INTERNATIONAL STANDARD

ISO 14723

Second edition
2009-06-15

Petroleum and natural gas industries — Pipeline transportation systems — Subsea pipeline valves

Industries du pétrole et du gaz naturel — Systèmes de transport par conduites — Vannes de conduites immergées

Reference number
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Contents

Page

Foreword

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

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

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

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

ISO 14723 was prepared by Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries*, Subcommittee SC 2, *Pipeline transportation systems*.

This second edition cancels and replaces the first edition (ISO 14723:2001), which has been technically revised.

Introduction

This International Standard is based on ISO 14313. It has been developed to address special requirements specific to subsea pipeline valves.

It is necessary that users of this International Standard be aware that further or differing requirements can be required for individual applications. This International Standard is not intended to inhibit a contractor from offering, or the company from accepting, alternative engineering solutions for the individual application. This can be particularly applicable where there is innovative or developing technology. Where an alternative is offered, it is the responsibility of the manufacturer to identify any variations from this International Standard and provide details.

Petroleum and natural gas industries — Pipeline transportation systems — Subsea pipeline valves

1 Scope

This International Standard specifies requirements and gives recommendations for the design, manufacturing, testing and documentation of ball, check, gate and plug valves for subsea application in offshore pipeline systems meeting the requirements of ISO 13623 for the petroleum and natural gas industries.

This International Standard is not applicable to valves for pressure ratings exceeding PN 420 (Class 2500).

2 Conformance

2.1 Rounding

Except as otherwise required by this International Standard, to determine conformance with the specified requirements, observed or calculated values shall be rounded to the nearest unit in the last right-hand place of figures used in expressing the limiting value, in accordance with the rounding method of ISO 31-0:1992, Annex B, Rule A.

2.2 Compliance to standard

A quality system should be applied to assist compliance with the requirements of this International Standard.

NOTE ISO/TS 29001 gives sector-specific guidance on quality management systems.

The manufacturer shall be responsible for complying with all of the applicable requirements of this International Standard. It shall be permissible for the purchaser to make any investigation necessary in order to be assured of compliance by the manufacturer and to reject any material that does not comply.

3 Normative references

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

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

ISO 31-0:1992, *Quantities and Units — Part 0: General Principles*

ISO 148-1, *Metallic materials — Charpy pendulum impact test — Part 1: Test method*

ISO 228-1, *Pipe threads where pressure-tight joints are not made on the threads — Part 1: Dimensions, tolerances and designation*

ISO 5208:2008, *Industrial valves — Pressure testing of metallic valves*

ISO 9606 (all parts), *Qualification test of welders — Fusion welding*

ISO 9712, *Non-destructive testing — Qualification and certification of personnel*

ISO 10474, *Steel and steel products — Inspection documents*

ISO 15156 (all parts), *Petroleum and natural gas industries — Materials for use in* H_2S*-containing environments in oil and gas production*

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

ISO 15609 (all parts), *Specification and qualification of welding procedures for metallic materials — Welding procedure specification*

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

ASME[1] 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 B16.34-2004, *Valves Flanged, Threaded, and Welding End*

ASME B16.47-2006, *Large Diameter Steel Flanges: NPS 26 Through NPS 60*

ASME B31.4-2006, *Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids*

ANSI/ASME B31.8-2007, *Gas Transmission and Distribution Piping Systems*

ASME Boiler and Pressure Vessel Code, BPVC Section V:2007, *Nondestructive Examination* (BPVC)

ASME Boiler and Pressure Vessel Code, BPVC Section VIII, Division 1:2007, *Rules for Construction of Pressure Vessels* (BPVC)

ASME Boiler and Pressure Vessel Code, BPVC Section VIII, Division 2 :2004, *Alternative Rules* (BPVC)

ASME Boiler and Pressure Vessel Code, BPVC Section IX, *Welding and Brazing — Qualifications* (BPVC)

ASNT SNT-TC-1A[2], Recommended Practice No. SNT-TC-1A — *Non-Destructive Testing*

ASTM[3] A320/A320M, *Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for Low-Temperature Service*

ASTM A370, *Standard Test Methods and Definitions for Mechanical Testing of Steel Products*

ASTM A578/A578M-07, *Standard Specification for Straight-Beam Ultrasonic Examination of Rolled Steel Plates for Special Applications*

ASTM A609/A609M-02, *Standard Practice for Castings, Carbon, Low-Alloy, and Martensitic Stainless Steel Ultrasonic Examination Thereof*

ASTM E562, *Standard Test Method for Determining Volume Fraction by Systematic Manual Point Count*

1) American Society of Mechanical Engineers, 345 East 47th Street, NY 10017-2392, USA.

2) American Society of Non-Destructive Testing, PO box 28518, 1711 Arlingate Lane, Columbus, OH 43228-0518, USA.

3) American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, USA.

AWS QC1[4)], *Standard for AWS Certification of Welding Inspectors*

EN 287 (all parts), *Qualification test of welders — Fusion welding*

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

EN 10204:2004, *Metallic materials — Types of inspection documents*

MSS[5)] SP-44, *Steel Pipeline Flanges*

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

NACE TM0284, *Standard Test Method — Evaluation of Pipeline and Pressure Vessel Steels for Resistance to Hydrogen-Induced Cracking*

4 Terms and definitions

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

4.1
ASME rating class
numerical pressure design class defined in ASME B16.34 and used for reference purposes

NOTE The ASME rating class is designated by the word “Class” followed by a number.

[ISO 14313:2007, 4.1]

4.2
bi-directional valve
valve designed for blocking the fluid in both downstream and upstream directions

[ISO 14313:2007, 4.2]

4.3
bleed
drain or vent

[ISO 14313:2007, 4.3]

4.4
block valve
gate, plug or ball valve that blocks flow into the downstream conduit when in the closed position

NOTE Valves are either single- or double-seated, bi-directional or uni-directional.

[ISO 14313:2007, 4.4]

4.5
breakaway thrust
breakaway torque
maximum thrust or torque required to operate a valve at maximum pressure differential

[ISO 14313:2007, 4.5]

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4) The American Welding Society, 550 NW LeJeune Road, Miami, FL 33126, USA.

5) Manufacturers Standardization Society of the Valve & Fittings Industry Inc., 127 Park Street N.E., Vienna, VA 22180, USA.

4.6
by agreement
agreed between manufacturer and purchaser

[ISO 14313:2007, 4.6]

4.7
double-block-and-bleed valve
DBB
single valve with two seating surfaces that in the closed position provides a seal against pressure from both ends of the valve with a means of venting/bleeding the cavity between the seating surfaces

[ISO 14313:2007, 4.7]

4.8
double-isolation-and-bleed valve
DIB
single valve with two seating surfaces, each of which in the closed position provides a seal against pressure from a single source, with a means of venting/bleeding the cavity between the seating surfaces

NOTE This feature can be provided in one direction or in both directions.

[ISO 14313:2007, 4.8]

4.9
drive train
all parts of a valve drive between the operator and the obturator, including the obturator but excluding the operator

[ISO 14313:2007, 4.9]

4.10
flow coefficient
K_v
volumetric flow rate of water at a temperature between 5 °C (40 °F) and 40 °C (104 °F) passing through a valve and resulting in a pressure loss of 0,2 MPa (1 bar, 14,7 psi)

NOTE 1 K_v is expressed in SI units of cubic metres per hour.

NOTE 2 K_v is related to the flow rate coefficient, C_v, expressed in USC units of US gallons per minute at 15,6 °C (60 °F) resulting in a 1 psi pressure drop as given by Equation (1):

$$K_v = \frac{C_v}{1{,}156} \tag{1}$$

[ISO 14313:2007, 4.10]

4.11
full-opening valve
valve with an unobstructed opening not smaller than the internal bore of the end connections

[ISO 14313:2007, 4.11]

4.12
handwheel
wheel consisting of a rim connected to a hub, for example by spokes, and used to operate manually a valve requiring multiple turns

[ISO 14313:2007, 4.12]

4.13
locking device
part or an arrangement of parts for securing a valve in the open and/or closed position

[ISO 14313:2007, 4.13]

4.14
manual actuator
manual operator
wrench (lever) or handwheel with or without a gearbox

[ISO 14313:2007, 4.14]

4.15
maximum pressure differential
MPD
maximum difference between the upstream and downstream pressure across the obturator at which the obturator may be operated

[ISO 14313:2007, 4.15]

4.16
nominal pipe size
NPS
numerical imperial designation of size, which is common to components in piping systems of any one size

NOTE Nominal pipe size is designated by the abbreviation "NPS" followed by a number.

[ISO 14313:2007, 4.16]

4.17
nominal pressure class
PN
numerical pressure design class used for reference purposes

NOTE Nominal pressure class is designated by the abbreviation "PN" followed by a number.

[ISO 14313:2007, 4.17]

4.18
nominal size
DN
numerical metric designation of size that is common to components in piping systems of any one size

NOTE Nominal size is designated by the abbreviation "DN" followed by a number.

[ISO 14313:2007, 4.18]

4.19
obturator
closure member
part of a valve, such as a ball, clapper, disc, gate or plug that is positioned in the flow stream to permit or prevent flow

[ISO 14313:2007, 4.19]

4.20
operator
device (or assembly) for opening or closing a valve

[ISO 14313:2007, 4.20]

4.21
packing gland
component used to compress the stem packing

[ISO 14313:2007, 4.21]

4.22
piggability
capability of a valve to permit the unrestricted passage of a pig

[ISO 14313:2007, 4.23]

4.23
pipe pup
transition piece
piece(s) of pipe or forged material, welded to the valve to prevent valve-seal damage from girth welding, for matching of valve material to pipeline strength properties, or to provide a valve end matching the pipeline dimensions

4.24
position indicator
device to show the position of the valve obturator

[ISO 14313:2007, 4.22]

4.25
powered operator
powered actuator
electric, hydraulic or pneumatic device bolted or otherwise attached to the valve for powered opening and closing of the valve

[ISO 14313:2007, 4.24]

4.26
pressure cap
cap designed to contain internal pressure in the event of seal leakage or to prevent ingress due to hyperbaric pressure

NOTE A pressure cap may also be used for protection; see 4.36.

4.27
pressure class
numerical pressure design class expressed in accordance with either the nominal pressure (PN) class or the ASME rating class

NOTE In this International Standard, the pressure class is stated by the PN class, followed by the ASME rating class in parentheses.

[ISO 14313:2007, 4.25]

4.28
pressure-containing parts
parts whose failure to function as intended results in a release of contained fluid into the environment

[ISO 14313:2007, 4.26]

4.29
pressure-controlling parts
parts, such as seat and obturator, intended to prevent or permit the flow of fluids

[ISO 14313:2007, 4.27]

4.30
process-wetted parts
parts exposed directly to the pipeline fluid

[ISO 14313:2007, 4.28]

4.31
reduced-opening valve
valve with the opening through the obturator smaller than at the end connection(s)

[ISO 14313:2007, 4.29]

4.32
remote-operated vehicle
ROV
underwater vehicle operated remotely from a surface vessel or installation

4.33
seating surfaces
contact surfaces of the obturator and seat which ensure valve sealing

[ISO 14313:2007,4.30]

4.34
shaft
part of a check valve that connects the obturator to the operator and that can consist of one or more components

4.35
stem
part that connects the obturator to the operator and that can consist of one or more components

[ISO 14313:2007, 4.31]

4.36
stem/shaft protector
cover to protect valve parts from mechanical damage

NOTE A pressure cap may also be used for protection.

4.37
support ribs or legs
metal structure that provides a stable footing when the valve is set on a fixed base

[ISO 14313:2007, 4.33]

4.38
through-conduit valve
valve with an unobstructed and continuous cylindrical opening

[ISO 14313:2007, 4.34]

4.39
uni-directional valve
valve designed for blocking the flow in one direction only

[ISO 14313:2007, 4.35]

4.40
unless otherwise agreed
⟨modification of the requirements of this International Standard⟩ unless the manufacturer and purchaser agree on a deviation

4.41
unless otherwise specified
⟨modification of the requirements of this International Standard⟩ unless the purchaser specifies otherwise

5 Symbols and abbreviated terms

5.1 Symbols

C_v Flow coefficient expressed in USC units

K_v Flow coefficient expressed in SI units

t thickness

5.2 Abbreviated terms

BM base metal

CE carbon equivalent

DBB double-block-and-bleed

DIB double-isolation-and-bleed

DN nominal size

HAZ heat-affected zone

HBW Brinell hardness, tungsten-ball indenter

HIC hydrogen-induced cracking

HRB Rockwell hardness, B scale

HRC Rockwell hardness, C scale

HV Vickers hardness

MPD maximum pressure differential

MT magnetic-particle testing

NDE non-destructive examination

NPS nominal pipe size

PN nominal pressure

PQR procedure qualification record

PT penetrant testing

PWHT post-weld heat treatment

QL quality level

ROV	remote-operated vehicle
RT	radiographic testing
SMYS	specified minimum yield strength
SSIV	subsea isolation valve
USC	United States customary (units)
	NOTE The full stop (period) is used as a decimal separator for USC units.
UT	ultrasonic testing
VT	visual testing
WM	weld metal
WPS	weld-procedure specification
WPQ	welder performance qualification

6 Valve types and configurations

6.1 Valve types

6.1.1 Gate valves

Typical configurations for gate valves with flanged and welding ends are shown, for illustration purposes only, in Figures 1 and 2.

Gate valves shall have an obturator that moves in a plane perpendicular to the direction of flow.

6.1.2 Plug valves

Typical configurations for plug valves with flanged and welding ends are shown, for illustration purposes only, in Figure 3.

Plug valves shall have a cylindrical or conical obturator that rotates about an axis perpendicular to the direction of flow.

6.1.3 Ball valves

Typical configurations for ball valves with flanged or welding ends are shown, for illustration purposes only, in Figures 4, 5 and 6.

Ball valves shall have a spherical obturator that rotates on an axis perpendicular to the direction of flow.

6.1.4 Check valves

Typical configurations for check valves are shown, for illustration purposes only, in Figures 7 to 13. Check valves can also be of the wafer, axial-flow and lift type.

Check valves shall have an obturator that responds automatically to prevent flow in one direction.

6.2 Valve configurations

6.2.1 Full-opening valves

Full-opening flanged-end valves shall be unobstructed in the fully opened position and have an internal bore as specified in Table 1. There is no restriction on the upper limit of valve bore sizes.

Full-opening through-conduit valves shall have a circular bore in the obturator that allows a sphere to pass with a nominal size not less than that specified in Table 1.

Welding-end valves can require a smaller bore at the welding end to mate with the pipe.

Valves with a non-circular opening through the obturator shall not be considered full opening.

6.2.2 Reduced-opening valves

Reduced-opening valves with a circular opening through the obturator shall be supplied with a minimum bore as follows, unless otherwise specified:

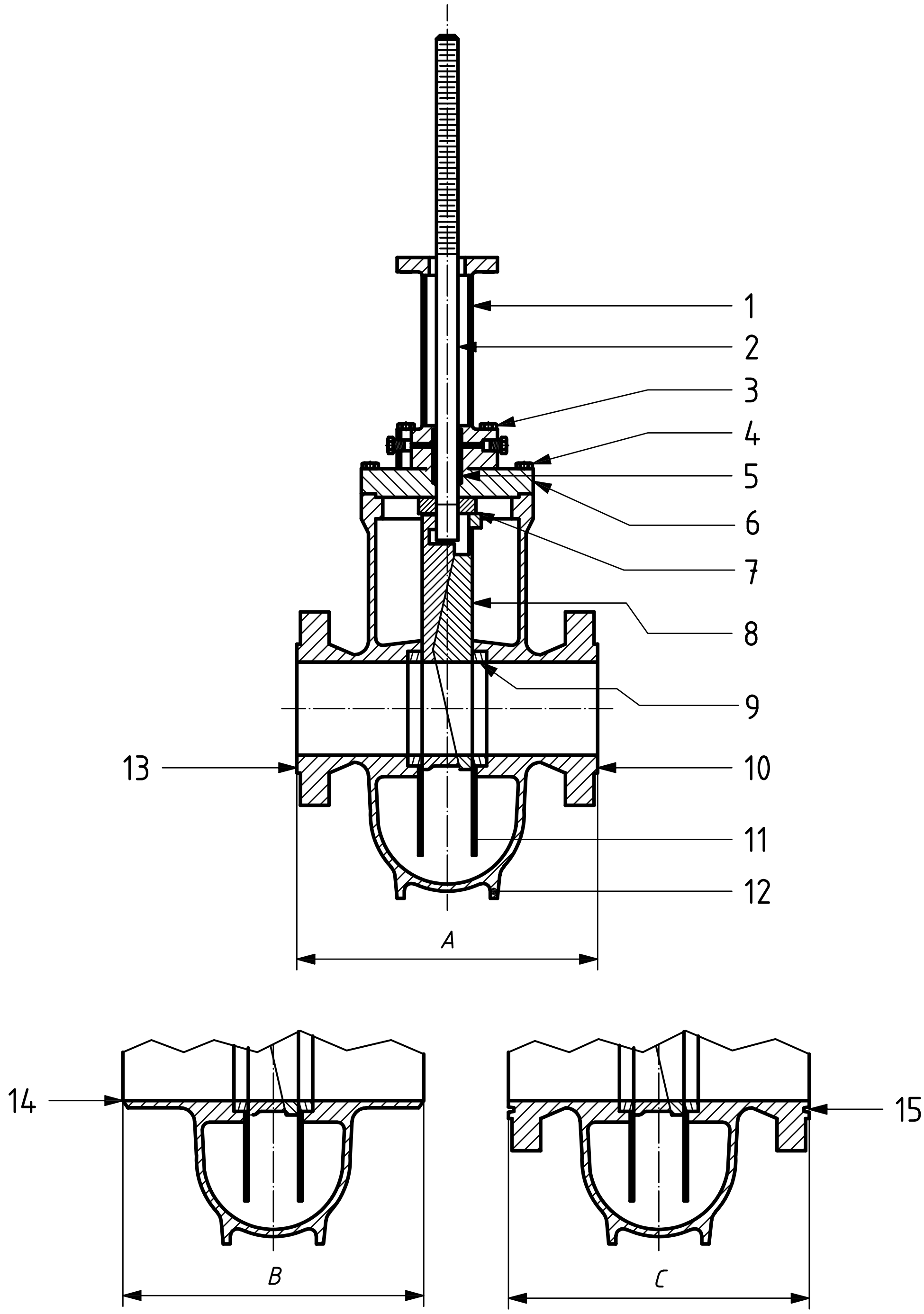
- valves DN 300 (NPS 12) and below: one size below nominal size of valve with bore according to Table 1;
- valves DN 350 (NPS 14) to DN 600 (NPS 24): two sizes below nominal size of valve with bore according to Table 1;
- valves above DN 600 (NPS 24): by agreement.

EXAMPLE A DN 400 (NPS 16) – PN 250 (Class 1500) reduced-opening ball valve has a minimum bore of 287 mm.

Reduced-opening valves with a non-circular opening through the obturator shall be supplied with a minimum opening by agreement.

Table 1 — Minimum bore for full-opening valves by pressure class

DN	NPS	Minimum bore dimension mm			
		PN 20 to 100 (Class 150 to 600)	PN 150 (Class 900)	PN 250 (Class 1500)	PN 420 (Class 2500)
15	1/2	13	13	13	13
20	3/4	19	19	19	19
25	1	25	25	25	25
32	1 1/4	32	32	32	32
40	1 1/2	38	38	38	38
50	2	49	49	49	42
65	2 1/2	62	62	62	52
80	3	74	74	74	62
100	4	100	100	100	87
150	6	150	150	144	131
200	8	201	201	192	179
250	10	252	252	239	223
300	12	303	303	287	265
350	14	334	322	315	292
400	16	385	373	360	333
450	18	436	423	406	374
500	20	487	471	454	419
550	22	538	522	500	—
600	24	589	570	546	—
650	26	633	617	594	—
700	28	684	665	641	—
750	30	735	712	686	—
800	32	779	760	730	—
850	34	830	808	775	—
900	36	874	855	819	—
950	38	925	904	—	—
1 000	40	976	956	—	—
1 050	42	1 020	1 006	—	—
1 200	48	1 166	1 149	—	—
1 350	54	1 312	—	—	—
1 400	56	1 360	—	—	—
1 500	60	1 458	—	—	—



Key

1 yoke
2 stem
3 yoke bolting
4 bonnet bolting
5 stem packing
6 bonnet
7 gate stop
8 gate assembly
9 seat ring
10 body
11 gate guide
12 support ribs or legs
13 raised face
14 welding end
15 ring joint

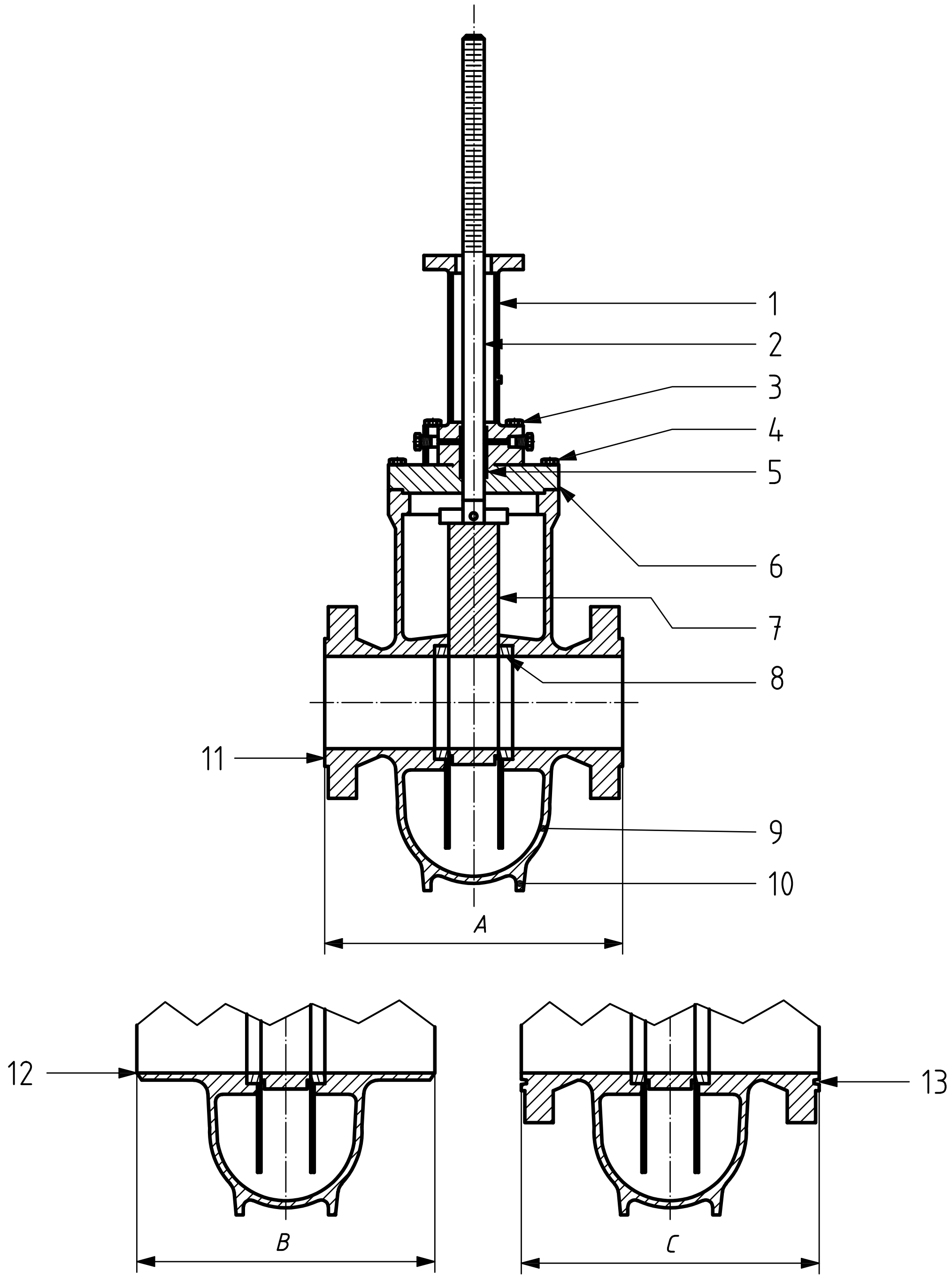
A raised-face face-to-face dimension

B welding-end end-to-end dimension

C ring-joint end-to-end dimension

NOTE See Tables 2 to 6 for dimensions *A*, *B* and *C*.

Figure 1 — Typical expanding-gate/rising-stem gate valve



Key

1 yoke
2 stem
3 yoke bolting
4 bonnet bolting
5 stem packing
6 bonnet
7 gate
8 seat ring
9 body
10 support ribs or legs
11 raised face
12 welding end
13 ring joint

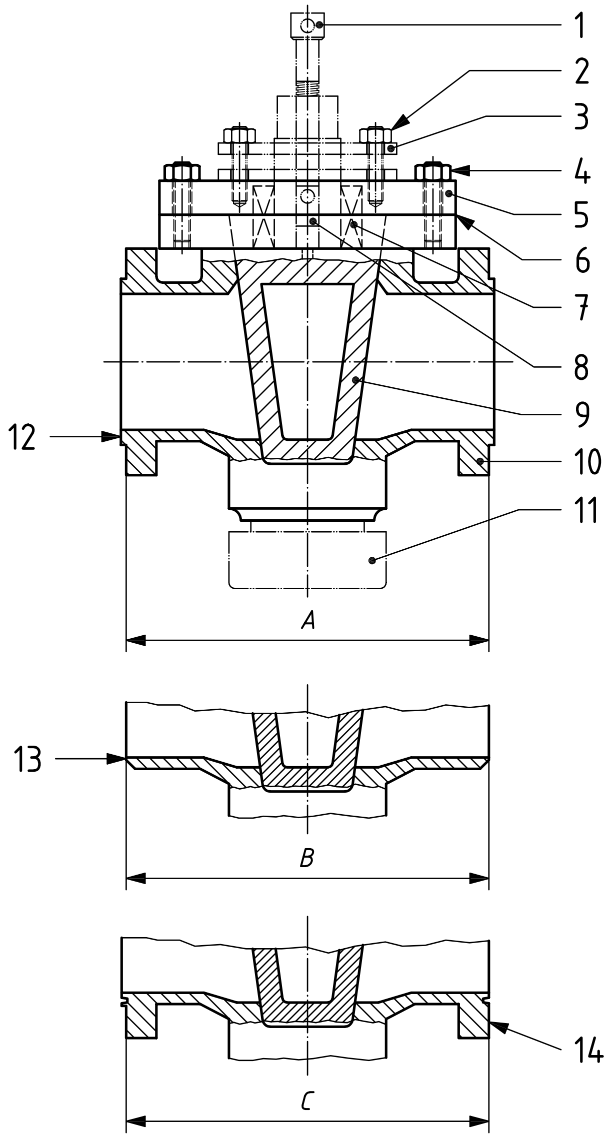
A raised-face face-to-face dimension

B welding-end end-to-end dimension

C ring-joint end-to-end dimension

NOTE See Tables 2 to 6 for dimensions *A*, *B* and *C*.

Figure 2 — Typical slab-gate/through-conduit rising-stem gate valve



Key

1 lubricator screw
2 gland studs and nuts
3 gland
4 cover studs and nuts
5 cover
6 cover gasket
7 stem packing
8 lubricant check valve
9 plug
10 body
11 stop collar
12 raised face
13 welding end
14 ring joint

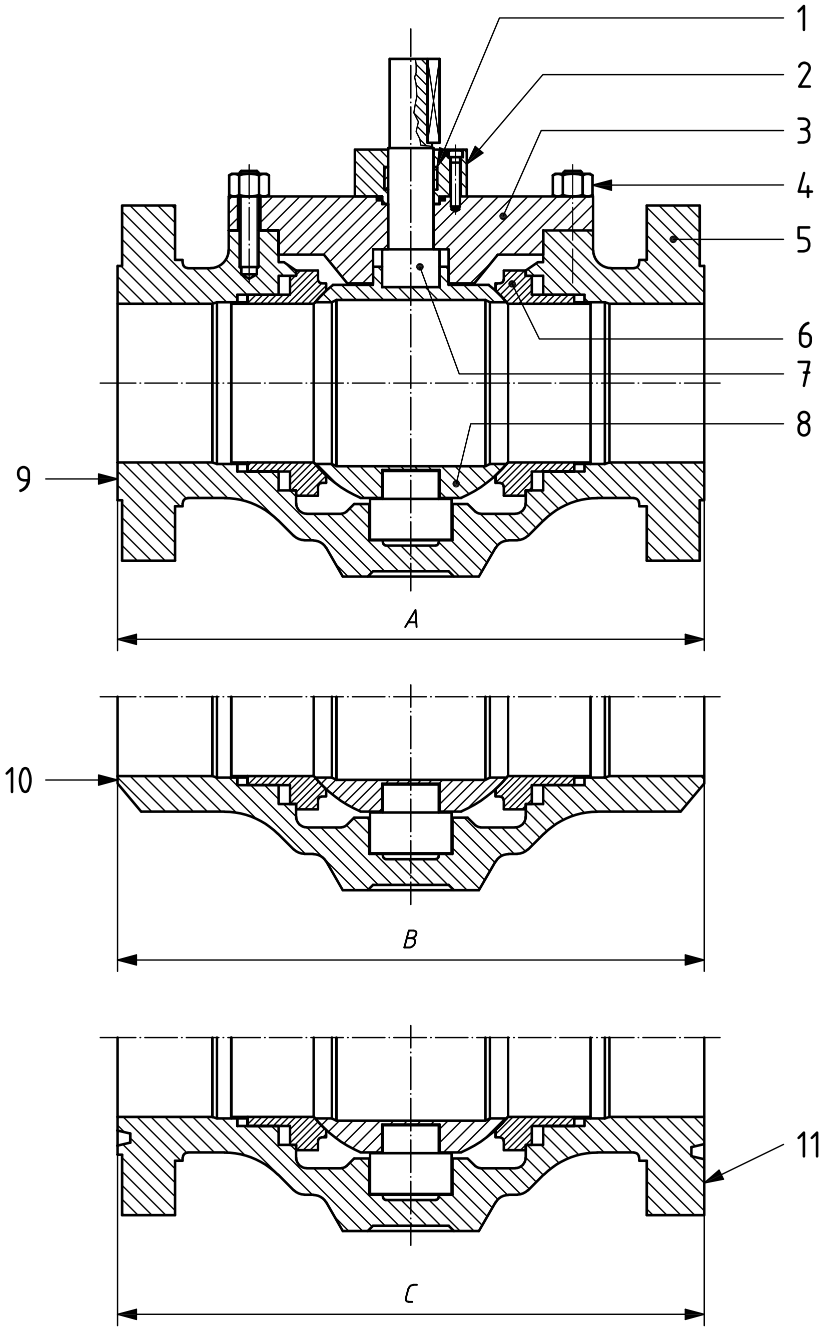
A raised-face face-to-face dimension

B welding-end end-to-end dimension

C ring-joint end-to-end dimension

NOTE See Tables 2 to 6 for dimensions *A*, *B* and *C*.

Figure 3 — Typical plug valve



Key

1 stem seal
2 bonnet cover
3 bonnet
4 body bolting
5 body
6 seat ring
7 stem
8 ball
9 raised face
10 welding end
11 ring joint

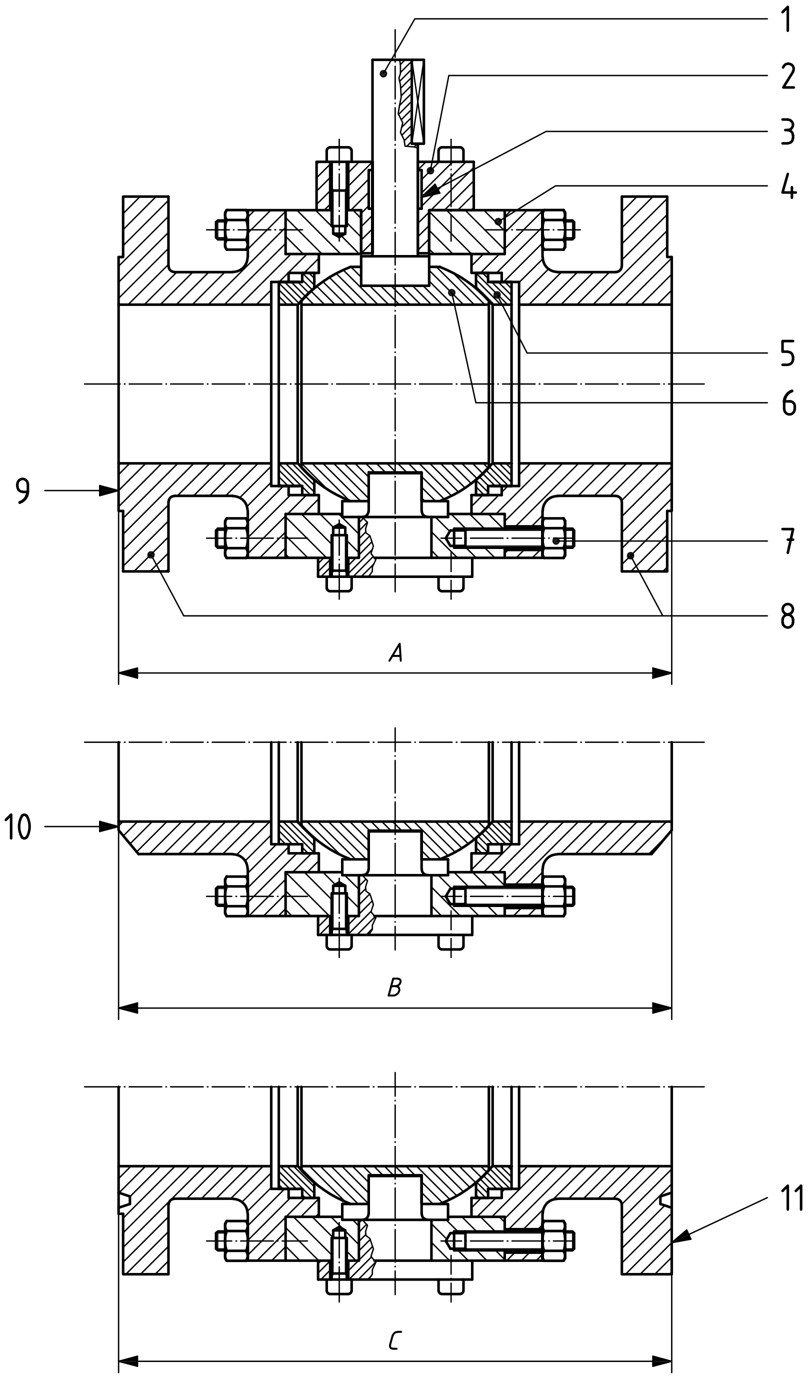
A raised-face face-to-face dimension

B welding-end end-to-end dimension

C ring-joint end-to-end dimension

NOTE See Tables 2 to 6 for dimensions *A*, *B* and *C*.

Figure 4 — Typical top-entry ball valve



Key

1 stem
2 body cover
3 stem seal
4 body
5 seat ring
6 ball
7 body bolting
8 closure
9 raised face
10 welding end
11 ring joint

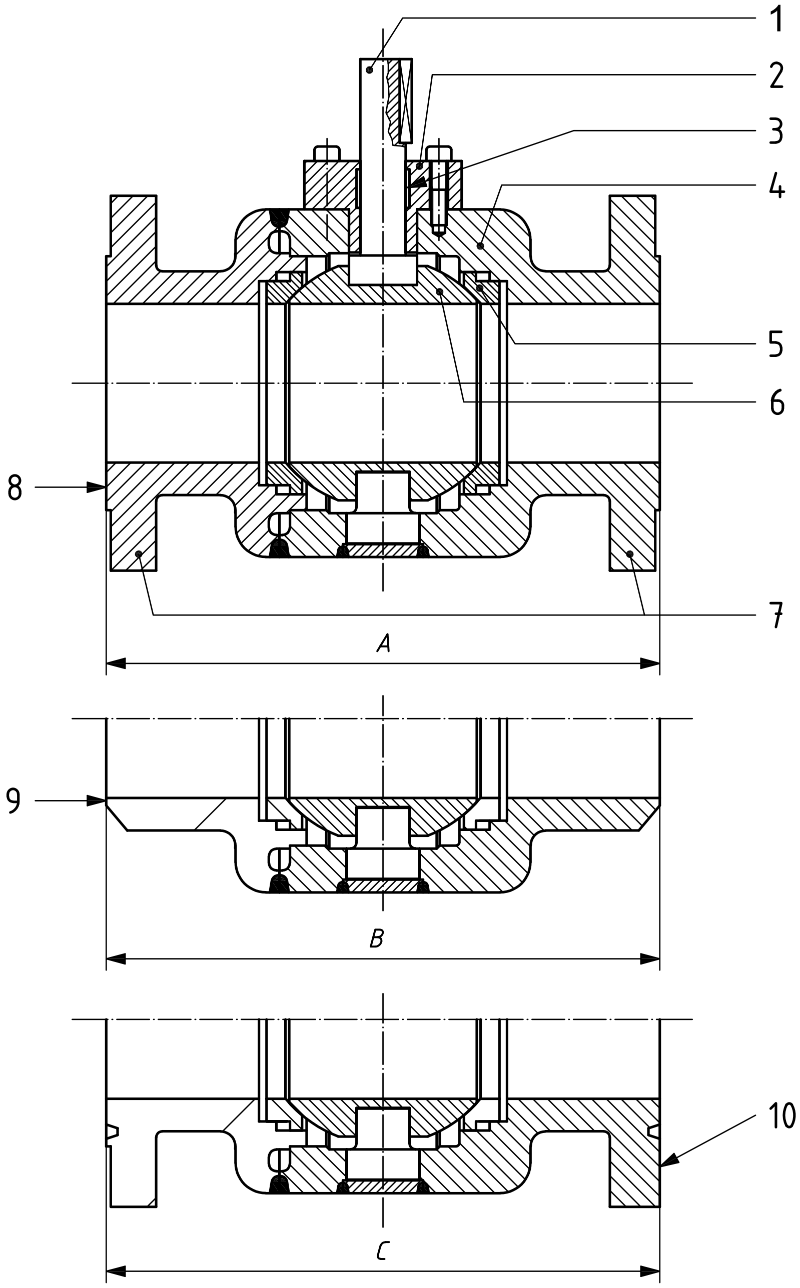
A raised-face face-to-face dimension

B welding-end end-to-end dimension

C ring-joint end-to-end dimension

NOTE See Tables 2 to 6 for dimensions *A*, *B* and *C*.

Figure 5 — Typical three-piece ball valve



Key

1 stem
2 body cover
3 stem seal
4 body
5 seat ring
6 ball
7 closure
8 raised face
9 welding end
10 ring joint

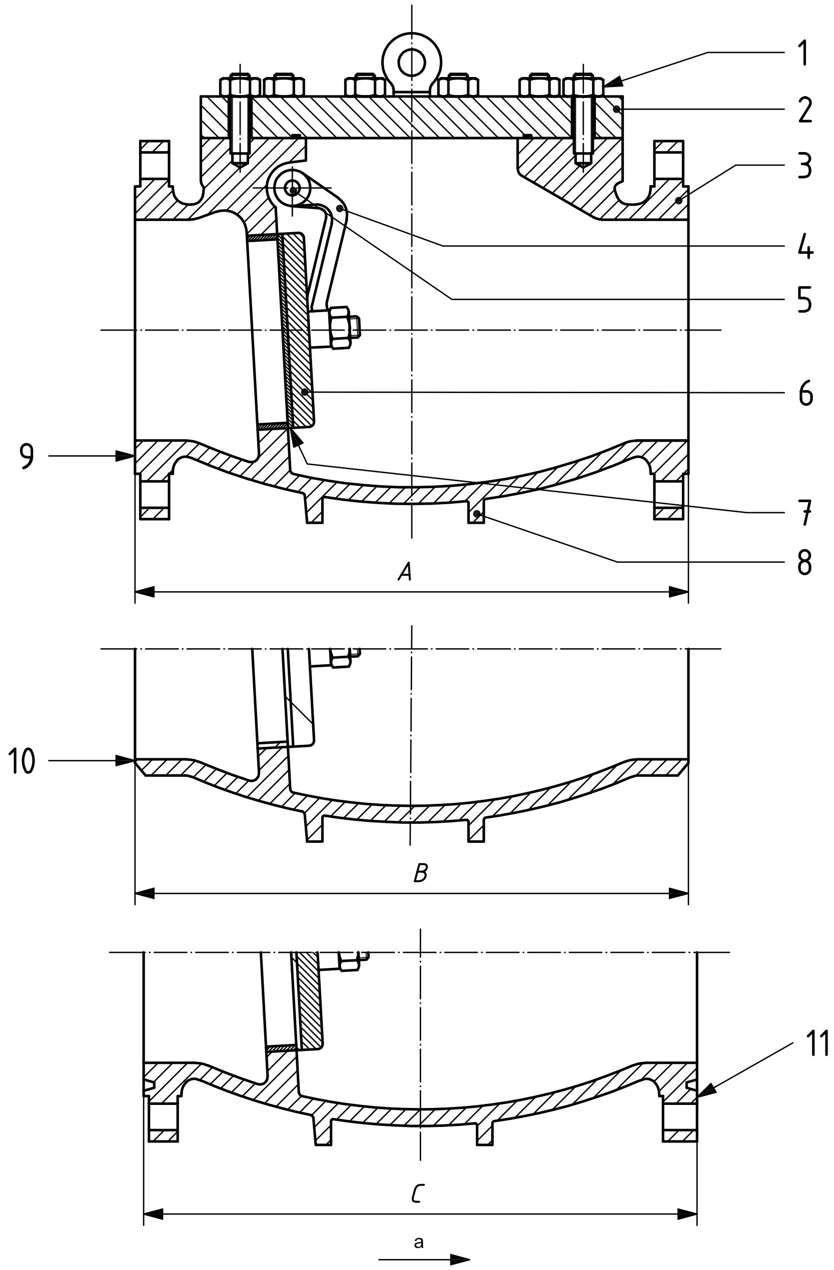
A raised-face face-to-face dimension

B welding-end end-to-end dimension

C ring-joint end-to-end dimension

NOTE See Tables 2 to 6 for dimensions *A*, *B* and *C*.

Figure 6 — Typical welded-body ball valve



Key

1 cover bolting
2 cover
3 body
4 clapper disc arm
5 shaft
6 clapper disc
7 seat ring
8 support ribs or legs
9 raised face
10 welding end
11 ring joint

A raised-face face-to-face dimension

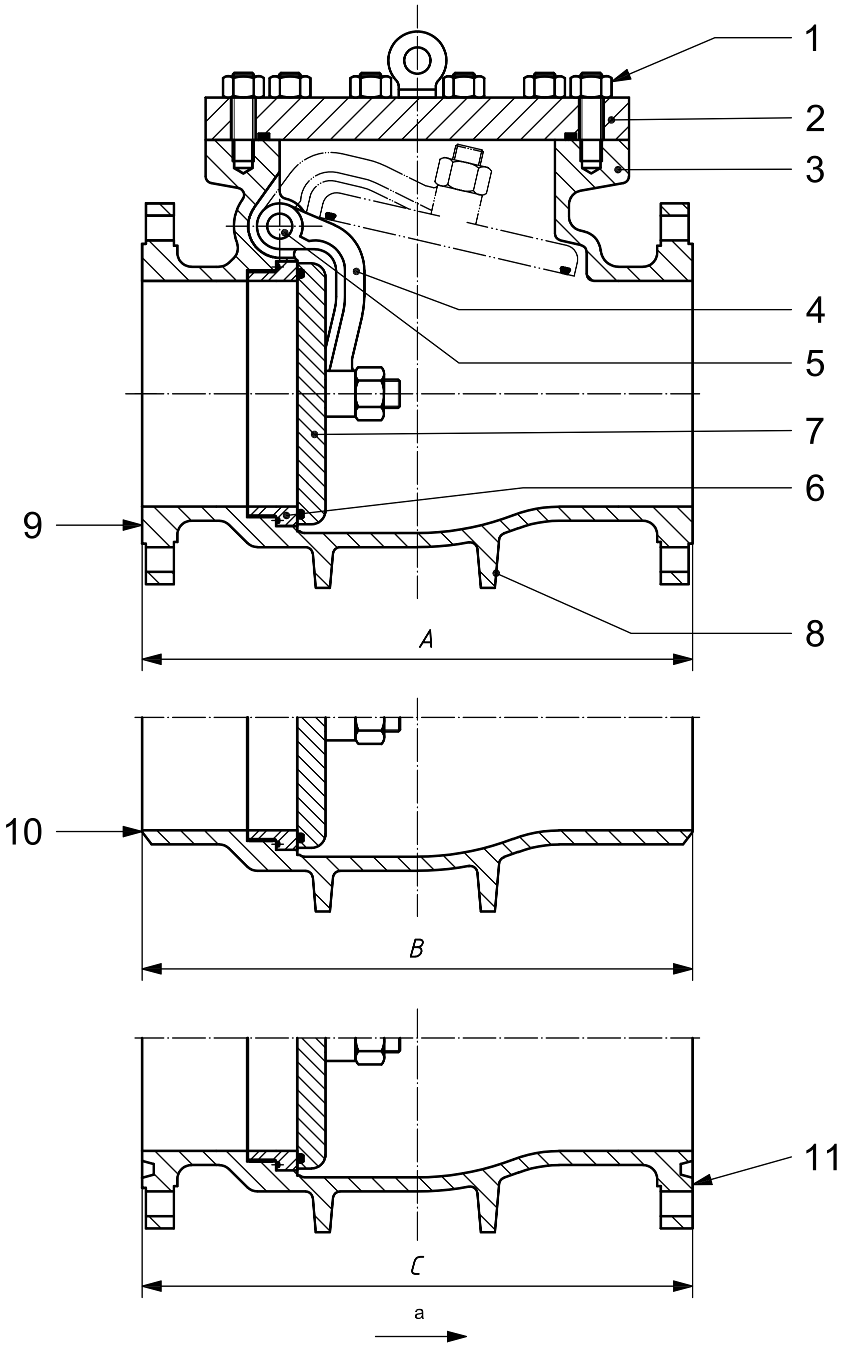
B welding-end end-to-end dimension

C ring-joint end-to-end dimension

NOTE See Tables 2 to 6 for dimensions *A*, *B* and *C*.

[a] Direction of flow.

Figure 7 — Typical reduced-opening swing check valve



Key

1 cover bolting
2 cover
3 body
4 clapper disc arm
5 shaft
6 seat ring
7 clapper disc
8 support ribs or legs
9 raised face
10 welding end
11 ring joint

A raised-face face-to-face dimension

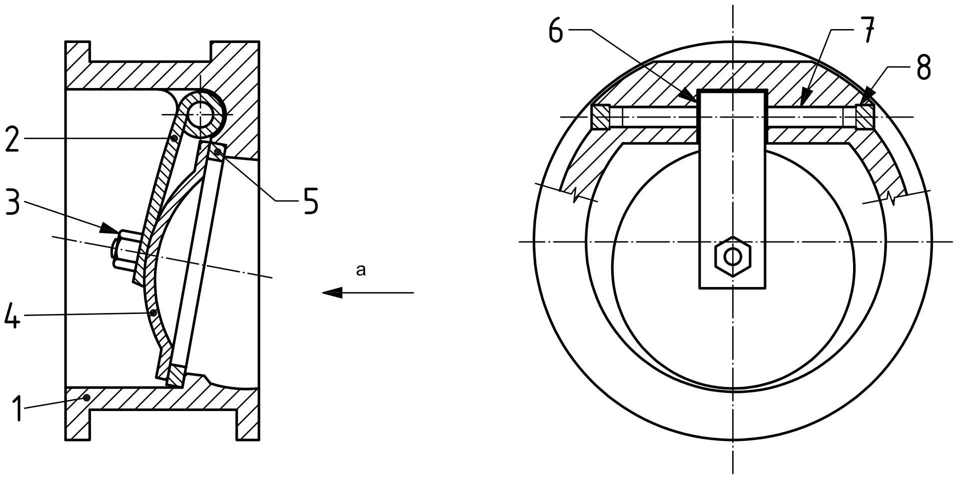
B welding-end end-to-end dimension

C ring-joint end-to-end dimension

NOTE See Tables 2 to 6 for dimensions *A*, *B* and *C*.

[a] Direction of flow.

Figure 8 — Typical full-opening swing check valve

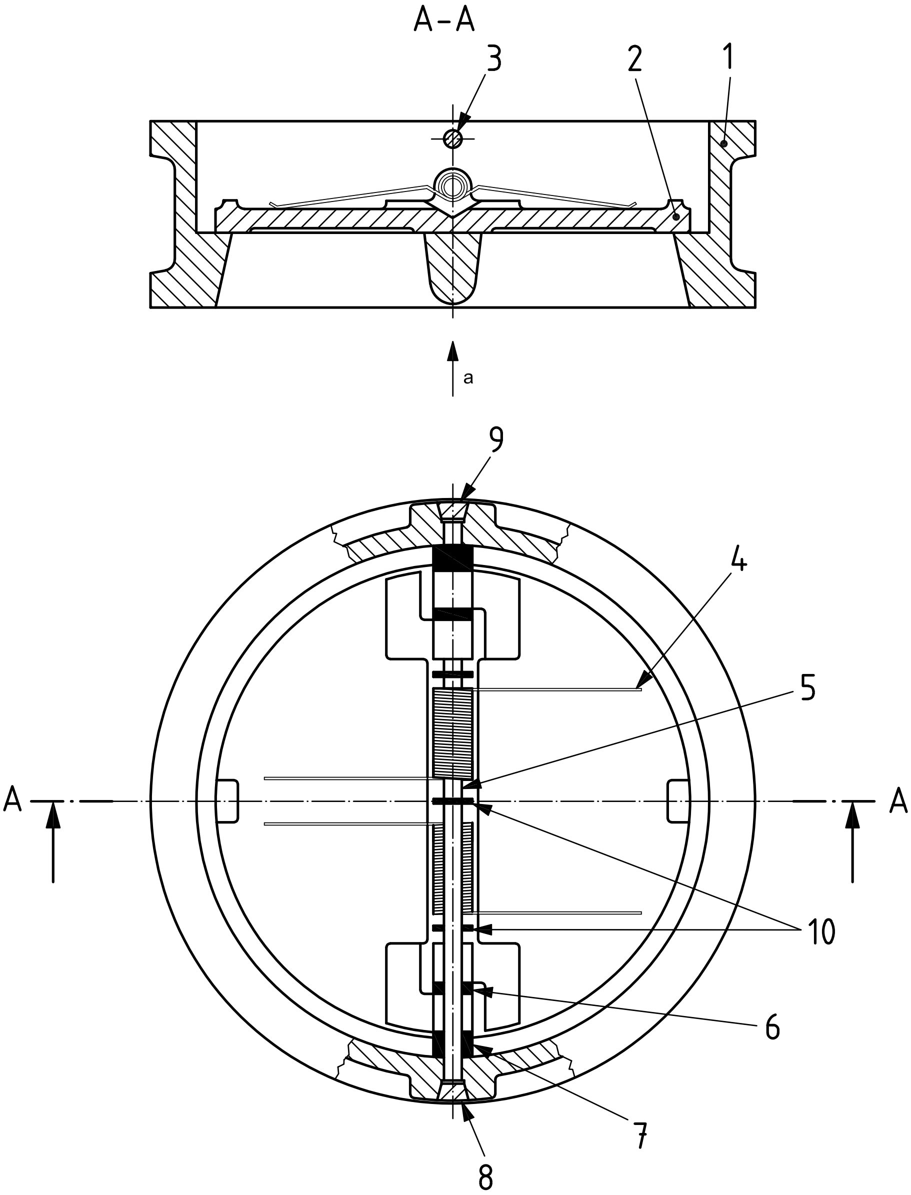


Key

1 body
2 hinge
3 nut
4 closure plate/stud assembly
5 seat ring
6 bearing spacers
7 hinge pin
8 hinge pin retainers

[a] Direction of flow.

Figure 9 — Typical single-plate wafer-type check valve, long pattern

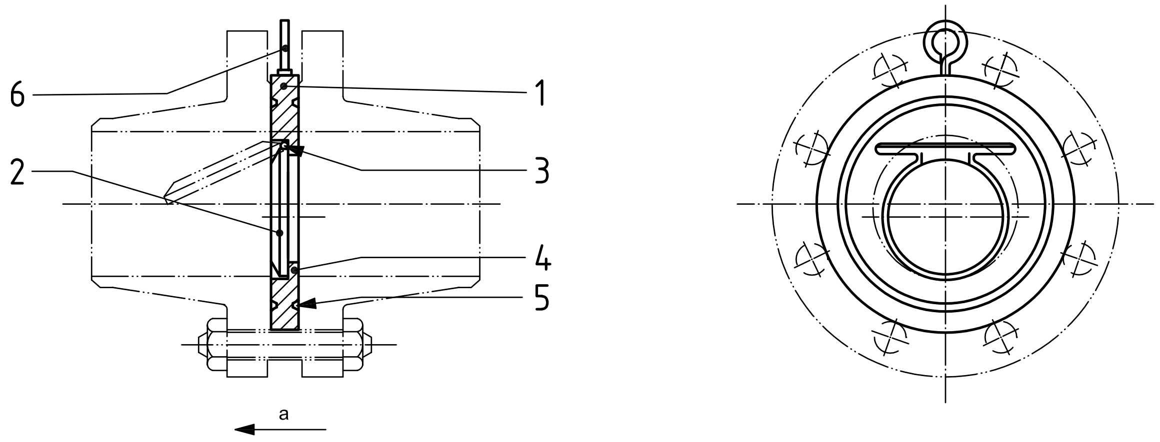


Key

1 body
2 closure plate
3 stop pin
4 spring
5 hinge pin
6 plate lug bearings
7 body lug bearings
8 stop pin retainers
9 hinge pin retainers
10 spring bearings

[a] Direction of flow.

Figure 10 — Typical dual-plate wafer-type check valve, long pattern

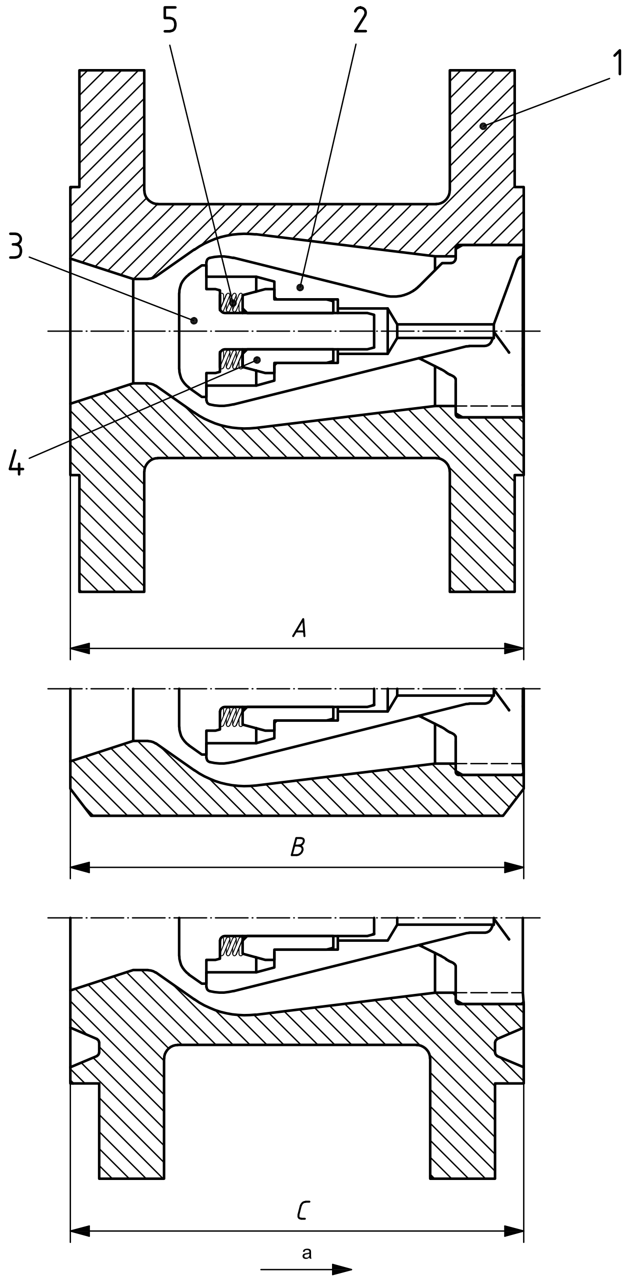


Key

1 body
2 clapper
3 pin
4 clapper seal
5 body seal
6 lifting eye

a Direction of flow.

Figure 11 — Typical single-plate wafer-type check valve, short pattern



Key

1 body
2 rod guidance
3 disc
4 bearing
5 spring

A raised-face face-to-face dimension

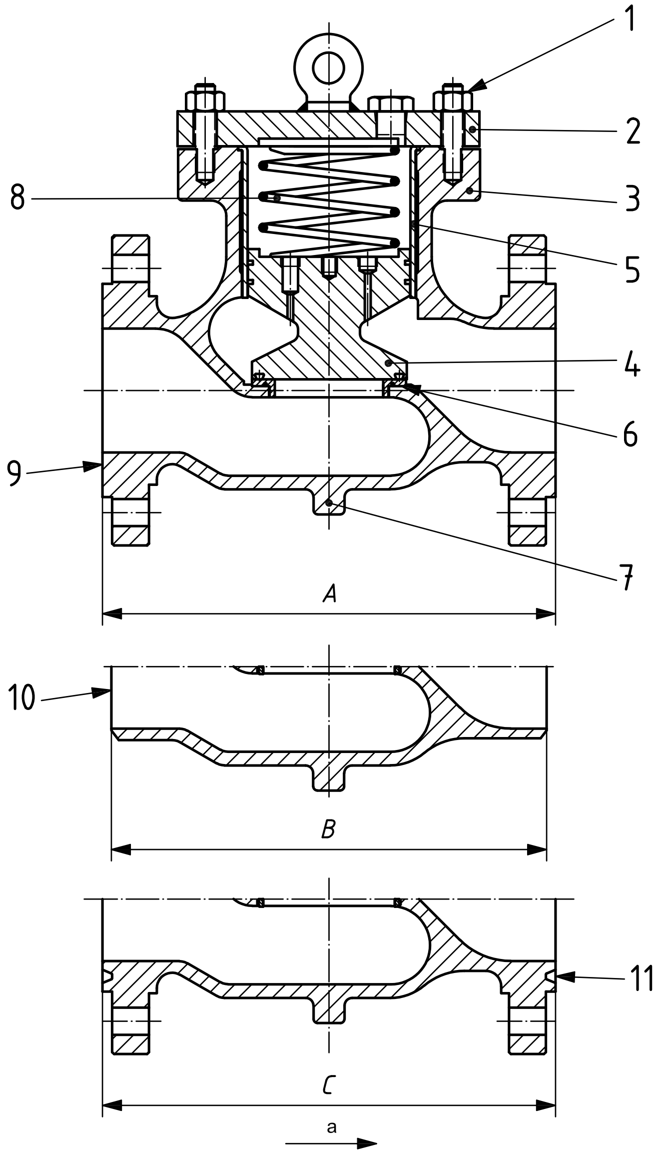
B welding-end end-to-end dimension

C ring-joint end-to-end dimension

NOTE See Tables 2 to 6 for dimensions *A*, *B* and *C*.

[a] Direction of flow.

Figure 12 — Typical axial flow check valve



Key

1 cover bolting
2 cover
3 body
4 piston
5 liner
6 seat ring
7 support ribs or legs
8 spring
9 raised face
10 welding end
11 ring joint

A raised-face face-to-face dimension

B welding-end end-to-end dimension

C ring-joint end-to-end dimension

NOTE See Tables 2 to 6 for dimensions *A*, *B* and *C*.

[a] Direction of flow.

Figure 13 — Typical piston check valve

7 Design

7.1 Design codes and calculations

Pressure-containing parts, including bolting, shall be designed with materials specified in Clause 8.

Design and calculations for pressure-containing elements shall be in accordance with an internationally recognized design code or standard with consideration for pipe loads, operating forces, etc. The choice of standard shall be by agreement.

NOTE 1 Examples of internationally recognized design codes or standards are ASME BPVC, Section VIII, Division 1 or Division 2, ASME B16.34, EN 12516-1 and EN 13445-3.

The allowable stress values shall be consistent with the selected design code or standard.

If the selected design code or standard specifies a test pressure less than 1,5 times the design pressure, then the design pressure for the body calculation shall be increased such that the hydrostatic test pressure in 11.2 can be applied.

NOTE 2 Some design codes or standards require a consistent and specific application of requirements for fabrication and testing, including NDE.

7.2 Pressure and temperature ratings

The nominal pressure (PN) class or the ASME rating class shall be used for the specification of the required pressure class.

Valves covered by this International Standard shall be furnished in one of the following classes:

— PN 20 (class 150);

— PN 50 (class 300);

— PN 64 (class 400);

— PN 100 (class 600);

— PN 150 (class 900);

— PN 250 (class 1500);

— PN 420 (class 2500).

Pressure-temperature ratings for class-rated valves shall be in accordance with the applicable rating table for the appropriate material group in ASME B16.34.

Pressure-temperature ratings for PN-rated valves shall be in accordance with the applicable rating table for the appropriate material group in EN 1092-1.

If intermediate design pressures and temperatures are specified by the purchaser, the pressure-temperature rating shall be determined by linear interpolation.

Pressure-temperature ratings for valves made from materials not covered by ASME B16.34 and EN 1092-1 shall be determined from the material properties in accordance with the applicable design standard.

NOTE Non-metallic parts can limit maximum pressures and minimum and maximum operating temperatures.

The maximum operating pressure at the minimum and maximum operating temperatures shall be marked on the nameplate.

The minimum design temperature shall be 0 °C unless otherwise specified by the purchaser.

7.3 Cavity relief

Cavity relief to the environment shall not be used, unless otherwise agreed.

7.4 External pressure and loads

Valves shall be designed for internal pressure, temperature and external hydrostatic pressure. In the case of external pressure, vacuum condition shall be assumed to apply inside the valve. Stems shall also be designed for loads due to internal and external pressures.

The purchaser shall specify any other construction, test, functional or accidental load combinations that shall be accounted for in the design.

NOTE ISO 13623 specifies construction, functional and accidental loads and provides examples of such loads for consideration by the purchaser.

7.5 Sizes

Valves constructed in accordance with this International Standard shall be furnished in nominal sizes as listed in Table 1.

NOTE In this International Standard, DN sizes are stated first, followed by the equivalent NPS size in parentheses.

Except for reduced-opening valves, valve sizes shall be specified by the nominal sizes (DN) or nominal pipe size (NPS).

Reduced-opening valves with a circular opening shall be specified by the nominal size of the end connections and the nominal size of the reduced opening in accordance with 6.2.2.

EXAMPLE 1 A DN 400 (NPS 16) – PN 20 (Class 150) valve with a reduced 303 mm diameter circular opening is specified as DN 400 (NPS 16) × DN 300 (NPS 12).

Reduced-opening valves with a non-circular opening and reduced-opening check valves shall be designated as reduced-bore valves and specified by the nominal size corresponding to the end connections, followed by the letter “R”.

EXAMPLE 2 A reduced-bore valve with DN 400 (NPS 16) end connections and a 381 mm × 305 mm rectangular opening is specified as 400R (16R).

7.6 Face-to-face and end-to-end dimensions

Unless otherwise agreed, face-to-face (A) and end-to-end (B and C) dimensions of valves shall be in accordance with Tables 2 to 6; see Figures 1 to 8 and 12 and 13 for diagrams of dimensions A, B and C.

Face-to-face and end-to-end dimensions for valve sizes not specified in Tables 2 to 6 shall be in accordance with ASME B16.10. Face-to-face and end-to-end dimensions not shown in Tables 2 to 6 or in ASME B16.10 shall be established by agreement.

The length of valves having one welding end and one flanged end shall be determined by adding half the length of a flanged-end valve to half the length of a welding-end valve.

Tolerances on the face-to-face and end-to-end dimensions shall be ± 2 mm for valve sizes DN 250 (NPS 10) and smaller, and ± 3 mm for valve sizes DN 300 (NPS 12) and larger.

The nominal size and face-to-face or end-to-end dimensions shall be stated on the nameplate.

Table 2 — Gate valves — Face-to-face (A) and end-to-end (B and C) dimensions

DN	NPS	Raised face *A*	Welding end *B*	Ring joint *C*	Raised face *A*	Welding end *B*	Ring joint *C*	Raised face *A*	Welding end *B*	Ring joint *C*	Raised face *A*	Welding end *B*	Ring joint *C*	Raised face *A*	Welding end *B*	Ring joint *C*	Raised face *A*	Welding end *B*	Ring joint *C*	Raised face *A*	Welding end *B*	Ring joint *C*
		PN 20 (Class 150)			PN 50 (Class 300)			PN 64 (Class 400)			PN 100 (Class 600)			PN 150 (Class 900)			PN 250 (Class 1 500)			PN 420 (Class 2 500)		
50	2	178	216	191	216	216	232	292	292	295	292	292	295	368	368	371	368	368	371	451	451	454
65	21/2	191	241	203	241	241	257	330	330	333	330	330	333	419	419	422	419	419	422	508	508	514
80	3	203	283	216	283	283	298	356	356	359	356	356	359	381	381	384	470	470	473	578	578	584
100	4	229	305	241	305	305	321	406	406	410	432	432	435	457	457	460	546	546	549	673	673	683
150	6	267	403	279	403	403	419	495	495	498	559	559	562	610	610	613	705	705	711	914	914	927
200	8	292	419	305	419	419	435	597	597	600	660	660	664	737	737	740	832	832	841	1 022	1 022	1 038
250	10	330	457	343	457	457	473	673	673	676	787	787	791	838	838	841	991	991	1 000	1 270	1 270	1 292
300	12	356	502	368	502	502	518	762	762	765	838	838	841	965	965	968	1 130	1 130	1 146	1 422	1 422	1 445
350	14	381	572	394	762	762	778	826	826	829	889	889	892	1 029	1 029	1 038	1 257	1 257	1 276	—	—	—
400	16	406	610	419	838	838	854	902	902	905	991	991	994	1 130	1 130	1 140	1 384	1 384	1 407	—	—	—
450	18	432	660	445	914	914	930	978	978	981	1 092	1 092	1 095	1 219	1 219	1 232	1 537	1 537	1 559	—	—	—
500	20	457	711	470	991	991	1 010	1 054	1 054	1 060	1 194	1 194	1 200	1 321	1 321	1 334	1 664	1 664	1 686	—	—	—
550	22	—	—	—	1 092	1 092	1 114	1 143	1 143	1 153	1 295	1 295	1 305	—	—	—	—	—	—	—	—	—
600	24	508	813	521	1 143	1 143	1 165	1 232	1 232	1 241	1 397	1 397	1 407	1 549	1 549	1 568	1 943	1 943	1 972	—	—	—
650	26	559	864	—	1 245	1 245	1 270	1 308	1 308	1 321	1 448	1 448	1 461	—	—	—	—	—	—	—	—	—
700	28	610	914	—	1 346	1 346	1 372	1 397	1 397	1 410	1 549	1 549	1 562	—	—	—	—	—	—	—	—	—
750	30	610[a]	914	—	1 397	1 397	1 422	1 524	1 524	1 537	1 651	1 651	1 664	—	—	—	—	—	—	—	—	—
800	32	711	965	—	1 524	1 524	1 553	1 651	1 651	1 667	1 778	1 778	1 794	—	—	—	—	—	—	—	—	—
850	34	762	1 016	—	1 626	1 626	1 654	1 778	1 778	1 794	1 930	1 930	1 946	—	—	—	—	—	—	—	—	—
900	36	711[b]	1 016	—	1 727	1 727	1 756	1 880	1 880	1 895	2 083	2 083	2 099	—	—	—	—	—	—	—	—	—

Dimension in mm.

[a] Through-conduit valves shall be 660 mm.

[b] Through-conduit valves shall be 813 mm.

Table 3 — Plug valves — Face-to-face (*A*) and end-to-end (*B* and *C*) dimensions

DN	NPS	Dimension mm											
		Short-pattern			Regular-pattern			Venturi-pattern			Round-port, full-bore		
		Raised face *A*	Welding end *B*	Ring joint *C*	Raised face *A*	Welding end *B*	Ring joint *C*	Raised face *A*	Welding end *B*	Ring joint *C*	Raised face *A*	Welding end *B*	Ring joint *C*
PN 20 (Class 150)													
50	2	178	267	191	—	—	—	—	—	—	267	—	279
65	2 1/2	191	305	203	—	—	—	—	—	—	298	—	311
80	3	203	330	216	—	—	—	—	—	—	343	—	356
100	4	229	356	241	—	—	—	—	—	—	432	—	445
150	6	267	457	279	394	—	406	—	—	—	546	—	559
200	8	292	521	305	457	—	470	—	—	—	622	—	635
250	10	330	559	343	533	—	546	533	559	546	660	—	673
300	12	356	635	368	610	—	622	610	635	622	762	—	775
350	14	—	—	—	—	—	—	686	686	699	—	—	—
400	16	—	—	—	—	—	—	762	762	775	—	—	—
450	18	—	—	—	—	—	—	864	864	876	—	—	—
500	20	—	—	—	—	—	—	914	914	927	—	—	—
600	24	—	—	—	—	—	—	1 067	1 067	1 080	—	—	—
PN 50 (Class 300)													
50	2	216	267	232	—	—	—	—	—	—	283	283	298
65	2 1/2	241	305	257	—	—	—	—	—	—	330	330	346
80	3	283	330	298	—	—	—	—	—	—	387	387	403
100	4	305	356	321	—	—	—	—	—	—	457	457	473
150	6	403	457	419	403	—	419	403	457	419	559	559	575
200	8	419	521	435	502	—	518	419	521	435	686	686	702
250	10	457	559	473	568	—	584	457	559	473	826	826	841
300	12	502	635	518	—	—	—	502	635	518	965	965	981
350	14	—	—	—	—	—	—	762	762	778	—	—	—
400	16	—	—	—	—	—	—	838	838	854	—	—	—
450	18	—	—	—	914	—	930	914	914	930	—	—	—
500	20	—	—	—	991	—	1 010	991	991	1 010	—	—	—
550	22	—	—	—	1 092	—	1 114	1 092	1 092	1 114	—	—	—
600	24	—	—	—	1 143	—	1 165	1 143	1 143	1 165	—	—	—
650	26	—	—	—	1 245	—	1 270	1 245	1 245	1 270	—	—	—
700	28	—	—	—	1 346	—	1 372	1 346	1 346	1 372	—	—	—
750	30	—	—	—	1 397	—	1 422	1 397	1 397	1 422	—	—	—
800	32	—	—	—	1 524	—	1 553	1 524	1 524	1 553	—	—	—
850	34	—	—	—	1 626	—	1 654	1 626	1 626	1 654	—	—	—
900	36	—	—	—	1 727	—	1 756	1 727	1 727	1 756	—	—	—

Table 3 (*continued*)

DN	NPS	Dimension mm											
		Short-pattern			Regular-pattern			Venturi-pattern			Round-port, full-bore		
		Raised face	Welding end	Ring joint	Raised face	Welding end	Ring joint	Raised face	Welding end	Ring joint	Raised face	Welding end	Ring joint
		A	*B*	*C*	*A*	*B*	*C*	*A*	*B*	*C*	*A*	*B*	*C*
		PN 64 (Class 400)											
50	2	—	—	—	292	292	295	—	—	—	330	—	333
65	21/2	—	—	—	330	330	333	—	—	—	381	—	384
80	3	—	—	—	356	356	359	—	—	—	445	—	448
100	4	—	—	—	406	406	410	—	—	—	483	559	486
150	6	—	—	—	495	495	498	495	495	498	610	711	613
200	8	—	—	—	597	597	600	597	597	600	737	845	740
250	10	—	—	—	673	673	676	673	673	676	889	889	892
300	12	—	—	—	762	762	765	762	762	765	1 016	1 016	1 019
350	14	—	—	—	—	—	—	826	826	829	—	—	—
400	16	—	—	—	—	—	—	902	902	905	—	—	—
450	18	—	—	—	—	—	—	978	978	981	—	—	—
500	20	—	—	—	—	—	—	1 054	1 054	1 060	—	—	—
550	22	—	—	—	—	—	—	1 143	1 143	1 159	—	—	—
600	24	—	—	—	—	—	—	1 232	1 232	1 241	—	—	—
650	26	—	—	—	—	—	—	1 308	1 308	1 321	—	—	—
700	28	—	—	—	—	—	—	1 397	1 397	1 410	—	—	—
750	30	—	—	—	—	—	—	1 524	1 524	1 537	—	—	—
800	32	—	—	—	—	—	—	1 651	1 651	1 667	—	—	—
850	34	—	—	—	—	—	—	1 778	1 778	1 794	—	—	—
900	36	—	—	—	—	—	—	1 880	1 880	1 895	—	—	—
PN 100 (Class 600)													
50	2	—	—	—	292	292	295	—	—	—	330	—	333
65	21/2	—	—	—	330	330	333	—	—	—	381	—	384
80	3	—	—	—	356	356	359	—	—	—	445	—	448
100	4	—	—	—	432	432	435	—	—	—	508	559	511
150	6	—	—	—	559	559	562	559	559	562	660	711	664
200	8	—	—	—	660	660	664	660	660	664	794	845	797
250	10	—	—	—	787	787	791	787	787	791	940	1 016	943
300	12	—	—	—	—	—	—	838	838	841	1 067	1 067	1 070
350	14	—	—	—	—	—	—	889	889	892	—	—	—
400	16	—	—	—	—	—	—	991	991	994	—	—	—
450	18	—	—	—	—	—	—	1 092	1 092	1 095	—	—	—
500	20	—	—	—	—	—	—	1 194	1 194	1 200	—	—	—
550	22	—	—	—	—	—	—	1 295	1 295	1 305	—	—	—
600	24	—	—	—	—	—	—	1 397	1 397	1 407	—	—	—
650	26	—	—	—	—	—	—	1 448	1 448	1 461	—	—	—
750	30	—	—	—	—	—	—	1 651	1 651	1 664	—	—	—
800	32	—	—	—	—	—	—	1 778	1 778	1 794	—	—	—
850	34	—	—	—	—	—	—	1 930	1 930	1 946	—	—	—
900	36	—	—	—	—	—	—	2 083	2 083	2 099	—	—	—

Table 3 (*continued*)

DN	NPS	Short-pattern Raised face *A*	Short-pattern Welding end *B*	Short-pattern Ring joint *C*	Regular-pattern Raised face *A*	Regular-pattern Welding end *B*	Regular-pattern Ring joint *C*	Venturi-pattern Raised face *A*	Venturi-pattern Welding end *B*	Venturi-pattern Ring joint *C*	Round-port, full-bore Raised face *A*	Round-port, full-bore Welding end *B*	Round-port, full-bore Ring joint *C*
		Dimension mm											
		PN 150 (Class 900)											
50	2	—	—	—	368	—	371	—	—	—	381	—	384
65	21/2	—	—	—	419	—	422	—	—	—	432	—	435
80	3	—	—	—	381	381	384	—	—	—	470	—	473
100	4	—	—	—	457	457	460	—	—	—	559	—	562
150	6	—	—	—	610	610	613	610	610	613	737	—	740
200	8	—	—	—	737	737	740	737	737	740	813	—	816
250	10	—	—	—	838	838	841	838	838	841	965	—	968
300	12	—	—	—	—	—	—	965	965	968	1 118	—	1 121
400	16	—	—	—	—	—	—	1 130	1 130	1 140	—	—	—
		PN 250 (Class 1 500)											
50	2	—	—	—	368	—	371	—	—	—	391	—	394
65	21/2	—	—	—	419	—	422	—	—	—	454	—	457
80	3	—	—	—	470	470	473	—	—	—	524	—	527
100	4	—	—	—	546	546	549	—	—	—	625	—	629
150	6	—	—	—	705	705	711	705	705	711	787	—	794
200	8	—	—	—	832	832	841	832	832	841	889	—	899
250	10	—	—	—	991	991	1 000	991	991	1 000	1 067	—	1 076
300	12	—	—	—	1 130	1 130	1 146	1 130	1 130	1 146	1 219	—	1 235
		PN 420 (Class 2 500)											
50	2	—	—	—	451	—	454	—	—	—	—	—	—
65	21/2	—	—	—	508	—	514	—	—	—	—	—	—
80	3	—	—	—	578	—	584	—	—	—	—	—	—
100	4	—	—	—	673	—	683	—	—	—	—	—	—
150	6	—	—	—	914	—	927	—	—	—	—	—	—
200	8	—	—	—	1 022	—	1 038	—	—	—	—	—	—
250	10	—	—	—	1 270	—	1 292	—	—	—	—	—	—
300	12	—	—	—	1 422	—	1 445	—	—	—	—	—	—

Table 4 — Ball valves — Face-to-face (*A*) and end-to-end (*B* and *C*) dimensions

DN	NPS	Dimension mm											
		Full-bore and reduced-bore			Short-pattern, full-bore and reduced-bore			Full-bore and reduced-bore			Short-pattern, full-bore and reduced-bore		
		Raised face *A*	Welding end *B*	Ring joint *C*	Raised face *A*	Welding end *B*	Ring joint *C*	Raised face *A*	Welding end *B*	Ring joint *C*	Raised face *A*	Welding end *B*	Ring joint *C*
		PN 20 (Class 150)						PN 50 (Class 300)					
50	2	178	216	191	—	—	—	216	216	232	—	—	—
65	21/2	191	241	203	—	—	—	241	241	257	—	—	—
80	3	203	283	216	—	—	—	283	283	298	—	—	—
100	4	229	305	241	—	—	—	305	305	321	—	—	—
150	6	394	457	406	267	403	279	403	457	419	—	—	—
200	8	457	521	470	292	419	305	502	521	518	419	419	435
250	10	533	559	546	330	457	343	568	559	584	457	457	473
300	12	610	635	622	356	502	368	648	635	664	502	502	518
350	14	686	762	699	—	—	—	762	762	778	—	—	—
400	16	762	838	775	—	—	—	838	838	854	—	—	—
450	18	864	914	876	—	—	—	914	914	930	—	—	—
500	20	914	991	927	—	—	—	991	991	1 010	—	—	—
550	22	—	—	—	—	—	—	1 092	1 092	1 114	—	—	—
600	24	1 067	1 143	1 080	—	—	—	1 143	1 143	1 165	—	—	—
650	26	1 143	1 245	—	—	—	—	1 245	1 245	1 270	—	—	—
700	28	1 245	1 346	—	—	—	—	1 346	1 346	1 372	—	—	—
750	30	1 295	1 397	—	—	—	—	1 397	1 397	1 422	—	—	—
800	32	1 372	1 524	—	—	—	—	1 524	1 524	1 553	—	—	—
850	34	1 473	1 626	—	—	—	—	1 626	1 626	1 654	—	—	—
900	36	1 524	1 727	—	—	—	—	1 727	1 727	1 756	—	—	—
950	38	—	—	—	—	—	—	—	—	—	—	—	—
1 000	40	—	—	—	—	—	—	—	—	—	—	—	—
1 100	42	—	—	—	—	—	—	—	—	—	—	—	—
1 200	48	—	—	—	—	—	—	—	—	—	—	—	—
1 400	54	—	—	—	—	—	—	—	—	—	—	—	—
1 500	60	—	—	—	—	—	—	—	—	—	—	—	—

Table 4 (*continued*)

DN	NPS	Dimension mm											
		Full-bore and reduced-bore			Short-pattern, full-bore and reduced-bore			Full-bore and reduced-bore			Short-pattern, full-bore and reduced-bore		
		Raised face *A*	Welding end *B*	Ring joint *C*	Raised face *A*	Welding end *B*	Ring joint *C*	Raised face *A*	Welding end *B*	Ring joint *C*	Raised face *A*	Welding end *B*	Ring joint *C*
		PN 64 (Class 400)						PN 100 (Class 600)					
50	2	—	—	—	—	—	—	292	292	295	—	—	—
65	21/2	—	—	—	—	—	—	330	330	333	—	—	—
80	3	—	—	—	—	—	—	356	356	359	—	—	—
100	4	406	406	410	—	—	—	432	432	435	—	—	—
150	6	495	495	498	—	—	—	559	559	562	—	—	—
200	8	597	597	600	—	—	—	660	660	664	—	—	—
250	10	673	673	676	—	—	—	787	787	791	—	—	—
300	12	762	762	765	—	—	—	838	838	841	—	—	—
350	14	826	826	829	—	—	—	889	889	892	—	—	—
400	16	902	902	905	—	—	—	991	991	994	—	—	—
450	18	978	978	981	—	—	—	1 092	1 092	1 095	—	—	—
500	20	1 054	1 054	1 060	—	—	—	1 194	1 194	1 200	—	—	—
550	22	1 143	1 143	1 153	—	—	—	1 295	1 295	1 305	—	—	—
600	24	1 232	1 232	1 241	—	—	—	1 397	1 397	1 407	—	—	—
650	26	1 308	1 308	1 321	—	—	—	1 448	1 448	1 461	—	—	—
700	28	1 397	1 397	1 410	—	—	—	1 549	1 549	1 562	—	—	—
750	30	1 524	1 524	1 537	—	—	—	1 651	1 651	1 664	—	—	—
800	32	1 651	1 651	1 667	—	—	—	1 778	1 778	1 794	—	—	—
850	34	1 778	1 778	1 794	—	—	—	1 930	1 930	1 946	—	—	—
900	36	1 880	1 880	1 895	—	—	—	2 083	2 083	2 099	—	—	—
950	38	—	—	—	—	—	—	—	—	—	—	—	—
1 000	40	—	—	—	—	—	—	—	—	—	—	—	—
1 100	42	—	—	—	—	—	—	—	—	—	—	—	—
1 200	48	—	—	—	—	—	—	—	—	—	—	—	—
1 400	54	—	—	—	—	—	—	—	—	—	—	—	—
1 500	60	—	—	—	—	—	—	—	—	—	—	—	—

Table 4 (*continued*)

DN	NPS	Dimension mm											
		Full-bore and reduced-bore			Short-pattern, full-bore and reduced-bore			Full-bore and reduced-bore			Short-pattern, full-bore and reduced-bore		
		Raised face *A*	Welding end *B*	Ring joint *C*	Raised face *A*	Welding end *B*	Ring joint *C*	Raised face *A*	Welding end *B*	Ring joint *C*	Raised face *A*	Welding end *B*	Ring joint *C*
		PN 150 (Class 900)						PN 250 (Class 1 500)					
50	2	368	368	371	—	—	—	368	368	371	—	—	—
65	2 1/2	419	419	422	—	—	—	419	419	422	—	—	—
80	3	381	381	384	—	—	—	470	470	473	—	—	—
100	4	457	457	460	—	—	—	546	546	549	—	—	—
150	6	610	610	613	—	—	—	705	705	711	—	—	—
200	8	737	737	740	—	—	—	832	832	841	—	—	—
250	10	838	838	841	—	—	—	991	991	1 000	—	—	—
300	12	965	965	968	—	—	—	1 130	1 130	1 146	—	—	—
350	14	1 029	1 029	1 038	—	—	—	1 257	1 257	1 276	—	—	—
400	16	1 130	1 130	1 140	—	—	—	1 384	1 384	1 407	—	—	—
450	18	1 219	1 219	1 232	—	—	—	1 537	—	1 559	—	—	—
500	20	1 321	1 321	1 334	—	—	—	1 664	—	1 686	—	—	—
550	22	—	—	—	—	—	—	—	—	—	—	—	—
600	24	1 549	1 549	1 568	—	—	—	1 943	—	1 972	—	—	—
650	26	1 651	—	1 673	—	—	—	—	—	—	—	—	—
700	28	—	—	—	—	—	—	—	—	—	—	—	—
750	30	1 880	—	1 902	—	—	—	—	—	—	—	—	—
800	32	—	—	—	—	—	—	—	—	—	—	—	—
850	34	—	—	—	—	—	—	—	—	—	—	—	—
900	36	2 286	—	2 315	—	—	—	—	—	—	—	—	—
950	38	—	—	—	—	—	—	—	—	—	—	—	—
1 000	40	—	—	—	—	—	—	—	—	—	—	—	—
1 100	42	—	—	—	—	—	—	—	—	—	—	—	—
1 200	48	—	—	—	—	—	—	—	—	—	—	—	—
1 400	54	—	—	—	—	—	—	—	—	—	—	—	—
1 500	60	—	—	—	—	—	—	—	—	—	—	—	—

Table 4 (*continued*)

DN	NPS	Dimension mm					
		Full-bore and reduced-bore			Short-pattern, full-bore and reduced-bore		
		Raised face *A*	Welding end *B*	Ring joint *C*	Raised face *A*	Welding end *B*	Ring joint *C*
		PN 420 (Class 2 500)					
50	2	451	451	454	—	—	—
65	21/2	508	508	514	—	—	—
80	3	578	578	584	—	—	—
100	4	673	673	683	—	—	—
150	6	914	914	927	—	—	—
200	8	1 022	1 022	1 038	—	—	—
250	10	1 270	1 270	1 292	—	—	—
300	12	1 422	1 422	1 445	—	—	—
350	14	—	—	—	—	—	—
400	16	—	—	—	—	—	—
450	18	—	—	—	—	—	—
500	20	—	—	—	—	—	—
550	22	—	—	—	—	—	—
600	24	—	—	—	—	—	—
650	26	—	—	—	—	—	—
700	28	—	—	—	—	—	—
750	30	—	—	—	—	—	—
800	32	—	—	—	—	—	—
850	34	—	—	—	—	—	—
900	36	—	—	—	—	—	—
950	38	—	—	—	—	—	—
1 000	40	—	—	—	—	—	—
1 100	42	—	—	—	—	—	—
1 200	48	—	—	—	—	—	—
1 400	54	—	—	—	—	—	—
1 500	60	—	—	—	—	—	—

Table 5 — Check valves, full-opening and reduced types — Face-to-face (A) and end-to-end (B and C) dimensions

DN	NPS	Dimension mm																				
		Raised face	Welding end	Ring joint	Raised face	Welding end	Ring joint	Raised face	Welding end	Ring joint	Raised face	Welding end	Ring joint	Raised face	Welding end	Ring joint	Raised face	Welding end	Ring joint	Raised face	Welding end	Ring joint
		A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
		PN 20 (Class 150)			PN 50 (Class 300)			PN 64 (Class 400)			PN 100 (Class 600)			PN 150 (Class 900)			PN 250 (Class 1 500)			PN 420 (Class 2 500)		
50	2	203	203	216	267	267	283	292	292	295	292	292	295	368	368	371	368	368	371	451	451	454
65	21/2	216	216	229	292	292	308	330	330	333	330	330	333	419	419	422	419	419	422	508	508	514
80	3	241	241	254	318	318	333	356	356	359	356	356	359	381	381	384	470	470	473	578	578	584
100	4	292	292	305	356	356	371	406	406	410	432	432	435	457	457	460	546	546	549	673	673	683
150	6	356	356	368	445	445	460	495	495	498	559	559	562	610	610	613	705	705	711	914	914	927
200	8	495	495	508	533	533	549	597	597	600	660	660	664	737	737	740	832	832	841	1 022	1 022	1 038
250	10	622	622	635	622	622	638	673	673	676	787	787	791	838	838	841	991	991	1 000	1 270	1 270	1 292
300	12	699	699	711	711	711	727	762	762	765	838	838	841	965	965	968	1 130	1 130	1 146	1 422	1 422	1 445
350	14	787	787	800	838	838	854	889	889	892	889	889	892	1 029	1 029	1 038	1 257	1 257	1 276	—	—	—
400	16	864	864	876	864	864	879	902	902	905	991	991	994	1 130	1 130	1 140	1 384	1 384	1 407	—	—	—
450	18	978	978	991	978	978	994	1 016	1 016	1 019	1 092	1 092	1 095	1 219	1 219	1 232	1 537	1 537	1 559	—	—	—
500	20	978	978	991	1 016	1 016	1 035	1 054	1 054	1 060	1 194	1 194	1 200	1 321	1 321	1 334	1 664	1 664	1 686	—	—	—
550	22	1 067	1 067	1 080	1 118	1 118	1 140	1 143	1 143	1 153	1 295	1 295	1 305	—	—	—	—	—	—	—	—	—
600	24	1 295	1 295	1 308	1 346	1 346	1 368	1 397	1 397	1 407	1 397	1 397	1 407	1 549	1 549	1 568	1 943	1 943	1 972	—	—	—
650	26	1 295	1 295	—	1 346	1 346	1 372	1 397	1 397	1 410	1 448	1 448	1 461	—	—	—	—	—	—	—	—	—
700	28	1 448	1 448	—	1 499	1 499	1 524	1 600	1 600	1 613	1 600	1 600	1 613	—	—	—	—	—	—	—	—	—
750	30	1 524	1 524	—	1 594	1 594	1 619	1 651	1 651	1 664	1 651	1 651	1 664	—	—	—	—	—	—	—	—	—
900	36	1 956	1 956	—	2 083	2 083	—	2 083	2 083	—	2 083	2 083	—	—	—	—	—	—	—	—	—	—
950	38	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1 000	40	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1 100	42	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1 200	48	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1 400	54	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1 500	60	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table 6 — Single- and dual-plate, long- and short-pattern, wafer-type check valves — Face-to-face dimensions

DN	NPS	Face-to-face dimension mm													
		PN 20 (Class 150)		PN 50 (Class 300)		PN 64 (Class 400)		PN 100 (Class 600)		PN 150 (Class 900)		PN 250 (Class 1 500)		PN 420 (Class 2 500)	
		Short-pattern	Long-pattern	Short-pattern	Long-pattern	Short-pattern	Long-pattern	Short-pattern	Long-pattern	Short-pattern	Long-pattern	Short-pattern	Long-pattern	Short-pattern	Long-pattern
50	2	19	60	19	60	19	60	19	60	19	70	19	70	—	70
65	21/2	19	67	19	67	19	67	19	67	19	83	19	83	—	83
80	3	19	73	19	73	19	73	19	73	19	83	22	83	—	86
100	4	19	73	19	73	22	79	22	79	22	102	32	102	—	105
150	6	19	98	22	98	25	137	29	137	35	159	44	159	—	159
200	8	29	127	29	127	32	165	38	165	44	206	57	206	—	206
250	10	29	146	38	146	51	213	57	213	57	241	73	248	—	250
300	12	38	181	51	181	57	229	60	229	—	292	—	305	—	305
350	14	44	184	51	222	64	273	67	273	—	356	—	356	—	—
400	16	51	191	51	232	64	305	73	305	—	384	—	384	—	—
450	18	60	203	76	264	83	362	83	362	—	451	—	468	—	—
500	20	64	219	83	292	89	368	92	368	—	451	—	533	—	—
600	24	—	222	—	318	—	394	—	438	—	495	—	559	—	—
750	30	—	—	—	—	—	—	—	—	—	—	—	—	—	—
900	36	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1 100	42	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1 200	48	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1 400	54	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1 500	60	—	—	—	—	—	—	—	—	—	—	—	—	—	—

7.7 Valve operation

The purchaser should specify the method of operation and the maximum pressure differential (MPD) at which the valve is required to be opened by the lever, gearbox or actuator. If not specified, the pressure rating as determined in accordance with 7.2 for material at 38 °C (100 °F) shall be the MPD.

The manufacturer shall provide the following data to the purchaser, if requested:

— flow coefficient C_v or K_v;

— breakaway thrust or torque for new valve;

— maximum allowable stem thrust or torque on the valve and, if applicable, the maximum allowable input torque to the gearbox;

— number of turns for manually operated valves.

7.8 Pigging

The purchaser shall specify the requirements for piggability of the valves.

NOTE Guidance can be found in Annex D.

7.9 Valve ends

7.9.1 Flanged ends

7.9.1.1 General

Flanges shall be furnished with raised face or ring joint face (raised face or full face). Dimensions, tolerances and finishes, including drilling templates, flange facing, spot facing and back facing, shall be in accordance with

- ASME B16.5 for sizes up to and including DN 600 (NPS 24), except DN 550 (NPS 22);
- MSS SP-44 for DN 550 (NPS 22);
- ASME B16.47, Series A, for DN 650 (NPS 26) and larger sizes;
- EN 1092-1 for PN flanges.

If none of the above standards applies, the selection of another design code or standard shall be by agreement.

The manufacturing method shall ensure flange alignment in accordance with 7.9.1.2, 7.9.1.3 and 7.9.1.4.

7.9.1.2 Offset of aligned flange centrelines — Lateral alignment

For valves up to and including DN 100 (NPS 4), the maximum flange misalignment from face-to-face shall be 2 mm (0.079 in).

For valves larger than DN 100 (NPS 4), the maximum flange misalignment from face-to-face shall be 3 mm (0.118 in).

7.9.1.3 Parallelism of aligned flange faces — Angular alignment

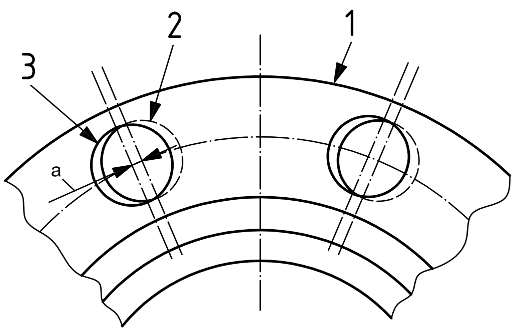
The maximum measured difference between end flanges shall be 2,5 mm/m (0.03 in/ft).

7.9.1.4 Total allowable misalignment of bolt holes

For valves up to and including DN 100 (NPS 4), the maximum total allowable misalignment from face-to-face shall be no greater than 2 mm (0.079 in) at the bolt holes; see Figure 14.

For valves larger than DN 100 (NPS 4), the maximum total allowable misalignment from face-to-face shall be no greater than 3 mm (0.118 in) at the bolt holes.

The surface of the nut bearing areas at the back faces of flanged valves shall be parallel to within 1° of the flange faces.



Key

1 flange
2 hole in first flange
3 hole in opposite flange to be aligned

[a] Bolt hole misalignment (see 7.9.1.4).

Figure 14 — Bolt hole misalignment

7.9.2 Welding ends

Welding ends shall conform to ASME B31.4-2006, Figures 434.8.6 (a) (1) and (2) or ASME B31.8-2007, Figures I-4 and I-5, unless otherwise agreed. In the case of a heavy-wall valve body, the outside profile may be tapered at 30° and then to 45° as illustrated in ASME B16.25-2003, Figure 1.

The purchaser shall specify the outside diameter, wall thickness, material grade, SMYS and any special chemistry of the mating pipe, and whether cladding has been applied.

7.9.3 Alternate valve end connections

Other end connections may be specified by the purchaser.

7.10 Bypasses, drains and vents

The use of bypass, drain and vent connections should be avoided. If required, they shall be welded, flanged or threaded as specified by the purchaser.

WARNING — Threaded connections can be susceptible to crevice corrosion.

Thread profiles shall be tapered in accordance with ISO 7-1 unless otherwise agreed. Tapered threads shall be capable of providing a seal and shall comply with ASME B1.20.1. If the use of parallel threads is specified, the connection shall have a head section for trapping and retaining a sealing member suitable for the specified valve service. Parallel threads shall comply with ISO 228-1.

Minimum sizes shall be in accordance with Table 7 or by agreement.

Table 7 — Thread/pipe sizes for bypass, drain and vent

Nominal valve size		Thread/pipe size
DN	**NPS**	mm (in)
15 to 40	1/2 to 11/2	8 (1/4)
50 to 100	2 to 4	15 (1/2)
150 to 200	6 to 8	20 (3/4)
> 200	> 8	25 (1)

7.11 Manual actuator-manual operator — Handwheels and wrenches

Wrenches for valves shall either be of an integral design or shall consist of a head that fits on the stem and is designed to take an extended handle. The head design shall allow permanent attachment of the extended section if specified by the purchaser.

The maximum force required at the handwheel or wrench to apply the breakaway torque or thrust shall not exceed 180 N (40 lbf).

Wrenches that are of integral design (not loose) shall not be longer than twice the face-to-face or end-to-end dimension, unless otherwise agreed.

NOTE Loose wrenches are not considered part of the valve and are not required to meet the maximum length requirements.

Handwheel diameter(s) should not exceed the face-to-face or end-to-end length of the valve or 1 000 mm, whichever is smaller, unless otherwise agreed. Except for valve sizes DN 40 (NPS 11/2) and smaller, spokes shall not extend beyond the perimeter of the handwheel, unless otherwise agreed.

If specified by the purchaser, the handwheel of the gearbox input shaft shall be provided with a torque-limiting device, such as a shear pin, to prevent damage to the drive train.

The direction of closing shall be clockwise, unless otherwise specified.

7.12 Locking devices

Valves shall be supplied with locking devices if specified by the purchaser. Locking devices for check valves shall be designed to lock the valve in the open position only.

Locking devices for other types of valves shall be designed to lock the valve in the open and/or closed position.

7.13 Position of the obturator

Except for check valves, the position of the obturator shall not be altered by dynamic forces of the passing flow or, in the case of screw-operated gate valves, by forces generated from internal or external pressure.

7.14 Position indicators

Valves fitted with manual or powered actuators shall be furnished with a visible indicator to show the open and closed position of the obturator.

For plug and ball valves, the wrench and/or position indicator shall be in line with the pipeline when the valve is open and transverse when the valve is closed. The design shall be such that the component(s) of the indicator and/or wrench cannot be assembled to falsely indicate the valve position.

Valves without position stops shall have provisions for the verification of open and closed alignment with the operator/actuator removed.

7.15 Travel stops

Travel stops shall be provided on the valve and/or operator and they shall locate the position of the obturator in the open and closed position. If the operator is subsea retrievable, the valve shall be fitted with a feature to secure proper alignment. The travel stops shall not affect the sealing capability of the valve.

7.16 ROV interface

The purchaser shall specify the ROV interface requirements.

If an ROV interface is provided, the supplier shall advise the number of ROV turns required to fully stroke the valve and the force/torque requirements throughout the opening and closing strokes as follows:

a) normal operating force/torque;

b) maximum force/torque of the drive train that does not result in the stress limits exceeding those of 7.20.2;

c) minimum force/torque of the drive train bolting that can result in the stress limits exceeding those of 7.20.3.

NOTE Typical ROV interfaces are described in ISO 13628-8.

7.17 Sealant injection

Seat and/or stem sealant injection shall not be provided unless otherwise specified. If provided, all sealant injection ports shall have a double barrier. The first (inner) barrier shall be a check valve located within the valve body. The second barrier shall be either a check valve with a pressure-retaining cap or an isolation valve.

7.18 Lifting points and supports

Valves of size DN 200 (NPS 8) and larger shall be provided with lifting points, unless otherwise agreed. The manufacturer shall verify the suitability of the lifting points and recommend the lifting procedure. Each lifting point shall have a safe working load at least equal to the valve mass and shall be so marked.

If the valve manufacturer is responsible for the supply of the valve and operator assembly, the valve manufacturer shall verify the suitability of the lifting points for the complete assembly.

If the purchaser is responsible for the supply of the operator assembly, the purchaser shall provide adequate information to enable the manufacturer to verify the suitability of the lifting points for the complete assembly.

NOTE Regulatory requirements can specify special design, manufacturing and certification of lifting points.

Valves of size DN 200 (NPS 8) and larger shall be provided with support ribs or legs, unless otherwise agreed.

7.19 Valve operator interface

The actuator power source shall be specified by the purchaser.

Actuators and gearboxes shall be mounted on the valves by the valve manufacturer at the factory, unless otherwise agreed.

The interface between actuators and valve bonnet or stem extension assemblies shall be designed to prevent misalignment or improper assembly of the components and preserve orientation of the obturator.

The interface between actuators or gearboxes and valve bonnet or stem extension assemblies shall be sealed, for example with gaskets or O-rings, to prevent external contaminants from entering the assembly. The resulting space shall be pressure-balanced to the environment, filled with an appropriate pressure compensating fluid and provided with a pressure relief valve.

Alternatively, the resulting space shall be capable of withstanding the valve design pressure and external hydrostatic pressure, in which case it shall be hydrostatically tested in accordance with this International Standard and provided with a means of relieving built-up pressure prior to dismantling.

The compensating system design shall take into account the likely volume changes prior to deployment.

The hydrostatic head pressure shall be taken into account when designing the actuator/gearbox.

Means shall be provided to prevent over-pressure in the actuator or gearbox from stem or bonnet seal leakage.

The output of the actuator shall not exceed the stress limits of the valve drive train permitted by 7.20.2, unless otherwise agreed.

WARNING — Permanent deformation or failure of drive-train components can occur if they are exposed to thrust or torque exceeding these stress limits.

NOTE Typical quarter-turn valve-to-actuator interfaces are given in ISO 5211.

The manufacturer shall state the maximum permissible input torque or thrust for the valve operator.

If specified by the purchaser, valves shall be provided with a pressure cap.

The purchaser shall specify whether it is required that a gearbox or an actuator be capable of being removed from the valve subsea.

7.20 Drive trains

7.20.1 Design thrust or torque

The design thrust or torque for all drive train calculations shall be at least two times the breakaway thrust or torque.

NOTE This design factor is to allow for thrust or torque increase in service due to infrequent cycling, low-temperature operation and the adverse effect of debris.

The minimum design thrust or torque shall be based on the operating mode that requires the greatest value of the thrust or torque. The manufacturer shall identify which of the following operating modes requires the greatest thrust or torque:

- close to open, with a pressure differential equal to MPD;
- close to open, with MPD on both sides of the obturator and with the valve cavity at atmospheric pressure;
- open to close, with the MPD in the valve bore and the valve cavity at atmospheric pressure.

7.20.2 Allowable stresses

Tensile stresses in drive-train components, including stem extensions, shall not exceed 67 % of SMYS when delivering the design thrust or torque. Shear, torsion and bearing stresses shall not exceed the limits specified in ASME BPVC, Section VIII, Division 2:2004, Part AD-132, except that design stress intensity values, S_m, shall be 67 % of SMYS.

These stress limits do not apply to the components of rolling-element or other proprietary bearings or high bearing-strength-capable materials that are included in the drive train where manufacturer's recommendations or limits derived from tests and service experience apply. These limits shall be justified in design documents.

The drive train shall be designed such that the weakest component is outside the pressure boundary.

A strength efficiency factor of 0,75 shall be used for fillet welds.

7.20.3 Drive train bolting

Bolting in the drive train shall be designed to accommodate the direct loading applied by the full actuator/gearbox output and, if applicable, loads from pressure. Bolting shall not be subjected to direct shear.

7.21 Stem retention

Valves shall be designed to ensure that the stem does not eject under any internal pressure condition or if the packing gland components and/or valve operator mounting components are removed.

7.22 Stem/shaft protector

If specified by the purchaser, the design shall have provisions for fitting a stem/shaft protector or cap. If the protector or cap can contain pressure, the protector or cap and method of attachment shall be capable of withstanding the valve design pressure and external hydrostatic pressure and shall be hydrostatically tested in accordance with this International Standard. The protector or cap shall have provisions for venting prior to removal and during fitting.

7.23 Hydraulic lock

If valves or valve components are designed for subsea maintenance, provisions shall be made for venting of all enclosed cavities to ensure that entrapped fluid does not prevent the disassembly, or subsequent reassembly of the components.

7.24 Corrosion/erosion

If specified by the purchaser, the manufacturer shall take precautions in the valve design and material selection to ensure that corrosion or erosion does not affect the correct functioning of the valve over its design life. Such precautions may include corrosion-resistant overlay in sealing areas, gasket contact areas or all process-wetted surfaces. Commissioning and hydrostatic test conditions shall also be considered and may require corrosion protection.

If a specific corrosion/erosion allowance is specified, the manufacturer shall also ensure that design thickness calculations include a loss of thickness equal to the corrosion/erosion allowance specified.

7.25 Hyperbaric performance

The manufacturer shall demonstrate by calculation or other means that the valve and/or operator are suitable for the required water depth.

If hyperbaric testing is specified by the purchaser to demonstrate suitability, hyperbaric testing shall be performed in accordance with Clause B.5.

7.26 Design documents

The design shall be documented in a retrievable and reproducible form.

7.27 Design document review

Design documentation shall be reviewed and verified by competent personnel other than the person who performed the original design.

8 Materials

8.1 Material specification

Specifications for pressure-containing and pressure-controlling metallic parts shall be issued by the manufacturer and shall address the following, as a minimum:

- chemical analysis;
- carbon equivalent, if applicable;
- heat treatment;
- mechanical properties including Charpy impact values and hardness, if applicable;
- NDE;
- testing;
- certification.

Metallic pressure-containing and pressure-controlling parts shall be made of materials consistent with the pressure-temperature rating as determined in accordance with 7.2. Use of other materials shall be by agreement.

All austenitic and duplex stainless steels shall be solution-treated and water-quenched.

Free-machining re-sulfurized or similar steels shall not be used for any purpose.

The chemical composition, mechanical properties, microstructure, heat treatment and testing of complex alloys (e.g. duplex stainless steels) including welds, require special consideration and shall be by agreement.

Corrosion tests to demonstrate corrosion resistance of the heat and heat-treatment batch combination of high alloy steels used for the manufacturing of the valve should be specified by the purchaser.

8.2 Service compatibility

All process-wetted parts, metallic and non-metallic, and lubricants shall be suitable for the commissioning fluids and service specified by the purchaser. Metallic materials shall be selected so as to avoid corrosion and galling that can impair function and/or pressure-containing capability.

Materials for external components shall be suitable for the subsea environment or shall be suitably protected. Functionality of exposed stems and shafts shall take into account the possibility of calcareous growth as a result of cathodic protection. Care shall be taken to avoid galvanic couples.

Selection of elastomeric materials for valves intended for hydrocarbon gas service at pressures of PN 100 (Class 600) and above shall consider the effect of explosive decompression.

Graphite should not be used for stem packing, seals or gaskets that can come into contact with sea water.

The hardness of ferrous and non-ferrous materials that are subject to cathodic protection shall not exceed 34 HRC (321 HBW).

8.3 Forged parts

Each forging shall be hot-worked and heat-treated to produce uniform grain size and the required mechanical properties in the finished product.

8.4 Composition limits

The chemical composition of carbon steel pressure-containing and pressure-controlling parts shall be in accordance with the applicable material standards.

The chemical composition of carbon steel welding ends shall meet the following requirements, unless otherwise agreed.

a) The carbon content shall not exceed 0,21 % mass fraction.

b) The sulfur content shall not exceed 0,020 % mass fraction.

c) The phosphorus content shall not exceed 0,020 % mass fraction.

d) The carbon equivalent, CE, shall not exceed 0,41 % mass fraction.

The CE shall be calculated in accordance with Equation (2):

$$CE = C + Mn/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15 \qquad (2)$$

where the symbols of the elements represent the percent mass fraction of the corresponding element.

NOTE The formatting for Equation (2) does not conform to the standard ISO formatting but it has been accepted, exceptionally, on the basis of its long-standing and well-established history in the industry.

The chemical composition of other carbon steel parts shall be in accordance with the applicable material standards.

The carbon content of austenitic stainless-steel welding ends shall not exceed 0,03 % mass fraction, except for stabilized material, in which case a carbon content of up to 0,08 % mass fraction is permissible.

The chemical composition of other materials shall be established by agreement.

Duplex stainless steel used for pressure-containing and pressure-controlling parts shall include a microstructure examination in accordance with the ASTM E562 point-count method. Test specimens shall be cut from a separate or attached block taken from the same heat in the final heat-treated condition. Acceptance criteria shall be 35 % to 65 % delta ferrite content, unless otherwise agreed. The microstructure shall be free from inter-metallic phases and precipitates.

8.5 Impact test requirements of steels

All carbon-alloy steels and non-austenitic stainless steel for pressure-containing parts and bolting in valves shall meet the impact test requirements of the applicable material specification and pipeline design standard.

All carbon-alloy steels and non-austenitic stainless steel for pressure-containing parts in valves with a specified design temperature below 0 °C (32 °F) shall be impact-tested using the Charpy V-notch technique in accordance with ISO 148-1 or ASTM A370.

WARNING — ASTM A370 mechanical properties might not represent the minimum strength in the actual section thickness.

NOTE Design standards or local requirements can require impact testing for minimum design temperatures higher than 0 °C (32 °F).

A minimum of one impact test, comprised of a set of three specimens, shall be performed on a representative test bar of each heat of the material in the final heat-treated condition.

Test specimens shall be cut from a separate or attached block taken from the same heat , reduced by forging where applicable, and heat-treated to the same heat treatment, including stress-relieving, as the product materials, except that it is not necessary to retest pressure-containing parts stress-relieved at or below a previous stress-relieving or tempering temperature. The impact test shall be performed at the lowest temperature as defined in the applicable material specifications and pipeline design standard. For duplex stainless steel, the temperature of the impact test shall be –46 °C (–50 °F).

Except for material for bolting, impact test results for full-size specimens of carbon and low-alloy steels shall meet the requirements of Table 8. Where the material specification or the pipeline-design standard requires impact values higher than those shown in Table 8, the higher values shall apply. Impact test results for bolting material shall meet the requirements of ASTM A320/A320M.

Toughness testing may be performed during the qualification of the valve manufacturing procedure provided that the material for testing is heat-treated using the same equipment as during valve production.

Table 8 — Charpy V-notch impact requirements for carbon and low-alloy steels

Specified minimum yield strength MPa	**Average of three specimens** J	**Minimum of single specimen** J
< 277	28	21
277 to 299	30	23
300 to 321	32	25
> 321	37	28

Charpy impact values for full-size specimens of duplex stainless steels shall be as follows:

a) average of three specimens: 60 J minimum;

b) no single specimen less than 50 J.

Charpy impact values for other materials shall be by agreement.

8.6 Bolting

Bolting material shall be suitable for the specified valve service and pressure rating.

Carbon and low-alloy bolting material with a hardness exceeding HRC 34 (HBW 321) shall not be used for valve applications where hydrogen embrittlement can occur, unless otherwise agreed.

NOTE Hydrogen embrittlement can occur in pipelines with cathodic protection.

Hardness limits for other bolting materials shall be by agreement.

8.7 Sour service

8.7.1 Sulfide stress cracking

Materials for pressure-containing and pressure-controlling parts and bolting shall meet the requirements of ISO 15156 (all parts) if sour service is specified by the purchaser.

The purchaser should as a minimum provide the partial pressure of H_2S, percent chlorides, pH and temperature.

8.7.2 Hydrogen-induced cracking

Process-wetted and pressure-controlling parts for valves in sour service applications and manufactured from plate shall be resistant to HIC.

Resistance shall be demonstrated by HIC testing in accordance with NACE TM0284, per heat, per heat-treatment batch combination.

Defects shall not exceed the following limits, unless otherwise agreed:

a) maximum crack sensitivity ratio, CSR, equal to 1,5 %;

b) maximum crack length ratio, CLR, equal to 15 %;

c) maximum crack thickness ratio, CTR, equal to 5 %;

d) maximum crack length in any one section equal to 5 mm.

9 Welding

9.1 Qualifications

Welding, including weld overlays and repair welding, of pressure-containing and pressure-controlling parts shall be performed in accordance with procedures qualified to ISO 15607, ISO 15609, ISO 15614-1 or ASME BPVC, Section IX and 9.2 and 9.3 of this International Standard. Welders and welding operators shall be qualified in accordance with ISO 9606 (all parts), ASME BPVC, Section IX or EN 287 (all parts).

NOTE 1 The purchaser, pipeline design standards, material specifications and/or local requirements can specify additional requirements.

For duplex stainless steels, the procedure qualification shall include a microstructure examination in accordance with the ASTM E562 point-count method. Acceptance criteria shall be 35 % to 65 % delta ferrite content, unless otherwise agreed. The microstructure shall be free from inter-metallic phases and precipitates.

The results of all qualification tests shall be documented in a PQR.

PWHT shall be performed in accordance with the relevant material specification.

NOTE 2 Some pipeline-welding standards can have more stringent requirements for the essential variables of welding. It can be necessary to provide full weld test rings, in the same heat treatment condition as the finished valve, for weld procedure qualification.

If specified, pipe-pup and transition-piece welds shall meet the requirements of the applicable pipeline design code.

NOTE 3 Welding of carbon steel pipe, with or without PWHT, can significantly reduce its mechanical properties and additional mechanical testing can be required.

9.2 Impact testing requirements of weldments

Qualifications of procedures for welding, including repair welding, of pressure-containing parts shall meet the impact-test requirements of the applicable pipeline design standard.

As a minimum, impact testing shall be carried out for the qualification of procedures for welding on valves with a design temperature below 0 °C (32 °F).

NOTE Design standards and/or local requirements can require impact testing at minimum design temperatures above 0 °C (32 °F).

A set of three weld-metal impact specimens shall be taken from the WM at the location shown in Figure 15. The specimens shall be oriented with the notch perpendicular to the surface of the material.

A set of three impact specimens shall be taken from the HAZ at the location shown in Figure 16. The notch shall be placed perpendicular to the material surface at a location resulting in a maximum amount of HAZ material located in the resulting fracture.

HAZ tests shall be conducted for each of the materials being joined, when the base materials being joined are of a different P-number and/or Group-number in accordance with ISO 9606 (all parts), ISO 15607, ISO 15609, ISO 15614-1 or ASME BPVC, Section IX, or when one or both of the base materials being joined are not listed in the P-number grouping.

Impact testing shall be performed in accordance with ISO 148-1 or ASTM A370 using the Charpy V-notch technique. Specimens shall be etched to determine the location of the weld and HAZ.

The temperature of the impact test for welds and heat-affected zones shall be at or below the minimum design temperature specified for the valve. For duplex stainless steel, the temperature of the impact test shall be –46 °C (–50 °F). Impact test results for full-size specimens shall meet the requirements of Table 8. If the material specification or the pipeline design standard requires impact values higher than those shown in Table 8, the higher values shall apply.

Charpy impact values for full-size specimens of duplex stainless steel weldments shall be as follows:

a) average of three specimens: 45 J minimum;

b) no single specimen less than 35 J.

9.3 Hardness testing

Hardness testing shall be carried out as part of the welding procedure qualification on pressure-containing and pressure-controlling parts in valves required to meet ISO 15156 (all parts).

Hardness surveys shall be performed on the BM, WM and HAZ in accordance with the requirements of ISO 15156-2. Hardness method used shall be Vickers HV_5 or HV_{10}.

NOTE For existing qualification, other hardness measurement methods, such as HRC or HRB, are acceptable.

9.4 Repair

Minor defects may be removed by grinding, provided there is a smooth transition between the ground area and the original contour and the minimum wall thickness requirements are not affected.

Repair of defects shall be performed in accordance with a documented procedure specifying requirements for defect removal, welding, heat treatment, NDE and reporting as applicable.

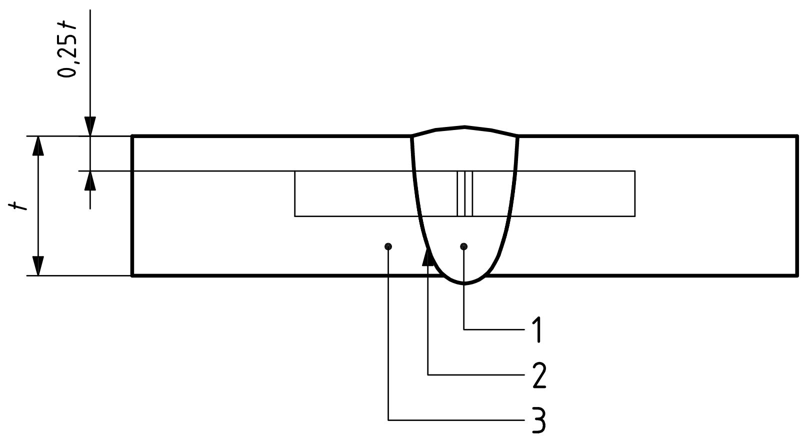
Repairs of fabrication welds (pipe pups to valve) shall be limited to 30 % of the weld length for partial-penetration repairs or 20 % of the weld length for full-penetration repairs, except that the minimum length of any weld repair shall be 50 mm.

The heat treatment (if applicable) of weld repairs shall be in accordance with the applicable material standard.

Repair of castings shall be limited to 25 % of total surface area inspected.

No casting repair shall exceed 50 % of the wall thickness of the affected area, unless by agreement.

Weld repair of forgings and plates to correct manufacturing defects shall be by agreement.

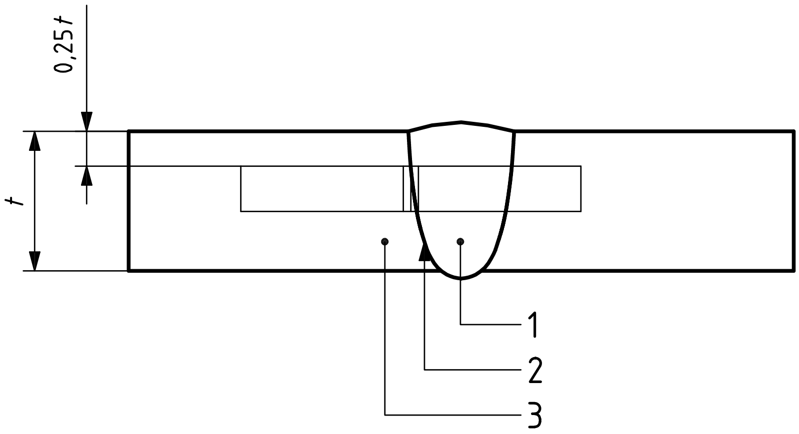


Key

1 weld metal
2 heat-affected zone
3 base metal

t thickness

Figure 15 — Charpy V-notch weld metal (WM) specimen location



Key

1 weld metal
2 heat-affected zone
3 base metal

t thickness

Figure 16 — Charpy V-notch heat-affected zone (HAZ) specimen location

10 Quality control

10.1 NDE requirements

Any purchaser-specified NDE requirements shall be selected from the list in accordance with Annex A. Final NDE activities shall be conducted after heat treatment, unless otherwise agreed.

10.2 Measuring and test equipment

10.2.1 General

Measuring and test equipment used to inspect, test or examine materials, parts of subsea valves or assemblies shall be identified, controlled and calibrated at intervals specified in the manufacturer's instructions.

10.2.2 Dimension-measuring equipment

Dimension-measuring equipment shall be controlled and calibrated in accordance with methods specified in documented procedures.

10.2.3 Pressure-measuring devices

10.2.3.1 Type and accuracy

Test pressure-measuring devices shall be either pressure gauges or pressure transducers that are accurate within ± 2,0 % of the full-scale reading.

10.2.3.2 Gauge range

Pressure measurements shall be made between 25 % and 75 % of the full pressure range of the measuring device.

10.2.3.3 Calibration procedure

Pressure-measuring devices shall be periodically recalibrated with a master pressure-measuring device or a dead-weight tester at 25 %, 50 % and 75 % of the full pressure scale.

10.2.4 Temperature-measuring devices

Temperature-measuring devices shall be capable of indicating and recording minimum temperature fluctuations of 5 °C (8 °F).

10.3 Qualification of inspection and test personnel

10.3.1 NDE personnel

NDE personnel shall be qualified in accordance with the requirements specified in ISO 9712 or ASNT SNT-TC-1A.

10.3.2 Inspection and test personnel

Inspection and test personnel performing visual examinations shall have passed an annual eye examination in accordance with ISO 9712 or ASNT SNT-TC-1A within the previous twelve months.

10.3.3 Welding inspectors

Personnel performing visual inspection of welding operations and completed welds shall be qualified and certified to the requirements of the AWS QC1 or equivalent, or to the requirements of the manufacturer's documented training programme.

10.4 NDE

The extent, method and acceptance criteria for NDE of parts shall be in accordance with Annex A, which specifies two levels of NDE requirements (QL1 and QL2) to assist the purchaser with the selection of a set of requirements appropriate for the intended valve duty.

NOTE The extent of NDE for QL2 is more stringent than for QL1.

The purchaser shall specify the NDE level at the time of the order placement, considering the following factors:

- service fluid;
- size/pressure/temperature;
- location;
- material of construction;
- criticality and function.

All NDE of fabrication welds shall be carried out in the final heat-treated condition and shall be performed in accordance with written procedures.

10.5 NDE of repairs

After defect removal, the excavated area shall be examined by magnetic-particle testing, MT, or penetrant testing, PT, methods in accordance with Annex A. Repair welds on pressure-containing parts shall be examined using the same NDE method that is used to detect the defect with a minimum of MT or PT.

Acceptance criteria shall be as specified in Annex A for the appropriate product form. The final NDE activities shall be conducted after post-weld heat treatment, unless otherwise agreed.

The NDE requirements specified by the purchaser in 10.1 shall also apply to repair welding.

10.6 Visual inspection of castings

All castings, as a minimum, shall be visually inspected in accordance with MSS SP-55.

11 Testing

11.1 General

Each valve shall be tested prior to shipment. The purchaser shall specify which particular supplementary tests in Annex B shall be performed.

Valves for gas service shall be subject to a gas shell test in accordance with B.4.2, unless otherwise agreed.

Testing shall be performed in the sequence detailed in 11.2 to 11.6, unless otherwise agreed, except that the operational/functional tests specified in 11.3 may be performed in conjunction with hydrostatic seat testing specified in 11.4. Seat sealing integrity shall be verified after all operational/functional testing. Pressure testing, including pipe pups if applicable, shall be carried out before coating of the valves.

Test fluids for the hydrostatic test shall be fresh water containing a corrosion inhibitor and, by agreement, antifreeze. The chloride content of test water in contact with austenitic- and duplex-stainless-steel wetted components of valves shall not exceed 30 µg/g (30 ppm by mass).

Valves shall be tested with the seating and sealing surfaces free from sealant, except where the sealant is the primary means of sealing. A secondary sealant system, if provided, shall not be used before or during the tests. Tests specified with the valve half-open may also be performed with the valve fully open, provided the body cavity is simultaneously filled and pressurized through a cavity connection.

If valve-body connections are not available for direct monitoring, methods for monitoring pressures and/or leakage shall be determined.

Supply pressure shall be stabilized prior to the start of pressure testing and shall be held for the minimum test durations listed in Tables 9 and 10. After stabilization, the pressure source shall be isolated from the valve.

A chart recorder shall be used for all hydrostatic tests above 1 MPa (10 bar).

Pressure testing shall be performed in accordance with documented procedures.

11.2 Hydrostatic shell test

Valve ends shall be closed off and the obturator placed in the partially open position during the test. If specified by the purchaser, the method of closing the ends shall permit the transmission of the full-pressure force acting on the end blanks to the valve body. If present, external relief valves shall be removed and their connections plugged.

The test pressure shall be 1,5 or more times the pressure rating determined in accordance with 7.2 for material at 38 °C (100 °F). The duration shall not be less than that specified in Table 9.

Table 9 — Minimum duration of hydrostatic shell tests

Valve size		Test duration
DN	NPS	h
15 to 40	1/2 to 11/2	1
50 to 100	2 to 4	2
150 to 250	6 to 10	4
> 300	> 12	6

No visible leakage is permitted during the hydrostatic shell test. There shall be no variation in pressure that cannot be accounted for by temperature fluctuations.

If the pressure rating of the pipe pups is insufficient for the hydrostatic-shell test pressure, then the pups shall be welded to the valve following the valve-shell test and the valve and pup(s) tested at a pressure specified by the purchaser.

Stem/shaft protectors or caps shall be tested at a pressure no less than the hydrostatic-shell test pressure. The test duration shall be a minimum of 2 h. No visible leakage is permitted during the test.

11.3 Operational/functional test

11.3.1 Manual valves

Each manual or ROV-operated valve, excluding check valves, shall be operated a minimum of four times while subject to the differential pressure specified in 7.7. The valve shall be operated for each appropriate condition defined in 11.4. Valves requiring input forces exceeding that specified in 7.20.1, or that fail to seal after operation, shall be rejected.

11.3.2 Power-operated/actuated valves

Each power-operated/actuated valve, excluding check valves, shall be operated a minimum of four times while subjected to the differential pressure specified in 7.7. The valve shall be operated for each appropriate condition defined in 11.4.4.1 and 11.4.4.2 and the thrust or torque shall be measured. Valves requiring thrust or torque exceeding the predicted manual or power values specified in 7.20.1, or that fail to seal after operation, shall be rejected.

11.3.3 Check valves

Each check valve fitted with an operating mechanism shall be operated (close-open-close) five times while the entire body cavity is subjected to the rated pressure listed in 7.2. Valves that fail to operate, fail to seal after cycling or require torque exceeding the predicted manual or power values specified in 7.20.1.shall be rejected.

11.4 Hydrostatic seat test

11.4.1 Preparation

Lubricants or sealants shall be removed from seats and obturator sealing surfaces, except where the lubricant or sealant is the primary means of sealing. Assembly lubricants for metal-to-metal contact surfaces may be used by agreement.

11.4.2 Test pressure and duration

The test pressure for all seat tests shall not be less than 1,1 times the pressure rating determined in accordance with 7.2 for material at 38 °C (100 °F). The test duration shall be in accordance with Table 10.

Table 10 — Minimum duration of seat tests

Valve size		Test duration
DN	NPS	min
15 to 40	1/2 to 11/2	5
50 to 100	2 to 4	10
$\geqslant$ 150	$\geqslant$ 6	30

11.4.3 Acceptance criteria

Leakage for soft-seated valves and lubricated plug valves shall not exceed ISO 5208:2008, rate A (no visible leakage). For metal-seated valves, the leakage rate shall not exceed ISO 5208:2008, rate C, except that the leakage rate during the seat test in Clause B.8 shall not be more than two times ISO 5208:2008, rate C, unless otherwise specified. The test procedures for various types of block valves are given in 11.4.4. For metal-seated check valves, the leakage rate shall not exceed ISO 5208:2008, rate D.

NOTE Special application can require that the leakage rate be less than ISO 5208:2008, rate C.

11.4.4 Seat test procedures for block valves

11.4.4.1 Uni-directional valve

With the valve half-open, the valve and its cavity shall be completely filled with test fluid. The valve shall then be closed and the test pressure applied to the appropriate end of the valve.

Leakage from the upstream seat shall be monitored via the valve body-cavity vent or drain connection, where provided. For valves without a body cavity or drain connection, or downstream-seated valves, seat leakage shall be monitored at the respective downstream end of the valve (the valve end downstream of the pressurized test fluid).

11.4.4.2 Bi-directional valve

With the valve half-open, the valve and its cavity shall be completely filled with test fluid. The valve shall then be closed and the test pressure applied successively to both ends of the valve.

Seat leakage shall be monitored from each seat via the valve body-cavity vent or drain connection, where provided. For valves without a body cavity or drain connection, seat leakage shall be monitored from the respective downstream end of the valve.

11.4.4.3 Additional seat testing

If the purchaser specifies that the functionality for the valve be that of double-block-and-bleed (DBB) valves, the test described in Clause B.8 shall be performed.

If the purchaser specifies that the functionality for the valve be that of double-isolation-and-bleed (DIB-1), both seats bi-directional, the test described in Clause B.9 shall be performed.

If the purchaser specifies that the functionality for the valve be that of DIB-2, one seat uni-directional and one seat bi-directional, the test described in Clause B.10 shall be performed.

11.4.4.4 Check valves

The pressure shall be applied in the direction of the required flow blockage.

11.5 Cavity-relief test

If a body-cavity relief test is specified by the purchaser, each valve shall be tested in accordance with Annex B.

11.6 Low-pressure-gas seat test

11.6.1 Preparation

The valve shall be drained of hydrostatic test fluid prior to the start of the low-pressure-gas seat test.

11.6.2 Test pressure and duration

The seat test in 11.4 shall be repeated at a test pressure of 0,5 ± 0,007 MPa (5,5 bar ± 0,7 bar; 80.8 psi ± 10.3 psi). The test medium shall be air or nitrogen. The seat test duration shall be as specified in Table 10.

11.6.3 Acceptance criteria

For soft-seated valves and lubricated plug valves, the leakage rate shall not exceed ISO 5208:2008, rate A (no visible leakage). For metal-seated valves, the leakage rate shall not exceed ISO 5208:2008, rate C. For metal-seated check valves, the leakage rate shall not exceed ISO 5208:2008, rate D.

11.7 Draining

Valves shall be drained of test fluids and, where applicable, lubricated before shipment.

11.8 Installation of body connections after testing

All test ports shall be sealed on completion of testing in accordance with documented procedures, unless otherwise agreed.

12 Coating

Coating requirements shall be by agreement.

Non-corrosion-resistant valves shall be blast-cleaned, primed and/or painted externally prior to shipment in accordance with a procedure approved by the purchaser.

Corrosion-resistant valves shall be blast-cleaned with sand or other non-ferrous medium prior to shipment and shall not be coated, unless otherwise agreed.

Flange faces, weld bevel ends, exposed stems, shafts and sealant injection fittings shall be protected during blast cleaning and shall not be coated.

Parts and equipment that have bare metallic surfaces shall be protected with a rust preventative that can provide protection at temperatures up to 50 °C (122 °F).

13 Marking

Valves shall be marked in accordance with the requirements of Table 11.

Body/cover/closure stamping shall be performed using a low-stress die-stamp, rounded “V” or dot-face type. The valve unique serial number shall be of such a size that it is visually legible; however the stamp size shall not be smaller than 6 mm (0.250 in).

Each valve shall be provided with an austenitic stainless-steel nameplate securely affixed and so located that it is easily accessible. The marking on the nameplate shall be visually legible.

The nameplate and serial number may be omitted for valves smaller than DN 50 (NPS 2), by agreement.

NOTE The purchaser can specify requirements for the marking of valve components.

For valves with one seat uni-directional and one seat bi-directional, the directions of both seats shall be specified on a separate identification plate as illustrated in Figure 17. In Figure 17, the symbol to the right indicates the bi-directional seat and that to the left indicates the uni-directional seat.

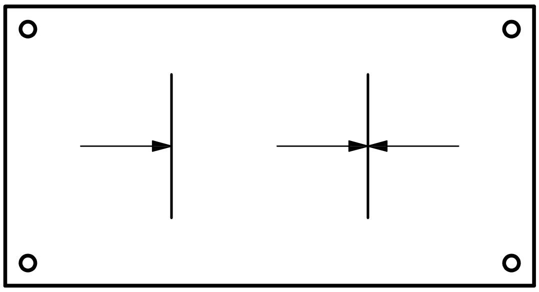


Figure 17 — Typical identification plate for a valve with one seat uni-directional (to the left) and one seat bi-directional (to the right)

An example of valve marking is given in Annex E.

Table 11 — Valve marking

Item No.	Marking	Location
1	Manufacturer's name or trademark	On both body and nameplate
2	Pressure class	On both body and nameplate
3	Maximum water depth	On nameplate
4	Pressure/temperature rating: a) Maximum operating pressure at the maximum operating temperature b) Maximum operating pressure at the minimum operating temperature	On nameplate
5	Face-to-face/end-to-end dimensions (see 7.6)	On nameplate
6	Body material designation [a]: Material symbol, e.g. ISO, ASME or ASTM	On both body and nameplate. Melt identification (e.g. cast or heat number) on body only
7	Bonnet/cover material designation: Material symbol, e.g. ISO, ASME or ASTM	On bonnet/cover [including melt identification (e.g. heat number)]
8	Trim identification [b]: Symbols indicating material of stem and sealing faces of closure members, if different from that of body	On nameplate
9	Nominal valve size: a) Full-opening valves: nominal valve size b) Reduced-opening valves: as specified in 7.5.	On body or nameplate or both (where practicable)
10	Ring-joint groove number	On valve flange edge
11	SMYS (units) of valve ends, where applicable	On body welding ends
12	Flow direction (for check valves only)	On body
13	Seat sealing direction valves with preferred direction only; see Figure 17	Separate identification plate on valve body
14	Seat test in accordance with Clauses B.8, B.9, or B.10; or DBB, DIB-1 or DIB-2, where applicable	On nameplate
15	Unique serial number	On both body and nameplate
16	Date of manufacture (month and year)	On nameplate
17	ISO 14723 [c]	On nameplate

[a] When the body is fabricated of more than one type of steel, the end connection material governs marking.

[b] MSS SP-25 gives guidance on marking.

[c] For identical national adoptions of this International Standard, other nationally recognized designations, e.g. ISO 14723/API 6DSS, may be marked in addition to ISO 14723.

14 Preparation for shipment

Flanged and welding ends shall be blanked off to protect the gasket surfaces, welding ends and valve internals during shipment.

Protective covers shall be made of wood, wood fibre, plastic or metal and shall be securely attached to the valve ends by bolting, steel straps, steel clips or suitable friction-locking devices. The design of the covers shall prevent the valves from being installed unless the covers have been removed.

Plug, ball and reverse-acting through-conduit gate valves shall be shipped in the fully open position, unless fitted with a fail-to-close actuator.

Other gate-valve types shall be shipped with the gate in the fully closed position.

Check valves DN 200 (NPS 8) and larger shall be shipped with the disc secured (blocked open or closed) during transport. A warning label shall be attached to the protective cover with instructions to remove, prior to installation, material from inside the valve that secures the disc.

15 Documentation

15.1 Documentation retained by manufacturer

The documentation listed below shall be retained by the manufacturer for a minimum of ten years following the date of manufacture:

a) design documentation;

b) WPS;

c) PQR;

d) WPQ;

e) qualification records of NDE personnel;

f) records of test equipment calibration;

g) material test report for body, bonnet/cover(s) and end connector(s)/closure(s) traceable to the unique valve serial number;

h) serial number;

i) test results (pressure, torque, thrust, etc.);

j) external coating procedures and records;

k) for sour service valves, certificate of compliance to ISO 15156 (all parts).

NOTE Purchaser or regulatory requirements can specify a longer record retention period.

15.2 Documentation shipped with valve

The documentation listed below shall be supplied by the manufacturer and shipped with each valve:

a) certificate of compliance to this International Standard: ISO 14723:2009;

b) test report (including pressure, test duration, leakage rate, ROV input torque/thrust and test medium) together with test charts;

c) coating/plating certification;

d) material test reports for pressure-containing and pressure-controlling parts;

e) statement of quality level applied to NDE records; see Clause A.2;

f) certificate stating the maximum allowable torque/thrust value for the drive train (ball, gate and plug valves only), if applicable;

g) lifting procedure;

h) installation, operation and maintenance instructions/manuals;

i) general arrangement drawings.

Documentation shall be provided by the manufacturer in legible, retrievable and reproducible form and shall be free from damage.

The purchaser may specify supplementary documentation, for example, as described in Annex C.

Annex A
(normative)

Requirements for non-destructive examination

A.1 General

This annex specifies two quality levels of non-destructive examination (NDE) requirements for subsea pipeline valves.

A.2 Specification of quality levels

Table A.1 specifies the NDE requirements for QL1 and QL2.

Table A.1 — NDE requirements

Part	QL1			QL2		
	Cast	Forged	Plate	Cast	Forged	Plate
Body	VT1	VT2	VT2	VT1	VT2	VT2
Closures and end connections	RT1 [a]	—	UT2	RT1 [a, f]	UT2	UT2
Bonnet/cover	—	—	—	UT1 [g]	MT1 or PT1	MT1 or PT1
Gland housing	—	—	VT2	MT1 or PT1	—	—
Welding ends [b]	VT1 RT3 or UT4 MT1 or PT1	VT2 UT2 MT1 or PT1	VT2 UT2 MT1 or PT1	VT1 RT3 or UT4 MT1 or PT1	VT2 UT2 MT1 or PT1	VT2 UT2 MT1 or PT1
Stem or shaft [c, g]	N/A	VT2	N/A	N/A	VT2 UT2 MT1 or PT1	N/A
Trunnion [d, g] Trunnion/bearing plates	VT1 MT1 or PT1	— —	VT2 —	VT1 UT1 MT1 or PT1	VT2 — —	VT2 UT2 MT1 or PT1
Bolting-pressure containing	N/A	VT2	N/A	N/A	VT2 MT1 or PT1	N/A
Seals gaskets	VT4			VT4		
Pressure cap	VT1 RT3 or UT4 —	VT2 — —	VT2 UT2 PT1	VT1 RT3 or UT4 MT1 or PT1	VT2 UT2 MT1 or PT1	VT2 UT2 MT1 or PT1
Ball/gate [c]	VT1	VT2	VT2	VT1 MT1 or PT1	VT2 MT1 or PT1	VT2 MT1 or PT1
Plug/clapper disc [c, g]	VT1	VT2	VT2	VT1 RT3 or UT4 MT1 or PT1	VT2 MT1 or PT1 —	VT2 MT1 or PT1 —

Table A.1 (*continued*)

Part	QL1			QL2		
	Cast	Forged	Plate	Cast	Forged	Plate
Clapper disc arm	VT1	VT2	VT2	VT1 UT4 MT1 or PT1	VT2 MT1 or PT1	VT2 MT1 or PT1 UT2
Seat rings [c,g]	VT1	VT2	VT2	VT1 MT1 or PT1	VT2 MT1 or PT1	VT2 MT1 or PT1
Seat springs	VT4			VT4		
Pressure-containing welds	VT3 RT2 or UT3 PT1 MT1			VT3 RT2 or UT3 PT1 MT1		
Reinforcement and stiffening welds	VT4			VT4		
Fillet and attachment welds to pressure-containing parts	VT3 MT1 or PT1			VT3 MT1 or PT1		
Pipe pup to valve welds Pipe pups [e]	VT3 RT2 MT1 or PT1			VT3 RT2 MT1 or PT1		
Corrosion-resistant overlay	VT4 PT1			VT4 UT3 PT1		
Plating	VT4			VT4		
Hardfacing	VT4 PT1			VT4 PT1		
Sealing surfaces	MT2 or PT2			MT2 or PT2		

NOTE 1 See Table A.2 for specification of the examinations referred to in Table A.1.

NOTE 2 "N/A" means that the manufacturer is not allowed to use this material form for that specific part.

[a] RT1 may be replaced by UT4 by agreement.

[b] NDE back 50 mm from weld end.

[c] It is necessary to perform MT/PT prior to coating, plating or overlay.

[d] The trunnion may be pressure-containing or pressure-controlling, depending on design type. If the trunnion is a pressure-containing part then the requirements for body apply.

[e] NDE requirements for pipe pups shall be established by agreement.

[f] RT1 plus UT1 may be replaced by RT3.

[g] Requirements for examination of bar material shall be as for forgings.

A.3 Specification of tests

Table A.2 specifies the extent, method and acceptance criteria for each of the tests referred to in Table A.1.

Table A.2 — Extent, method and acceptance criteria of NDE examination

Examination	NDE	Extent	Method	Acceptance
RT1	RT casting	Critical areas as per ASME B16.34	ASME BPVC, Section V:2007, Article 3	ASME BPVC, Section VIII Div. 1:2007, Appendix 7
RT2	RT weldments	100 % where practicable	ASME BPVC, Section V:2007, Article 2	ASME BPVC, Section VIII, Div. 1:2007, UW51 (linear indications); ASME BPVC, Section VIII, Div. 1:2007, Appendix 4 (round indications)
RT3	RT casting	100 %	ASME BPVC, Section V:2007, Article 3	ASME BPVC, Section VIII, Div. 1:2007, Appendix 7
UT1	UT casting	Remaining areas not covered by RT1	ASME BPVC, Section V:2007, Article 5	ASTM A609/A609M-02, Table 2, quality level 2
UT2	UT forging and plate	All surfaces	ASME BPVC, Section V:2007, Article 5	Forgings : ASME BPVC, Section VIII, Div. 1:2007, UF 55 Plate: ASTM A578/A578M-07, acceptance standard level B
UT3	UT weldments	100 %	ASME BPVC, Section V:2007, Article 5 (direct and shear wave); Article 23	ASME BPVC, Section VIII Div. 1:2007, Appendix 12; ASTM A578/A578M
	UT overlay	100 %	—	ASTM A578/A578M-07 acceptance standard level C
UT4	casting	100 %	ASME BPVC, Section V:2007, Article 5	ASTM A609/A 609M-02, Table 2, quality level 1
MT1	MT	100 % accessible surfaces	ASME BPVC, Section V:2007, Article 7	ASME BPVC, Section VIII, Div. 1:2007, Appendix 6
MT2	MT	100 % sealing surfaces	ASME BPVC, Section V:2007, Article 7	No rounded or linear indications
PT1	PT	100 % accessible surfaces	ASME BPVC, Section V:2007, Article 6	ASME BPVC, Section VIII, Div. 1:2007, Appendix 8
PT2	PT	100 % sealing surfaces	ASME BPVC, Section V:2007, Article 6	No rounded or linear indications
VT1	VT casting	All surfaces	MSS SP-55	Type 1: none acceptable; Types 2 to 12: A and B
VT2	VT forging and plate	All surfaces	As required by ASTM product specification	As required by ASTM product specification
VT3	VT weldments	All surfaces	ASME BPVC, Section V:2007, Article 9	All pressure-containing welds shall have complete joint penetration. Undercut shall not reduce the thickness in the area (considering both sides) to below the minimum thickness. Surface porosity and exposed slag are not permitted on or within 45 mm of seating surfaces.
VT4	VT weldments and others	All surfaces	ASME BPVC, Section ,V:2007, Article 9	No visible defects

Annex B
(normative)

Supplementary test requirements

B.1 General

This annex specifies requirements for supplementary testing that shall be performed by the manufacturer if specified by the purchaser. The frequency of testing shall also be specified by the purchaser, if not defined in this annex.

B.2 Hydrostatic testing

By agreement, hydrostatic testing may be performed at pressures higher than specified in 11.2 and 11.4 and/or for longer periods than specified in Tables 9 or 10.

B.3 Low-pressure gas seat testing

The seat test specified in 11.6 shall be repeated at a test pressure between 0,05 MPa (0,5 bar; 7.3 psi) and 0,10 MPa (1,0 bar; 14.5 psi) using air or nitrogen as the test medium.

The acceptable leakage rate for low-pressure gas seat testing shall be

— ISO 5208:2008, rate A (no visible leakage), for soft-seated valves and lubricated plug valves;

— ISO 5208:2008, rate C, for metal-seated block valves;

— ISO 5208:2008, rate D, for metal-seated check valves.

B.4 High-pressure gas testing

B.4.1 General

High-pressure gas testing shall be performed after hydrostatic shell testing.

WARNING — High-pressure gas testing involves potential hazards. Appropriate safety precautions shall be taken.

B.4.2 Shell testing

Valves designated by the purchaser shall have a high-pressure-gas shell test performed using inert gas as the test medium. The minimum test pressure shall be 1,1 times the pressure rating determined in accordance with 7.2 for the materials at 38 °C (100 °F). The test duration shall be in accordance with Table B.1.

Table B.1 — Minimum duration of gas shell tests

Valve size		Test duration
DN	**NPS**	h
15 to 40	1/2 to 11/2	2
50 to 450	2 to 18	4
⩾ 500	⩾ 20	6

Acceptance criteria shall be no visible leakage unless the test is performed using nitrogen with a helium tracer measured using a mass spectrometer; a maximum of 0,27 ml/min is allowed from any leak path.

B.4.3 High-pressure-gas seat test

The seat test specified in 11.4 shall be performed using an inert gas as the test medium. The test pressure and duration shall be as specified in 11.4.2.

Acceptance criteria shall be as follows:

— ISO 5208:2008, rate A (no visible leakage), for soft-seated valves and lubricated plug valves;

— two times that allowed by ISO 5208:2008, rate D, for metal-seated valves, unless otherwise agreed.

B.5 Hyperbaric qualification testing

If specified, the valve shall be subjected to a hyperbaric test at a minimum pressure equivalent to 1,1 times the design water depth, in accordance with written procedures. The agreed test method should simulate the operational requirements of the valve and should include both static and functional tests as appropriate.

The use of test fixtures is also allowed, by agreement, when circumstances dictate.

EXAMPLE When large assemblies make full testing impractical or when specific seal arrangements are involved.

B.6 Cathodic protection continuity test

If the valve is being installed in a cathodically protected system, all external items of the valve, actuator and other connected equipment shall be checked for electrical continuity before coating.

Continuity shall be measured using a DC power source not exceeding 12 V. The measured resistance shall not exceed 10 Ω.

B.7 Seal type test

If valve stems, shafts or body joints are sealed with a multiple-seal arrangement, a minimum of one sample of each seal design having a unique size, type and rating shall be tested in such a manner that the effectiveness of each individual seal is demonstrated.

The test fluid shall be water or inert gas, as specified.

Test pressures and durations shall be in accordance with 11.2 and/or Clause B.2, as applicable, unless otherwise agreed.

If this requires the provision of temporary test ports, these shall be plugged and sealed as required by 7.10.

B.8 Double-block-and-bleed (DBB) valves

With the valve half-open, the valve and its cavity shall be completely filled with test fluid. The valve shall then be closed and the valve-body vent valve opened to allow excess test fluid to overflow from the valve cavity test connection. The test pressure shall be applied simultaneously from both valve ends.

Seat tightness shall be monitored via overflow through the valve cavity connection.

B.9 Double-isolation-and-bleed (DIB-1) valves (both seats bi-directional)

Each seat shall be tested in both directions.

Cavity-relief valves shall be removed if fitted. The valve and cavity shall be filled with test fluid, with the valve half-open, until the test fluid overflows through the cavity relief connection.

To test for seat leakage in the direction of the cavity, the valve shall be closed. The test pressure shall be applied successively to each valve end to test each seat separately from the upstream side. Leakage shall be monitored via the valve cavity pressure relief connection.

Thereafter, each seat shall be tested as a downstream seat. Both ends of the valve shall be drained and the valve cavity filled with test fluid. Pressure shall then be applied whilst monitoring leakage through each seat at both ends of the valve. Some valve designs can require the balancing of the upstream and valve cavity pressure during the downstream seat test.

B.10 Double-isolation-and-bleed (DIB-2) valves (one seat uni-directional and one seat bi-directional)

The bi-directional seat shall be tested in both directions.

Cavity-relief valves shall be removed if fitted. The valve and cavity shall be filled with test fluid, with the valve half-open, until the test fluid overflows through the cavity relief connection.

To test for seat leakage in the direction of the cavity, the valve shall be closed. The test pressure shall be applied successively to each valve end to test each seat separately from the upstream side. Leakage shall be monitored via the valve cavity pressure relief connection.

To test the bi-directional seat from the cavity, test pressure shall be applied simultaneously to the valve cavity and upstream end. Leakage shall be monitored at the downstream end of the valve.

B.11 Torque/thrust functional testing

The maximum torque or thrust required to operate ball, gate or plug valves shall be measured at the pressure specified by the purchaser for the following valve operations:

a) open to closed with the bore pressurized and the cavity at atmospheric pressure;

b) closed to open with both sides of the obturator pressurized and the cavity at atmospheric pressure;

c) closed to open with one side of the obturator pressurized and the cavity at atmospheric pressure;

d) as in c) but with the other side of the obturator pressurized.

Torque or thrust values shall be measured with seats free of sealant, except where the sealant is the primary means of sealing. If necessary for assembly, a lubricant with a viscosity not exceeding that of SAE 10W motor oil or equivalent may be used.

Thrust and torque testing shall be performed following hydrostatic shell testing and, if specified, prior to any low-pressure gas seat testing.

The measured torque or thrust results shall be documented and shall not exceed the manufacturer's documented breakaway torque/thrust.

B.12 Drive train strength test

B.12.1 General

The test torque shall be the greater of

— twice the manufacturer's predicted breakaway torque/thrust, or

— twice the measured breakaway torque/thrust.

The test torque shall be applied with the obturator blocked for a minimum time of 1 min.

NOTE For gate valves, the thrust can be tensile or compressive, whichever is the most stringent condition.

B.12.2 Acceptance criteria

The test shall not cause any permanent visible deformation of the drive train.

For ball and plug valves, the total torsional deflection of the extended drive train when delivering the design torque shall not exceed the overlap contact angle between the seat and obturator.

B.13 Cavity-relief testing

B.13.1 Frequency

Each valve shall be tested.

Cavity-relief testing is not required if protection of the cavity against over-pressure is ensured, for both the open and the closed position, by a hole in the obturator or around the seat seal.

B.13.2 Trunnion-mounted ball valves and through-conduit gate valves with internal-relieving seats

The procedure for cavity-relief testing of trunnion-mounted ball valves and through-conduit gate valves with internal-relieving seats shall be as follows.

a) Fill the valve in the half-open position with water.

b) Close the valve and allow water to overflow from the test connection at each end of the valve.

c) Apply pressure to the valve cavity until one seat relieves the cavity pressure into the valve end; record this relief pressure.

d) For valve types with second-seat relief, continue to increase the pressure to the cavity until the second seat relieves; record the relief pressure of the second seat.

Failure to relieve at a pressure less than 1,33 times the valve pressure rating shall be cause for rejection.

B.13.3 Floating-ball valves

The procedure for cavity-relief testing of floating-ball valves shall be as follows.

a) With the valve half-open, pressurize the valve to 1,33 times the valve pressure rating specified in 7.2 for the material at 38 °C (100 °F).

b) Close the valve and vent each end to atmospheric pressure.

c) Open the valve to the half-open position and monitor for the release of test medium trapped in the cavity.

Evidence of trapped pressurizing medium in the cavity shall be cause for rejection.

B.14 Additional testing

The purchaser shall specify any additional testing requirements not covered by this International Standard.

Annex C
(informative)

Supplementary documentation requirements

C.1 Supplementary documentation

The purchaser may select supplementary documentation from the list below:

a) NDE records;

b) WPS;

c) PQR;

d) WPQ;

e) for sour service valves, certificate of compliance to ISO 15156 (all parts);

f) hardness test report on pressure-containing parts;

g) hardness test report on pressure-controlling parts;

h) heat-treatment certification records, e.g. charts;

i) design calculations for pressure-containing parts and/or the drive train;

j) design calculations for pressure-controlling parts;

k) NDE personnel-qualification records;

l) NDE procedures;

m) calibration records (it is the responsibility of the purchaser to identify requirements for equipment when ordering);

n) material inspection certificates in accordance with ISO 10474 or EN 10204 (the purchaser shall specify the type of certification, and for which parts, when ordering);

o) design verification by certification body/agency;

p) type approval by certification body/agency;

q) cross-sectional drawings with a list of parts and materials;

r) flow coefficient, C_V or K_V;

s) current quality management system certificate.

Annex D
(informative)

Purchasing guidelines

D.1 General

This annex provides guidelines to assist the purchaser with valve-type selection and specification of specific requirements when ordering valves.

D.2 Field testing

Pressures during the testing of installed valves should not exceed the pressure rating of the valve by more than 50 % when testing with the valve partially open or by more than 10 % of the pressure rating when testing against a closed valve.

D.3 Pigging

The purchaser should examine the valve design for piggability when ordering valves for use in pipelines requiring pigging.

NOTE 1 Venturi or reduced-bore valves are not suitable for most pigging operations, including intelligent pigging, but can allow the passage of foam pigs.

NOTE 2 A valves in which the drive member or the obturator obstructs the bore in the otherwise fully open position, e.g. a dual-plate check valve, is not piggable.

NOTE 3 Certain full-opening valves with pockets can allow a bypass of fluid around a short pig or sphere.

D.4 Valve operator compatibility

The design of the complete valve and actuator/operator unit should be the responsibility of the valve manufacturer.

This is to ensure

a) compatibility of the mechanical interface between the valve and the actuator/operator;

b) matching of the actuator/operator output to the valve force/torque, including any factor of safety required or specified by the purchaser;

c) functional testing of the combined valve and actuator/operator assembly.

D.5 Valve data sheet

The valve data sheet in Table D.1 can be used to assist with the specification of valves when ordering.

D.6 Information provided

Table D.2 provides a list of information that it is necessary for the purchaser and/or manufacturer to provide.

Table D.1 — Valve data sheet

Specification requirements

Materials of construction

____

Location and function ____________________

Nominal size ____________________

Maximum water depth ____________________

Maximum operating pressure ____________________

Maximum field test pressure (see Clause D.2) ____________________

Pressure class ____________________

Design temperature ____________________

Maximum service temperature ____________________

Minimum service temperature ____________________

Liquid or gas service ____________________

Flow medium composition ____________________

Special flow requirements: blow down, solids, pigs, etc. ____________________

Corrosive conditions ____________________

Valve

Type: Plug ________ Gate ________ Ball ________ Check ________

Design configuration ____________________

Full-round opening required? ________ Minimum bore ________

End connections

Upstream pipe: OD ________ ID ________ Material ________

Pipe pup length ________

Flanged end? Yes ________ No ________

Plain raised face or ring joint ____________________

If ring joint, flat or raised face? ____________________

Size and pressure class, as per ASME B16.5______ or MSS SP-44________ or ASME B16.47, Series A ________

Ring gasket or other gasket type and size ____________________

Note: Gaskets are not furnished as a part of the valve.

Welding end? Yes ________ No ________

Attach specifications for welding end configuration.

Special flanges and mechanical joints? ____________________

Downstream pipe: OD ________ ID ________ Material ________

Pipe pup length ________

Flanged end? Yes ________ No ________

Plain raised face or ring joint? ____________________

If ring joint, flat or raised face? ____________________

Size and pressure class, as per ASME B16.5______ or MSS SP-44________ or ASME B16.47, Series A ________

Ring gasket or other gasket type and size ____________________

Note: Gaskets are not furnished as a part of the valve.

Welding end? Yes ________ No ________

Attach specifications for welding end configuration.

Special flanges and mechanical joints? ____________________

Length: Any special requirements for end-to-end or face-to-face dimension? ____________________

Table D.1 (*continued*)

Valve operation

Is valve actuated? If so, state manual or ROV-operated ____

If actuated, provide valve closing times ____

Is gearbox with handwheel required? If so, give details ____

For a handwheel on a horizontal shaft, the distance from the centreline of the valve opening to the handwheel: _______________ mm

Or, for a handwheel on a vertical shaft, the distance from the centreline of the valve opening to the centre of the rim of the handwheel____ mm

Wrench required? ____

Locking device required? ____ Type_____________________________________

ROV interface required? Type _______________ Class ______________ Horizontal ____________ Vertical _____________

Valve support

Are support ribs or legs required?____

Other requirements

Supplementary requirements (see Annexes B and C) ____

NDE requirements: QL1 ________________ QL2 _________________

ISO 15156? Yes ____________________ No __________________

If yes, specify concentration of H_2S ______, % pH ______, % chlorides _______ and temperature _________

Drain connections: Any requirements?____

Bypass connections: Any requirements? ____

Supplementary documentation required (see Annex C)____

Third-party witness of processes/test ____

Painting requirements____

Table D.2 — Summary of information provided by manufacturer and/or purchaser

Subclause	Information provided	Provider [a]
6.2.2	Reduced bore sizes other than those shown in tables	P
6.2.2	Obturator size for non-circular openings	A
6.2.2	Obturator openings in reduced bore valves above DN 600 (NPS 24)	A
7.2	Intermediate design pressure and temperatures	P
7.1	Pressure vessel design	A
7.2	Minimum design temperature	P
7.7	Advise MPD	P
7.3	Cavity relief	A
7.4	External loads	P
7.6	Face-to-face or end-to-end dimension	A
7.6	Tolerances other than those listed	A
7.7	Valve operation data, torque/thrust, C_v, K_v or number-of-turns data	M-P
7.8	Requirements for piggability	P
7.9.1	Alternate standard for flanges	A
7.9.2	Weld bevels	A
7.9.2	Mating pipe data	P
7.9.3	Other end connection	P
7.10	Alternative vent/drain connections	P
7.10	Thread profiles	A
7.10	Connection sizes	A
7.11	Wrench head design	P
7.11	Handwheel diameter(s)	A
7.11	Number of turns	M
7.12	Locking devices	P
7.16	ROV interface	P
7.17	Sealant injection	P
7.18	Lifting points	A
7.18	Lifting procedure	M
7.19	Actuator power source	P
7.19	Fitting of gearboxes and actuators other than at valve manufacturers' works	A
7.19	Maximum torque	M
7.19	Thrust/torque	A
7.19	Pressure cap	P
7.19	Requirement for removal of gearbox from subsea	P
7.20.1	Greater operation factor	M
7.22	Protector/pressure cap	P
7.24	Corrosion/erosion allowance	P
7.24	Corrosion-protection measures	M
7.25	Hyperbaric test	P
8.1	Material specification	A
8.1	Corrosion test	P
8.2	Commissioning fluids	P
8.4	Composition limits	A
8.4	Chemical composition of welding end	A
8.4	Chemical composition of other materials	A
8.5	Charpy tests for other materials	A
8.6	Bolting for hydrogen embrittlement	A
8.7.1	Sour service	P
8.7.2	HIC acceptance criteria	A

Table D.2 (*continued*)

Subclause	Information provided	Provider [a]
9.1	Ferrite austenite ratios of welded duplex steels	
9.1	Additional welding requirements to meet pipeline requirements	P
9.3	Use of other hardness test methods	A
9.4	Through-wall weld repairs	A
9.4	Weld repairs to correct defects in plates and forgings	A
9.4	Specification for defect removal and repair	M
10.1	NDE requirements	P
10.4	NDE level	P
10.5	NDE before final heat treatment	A
10.5	NDE requirements for weld repair	P
11.1	Supplementary tests in Annex B	P
11.1	Gas shell test	A
11.1	Test sequence	A
11.1	Use of antifreeze in test water	A
11.2	Method of closing ends	A
11.2	Pipe pup test pressure	P
11.4.1	Lubricant removed for testing	A
11.4.3	Other leakage rates	A
11.4.4.3	Valve seat functionality	P
11.5	Cavity relief test	P
12	Coating requirements	A
Annex A	NDE requirements	P
Annex B	Supplementary test requirements	P
Annex C	Supplementary documentation requirements	P
Annex D	Purchasing guidelines	P

[a] M indicates information supplied by manufacturer.
M-P indicates information supplied by manufacturer when required by purchaser.
P indicates information supplied by purchaser.
A indicates information established by agreement.

Annex E
(informative)

Marking example

To illustrate the requirements for marking specified in this International Standard, a 200 mm carbon steel check valve with welding ends, a 660 mm face-to-face dimension, a maximum operating pressure rating of 10 MPa (100 bar), 13 % chromium steel trim and manufactured in June 2008 should be marked as follows:

	On body	Item from Table 10
	ABCO	(Item 1: name of manufacturer)
	PN 100	(Item 2: pressure class)
	LCC	(Item 6: body material grade and melt identification)
	DN 200	(Item 9: nominal valve size [a]). NOTE Item 9 can also be marked on nameplate or on both body and nameplate.
	SMYS 275 MPa	(Item 11: SMYS on weld end)
		(Item 12: flow direction for check valve only)
	12345	(Item 14: serial number)

	On bonnet/cover	
	LF2 / 6789	(Item 7: bonnet/cover material grade and melt identification)

	On nameplate	
	ABCO	(Item 1: manufacturer)
	PN 100	(Item 2: pressure class)
	150 m	(Item 3: water depth)
	10 MPa (100 bar) at −29 °C	(Item 4: maximum operating pressure at minimum operating temperature
	9 MPa (90 bar) at 121 °C	maximum operating pressure at maximum operating temperature)
	660 mm	(Item 5: face-to-face dimension)
	LCC	(Item 6: body material)
	Stem CR13 Disc CR13 Seat CR13 or CR13 CR13 CR13 or CR13 CR13 CR13	(Item 8: trim identification)
	DN 200 or DN 200 × 150 or DN 200R	(Item 9: nominal valve size for full-opening valve) (Item 9: nominal valve size for reduced-bore valve) (Item 9: nominal valve size for reduced-bore valve)
	DIB	(Item 14: test per annex B.10) as applicable
	12345	(Item 15: serial number)
	6-08 or 6/08	(Item 16: date of manufacture)
	ISO 14723	(Item 17: number of this International Standard)

Bibliography

[1] ISO 5211, *Industrial valves — Part-turn actuator attachment*

[2] ISO 13623, *Petroleum and natural gas industries — Pipeline transportation systems*

[3] ISO 13628-8, *Petroleum and natural gas industries — Design and operation of subsea production systems — Part 8: Remotely Operated Vehicle (ROV) interfaces on subsea production systems*

[4] ISO 14313, *Petroleum and natural gas industries — Pipeline transportation systems — Pipeline valves*

[5] ISO/TS 29001, *Petroleum, petrochemical and natural gas industries — Sector-specific quality management systems — Requirements for product and service supply organizations*

[6] ASME B16.25-2003, *Buttwelding Ends*

[7] EN 12516-1 *Industrial valves — Shell design strength — Part 1: Tabulation method for steel valve shells*

[8] EN 13445-3, *Unfired pressure vessels — Part 3: Design*

[9] MSS SP-25, *Standard Marking System for Valves, Fittings, Flanges and Unions*

ICS 75.200

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