

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

API STANDARD 600

~~FOURTEENTH~~FIFTEENTH EDITION, ~~MAY-XX~~ 202X4

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1 Scope

1.1 This standard specifies the requirements for a heavy-duty series of bolted bonnet steel gate valves for petroleum refinery, [petrochemical](#) 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.

1.2 This standard establishes additional requirements for gate valves that are otherwise in full conformance to the requirements of ASME B16.34, Standard Class.

1.3 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.

Commented [RS1]: Per Ron M., Pressure seal bonnet MSS SP-144 Style B is an API 600 Pressure Seal Bonnet that we want to reference in 5.5.11, but not necessarily in the Scope.

1.4 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; [1100, 1150, 1200](#)

corresponding to nominal pipe sizes NPS:

- 1, 1 ¹/₄, 1 ¹/₂, 2, 2 ¹/₂, 3, 4, 6, 8, 10, 12, 14, 16, 18, 20, 24, 26, 28, 30, 32, 34, 36, 38, 40, [42](#); [44, 46, 48](#)

and applies to pressure class designations:

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

Commented [RS2]: Per Ron M. Historic survey around Face-To-Face led to the size limitation; IOGP requirements to setting FTF dimensions extends to 48"; Real issue is setting dimensions instead of leaving it to the Manufacturers and Owners/Users. Strongly consider larger sizes. Limited proposals beyond 48".

1.5 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 RP 591, Process Valve Qualification Procedure](#)

[API Specification 6D, Specification for Valves](#)

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

[API Recommended Practice 615, Valve Selection Guide](#)

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*

[ASME B18.31.2, Continuous Thread Stud, Double-End Stud, and Flange Bolting Stud \(Stud Bolt\) \(Inch Series\)](#)

[ASME B18.31.1M, Metric Continuous and Double-End Studs](#)

ISO 5210 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*

[ISO 21011, Cryogenic Vessels - Valves for Cryogenic Service](#)

[ISO 28921-1 Industrial Valves – Isolating Valves for Low-Temperature Applications Part 1: Design, Manufacturing and Production Testing](#)

Commented [RS3]: '2' Is this a typo?

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.

MSS SP-91 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*

[MSS SP-160 Valves for Hydrogen Fluoride Alkylation Service](#)

[ANSI/NACE MR 0103/ ISO 17945, Petroleum, petrochemical and natural gas industries—Metallic materials resistant to sulfide stress cracking in corrosive petroleum refining environments.](#)

[ANSI/NACE MR0175/ ISO 15156, Petroleum and natural gas industries —Materials for use in H2S-containing environments in oil and gas production.](#)

Commented [RS4]: '3' Is this a typo? Also MSS Address has changed.

3 Terms and Definitions

Commented [RS5]: Ensure that common definitions are equivalent throughout API Standards - such as alphanumeric for DN and NPS.

For the purposes of this document, the following definitions apply. [For additional terms and definitions, refer to API RP 615.](#)

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. 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 alphanumeric 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 NDE

[Nondestructive examination](#)
[The process of determining the product compliance by nondestructive means against established acceptance or rejection criteria.](#)

3.43 NPS

An alphanumeric 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

³ Manufacturers Standardization Society of the Valve and Fittings Industry, [127 Park Street, NE, Vienna441 North Lee Street, Alexandria, Virginia, 22180314](#), [www.msshq.org](#).

identifier without the prefix “NPS” The dimensionless size identification number does not represent a measurable value and is not used for calculation purposes.

3.545 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.

Commented [RS6]: Per Ron M. - Consider capitalizing Standard Class (official designation in ASME B16.34).

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).

4.33 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. ~~For t~~The use of a pressure rating corresponding to a temperature other than that of the contained fluid -it shall follow the 'Rating Temperature' of ASME B16.34 is the responsibility of the user.

Commented [RS7]: Consider Rating Temperature Section

~~4.4 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. The use of valves at lower temperatures is the responsibility of the user. Consideration should be given to the use of valves at lower temperatures with respect to the loss of ductility and impact strength of many materials at low temperature.~~

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

Commented [RS9]: Consider another location for this Note. Referenced in ASME B16.34 as well.

~~(e.g. This may done by drilling a hole with a diameter greater than or equal to 3 mm (0.12 in.) in the closure member outside the seat facing area to the high pressure side. This makes the valve unidirectional and appropriate marking shall be made on the valve.)~~

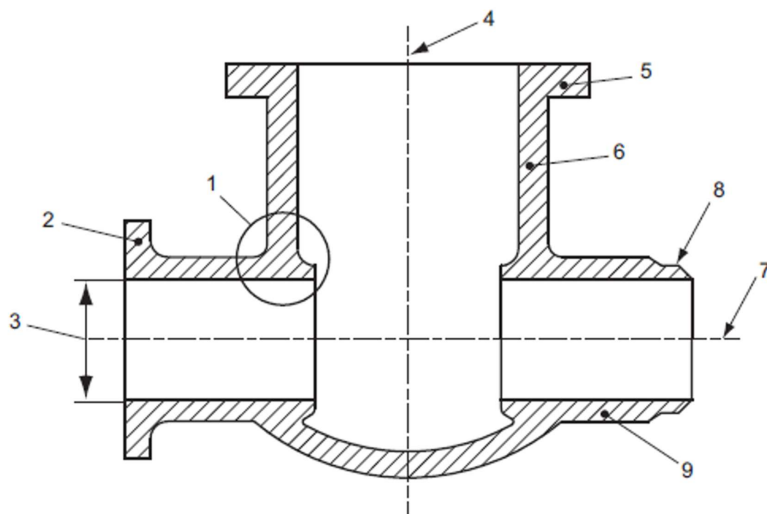
~~The use of valves at lower temperatures is the responsibility of the user. Consideration should be given to the loss of ductility and impact strength of many materials at low temperature.~~

Commented [RS10]: MP - Consider removing the word 'many'.

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 24, 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.

Commented [RS11]: Reference t_m to Table 1, so it is clear.

5.1.3 For minimum wall thicknesses not provided in Table 2, minimum wall thickness shall be calculated and validated as follows:

a. Design and calculations shall be in accordance with ASME B31.3:2024, 304.7.2 b, c and d requirements for unlisted components.

b. Wall thickness shall not be less than the thickness required for ASME B16.34 standard class including any corrosion allowance if specified by the Purchaser, and

c. Valve design shall be subjected to design validation testing in accordance with API 6D:2021, Annex F, or the purchaser's specified validation testing.

5.2 Bonnet Wall Thickness

Commented [RS12]: MP - Consider adding a Figure for the bonnet wall thickness. Per PH - could be tricky with varying wall thicknesses.

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 24. 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 in the purchase order by the purchaser.

5.3.1.2 Unless otherwise specified, in the purchase order, 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.

5.3.1.32 — Face-to-face dimensions shall be in accordance with ASME B16.10 or ISO 5752. For sizes not listed, dimensions shall be as per Table 1, agreed to between purchaser and manufacturer. For dimensions not listed in ASME B16.10, ISO 5752 or Table 1, face-to-face dimensions shall be established by an agreement between the purchaser and manufacturer.

5.3.1.4 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.

5.3.1.42.1 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. Unless otherwise specified, attachment welds shall conform to ASME B31.3 for Normal Fluid Service, including heat treatment, welding procedure specification qualifications, welder or welding operator qualifications, NDE, and its acceptance criteria. Heat treatment shall be performed in accordance with ASME B31.3 or Purchaser specification.

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

5.3.1.5 Parallelism of Flanges

Valve shall be designed to have the maximum parallelism misalignment :

For valves up to DN 600 (NPS 24), shall be 2.5 mm/m (0.03 in./ft).

For valves larger than DN 600 (NPS 24), the maximum parallelism misalignment shall be 1.75 mm/m (0.02 in./ft).

Commented [RS13]: Consider IOGP S-611 Table for face-to-face dimensions.

Table 1 – Additional Face-to-Face Dimensions

<u>Valve Size</u> <u>DN (NPS)</u>	<u>Class 150</u> <u>mm (in.)</u>	<u>Class 300</u> <u>mm (in.)</u>	<u>Class 600</u> <u>mm (in.)</u>
<u>1000 (40)</u>	<u>As per ASME B16.10/</u> <u>ISO 5752</u>	<u>1930 (76)</u>	<u>2286 (90)</u>
<u>1050 (42)</u>	<u>787 (31)</u>	<u>1981 (78)</u>	<u>2438 (96)</u>
<u>1200 (48)</u>	<u>864 (34)</u>	<u>2235 (88)</u>	<u>2540 (100)</u>

Commented [RS14]: Survey manufacturers

Table 24—Minimum Wall Thickness for Body and Bonnet (Footnote a & b)

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
1100	---	---	---	---	---	---	44
1150	---	---	---	---	---	---	46
1200	---	---	---	---	---	---	48
^a Wall thicknesses match class 1500 to correspond to B16.5 flange dimensions for class 900.							
^b For unspecified size and pressure class wall thickness listed above, see Section 5.1.3							

~~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. For sizes not listed in ASME B16.10, end to end dimensions shall be by an agreement between the purchaser and manufacturer.

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 B16.34 to be specified by the purchaser shall meet the Special Class requirements per Section 8 of ASME B16.34 or 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 2.3

--- for classes 150 and 300 in sizes DN 1100 to 1200 (NPS 44 to NPS 48); the manufacturer's standard shall be used unless otherwise specified by the purchaser.

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 9.8 are permitted. Integral body seats without overlays are permitted only in ASME B16.34 Group 2 and 3 body materials ~~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 32—Minimum Inside Diameter for Sizes DN 800 to DN 1050 (NPS 32 to NPS 42) in classes 150 and 300

Commented [RS15]: Need this to go to 48"

Commented [RS16]: Would have to modify the Table if we have to go to larger sizes. Currently slightly reduced ports, most likely a survey of manufacturers.

Commented [RS17]: Non-mandatory Appendix A in ASME B16.34 that provides the relationship between wall thickness and inside diameter might provide these dimensions making the Table not necessary.

Commented [RS17R2]: ASME B16.34 is slightly bigger than the dimensions in Table 2.

DN (NPS)	Classes 150 and 300
	Inside Diameter 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.

5.5.4 The bonnet flange gasket shall be one of the following:

- solid metal or grooved (profiled) metal gasket, ~~either option~~ with graphite facings;
- metal ring joint;
- spiral wound metal gasket with filler and a centering/compression ring;

- spiral wound metal gasket with filler but without a centering/compression ring, to be used only in “tongue and groove” or “spigot and recess” joints that prevent the gasket from unwinding and from buckling damage.

For class 150, the following are also acceptable:

- corrugated metal insert with graphite facings;
- when approved by the purchaser, flexible graphite sheet, reinforced with a stainless steel flat, perforated, tanged, or corrugated insert equipped with annular containment rings;
- when approved by the purchaser, other suitable facings may be used.

5.5.5 Except for class 150, the gasket shall not extend beyond the inner edge of the bolt holes.

5.5.6 Except for class 150 valves and valves in sizes DN 65 (NPS 2½) and smaller, bonnet-to-body flanges shall be circular.

Commented [RS18]: Consider or instead of and here. Because we do allow Class 150 valves to have a non0circular body to bonnet flange configuration above 2-½"

5.5.7 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.

5.5.8 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:

- M10 or ⅜ when 25 ≤ DN ≤ 65 (1 ≤ NPS ≤ 2½);
- M12 or ½ when 80 ≤ DN ≤ 200 (3 ≤ NPS ≤ 8);
- M16 or ⅝ when DN ≥ 250 (NPS ≥ 10).

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

5.5.10 At assembly, gasket contact surfaces shall be free of sealing compounds.

5.5.11 If pressure seal bonnet design is specified, 5.5.1 through 5.5.10 are not applicable. In addition, the bonnet joint construction shall be in accordance with MSS SP-144 Style B unless otherwise specified by the purchaser.

5.6 Gate

5.6.1 Gate configurations are categorized as illustrated in Figure 2.

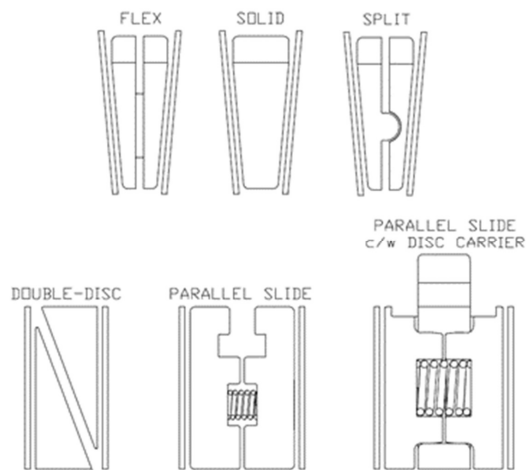


Figure 2—Types of Valve Gates

5.6.1.1 A one-piece wedge gate—as either a solid or flexible wedge design—shall be furnished, unless otherwise specified by the purchaser.

5.6.1.2 A two-piece split wedge gate or parallel seat double-disc gate may be furnished when specified by the purchaser. A split wedge gate consists of two independent seating parts that conform to the body seats when closed. The split wedge shall be designed so that the pieces cannot become separated, regardless of the gate position or valve orientation. A double-disc gate has a spreading mechanism (i.e., a wedging device or spring) that forces the two parallel discs to the body seats when closed.

5.6.2 Except for a double-disc gate, in the open position, the gate shall completely clear the valve seat openings.

5.6.3 The body and gate shall have guide surfaces to minimize wear of the gate seats during operation of the valve, to accurately position the gate throughout the travel distance to its seat, and to ensure the alignment of the gate and stem in all orientations without gate binding, including any valve orientation placing the stem in the horizontal position. Methods to improve disc guiding include but are not limited to the following, where applicable:

- surface hardened guide surfaces;
- **inherently hard material (guide and wedge)**
- hardness differential between body and disc guides;
- clearances between body and disc guides;
- total guide length;
- radii and chamfers of components.

NOTE The above methods are not intended as inspection requirements.

For sizes **DN 650 (NPS 26)**, **DN 300 (NPS 12)** and above, at a minimum, wedge guides and body guides shall be surface hardened, unless otherwise agreed by the purchaser, and provided with appropriate surface finish and clearances to allow for proper valve operation in any orientation. **The manufacturer may provide in their installation and operation manual any operational limitations as a result of stem and valve orientation.**

5.6.4 Wedge guides and/or body guides shall not protrude beyond the seat rings into the port area of the valve. **The manufacturer shall provide in their installation and operation manual any operational limitations as a result of stem and valve orientation.**

5.6.5 Gate 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.).

Commented [RS19]: This can be reworded to eliminate the need for the Note regarding inspection.

Commented [RS20]: Consider smaller size for hard-facing to improve reliability in any orientation, material, pressure classes, etc.

Commented [RS21]: Consider moving this second sentence to 5.6.3. (JA); Or separate these two sentences.

Commented [RS22]: Consider moving this second sentence to 5.6.3. (JA); Or separate these two sentences.

5.6.6 Wedge gates shall be designed to account for seat wear. The dimensions that fix the position of the gate seats relative to the body seats shall be such that the gate, starting from the time of manufacture, can, as a result of seat wear, move into the seats leaving by a height distance, h , defined as wear travel. Wear travel is in a direction that is parallel with the seating surface. The required minimum wear travel varies with valve size in accordance with Table 4.3. The technique of inspecting wear travel is provided in below Annex E (see Figure 3). Wear Travel Measurement Technique

- 1) Perform inspection on the assembled valve prior to Pressure tests initial hydrotest.
- 2) Valve to be inspected in the stem vertical position and free of internal pressure.
- 3) Valve to be closed until 360 degrees of contact is made between the disc and seat.
- 4) Measure dimension h on Figure 3 (disc seat/body seat interface at the 6 o'clock position).

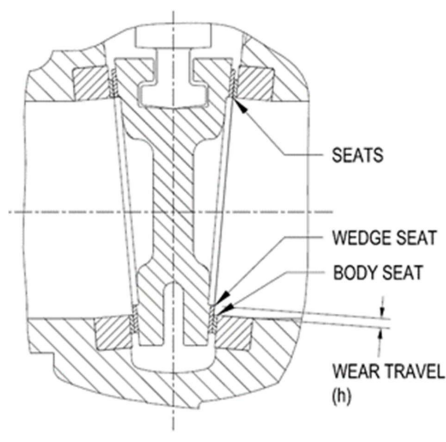


Figure 3—Wear Travel Detail

Table 4—Minimum Wear Travel and Maximum Stem Projection

<u>Valve Size Range, DN (NPS)</u>	<u>Minimum Wear Travel, h mm (in.)</u>	<u>Maximum Stem Projection mm (in.)</u>
<u>$DN \leq 50$ (NPS ≤ 2)</u>	<u>2.3 (0.09)</u>	<u>11.5 (0.45)</u>
<u>$65 \leq DN \leq 150$ ($2\frac{1}{2} \leq NPS \leq 6$)</u>	<u>3.3 (0.13)</u>	<u>16.5 (0.65)</u>
<u>$200 \leq DN \leq 300$ ($8 \leq NPS \leq 12$)</u>	<u>6.4 (0.25)</u>	<u>19.2 (0.75)</u>
<u>$350 \leq DN \leq 450$ ($14 \leq NPS \leq 18$)</u>	<u>9.7 (0.38)</u>	<u>29.1 (1.14)</u>
<u>$500 \leq DN \leq 600$ ($20 \leq NPS \leq 24$)</u>	<u>12.7 (0.50)</u>	<u>38.1 (1.50)</u>
<u>$650 \leq DN \leq 700$ ($26 \leq NPS \leq 28$)</u>	<u>16.0 (0.62)</u>	<u>48.0 (1.86)</u>
<u>$750 \leq DN \leq 900$ ($30 \leq NPS \leq 36$)</u>	<u>19.1 (0.75)</u>	<u>57.3 (2.25)</u>
<u>$950 \leq DN \leq 1200$ ($38 \leq NPS \leq 48$)</u>	<u>25.4 (1.00)</u>	<u>76.2 (3.00)</u>

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 stem nut, which links the handwheel to the stem.
- 5.7.2 The yoke and stem nut assembly design shall permit stem nut removal while the valve is under pressure and backseated.
- 5.7.3 Yokes that are separate shall have yoke-to-bonnet mating surfaces machined so as to assure a proper bearing assembly interface.

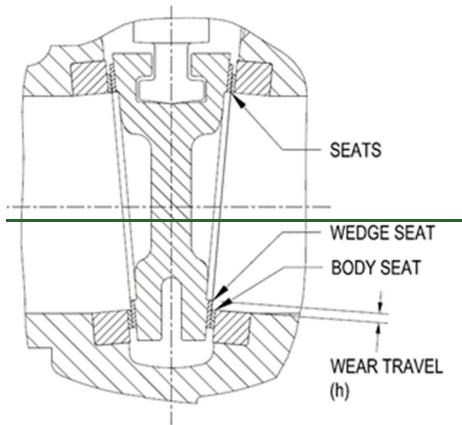


Figure 3—Wear Travel Detail

Table 3—Minimum Wear Travel and Maximum Stem Projection

Valve Size Range, DN (NPS)	Minimum Wear Travel, h mm (in.)	Maximum Stem Projection mm (in.)
DN ≤ 50 (NPS ≤ 2)	2.3 (0.09)	11.5 (0.45)
65 ≤ DN ≤ 150 (2 1/2 ≤ NPS ≤ 6)	3.3 (0.13)	16.5 (0.65)
200 ≤ DN ≤ 300 (8 ≤ NPS ≤ 12)	6.4 (0.25)	19.2 (0.75)
350 ≤ DN ≤ 450 (14 ≤ NPS ≤ 18)	9.7 (0.38)	29.1 (1.14)
500 ≤ DN ≤ 600 (20 ≤ NPS ≤ 24)	12.7 (0.50)	38.1 (1.50)
650 ≤ DN ≤ 700 (26 ≤ NPS ≤ 28)	16.0 (0.62)	48.0 (1.86)
750 ≤ DN ≤ 900 (30 ≤ NPS ≤ 36)	19.1 (0.75)	57.3 (2.25)
950 ≤ DN ≤ 1050 (38 ≤ NPS ≤ 42)	25.4 (1.00)	76.2 (3.00)

- 5.7.4 The yoke-to-stem nut bearing surfaces shall be machined flat and parallel to yoke-bonnet mating surface. A lubricating fitting shall be provided for the bearing surfaces.

5.8 Stem and Stem Nut

5.8.1

a. The minimum stem diameter, d_s , shall be as given in Table 54.

b. To allow the use of standard diameter round bars, an undertolerance is permitted in accordance with Table 54a. For stem diameters not listed in Table 5a, minimum undertolerance shall be based upon standard round bar.

c. 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. At the manufacturer's option, the minimum major thread diameter of the stem may be reduced from the values shown in Table 54 by no more than 1.6 mm (0.063 in.). There are no limitations in the diameter difference between the stem diameter and major thread diameter.

d. The stem surface area in contact with the packing shall have a surface finish, R_a , of 0.80 μm (32 $\mu\text{in.}$) or smoother.

e. The actual stem diameter shall take into account the valve design details and the stem material strength characteristics. Note that the stem strength including buckling failure shall be considered when calculating the maximum input force from the handwheel and gear box (if equipped). in accordance with MSS SP-91 or in accordance with maximum rim pull when specified by the purchaser. The MAST (maximum allowable stem torque) shall be available to the purchaser from the valve manufacturer. Consider input factors provided in MSS SP-91 when determining the maximum input force.

Commented [RS23]: Allowance to select a thread diameter based upon the minimum stem diameter. Consider rewording, seems confusing.

Commented [RS24]: Minimum stem diameter based upon F6 material

Table 54—Minimum Stem Diameter — Footnote a

Class Designation	150	300	600	900	1500	2500	Class Designation
Nominal Size DN	Minimum Stem Diameter d_s mm (in.)						Nominal Pipe Size NPS
25	15.89 ($\frac{5}{8}$)	15.89 ($\frac{5}{8}$)	15.89 ($\frac{5}{8}$)	19.05 ($\frac{3}{4}$)	19.05 ($\frac{3}{4}$)	19.05 ($\frac{3}{4}$)	1
32	15.89 ($\frac{5}{8}$)	15.89 ($\frac{5}{8}$)	15.89 ($\frac{5}{8}$)	19.05 ($\frac{3}{4}$)	19.05 ($\frac{3}{4}$)	19.05 ($\frac{3}{4}$)	1 $\frac{1}{4}$
40	17.46 ($\frac{11}{16}$)	19.05 ($\frac{3}{4}$)	19.05 ($\frac{3}{4}$)	22.23 ($\frac{7}{8}$)	22.23 ($\frac{7}{8}$)	22.23 ($\frac{7}{8}$)	1 $\frac{1}{2}$
50	19.05 ($\frac{3}{4}$)	19.05 ($\frac{3}{4}$)	19.05 ($\frac{3}{4}$)	25.40 (1)	25.40 (1)	25.40 (1)	2
65	19.05 ($\frac{3}{4}$)	19.05 ($\frac{3}{4}$)	22.23 ($\frac{7}{8}$)	28.58 (1 $\frac{1}{8}$)	28.58 (1 $\frac{1}{8}$)	31.75 (1 $\frac{1}{4}$)	2 $\frac{1}{2}$
80	22.23 ($\frac{7}{8}$)	22.23 ($\frac{7}{8}$)	25.40 (1)	28.58 (1 $\frac{1}{8}$)	31.75 (1 $\frac{1}{4}$)	31.75 (1 $\frac{1}{4}$)	3
100	25.40 (1)	25.40 (1)	28.58 (1 $\frac{1}{8}$)	31.75 (1 $\frac{1}{4}$)	34.93 (1 $\frac{3}{8}$)	34.93 (1 $\frac{3}{8}$)	4
150	28.58 (1 $\frac{1}{8}$)	31.75 (1 $\frac{1}{4}$)	38.10 (1 $\frac{1}{2}$)	41.28 (1 $\frac{5}{8}$)	44.45 (1 $\frac{3}{4}$)	47.63 (1 $\frac{7}{8}$)	6
200	31.75 (1 $\frac{1}{4}$)	34.93 (1 $\frac{3}{8}$)	41.28 (1 $\frac{5}{8}$)	47.63 (1 $\frac{7}{8}$)	53.98 (2 $\frac{1}{8}$)	60.33 (2 $\frac{3}{8}$)	8
250	34.93 (1 $\frac{3}{8}$)	38.10 (1 $\frac{1}{2}$)	47.63 (1 $\frac{7}{8}$)	53.98 (2 $\frac{1}{8}$)	63.50 (2 $\frac{1}{2}$)	73.03 (2 $\frac{7}{8}$)	10
300	38.10 (1 $\frac{1}{2}$)	41.28 (1 $\frac{5}{8}$)	50.80 (2)	57.15 (2 $\frac{1}{4}$)	69.85 (2 $\frac{3}{4}$)	82.55 (3 $\frac{1}{4}$)	12
350	41.28 (1 $\frac{5}{8}$)	44.45 (1 $\frac{3}{4}$)	57.15 (2 $\frac{1}{4}$)	60.33 (2 $\frac{3}{8}$)	76.20 (3)	—	14
400	44.45 (1 $\frac{3}{4}$)	47.63 (1 $\frac{7}{8}$)	60.33 (2 $\frac{3}{8}$)	63.50 (2 $\frac{1}{2}$)	76.20 (3)	—	16
450	47.63 (1 $\frac{7}{8}$)	50.80 (2)	63.50 (2 $\frac{1}{2}$)	69.85 (2 $\frac{3}{4}$)	—	—	18
500	50.80 (2)	53.98 (2 $\frac{1}{8}$)	69.85 (2 $\frac{3}{4}$)	76.20 (3)	—	—	20
600	57.15 (2 $\frac{1}{4}$)	63.50 (2 $\frac{1}{2}$)	76.20 (3)	—	—	—	24
650	60.33 (2 $\frac{3}{8}$)	69.85 (2 $\frac{3}{4}$)	—	—	—	—	26
700	63.50 (2 $\frac{1}{2}$)	76.20 (3)	—	—	—	—	28

750	63.50 (2 ^{1/2})	82.60 (3 ^{1/4})	—	—	—	—	30
800	66.68 (2 ^{5/8})	85.73 (3 ^{3/8})	—	—	—	—	32
850	69.85 (2 ^{3/4})	85.73 (3 ^{3/8})	—	—	—	—	34
900	69.85 (2 ^{3/4})	88.90 (3 ^{1/2})	—	—	—	—	36
950	76.20 (3)	95.25 (3 ^{3/4})	—	—	—	—	38
1000	79.38 (3 ^{1/8})	98.43 (3 ^{7/8})	—	—	—	—	40
1050	82.60 (3 ^{1/4})	101.6 (4)	—	—	—	—	42
							44
							46
							48

Note a – For sizes not listed consult 5.8.1

Table 54a—Permitted Undertolerance

Minimum (mm)		Minimum (in.)	
Diameter	Undertolerance	Diameter	Undertolerance
≤ 15.0	0.31	≤ 5/8	0.012
> 15.0 to 22.2	0.33	> 5/8 to 7/8	0.013
> 22.2 to 25.4	0.36	> 7/8 to 1	0.014
> 25.4 to 28.6	0.38	> 1 to 1 ^{1/8}	0.015
> 28.6 to 31.8	0.41	> 1 ^{1/8} to 1 ^{1/4}	0.016
> 31.8 to 34.9	0.43	> 1 ^{1/4} to 1 ^{3/8}	0.017
> 34.9 to 38.1	0.48	> 1 ^{3/8} to 1 ^{1/2}	0.019
> 38.1 to 41.3	0.53	> 1 ^{1/2} to 1 ^{5/8}	0.021
> 41.3 to 50.8	0.66	> 1 ^{5/8} to 2	0.026
> 50.8 to 82.6	0.76	> 2 to 3 ^{1/4}	0.030
> 82.6 to 101.6	0.81	> 3 ^{1/4} to 4	0.032

5.8.2 Stems shall have a gate attachment means at one end and an external trapezoidal-style thread form at the other. Stem nuts shall be used for the handwheel attachment and to drive the operating stem thread.

5.8.3 The 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 left-handed so that a direct operated handwheel rotated in a clockwise direction closes the valve. For manually operated valves, the minimum thread engagement length between the stem and the stem nut shall be 1½ times the stem diameter.

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 The stem end that connects to a gate shall be in the form of a "T", except that for a double-disc gate, the end connection may be threaded.

5.8.6 The stem connection shall be designed to prevent the stem from turning or from becoming disengaged from the gate while the valve is in service.

5.8.7 The stem design shall be such that the strength of the stem-to-gate connection and the part of the stem within the valve pressure boundary shall, under axial load, exceed the strength of the stem at the root of the operating thread.

5.8.8 The stem shall include a conical or spherical raised surface that seats against the bonnet backseat when the gate is at its full open position. 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.

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

5.8.10 The stem-nut-to-handwheel attachment shall be through a hexagonal interface, a round interface having a keyway, or another means of equivalent strength.

5.8.11 When the stem nut is retained in the yoke by means of a threaded bushing, 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.

5.8.12 The closed-position stem thread projection beyond the stem nut, on a new manual handwheel-operated valve, shall be based on the minimum wear travel values listed in Table 43. The minimum distance shall be equal to the manufacturer's specified wear travel and the maximum as indicated in Table 43.

5.8.13 Valves DN $\geq$ 150 (NPS $\geq$ 6) with pressure class $\geq$ 600 shall be furnished with stem nuts having ball or roller bearings.

5.9 Packing and Packing Box

5.9.1 The packing may be square, rectangular, ~~or or~~ trapezoidal in cross-section. The nominal radial width of the packing, w , shall be in accordance with Table 65 and Table 6 for respective units (metric/U.S. Customary).

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, R_a , of $\leq 4.5 \mu\text{m}$ (175 $\mu\text{in.}$), or smoother.~~

5.9.3 ~~To ensure there is future packing adjustment available after the packing is installed and compressed to the specified gland load, the remaining adjustment length of the packing gland at the time of shipment, with the gland tight, shall be greater than $1\frac{1}{2}$ times the packing width specified in Table 65 and Table 6 for respective units (metric/U.S. Customary).~~

5.9.34 The maximum 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 $d_h + 2w + y$. See Table 65 and Table 6 for the required values.

5.9.45 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. Packing gland assembly (including gland flange, follower, bolting, and anchoring pins) shall have adequate strength to transmit load without permanent deformation under required packing load.

5.9.65 A lantern ring shall be provided only if so specified by the purchaser. 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.

Commented [RS26]: Non-graphitic packing allowed; Standard allows for non-API 622/624 packing and still manufactured under the API 600 Standard. Consider removing any reference to shapes in this section.

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Commented [RS29]: Allowance for packing adjustment

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

5.9.87 See 5.13 for additional packing requirements.

Table 65—Nominal Radial Width of Packing (Metric) (U.S. Customary)

Nominal Stem Diameter d_H mm (in)	Nominal Radial Width of the Packing w mm (in)	Maximum Packing Box Clearance Factor y mm (in)
$15 < d_H \leq 27$ (5/8 < $d_H \leq 1$)	6.4 (1/4)	0.4 (1/64)
$27 < d_H \leq 37$ (1 < $d_H \leq 1\text{-}3/8$)	7.9 (5/16)	0.4 (1/64)
$37 < d_H \leq 49$ (1-3/8 < $d_H \leq 1\text{-}7/8$)	9.5 (3/8)	0.4 (1/64)
$49 < d_H \leq 56$ (1-7/8 < $d_H \leq 2\text{-}1/8$)	11.1 (7/16)	0.8 (1/32)
$56 < d_H \leq 74$ (2-1/8 < $d_H \leq 2\text{-}7/8$)	12.7 (1/2)	0.8 (1/32)
$74 < d_H \leq 102$ (2-7/8 < $d_H \leq 4$)	14.3 (9/16)	0.8 (1/32)

Table 6—Nominal Radial Width of Packing (U.S. Customary)

Nominal Stem Diameter d_H in.	Nominal Radial Width of the Packing w in.	Maximum Packing Box Clearance Factor y in.
$5/8 < d_H \leq 1$	$1/4$	$1/64$
$1 < d_H \leq 1\text{-}3/8$	$5/16$	$1/64$
$1\text{-}3/8 < d_H \leq 1\text{-}7/8$	$3/8$	$1/64$
$1\text{-}7/8 < d_H \leq 2\text{-}1/8$	$7/16$	$1/32$
$2\text{-}1/8 < d_H \leq 2\text{-}7/8$	$1/2$	$1/32$
$2\text{-}7/8 < d_H \leq 4$	$9/16$	$1/32$

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 meeting the requirements of ASME B18.31.2 or ASME B18.31.1M with heavy, semi-finished hexagon nuts that are in accordance with ASME B18.2.2 or ASME B18.2.6M.

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

5.10.3 Gland bolts shall be hinged eyebolts, headed bolts, stud bolts, or studs. Hexagon nuts shall be used.

5.10.4 Bolting with diameters 25 mm (1 in.) and smaller shall have coarse (UNC) threads or the most nearly corresponding metric threads. Bolting with diameters larger than 25 mm (1 in.) 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 shall be tolerance class 6H in accordance with ASME B1.13M.

5.10.5 Full stud thread shall extend beyond the nut face to ensure full thread engagement. The chamfer at the end of the stud is not considered part of the thread. Studs shall project beyond the outer nut face by a minimum of one thread

Commented [RS30]: Consider removing it.

Commented [RS31]: Extend 1-3 threads above nut face

and a maximum of three full threads, excluding chamfer, to ensure full thread engagement while minimizing corrosion risk and interference.

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 counterclockwise direction.

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. Fabricated handwheel spokes shall not extend beyond the rim of the handwheel.

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 nut by a threaded handwheel nut. The handwheel connection to stem nut shall be designed to prevent loosening due to normal service or vibration.

5.11.5 The handwheel and gearbox, if supplied, of the valves shall be designed to operate (fully open and fully close the valve) against a maximum rated differential pressure equal to the full pressure rating at 38 °C (100 °F). Unless otherwise specified, when a manual gear operator is provided, the output torque/thrust rating shall be at least 1.5 times the maximum required operating torque/thrust of the valve.

5.11.56 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 or gear input shaft to the bottom of the chain loop;
NOTE Chainwheels may present a risk of injury or damage if not properly designed, installed, secured, operated, and maintained.
- addition of safety cables for chainwheel operators
- 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.

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

5.11.8 The handwheel diameter shall not exceed the face-to-face length of the valve for classes 300 and above, unless agreed upon by the purchaser and manufacturer.

5.11.9 Handwheel dimensions for class 150 valves shall not exceed twice the face-to-face dimensions or 800 mm (32 in), whichever is smaller, unless agreed upon by the purchaser and manufacturer.

5.12 Bypasses and Other Auxiliary Connections

Auxiliary connections to the body and/or bonnet, such as bypasses or 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. When required for valve DN 50 (NPS 2) or larger, auxiliary connections shall be sized

Commented [RS32]: Per RM, potential ISO reference to EN requirements on brackets.

~~and located as specified in ASME B16.34.~~ The size and location of auxiliary connections shall be indicated on the purchase order.

Commented [RS33]: Is NDE and Documentation of this welding covered elsewhere?

5.13 Fugitive Emission Design Requirement

5.13.1 The valve shall be type tested to the requirements of API 624.

5.13.2 Packing that meets the qualification requirements of API 624 shall be used unless otherwise specified by the purchaser. Refer to 8.2.2 and 8.2.3 for marking requirements.

Commented [RS34]: Look for common notes regarding this in other Standards. We can work on wordsmithing something for clarify.

5.14 Lifting

~~Lifting provisions shall be provided for valves over 250 kg (550 lbs.) weight including accessories. The type of provision shall be identified by the manufacturer.~~

6 Materials

6.1 Materials Other Than Trim Materials

Materials requirements and limitations for body, bonnet, and valve parts other than trim are listed in Table 87. ~~Material of valves parts shall be provided on the valve bill of material.~~ See Annex C for identification of valve terms.

Table 77—Materials for Parts

Commented [RS35]: Review specific parts relative to 6.2.1.e “Small internal parts...”

Part	Material
Body and bonnet	As selected from ASME B16.34, material Group 1, Group 2, and Group 3.
Gate	Steel or other corrosive-resistant alloy, at least equal in corrosion resistance to that of the body material.
Yoke, separate from bonnet	Carbon steel (for ASME B16.34 Material Group 2 and 3, agreed to by the purchaser) or same ASME B16.34 material group as the bonnet.
Bolting: body to bonnet	Unless other materials are agreed between the purchaser and manufacturer, the bolting material listed in Annex D is recommended. Bolting shall be selected to satisfy valve pressure and temperature range. However, for service temperatures below –29 °C (–20 °F) or above 454 °C (850 °F), the purchase order shall specify the bolting material. Bolting shall not be cadmium plated or galvanized
Bonnet gasket	For temperature range from –29 °C to 427 °C (–20 °F to 800 °F). 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. The purchaser may specify alternate material.
Bolting: gland and yoke	Bolting material at least equal in minimum tensile strength to of ASTM A307, —Grade B. Unless otherwise specified, gland bolts and nuts shall be at least equal in corrosion resistance to that of the body material. Bolting shall not be cadmium plated or galvanized
Seat ring	As in Table 88, except that where seal welds, strength welds, or weld deposit facings are used, the base weld material shall have a corrosion resistance at least equal to that of the body material.
Gland and gland flange	Material with melting point above 955 °C (1750 °F).

Packing	Graphitic material suitable for steam and petroleum fluids for temperature range from –29 °C to 427 °C (–20 °F to 800 °F). Shall contain a corrosion inhibitor. <u>The purchaser may specify alternate material. Active sacrificial corrosion inhibitor (e.g. zinc) shall not be used.</u> NOTE Effective low emissions performance may be limited to lower temperatures.
Lantern ring or spacer ring	Material having corrosion resistance at least equal to that of the <u>stem body material</u> .
Stem nut	Austenitic ductile iron or copper alloy with melting point above 955 °C (1750 °F).
Handwheel	Malleable iron, carbon steel, ductile iron, or corrosive-resistant alloy.
Handwheel nut (retaining)	Steel, malleable iron, ductile iron, non-ferrous copper alloy, or corrosive-resistant alloy.
Pipe plugs	<u>The material used for plugs for tapped connections shall have the same nominal chemical composition as the body material (see 5.12).</u> <u>Nominal composition shall be the same as the shell body material. Cast iron plugs shall not be used. The material used for plugs for tapped connections shall have the same nominal chemical composition as the shell body material (see 5.12).</u> <u>The purchaser may request a plug with higher corrosion resistance.</u>
Bypass piping and valves	Nominal composition shall be the same as the shell body material. <u>Any bolting on the bypass valve shall not be cadmium plated or galvanized</u>
Pin, double disk stem to gate	Meet or exceed the corrosion resistance of trim material.
Identification plate	Austenitic stainless steel or nickel alloy attached to the valve by corrosion-resistant fasteners or by welding.

Commented [RS36]: Is it clear that the base packing should meet API 622; There can always be an alternate material selected.

Commented [RS37]: Should the minimum be equal to the trim material to minimize the potential for corrosion in this critical area?

6.2 Trim

6.2.1 The trim comprises the following:

- stem;
- body seating surface;
- gate seating surface;
- backseat bushing, or a deposited weld when specified for the backseat;
- small internal parts that normally contact the service fluid.

6.2.2 The trim material, except as stated in items a) through g) below, shall be the manufacturer's standard material for the type listed in Table 98 for the trim number specified in the purchase order. The typical specifications included in Table 98 represent some acceptable grades.

- Table 8 provides common trim combinations; alternate trim combinations may be used by an agreement between the purchaser and manufacturer.
- If a trim number listed in Table 88 is specified, an alternative trim number as shown in Table 99 may be furnished.
- If a single seating surface material is furnished (e.g., trim 5), both the seating surface of the body seat ring and the seating surface of the gate shall be made of the type of material shown in Table 88.
- If a combination seating surface material is furnished (e.g., trim 8), the seating surface of the body seat ring shall be made of one of the two types of material shown in Table 88, and the seating surface of the gate shall be made of the other type of material shown:

- ed) The stem, backseat bushing, and small internal parts [see 6.2.1, item e)] shall be of the type of material and hardness listed in Table 88. The stem shall be a wrought material.
- fe) When weld deposited backseat is used, the weld material shall be nominally the same as indicated in the "Stem/Backseat Bushing" material column or "Welded" column in Table 88. See backseat contact area in Figure 4 for typical location of weld deposited backseat.
- gf) The backseat seating surface does not require hardfacing unless specified by the purchaser. When specified, see the "Seating Surface Typical Specification Grade" Welded column in Table 88. For typical hardfacing location, see backseat contact area in Figure 4.
- hg) The base material of the valve wedge/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. Alternatively, the wedge or disc material may be made of solid trim material.

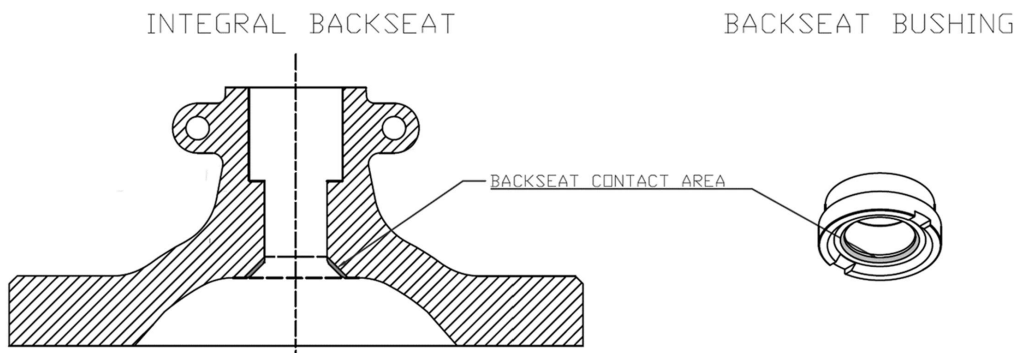


Figure 4—Backseat Contact Area for Integral Backseats and Backseat Bushings

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. Note, wear travel shall be established per Section 5.6.6.

7.1.2 Inspection and examination shall be performed on each valve in accordance with API 598.

7.1.3 If additional inspection and/or examination is required by the purchase order, it shall be in accordance with the Purchaser's specified requirements.

Commented [RS38]: Eliminated casting quality section and sent it to API 598 TF for consideration.

7.2 Pressure Tests

7.2.1 Each valve shall be pressure tested as specified in API 598.

7.2.2 For valves equipped with gear operators, all API 598 seat leak tests shall be performed with the gear operator installed. For operators (actuators, gears, etc.) equipped with position indicators, the indication of position (open and closed) shall be utilized during the appropriate closure test.

7.2.3 When specified in purchase order, additional testing shall be performed.

7.3 Repairs of Defects

~~Defects in the shell of a cast or forged, carbon or alloy steel valve that are revealed by inspection or testing shall be repaired as permitted by the most nearly applicable ASTM cast or forged material specification listed in ASME B16.34.~~ 7.3.1 When examination, inspection, or testing reveals a defect in the body of a cast, carbon or alloy steel, valve, the defect shall be repaired as permitted by the ASTM specification to which the valve was manufactured.

7.3.2 Repair of defects by welding in the shell of a forged valve is prohibited.

Commented [RS39]: Consider adding additional requirement in API 602

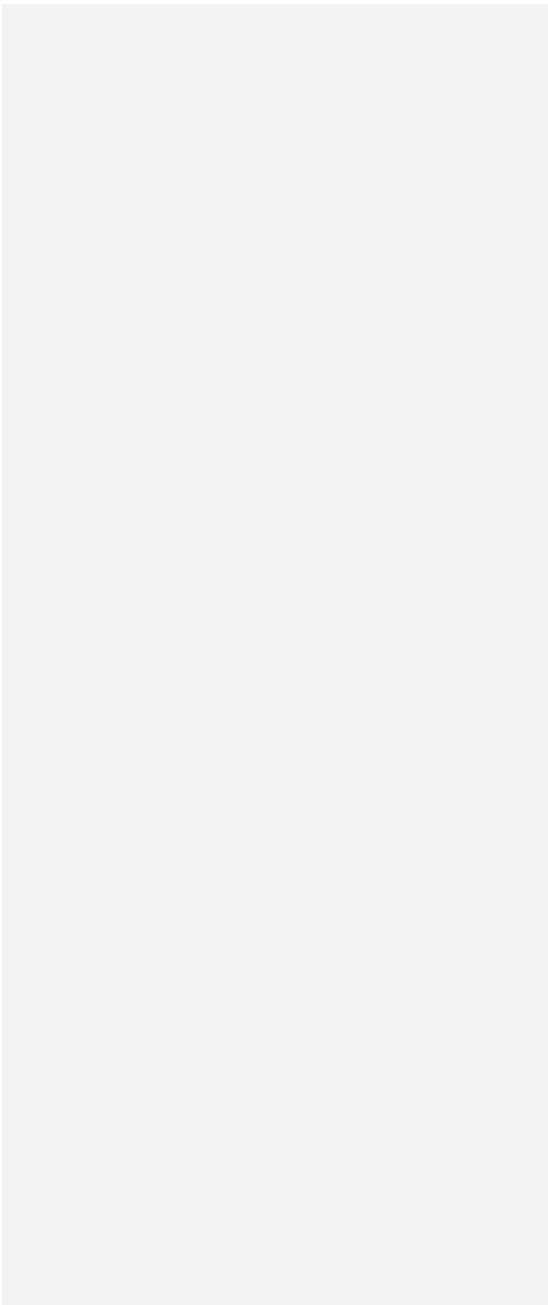


Table 88—Nominal Seating Surface, Stem and Backseat Bushing or Weld-deposit Materials and Hardness<Tbl_Sideturn></Tbl_Sideturn>

Trim Number	Seating Nominal Trim	Seating Surface Hardness (HB _W) Minimum ^a	Seating Surface Material Type ^b	Seating Surface Typical Specifications Grade			Stem/Backseat Bushing ^p		Stem Hardness (HB _W)	Backseat Bushings Hardness (HB _W)
				Cast (Integral)	Forged (Integral)	Welded ^m	Material Type _b	Typical Specifications Type		
1	F6	TRIM NUMBER 1 IS OBSOLETE ^h								
2	304	Note ^d	18Cr-8Ni	ASTM A351 (CF8) <u>UNS J92600</u>	ASTM A182 (F 304) <u>UNS S30400</u>	AWS A5.9 ER308	18Cr-8Ni	ASTM A276-T304 <u>UNS S30400</u>	Note ^d	Note ^d
2A	304 and Hardfaced	Note ^d	18Cr-8Ni	ASTM A351 CF8 <u>UNS J92600</u>	ASTM A182 F 304 <u>UNS S30400</u>	AWS A5.9 ER308	18Cr-8Ni	ASTM A276 304 <u>UNS S30400</u>	Note ^d	Note ^d
		350 ⁱ	Co-Cr Alloy ^g	N/A	N/A	AWS A5.13 ECoCr-A or AWS A5.21 ERCoCr-A				
2B		Note ^d	18Cr-8Ni	ASTM A351 CF8 <u>UNS J92600</u>	ASTM A182 F 304 <u>UNS S30400</u>	AWS A5.9 ER308				
		350 ⁱ	Ni-Cr Alloy	N/A	N/A	MFG Standard				
3	F310	Note ^d	25Cr-20Ni	NA	ASTM A182 (F 310) <u>UNS S31000</u>	AWS A5.9 ER310	25Cr-20Ni	ASTM A276 -T310 <u>UNS S31000</u>	Note ^d	Note ^d
4	Hard F6	750 ^e	Hard 13Cr ^b	NA	Note ^f	NA	13Cr ^b	ASTM A276-T410 <u>UNS S41000</u> or ASTM A276-T420 <u>UNS S42000</u>	200 min 275 max	250 min.
5	F6 and Full Hardfaced Hardfaced Hardfaced	350 ^e 350 ^e 350 ^e	Co-Cr Alloy ^g	NA	NA	AWS A5.13 ECoCr-A or AWS A5.21 ERCoCr-A	13Cr ^b 13Cr 13Cr	ASTM A276 T410 <u>UNS S41000</u> or ASTM A276 T420 <u>UNS S42000</u> ASTM A276 T410 or T420 ASTM A276 T410 or T420	200 min 275 max 200 min 275 max 200 min 275 max	250 min. 250 min. 250 min.
5A			Ni-Cr Alloy	NA	NA	Note ^h MFG Standard				
5B			Co-Cr-Ni-Mo ^j <u>UNS R31233</u>	NA	NA	UNS R31233-				
6	F6 and Cu-Ni	250/250 ^j	13Cr ^b	ASTM A 217 (CA 15) <u>UNS J91150</u>	ASTM A182 (F6a) <u>UNS S41000</u>	AWS A5.9 ER410	13Cr ^b	ASTM A276 T410 <u>UNS S41000</u> or ASTM A276 T420 <u>UNS S42000</u>	200 min 275 max	250 min
		175 ⁱ	Cu-Ni Alloy	NA	Note ^k	NA				

Commented [RS40]: Discussion started with concern about Trim 4 material call-out. Then the group stated that this is not utilized any more in industry. TF decision to delete this and wait for comments.

7	F6 and Hard F6	250 ⁱ Hard 13Cr NA ASTM A182 (F6a) TRIM NUMBER 7 IS OBSOLETE ^h Note ^f AWS A5.9 ER410 200 min 250 min.	750 ⁱ 13Cr ASTM A 217 (CA 15) NA 13Cr ASTM A276 T410 or T420 275 max							
8	F6 and Hardfaced F6 and Hardfaced	250 ⁱ	13Cr ^b	ASTM A 217 (CA 15) <u>UNS J91150</u>	ASTM A182 (F 6a) <u>UNS S41000</u>	AWS A5.9 ER410	13Cr 13Cr	ASTM A276 T410 <u>UNS S41000</u> or <u>ASTM A276 T420</u> <u>UNS S420000</u> ASTM A276 T410 or T420	200 min 275 max 200 min 275 max	250 min 250 min.
		350 ⁱ	Co-Cr Alloy ^g	NA	NA	AWS A5.13 ECoCr-A or AWS A5.21 ERCoCr-A				
8A		250 ⁱ	13Cr ^b	ASTM A 217 (CA 15) <u>UNS J91150</u>	<u>ASTM A182 F 6a</u> <u>UNS S41000</u> ASTM- A182 (F6a)	AWS A5.9 ER410				
		350 ⁱ	Ni-Cr Alloy	NA	NA	Note ^h MFG Standard				
9	<u>Alloy 400</u> Monel TM *	Note ^d	Ni-Cu Alloy	NA	MFG Standard	NA	Ni-Cu Alloy	MFG Standard	Note ^d	Note ^d
10	316	Note ^d	18Cr-12 ^b Ni-2Mo	ASTM A351 (CF8M) <u>UNS J92900</u>	ASTM A182 (F 316) <u>UNS S31600</u>	AWS A5.9 ER316	18Cr-12 ^b Ni-2Mo	ASTM A276 T316 <u>UNS S31600</u>	Note ^d	Note ^d
11	<u>Alloy 400</u> Monel TM * and Hardfaced 11A	Note ^d	Ni-Cu Alloy	NA	MFG Standard	NA	Ni-Cu Alloy	MFG Standard	Note ^d	Note ^d
		350 ⁱ	Co-Cr ^g Trim 5- or 5A	NA	NA	See Trim 5 or 5A AWS A5.13 ECoCr-A or AWS A5.21 ERCoCr-A				
		Note ^d	Ni-Cu Alloy	NA	MFG Standard	NA				
		350 ⁱ	Ni-Cu Alloy	NA	NA	MFG Standard				
12	316 and Hardfaced	Note ^d	18Cr-12 ^b Ni-2Mo	ASTM A351 (CF8M) <u>UNS J92900</u>	ASTM A182 (F 316) <u>UNS S31600</u>	AWS A5.9 ER316	18Cr-12 ^b Ni-2Mo	ASTM A276 T316 <u>UNS S31600</u>	Note ^d	Note ^d
		350 ⁱ	Co-Cr Alloy Hardface per Trim 8 or 8A	NA	NA	Hardface per Trim 8 or 8A AWS A5.13 ECoCr-A or AWS A5.21 ERCoCr-A				

12A		Note d	18Cr-12Ni-2Mo	ASTM A351 CF8M UNS J92900	ASTM A182 F 316 UNS S31600	AWS 5.9 ER316				
		350 i	Ni-Cr Alloy	NA	NA	MFG Standard				
13	Alloy 20	Note d	19Cr-29Ni	ASTM A351 (CN7M) UNS N08007	ASTM B46273 UNS 08020	AWS A5.9 ER320	19Cr-29Ni	ASTM B473 UNS N08020	Note d	Note d
14	Alloy 20 and Hardfaced	Note d	19Cr-29Ni	ASTM A351 (CN7M) UNS N08807	ASTM B46273 UNS N08020	AWS A5.9 ER320	19Cr-29Ni	ASTM B473 UNS N08020	Note d	Note d
		350 i	Co-Cr Alloy g Hardface per Trim 8 or 8A	NA	NA	AWS A5.13 ECoCr-A or AWS A5.21 ERCoCr-A Hardface per Trim 8 or 8A				
14A		Note d	19Cr-29Ni	ASTM A351 CN7M UNS N08807	ASTM B462 UNS N08020	AWS A5.9 ER320	19Cr-29Ni	ASTM B473 UNS N08020	Note d	Note d
		350 i	Ni-Cr Alloy	NA	NA	MFG Standard				
15	304 and Full Hardfaced	350 e	Co-Cr Alloy g	NA	NA	AWS A5.13 ECoCr-A or AWS A5.21 ERCoCr-A	18Cr-8Ni	ASTM A276 -T304 UNS S40300	Note d	Note n
			Ni-Cr Alloy	NA	NA	MFG Standard				
16	316 and Full Hardfaced	350 e	Co-Cr Alloy g	NA	NA	AWS A5.13 ECoCr-A or AWS A5.21 ERCoCr-A	18Cr- 12 8Ni- 2Mo	ASTM A276 -T316 UNS S31600	Note d	Note n
			Ni-Cr Alloy	NA	NA	MFG Standard				
17	347 and Full Hardfaced	350 e	Co-Cr Alloy g	NA	NA	AWS A5.13 ECoCr-A or AWS A5.21 ERCoCr-A	18Cr-10Ni- Cb	ASTM A276 -T347 UNS S34700	Note d	Note n
			Ni-Cr Alloy	NA	NA	MFG Standard				
18	Alloy 20 and Full Hardfaced	350 e	Co-Cr Alloy g	NA	NA	AWS A5.13 ECoCr-A or AWS A5.21 ERCoCr-A	19Cr-29Ni	ASTM B473 UNS N08020	Note d	Note n
			Ni-Cr Alloy	NA	NA	MFG Standard				
19	Nickel Alloy**	Note d	Ni Alloy	MFG Standard**	MFG Standard**	MFG Standard**	Ni Alloy**	MFG Standard**	Note d	Note n
20	Nickel Alloy and Hardfaced	Note d	Ni Alloy	MFG Standard	MFG Standard	MFG Standard	Ni Alloy	MFG Standard	Note d	Note n
		350 i	Co-Cr Alloy g	NA	NA	AWS 5.13 ECoCr-A or AWS 5.21 ERCoCr-A				

20A		Note d	Ni Alloy	MFG Standard	MFG Standard	MFG Standard					
		350 i	Ni-Cr Alloy	NA	NA	MFG Standard					
19A21	Alloy 625	Note d	Alloy 625 Ni-Cr Alloy	ASTM A494 (CW6MC) UNS N26625	ASTM B564 UNS N06625	AWS A5.14 ERNiCrMo-3	Alloy 625 Ni-Cr Alloy	ASTM B564 UNS N06625	Note d	Note n	
19B	Alloy C276	Note d	Alloy C276	ASTM A494 (CW2M)	ASTM B564 UNS N10276	AWS A5.14 ERNiCrMo-4	Alloy C276	ASTM B564 UNS N10276	Note d	Note n	
19G	Alloy 825	Note d	Alloy 825	ASTM A494 (CU5MCuC)	ASTM B564 UNS N08825	AWS A5.14 ERNiCrMo-3	Alloy 825	ASTM B564 UNS N08825	Note d	Note n	
20	Nickel** and Hardfaced	Note d 350 i	Ni Alloy Co-Cr A-9	MFG Standard** NA	MFG Standard** NA	MFG Standard** AWS 5.13 ECoCr-A or AWS 5.21 ERCoCr-A	Ni Alloy**	MFG Standard**	Note d	Note n	
20A22	Alloy 625 and Hardfaced	Note d	Alloy 625 Ni-Cr Alloy	ASTM A494 (CW6MC) UNS N26625	ASTM B564 -UNS N06625	AWS A5.14 ERNiCrMo-3	Alloy 625 Ni-Cr Alloy	ASTM B564 UNS N06625	Note d	Note n	
		350 i	Co-Cr Alloy g	NA	NA	AWS 5.13 ECoCr-A or AWS 5.21 ERCoCr-A					
22A		Note d	Ni-Cr Alloy	ASTM A494 CW6MC UNS N26625	ASTM B564 UNS N06625	AWS A5.14 ERNiCrMo-3					
		350 i	Ni-Cr Alloy	NA	NA	MFG Standard					
23	Alloy C276	Note d	Ni-Cr Alloy	ASTM A494 CW2M UNS N26455	ASTM B564 UNS N10276	AWS A5.14 ERNiCrMo-4	Ni-Cr Alloy	ASTM B564 UNS N10276	Note d	Note n	
20B24	Alloy C276 and Hardfaced	Note d	Alloy C276 Ni-Cr Alloy	ASTM A494 (CW2M) UNS N26455	ASTM B564 UNS N10276	AWS A5.14 ERNiCrMo-4	Alloy C276 Ni-Cr Alloy	ASTM B564 UNS N10276	Note d	Note n	
		350 i	Co-Cr Alloy g	NA	NA	AWS 5.13 ECoCr-A or AWS 5.21 ERCoCr-A					
24A		Note d	Ni-Cr Alloy	ASTM A494 CW2M UNS N26455	ASTM B564 UNS N10276	AWS A5.14 ERNiCrMo-4					
		350 i	Ni-Cr Alloy	NA	NA	MFG Standard					
25	Alloy 825	Note d	Ni-Cr Alloy	ASTM A494 CU5MCuC UNS N08826	ASTM B564 UNS N08825	AWS A5.14 ERNiCrMo-3	Ni-Cr Alloy	ASTM B564 UNS N08825	Note d	Note n	
20C26	Alloy 825 and Hardfaced	Note d	Alloy 825 Ni-Cr Alloy	ASTM A494 (CU5MCuC)	ASTM B564 -UNS N08825	AWS A5.14 ERNiCrMo-3	Alloy 825 Ni-Cr Alloy	ASTM B564 UNS N08825	Note d	Note n	

				UNS N08826						
		350 ⁱ	Co-Cr Alloy ^g	NA	NA	AWS 5.13 ECoCr-A or AWS 5.21 ERCoCr-A				
26A		Note^d	Ni-Cr Alloy	ASTM A494 CU5MCuC UNS N08826	ASTM B564 UNS N08825	AWS A5.14 ERNiCrMo-3				
		350 ⁱ	Ni-Cr Alloy	NA	NA	MFG Standard				
247	Nickel Alloy and Full Hardfaced^{**}	350 ^{ei}	Co-Cr Alloy ^g	NA	NA	AWS 5.13 ECoCr-A or AWS 5.21 ERCoCr-A	Ni Alloy ^{**}	MFG Standard ^{**}	Note^d	Noteⁿ
			Ni-Cr Alloy	NA	NA	MFG Standard				
28	Duplex (F51) and Hardfaced	Note^d	22Cr-5Ni-3Mo-N	ASTM A995 CD3MN (4A) UNS J92205	ASTM A182 F 51 UNS S31803	AWS A5.9 ER2209	22Cr-5Ni-3Mo-N	ASTM A276 UNS S31803^c	Note^d	Noteⁿ
		350 ⁱ	Co-Cr Alloy^g	NA	NA	AWS 5.13 ECoCr-A or AWS 5.21 ECoCr-A				
28A		Note^d	22Cr-5Ni-3Mo-N	ASTM A995 CD3MN (4A) UNS J92205	ASTM A182 F 51 UNS S31803	AWS A5.9 ER2209				
		350 ⁱ	Ni-Cr Alloy	NA	NA	MFG Standard				
29	Duplex (F51) and Full Hardfaced	350 ^e	Co-Cr Alloy^g	NA	NA	AWS 5.13 ECoCr-A or AWS 5.21 ECoCr-A	22Cr-5Ni-3Mo-N	ASTM A276 UNS S31803	Note^d	Noteⁿ
			Ni-Cr Alloy	NA	NA	MFG Standard				
30	Super Duplex (F53) and Hardfaced	Note^d	25Cr-5Ni-Mo-Cu-N	ASTM A995 CD4MCuN (1B) UNS J93372	ASTM A182 F 53 UNSS32750	AWS A5.9 ER2594	25Cr-7Ni-4Mo-Cu-N	ASTM A276 UNS S32750	Note^d	Noteⁿ
		350 ⁱ	Co-Cr Alloy^g	NA	NA	AWS 5.13 ECoCr-A or AWS 5.21 ECoCr-A				
30A		Note^d	25Cr-7Ni-4Mo-Cu-N	ASTM A995 CD4MCuN (1B) UNS J93372	ASTM A182 F 53 UNSS32750	AWS A5.9 ER2594				
		350 ⁱ	Ni-Cr Alloy	NA	NA	MFG Standard				
31	Super Duplex (F53) and Full Hardfaced	350 ^e	Co-Cr Alloy^g	NA	NA	AWS 5.13 ECoCr-A or AWS 5.21 ECoCr-A	25Cr-7Ni-4Mo-Cu-N	ASTM A276 UNS S32750	Note^d	Noteⁿ

			Ni-Cr Alloy	NA	NA	MFG Standard				
32	Super Duplex (F55) and Hardfaced	Note ^d	25Cr-7Ni-3Mo-Cu-N-W	ASTM A995 CD3MWCuN (6A) UNS J93380	ASTM A182 UNS S32760	AWS A5.9 ER2594	25Cr-7Ni-3Mo-Cu-N-W	ASTM A276 UNS S32760	Note ^d	Note ⁿ
		350 ^l	Co-Cr Alloy	NA	NA	AWS 5.13 ECoCr-A or AWS 5.21 ECoCr-A				
32A	Super Duplex (F55) and Hardfaced	Note ^d	25Cr-7Ni-3Mo-Cu-N-W	ASTM A995 CD3MWCuN (6A) UNS J93380	ASTM A182 UNS S32760	AWS A5.9 ER2594	25Cr-7Ni-3Mo-Cu-N-W	ASTM A276 UNS S32760	Note ^d	Note ⁿ
		350 ^l	Ni-Cr Alloy	NA	NA	MFG Standard				
33	Super Duplex (F55) and Full Hardfaced	350 ^l	Co-Cr Alloy	NA	NA	AWS 5.13 ECoCr-A or AWS 5.21 ECoCr-A	25Cr-7Ni-3Mo-Cu-N-W	ASTM A276 UNS S32760	Note ^d	Note ⁿ
			Ni-Cr Alloy	NA	NA	MFG Standard				
34	Super Duplex (F61) and Full Hardfaced	350 ^e	Co-Cr Alloy	NA	NA	AWS 5.13 ECoCr-A or AWS 5.21 ECoCr-A	Cr-Ni-Mo-Cu Alloy	ASTM A276 UNS S32250	Note ^d	Note ⁿ
			Ni-Cr Alloy	NA	NA	MFG Standard				
35	UNS R31233 and Full Hardfaced	350 ^e	Co-Cr-Ni-Mo-Alloy ^l	NA	NA	UNS R31233	MFG Standard	MFG Standard	Note ^d	Note ⁿ

NOTE Cr = Chromium; Ni = Nickel; Co = Cobalt; Cu = Copper; NA = Not Applicable; Cb = Columbium; Mo = Molybdenum; N = Nitrogen; W = Tungsten; MFG Standard = Manufacturer's Standard; NA = Not Applicable

^{*} Monel is used strictly as an example of any nickel-copper alloy 400 matching UNS N04400 specifications. It does not constitute any endorsement of any specific product or company by API.

^{**} Trim materials, including stem and base material for HF trim items, shall have a corrosion resistance and temperature limit at least equal to the valve body's corrosion resistance and pressure temperature rating.

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

^b Free machining grades of 13Cr are prohibited.

^c ~~Not used~~ Seating material UNS S32205 (F60) can be used as an alternative to UNS S31803 (F51)

^d Manufacturer's standard hardness.

^e Differential hardness between the body and disc seating surfaces is not required.

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

^g AWS A5.13 ECoCr-A or AWS A5.21 ERCrCoCr-A: This classification includes such trademark materials as Stellite 6™ *, Stoddy 6™ * and Wallex 6™ *. For Plasma Transfer Arc Welding (PTAW) process powder with the metallurgy equivalent to UNS R30006 can also be used. 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 ERCrCoCr-E. * Trademarks are examples only and do not constitute an endorsement of this product by API.

^h Manufacturer's standard hardfacing with a maximum iron content of 25%. Trim # 1 and 7 are obsolete. Common substitutes are 5 (for 1) and 8 (for 7)

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

j ~~Not used. This classification includes the trademark Ultimet™~~

k Manufacturer's standard with 30 Ni minimum.

l Not used.

m Typical backseat seating surface hardfacing or overlay, when specified.

n Per manufacturer's standard if not hardfaced, 250 HB_V minimum if hardfaced.

o Not used

p For weld deposit on an integral backseat, the same nominal material and typical specification shall apply.

Commented [RS41]: Notes should be reviewed.

Table 99—Trim Numbers and Alternative Trim Numbers

Specified Trim Number	Alternative Trim Number
<u>2 (F304)</u>	<u>2A (304 and Hardfaced),</u> <u>2b (304 and Hardfaced) or</u> <u>15 (304 and Full Hardfaced)</u>
<u>5A (F6 and Full Hardfaced)</u>	<u>5 (F6 and Full Hardfaced)</u>
<u>8 (F6 and Hardfaced)</u>	<u>5 (F6 and Full Hardfaced)</u>
<u>8A (F6 and Hardfaced)</u>	<u>8 (F6 and Hardfaced),</u> <u>5 (F6 and Full Hardfaced) or</u> <u>5A (F6 and Full Hardfaced)</u>
<u>10 (316)</u>	<u>12 (316 and Hardfaced),</u> <u>or 16 (316 and Full Hardfaced) or</u> <u>12A (316 and Hardfaced) or</u> <u>16 (316 and Full Hardfaced)</u>
<u>12 (316 and Hardfaced)</u> <u>12A (316 and Hardfaced)</u>	<u>16 (316 and Full Hardfaced)</u>
<u>13 (Alloy 20)</u>	<u>14 (Alloy 20 and Hardfaced),</u> <u>14A (Alloy 20 and Hardfaced) or</u> <u>18 (Alloy 20 and Full Hardfaced)</u>
<u>42</u>	<u>46</u>
<u>14 (Alloy 20 and Hardfaced)</u>	<u>18 (Alloy 20 and Full Hardfaced)</u>
<u>15 (304 and Full Hardfaced)</u>	<u>16 (316 and Full Hardfaced)</u>
<u>21 (Alloy 625)</u>	<u>22 (Alloy 625 and Hardfaced),</u> <u>22A (Alloy 625 and Hardfaced) or</u> <u>27 (Nickel Alloy* and Full Hardfaced)</u>
<u>23 (Alloy C276)</u>	<u>24 (Alloy C276 and Hardfaced),</u> <u>24A (Alloy C276 and Hardfaced) or</u> <u>27 (Nickel Alloy* and Full Hardfaced)</u>
<u>25 (Alloy 825)</u>	<u>26 (Alloy 825 and Hardfaced),</u> <u>26A (Alloy 825 and Hardfaced) or</u> <u>27 (Nickel Alloy* and Full Hardfaced)</u>
<u>22 (Alloy 20 and Hardfaced)</u> <u>22A (Alloy 20 and Hardfaced)</u>	<u>27 (Nickel Alloy* and Full Hardfaced)</u>
<u>24 (Alloy C276 and Hardfaced)</u> <u>24A (Alloy C276 and Hardfaced)</u>	<u>27 (Nickel Alloy* and Full Hardfaced)</u>
<u>26 (Alloy 825 and Hardfaced)</u> <u>26A (Alloy 825 and Hardfaced)</u>	<u>27 (Nickel Alloy* and Full Hardfaced)</u>
<u>28 (Duplex (F51) and Hardfaced)</u> <u>28A (Duplex (F51) and Hardfaced)</u>	<u>29 (Duplex (F51) and Full Hardfaced)</u>
<u>30 (Super Duplex (F53) and Hardfaced)</u> <u>30A (Super Duplex (F53) and Hardfaced)</u>	<u>31 (Super Duplex (F53) and Full Hardfaced)</u>
<u>32 (Super Duplex (F55) and Hardfaced)</u> <u>32A (Super Duplex (F55) and Hardfaced)</u>	<u>33 (Super Duplex (F55) and Full Hardfaced)</u>
Note: * Nickel-alloy materials shall have a corrosion resistance at least equal to that of the specified trim material, as measured by PREN or some other industry specification	

Commented [RS42]: Are there any other Alternative Trim combination that we want to review.; for example Trim 13 and 14 for 18?

8.1 General

8.1.1 Valves shall be marked in accordance with the requirements of ASME B16.34, except that the nameplate shall include the designation "API 600" in addition to the designation "ASME B16.34".

8.1.2 If the nameplate rivet holes are in a pressure containing component, they shall be drilled prior to valve testing.

8.2 Specific Markings

8.2.1 Valves designed for or modified to have unidirectional flow capability, i.e., capability to block flow in only one direction, 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 body that indicates the direction for which flow is permitted.

8.2.2 Valves equipped with packing complying to API 624 shall be marked in accordance with API 624.

8.2.3 Valves equipped with packing not complying with API 624 shall not be marked in accordance with API 624. Such valves shall have a tag attached indicating the installed packing material (e.g., "PTFE Packing", "Graphite Packing").

Commented [RS43]: API 608 has moved away from the flow direction arrow to "HP End" marking. TF to consider the API 608 language.f

Commented [RS43R2]: Certain customers do not want "HP End" marked on valve - might be confusing to their operators.

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, unless otherwise agreed by the purchaser. Painting of ASME B16.34 Group 2 or Group 3 body shell materials is not required, unless specified in the Purchase Order.

9.1.2 Machined or threaded surfaces, except those of austenitic stainless steel and nickel alloy 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 the protective cover.

Commented [RS44]: Seems to be a typo, steel straps is one method.

9.2.2 Tapped connections shall be fitted with fully tightened and sealed threaded plugs. The material used for plugs for tapped connections shall have the same nominal chemical composition as the shell body material (see 5.12).

9.3 Gate Position

The valve shall be shipped with the gate closed.

9.4 Cleaning and Drying

If water was used during the shell test, backseat, seat closure, or other tests either internally or externally, the valve shall be blown out with air or nitrogen to remove any standing water or residual moisture per the manufacturer's written procedure. The valve shall be in the partially open position during dry out.

Commented [RS45]: Consider language in API 6D, 608, 609.

9.4.5 Stem Packing

The valve shall be shipped with the lantern ring, if specified, and the packing installed and tight (refer to 5.9.3). ~~The remaining adjustment length of the packing gland at the time of shipment, with the gland tight, shall be greater than 1½ times the packing width specified in Table 5 and Table 6 for respective units (metric/U.S. Customary).~~

Commented [RS46]: Consider moving to 5.9 under design section.

9.56 Packaging

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

9.56.2 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.

Commented [RS47]: TF looking to expand requirements here. Will look at IOGP and other references.

9.67 Purchase Order Information

Items marked with an asterisk in Annex B are considered an integral part of this standard, and shall be specified by the purchaser.

10 Special Services

10.1 NACE Requirements

When specified in the purchase order, valves shall additionally meet the requirements of NACE MR0103/ISO 17945. The purchaser may specify either exposed bolting or non-exposed bolting as defined in NACE MR0103/ISO 17945. The purchaser may specify NACE MR0175/ISO 15156 in lieu of NACE MR0103/ISO 17945.

10.2 Cryogenic Service

When specified in the purchase order, valves in cryogenic service shall additionally meet the requirements of MSS SP-134, ISO 21011 or ISO 28921-1. Optional low temperature cryogenic testing may also be specified by the purchaser.

When noted in the PO as MSS SP-134, all additional requirements of MSS SP-134 supersede the API 600 requirements.

10.3 Hydrogen Fluoride (HF) Alkylation Service

When specified in the purchase order, valves in Hydrogen Fluoride (HF) Alkylation Service shall additionally meet the requirements of MSS SP-160.

When noted in the PO as MSS SP-160, all additional requirements of MSS SP-160 supersede the API 600 requirements (e.g. Table 7 materials, testing, NDE, casting quality).

Items marked with an asterisk in Annex B are considered an integral part of this standard, and shall be specified by the purchaser.

Annex A

The information in this annex has been intentionally removed.

See Annex A of API Specification Q1 or the API website for information pertaining to the API Monogram Program and use of the API Monogram on applicable products.

Annex B

(normative)

Information to be Specified by the Purchaser

- 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 600 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 [for sizes over DN 600 (NPS 24) specify Series A or B], or welding ends, including bore *;
 - d) auxiliary connections and openings;
 - e) valve orientation;
 - f) additional hard facing of body and/or wedge guides;
 - g) bonnet gasket and/or bonnet flange facing;
 - h) tapped openings;
 - i) wedge gate or double-disc gate (also type of wedge, if required)*;
 - j) lantern ring;
 - k) chainwheel and chain; and safety cables, if furnished as original equipment
 - 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; frequency of operation;
 - 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 the manufacturer's permissible options (e.g., NACE MR 0103 including bolting);
 - 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 the purchaser;
 - x) Optional low-pressure and high-pressure closure test;
 - y) supplementary examination and testing;
 - z) export packaging;
 - aa) pressure seal bonnet;

bb) alternate paint system or color (from the manufacturer standard)

cc) Painting of Group 2 or 3 shell materials-

dd) Cryogenic service per MSS SP-134, ISO 21011 or ISO 28921-1

ee) Hydrogen fluoride alkylation service per MSS SP-160

ff) MAST (Maximum Allowable Stem Torque) for the valve design

(informative)

Identification of Valve Terms

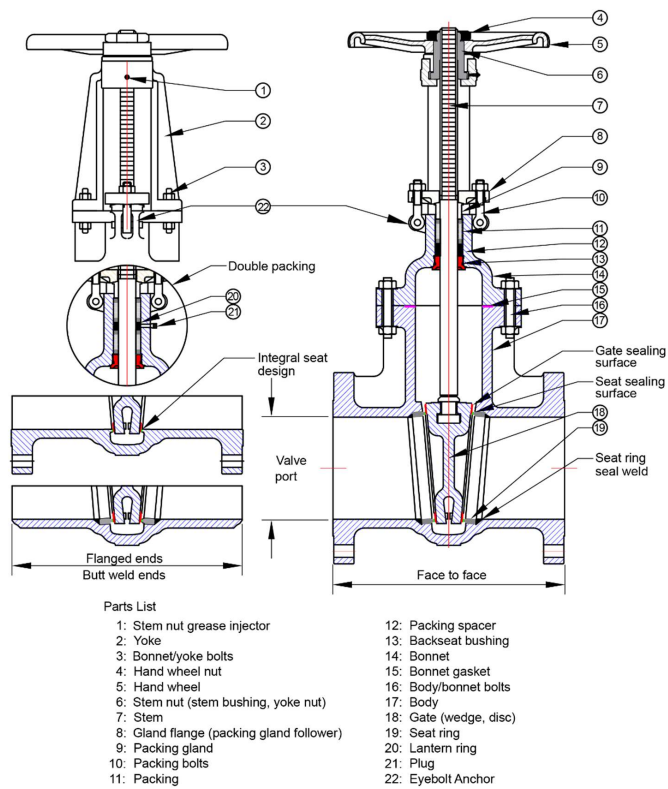


Figure C.1—Valve Nomenclature

(informative)

Valve Material Combinations

Table D.1, Table D.2, and Table D.3 list valve body, bonnet, and cover materials (ASME B16.34, Material Groups 1, 2, and 3) 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 D.1 and Table D.2, corresponding bolting materials listed in EN 10269 may be substituted in accordance with Table D.4.

Table D.1—Typical 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 ^a
1.1	C-Si; C-Mn-Si-C-Mn-Si-V 3 ¹ / ₂ -Ni	A105-or- A216-WCB A350-LF2-CL1 A350-LF6-CL1 A350-LF3	8, 8A 8-8A 10 10	A193 B7/2H, B7M/2HM ^b A194 2H, 2HM B7/2H ^b B8M-CL2/8M ^{b-c-d} B8M-CL2/8M ^{b-c-d}
	C-Mn-Si	A350-LF2-CL1	10	A193 B8M-CL2 ^{b-c-d} A194 8M
	C-Mn-Si-V	A350-LF6-CL1		
	3 ¹ / ₂ -Ni	A350-LF3		
1.2	C-Mn-Si C-Mn-Si-V 2 ¹ / ₂ -Ni 3 ¹ / ₂ -Ni	A216-WCC A352-LCC A350-LF6-CL2 A352-LG2 A352-LG3	8, 8A 8-8A 10 10 10	A193 B7/2H, B7M/2HM ^b A194 2H, 2HM B8M-CL2/8M ^{b-c-d} B8M-CL2/8M ^{b-c-d} B8M-CL2/8M ^{b-c-d}
	C-Mn-Si-V	A350-LF6-CL2	10	A193 B8M-CL2 ^{b-c-d} A194 8M
	2 ¹ / ₂ -Ni	A352-LC2		
	3 ¹ / ₂ -Ni	A352-LC3		
1.3	C-Si-C- ¹ / ₂ Mo	A352-LCB A217-WC1 A352-LC1	8, 8A 8-8A 10	A193 B7/2H, B7M/2HM ^b A194 2H, 2HM B7/2H, B7M/2HM B8M-CL2/8M ^{b-c-d}
	C- ¹ / ₂ Mo	A217-WC1	10	A193 B8M-CL2 ^{b-c-d} A194 8M
	C- ¹ / ₂ Mo	A352-LC1		
1.4	C-Mn-Si	A350-LF1	8	A193 B7/2H, B7M/2HM ^b A194 2H, 2HM
1.5	C- ¹ / ₂ Mo	A182-F1	8	A193 B7/2H, B7M/2HM ^b A194 2H, 2HM
1.7	¹ / ₂ Cr- ¹ / ₂ Mo Ni- ¹ / ₂ Cr- ¹ / ₂ Mo ³ / ₄ Ni- ³ / ₄ Cr-1Mo	A182-F2 A217-WC4 A217-WC5	8	A193 B7/2H, B7M/2HM ^b A194 2H, 2HM
	Ni- ¹ / ₂ Cr- ¹ / ₂ Mo	A217-WC4		
	³ / ₄ Ni- ³ / ₄ Cr-1Mo	A217-WC5		
1.9	¹ / ₄ Cr- ¹ / ₂ Mo ¹ / ₄ Cr- ¹ / ₂ Mo-Si	A217-WC6 A182-F11-CL2	8	A193 B16/8M ^e A194 8M
	¹ / ₄ Cr- ¹ / ₂ Mo-Si	A182-F11-CL2		
1.10	2 ¹ / ₄ Cr-1Mo	A182-F22-CL3 A217-WC9	8	A193 B16/8M ^e A194 8M
1.11	3Cr-1Mo	A182-F21	8	A193 B16 ^e A194 8M

1.13	5Cr- ¹ / ₂ Mo	A182-F5a- or A217-C5	8	A193 B16/8M^e A194 8M
1.14	9Cr-1 Mo	A182-F9- or A217-C12	8	A193 B16/8M^e A194 8M
1.15	9Cr-1Mo-V	A182-F91-Type1 A217-C12A	8	A193 B16/8M^e A194 8M
1.17	1Cr- ¹ / ₂ Mo 5Cr-¹/₂Mo	A182-F12-CL2 A182-F5	8	A193 B16/8M^e A194 8M
	5Cr-¹/₂Mo	A182-F5		
1.18	9Cr-2W-V	A182-F92	8	A193 B16^e A194 8M

NOTE 1 For [Table D.1](#) table superscript notes, see [Table D.2](#).

NOTE 2 For bolting materials in accordance with EN 10269, see [Table D.4](#).

NOTE 3 When substituting bolting materials (e.g., austenitic or Group 3 materials) for those recommended in this table, consideration should be given to the changes in material stress strain properties and differential thermal expansion between bolting and other joint components, which may result in reduced joint tightness.

Note 4 Bolting shall not be cadmium plated or galvanized

Table D.2—[Typical](#) Material Combinations for Group 2 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 ^a
2.1	18Cr-8Ni	A182-F304 /A351-CF3 A182-F304H /A351-CF8 A351-CF10	Note 1 ²	A193 B8M-CL2/8M^{c d} A194 8M
2.2	16Cr-12Ni-2Mo 18Cr-8Ni 18Cr-13Ni-3Mo 19Cr-10Ni-3Mo	A182-F316- or A351-CF3M; A182-F316H- or A351-CF8M A351-CF10M A351-CF3A or A351-CF8A A182-F317 A351-CG8M	10	A193 B8M-CL2/8M^{c d} A194 8M
	18Cr-8Ni	A351-CF3A A351-CF8A		
	18Cr-13Ni-3Mo	A182-F317		
	19Cr-10Ni-3Mo	A351-CG8M A351-CG3M		
2.3	18Cr-8Ni 16Cr-12Ni-2Mo 16Cr-12Ni-2Mo 18Cr-13Ni-3Mo	A182-F304L A182-F316L A182-F316L A182-F317L	10	A193 B8M-CL2/8M^{c d} A194 8M
2.4	18Cr-10Ni-Ti	A182-F321 A182-F321H	10	A193 B8M-CL2/8M^{c d} A194 8M
2.5	18Cr-10Ni-Cb	A182-F347H -A182-F347 A182-F348 A182-F348H	10	A193 B8M-CL2/8M^{c d} A194 8M
2.7	25Cr-20Ni	A182-F310H	10	A193 B8M-CL2/8M^{c d} A194 8M
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	A182-F44 A351-CK3MCuN A182-F51 A182-F53 - A351-CE8MN - A351-CD4MCu A351-CD3MWCuN A182-F55	Note 1 ^f	A193 B8M-CL2/8M^{c d} A194 8M

	25Cr-7Ni-3.5Mo-N-Cu-W			
2.10	25Cr-12Ni	A351-CH8 A351-CH20	Note ^f	A193 B8M-CL2/8M ^{c d} A194 8M
2.11	18Cr-10Ni-Cb	A351-CF8C	Note ^f	A193 B8M-CL2/8M ^{c d} A194 8M
2.12	25Cr-20Ni	A351-CK20	Note ^f	A193 B8M-CL2/8M ^{c d} A194 8M
2.13	22Cr-5Ni-3Mo-N	A182-F51 A995-CD3MN A182-F60	Note ^f	A193 B8M-CL2 ^{c d} A194 8M
	25Cr-7Ni-4Mo-N	A182-F53		
	24Cr-10Ni-4Mo-N	A995 CE8MN		
	25Cr-5Ni-3Cu-2Mo-N	A995 CD4MCuN		
	25Cr-7Ni-3.5Mo-W-N	A995 CD3MWCuN		
	25Cr-7.5Ni-3.5Mo-N-Cu-W	A182 F55		
NOTE 1 For bolting materials in accordance with EN 10269, see Table D.4 .				
NOTE 2 When substituting bolting materials (e.g. austenitic or group three materials) for those recommended in this table, consideration should be given to the changes in material stress strain properties and differential thermal expansion between bolting and other joint components, which may result in reduced joint tightness.				
Note 3 Bolting shall not be cadmium plated or galvanized				
Superscript notes below apply to Table D.1 and Table D.2				
^a Temperature limitations on bolting are as follows: A193 Gr B7, Gr B7M , 538 °C (1000 °F); A320 Gr L7, 638-427 °C (81400 °F) ; A320 Gr L7M , 538 °C (1000 °F); A193 Gr B16, 595 °C (1100 °F); A193 Gr B8-CL1, Gr B8A-CL1A, Gr B8M-CL1, and Gr B8MA-CL1A, 816 °C (1500 °F); A193 Gr B8-CL2, Gr B8M-CL2, Gr B8M2-CL2B and Gr B8M3-CL2C, 538 °C (1000 °F). ^b ASTM A320 , Gr L7 or Gr L7M bolts and ASTM A194 , Gr 7 or Gr 7M 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 and ASTM A194, Gr 8 nuts is are a suitable substitute provided that the requirements of 5.5.89 are met. Substituting with class 1 bolting may result in derating of the valve. ^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 D.3—Typical Material Combinations for Group 3 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 ^{ab}
3.1	35Ni–35Fe–20Cr–Cb	A182 N08020 B462 N08020	13, 14	B473 N08020
3.2	99Ni	B564 N02200	19, 20	B160 N02200B164 N04400 ^d
3.4	67Ni-30Cu 67Ni-30Cu-S	B564 N04400 A494 M-35–1 A494 M-35–2	9, 11	B164 N04400 ^d
	67Ni-30Cu-S	A494 M-35–2		
3.5	72Ni–15Cr–8Fe	B564 N06600	19, 20	B166 N06600 ^e
3.6	33Ni–42Fe–21Cr	A182 N08800 B564 N08800	19, 20	B408 N08800 ^e
3.7	65Ni-28Mo-2Fe 64Ni-29.5Mo-2Cr-2Fe-Mn-W	B462 N10665 B564 N10665 B564 N10665 B462 N10675 B564 N10675	19, 20	B335 N10665 ^d B335 N10675 ^d
	64Ni-29.5Mo-2Cr-2Fe-Mn-W	B462 N10675		

		B564 N10675		
3.8	54Ni-16Mo-15Cr	B462 N10276 B564 N10276	19B, 20B23, 24	B574 N10276
	60Ni-22Cr-9Mo-3.5Cb 42Ni-21.5Cr-3Mo-2.3Cu	B564 N06625 B564 N08825	19A, 20A21, 22 19C, 20C	B446 N06625B637-N07718 B637-N07718
	42Ni-21.5Cr-3Mo-2.3Cu	B564 N08825	25, 26	B425 N08825
	55Ni-21Cr-13.5Mo 55Ni-23Cr-16Mo-1.6Cu	B462 N06022 B564 N06022 B462 N06200	19, 20 19, 20	B574 N06022N10276 B574-N10276
	55Ni-23Cr-16Mo-1.6Cu	B462 N06200 B564 N06200		B574 N06200
3.10	25Ni-47Fe-21Cr-5Mo	A182 N08700	19, 20	B672 N08700
3.11	44Fe-25Ni-21Cr-Mo	A182 N08904	19, 20	B649 N08925
3.12	46Fe-24Ni-21Cr-6Mo-Cu-N 58Ni-33Cr-8Mo	A182 N08367 B462 N08367 A351 CN3MN B462 N06035	19, 20	B691 N08367B637-N07718
	58Ni-33Cr-8Mo	B462 N06035 B564 N06035		B574 N06035
3.13	31Ni-33Fe-27Cr-6.6Mo-Cu-Low C-N	B564 N08031	19, 20	B581 N08031B574-N10276 B574-N06022
3.14	40Ni-29Cr-15Fe-5Mo	B462 N06030	19, 20	B581 N06030
3.15	42Ni33Ni-42Fe-21Cr Ni-Mo Ni-Mo-Cr	B564 N08810 A494-N-12MV A494-CW-12MW	19, 20	B408 N08810 B574-N10276
	62Ni-28Mo-5Fe	A494 N-12MV		B335 N10001
	53Ni-17Mo-16Cr-6Fe-5W	A494 CW-12MW		B574 N10276
3.17	29Ni-2012.5Cr-342.5Cu-242.5Mo	A351 CN7M	19, 2013, 14	B473 N08020B574-N10276
3.19	57Ni-22Cr-14W-2Mo-La	B564 N06230	19, 20	B572 N06230B408-N08800
NOTE 1 If alternative bolting material from Table D.2 are used, temperature limitation from Table D.2 superscript note is applicable NOTE 2 When substituting bolting materials (e.g. austenitic or group three materials) for those recommended in this table, consideration should be given to the changes in material stress strain properties and differential thermal expansion between bolting and other joint components, which may result in reduced joint tightness. Note 3 Bolting shall not be cadmium plated or galvanized ^a Bolting materials are suggested to help with material selection, ASTM A193, B8M-CL1 and Gr B8M-CL2 bolting are acceptable as agreed between Manufacture and Purchaser provided requirements in 5.5.8 and 5.5.9 are met. ^b All bolting shall have similar coefficient of thermal expansion to the body and bonnet material. ^c Material specifications have maximum diameter limit of 2.5 in. ^d Material specifications have maximum diameter limit of 3.5 in. ^e Materials have yield strength below 50ksi, alternative higher strength bolting may be required to satisfy joint design requirements.				

Table D.4—Alternative Body to Bonnet Bolting Materials

As Related to Table D.1 and Table D.2		As Related to Table Notes in Table D.1 and Table D.2	
ASTM Bolting Material	EN 10269 Bolting Material Grade Designation	ASTM Bolting Material	EN 10269 Bolting Material- Grade

	Name	Number	Heat treatment condition		
A193 B7 A193 B7M	42CrMo4	1.7225	Quenched and tempered		
A193 B16	40CrMoV4-6	1.7711	Quenched and tempered		
A320 L7 A320 L7M	42CrMo4	1.7225	Quenched and tempered		
A194 2H A194 2HM	C45E	1.1191	Quenched and tempered		
A194 7 A194 7M	42CrMo4	1.7225	Quenched and tempered		
A193 B8M, CL 2 A193 B8M2, CL 2B A193 B8M3, CL 2C	X5CrNiMo 17-12-2	1.4401	Cold work hardened with a minimum tensile strength 700MPa		
A193 B8M, CL 1 A193 B8MA, CL 1A	X5CrNiMo 17-12-2	1.4401	Solution Annealed		
A193, B8 CL 2	X5CrNi18-10	1.4301	Cold work hardened with a minimum tensile strength 700MPa		
A193 B8, CL 1 A193 B8A, CL 1A	X5CrNi 18-10	1.4301	Solution Annealed		
A194 8M	X5CrNiMo 17-12-2	1.4401	Solution Annealed		
A194 8	X5CrNi 18-10	1.4301	Solution Annealed		
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	X5CrNi 18-10 (1.4301)—AT
				A194 GR-7	42CrMo4 (1.7225)—QT

NOTE 1 Temperature limitations applicable for ASTM bolting materials, from table notes for **Table D.2** superscript notes, also apply for corresponding substitute EN bolting materials.

Note 2 Bolting shall not be cadmium plated or galvanized

Annex E

(informative)

Wear Travel Measurement Technique

- 1) Perform inspection on the assembled valve prior to initial hydrotest.
- 2) Valve to be inspected in the stem vertical position and free of internal pressure.
- 3) Valve to be closed until 360 degrees of contact is made between the disc and seat.
- 4) Measure dimension *h* on Figure 3 (disc seat/body seat interface at the 6 o'clock position).

Bibliography

- [1] [API Standard 589, Standard on Fire Test for Evaluation of Valve Stem Packing and Piping Flange Gaskets](#)
- [2] ASME B1.20.1, *Pipe Threads, General Purpose (Inch)*
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- [54] ASME Boiler and Pressure Vessel Code (BPVC), *Section IX: Welding and Brazing Qualifications*
- [65] ASTM A193,⁴ *Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature of High Pressure Service and Other Special Purpose Applications*
- [76] ASTM A194, *Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both*
- [87] ASTM A307, *Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength*
- [98] ASTM A320, *Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service*
- [109] EN 1092-1,⁵ *Flanges and their joints—Circular flanges for pipes, valves, fittings and accessories, PN designated—Part 1: Steel flanges*
- [1140] ISO 7-1, *Pipe threads where pressure-tight joints are made on the threads—Part 1: Dimensions, tolerances and designation*
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- [1514] MSS SP-55, *Quality Standard for Steel Castings for Valves, Flanges and Fittings and Other Piping Components — Visual Method for Evaluation of Surface Irregularities*
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⁴ ASTM International, 100 Barr Harbor Drive, West Conshohocken, Pennsylvania 19428, www.astm.org.

⁵ European Standards s.r.o., Krimická 134, 318 00 Pilsen, Czech Republic, VAT: CZ09567909; www.en-standard.eu.

⁶ NACE International, 15835 Park Ten Place, Houston, TX 77084, www.nace.org.