Steel Globe Valves—Flanged and Butt-welding Ends, Bolted Bonnets

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Contents

Contents

Steel Globe Valves—Flanged and Butt-welding Ends, Bolted Bonnets

1 Scope

This API standard specifies the requirements for a heavy-duty series of bolted bonnet steel globe valves for petroleum refinery and related applications where corrosion, erosion and other service conditions would indicate a need for heavy wall sections and large stem diameters.

This standard sets forth the requirements for the following globe valve features:

— bolted bonnet,

— outside screw and yoke,

— rotating rising stems, and nonrotating rising stems,

— rising handwheels and nonrising handwheels,

— conventional, y-pattern, right-angle,

— stop-check (nonreturn type globe valves in which the disc may be positioned against the seat by action of the stem, but is free to rise as a check valve due to flow from under the disc, when the stem is in a full or partially open position),

— plug, narrow, conical, ball, or guided disc,

— metallic seating surfaces,

— flanged or butt-welding ends.

It covers valves of the nominal pipe sizes NPS:

— 2, $2^1/_2$, 3, 4, 6, 8, 10, 12, 14, 16, 18, 20, 24;

corresponding to nominal pipe sizes DN:

— 50, 65, 80, 100, 150, 200, 250, 300, 350, 400, 450, 500, 600;

applies for pressure class designations:

— 150, 300, 600, 900, 1500, 2500.

2 Normative References

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

API Standard 598, *Valve Inspection and Testing*

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

[1] ASME International, 3 Park Avenue, New York, New York 10016-5990, www.asme.org.

ASME B1.5, *Acme Screw Threads*

ASME B1.8, *Stub Acme Screw Threads*

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

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

ASME B16.5, *Pipe Flanges and Flanged Fittings NPS 1/2 through NPS 24 Metric/Inch*

ASME B16.10, *Face-to Face and End-to-End Dimensions of Valves*

ASME B16.11, *Forged Steel Fittings, Socket-Welding and Threaded*

ASME B16.25, *Buttwelding Ends*

ASME B16.34, *Valves—Flanged, Threaded and Welding End*

ASME B18.2.2, *Square and Hex Nuts (Inch Series)*

ASME B18.2.4.6M, *Metric Heavy Hex Nuts*

ASME B31.3, *Process Piping*

ASTM A307 [2], *Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength*

ISO 5210 [3], *Industrial valves—Multi-turn valve actuator attachments*

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

ISO 15649, *Petroleum and natural gas industries—Piping*

MSS SP-55 [4], *Quality Standard for Steel Castings for Valves, Flanges and Fittings and Other Piping Components — Visual Method for Evaluation of Surface Irregularities*

MSS SP-102*, Multi-turn Valve Actuator Attachment - Flange and Driving Component Dimensions and Performance Characteristics*

NACE MR 0103 [5], *Materials Resistant to Sulfide Stress Cracking in Corrosive Petroleum Refining Environments*

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[2] ASTM International, 100 Barr Harbor Drive, West Conshohocken, Pennsylvania 19428, www.astm.org.

[3] International Organization for Standardization, 1, ch. de la Voie-Creuse, Case postale 56, CH-1211, Geneva 20, Switzerland, www.iso.org.

[4] Manufacturers Standard Society of the Valve and Fittings Industry, Inc., 127 Park Street, N.E., Vienna, Virginia 22180-4602, www.mss-hq.com.

[5] NACE International (formerly the National Association of Corrosion Engineers), 1440 South Creek Drive, Houston, Texas 77218-8340, www.nace.org.

3 Terms and Definitions

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

3.1
Class
An alphanumeric designation that is used for reference purposes relating to valve pressure/temperature capability, taking into account valve material mechanical properties and valve dimensional characteristics. It comprises "Class" followed by a dimensionless whole number. The number following "Class" does not represent a measurable value and is not used for calculation purposes except where specified in this standard. The allowable pressure for a valve having a class number depends on the valve material and its application temperature and is to be found in tables of pressure/temperature ratings.

3.2
DN
An alpha numeric designation of size that is common for components used in a piping system, used for reference purposes, comprising the letters "DN" followed by a dimensionless number indirectly related to the physical size of the bore or outside diameter of the end connection as appropriate. The dimensionless number following "DN" does not represent a measurable value and is not used for calculation purposes except where specified.

3.3
NPS
An alpha numeric designation of size that is common for components used in a piping system, used for reference purposes, comprising the letters "NPS" followed by a dimensionless number indirectly related to the physical size of the bore or outside diameter of the end connection as appropriate. The dimensionless number may be used as a valve size identifier without the prefix "NPS." The dimensionless size identification number does not represent a measurable value and is not used for calculation purposes.

4 Pressure/Temperature Ratings

4.1 Pressure/temperature ratings shall be in accordance with those specified in the tables of ASME B16.34 for standard class for the applicable material specification and the applicable class.

4.2 Restrictions of temperature and concurrent pressure, or pressure and concurrent temperature (e.g. those imposed by special soft seals or special trim materials), shall be marked on the valve identification plate (see Section 8).

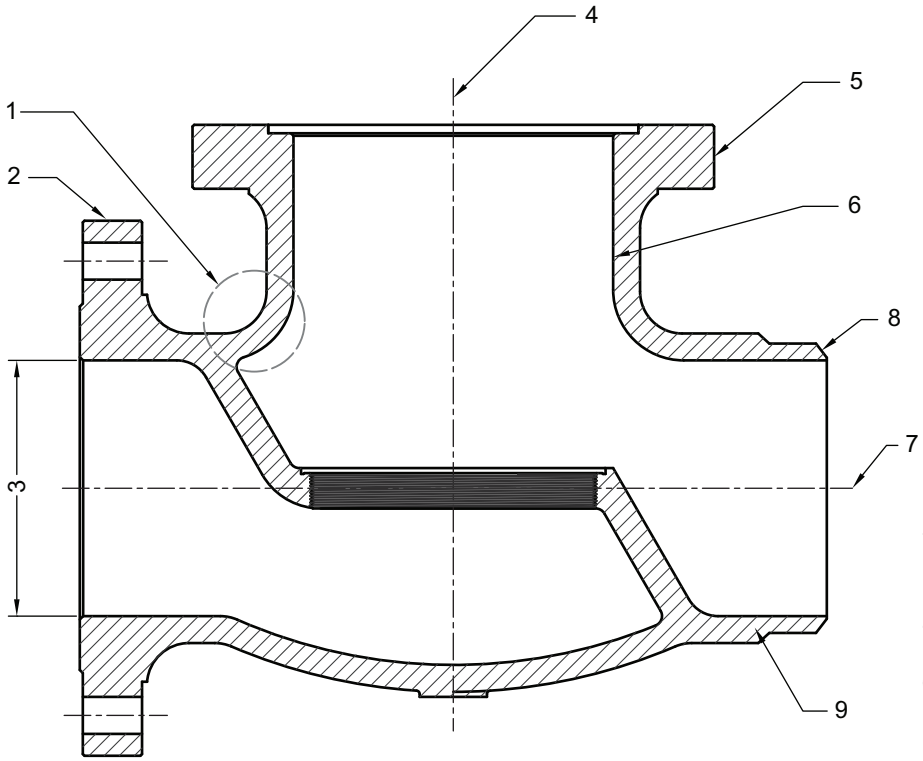
4.3 The temperature for a corresponding pressure rating is the maximum temperature of the pressure-containing shell of the valve. In general, this temperature is the same as that of the contained fluid. The use of a pressure rating corresponding to a temperature other than that of the contained fluid is the responsibility of the user.

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

5 Design

5.1 Body Wall Thickness

5.1.1 A valve body schematic is shown as Figure 1. The minimum body wall thickness, t_m, at the time of manufacture shall be as given in Table 1, except as indicated in 5.1.2 for butt-welding valve ends. Additional metal thickness needed for assembly stresses, stress concentrations, and shapes other than circular shall be determined by individual manufacturers, since these factors vary widely.



KEY

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

Figure 1—Identification of Terms

Table 1—Minimum Wall Thickness for Body and Bonnet

Class Designation	150	300	600	900	1500	2500	Nominal Size
NPS	Minimum Wall Thickness t_m in. (mm)						Nominal Size DN
2	0.34 (8.6)	0.38 (9.7)	0.44 (11.2)	0.54 (13.7)	0.75 (19.1)	0.88 (22.4)	50
$2^1/_2$	0.38 (9.7)	0.44 (11.2)	0.47 (11.9)	0.61 (15.5)	0.88 (22.4)	1.00 (25.4)	65
3	0.41 (10.4)	0.47 (11.9)	0.50 (12.7)	0.75 (19.1)	0.94 (23.9)	1.19 (30.0)	80
4	0.44 (11.2)	0.50 (12.7)	0.63 (16.0)	0.84 (21.3)	1.13 (28.7)	1.41 (35.8)	100
6	0.47 (11.9)	0.63 (16.0)	0.75 (19.1)	1.03 (26.2)	1.50 (38.1)	1.91 (48.5)	150
8	0.50 (12.7)	0.69 (17.5)	1.00 (25.4)	1.25 (31.8)	1.88 (47.8)	2.44 (62.0)	200
10	0.56 (14.2)	0.75 (19.1)	1.13 (28.7)	1.44 (36.6)	2.25 (57.2)	2.66 (67.6)	250
12	0.63 (16.0)	0.81 (20.6)	1.25 (31.8)	1.66 (42.2)	2.63 (66.8)	3.41 (86.6)	300
14	0.66 (16.8)	0.88 (22.4)	1.38 (35.1)	1.81 (46.0)	2.75 (69.9)	—	350
16	0.69 (17.5)	0.94 (23.9)	1.50 (38.1)	2.06 (52.3)	3.13 (79.5)	—	400
18	0.72 (18.3)	1.00 (25.4)	1.63 (41.4)	2.25 (57.2)	3.50 (88.9)	—	450
20	0.75 (19.1)	1.06 (26.9)	1.75 (44.5)	2.50 (63.5)	3.88 (98.6)	—	500
24	0.81 (20.6)	1.19 (30.2)	2.00 (50.8)	2.88 (73.2)	4.50 (114.3)	—	600

5.1.2 The weld end preparation in butt-welding end valves (see 5.3.2) shall not reduce the body wall thickness to less than the values specified in 5.1.1 within a region closer than t_m to the outside surface of the body neck, measured along the run direction. The transition to the weld preparation shall be gradual and the section shall be essentially circular through the entire length of the transition. Sharp discontinuities or abrupt changes in section in areas that infringe into the transition shall be avoided, except that test collars or bands, either welded or integral, are allowed. In no case shall the thickness be less than 0.77 t_m at a distance of 2 t_m from the weld end.

5.2 Bonnet Wall Thickness

The minimum bonnet wall thickness at the time of manufacture, except for the neck extension that contains the packing, shall be t_m as given in Table 1. For the neck extension, the local minimum wall thickness shall be based on the local diameter, e.g. the inside diameter of the stem bore or packing box bore, and shall be in accordance with Table 2. For an Inside Diameter not listed in Table 2, linear interpolation within the appropriate Class Designation listing shall be used.

5.3 Body Dimensions

5.3.1 Flanged Ends

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

5.3.1.2 Face-to-face dimensions shall be in accordance with ASME B16.10 or ISO 5752. Body end flanges and bonnet flanges shall be cast or forged integral with the body. However, flanges may be attached by welding when approved by the purchaser.

5.3.1.2.1 Welding a flange to a valve body shall be by full penetration butt-welding. Unless otherwise specified, attachment welds shall conform to ASME B31.3 or ISO 15649 for normal fluid service, including weld quality acceptance criteria and qualifications for the weld procedure and welder or welding operator. Heat treatment shall be performed in accordance with Table 3.

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

5.3.2 Butt-welding Ends

5.3.2.1 Butt-welding ends for valve sizes greater than NPS 2 shall conform to the requirements of ASME B16.25 for the bore specified for use without backing rings. Conversion of a flanged end valve to a butt-welding valve is not permitted except by agreement between the purchaser and manufacturer.

5.3.2.2 End-to-end dimensions for butt-welding end class designated valves shall be in accordance with ASME B16.10, unless otherwise specified by the purchaser.

5.3.3 Socket Welding Ends

Socket welding ends shall conform to the requirements of ASME B16.11.

5.3.4 Threaded Ends

The end threads shall be taper pipe thread meeting the requirements of ASME B1.20.1.

5.3.5 Body Seats

5.3.5.1 The inside diameter of the seat opening shall not be less than that specified in Table 4 for the nominal pipe size and pressure class.

Table 2—Minimum Wall Thickness for Bonnet Neck Extension

Class Designation	150	300	600	900	1500	2500
Bonnet Neck Extension Inside Diameter in. (mm)	**Minimum Wall Thickness** in. (mm)					
1.25 (32)	0.189 (4.8)	0.189 (4.8)	0.189 (4.8)	0.256 (6.5)	0.343 (8.7)	0.531 (13.5)
1.38 (35)	0.189 (4.8)	0.189 (4.8)	0.201 (5.1)	0.280 (7.1)	0.382 (9.9)	0.575 (14.6)
1.50 (38)	0.189 (4.8)	0.189 (4.8)	0.224 (5.7)	0.295 (7.5)	0.402 (10.2)	0.625 (15.9)
1.75 (45)	0.210 (5.3)	0.220 (5.6)	0.240 (6.1)	0.310 (7.9)	0.440 (11.2)	0.750 (19.1)
1.875 (48)	0.210 (5.3)	0.220 (5.6)	0.240 (6.1)	0.310 (7.9)	0.440 (11.2)	0.750 (19.1)
2.00 (51)	0.220 (5.6)	0.250 (6.4)	0.250 (6.4)	0.310 (7.9)	0.460 (11.7)	0.790 (20.1)
2.25 (57)	0.220 (5.6)	0.250 (6.4)	0.260 (6.6)	0.340 (8.6)	0.500 (12.7)	0.875 (22.2)
2.38 (60)	0.220 (5.6)	0.250 (6.4)	0.268 (6.9)	0.346 (8.9)	0.530 (13.5)	0.913 (23.2)
2.50 (63.5)	0.220 (5.6)	0.250 (6.4)	0.280 (7.1)	0.362 (9.1)	0.560 (14.2)	0.950 (24.1)
2.62 (67)	0.220 (5.6)	0.260 (6.6)	0.280 (7.1)	0.375 (9.5)	0.590 (15.0)	1.000 (25.4)
2.87 (73)	0.220 (5.6)	0.272 (6.9)	0.300 (7.6)	0.412 (10.5)	0.625 (15.9)	1.093 (27.8)
3.25 (82.5)	0.240 (6.1)	0.280 (7.1)	0.320 (8.1)	0.440 (11.2)	0.687 (17.5)	1.218 (30.9)
3.50 (89)	0.250 (6.4)	0.295 (7.5)	0.340 (8.6)	0.472 (11.9)	0.750 (19.1)	1.290 (32.8)
3.62 (92)	0.250 (6.4)	0.295 (7.5)	0.360 (9.1)	0.480 (12.2)	0.750 (19.1)	1.340 (34.0)
3.75 (95)	0.250 (6.4)	0.300 (7.6)	0.370 (9.4)	0.490 (12.5)	0.780 (19.8)	1.375 (34.9)
3.87 (98)	0.250(6.4)	0.300 (7.6)	0.370 (9.4)	0.500 (12.7)	0.812 (20.6)	1.420 (36.1)
4.25 (108)	0.250 (6.4)	0.320 (8.1)	0.390 (9.95)	0.528 (13.5)	0.860 (21.8)	1.510 (38.4)
4.38 (111)	0.250 (6.4)	0.320 (8.1)	0.412 (10.5)	0.560 (14.2)	0.912 (23.2)	1.590 (40.4)
4.63 (118)	0.260 (6.6)	0.330 (8.4)	0.420 (10.7)	0.580 (14.7)	0.960 (24.4)	1.687 (42.8)
5.125 (130)	0.280 (7.1)	0.346 (8.9)	0.445 (11.4)	0.638 (16.3)	1.043 (26.4)	1.846 (47.0)
5.250 (133)	0.280 (7.1)	0.346 (8.9)	0.445 (11.4)	0.650 (16.5)	1.070 (27.2)	1.890 (48.0)
5.375 (137)	0.280 (7.1)	0.362 (9.1)	0.460 (11.7)	0.660 (16.8)	1.093 (27.8)	1.937 (49.2)
5.500 (140)	0.280 (7.1)	0.362 (9.1)	0.472 (11.9)	0.680 (17.3)	1.125 (28.6)	1.976 (50.0)
6.250 (159)	0.290 (7.4)	0.382 (9.9)	0.515 (13.1)	0.760 (19.3)	1.260 (32.0)	2.240 (56.9)
6.625 (168)	0.290 (7.4)	0.400 (10.2)	0.560 (14.2)	0.810 (20.6)	1.360 (34.5)	2.420 (61.5)
7.375 (187)	0.300 (7.6)	0.430 (10.9)	0.600 (15.2)	0.870 (22.1)	1.460 (37.1)	2.625 (66.7)

Table 3—Post Weld Heat Treatment for Flange to Body Weld

Material	Thickness [a] *t* in. (mm)	Temperature Range °F (°C)	Holding Time hr/in. (min/mm)	Weld Hardness HBN Max
Carbon steels	t > 0.75 (19)	1100 to 1200 (593 to 649)	1 (2.4) (minimum 1 hr)	—
Alloy steels: $1/2$ % < Cr ≤ 2 %	t > 0.50 (13)	1300 to 1375 (704 to 746)	1 (2.4) (minimum 2 hr)	225
$2\,1/4$ % ≤ Cr ≤ 10 %	All	1300 to 1400 (704 to 760)	1 (2.4) (minimum 2 hr)	241
Nickel alloy steels	t > 0.75 (19)	1100 to 1175 (593 to 635)	$1/2$ (1.2) (minimum 1 hr)	—
Austenitic steels [a, b]	All	solution anneal per the material specification		
Other materials	All	per the material specification		

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

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

Table 4—Minimum Seat Diameter

Class Designation	150	300	600	900	1500	2500	
Nominal Size NPS	Minimum Seat Diameter in. (mm)						Nominal Size DN
2	1.65 (42)	1.65 (42)	1.65 (42)	1.65 (42)	1.65 (42)	1.50 (38)	50
$2\,1/2$	2.20 (56)	2.20 (56)	2.20 (56)	2.07 (52)	2.07 (52)	1.87 (47)	65
3	2.71 (69)	2.71 (69)	2.71 (69)	2.71 (69)	2.48 (63)	2.25 (57)	80
4	3.54 (90)	3.54 (90)	3.54 (90)	3.54 (90)	3.26 (83)	2.87 (73)	100
6	5.31 (135)	5.31 (135)	5.31 (135)	5.18 (132)	4.85 (123)	4.37 (111)	150
8	7.17 (182)	7.17 (182)	7.17 (182)	6.76 (172)	6.31 (160)	5.75 (146)	200
10	8.82 (224)	8.82 (224)	8.74 (222)	8.45 (215)	7.88 (200)	7.25 (184)	250
12	10.81 (275)	10.81 (275)	9.84 (250)	9.84 (250)	9.38 (238)	8.62 (219)	300
14	11.93 (303)	11.93 (303)	11.59 (294)	*	*	*	350
16	13.73 (349)	13.73 (349)	*	*	*	*	400
18	15.60 (396)	*	*	*	*	*	450
20	17.47 (444)	*	*	*	*	*	500
24	21.21 (539)	*	*	*	*	*	600

* Unlisted seat diameter shall be in agreement between the manufacturer and the purchaser.

5.3.5.2 Integral seats with overlays per Table 8 are permitted. Integral body seats (without overlays) are permitted in austenitic stainless steel and other group 2 materials bodies. An austenitic stainless steel or a hardfacing material may be weld-deposited either directly on the valve body or on a separate body seat ring.

5.3.5.3 Finished thickness of any facing material shall be not less than 0.06 in. (1.6 mm). Where a separate seat ring is provided, it shall be shoulder or bottom seated, and either threaded and seal welded or inserted and seal welded in place.

5.3.5.4 Body seat rings shall have adequate seating area surface and shall have edges designed to prevent galling or any other damage. Body seat ring seal surface area shall be designed so that the contact stress of the disc against the seat shall be less than the yield strength of both seating materials, to prevent plastic deformation or any other damage to the seating surfaces.

5.3.5.5 Sealing compounds or greases shall not be used when assembling seat rings; however, a light lubricant having a viscosity no greater than kerosene may be used to prevent galling of mating threaded surfaces.

5.4 Bonnet Design

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

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

— a bushing positively secured, by tab, tack or seal welding, against coming loose, i.e. not relying on friction;

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

— an austenitic stainless steel or hardfaced weld deposit that is a minimum of 0.06 in. (1.6 mm) thick.

5.4.3 Bonnets shall be one-piece castings or forgings. Bonnets may be attached by welding when approved by the purchaser and are subject to the same exceptions and requirements as specified in 5.3.1.2.1.

5.4.4 The gland bolting shall not be anchored to the bonnet or yoke through a fillet welded attachment or stud welded pins. The anchor design shall not include slotted holes or brackets which do not retain gland bolting during repacking.

5.5 Bonnet-to-body Joint

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

5.5.2 The bonnet-to-body joint shall be one of the following types, as illustrated in ASME B16.5:

— raised face,

— tongue and groove,

— spigot and recess,

— ring joint.

5.5.3 The bonnet flange gasket shall be suitable for the temperature range –20 °F (–29 °C) to 1000 °F (538 °C) and be one of the following:

— solid metal, corrugated, or grooved (profiled) metal gasket with suitable facing;

— metal ring joint;

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

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

5.5.4 Bonnet-to-body flanges shall be circular.

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

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

— either $^{3}/_{8}$ in. or M10 when $2 \leq \text{NPS} \leq 2^{1}/_{2}$ ($50 \leq \text{DN} \leq 65$);

— either $^{1}/_{2}$ in. or M12 when $3 \leq \text{NPS} \leq 8$ ($80 \leq \text{DN} \leq 200$);

— either $^{5}/_{8}$ in. or M16 when $\text{NPS} \geq 10$ ($\text{DN} \geq 250$).

5.5.7 The total cross-sectional area of the bolts in valve bonnet bolting shall be in accordance with the requirements of ASME B16.34.

5.5.8 At assembly, gasket contact surfaces shall be free of sealing compounds. A light coating of a lubricant, no heavier than kerosene, may be applied if needed to assist in proper gasket assembly.

5.6 Disc

5.6.1 Typical disc configurations are illustrated in Figure 2.

5.6.1.1 A one-piece disc design shall be furnished, unless otherwise specified by the purchaser.

5.6.1.2 When assembled, the globe valve disc to stem retention shall be such that the disc cannot become detached from the stem as a result of flow-induced vibrations or attached piping movement. The means of disc-to-stem retention shall be of a design that allows the disc to align with the valve seat.

5.6.2 Disc shall be of a design to accommodate proper seating.

5.6.3 The disc shall be guided throughout its full range of travel. Guiding may be provided by stem, body, or other means. For Class 900 and higher, the disc shall be guided by means other than the stem and shall be guided throughout its full range of travel. Guides need not be hard-faced unless specified in the purchase order or when required to allow for proper operation in required configuration.

5.6.4 Disc seating surfaces shall be integral or have a facing of weld material. Weld-deposited seating surfaces shall have a minimum finished facing material thickness of 0.06 in. (1.6 mm). A disc of solid metal equal to the trim material is permitted.

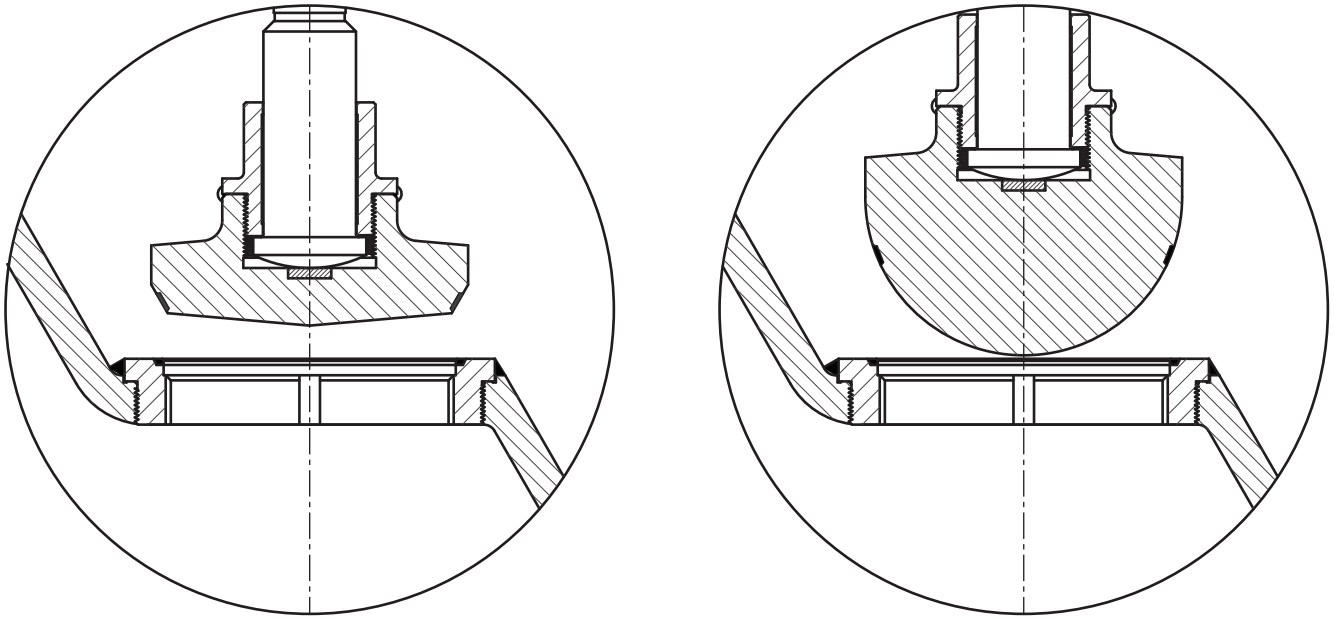


Figure 2—Typical Discs

5.6.5 A hardened wear pad may be provided between the disc and stem to prevent wear and galling. The wear pad may be either a separate disc or an integrally welded pad.

5.7 Yoke

5.7.1 The yoke may be either an integral part of the bonnet or a separate part. The yoke shall retain the yoke bushing for rising and rotating stem valves or the stem nut for non-rotating rising stem globe valves.

5.7.2 The design of the yoke bushing or stem nut shall allow for the removal of the handwheel while keeping the stem (and disc) in a fixed position.

5.7.3 Yokes that are separate shall have yoke-to-bonnet mating surfaces machined so as to assure a proper bearing assembly interface.

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

5.7.5 If the non-rotating stem feature is accomplished by using flat guiding surfaces on the yoke these surfaces shall be machined to provide proper guiding without galling.

5.8 Stem, Stem Nut, and Yoke Bushing

5.8.1 The minimum stem diameter, d_s, shall be as given in Table 5. The minimum stem diameter applies to the stem along the surface area that comes into contact with the packing and to the major diameter of the trapezoidal stem thread. However, the major diameter of the stem thread may be reduced, at the manufacturer's option, by no more than 0.06 in. (1.6 mm). The stem surface area in contact with the packing shall have a surface finish, Ra, of 32 µin. (0.80 µm) or smoother.

5.8.2 Stems shall have a disc attachment means at one end and an external trapezoidal style thread form at the other. A yoke bushing on rising and rotating stems or a stem nut on non-rotating rising stems shall be provided.

Table 5—Minimum Stem Diameter

Class Designation	150		300		600		900		1500		2500		
Nominal Size NPS	Minimum Stem Diameter d_s in. (mm)												Nominal Size DN
2	3/4	(19)	3/4	(19)	7/8	(22)	1	(25)	1 1/8	(29)	1 1/2	(38)	50
2 1/2	7/8	(22)	7/8	(22)	1	(25)	1 3/8	(35)	1 3/8	(35)	1 5/8	(41)	65
3	1	(25)	1	(25)	1 1/8	(29)	1 3/8	(35)	1 1/2	(38)	1 3/4	(44)	80
4	1 1/8	(29)	1 1/8	(29)	1 1/4	(32)	1 3/4	(44)	1 7/8	(48)	2	(51)	100
6	1 1/4	(32)	1 3/8	(35)	1 7/8	(48)	2 1/4	(57)	2 3/4	(70)	3 1/8	(79)	150
8	1 3/8	(35)	1 3/4	(44)	2 1/2	(64)	2 7/8	(73)	3 1/2	(89)	4	(102)	200
10	1 1/2	(38)	2 1/4	(57)	3 1/4	(83)	3 1/2	(89)	4 1/4	(108)	4 7/8	(124)	250
12	1 3/4	(44)	2 5/8	(67)	3 3/8	(86)	4 1/8	(105)	5	(127)	5 3/4	(146)	300
14	1 7/8	(48)	2 7/8	(73)	3 7/8	(98)	-		-		-		350
16	2 1/4	(57)	3 3/8	(86)	-		-		-		-		400
18	2 1/2	(64)	-		-		-		-		-		450
20	2 3/4	(70)	-		-		-		-		-		500
24	3 1/2	(89)	-		-		-		-		-		600

5.8.2.1 The yoke bushing shall be threaded internally to engage the stem, and it shall be threaded or otherwise suitably fitted into the yoke. The bushing shall be secured in place using either a lock weld or a positive mechanical lock. Locking by simple metal upsetting such as peening or staking is not permitted.

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

5.8.4 The stem shall be one-piece wrought material. A stem that is a welded fabrication or threaded assembly shall not be provided.

5.8.5 Out of straightness of the entire length of the stem shall not exceed 0.001 in/in (0.001 mm/mm).

5.8.6 The stem-to-disc connection (except for stop-check valves) shall be designed to prevent disengagement of the stem from the disc in any position of the disc or orientation of the valve. The bottom of the stem shall be contoured with a radial curvature large enough to allow contact with the closure element through any misalignment.

5.8.7 The stem, yoke bushing/stem nut, disc connection and bonnet shall be designed to withstand the closing of the valve against the full rated pressure under the disc and to withstand the opening of the valve against the full rated pressure over the disc.

5.8.8 The yoke bushing and stem shall be designed to withstand the closing of the valve against the full rated pressure under the disc, and to withstand the opening of the valve against the full rated pressure with flow over the disc.

5.8.9 The one-piece stem shall include a conical or spherical raised surface that seats against the bonnet backseat when the valve is at its full open position. Alternatively, the backseat may be integral to the disc retainer. A stem-bonnet backseat is a requirement of this standard and, as such, is not meant to imply a manufacturer's recommendation of its use for the purpose of adding or replacing packing while the valve is under pressure.

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

5.8.11 The stem-to-handwheel attachment shall be through a tapered square interface or another means of equivalent strength. A threaded extension shall be provided at the top of the stem for engaging a handwheel retainer nut. The stem-nut-to-handwheel attachment, where provided, shall be through a hexagonal interface, a round interface having a keyway or another means of equivalent strength.

5.8.12 The stem shall be of sufficient length to ensure that the handwheel stands clear of the yoke bushing or stem nut when the valve is in the worn closed position and shall have adequate hand clearance between the handwheel and any part of the yoke.

5.8.13 As a means to determine disc position in both the open and closed positions, the following design criteria shall apply.

— For rotating rising stems with rising handwheels, the following maximum stem exposures shall be met for the following valve sizes:

  a) valve sizes $2 \leq \text{NPS} \leq 3$, $^1/_2$ in. : $50 \leq \text{DN} \leq 80$, 12.7 mm (maximum stem exposure);

  b) valve sizes $4 \leq \text{NPS} \leq 12$, $^3/_4$ in. : $100 \leq \text{DN} \leq 300$, 19.1 mm (maximum stem exposure);

  c) valve sizes $14 \leq \text{NPS} \leq 24$, 1 in. : $350 \leq \text{DN} \leq 600$, 25.4 mm (maximum stem exposure).

— This requirement for non-rotating rising stems with non-rising handwheels is optional if another method to determine the disc position in both the open and closed positions is provided.

— For gear operated valves, the manufacturer shall provide a means to determine the disc position in both the open and closed positions.

5.8.14 Valves NPS ≥ 6 (DN ≥ 150) with pressure class ≥ 600, shall be furnished with stem nuts having ball or roller bearings. Use of a hammer-blow handwheel on NPS 6 thru 12 Class 600 and higher valves is permitted as an option to the use of bearings.

5.8.15 For rotating stem nut for non-rotating stem designs, consideration shall be given to chamfering or radiusing stem nut bearing surfaces to minimize stress concentration.

5.9 Packing and Packing Box

5.9.1 The packing may be either square or rectangular or trapezoidal in cross-section. The nominal radial width of the packing, w, shall be in accordance with Table 6.

5.9.2 The nominal depth of the packing box shall accommodate a minimum of five uncompressed rings of packing. Unless otherwise specified by the purchaser, the packing box surface area in contact with the packing material shall have a surface finish, Ra, of 175 µin. (4.5 µm) or smoother.

Table 6—Nominal Radial Width of Packing

Nominal Stem Diameter d_n in. (mm)	Nominal Radial Width of the Packing w in. (mm)	Packing Box Clearance Factor y in. (mm)
$3/4 = d \leq 1$ ($19 < d \leq 27$)	$1/4$ (6.4)	$1/64$ (0.4)
$1 < d \leq 1\,3/8$ ($27 < d \leq 37$)	$5/16$ (7.9)	$1/64$ (0.4)
$1\,3/8 < d \leq 1\,7/8$ ($37 < d \leq 49$)	$3/8$ (9.5)	$1/64$ (0.4)
$1\,7/8 < d \leq 2\,1/8$ ($49 < d \leq 56$)	$7/16$ (11.1)	$1/32$ (0.8)
$2\,1/8 < d \leq 2\,7/8$ ($56 < d \leq 74$)	$1/2$ (12.7)	$1/32$ (0.8)
$2\,7/8 < d \leq 3\,5/8$ ($74 < d < 92$)	$9/16$ (14.3)	$1/32$ (0.8)
$3\,5/8 < d \leq 4\,1/4$ ($92 < d < 108$)	$5/8$ (15.9)	$1/32$ (0.8)
$4\,1/4 < d \leq 4\,7/8$ ($108 < d < 124$)	$11/16$ (17.5)	$1/32$ (0.8)
$4\,7/8 < d \leq 5\,3/4$ ($124 < d < 146$)	$13/16$ (20.6)	$1/32$ (0.8)

5.9.3 The nominal bore (inside diameter) of the packing box shall be the sum of the nominal valve stem diameter plus twice the nominal packing width plus a clearance factor, y, i.e. equal to $d_n + 2w + y$. See Table 6 for the required values.

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

5.9.5 A lantern ring shall be provided only if so specified by the purchaser. In order to accommodate the lantern ring, the packing box depth shall be at least equivalent to that of a minimum of three uncompressed rings of packing above the lantern ring and three uncompressed rings of packing below the lantern ring plus the length of the lantern ring.

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

5.10 Bolting

5.10.1 Bolting shall be standard inch series bolting, except if the purchaser specifies metric series bolting. Bolting for the bonnet-to-body joint shall be continuously threaded stud bolts with heavy, semi-finished hexagon nuts that are in accordance with ASME B18.2.2 or ASME B18.2.4.6M.

5.10.2 Body to bonnet bolting materials shall meet the requirements of ASME B16.34.

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

5.10.4 Gland bolts, with hexagonal nuts, shall be hinged eyebolts, headed bolts, stud bolts or studs.

5.10.5 Bolting with diameters 1 in. (25 mm) and smaller shall have coarse (UNC) threads or the most nearly corresponding metric threads. Bolting with diameters larger than 1 in. (25 mm) shall be 8-thread series (8UN) or the most nearly corresponding metric threads. Bolt threads shall be Class 2A and nut threads shall be Class 2B, in

accordance with ASME B1.1. Studs used for gland bolting shall use a Class 5 interference fit conforming to ASME B1.12. When metric bolting is used metric bolt threads shall be tolerance Class 6G and nuts tolerance Class 6H in accordance with ASME B1.13M.

5.11 Operation

5.11.1 Unless otherwise specified by the purchaser, the valve shall be supplied with a direct operated handwheel that opens the valve when turned in a counter-clockwise direction. “Hammer-blow” handwheels or gear operators may be provided at the manufacturer’s option.

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

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

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

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

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

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

— electric, hydraulic, pneumatic or other actuator type;

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

— power supply attributes for power actuators.

5.11.6 Valve-to-gear-box or power actuator flange mating dimensions shall be according to ISO 5210 or MSS SP-102 and shall comply with the purchaser’s specifications.

5.11.7 Consider the effects of severe operating conditions, and the effects of orientation in other than stem-vertical positions, in sizing handwheels. Refer to MSS SP-91 and MSS SP-102.

5.12 Stop-Check

5.12.1 Stop-check valves shall be provided with a means to equalize pressure in the bonnet above the disc to the downstream side.

5.12.2 Stop-check valves shall have suitable disc or bottom guiding to ensure the disc moves freely during check valve operation.

5.12.3 Stop-check valves shall be tested in accordance with the requirements of API 598 for both globe and check valves and shall meet the acceptance criteria of both types of tests.

5.12.4 Stop-check valves shall be suitable for installation with the stem in the vertical orientation or in an orientation where the stem is within 45 degrees of vertical orientation.

5.13 Bypasses and Other Auxiliary Connections

Auxiliary connections to the body and/or bonnet, such as drains shall be furnished only if specified on the purchase order. The design and construction of the joint and the piping of auxiliary connections shall conform to the requirements of ASME B16.34. Auxiliary connections shall be sized and located as specified in ASME B16.34. The size and location of auxiliary connections shall be indicated on the purchase order.

6 Materials

6.1 Materials Other Than Trim Materials

Materials for body, bonnet, and valve parts other than trim items shall be selected from Table 7.

6.2 Trim

6.2.1 The trim is comprised of the following:

a) stem;

b) body seating surface;

c) disc seating surface;

d) bushing, or a deposited weld, for the backseat;

e) small internal parts that normally contact the service fluid, including split rings and other disc-to-stem retaining components, are considered part of the trim.

6.2.2 The trim material, except as stated in Items a) through e) below, shall be the manufacturer's standard material for the type listed in Table 8 for the trim number specified in the purchase order. The typical specifications included in Table 8 represent some acceptable grades.

a) If a trim number listed in Table 8 is specified, then an alternative trim number as shown in Table 9 may be furnished with approval of the purchaser.

b) If a single trim (e.g. trim 5) is furnished, both the seating surface of the body seat ring and the seating surface of the disc shall be made of the type of material shown in Table 8.

c) If a combination trim (e.g. trim 8) is furnished, the seating surface of the body seat ring shall be made of one of the two types of material shown in Table 8, and the seating surface of the disc shall be made of the other type of material shown.

d) The stem, backseat, and stem hole guide, and the small internal parts (see 6.2.1 e) shall be of the type of material and hardness listed in Table 8. The stem shall be a wrought material.

e) Hardfacing of both the seat ring and disc seating surface is required for Class 900 and higher rated valves.

6.2.3 The base material of the valve disc and separate body seat ring, when used, shall be of a nominal material composition equal to the body or to that of the stem material, except for disc material made of solid trim material as allowed by 5.3.3.2.

Table 7—Materials for Parts

Part	Material
Body and bonnet	As selected from ASME B16.34, Group 1 and Group 2.
Disc	Steel, at least equal in corrosion resistance to that of the body material.
Yoke, separate	Carbon steel, stainless steel, or same material as the bonnet.
Bolting: body to bonnet	Unless other materials are agreed between the purchaser and manufacturer the bolting material listed in Annex C is recommended. However, for service temperatures below –20 °F (–29 °C) or above 850 °F (454 °C), the purchase order shall specify the bolting material.
Bonnet gasket	The metallic portion exposed to the service environment shall be of a material that has a corrosion resistance at least equal to that of the body material.
Bolting: gland and yoke	Bolting material at least equal to ASTM A307—Grade B.
Seat ring	As in Table 8 except the base material of the seat ring, if used, and the base weld material of seal welds, strength welds or weld deposit facings shall be of nominal material composition equal to the body material or the stem material. (see 6.2.3)
Gland flange	Steel.
Gland	Material having a corrosion resistance at least equal to that of the body material.
Packing	Suitable for steam and petroleum fluids for temperature range from –20 °F (–29 °C) to 1000 °F (538 °C). Shall contain a corrosion inhibitor.
Lantern ring or spacer ring	Material having corrosion resistance at least equal to that of the body material.
Stem nut	Austenitic ductile iron or copper alloy with melting point above 1750 °F (955 °C).
Handwheel	Malleable iron, carbon steel, or ductile iron.
Handwheel nut (retaining)	Steel, malleable iron, ductile iron, or non-ferrous copper alloy.
Pipe plugs	Nominal composition shall be the same as the shell material. Cast iron plugs shall not be used.
Bypass piping and valves	Nominal composition shall be the same as the shell material.
Identification plate	Austenitic stainless steel or nickel alloy attached to the valve by corrosion-resistant fasteners or by welding.

7 Testing, Inspection, and Examination

7.1 Inspection and Examination

7.1.1 The valve manufacturer shall examine each valve to assure compliance to this standard.

7.1.2 If inspection by the purchaser is specified in the purchase order, inspection shall be in accordance with API 598. Examination by the manufacturer shall be as specified in API 598.

7.2 Pressure Tests

Each valve shall be pressure tested by the manufacturer as specified in API 598.

Table 8—Nominal Seating Surface, Stem, and Backseat Bushing or Weld Deposited Materials and Hardness

Trim Number	Nominal Trim	Seat Surface Hardness (HB) Minimum [a]	Seat Surface Material Type [b]	Seat Surface Typical Specifications Grade			Stem/Bushing			Backseat Bushing Hardness (HB)
				Cast	Forged	Welded [m]	Material Type [b]	Typical Specifications Type	Stem Hardness (HB)	
1	F6	Note [c]	13Cr	ASTM A217(CA15)	ASTM A182 (F6a)	AWS A5.9 ER410	13Cr	ASTM A276-T410 or T420	200 min 275 max	250 min.
2	304	Note [d]	18Cr-8Ni	ASTM A351 (CF8)	ASTM A182 (F304)	AWS A5.9 ER308	18Cr-8Ni	ASTM A276-T304	Note [d]	Note [d]
3	F310	Note [d]	25Cr-20Ni	NA	ASTM A182 (F310)	AWS A5.9 ER310	25Cr-20Ni	ASTM A276-T310	Note [d]	Note [d]
4	Hard F6	750 [e]	Hard 13Cr	NA	Note [f]	NA	13Cr	ASTM A276-T410 or T420	200 min 275 max	250 min.
5	Hardfaced	350 [e]	Co-Cr A [g]	NA	NA	AWS A5.13 ECoCr-A or AWS A5.21 ERCoCr-A	13Cr	ASTM A276 T410 or T420	200 min 275 max	250 min.
5A	Hardfaced	350 [e]	Ni-Cr	NA	NA	Note [h]	13Cr	ASTM A276 T410 or T420	200 min 275 max	250 min.
6	F6 and Cu-Ni	250 [i] 175 [i]	13Cr and Cu-Ni	ASTM A217 (CA 15) NA	ASTM A182 (F6a) Note [k]	AWS A5.9 ER410 NA	13Cr NA	ASTM A276 T410 or T420 NA	200 min 275 max NA	250 min NA.
7	F6 and Hard F6	250 [i] 750 [i]	13Cr and Hard 13Cr	ASTM A217 (CA 15) NA	ASTM A182 (F6a) Note [f]	AWS A5.9 ER410 NA	13Cr NA	ASTM A276 T410 or T420 NA	200 min 275 max NA	250 min. NA
8	F6 and Hardfaced	250 [i] 350 [i]	13Cr and Co-Cr A [g]	ASTM A217 (CA 15) NA	ASTM A182 (F6a) NA	AWS A5.9 ER410 AWS A5.13 ECoCr-A or AWS A5.21 ERCoCr-A	13Cr NA	ASTM A276 T410 or T420 NA	200 min 275 max NA	250 min NA
8A	F6 and Hardfaced	250 [i] 350 [i]	13Cr and Ni-Cr	ASTM A217 (CA 15) NA	ASTM A182 (F6a) NA	AWS A5.9 ER410 Note [h]	13Cr NA	ASTM A276 T410 or T420 NA	200 min 275 max NA	250 min. NA
9	Monel	Note [d]	Ni-Cu Alloy	NA	MFG Standard	NA	Ni-Cu Alloy	MFG Standard	Note [d]	Note [d]
10	316	Note [d]	18Cr-8Ni	ASTM A351 (CF8M)	ASTM A183 (F316)	AWS A5.9 ER316	18Cr-8Ni-Mo	ASTM A276-T316	Note [d]	Note [d]
11	Monel and Hardfaced	Note [d] 350 [i]	Ni-Cu Alloy and Trim 5 or 5A	NA	MFG Standard	NA See Trim 5 or 5A	Ni-Cu Alloy NA	MFG Standard NA	Note [d] NA	Note [d] NA
12	316 and Hardfaced	Note [d] 350 [i]	18Cr-8Ni-Mo and Trim 5 or 5A	ASTM A351 (CF8M)	ASTM A182 (F316)	AWS A5.9 ER316 See Trim 5 or 5A	18Cr-8Ni-Mo NA	ASTM A276-T316 NA	Note [d] NA	Note [d] NA
13	Alloy 20	Note [d]	19Cr-29Ni	ASTM A351 (CN7M)	ASTM B473	AWS A5.9 ER320	19Cr-29Ni	ASTM B473	Note [d]	Note [d]

Table 8—Nominal Seating Surface, Stem, and Backseat Bushing or Weld Deposited Materials and Hardness (Continued)

Trim Number	Nominal Trim	Seat Surface Hardness (HB) Minimum [a]	Seat Surface Material Type [b]	Seat Surface Typical Specifications Grade			Stem/Bushing			Backseat Bushing Hardness (HB)
				Cast	Forged	Welded [m]	Material Type [b]	Typical Specifications Type	Stem Hardness (HB)	
14	Alloy 20 and Hardfaced	Note [d] 350 [i]	19Cr-29Ni and Trim 5 or 5A	ASTM A351 (CN7M) NA	ASTM B473 NA	AWS A5.9 ER320 See Trim 5 or 5A	19Cr-29Ni NA	ASTM B473 NA	Note [d] NA	Note [d] NA
15	Hardfaced	350 [e]	Co-Cr A [g]	NA	NA	AWS A5.13 ECoCr-A or AWS A5.21 ERCoCr-A	18Cr-8Ni	ASTM A276-T304	Note [d]	Note [n]
16	Hardfaced	350 [e]	Co-Cr A [g]	NA	NA	AWS A5.13 ECoCr-A or AWS A5.21 ERCoCr-A	18Cr-8Ni-Mo	ASTM A276-T316	Note [d]	Note [n]
17	Hardfaced	350 [e]	Co-Cr A [g]	NA	NA	AWS A5.13 ECoCr-A or AWS A5.21 ERCoCr-A	18Cr-10Ni-Cb	ASTM A276-T347	Note [d]	Note [n]
18	Hardfaced	350 [e]	Co-Cr A [g]	NA	NA	AWS A5.13 ECoCr-A or AWS A5.21 ERCoCr-A	19Cr-29Ni	ASTM B473	Note [d]	Note [n]

NOTE Cr=Chromium;Ni=Nickel;Co=Cobalt;Cu=Copper;NA=Not Applicable.

[a] HB (formerly BHN) is the symbol for the Brinell hardness per ASTM E10.

[b] Free machining grades of 13Cr are prohibited.

[c] Body and disc seat surfaces should be 250 HB minimum with a 50 HB minimum differential between the body and disc seat surfaces.

[d] Manufacturer's standard hardness.

[e] Differential hardness between the body and disc seat surfaces is not required.

[f] Case hardness by nitriding to a thickness of 0.13 mm (0.005 in.) minimum.

[g] This classification includes such trademark materials as Stellite 6™ *, Stoody 6™ * and Wallex 6™ *. CoCr-E (Stellite 21™ * or equal) may be used only with purchaser approval and typical CoCr-E alloys include AWS A5.13 ECoCr-E or AWS A5.21 ERCoCr-E.

[h] Manufacturer's standard hardfacing with a maximum iron content of 25%.

[i] Hardness differential between the body and disc seat surfaces shall be the manufacturer's standard.

[j] Not used.

[k] Manufacturer’s standard with 30 Ni minimum.

[l] Not used.

[m] Typical backseat weld deposit material.

[n] Per manufacturer's standard if not hardfaced, 250 HB minimum if hardfaced.

[*] This term is used as an example only, and does not constitute an endorsement of this product by API.

Table 9—Trim Numbers and Alternative Trim Numbers

Specified Trim Number	Alternative Trim Number
1	8 or 8A
2	10
5A	5
8A	8
10	12 or 16
13	14
12	16

7.3 Inspection of Castings

Body and bonnet castings shall meet the inspection criteria of MSS SP-55.

7.4 Repairs of Defects

Defects in the shell of a cast carbon or alloy steel valve that are revealed by inspection or testing may be repaired as permitted by the most nearly applicable ASTM cast material specification listed in ASME B16.34.

8 Marking

8.1 General

Valves shall be marked in accordance with the requirements of ASME B16.34, except that the nameplate shall include the designation “API 623” in addition to the designation ASME B16.34.

8.2 Marking for Flow Direction

The direction of flow shall be marked with a flow direction arrow that is cast, forged, or stamped into the valve body outer wall, or with a separate identification plate permanently attached to the valve body that indicates flow direction.

9 Preparation for Shipment

9.1 Coatings

9.1.1 Unmachined exterior surfaces of the shell shall be painted per the manufacturer’s standard paint with an aluminum or silver color. Austenitic stainless steel valves shall not be painted.

9.1.2 Machined or threaded surfaces (except those on austenitic stainless steel materials) shall be coated with an easily removable rust preventative. The stem does not need to be coated if the stem packing contains a corrosion inhibitor.

9.2 Openings

9.2.1 Valve end flanges and welding ends shall be blanked to protect the gasket surfaces or welding ends and the valve internals during shipment and storage. The protective covers shall be made of wood, wood fiber, plastic, or

metal and shall be securely attached to the valve ends by bolts, steel, straps, steel clips, or suitable friction-locking devices. Covers shall be designed so that the valve cannot be installed without removal of protective cover.

9.2.2 Tapped connections shall be fitted with securely tightened, leak-tight threaded plugs. Use of anti-galling compounds is permissible. Thread sealants are not permitted unless allowed by the purchaser. The material used for plugs for tapped connections shall have the same nominal chemical composition as the shell material (see 5.13 and Table 7).

9.3 Disc Position

The valve shall be shipped with the disc closed.

9.4 Stem Packing

The valve shall be shipped with the lantern ring, if specified, and the packing installed and tightened to the manufacturer's specified gland load. The remaining adjustment length of the packing gland shall be greater than one-and-one-half times the packing width specified in Table 6.

9.5 Packaging

9.5.1 Unless export packaging is specified in the purchase order, valves may be shipped loose, palletized, or packed in a box or crate.

9.5.2 When export packaging is specified in the purchase order, valves shall be shipped individually or collectively in wooden boxes or crates in a manner that will prevent shifting within the package.

Annex A
(informative)

Information to be Specified by the Purchaser

NOTE Numbers in brackets are references to clauses or subsections of this standard.

1) Supplemental requirements of this standard shall be specifically stated in the purchase order.

2) If no supplemental requirements are to be taken to this standard, the purchase order just needs to refer to API 623 and to specify the items in the following list that are marked with an asterisk (*). The items listed below without an asterisk are options that may also be specified:

   a) valve size *;

   b) pressure class *;

   c) flanged ends, including flange facing finish; or welding ends, including bore *;

   d) auxiliary connections and openings;

   e) valve orientation;

   f) additional hard facing of body and/or disc guides;

   g) bonnet gasket and/or bonnet flange facing;

   h) tapped openings;

   i) type of disc, if required *;

   j) lantern ring;

   k) chainwheel and chain;

   l) gear operation, including type and arrangement, and the design maximum pressure differential across the valve;

   m) power operation, including type of power and power unit, and the design maximum pressure differential across the valve;

   n) bypass—specify either flanged or welded bonnet bypass valve;

   o) material of the valve shell *;

   p) nominal trim material *;

   q) any required exceptions to manufacturer’s permissible options (e.g. NACE MR 0103);

   r) handwheels;

   s) safety shield;

t) chainwheel and safety cables, if furnished as original equipment;

u) alternate stem packing material;

v) bonnet bolting material;

w) inspection by purchaser;

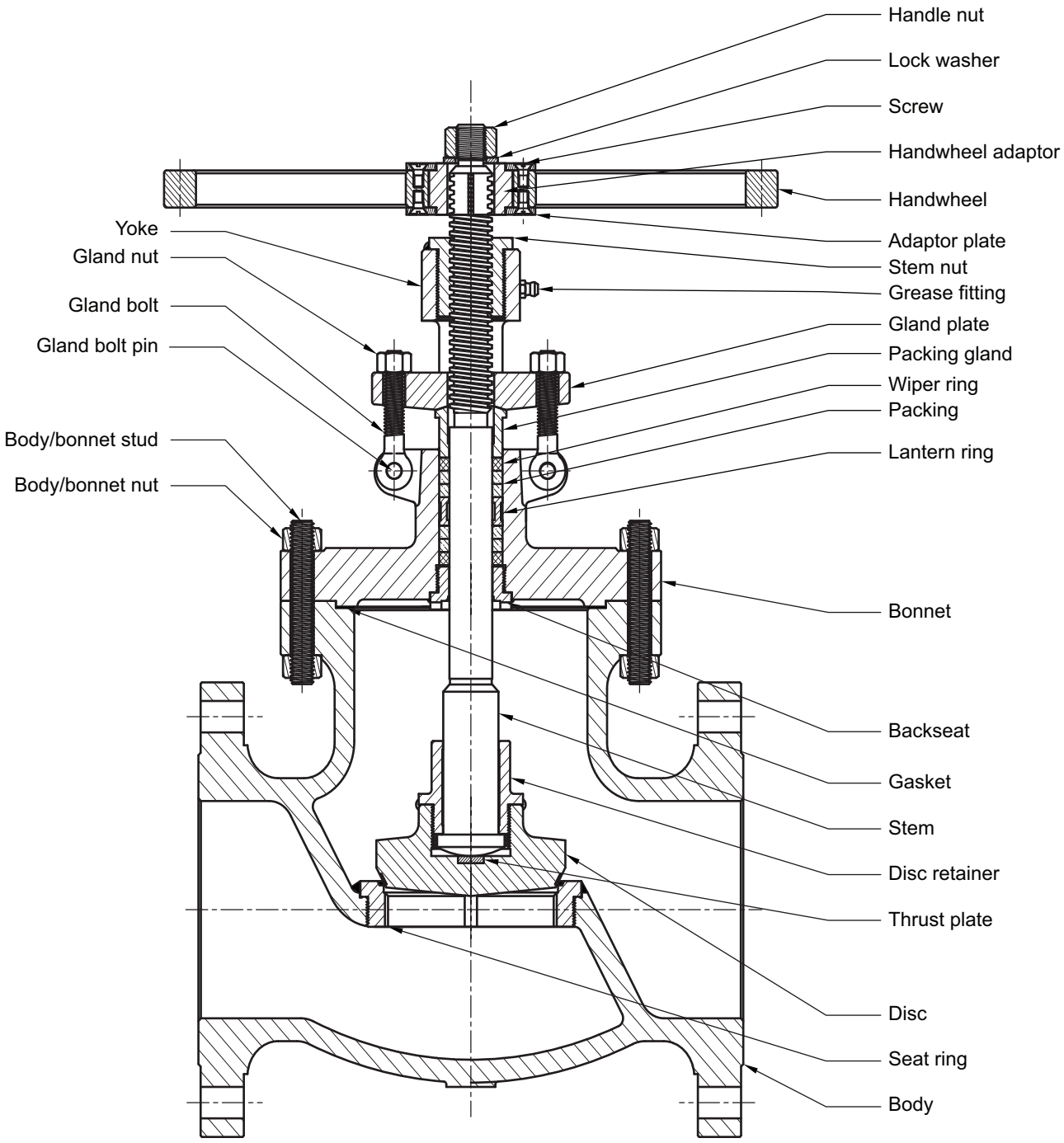
x) low-pressure closure test;

y) supplementary examination and testing;

z) export packaging.

Annex B
(informative)

Identification of Valve Terms



NOTE The only purpose of this figure is to identify part names. The construction of a valve is acceptable only when it complies with this standard in all respects.

Figure B.1—Valve Nomenclature

Annex C
(informative)

Valve Material Combinations

Table C.1 and Table C.2 list valve body, bonnet and cover materials (ASME B16.34, Material Groups 1 and 2) along with associated valve trim materials (trim numbers, Table 8) and ASTM A193 and ASTM A194 specification bolting materials. For ASTM A193 and ASTM A194 listed bolting materials in Table C.1 and Table C.2, corresponding bolting materials listed in EN 10269 may be substituted in accordance with Table C.3. Materials other than those listed in Table C.1, Table C.2 or Table C.3, are outside the scope of this standard (see 6.2).

Table C.1—Material Combinations for Group 1 Body, Bonnet, and Cover Materials

Material Group ASME B16.34	Body/Bonnet Material Abbreviation	Body, Bonnet and Cover ASTM Specification	Trim Material CN Designation	Body to Bonnet and Body to Cover Bolting ASTM Specification
1.1	C-Si	A105 or A216-WCB	8, 8A	B7/2H
	C-Mn-Si	A350-LF2-CL1	8, 8A	B7/2H [b]
	C-Mn-Si-V	A350-LF6-CL1	10	B8M-CL2/8M [b, c, d]
	3 1/2 Ni	A350-LF3	10	B8M-CL2/8M [b, c, d]
1.2	C-Mn-Si	A216-WCC	8, 8A	B7/2H
		A352-LCC	8, 8A	B7/2H
	C-Mn-Si-V	A350-LF6-CL2	10	B8M-CL2/8M [b, c, d]
	2 1/2Ni	A352-LC2	10	B8M-CL2/8M [b, c, d]
	3 1/2Ni	A352-LC3	10	B8M-CL2/8M [b, c, d]
1.3	C-Si C-1/2Mo	A352-LCB	8, 8A	B7/2H
		A217-WC1	8, 8A	B7/2H
		A352-LC1	10	B8M-CL2/8M [b, c, d]
1.4	C-Mn-Si	A350-LF1	8	B7/2H
1.5	C-1/2Mo	A182-F1	8	B7/2H
1.7	1/2Cr-1/2Mo	A182-F2	8	B7/2H
	Ni-1/2Cr-1/2Mo	A217-WC4		
	3/4Ni-3/4Cr-1Mo	A217-WC5		
1.9	1 1/4Cr-1/2Mo	A217-WC6	8	B16/8M [e]
	1 1/4Cr-1/2Mo-Si	A182-F11-CL2		
1.10	2 1/4Cr-1Mo	A182-F22-CL3	8	B16/8M [e]
		A217-WC9		
1.13	5Cr-1/2Mo	A182-F5a or A217-C5	8	B16/8M [e]
1.14	9Cr-1 Mo	A182-F9 or A217-C12	8	B16/8M [e]
1.15	9Cr-1Mo-V	A182-F91 or A217-C12A	8	B16/8M [e]
1.17	1Cr-1/2Mo	A182-F12-CL2	8	B16/8M [e]
	5Cr-1/2Mo	A182-F5		

NOTE 1 For Table C.1 table notes, see Table C.2.

NOTE 2 For bolting materials in accordance with EN 10269, see Table C.3.

Table C.2—Material Combinations for Group 2 Body to Bonnet Materials

Material Group ASME B16.34	Body/Bonnet Material Abbreviation	Body, Bonnet, and Cover ASTM Specification	Trim Material CN Designation	Body to Bonnet and Body to Cover Bolting ASTM Specification [a]
2.1	18Cr-8Ni	A182-F304/A351-CF3 A182-F304H/A351-CF8	2	B8M-CL2/8M [c, d]
2.2	16Cr-12Ni-2Mo 18Cr-8Ni 18CR-13Ni-3Mo 19Cr-10Ni-3Mo	A182-F316 or A351-CF3M, A182-F316H or A351-CF8M A351 CF3A A182-F317 or A182-F317H or A351 CF8A A351-CG8M	10	B8M-CL2/8M [c, d]
2.3	8Cr-8Ni 16Cr-12Ni-2Mo	A182-F304L A182-F316L	10	B8M-CL2/8M [c, d]
2.4	18Cr-10Ni-Ti	A182-F321 A182-F321H	10	B8M-CL2/8M [c, d]
2.5	18Cr-10Ni-Cb	A182-F347H A182-F347 A182-F348 A182-F348H	10	B8M-CL2/8M [c, d]
2.7	25Cr-20Ni	A182-F310	10	B8M-CL2/8M [c, d]
2.8	20Cr-18Ni-6Mo 22Cr-5Ni-3Mo-N 25Cr-7Ni-4Mo-N 24Cr-10Ni-4Mo-V 25Cr-5Ni-2Mo-3Cu 25Cr-7Ni-3.5Mo-W-Cb 25Cr-7Ni-3.5Mo-N-Cu-W	A182-F44 A351-CK3MCuN A182-F51 A182-F53 A351-CE8MN A351-CD4MCu A351-CD3MWCuN A182-F55	Note [f]	B8M-CL2/8M [c, d]
2.10	25Cr-12Ni	A351-CH8 A351-CH20	Note [f]	B8M-CL2/8M [c, d]
2.11	18Cr-10Ni-Cb	A351-CF8C	Note [f]	B8M-CL2/8M [c, d]
2.12	25Cr-20Ni	A351-CK20	Note [f]	B8M-CL2/8M [c, d]

NOTE For bolting materials in accordance with EN 10269, see Table C.3.

[a] Temperature limitations on bolting are as follows: Gr B7, 538 °C (1000 °F); Gr L7, 538 °C (1000 °F); Gr B16, 595 °C (1100 °F); Gr B8-CL1, Gr B8A-CL1A, Gr B8M-CL1, and Gr B8MA-CL1A, 816 °C (1500 °F); Gr B8-CL2, Gr B8M-CL2, Gr B8M2-CL2B and Gr B8M3-CL2C, 538 °C (1000 °F).

[b] ASTM A320, Gr L7 bolts, and ASTM A194, Gr 4 nuts may also be used.

[c] ASTM A193, Gr B8-CL1, Gr B8A-CL1A, Gr B8M-CL1, Gr B8MA-CL1A, Gr B8M2-CL2B, and Gr B8M3-CL2C bolting is a suitable substitute provided that the requirements of 5.5.7 are met.

[d] ASTM A193, Gr B8-CL2 bolts may also be used.

[e] ASTM A194, Gr 7 nuts may also be used.

[f] Trim material is not specified, however, trim material shall have corrosion resistance equal to the corrosion resistance of the valve body material.

Table C.3—Alternative Body to Bonnet Bolting Materials

As Related to Table C.1 and Table C.2		As Related to Table Notes in Table C.1 and Table C.2	
ASTM Bolting Material	**EN 10269 Bolting Material Grade**	**ASTM Bolting Material**	**EN 10269 Bolting Material Grade**
A193 B7 A193 B16	42CrMo4 (1.7225)—QT 40CrMoV4-6 (1.7711)—QT	A193 B8M2, CL 2B A193 B8M3, CL 2C	X5CrNiMo 17-12-2 (1.4401)—C700 X5CrNiMo 17-12-2 (1.4401)—C700
A193 B8M, CL 2 A194 2H	X5CrNiMo 17-12-2 (1.4401)—C700 C45E (1.1191)—QT	A193 B8M, CL 1 A193 B8MA, CL 1A	X5CrNiMo 17-12-2 (1.4401)—AT X5CrNiMo 17-12-2 (1.4401)—AT
A194 8M	X5CrNiMo 17-12-2 (1.4401)—AT	A193 B8, CL 1 A193 B8A, CL 1A	X5CrNi 18-10 (1.4301)—AT X5CrNi 18-10 (1.4301)—AT
		A193, B8 CL 2 A320, L7	X5CrNi 18-10 (1.4301)—C700 42CrMo4 (1.7225)—QT
		A194 GR 8 A194 GR 4	X5CrNi 18-10 (1.4301)—AT 42CrMo4 (1.7225)—QT
		A194 GR 7	42CrMo4 (1.7225)—QT

NOTE Temperature limitations applicable for ASTM bolting materials, table notes for Table C.2, also apply for corresponding substitute EN bolting materials.

Bibliography

[1] MSS SP-91, *Guidelines for Manual Operation of Valves*

[2] ASTM A193, *Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature of High Pressure Service and Other Special Purpose Applications*

[3] ASTM A194, *Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both*

[4] ASTM A320/A320M Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service

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