INTERNATIONAL STANDARD

# ISO 15761

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# Steel gate, globe and check valves for sizes DN 100 and smaller, for the petroleum and natural gas industries

*Robinets-vannes, robinets à soupape et clapets de non-retour en acier de dimensions DN 100 et inférieures, pour les industries du pétrole et du gaz naturel*



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# Foreword

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

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

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 International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 15761 was prepared by Technical Committee ISO/TC 153, *Valves*, Subcommittee SC 1, *Design, manufacture, marking and testing*.

Annexes A, B and C form a normative part of this International Standard. Annexes D and E are for information only.

## Introduction

The purpose of this International Standard is to establish basic requirements and practices for socket-welding, butt-welding, threaded and flanged end, steel gate, globe and check valves with reduced body seat openings, whose general construction parallels that specified by the American Petroleum Institute standard API 602[1] and the British Standard BS 5352[2].

The form of this International Standard corresponds to ISO 6002[3] and ISO 10434[4]. However, it is not the purpose of this International Standard to replace ISO 6002, ISO 10434 or any other International Standard not identified with petroleum or natural gas industry applications.

# Steel gate, globe and check valves for sizes DN 100 and smaller, for the petroleum and natural gas industries

## 1 Scope

This International Standard specifies the requirements for a series of compact steel gate, globe and check valves for petroleum and natural gas industry applications.

It is applicable to valves of

— nominal sizes DN 8, 10, 15, 20, 25, 32, 40, 50, 65, 80 and 100,

— corresponding to nominal pipe sizes NPS 1/4, 3/8, 1/2, 3/4, 1, 1 1/4, 1 1/2, 2, 2 1/2, 3 and 4,

and to pressure designations of Class 150, Class 300, Class 600, Class 800 and Class 1500.

Class 800 is not a listed class designation, but is an intermediate class number widely used for socket welding and threaded end compact valves.

It includes provisions for the following valve characteristics:

— outside screw with rising stems (OS & Y), in sizes $8 \leqslant DN \leqslant 100$ and pressure designations $150 \leqslant \text{Class} \leqslant 1500$ including Class 800;

— inside screw with rising stems (ISRS), in sizes $8 \leqslant DN \leqslant 65$ and pressure designations of $\text{Class} \leqslant 800$;

— socket welding or threaded ends, in sizes $8 \leqslant DN \leqslant 65$ and pressure designations of Class 800 and Class 1500;

— flanged or butt-welding ends, in sizes $15 \leqslant DN \leqslant 100$ and pressure designations of $150 \leqslant \text{Class} \leqslant 1500$, excluding flanged end Class 800;

— bonnet joint construction — bolted, welded, threaded with seal weld, and union nut for nominal pressure rating $\text{Class} \leqslant 800$;

— body seat openings;

— materials, as specified;

— testing and inspection.

This International Standard is applicable to valve end flanges in accordance with ASME B16.5 and valve body ends having tapered pipe threads to ISO 7-1 or ASME B1.20.1. It is applicable to extended body construction in sizes $15 \leqslant DN \leqslant 50$ and pressure designations of Class 800 and Class 1500, and to bellows and bellows assembly construction as may be adaptable to gate or globe valves in sizes $8 \leqslant DN \leqslant 50$. It covers bellows stem seal type testing requirements.

## 2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

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 2902, *ISO metric trapezoidal screw threads — General plan*

ISO 2903, *ISO metric trapezoidal screw threads — Tolerances*

ISO 2904, *ISO metric trapezoidal screw threads — Basic dimensions*

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 9956-1, *Specification and approval of welding procedures for metallic materials — Part 1: General rules for fusion welding*

ISO 9956-2, *Specification and approval of welding procedures for metallic materials — Part 2: Welding procedure specification for arc welding*

ISO 9956-3, *Specification and approval of welding procedures for metallic materials — Part 3: Welding procedure tests for arc welding of steels*

ISO 9956-4, *Specification and approval of welding procedures for metallic materials — Part 4: Welding procedure tests for the arc welding of aluminium and its alloys*

ISO 9956-5, *Specification and approval of welding procedures for metallic materials — Part 5: Approval by using approved welding consumables for arc welding*

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

ASME[1)] B1.5, *Acme screw threads*

ASME B1.8, *Stub Acme screw threads*

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 B16.34:1996, *Valves — Flanged, threaded and welding end*

ASME, *Boiler and Pressure Vessel Code, Section IX, Qualification standard for welding and brazing procedures, welders, brazers, and welding and brazing operators*

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

1) American Society of Mechanical Engineers



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

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

## 3 Terms and definitions

For the purposes of this International Standard, the terms and definitions of class and nominal pipe size given in ASME B16.34 and the following term and definition apply.[2)]

**3.1**
**nominal size**
**DN**
alphanumeric designation of size for components of a pipe work system, used for reference purposes, comprising the letters "DN" followed by a dimensionless whole number indirectly related to the physical size, in millimetres, of the bore or outside diameter of the end connections

NOTE 1 The number following "DN" does not represent a measurable value and should not be used for calculation purposes except where specified in the relevant standard.

NOTE 2 In those standards which use the DN designation system, any relationship between DN and component dimensions should be given, e.g. DN/OD or DN/ID.

(Adapted from ISO 6708:1995, definition 2.1.)

## 4 Pressure/temperature ratings

### 4.1 Valve ratings

#### 4.1.1 Applicability

The pressure/temperature ratings applicable to valves specified in this International Standard shall be in accordance with those specified in the tables of ASME B16.34 for standard class for the applicable material specification and class designation.

#### 4.1.2 Interpolated ratings

Pressure/temperature ratings for Class 800 shall be determined by the equation:

$$p_8 = \frac{1}{3} p_6 + \frac{2}{3} p_9$$

where

$p_8$ is the pressure at the specified temperature, expressed in bars[3)], for Class 800 rounded to the nearest 0,1 bar (= 10 kPa);

$p_6$ is the listed pressure, at the specified temperature, for Class 600, expressed in bars;

$p_9$ is the listed pressure, at the specified temperature, for Class 900, expressed in bars.

2) Pressure designation Class 800 has been added in order to identify widely used socket welding and threaded end valves having intermediate pressure/temperature ratings. It is not available for flanged end valves.

3) 1 bar = 0,1 MPa = $10^5$ Pa; 1 MPa = 1 N/mm$^2$

NOTE Pressure designation Class 900 is not specifically referenced in this International Standard because this designation is seldom used for the compact valves described herein. However, pressure/temperature ratings for this designation are included in the reference given in 4.1.1.

### 4.2 Temperature constraints

**4.2.1** 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.

**4.2.2** Restrictions of temperature and pressure, for example those imposed by special soft seals, special trim materials, packing or bellows stem seals, shall be marked on the valve identification plate (see 7.4).

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

## 5 Design

### 5.1 Reference design

**5.1.1** The reference design (the design to be provided when the purchaser does not specify otherwise or does not use annex E) for sizes DN $\leqslant$ 100 is for bolted-bonnet or cover construction, an outside stem thread for gate and globe valves and, for globe valves, has a conical disc. The reference design for threaded-end valves uses taper pipe threads in accordance with ASME B1.20.1. In addition, for valves DN $\leqslant$ 50, the reference design is to have a body and bonnet or cover of forged material. Valve parts are identified in annex D.

**5.1.2** Other configurations and types of material may be provided when specified in accordance with annex E. Requirements for extended body valves are given in annex A and those for bellows stem seals in annexes B and C.

### 5.2 Flow passageway

**5.2.1** The flow passageway includes the seat opening and the body ports leading to that opening. The body ports are the intervening elements that link the seat opening to the end connection, e.g. socket or flange.

**5.2.2** The minimum cross-sectional area requirement for the flow passageway applies for both the valve body ports and the seat opening. The minimum equivalent flow passageway cross-sectional area shall not be less than that obtained using the equivalent diameters in Table 1.



### 5.3 Wall thickness

**5.3.1** Minimum wall thickness values for valve bodies and bonnets are given in Tables 2 and 3. The manufacturer, taking into account such factors as bonnet bolting loads, rigidity needed for stem alignment, valve design details and the specified operating conditions, is responsible for determining if a larger wall thickness is required.

**5.3.2** The valve-body specified minimum wall thickness, except for the valve end connections and body extensions for bellows enclosures, shall be in accordance with Table 2.

**5.3.3** The bonnet specified minimum wall thickness for gate or globe valves, except for the neck extension that forms the packing chamber entryway, shall be in accordance with Table 2. The packing chamber extension shall have a local minimum wall thickness as specified in Table 3, based on the local inside diameter of the packing and stem hole.

**Table 1 — Minimum diameter of equivalent flow passageway**

| DN | Minimum diameter mm | | | NPS |
|---|---|---|---|---|
| | Class 150, Class 300, Class 600, Class 800 | Class 1500 | | |
| | Gate, globe or check | Gate | Globe | |
| 8 | 6 | 6 | 5 | 1/4 |
| 10 | 6 | 6 | 5 | 3/8 |
| 15 | 9 | 9 | 8 | 1/2 |
| 20 | 12 | 12 | 9 | 3/4 |
| 25 | 17 | 15 | 14 | 1 |
| 32 | 23 | 22 | 20 | 1 1/4 |
| 40 | 28 | 27 | 25 | 1 1/2 |
| 50 | 36 | 34 | 27 | 2 |
| 65 | 44 | 38 | | 2 1/2 |
| 80 | 50 | 47 | | 3 |
| 100 | 70 | 63 | | 4 |

**Table 2 — Minimum wall thickness for valve bodies**

| DN | Minimum wall thickness mm | | NPS |
|---|---|---|---|
| | Class 150, Class 300, Class 600, Class 800 | Class 1500 | |
| 8 | 3,1 | 3,8 | 1/4 |
| 10 | 3,3 | 4,3 | 3/8 |
| 15 | 4,1 | 4,8 | 1/2 |
| 20 | 4,8 | 6,1 | 3/4 |
| 25 | 5,6 | 7,1 | 1 |
| 32 | 5,8 | 8,4 | 1 1/4 |
| 40 | 6,1 | 9,7 | 1 1/2 |
| 50 | 7,1 | 11,9 | 2 |
| 65 | 8,4 | 14,2 | 2 1/2 |
| 80 | 9,7 | 16,5 | 3 |
| 100 | 11,9 | 21,3 | 4 |

NOTE Wall thickness values listed for Class 150, Class 300, and Class 600 are those required for Class 800 on the assumption that flanged end and butt-welding end valve bodies of these lower nominal pressures would have extensions added (integral or welded) to Class 800 valve bodies. See ISO 6002, ISO 10434, or ASME B16.34 for flanged end or butt-welding end valves having wall thickness requirements aligned to these lower nominal pressures.



## 5.4 Valve body

### 5.4.1 General

Requirements for a basic valve body and associated end connections are given here. See annex A for requirements for gate valve bodies having extended ends.

**Table 3 — Minimum wall thickness for bonnet and bellows extensions**

| Extension | Class 150 | Class 300 | Class 600 | Class 800 | Class 1500 |
|---|---|---|---|---|---|
| Inside diameter mm | Minimum wall thickness mm | | | | |
| 15 | 2,8 | 3,0 | 3,6 | 4,0 | 5,3 |
| 16 | 2,8 | 3,1 | 3,6 | 4,1 | 5,6 |
| 17 | 2,8 | 3,2 | 3,7 | 4,3 | 5,8 |
| 18 | 2,9 | 3,5 | 3,9 | 4,4 | 5,9 |
| 19 | 3,0 | 3,8 | 4,1 | 4,8 | 6,1 |
| 20 | 3,3 | 4,0 | 4,2 | 4,9 | 6,3 |
| 25 | 4,0 | 4,8 | 4,8 | 5,8 | 7,1 |
| 30 | 4,6 | 4,8 | 4,8 | 5,9 | 8,2 |
| 35 | 4,8 | 4,8 | 5,1 | 6,4 | 9,7 |
| 40 | 4,9 | 5,0 | 5,7 | 6,9 | 10,2 |
| 50 | 5,5 | 6,2 | 6,3 | 7,4 | 11,6 |
| 60 | 5,6 | 6,4 | 6,8 | 8,2 | 13,4 |
| 70 | 5,6 | 6,9 | 7,4 | 9,1 | 15,8 |
| 80 | 5,8 | 7,2 | 8,1 | 10,0 | 17,4 |
| 90 | 6,4 | 7,4 | 8,8 | 10,4 | 19,1 |
| 100 | 6,4 | 7,7 | 9,5 | 11,7 | 20,8 |
| 110 | 6,4 | 8,1 | 10,3 | 12,8 | 22,9 |
| 120 | 6,6 | 8,6 | 10,9 | 13,6 | 24,8 |
| 130 | 7,1 | 8,8 | 11,3 | 14,6 | 26,5 |
| 140 | 7,1 | 9,2 | 12,0 | 15,5 | 28,3 |

NOTE For bellows extension, see B.4.

### 5.4.2 Socket-welding ends

**5.4.2.1** The socket bore axis shall coincide with the end entry axis. Socket end faces shall be perpendicular to the socket bore axis. The socket bore diameter and its depth shall be in accordance with Table 4.



**Table 4 — Socket diameter and depth**

| DN | Diameter[a] mm | Depth[b] mm | NPS |
|---|---|---|---|
| 8 | 14,1 | 10 | 1/4 |
| 10 | 17,6 | 10 | 3/8 |
| 15 | 21,7 | 10 | 1/2 |
| 20 | 27,0 | 13 | 3/4 |
| 25 | 33,8 | 13 | 1 |
| 32 | 42,5 | 13 | 1 1/4 |
| 40 | 48,6 | 13 | 1 1/2 |
| 50 | 61,1 | 16 | 2 |
| 65 | 73,8 | 16 | 2 1/2 |

[a] The applicable diametral tolerance is $^{+0,5}_{-0}$ mm.

[b] The depth dimension is a minimum value.

**5.4.2.2** The minimum socket wall thickness, extending over the full socket depth, shall be in accordance with Table 5.

**Table 5 — Socket and threaded end minimum wall thickness**

| DN | Minimum wall thickness mm | | NPS |
|---|---|---|---|
| | Class 800 | Class 1500 | |
| 8 | 3,3 | 4,1 | 1/4 |
| 10 | 3,6 | 4,3 | 3/8 |
| 15 | 4,1 | 5,3 | 1/2 |
| 20 | 4,3 | 6,1 | 3/4 |
| 25 | 5,1 | 6,9 | 1 |
| 32 | 5,3 | 8,1 | 1 1/4 |
| 40 | 5,8 | 8,9 | 1 1/2 |
| 50 | 6,9 | 10,7 | 2 |
| 65 | 7,9 | 12,4 | 2 1/2 |

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

### 5.4.3 Threaded ends

**5.4.3.1** The threaded end thread axis shall coincide with the end entry axis. The minimum wall thickness at the threaded end shall be in accordance with Table 5. An approximate 45° lead-in chamfer, having an approximate depth of one-half the thread pitch, shall be applied at each threaded end.

**5.4.3.2** The end threads shall be taper pipe threads meeting the requirements of ASME B1.20.1. When specified in the purchase order, taper pipe threads in accordance with ISO 7-1 may be substituted.

**5.4.3.3** Threads shall be gauged in accordance with ISO 7-2 or ASME B1.20.1, as applicable.

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

### 5.4.4 Flanged ends

**5.4.4.1** End flanges shall comply with the dimensional requirements of ASME B16.5. Unless otherwise specified, raised face end flanges shall be provided.

This International Standard does not provide for flanged ends for Class 800 valves.

**5.4.4.2** End flanges and bonnet flanges shall be cast or forged integral with the body, except that cast or forged flanges attached by full penetration butt-welding or by inertia welding may be used. A purchaser requiring an integral flange body shall so specify. When a flange is attached by welding, the welding operator and welding procedure shall be qualified in accordance with ISO 9606-1 and ISO 9956-1 to ISO 9956-5, or ASME-BPVC, Section IX. Alignment rings, integral or loose, used as a welding aid shall be completely removed following welding, while care shall be 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.

**5.4.4.3** Face-to-face dimensions for flanged end valves, Class 150, Class 300 and Class 600, shall be in accordance with ISO 5752 — Basic Series 3, 4 and 5 for gate valves, and 5, 10 and 21 for globe and check valves — except that the applicable tolerance shall be in accordance with Table 6. For Class 1500, the face-to-face dimensions shall be as shown in Table 6.

**Table 6 — Face-to-face dimensions for Class 1500**

| DN | Dimensions<br>mm | NPS |
|---|---|---|
| 15 | 216 | 1/2 |
| 20 | 229 | 3/4 |
| 25 | 254 | 1 |
| 32 | 279 | 1 1/4 |
| 40 | 305 | 1 1/2 |
| 50 | 368 | 2 |
| 65 | 419 | 2 1/2 |
| 80 | 470 | 3 |
| 100 | 546 | 4 |
| The applicable length tolerance shall be ± 1,6 mm (see 5.4.4.3). | | |
| NOTE These dimensions and tolerances are in accordance with ASME B16.10. | | |



### 5.4.5 Butt-welding ends

**5.4.5.1** Unless otherwise specified by the purchaser, butt-welding ends shall be in accordance with Figure 1 and Table 7.

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

Intersections should be slightly rounded.

For nominal outside diameters and wall thickness of standard steel pipe, see ISO 4200.

**5.4.5.2** End-to-end dimensions for butt-welding end valves shall be established by the manufacturer.

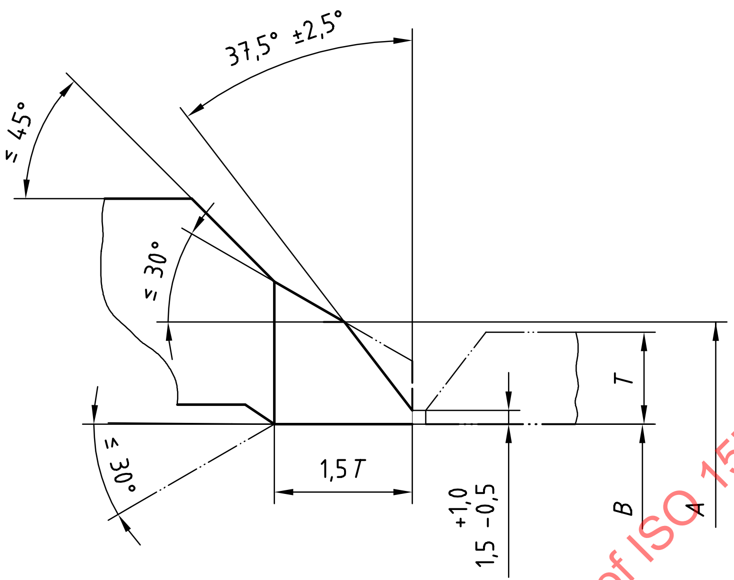
### 5.4.6 Body seats

**5.4.6.1** Integral body seats are permitted in austenitic stainless steel bodies. An austenitic stainless steel or a hard facing material may be weld-deposited either directly on a valve body or on a separate body seat ring. Weld-deposited seating surfaces shall have a minimum finished facing material thickness of 1 mm. Body seating surfaces shall not have sharp corners, e.g. corners with an edge disposed to cause damage in conjunction with gate or disc seating surfaces at either the inner or outer seat circumference.

**5.4.6.2** Except as provided in 5.4.6.1, valve bodies shall have separate removable seat rings that are threaded, rolled or pressed in place, however, rolled or pressed seat rings shall not be used with globe valves unless they are seal welded. Sealing compounds or greases shall not be used when assembling seat rings, however, a light lubricant having a viscosity no greater than kerosene may be used to prevent galling when assembling mating surfaces.

**5.4.6.3** The inside diameter of the body seat flow passageway shall be in accordance with Table 1.

Dimensions in millimetres




**Key**

$A$ is the nominal outside diameter of the welding end.

$B$ is the nominal inside diameter of the pipe.

$T$ is the nominal wall thickness of the pipe.

**Figure 1 — Butt-welding ends**

**Table 7 — Butt-welding end diameters**

| DN | 8 | 10 | 15 | 20 | 25 | 32 | 40 | 50 | 65 | 80 | 100 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $A$<br>mm | 15 | 19 | 23 | 28 | 35 | 44 | 50 | 62 | 78 | 91 | 117 |
| The tolerance for diameter $A$ shall be $\pm$ 1 mm for DN $\leqslant$ 20 and $+$2,5/ $-$ 1 mm for DN $\geqslant$ 25.<br>The tolerance for diameter $B$ shall be $\pm$ 1 mm (see Figure 1). | | | | | | | | | | | |

## 5.5 Valve bonnet or cover

**5.5.1** The bonnet of a gate or globe valve or the cover of a check valve shall be secured to the body, subject to the requirements of 5.5.2 to 5.5.8, by one of the following methods:

— bolting;

— welding;

— threaded with a seal weld;

— threaded union nut, provided it is of Class $\leqslant$ 800.

**5.5.2** Gasketed joints shall be of a design that confines the gasket and prevents its over-compression. At assembly, all gasket contact surfaces shall be free of heavy oils, grease and sealing compounds. A light coating of lubricant, no heavier than kerosene, may be applied if needed to assist in proper gasket assembly. The gasket, unless otherwise specified by the purchaser, shall be suitable for a valve temperature range of $-29$ °C to 540 °C.

**5.5.3** Bonnet flange gaskets, unless otherwise specified by the purchaser, shall be spiral wound metal with a flexible graphite filler. The wound metal shall be of type 18Cr-8Ni or 18Cr-8Ni-Mo and of either regular or low carbon grade.

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

**5.5.5** A bolted bonnet or cover to the body joint shall be secured by a minimum of four cap screws, studs or stud bolts. Internal socket head cap screws shall not be used. The minimum bolt size permitted is M10 (or 3/8 in).

**5.5.6** The bolting shall, as a minimum, meet the following bolt cross-sectional area requirements:

$$P_c \frac{A_g}{A_b} \leqslant 65{,}25\, S_b \leqslant 9\,000$$

where

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

$P_c$ is the class designation number, e.g. Class 800;

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

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

The value of $A_b$ 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 specified service conditions.

**5.5.7** Threaded pressure-retaining joints shall, as a minimum, meet the following thread shear area requirements:

$$P_c \frac{A_g}{A_s} \leqslant 4\,200$$

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

This is a minimum requirement for thread shear area for all pressure retaining joints including threaded bonnet joints. The manufacturer is responsible for providing any additional thread engagement as may be required for valve design details such as gasket compression essentials or specified service conditions.

**5.5.8** Bonnets welded directly to valve bodies shall be secured by a full penetration weld having two or more welding passes (layers). The welding operator and welding procedure shall be in accordance with 6.2.3. Heat treatment following welding shall be performed as required by the material specification.



## 5.6 Obturator

### 5.6.1 Seating surfaces

Obturator seating surfaces shall be integral or have a facing of weld metal. Weld-deposited seating surfaces shall have a minimum finished facing material thickness of 1 mm.

### 5.6.2 Gate valve obturators

**5.6.2.1** Gate valves shall be provided with a one-piece wedge gate. The installed wedge gate outer seating surfaces shall be free of sharp edges so as not to score or gouge the body seating surfaces during opening or closing.

**5.6.2.2** A slot near the top of the wedge gate shall be provided to receive the button or tee-head stem connection. The wedge gate shall be guided in the body in a manner that prevents rotation and leads the gate re-entry between the seats.

**5.6.2.3** The wedge gate shall be designed to account for seat wear. The dimensions that fix the position of the wedge gate seats relative to the body seats shall be such that the wedge gate, starting from the time when the valve is new, can move into the seats, should the seats wear, a distance defined as wear travel. Wear travel is in a direction parallel with the valve stem. The required minimum wear travel, $h_w$, varies with valve size in accordance with Table 8.

**Table 8 — Wear travel distance for gate valve disks**

| DN | Minimum wear travel distance $h_w$ mm | NPS |
|---|---|---|
| $8 \leqslant$ DN $\leqslant 20$ | 1 | $1/4 \leqslant$ NPS $\leqslant 3/4$ |
| $25 \leqslant$ DN $\leqslant 32$ | 1,5 | $1 \leqslant$ NPS $\leqslant 1\ 1/4$ |
| $40 \leqslant$ DN $\leqslant 65$ | 2 | $1\ 1/2 \leqslant$ NPS $\leqslant 2\ 1/2$ |
| $80 \leqslant$ DN $\leqslant 100$ | 3 | $3 \leqslant$ NPS $\leqslant 4$ |

### 5.6.3 Globe valve obturators

**5.6.3.1** Globe valves shall be provided with disks that are non-integral with the stem. The disk shall have a conical (plug) seating face or, when specified by the purchaser, a flat seating face.

**5.6.3.2** When assembled, the globe valve disk-to-stem retaining design shall be such that the disk cannot become detached from the stem as a result of vibration emanating from either flow through the valve or attached piping movement. The means of disk-to-stem retention shall be of a design that allows the disk to align with the valve seat.

### 5.6.4 Check valve obturators

**5.6.4.1** Check valves shall be provided with either piston, ball or swing type obturators.

**5.6.4.2** Piston type and ball type check valve obturators shall be guided over the full length of their travel. The guide and disk combination shall be designed so that a damping of the movement occurs towards the top end of the disk travel.

**5.6.4.3** Piston check and ball check valves shall be designed so that, when in the fully opened position, the net flow area between the obturator and the body seat is greater than or equal to that of the seat opening corresponding to the seat diameter shown in Table 1.

**5.6.4.4** Obturator-to-hinge retaining nuts shall be positively secured by mechanical means.



## 5.7 Stem

**5.7.1** Stems are designated as either inside screw (ISRS) or outside screw (OS & Y). The reference standard design is OS & Y. Stems with inside screw shall be limited to gate and globe valves having pressure designation Class $\leqslant 800$ in the nominal size range $8 \leqslant$ DN $\leqslant 65$.

**5.7.2** The minimum stem diameter, $d_S$, for gate and globe valves, measured where the stem passes through the packing, shall be in accordance with Table 9. These are specified minimum values, not design minimum values. The manufacturer, taking into account the stem material, the valve design and the specified operating conditions, is responsible for determining if a larger diameter stem is required.

**5.7.3** The stem shall be one-piece wrought material. Stems fabricated by welding are not permitted. The stem surface that passes through the packing shall have a surface finish value of $Ra \leqslant 0{,}80\ \mu m$.

**Table 9 — Minimum stem diameter**

| DN | Minimum stem diameter, $d_s$ mm — Class 150, Class 300, Class 600, Class 800 | Class 1500 | | NPS |
|---|---|---|---|---|
| | Gate or globe | Gate | Globe | |
| 8 | 7,0 | 10,0 | 10,0 | 1/4 |
| 10 | 7,0 | 10,0 | 10,0 | 3/8 |
| 15 | 8,5 | 10,0 | 10,0 | 1/2 |
| 20 | 9,5 | 11,0 | 11,0 | 3/4 |
| 25 | 11,0 | 14,0 | 14,0 | 1 |
| 32 | 12,5 | 15,5 | 15,5 | 1 1/4 |
| 40 | 14,5 | 15,5 | 15,5 | 1 1/2 |
| 50 | 16,0 | 16,5 | 16,5 | 2 |
| 65 | 17,5 | 19,0 | — | 2 1/2 |
| 80 | 19,0 | 25,0 | — | 3 |
| 100 | 22,0 | 28,5 | — | 4 |

**5.7.4** The stem threads shall be of trapezoidal form in accordance with ISO 2902, ISO 2903 and ISO 2904, or ASME B1.5 and ASME B1.8, with nominal dimensional variations allowed. Stem threads shall be such that a direct operated hand wheel rotated in a clockwise direction will close the valve. The major diameter of the stem threads shall not be less than 1,5 mm below that of the actual stem diameter (see 5.7.2).

**5.7.5** The means of stem-to-obturator attachment shall be designed so as to prevent the stem from becoming disengaged from the obturator while the valve is in service. For attachment to the obturator, the stem shall have an integral tee for outside stem thread gate valves and an integral cylindrical button for inside stem thread gate valves and for all globe valves. Threaded or pinned stem attachment means shall not be used.

**5.7.6** Valve stems, except those used in globe valves where the backseat function is with a disk component, shall include a conical or spherical raised surface that will seat against the bonnet backseat when the obturator is at its full open position. A back seating arrangement is a requirement for all gate and globe valves and, as such, is not meant to imply a manufacturer's recommendation for use for the purpose of adding or replacing packing while the valve is under pressure.

**5.7.7** Gate valve stem design shall be such that, for valves with outside screw stems, the strength of the stem-to-wedge 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. For both outside and inside screw valves, the design of the stem, wedge gate and stem connection to the wedge gate shall be such that, were mechanical failure to occur, it would do so at a stem section outside the valve pressure boundary.

**5.7.8** The means of stem disk attachment in globe valves shall be such that the disk articulates in order to permit alignment with the seat. The stem thrust point against the disk shall be rounded and the disk components making up the means of disk-to-stem assembly attachment shall be positively secured to prevent loosening due to fluid or piping induced vibration.

## 5.8 Stem nut or stem bushing

**5.8.1** The internal thread in the stem nut (yoke sleeve or stem bushing) shall be of trapezoidal form in accordance with ISO 2902, ISO 2903 and ISO 2904, or ASME B1.5 and ASME B1.8, with nominal dimensional variations permitted.

**5.8.2** The fixed stem nut used in globe valves shall be threaded or otherwise fitted onto the yoke and positively locked in position.

## 5.9 Packing, packing chamber and gland

**5.9.1** The minimum uncompressed total height of the installed packing, $h_p$, shall be in accordance with Table 10. The packing height values in Table 10 are directly related to the stem diameters shown in Table 9. When a stem diameter greater than that of Table 9 is used, the manufacturer shall determine if the uncompressed packing height needs to be increased.

**Table 10 — Minimum uncompressed packing height**

| DN | Minimum uncompressed packing height, $h_p$ mm | | NPS |
|---|---|---|---|
| | Class 150, Class 300, Class 600, Class 800 | Class 1500 | |
| 8 | 12 | 22 | 1/4 |
| 10 | 12 | 22 | 3/8 |
| 15 | 15 | 22 | 1/2 |
| 20 | 15 | 25 | 3/4 |
| 25 | 25 | 30 | 1 |
| 32 | 25 | 38 | 1 1/4 |
| 40 | 28 | 38 | 1 1/2 |
| 50 | 28 | 38 | 2 |
| 65 | 31 | 44 | 2 1/2 |
| 80 | 38 | 47 | 3 |
| 100 | 44 | 50 | 4 |

**5.9.2** The packing chamber bore shall have a surface finish, $Ra$, of 3,2 µm or smoother. The bottom of the packing chamber shall be flat.

**5.9.3** A gland shall be provided for packing compression. The gland may be either a self-aligning gland or an integral part of the gland flange. The outer end of a separate gland shall have a lip whose outer diameter exceeds the diameter of the packing chamber bore so as to block its entry into the bore.

**5.9.4** Packing in the form of a single-piece spiral shall not be used.

## 5.10 Packing retention

**5.10.1** Packing and packing gland retention for valves with outside screw stems shall be by bolting through two holes in a gland flange that is either separate from, or integral to, the gland. Open gland flange bolt slots shall not be used.

**5.10.2** Gland flange bolts shall be hinged eyebolts, headed bolts, stud bolts or studs. Hexagon nuts shall be used. The gland flange bolting arrangement shall be such that the bolts, after removal of the packing adjustment nuts, remain connected to the valve.

**5.10.3** The gland bolting for gate and globe valves shall not be anchored to the bonnet or yoke through a fillet welded attachment or stud welded pins. The gland bolting design shall be such that during repacking the gland bolts will be positively retained.

**5.10.4** Packing and packing gland retention for valves with inside screw stems shall be by a packing nut threaded directly onto the valve bonnet or in accordance with 5.10.1, 5.10.2 and 5.10.3. For application restrictions applying to inside screw stem threads, see 5.7.

## 5.11 Hand wheel

**5.11.1** Gate and globe valves shall be supplied with direct operated hand wheels that close the valve when turned in a clockwise direction.

**5.11.2** The hand wheel shall be a spoke and rim design that makes an effective grip possible.

**5.11.3** The hand wheel shall be secured to the stem or stem nut by a threaded hand wheel nut.

# 6 Materials

## 6.1 Trim materials

**6.1.1** Trim items include the stem, the obturator seat surfaces and the body or seat ring seat surfaces. The trim materials shall be in accordance with Table 11, unless other materials are agreed upon between the purchaser and manufacturer. The trim combination number (CN) identifies both the stem material and the associated seating surface material.

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

**6.1.3** The trim material shall be the manufacturer's standard trim material corresponding to a listed trim CN, unless otherwise specified in the purchase order. For a specified CN in a purchase order, an alternative CN may be furnished in accordance with Table 12. It is not permissible to furnish a listed specified CN when an alternative CN is specified in a purchase order without the agreement of the purchaser.

## 6.2 Materials other than trim

**6.2.1** Materials for valve parts other than trim items shall be in accordance with Table 13.

**6.2.2** Defects in the cast or forged valve pressure shell materials revealed during manufacturing operations or testing may be repaired as permitted by the most nearly applicable specification for forgings or castings. All repair welding shall be in accordance with written procedure. Filler rods used for repairs shall be such as to produce a repair weld having characteristics similar to the parent metal. Repairs shall be heat treated after repair welding in accordance with the material specification.

**6.2.3** Fabrication welding operations shall be performed by qualified welding operators in accordance with qualified welding procedures. Both shall be qualified in accordance with ISO 9606-1 and ISO 9956-1 to ISO 9956-5 or ASME-BPVC, Section IX.

# 7 Marking

## 7.1 Legibility

Each valve identified as being in accordance with this International Standard shall be clearly marked as such on the body and on an identification plate in accordance with ISO 5209 and the following. In the event of conflict, the requirements of the present clause shall apply.

**Table 11 — Basic trim materials**

| Part | Combination number | Trim material description | Brinell hardness |
|---|---|---|---|
| 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 or 11 | NiCu alloy | c |
| | 10, 12 or 16 | 18Cr-8Ni-Mo | c |
| | 13, 14 or 18 | 19Cr-29Ni | c |
| | 17 | 18Cr-10Ni-Cb | c |
| Seating surfaces | 1 | 13Cr | 250 min[b] |
| | 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 | 250 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 | 350 min[c] |
| | 11A | NiCu alloy/HFA | 350 min[c] |
| | 12 | 18Cr-8Ni-Mo/HF | 350 min[c] |
| | 12A | 18Cr-8Ni-Mo/HFA | 350 min[c] |
| | 13 | 19Cr-29Ni | c |
| | 14 | 19Cr-29Ni/HF | 350 min[c] |
| | 14A | 19Cr-29Ni/HFA | 350 min[c] |
| | 15, 16, 17 or 18 | HF | 350 min |

NOTE Abbreviations: Cr = Chromium; Ni = Nickel; Co = Cobalt; Mo = Molybdenum; Cb = Columbium; HF = Hard Facing using CoCr welding alloy; HFA = Hard Facing using NiCr welding alloy.

[a] Stems shall be of wrought material.

[b] A differential hardness of at least 50 Brinell points is required between mating surfaces.

[c] Not specified.



**Table 12 — Alternative CNs**

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

**Table 13 — Materials for valve parts other than trim items**

| Part | Material |
|---|---|
| Body and bonnet[a b] | A forging or casting material as selected from ASME B16.34 |
| Cover plate[a b] | A forging, casting, or plate material as selected from ASME B16.34 |
| Bonnet extension and union nut | A material of the same nominal composition as the bonnet as selected from the list of material from which the body was selected |
| Bellows | An austenitic stainless steel: Cr-Ni, Cr-Ni-Mo, Ti stabilized, or Nb stabilized, or a Ni-Cr-Mo-Cu alloy |
| Bellows fittings | Attachment rings and other bellows fittings shall be of materials suitable for attachment to the bellows and valve body or bonnet by welding |
| Obturator | Steel or base material compatible with the pressure/temperature rating and at least equal in corrosion resistance as the body material |
| Yoke, separate | Carbon steel or similar material composition as the bonnet |
| Bolting: body to bonnet and body to cover | Bolts to ASTM A193-B7 or EN 10269-42CrMo4 (1.7225) and nuts to ASTM A194-2H or EN 10269-C45E (1.1191). |
| Bolting: gland and yoke | Bolting material at least equal to either ASTM A307-Grade B or EN 10269-C35E (1.1181) |
| Seat ring | As in Table 11, except that when weld deposited facings are used the base material shall have a corrosion resistance equal to or greater than that of the body material |
| Gland flange | Steel |
| Packing nut | Steel |
| Gland | Material with a melting point above 955 °C |
| Packing | Non-asbestos material suitable for steam and petroleum fluids over a temperature range of −29 °C to 540 °C and containing a corrosion inhibitor |
| Gaskets | See 5.5.3 |
| Stem nut or stem bushing | Austenitic ductile iron, 13Cr steel, or copper alloy having a melting point above 955 °C |
| Hand wheel | Malleable iron, carbon steel, or ductile iron |
| Identification plate | A metal that is resistant to atmospheric corrosion |

[a] A preference for body and bonnet or cover material form (e.g. forging or casting) requires specification by the purchaser (see annex E).

[b] For valve sizes DN $\leqslant$ 50, the reference standard design specifies forging material for the body and bonnet, or cover (see 5.1).

## 7.2 Body marking

**7.2.1** Valve bodies shall be marked with the following information:

— manufacturer's name or trade mark;

— body material identification;

— pressure class designation number, e.g. Class 1500;

— nominal size, as either DN followed by the appropriate size number, e.g. DN 50, or the NPS number, e.g. 2;

— an arrow on check valve bodies to indicate the flow direction for which the valve is intended to be installed.

**7.2.2** For valves DN $< 25$, if the size or shape of the valve body precludes the inclusion of all the required markings, one or more may be omitted provided that they are shown on the identification plate. The sequence of omission shall be as follows:

a) nominal size;

b) pressure class designation;

c) body material.

## 7.3 Ring joint groove marking

Body end flanges require special marking when the end flanges are grooved for ring type joint assembly. When so grooved, the ring joint gasket groove number (e.g. R25) shall be stamped on the rim of both end flanges. Ring joint gasket groove numbers are given in ASME B16.5.

## 7.4 Identification plate marking

Each valve shall be provided with at least one identification plate. The identification plate marking, as applicable, shall include

— the manufacturer's name,

— the identifying number for this International Standard, i.e. "ISO 15761",

— pressure class designation, e.g. Class 800,

— manufacturer's identification number, e.g. catalogue number,

— trim identification for the stem, seat, and disk,

— maximum pressure at 38 °C,

— limiting temperature, if applicable,

— limiting pressure, if applicable, and

— any special use limitation.



# 8 Testing and inspection

## 8.1 Pressure tests

### 8.1.1 General

**8.1.1.1** Each assembled valve identified with this International Standard 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 by the following. Sealing compounds, greases or oils shall be removed from seating surfaces prior to pressure testing. It is permissible, however, for a film of oil no heavier than kerosene to be applied to prevent sealing surface galling. The manufacturer is responsible for establishing that neither the selected packing nor the bellows, if furnished, leak at the required test pressures.

**8.1.1.2** When water is used as the test fluid for pressure testing austenitic stainless steel valves or valves having austenitic stainless steel bellows, the chloride content of the test water shall not exceed 100 mg/l (= 100 ppm).

### 8.1.2 Shell test

**8.1.2.1** The shell test for each valve shall be at a pressure no less than 1,5 times the pressure corresponding to the valve's 38 °C pressure rating. The obturator shall be in a partially open position, except that, for a check valve, it may be in a fully open position. The packing in gate and globe valves shall be adjusted to maintain the test pressure.

**8.1.2.2** Paint or other coating materials capable of concealing leakage during the shell test shall not be applied to valve surfaces. However, valve surfaces may be protected by chemical conversion processes such as phosphate coating, provided that such treatments do not seal porosity.

**8.1.2.3** The minimum period of time that the shell test pressure is to be sustained shall be in accordance with Table 14.

**Table 14 — Test duration**

| Valve size | Test duration<br>s |
|---|---|
| DN $\leqslant$ 50 | 15 |
| DN $>$ 50 | 60 |

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

### 8.1.3 Closure leakage test

**8.1.3.1** For each gate valve, the closure test shall be a gas test with the test gas at a pressure between 500 kPa and 700 kPa (= 5 bar to 7 bar). The closure test is to be applied, one direction at a time, for both seat-sealing directions.

**8.1.3.2** For each check valve and globe valve the closure test shall be a high-pressure liquid test with the test liquid at a pressure no less than 1,1 times the valve pressure rating at 38 °C. When a globe valve is equipped with a power actuator the closure test may be performed at 110 % of the differential pressure used for determining the size of the actuator.

**8.1.3.3** Gate and globe valve stem packing shall be adjusted so that there is no visible leakage over the duration of the closure test. Throughout the duration of the closure test there shall be no visible evidence of leakage through the obturator or from behind installed seat rings.

**8.1.3.4** The minimum period of time that the test pressure is to be sustained for the purpose of obtaining a seat leakage measurement shall be in accordance with Table 14.

**8.1.3.5** Over the duration of the closure test, the maximum permitted seat leakage rate shall be in accordance with Table 15. For the gas test, zero leakage is defined[4)] as less than one bubble or 3 $mm^3$ over the specified test duration. For the liquid test, zero leakage is defined as no visible leakage over the specified test duration.

**8.1.3.6** When volumetric devices are used to measure seat leakage rates they shall be calibrated to yield results equivalent to those of Table 15 for the valve under test. These devices shall be calibrated with the same test fluid and at the same temperature as those of the valve closure tests. When these devices are used, the test duration specified in Table 14 shall not commence until a flow rate has been established into the device.

4) This does not define an exact relationship for determining the volume occupied by a bubble.

**8.1.3.7** Gate valves, for which only a low pressure gas test is specified, shall have valve closure structures designed to sustain pressure loads corresponding to the conditions of the optional high-pressure liquid test (see 8.1.4), and shall have the capability of meeting the leakage requirements of Table 15 for globe valves over a test duration in accordance with Table 14.

**Table 15 — Seat leakage rate**

| **DN** | 8 | 10 | 15 | 20 | 25 | 32 | 40 | 50 | 65 | 80 | 100 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **NPS** | 1/4 | 3/8 | 1/2 | 3/4 | 1 | 1 1/4 | 1 1/2 | 2 | 2 1/2 | 3 | 4 |
| | **Maximum permissible leakage rate**[a] $mm^3/s$ | | | | | | | | | | |
| **Gate (gas)** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 25 | 25 | 25 |
| **Globe and gate (liquid)** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12,5 | 12,5 | 12,5 |
| **Check (liquid)** | 12 | 18 | 25 | 37 | 50 | 62 | 75 | 100 | 125 | 150 | 200 |

[a] The closure test, as specified in 8.1.3.1 and 8.1.3.2, is a gas test for gate valves and a high pressure liquid test for globe and check valves.

### 8.1.4 Optional closure leakage test for gate valves

A closure test with the test liquid at a pressure no less than 1,1 times the valve pressure rating at 38 °C is not required for gate valves. It is an option that the purchaser may specify in the purchase order. Independent of the closure test requirement, valve closure structures shall be designed to sustain pressure loads under the conditions of this option and shall have the capability of meeting the leakage requirements specified in Table 15 for globe and gate valves over a test duration specified in Table 14.

### 8.1.5 Backseat leakage test

**8.1.5.1** The backseat test for gate and globe valves shall be either a gas test at the pressure given in 8.1.3.1 or a liquid test at the pressure given in 8.1.3.2 over the duration specified in 8.1.3.4. A backseat test is not required for a valve with a bellows stem seal.

**8.1.5.2** The stem backseat shall be engaged and the packing gland bolting or packing nut shall be loose during the backseat test. Visible backseat leakage is not permitted over the duration of the test. In the case of a gas test, it is permissible to apply a bubble detection solution.

**8.1.5.3** The gland bolting or packing nut shall be re-tightened following the backseat test.

## 8.2 Inspection

For each valve, the appropriate items listed in annex E shall be checked by the manufacturer before release for shipment.

# 9 Preparation for despatch

**9.1** After testing, the test fluid shall be drained from each valve in preparation for despatch.

**9.2** Stem packing shall be in place and the remaining packing adjustment, with the gland tight, shall be greater than one packing width.

**9.3** Except for austenitic stainless steel valves, unmachined exterior valve body and bonnet surfaces shall have a rust-preventative coating.

**9.4** Except for austenitic stainless steel valves, machined or threaded surfaces shall be coated with an easily removable rust inhibitor.

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

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

**9.7** At the time of shipment, the obturator of a gate or a globe valve shall be in the closed position.

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

# Annex A
(normative)

# Requirements for extended body gate valve bodies

## A.1 Scope

This annex specifies design, materials, fabrication and examination requirements for gate valve bodies to be used in valve assemblies identified as extended body valves. The valve body requirements stipulated in this annex, in combination with related gate valve requirements in the body of this International Standard, constitute the requirements applicable to extended body valves. An extended valve body has one end fitted with either a conventional internal taper pipe thread connection or a conventional internal socket welding connection. The opposite body end is prolongated, i.e. it is fitted with an extension that has an external end connection that is either an external taper pipe thread or an external weld end preparation.

## A.2 Applicability

**A.2.1** Extensions with external taper pipe threads are designated only for Class 800 in nominal sizes $20 \leqslant DN \leqslant 50$.

**A.2.2** Extensions with external weld end preparations are designated only for Class 800 and Class 1500 in nominal sizes $15 \leqslant DN \leqslant 50$. Weld end preparations covered include both socket welding and butt-welding types.

**A.2.3** Internal socket welding ends or internal taper pipe thread ends are designated only for Class 800 and Class 1500 in nominal sizes $15 \leqslant DN \leqslant 50$.

**A.2.4** Extended bodies covered by this International Standard are for valves whose end connections have the same nominal size for both the internal and the external ends, except that an extended valve body may be furnished with a DN 20 external end and a DN 15 internal end when the assembled valve otherwise meets all requirements for a DN 20 valve.

## A.3 Body configuration

### A.3.1 Extension length

The length of the extension or protrusion, $L$, required for an extended body, is the distance from the axis of the valve stem to the outer end of the extension's external end preparation. The required values for $L$ are specified in Tables A.1 and A.2. The minimum hand wheel clearance, the distance between the outer end of the external end preparation, and the outer diameter of the hand wheel, shall be 57 mm.

**Table A.1 — Threaded end extension for Class 800**

| DN | Maximum length $L$ mm | Maximum inside diameter ID mm | Minimum outside diameter OD mm | Minimum wall thickness $T$ mm | Maximum transition length $A$ mm | NPS |
|---|---|---|---|---|---|---|
| 20 | 115 | 16,5 | 25,9 | 4,8 | 23,4 | 3/4 |
| 25 | 180 | 21,3 | 32,5 | 5,6 | 28,2 | 1 |
| 40 | 230 | 38,1 | 47,5 | 6,1 | 29,2 | 1 1/2 |
| 50 | 255 | 47,5 | 59,4 | 7,1 | 30 | 2 |

**Table A.2 — Welding end extension for Class 800 and Class 1500**

| DN | Maximum length of welding end $L$ mm | | Minimum outside diameter OD mm | Minimum wall thickness $T$ mm | | NPS |
|---|---|---|---|---|---|---|
| | Socket | Butt | | Class 800 | Class 1500 | |
| 15 | 100 | 100 | 23,1 | 5,5 | 5,6 | 1/2 |
| 15 | 105 to 165 | 105 to 165 | 26,9 | 6,3 | 6,3 | 1/2 |
| 15 | 165 | 170 to 205 | 31,7 | 6,3 | 6,3 | 1/2 |
| 20 | 140 | 140 | 25,9 | 4,8 | 6,1 | 3/4 |
| 20 | 145 to 205 | 145 to 205 | 31,7 | 7,5 | 7,5 | 3/4 |
| 25 | 230 | 230 | 32,5 | 5,6 | 7,1 | 1 |
| 40 | 230 | 230 | 47,5 | 6,2 | 9,7 | 1 1/2 |
| 50 | 255 | 255 | 59,4 | 7,6 | 11,9 | 2 |

## A.3.2 Extensions having threaded ends

The minimum wall thickness and maximum length for extensions having threaded ends and the dimensions for threaded end preparations for Class 800 extended body valves shall be in accordance with Figure A.1 and Table A.1. The external end threads shall be in accordance with 5.4.3.2 and 5.4.3.3.

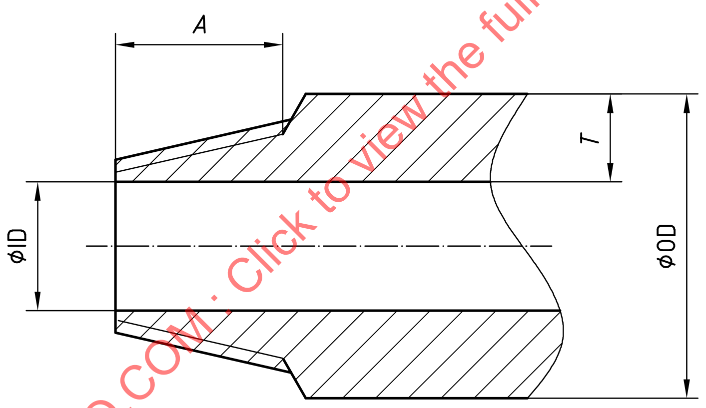


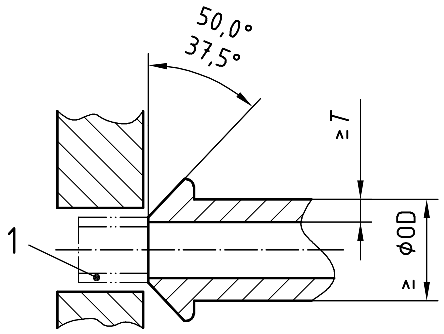

**Figure A.1 — Threaded end extension for Class 800**

## A.3.3 Extensions having welding ends

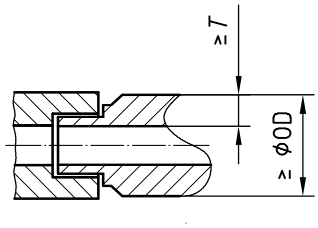
The minimum wall thickness and maximum length for extensions having either socket welding or butt-welding ends and the dimensions for butt-welding end preparations for extended body valves shall be in accordance with Figure A.2 and Table A.2. The dimensions for socket welding end preparations shall be in accordance with Figure A.3 and Table A.3. The integral backing (centring) ring illustrated in Table A.2 for butt-welding ends is provided at the manufacturer's option. Its length shall not be included when measuring the required length of the extension.

## A.4 Materials

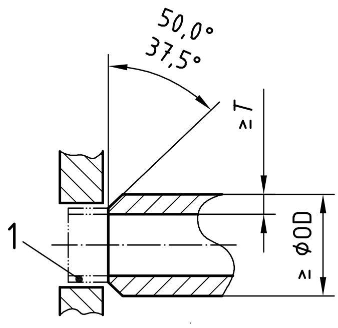
An extension welded to a valve body shall be of a material having a nominal chemical composition corresponding to that of the body material and listed in ASME B16.34. If a tubular form is used it shall be of seamless construction.




a) Integrally reinforced end for welding




b) Socket welded end



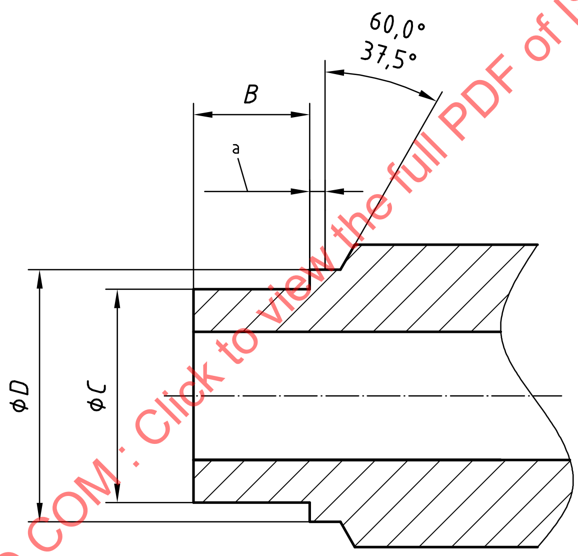

c) Bevelled end for welding

**Key**

1 Optional integral backing ring

**Figure A.2 — Welding end extension for Class 800 and Class 1500**






a 3 mm (0,12 in)

**Figure A.3 — Socket welding end preparation for Class 800 and Class 1500**

**Table A.3 — Socket welding end preparation for Class 800 and Class 1500**

| DN | Socket length $B$ mm | Socket diameter $C$ mm | Step diameter $D$ mm | NPS |
|---|---|---|---|---|
| 15 | 7,9 | 21,3 | 22,9 | 1/2 |
| 20 | 11,2 | 26,7 | 28,2 | 3/4 |
| 25 | 11,2 | 33,3 | 35,1 | 1 |
| 40 | 11,2 | 48,3 | 49,8 | 1 1/2 |
| 50 | 14,2 | 60,2 | 62,0 | 2 |
| Tolerances for dimensions $B$, $C$, and $D$ shall be $^{+0,2}_{-0,8}$ mm for 15 $\leqslant$ DN $\leqslant$ 40, and $\pm$ 0,8 mm for DN 50. | | | | |

## A.5 Body extension construction

**A.5.1** An extension shall be either cast or forged integral with the valve body or shall be a separate part attached to the valve body by welding. A purchaser requiring an integral extension must so specify. Welding an extension to a valve body shall be either by full penetration butt-welding or inertia welding. The welding operator and welding procedure shall be qualified in accordance with ISO 9606-1 and ISO 9956-1 to ISO 9956-5, or ASME-BPVC, Section IX.

**A.5.2** Integral alignment rings (centring backing rings) used to facilitate welding shall be removed by machining after welding. The welded extension and attachment weld shall have no internal tapers, nor other internal discontinuities, where the taper exceeds a four-to-one ratio in the axial to radial directions.

**A.5.3** The final wall thickness of the extension attachment weld shall not be less than that required for the extension by Tables A.1 or A.2, as applicable.

**A.5.4** The body-to-extension weld shall be given a post-weld heat treatment in accordance with Table A.4.

**Table A.4 — Post-weld heat treatment**

| Material | | Thickness $t$ mm | Temperature range °C | Holding time s/mm | Weld hardness HBN max. |
|---|---|---|---|---|---|
| Carbon steels | | $t > 19$ | 593 to 649 | 144 | — |
| Alloy steels: | 1/2 % $<$ Cr $\leqslant$ 2 % | All | 704 to 746 | 144 | 225 |
| | 2 1/4 % $\leqslant$ Cr $\leqslant$ 10 % | All | 704 to 760 | 144 | 241 |
| Nickel alloy steels | | $t > 19$ | 593 to 635 | 144 | |
| Austenitic steels[a] | | All | Solution anneal per material specification | | |
| Other materials | | All | Follow material specification | | |

[a] Except when materials being welded are L-grades or stabilized grades.

**A.5.5** The finished weld shall be free of cracks and shall show no indication of lack of fusion or incomplete penetration. The finished weld shall be ground, or otherwise finished to provide a smoothly contoured surface, and have a surface finish of $Ra \leqslant$ 12,5 µm.

## A.6 Marking

Valves that have valve bodies with welded end extensions shall be marked with the fabrication markings in accordance with 7.2. In addition, the body marking shall include the material identification for the extension, if different from the body material.



# Annex B
(normative)

# Requirements for valves with bellows stem seals

## B.1 Scope

This annex specifies design, materials, fabrication, testing and examination requirements for gate and globe valves having bellows stem seals. The requirements stipulated in this annex, in combination with related gate and globe valve requirements in the body of this International Standard, constitute the total requirements for bellows stem seal valves. These requirements are applicable for valves in nominal sizes $15 \leqslant DN \leqslant 50$ having a pressure designation of either Class 800 or Class 1500.



## B.2 Design

**B.2.1** Bellows stem seals do not eliminate the need for providing the stem packing required by 5.9 and 5.10 or the backseat required by 5.7.6. The packing shall be placed so that it functions as the stem seal in the event that bellows seal leakage occurs (see Figure D.3).

**B.2.2** One end of the bellows shall be attached to the stem just above the gate or to the disk linkage by welding. The opposite bellows end shall be welded either directly to the valve bonnet, to the valve body or to an intervening ring which in turn is either clamped or welded to the bonnet or body. When needed to accommodate large stem strokes, individual bellows may be welded in series.

**B.2.3** Stems in bellows-equipped valves shall be provided with the means to prevent stem rotation and thereby avoid transmitting torsional loads to the bellows.

**B.2.4** Valve-to-bellows assemblies shall be designed so that the bellows convolutions or leaves do not buckle or come into rubbing contact with the surrounding body, the bonnet extension or the enclosed stem.

## B.3 Pressure-temperature ratings

**B.3.1** The bellows assembly for a bellows stem seal valve shall be designed to meet the valve pressure rating at 38 °C, with the capability of accommodating a pressure test at 1,5 times the 38 °C pressure rating, while preserving the ability to meet the bellows life cycle requirements of annex C.

**B.3.2** For fluid service above 38 °C, the bellows design may limit the valve pressure rating to pressures less than those specified by 4.1 or the temperature to a value less than the maximum specified in 4.1. When this occurs, the valve manufacturer shall publish applicable pressure/temperature ratings and provide these to the user.

**B.3.3** Restrictions of temperature or pressure imposed by the bellows assembly design shall be marked on the identification plate (see 7.4).

**B.3.4** A bellows stem seal valve shall be limited to applications where temperatures are below the creep range of the bellows material. The temperature for the onset of creep shall be in accordance with ASME B16.34:1996, annex F.

## B.4 Extensions for bellows enclosure

**B.4.1** The cylindrical bonnet or body extension required to enclose a bellows stem seal (see annex D) shall have a minimum wall thickness the greater of either the body minimum wall thickness specified in Table 2 or the wall thickness specified in Table 3, using two-thirds of the actual local inside diameter of the extension. In the event that the material selected for the extension has a pressure/temperature rating less than the body material, considering the entire material temperature range, the minimum wall thickness of the extension shall be increased, as necessary, so that its pressure/temperature rating equals or exceeds that of the body.

**B.4.2** The bonnet or body extension that envelops the bellows shall be integral, attached by a threaded connection that is seal welded or attached by welding.

**B.4.3** The weld for an extension that is welded directly to the bonnet or body shall be a full penetration butt-weld. The welding operator and welding procedure shall be qualified in accordance with ISO 9606-1 and ISO 9956-1 to ISO 9956-5 or ASME-BPVC, Section IX. Heat treatment following welding, to ensure that the bonnet and extension materials are suitable for the full range of service conditions, shall be performed as required by the bonnet material specification.

## B.5 Type testing

**B.5.1** The adequacy of each design of bellows and its means of attachment, including attachment welds, shall be verified by type testing in accordance with annex C.

**B.5.2** A bellows assembly design change that alters cyclic life demonstrated by a type test, e.g. a change in bellows material, bellows thickness, number of plies, welding geometry or welding procedure, requires an entirely new life cycle type test.

**B.5.3** When the bellows or bellows assembly manufacturer is changed, or there is a change in the method of manufacture of the bellows or bellows assembly, an entirely new life cycle type test is required.

**B.5.4** A change in the number of convolutions of a qualified bellows (increasing or decreasing the overall bellows height) is not of itself cause for a new life cycle test, provided that the installed bellows travel ratio for compression and extension is less than or equal to that of the qualified bellows. These ratios are defined as

$$R_\mathrm{c} = \frac{h_\mathrm{f} - h_\mathrm{c}}{h_\mathrm{f}}$$

and

$$R_\mathrm{e} = \frac{h_\mathrm{e} - h_\mathrm{f}}{h_\mathrm{f}}$$

where

$R_\mathrm{c}$ is the bellows compression ratio;

$R_\mathrm{e}$ is the bellows extension ratio;

$h_\mathrm{f}$ is the unrestrained (free) bellows height;

$h_\mathrm{c}$ is the installed compressed bellows height;

$h_\mathrm{e}$ is the installed extended bellows height.

**B.5.5** A bellows valve shall be designed such that the qualified extension and compression ratios cannot be exceeded.

## B.6 Materials

**B.6.1** Some services may require special bellows materials. When specified by the user, materials other than those listed in Table 13 may be selected for the bellows.

**B.6.2** Fabrication welding operations related to bellows or bellows assemblies shall be performed by qualified welding operators in accordance with qualified welding procedures. Both shall be qualified in accordance with ISO 9606-1 and ISO 9956-1 to ISO 9956-5 or ASME-BPVC, Section IX.

**B.6.3** Bellows assemblies, as received from the bellows manufacturer, shall be contained in individual packages so as to prevent damage from handling or moisture prior to assembly.

## B.7 Pressure tests

**B.7.1** Prior to assembly, each bellows or bellows assembly shall be tested for leakage using a mass spectrometer leakage testing device having a sensitivity of $10^{-3}$ $mm^3/s$ of helium at standard atmospheric pressure and 20 °C, and shall show no detectable leakage, or other means that the manufacturer can demonstrate to be of equal leakage detection sensitivity.

**B.7.2** Pressure tests for bellows stem seal valves, with the manufacturer taking into account the consequences of a bellows failure during pressure testing, shall be without stem packing installed or with the stem packing adjustment bolting loosely assembled so as to not effect a stem seal.

**B.7.3** When water is used as the test fluid for pressure testing valves having austenitic stainless steel bellows, the chloride content of the test water shall not exceed 100 mg/l (= 100 ppm).

**B.7.4** A backseat test is not required for a valve with a bellows stem seal.

## B.8 Marking

**B.8.1** Each bellows assembly shall have a material identification marking.

**B.8.2** The bellows material marking shall appear on the valve identification plate.

## B.9 Preparation for despatch

After testing, special care shall be taken to drain test fluid from the bellows chamber.

# Annex C
(normative)

# Type testing of bellows stem seals

## C.1 Scope

This annex specifies type testing for the purpose of qualifying bellows and bellows assemblies to be used in gate or globe valves in accordance with this International Standard. Included are requirements for testing, examination, and acceptability.



## C.2 General requirements

**C.2.1** The bellows is the expandable metal part that acts as the initial stem seal preventing the contained fluid from escaping into the atmosphere surrounding the valve. A bellows assembly includes the bellows and related end fittings. The end fittings may be in the form of rings, caps or flanges attached to the bellows by welding.

**C.2.2** Each bellows assembly design and each bellows material shall be qualified by type testing. Type testing includes both ambient temperature and high-temperature testing. The ambient temperature tests shall be carried out at a pressure at least equal to the rated valve pressure for 38 °C. The high-temperature tests shall be carried out at a pressure at least equal to the rated valve pressure for either a temperature at least equal to 427 °C or the maximum temperature for which the bellows is designated.

**C.2.3** A successful qualification requires that three bellows assemblies of the same design and material be type tested at ambient conditions and three more be tested at the high temperature conditions, and that all six meet the qualification acceptance requirements. The six bellows assemblies for testing shall be randomly selected from a regular bellows assembly production lot.

## C.3 Test procedure

### C.3.1 Pre-test examination

**C.3.1.1** The bellows assemblies to be tested shall be clean.

**C.3.1.2** The unrestrained (free) height of each bellows shall be measured and recorded along with the compressed and extended heights for which the qualification applies. The compressed and extended ratios (see B.5.4) shall be calculated and recorded in the test report.

**C.3.1.3** All bellows assembly welds shall be examined using a liquid dye penetrant. Any indication of a crack or any other weld defect shall be cause for rejection.

**C.3.1.4** Each bellows assembly shall be subjected to a helium leakage test. The assembly shall show no detectable leakage when tested with an instrument with a sensitivity of $10^{-3}$ $mm^3/s$ of helium.

### C.3.2 Pressure test

**C.3.2.1** Each bellows assembly shall be pressure tested.

**C.3.2.2** The pressure test fluid shall be water containing less than 100 mg/l (= 100 ppm) of chlorides.

**C.3.2.3** For the pressure test, the bellows shall be positioned at its extended design height. Positioning may be either in a valve assembly or in a test fixture duplicating the intended valve assembly.

**C.3.2.4** The test fluid pressure shall be applied in the same direction (externally or internally) for which the bellows assembly is to be qualified.

**C.3.2.5** The test fluid pressure shall be not less than 1,5 times the rated pressure of the valve at 38 °C.

**C.3.2.6** The minimum pressure test duration shall be 5 min.

**C.3.2.7** Any visually detectable leakage over the test duration shall be cause for rejection.

### C.3.3 Cycle test

**C.3.3.1** Each bellows assembly shall be cycle tested.

**C.3.3.2** For the cycle test, the bellows assembly shall be installed in either a completely assembled valve (with the packing removed) or a test fixture that simulates the intended bellows valve installation and incorporates its maximum possible extension and compression.

**C.3.3.3** The frequency of cycling shall not exceed one cycle per second.

**C.3.3.4** One complete cycle is defined as movement of the bellows from the design compressed position to the design extended position and return to the compressed position corresponding to the valve open-closed-open positions.

**C.3.3.5** The ambient cycle test cycling shall be carried out at ambient temperature and with the bellows subjected to a water pressure, as a minimum, equal to the 38 °C intended valve pressure rating. The high-temperature cycle test shall be carried out at a temperature at least the greater of 427 °C or the maximum bellows assembly rated temperature, and with the bellows subjected to a pressure, as a minimum, equal to the intended valve pressure rating at the test temperature. The test fluid for the high temperature test may be liquid or gas, at the manufacturer's option.

**C.3.3.6** Water containing less than 100 mg/l (= 100 ppm) of chlorides shall be used.

**C.3.3.7** The minimum number of test cycles required for qualification for each bellows assembly shall be in accordance with Table C.1.

**Table C.1 — Bellows test cycles**

| Valve rating | Test cycles minimum | |
|---|---|---|
| | Gate valve | Globe valve |
| Class $\leqslant$ 800 | 2 000 | 5 000 |
| Class $>$ 800 | 2 000 | 2 000 |

### C.3.4 Post test examination

**C.3.4.1** Upon completion of the cycle test, repeat the liquid dye penetrant examination of C.3.1.3.

**C.3.4.2** After the liquid dye penetrant examination, each bellows assembly shall be tested for leakage in accordance with either a) or b), as follows.

a) Submerge the bellows assembly in water for a period of 5 min while applying air at a pressure greater than 560 kPa (= 5,6 bar).

b) Perform a helium leakage test using an instrument that has a sensitivity of $10^{-3}$ $mm^3/s$ of helium.

**C.3.4.3** Any detectable leakage either from the bellows or the bellows assembly welds shall be cause for failure.