum test duration[a] (s) | | | Valve size range NPS |
|---|---|---|---|---|
| | Shell | Closure | Optional backseat[b] | |
| DN ≤ 50 | 15 | 15 | 15 | NPS ≤ 2 |
| 65 ≤ DN ≤ 150 | 60 | 60 | 60 | 2½ ≤ NPS ≤ 6 |
| 200 ≤ DN ≤ 300 | 120 | 120 | 60 | 8 ≤ NPS ≤ 12 |
| 350 ≥ DN | 300 | 120 | 60 | 14 ≤ NPS |

[a] The minimum period of time that the test pressure is to be sustained for the purpose of obtaining a seat closure leakage measurement.

[b] See 7.1.3.

### 7.1.3 Closure tightness test

**7.1.3.1** The closure tightness test for each valve shall be either a gas leakage test or a liquid leakage test as categorized in Table 18.

a) For a gas leakage test the test gas pressure shall be between 400 kPa (4 bar) and 700 kPa (7 bar).

b) For a liquid leakage test the test liquid pressure shall not be less than 1,1 times the maximum allowable valve pressure rating at 38 °C.

**Table 18 — Closure tests by category**

| Valve size range | Pressure designation range[a] | |
|---|---|---|
| | Gas test | Liquid test |
| DN ≤ 100<br>NPS ≤ 4 | PN ≤ 100<br>Class ≤ 1 500 | PN > 100<br>Class > 1 500 |
| DN > 100<br>NPS > 4 | PN ≤ 100<br>Class ≤ 600 | PN > 100<br>Class > 600 |

[a] PN 100 is the highest PN designation, see Clause 1.

**7.1.3.2** A closure tightness test shall be applied in one direction at a time for each seating direction. The test method shall include filling the upstream side of the valve, the body cavity between the seats and the bonnet cavity with test fluid.

**7.1.3.3** The duration of the closure tightness test, the minimum period of time that the test pressure is to be sustained for the purpose of obtaining a seat closure leakage measurement, shall be in accordance with Table 17.

**7.1.3.4** Over the duration of the closure tightness test, the maximum permitted leakage rate past the valve seats shall be in accordance with Table 19. For the purpose of the gas test, zero leakage is defined as less than 3 $mm^3$ (1 bubble) leakage over the specified test duration. For the purpose of the liquid test, zero leakage is defined as no visible leakage over the specified test duration.

**Table 19 — Closure leakage rate**

| Valve size range DN | Maximum allowable gas leakage rate[a] | | Maximum allowable liquid leakage rate[a] | | Valve size range NPS |
|---|---|---|---|---|---|
| | ($mm^3$/s) | (bubbles/s) | ($mm^3$/s) | (drops/s) | |
| DN ≤ 50 | 0 | 0 | 0 | 0 | NPS ≤ 2 |
| 65 ≤ DN ≤ 150 | 25 | 0,4 | 12,5 | 0,2 | 2½ ≤ NPS ≤ 6 |
| 200 ≤ DN ≤ 300 | 42 | 0,7 | 20,8 | 0,4 | 8 ≤ NPS ≤ 12 |
| 350 ≥ DN | 58 | 0,9 | 29,2 | 0,5 | 14 ≥ NPS |

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

**7.1.3.5** Throughout the duration of the closure tightness test there shall be no visible evidence of leakage through the gate proper or from behind the installed seat rings.

**7.1.3.6** When volumetric devices are used to measure seat leakage rates, they shall be calibrated to yield results equivalent to those of Table 19 for the valves under test. These devices shall be calibrated with the same test fluid, at the same temperature, as used for the valve closure tests.

**7.1.3.7** Valves for which gas tests are specified in Table 18 shall have valve closure elements that are designed to sustain pressure loads corresponding to the conditions of the liquid test according to 7.1.3.1 b) and shall have the capability of meeting the liquid leakage requirements specified in Table 19. The manufacturer shall maintain a record of type tests that confirm that the high-pressure closure test criteria have been met.

**7.1.3.8** A block-and-bleed closure tightness test may be specified by a purchaser. Block-and-bleed closure requires that the two gate valve seating surfaces, with the disc in the closed position, block flow into the body cavity from both valve ends.

For block-and-bleed seat tightness testing, pressure shall be applied successively (not simultaneously) to each side of the closure member through the respective valve end port. Leakage past the seating surface, into the body cavity, shall be determined either at the packing chamber (with no packing installed) or through a tapped opening between the seats.

Closure tightness shall be measured with the valve stem vertical. The leakage rate from either seat shall not exceed that specified in Table 19.

### 7.1.4 Optional backseat tightness test

**7.1.4.1** A backseat test shall be performed when this option is specified in a valve procurement purchase order.

**7.1.4.2** The backseat test shall be either a gas test at a pressure in accordance with 7.1.3.1 a) or a liquid test at a pressure in accordance with 7.1.3.1 b).

**7.1.4.3** The stem backseat shall be engaged and the packing gland bolting shall be loose during the backseat test. Visible backseat leakage is not permitted over the duration of the test.

**7.1.4.4** The gland bolting shall be retightened following the backseat test.

**7.1.4.5** The duration of the backseat test, the minimum period of time that the test pressure is to be sustained for the purpose of obtaining a backseat closure leakage measurement, shall be in accordance with Table 17.

### 7.1.5 Optional closure tightness test

**7.1.5.1** A high-pressure liquid closure test is not required for all valves (see Table 18). It is, however, an option that the purchaser may specify. All valve closure structures shall be designed to sustain the pressures associated with this test (see 7.1.3.7).

**7.1.5.2** The test liquid shall be at a pressure of 1,1 times the valve pressure rating at 38 °C.

**7.1.5.3** The duration of the optional closure test, the minimum period of time that the test pressure is to be sustained for the purpose of obtaining a seat closure leakage measurement, shall be in accordance with Table 17.

**7.1.5.4** The maximum leakage rate over the duration of the test shall be in accordance with Table 19.

### 7.1.6 Fugitive emission testing

**7.1.6.1** The fully assembled valve shall be tested in accordance with ISO 15848-1 for type-testing and ISO 15848-2 for production testing.

**7.1.6.2** The valve shall meet FE Class BH or BM as a minimum for CO1 mechanical cycling and RT temperature range. For all other cycling or temperature classes, agreement should be reached between manufacturer and purchaser.

## 7.2 Inspection

### 7.2.1 Extent of inspection

The extent of the purchaser's inspection may be specified in the purchase order and, unless otherwise indicated, shall be limited to the following:

— inspection of the valve assembly to ensure compliance with the specifications of the purchase order, which may include the specified non-destructive of examinations;

— witnessing the required and, if specified, optional pressure tests and examinations;

— review of mill test reports and, if specified, non-destructive examination records including radiographs.

### 7.2.2 Site inspection

**7.2.2.1** If a purchase order requires purchaser's witnessing of 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.

**7.2.2.2** If a purchase order requires examinations that include valve bodies or bonnets 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.

## 7.3 Examination

**7.3.1** For each valve, the applicable items shall be checked by the manufacturer before release for shipment. See Annex A for information.

**7.3.2** The valve manufacturer shall, at some juncture in the manufacturing cycle, perform a visual examination of the cast surfaces of bodies, bonnets, covers and closure elements. The casting surfaces shall meet the requirements of MSS-SP-55 except that all Type I defects are unacceptable and defects in excess of Plates "a" and "b" or Type II through Type XII are unacceptable.

**7.3.3** The valve manufacturer's quality system program shall include requirements that ensure each valve conforms with this document.

**7.3.4** Required examinations shall be performed in accordance with written procedures that conform with the applicable standards.

## 7.4 Supplementary examination

Supplementary types of examination are required only if specified in the purchase order. Magnetic particle, radiographic, liquid penetrant and ultrasonic examination of castings or forgings may be specified as either the purchaser's own procedures or acceptance standards or those standardized in ASME B16.34-2016, Part 8.

# 8 Marking

## 8.1 Legibility

Each valve manufactured in accordance with this document shall be clearly marked in accordance with ISO 5209, except where the requirements of Clause 8 take precedence.

## 8.2 Body marking

**8.2.1** For both flanged end and butt-welding end valves, the mandatory body markings, subject to the provisions of 8.2.2, shall be as follows:

— manufacturer's name or trade mark;

— body material;

— pressure designation, as either PN followed by the rating number, e.g. PN 16, or the Class rating number, e.g. 150, as applicable;

— nominal size, as either DN followed by a size number, e.g. DN 500, or the NPS size number, e.g. 20, as applicable.

**8.2.2** For valves smaller than DN 50, if the size or shape of the valve body prevents the inclusion of all the required markings, one or more may be omitted, provided that they are shown on the identification plate. The markings which may be omitted are the following:

— nominal size;

— pressure Class designation;

— body material.

## 8.3 Ring joint marking

Body end flanges require special marking when Class designated valves have end flanges grooved for ring joint assembly. When grooved for ring joint assembly, the ring joint gasket number (e.g. R25) shall be marked on the rim of both end flanges. Ring joint gasket numbers are listed in ASME B16.5.

## 8.4 Identification plate marking

The identification plate marking shall include:

— manufacturer's name,

— pressure rating designation, e.g. PN 16 or Class 150,

— manufacturer’s identification number,

— maximum pressure at 38 °C,

— limiting temperature, if applicable,

— limiting pressure, if applicable,

— trim material description (see Table 15 for abbreviations), and

— compliance marking, i.e. ISO 10434.

## 8.5 Special marking for unidirectional valves

Valves designed for, or modified to only have, unidirectional capability, i.e. capability to block flow in one direction, shall have:

— either a cast-in or forged-in flow directional arrow on the valve body; or

— a separate identification plate attached to the valve body to identify the unidirectional flow direction.

The unidirectional flow shall be shown on the identification plate in accordance with Figure 7. When a separate plate is used, it shall be attached to the valve body by threaded or welded means.

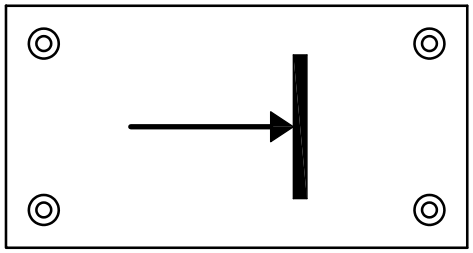


**Figure 7 — Typical unidirectional valve identification plate symbol**

## 9 Preparation for despatch

**9.1** Valves shall be shipped from the manufacturer's site with the lantern ring, if specified, and the packing installed. The remaining adjustment length of the packing gland at the time of this shipment, with the gland tight, shall be greater than 1,5 times the packing width, *w*, specified in Table 9.

**9.2** Except for austenitic stainless-steel valves and those valves of high alloy corrosion resistance, unmachined exterior valve surfaces shall be coated with aluminium colour paint.

**9.3** External machined surfaces, including threads, shall be coated with an easily removable rust inhibitor.

**9.4** Protective covers of wood, wood fibre, plastic or metal shall be securely affixed to the valve ends in order to safeguard the gasket surfaces or 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** At the time of shipment from the manufacturer's site the valve internals shall be free of test fluids and particulate matter, however, internal valves surfaces may be coated with an easily removable rust inhibitor.

**9.6** Plugs that were installed in tapped openings shall be fully tightened.

**9.7** At the time of shipment from the manufacturer's site, the gate shall be in the closed position.

**9.8** Unless otherwise specified by the purchaser, valves may be shipped loose, palletized or in boxes or crates.

# Annex A
(informative)

# Information to be specified by the purchaser

NOTE Numbers in brackets are references to clauses or subclauses of this document.

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

Pressure designation (PN or Class)[1)]: .....

Body cavity over-pressure evaluation [4.6]: .....

Body ends [5.3][1)]

Butt-welding [5.3.2.1]

End-to-end dimension [5.3.2.2]: .....

Flanged

Flange type [5.3.1.1] (raised face, flat face or ring joint): .....

Facing finish if other than standard [5.3.1.1]: .....

Flanges attached by welding [5.3.1.3]: .....

Tapped openings [5.12.3]: .....

Wedge style [5.6]: .....

Lantern ring [5.9.5]: .....

Operation other than handwheel [5.11]: .....

Auxiliary connections [5.12]: .....

Material [Clause 6]

Pressure containing shell material and bonnet to bonnet bolting [6.1][1)]: .....

Trim material combination number [6.2]: .....

Welding fabricated bodies or bonnets [6.3.1]: .....

Block-and-bleed testing [7.1.3.8]: .....

Optional backseat tightness test [7.1.4]: .....

Fugitive emission testing [7.1.6]: .....

Optional high-pressure closure tightness test [7.1.5]: .....

Extent of inspection [7.2.1]: .....

Witnessing tests [7.2.2]: .....

Supplementary examinations [7.4]: .....

1) Essential information to be provided by the purchaser.

Packaging for shipment [9.8]: .....