

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

Downstream Segment

API STANDARD 623
FIRST EDITION, MONTH YEAR

EFFECTIVE DATE: MONTH YEAR

SECOND BALLOT DRAFT

STEEL GLOBE VALVES—FLANGED AND BUTT-WELDING ENDS, BOLTED BONNETS

1 Scope

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

- bolted bonnet,
- outside screw and yoke,
- rotating rising stems, and non rotating rising stems
- rising handwheels and non rising handwheels
- conventional, y-pattern, right-angle or stop-check,
- plug, narrow, flat, 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)*

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 B36.10M, *Welded and Seamless Wrought Steel Pipe*

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

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

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

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

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

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

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

EN 1092-1 ³, *Flanges and their joints—Circular flanges for pipes, valves, fittings and accessories, PN designated—Part 1: Steel flanges*

ISO 7-1 ⁴, *Pipe threads where pressure-tight joints are made on the threads—Part 1: Dimensions, tolerances and designation*

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

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

ISO 6708, *Pipework components—Definition and selection of DN (nominal size)*

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

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

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

MSS SP-55 ⁵, *Quality Standard for Steel Castings for Valves, Flanges and Fittings and Other Piping Components — Visual Method for Evaluation of Surface Irregularities*

NACE MR 0103 ⁶, *Materials Resistant to Sulfide Stress Cracking in Corrosive Petroleum Refining Environments*

3 Definitions

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 International 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 European Committee for Standardization, Avenue Marnix 17, B-1000, Brussels, Belgium, www.cen.eu.

⁴ International Organization for Standardization, 1, ch. de la Voie-Creuse, Case postale 56, CH-1211, Geneva 20, Switzerland, www.iso.org.

⁵ Manufacturers Standard Society of the Valve and Fittings Industry, Inc., 127 Park Street, N.E., Vienna, Virginia 22180-4602, www.mss-hq.com.

⁶ NACE International (formerly the National Association of Corrosion Engineers), 1440 South Creek Drive, Houston, Texas 77218-8340, www.nace.org.

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.

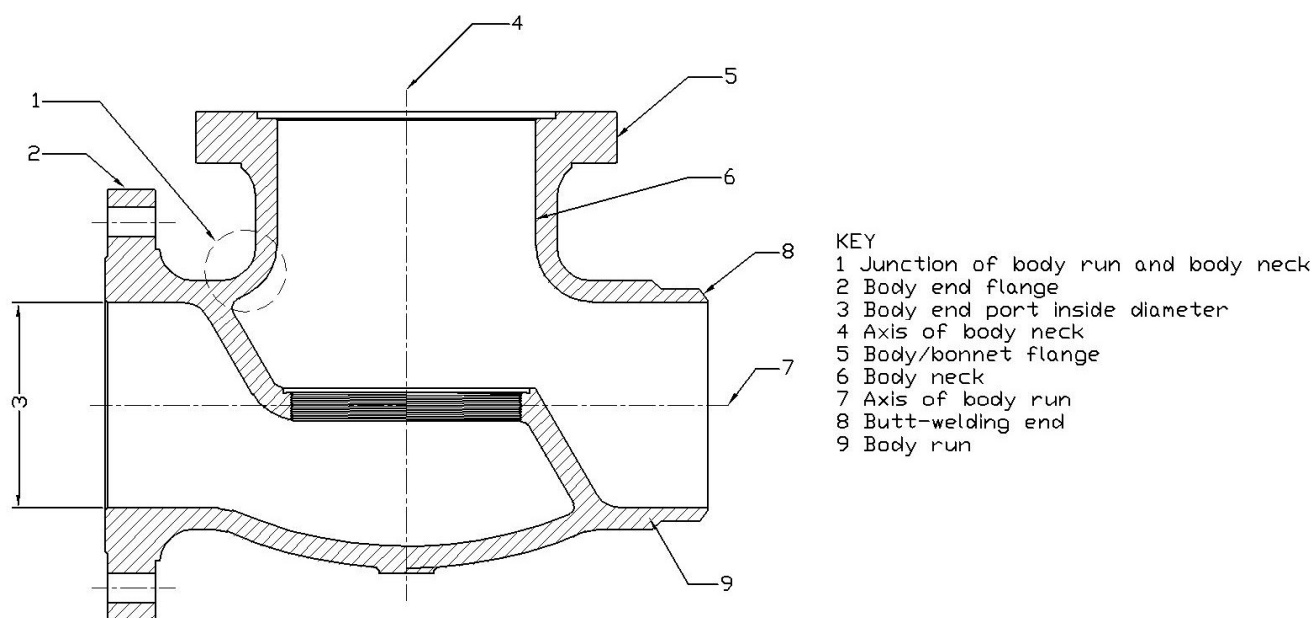


Figure 1—Identification of Terms

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)	0.75 (19.1)	0.75 (19.1)	0.88 (22.4)	50
2 1/2	0.38 (9.7)	0.44 (11.2)	0.47 (11.9)	0.88 (22.4)	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 $0.77t_m$ at a distance of $2t_m$ 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.

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)	0.200 (5.1)	0.280 (7.1)	0.390 (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)	0.270 (6.9)	0.350 (8.9)	0.530 (13.5)	0.912 (23.2)
2.50 (63.5)	0.220 (5.6)	0.250 (6.4)	0.280 (7.1)	0.360 (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)	0.470 (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)	0.530 (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)	0.350 (8.9)	0.450 (11.4)	0.640 (16.3)	1.040 (26.4)	1.850 (47.0)
5.250 (133)	0.280 (7.1)	0.350 (8.9)	0.450 (11.4)	0.650 (16.5)	1.070 (27.2)	1.890 (48.0)
5.375 (137)	0.280 (7.1)	0.360 (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)	0.360 (9.1)	0.470 (11.9)	0.680 (17.3)	1.125 (28.6)	1.968 (50.0)
6.250 (159)	0.290 (7.4)	0.390 (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)

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.

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

Material	Thickness ^a <i>t</i> 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:				
$1/2\% < \text{Cr} \leq 2\%$	$t > 0.50$ (13)	1300 to 1375 (704 to 746)	1 (2.4) (minimum 2 hr)	225
$2\ 1/4\% \leq \text{Cr} \leq 10\%$	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)	$\frac{1}{2}$ (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.				

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 Body Seats

5.3.3.1 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 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
2.5	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