

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

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

1 Scope

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

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

- bolted bonnet;
- outside screw and yoke;
- rising stems;
- non-rising handwheels;
- single or double gate;
- wedge or parallel seating;
- metallic seating surfaces;
- flanged or butt-welding ends.

It covers valves of the nominal pipe sizes DN:

- 25, 32, 40, 50, 65, 80, 100, 150, 200, 250, 300, 350, 400, 450, 500, 600, 650, 700, 750, 800, 850, 900, 950, 1000, 1050;

corresponding to nominal pipe sizes NPS:

- 1, 1 $\frac{1}{4}$, 1 $\frac{1}{2}$, 2, 2 $\frac{1}{2}$, 3, 4, 6, 8, 10, 12, 14, 16, 18, 20, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42;

and applies to pressure class designations:

- 150, 300, 600, 900, 1500, 2500.

This edition of API 600 states values in both metric and U.S. Customary units of measurement. These systems of units are to be regarded separately. The values stated in each system are not exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems constitutes nonconformance with this standard.

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*

API Standard 624, *Type Testing of Rising Stem Valves Equipped with Graphite Packing for Fugitive Emissions*

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 B1.13M, *Metric Screw Threads: M Profile*

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 B16.25, *Buttwelding Ends*

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

ASME B16.47, *Large Diameter Steel Flanges, NPS 26 Through NPS 60 Metric/Inch Standard*

ASME B18.2.2, *Nuts for General Applications: Machine Screw Nuts, Hex Flange, and Coupling Nuts (Inch Series)*

ASME B18.2.6M, *Metric Fasteners for Use in Structural Applications*

ASME B31.3, *Process Piping*

ISO 5210 2,² *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*

MSS SP-91 3,³ *Guidelines for Manual Operation of Valves*

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

MSS SP-134, *Valves for Cryogenic Service, including Requirements for Body/Bonnet Extensions*

MSS SP-144, *Pressure Seal Bonnet Valves*

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 the word “Class” followed by a dimensionless whole number. The number following the word “Class” does not represent a measurable value and is not used for calculation purposes, except where specified in this standard.

¹ American Society of Mechanical Engineers, Two Park Avenue, New York, New York 10016, www.asme.org.

² International Organization for Standardization, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, www.iso.org.

³ Manufacturers Standardization Society of the Valve and Fittings Industry, 127 Park Street, NE, Vienna, Virginia, 22180, www.msshq.org.

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

A numeric designation of size that is common for components used in a piping system and 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

A numeric designation of size that is common for components used in a piping system and 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.

3.4

shell

Comprised of the body, bonnet, and body-bonnet bolting that constitute the pressure boundary of an API 600 valve.

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.

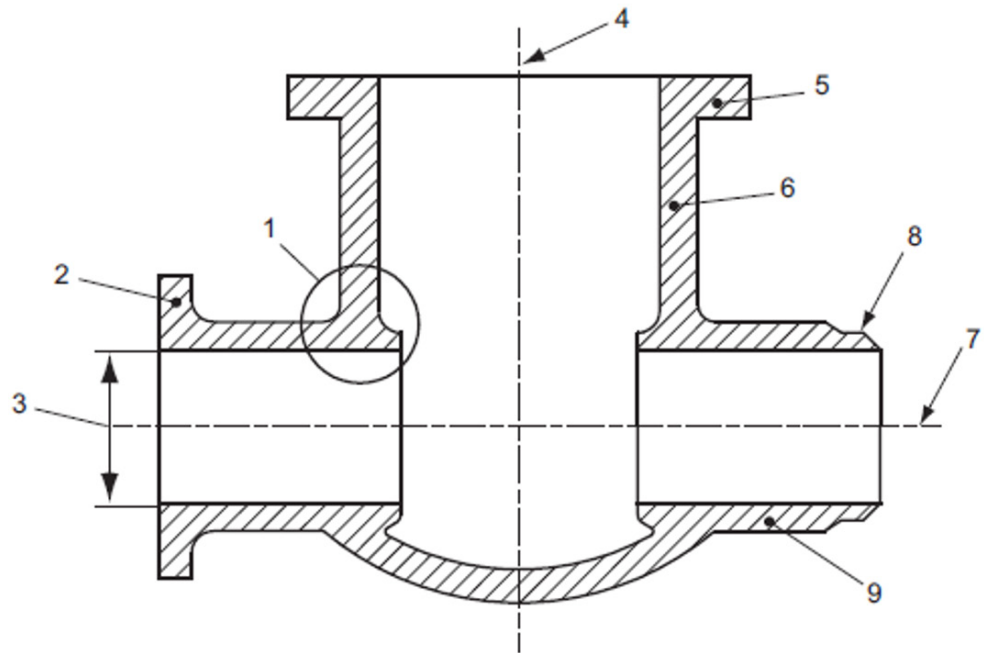
4.4 For temperatures below the lowest temperature listed in the pressure/temperature tables, the service pressure shall be no greater than the pressure for the lowest listed temperature. The use of valves at lower temperatures is the responsibility of the user. Consideration should be given to the loss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

NOTE For valves capable of trapping fluid, resulting in center cavity overpressure, refer to ASME B16.34 for a provision related to this requirement.

5 Design

5.1 Body Wall Thickness

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



Key

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

Figure 1—Identification of Terms

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 the valve body neck rules of ASME B16.34.

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 for sizes up to and including DN 600 (NPS 24). For sizes over DN 600 (NPS 24), body end flanges shall comply with the dimensional requirements of ASME B16.47 Series A or Series B as specified by the purchaser. Unless otherwise specified, raised face end flanges shall be provided. The purchaser may specify a flange facing finish other than that specified in ASME B16.5 or ASME B16.47, as applicable.

5.3.1.2 Face-to-face dimensions shall be in accordance with ASME B16.10 or ISO 5752. For sizes not listed, dimensions shall be as agreed to between purchaser and manufacturer. 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.

Table 1—Minimum Wall Thickness for Body and Bonnet

Class Designation	150	300	600	900	1500	2500	Class Designation
Nominal Size DN	Minimum Wall Thickness t_m mm (in.)						Nominal Pipe Size NPS
25	6.4 (0.25)	6.4 (0.25)	7.9 (0.31)	12.7 (0.50) ^a	12.7 (0.50)	15.0 (0.59)	1
32	6.4 (0.25)	6.4 (0.25)	8.6 (0.34)	14.2 (0.56) ^a	14.2 (0.56)	17.5 (0.69)	1 1/4
40	6.4 (0.25)	7.9 (0.31)	9.4 (0.37)	15.0 (0.59) ^a	15.0 (0.59)	19.1 (0.75)	1 1/2
50	8.6 (0.34)	9.7 (0.38)	11.2 (0.44)	19.1 (0.75) ^a	19.1 (0.75)	22.4 (0.88)	2
65	9.7 (0.38)	11.2 (0.44)	11.9 (0.47)	22.4 (0.88) ^a	22.4 (0.88)	25.4 (1.00)	2 1/2
80	10.4 (0.41)	11.9 (0.47)	12.7 (0.50)	19.1 (0.75)	23.9 (0.94)	30.2 (1.19)	3
100	11.2 (0.44)	12.7 (0.50)	16.0 (0.63)	21.3 (0.84)	28.7 (1.13)	35.8 (1.41)	4
150	11.9 (0.47)	16.0 (0.63)	19.1 (0.75)	26.2 (1.03)	38.1 (1.50)	48.5 (1.91)	6
200	12.7 (0.50)	17.5 (0.69)	25.4 (1.00)	31.8 (1.25)	47.8 (1.88)	62.0 (2.44)	8
250	14.2 (0.56)	19.1 (0.75)	28.7 (1.13)	36.6 (1.44)	57.2 (2.25)	67.6 (2.66)	10
300	16.0 (0.63)	20.6 (0.81)	31.8 (1.25)	42.2 (1.66)	66.8 (2.63)	86.6 (3.41)	12
350	16.8 (0.66)	22.4 (0.88)	35.1 (1.38)	46.0 (1.81)	69.9 (2.75)	—	14
400	17.5 (0.69)	23.9 (0.94)	38.1 (1.50)	52.3 (2.06)	79.5 (3.13)	—	16
450	18.3 (0.72)	25.4 (1.00)	41.4 (1.63)	57.2 (2.25)	88.9 (3.50)	—	18
500	19.1 (0.75)	26.9 (1.06)	44.5 (1.75)	63.5 (2.50)	98.6 (3.88)	—	20
600	20.6 (0.81)	30.2 (1.19)	50.8 (2.00)	73.2 (2.88)	114.3 (4.50)	—	24
650	21.4 (0.84)	31.6 (1.24)	—	—	—	—	26
700	22.2 (0.87)	33.3 (1.31)	—	—	—	—	28
750	23.0 (0.91)	34.9 (1.37)	—	—	—	—	30
800	23.8 (0.94)	36.0 (1.41)	—	—	—	—	32
850	24.6 (0.97)	38.1 (1.50)	—	—	—	—	34
900	25.3 (1.00)	39.6 (1.56)	—	—	—	—	36
950	26.1 (1.03)	41.3 (1.63)	—	—	—	—	38
1000	27.0 (1.06)	43.0 (1.69)	—	—	—	—	40
1050	27.7 (1.09)	44.4 (1.75)	—	—	—	—	42

^a Wall thicknesses match class 1500 to correspond to B16.5 flange dimensions for class 900.

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

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 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.

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

- the carbon content shall not exceed 0.23 % by mass;
- the carbon equivalent, CE, shall not exceed 0.43 as determined by the following formula:

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

where

C	is weight % Carbon;
Mn	is weight % Manganese;
Cr	is weight % Chromium;
Mo	is weight % Molybdenum;
V	is weight % Vanadium;
Ni	is weight % Nickel;
Cu	is weight % Copper.

5.3.2.4 The extent of the NDE requirement for butt-welding ends above those listed in ASME 16.34 to be 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 below:

- for all classes in sizes up to DN 600 (NPS 24): ASME B16.34;
- for classes 150 and 300 in sizes DN 650 to DN 750 (NPS 26 to NPS 30): ASME B16.34;
- for classes 150 and 300 in sizes DN 800 to 1050 (NPS 32 to NPS 42): refer to [Table 2](#).

5.3.3.2 Seating surfaces shall be integral or faced with weld metal. Finished thickness of any facing material shall be not less than 1.6 mm (0.06 in.).

5.3.3.3 Integral seats with overlays per [Table 8](#) are permitted. Integral body seats without overlays are permitted only in ASME B16.34 Group 2 and 3 material bodies.

5.3.3.4 Where separate seat rings are provided, they shall be shoulder or bottom seated, and either threaded or seal welded in place, except that for DN ≤ 50 (NPS ≤ 2), rolled or pressed-in seat rings may be used. Threaded seat rings shall be seal welded; tack welding or stitch welding is not permitted.

5.3.3.5 Body seat rings shall have adequate seating area surface and shall have edges equipped with a radius or chamfer as necessary, to prevent galling or any other damage to the disc when the valve is operated against pressure.

5.3.3.6 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.

Table 2—Minimum Inside Diameter for Sizes DN 800 to DN 1050 (NPS 32 to NPS 42) in classes 150 and 300

DN	NPS	Classes 150 and 300	
		mm	in.
800	32	779	30.67
850	34	830	32.68
900	36	874	34.41
950	38	925	36.42
1000	40	976	38.43
1050	42	1020	40.16

5.4 Bonnet

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 or spherical stem backseat in one of the following forms:

- a bushing positively secured against coming loose, i.e., not relying on friction;
- an integral surface in the case of an austenitic stainless steel or nickel alloy valve;
- an austenitic stainless steel, nickel alloy, or hardfaced weld overlay that is a minimum of 1.6 mm (0.06 in.) thick.

5.4.3 Bonnets shall be one-piece castings or forgings, unless extended bonnets are required for cryogenic or high-temperature applications. Cryogenic bonnets shall be in accordance with MSS SP-134.

5.4.4 The gland bolting shall be secured to the bonnet so that the bolting is retained during repacking. When eyebolts are used, the eyebolt pin shall be anchored on both sides of the eyebolt. The eyebolt anchors shall not include open slotted holes or be attached by fillet welds.

5.4.5 Tapped test openings shall be provided only if specified in the purchase order.

5.5 Bonnet-to-body Joint

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

5.5.2 For class 150 valves, the bonnet-to-body joint shall be one of the following types illustrated in ASME B16.5:

- flat face;
- raised face;
- tongue and groove;
- spigot and recess (i.e., male and female);
- ring joint.

5.5.3 For valves having pressure class designations higher than class 150, the bonnet-to-body joint shall be as in [5.5.2](#), except that the flat face joint is not permitted.