Corrosion-resistant, Bolted Bonnet Gate Valves—Flanged and Butt-welding Ends

API STANDARD 603
TENTH EDITION, JULY 2025

API MONOGRAM PROGRAM EFFECTIVE DATE: FEBRUARY 1, 2026

Special Notes

API publications necessarily address problems of a general nature. With respect to particular circumstances, local, state, and federal laws and regulations should be reviewed. The use of API publications is voluntary. In some cases, third parties or authorities having jurisdiction may choose to incorporate API standards by reference and may mandate compliance.

Neither API nor any of API's employees, subcontractors, consultants, committees, or other assignees make any warranty or representation, either express or implied, with respect to the accuracy, completeness, or usefulness of the information contained herein, or assume any liability or responsibility for any use, or the results of such use, of any information or process disclosed in this publication. Neither API nor any of API's employees, subcontractors, consultants, or other assignees represent that use of this publication would not infringe upon privately owned rights.

Users of this standard should not rely exclusively on the information contained in this document. Sound business, scientific, engineering, and safety judgment should be used in employing the information contained herein.

API is not undertaking to meet the duties of employers, manufacturers, or suppliers to warn and properly train and equip their employees, and others exposed, concerning health and safety risks and precautions, nor undertaking their obligations to comply with authorities having jurisdiction.

API publications may be used by anyone desiring to do so. Every effort has been made by the Institute to ensure the accuracy and reliability of the data contained in them; however, the Institute makes no representation, warranty, or guarantee in connection with this publication and hereby expressly disclaims any liability or responsibility for loss or damage resulting from its use or for the violation of any authorities having jurisdiction with which this publication may conflict.

API publications are published to facilitate the broad availability of proven, sound engineering and operating practices. These publications are not intended to obviate the need for applying sound engineering judgment regarding when and where these publications should be utilized. The formulation and publication of API publications is not intended in any way to inhibit anyone from using any other practices.

Any manufacturer marking equipment or materials in conformance with the marking requirements of an API standard is solely responsible for complying with all the applicable requirements of that standard. API does not represent, warrant, or guarantee that such products do in fact conform to the applicable API standard.

Foreword

Nothing contained in any API publication is to be construed as granting any right, by implication or otherwise, for the manufacture, sale, or use of any method, apparatus, or product covered by letters patent. Neither should anything contained in the publication be construed as insuring anyone against liability for infringement of letters patent.

The verbal forms used to express the provisions in this document are as follows.

Shall: As used in a standard, “shall” denotes a minimum requirement in order to conform to the standard.

Should: As used in a standard, “should” denotes a recommendation or that which is advised but not required in order to conform to the standard.

May: As used in a standard, “may” denotes a course of action permissible within the limits of a standard.

Can: As used in a standard, “can” denotes a statement of possibility or capability.

This document was produced under API standardization procedures that ensure appropriate notification and participation in the developmental process and is designated as an API standard. Questions concerning the interpretation of the content of this publication or comments and questions concerning the procedures under which this publication was developed should be directed in writing to the Director of Standards, American Petroleum Institute, 200 Massachusetts Avenue, NW, Suite 1100, Washington, DC 20001. Requests for permission to reproduce or translate all or any part of the material published herein should also be addressed to the director.

Generally, API standards are reviewed and revised, reaffirmed, or withdrawn at least every five years. A one-time extension of up to two years may be added to this review cycle. Status of the publication can be ascertained from the API Standards Department, telephone (202) 682-8000. A catalog of API publications and materials is published annually by API, 200 Massachusetts Avenue, NW, Suite 1100, Washington, DC 20001.

Suggested revisions are invited and should be submitted to the Standards Department, API, 200 Massachusetts Avenue, NW, Suite 1100, Washington, DC 20001, standards@api.org.

Contents

Figures

Tables

Corrosion-resistant, Bolted Bonnet Gate Valves—Flanged and Butt-welding Ends

1 Scope

1.1 This standard specifies the requirements for corrosion-resistant bolted bonnet gate valves meeting the requirements of Standard Class, ASME B16.34 and having full port openings for use in process piping applications.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 sealing;

— metallic seating surfaces;

— flanged or butt-welding ends.

Covering valves of the nominal pipe sizes (DN):

— 15; 20; 25; 32; 40; 50; 65; 80; 100; 150; 200; 250; 300; 350; 400; 450; 500; 600.

Corresponding to the nominal pipe sizes (NPS):

— $^{1}/_{2}$; $^{3}/_{4}$; 1; $1^{1}/_{4}$; $1^{1}/_{2}$; 2; $2^{1}/_{2}$; 3; 4; 6; 8; 10; 12; 14; 16; 18; 20; 24.

Applies to pressure class designations:

— 150; 300; 600.

1.2 Annex C illustrates a bolted bonnet gate valve for the purpose of establishing standard nomenclature for valveparts.

1.3 The dimensions in metric (SI) units are standard; customary units are shown for reference.

1.4 If product is supplied bearing the API Monogram, and is manufactured at a facility licensed by API, the requirements of Annex A shall apply.

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 anyamendments) applies.

API Standard 598, *Valve Inspection and Testing*

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

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

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 Standard*

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

ASME B16.20, *Metallic Gaskets for Pipe Flanges*

ASME B16.25, *Buttwelding Ends*

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

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

ASME B18.2.3.5M, *Metric Hex Bolts*

ASME B18.2.3.6M, *Metric Heavy Hex Bolts*

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

ASTM A193/A193M[2], *Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications*

ASTM A194/A194M, *Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both*

ASTM A439/A439M, *Standard Specification for Austenitic Ductile Iron Castings*

ASTM E10, *Standard Test Method for Brinell Hardness of Metallic Materials*

---

[1] American Society of Mechanical Engineers, 2 Park Avenue, New York, New York 10016, www.asme.org.
[2] ASTM International, 100 Bar Harbor Drive, P.O. Box C700, West Conshohocken, Pennsylvania 19428, www.astm.org.

AWS A5.13/A5.13M[3], *Specification for Surfacing Electrodes for Shielded Metal Arc Welding*

AWS A5.21/A5.21M, *Specification for Bare Electrodes and Rods for Surfacing*

EN 10269, *Specification for steels and nickel alloys for fasteners with specified elevated and/or low temperature properties*

ISO 5210[4], *Industrial valves — Multi-turn valve actuator attachments*

ISO 5752, *Metal valves for use in flanged pipe systems*

ISO 28921-1, *Industrial valves — Isolating valves for low-temperature applications—Part 1: Design, manufacturing and production testing*

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

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

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

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

MSS SP-144, *Pressure Seal Bonnet Valves*

3 Terms and Definitions

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

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

3.2
***diamètre nominal* (nominal size)**
DN
An alphanumeric size designation that is common for piping system components and is used for reference purposes.It comprises the letters “DN” followed by a dimensionless number indirectly related to the physical size of the bore oroutside diameter of the end connection as appropriate. The dimensionless number following

[3] American Welding Society, 8669 NW 36th Street, #130, Doral, Florida 33166-6672, www.aws.org.
[4] International Organization for Standardization, ISO Central Secretariat, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, www.iso.org.
[5] Manufacturers Standardization Society of the Valve and Fittings Industry, Inc., 411 N Lee Street, Alexandria, Virginia 22314, www.msshq.org.

"DN" does not represent a measurable value and is not used for calculation purposes, except where specified.

3.3
nominal pipe size
NPS
An alphanumeric size designation that is common for piping system components and is used for reference purposes. It comprises 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 also be used as a valve size identifier without the prefix "NPS." The dimensionless size identification number does not represent a measurable value and is not used for calculation purposes.

3.4
shell
The body, bonnet, and body-bonnet bolting which together constitute the pressure boundary of an API 603 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 both the applicable material specification and the applicable class.

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

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

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

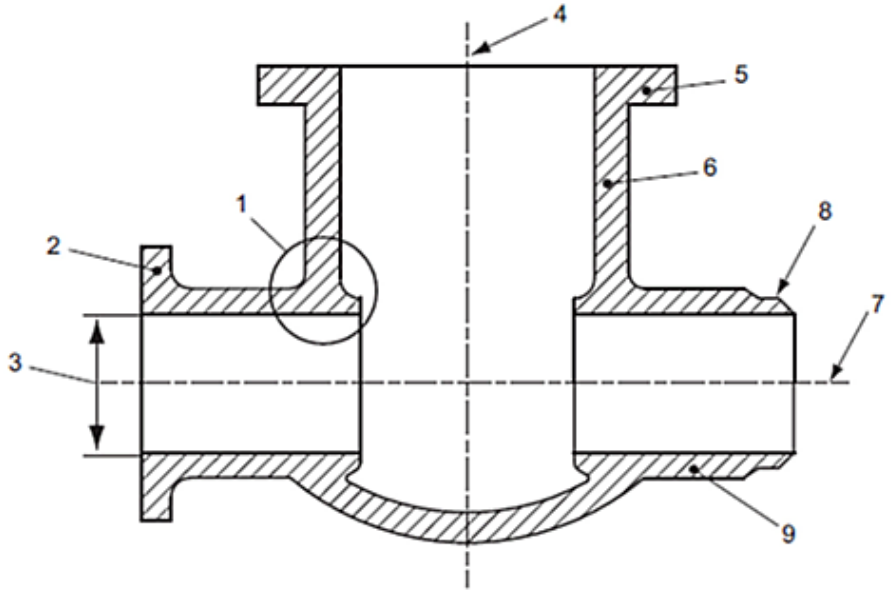
NOTE—See ASME B16.34 for the purchaser's responsibility for avoiding potential cavity overpressure from trapped fluids in double-seated valves.

5 Design

5.1 Body Wall Thickness

5.1.1 A valve body schematic is shown in Figure 1. The minimum body wall thickness, t_m, at the time of manufacture shall be as given in Table 1, except as indicated in 5.1.2 for butt-welding valve ends. Additional

metal thickness needed for assembly stresses, stress concentrations, and shapes other than circular shall be determined by individual manufacturers.



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

Table 1—Minimum Thickness of Shell/Bonnet Wall, t_m, and Minimum Stem Diameter, d_s

Nominal Size, DN	Class 150		Class 300		Class 600		Nominal Size, NPS
	Body/ Bonnet Wall Thickness, mm (in.)	Stem Diameter, mm (in.)	Body/ Bonnet Wall Thickness, mm (in.)	Stem Diameter, mm (in.)	Body/ Bonnet Wall Thickness, mm (in.)	Stem Diameter, mm (in.)	
15	3.2 (0.12)	10.7 (0.42)	3.3 (0.13)	12.3 (0.48)	3.6 (0.14)	12.3 (0.48)	1/2
20	3.6 (0.14)	10.7 (0.42)	3.8 (0.15)	12.3 (0.48)	4.2 (0.16)	12.3 (0.48)	3/4
25	4.0 (0.16)	12.3 (0.48)	4.3 (0.17)	15.5 (0.61)	4.8 (0.19)	15.5 (0.61)	1
32	4.4 (0.17)	12.3 (0.48)	4.8 (0.19)	15.5 (0.61)	5.1 (0.20)	15.5 (0.61)	1 1/4
40	4.8 (0.19)	13.9 (0.55)	5.2 (0.21)	18.7 (0.73)	5.5 (0.22)	18.7 (0.73)	1 1/2
50	5.5 (0.22)	15.5 (0.61)	6.1 (0.24)	18.7 (0.73)	6.2 (0.25)	18.7 (0.73)	2
65	5.8 (0.23)	15.5 (0.61)	6.5 (0.26)	18.7 (0.73)	7.1 (0.28)	21.8 (0.86)	2 1/2
80	6.0 (0.24)	18.7 (0.73)	6.9 (0.28)	21.8 (0.86)	7.9 (0.31)	25.0 (0.98)	3
100	6.4 (0.26)	21.8 (0.86)	7.8 (0.31)	25.0 (0.98)	9.6 (0.38)	28.2 (1.11)	4
150	7.2 (0.28)	25.0 (0.98)	9.4 (0.38)	31.3 (1.23)	13.1 (0.52)	37.6 (1.48)	6
200	8.0 (0.32)	28.2 (1.11)	11.1 (0.44)	34.4 (1.35)	16.3 (0.64)	40.7 (1.60)	8

Nominal Size, DN	Class 150		Class 300		Class 600		Nominal Size, NPS
	Body/ Bonnet Wall Thickness, mm (in.)	Stem Diameter, mm (in.)	Body/ Bonnet Wall Thickness, mm (in.)	Stem Diameter, mm (in.)	Body/ Bonnet Wall Thickness, mm (in.)	Stem Diameter, mm (in.)	
250	8.8 (0.35)	31.3 (1.23)	12.8 (0.51)	37.6 (1.48)	19.5 (0.77)	46.9 (1.84)	10
300	9.7 (0.38)	34.4 (1.35)	14.5 (0.58)	40.7 (1.60)	22.9 (0.90)	50.1 (1.97)	12
350	10.2 (0.40)	40.7 (1.60)	15.5 (0.62)	43.8 (1.72)	24.9 (0.98)	56.4 (2.22)	14
400	11.0 (0.43)	43.8 (1.72)	17.2 (0.68)	46.9 (1.84)	28.1 (1.11)	59.5 (2.34)	16
450	11.8 (0.47)	46.9 (1.84)	18.6 (0.74)	50.1 (1.97)	31.1 (1.22)	62.7 (2.47)	18
500	12.7 (0.50)	50.1 (1.97)	20.3 (0.81)	53.3 (2.09)	34.1 (1.34)	69.1 (2.72)	20
600	14.3 (0.56)	56.4 (2.22)	23.7 (0.94)	62.7 (2.47)	40.5 (1.60)	75.4 (2.97)	24

NOTE 1 See 5.8.1 and 5.8.3.

NOTE 2 Wall thickness calculated from equation of ASME B16.34, with minimum flow diameter (d) per ASME B16.34 for applicable valve DN or NPS and pressure class.

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, except that test collars or bands, either welded or integral, are allowed. Sharp discontinuities or abrupt changes in section in areas that infringe into the transition shall be avoided. In no case shall the thickness be less than $0.77t_m$ at a distance of $2t_m$ from the weld end.

5.2 Bonnet Wall Thickness

The minimum bonnet wall thickness at the time of manufacture, except for the part of the neck extension that contains the packing, shall be t_m, as given in Table 1. For the neck extension, the local minimum wall thickness shall be based on the local diameter, i.e., the inside diameter of the stem bore or packing box bore, and shall be in accordance with valve body neck rules of ASME B16.34.

5.3 Body

5.3.1 Flanged Ends

5.3.1.1 Body end flanges shall comply with the dimensional requirements of ASME B16.5. Unless otherwise specified, raised face end flanges shall be provided. The purchaser may specify a flange facing finish other than thatspecified in ASME B16.5.

5.3.1.2 Face-to-face dimensions shall be in accordance with ASME B16.10 or ISO 5752. Body end flanges and bonnet flangesshall be cast or forged integral with the body.

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 for Class 300 and above may be permitted by agreement between the purchaser and manufacturer.

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

5.3.2.3 Short pattern butt-welding end bolted bonnet valves are not permitted.

5.3.3 Body Seats

5.3.3.1 The inside diameter of the seat opening shall not be less than that specified in ASME B16.34 for the applicable valve DN or NPS and pressure class.

5.3.3.2 Body seats may be separate or integral with the body. When hardfacing is furnished, it shall be applied as a weld overlay of AWS A5.13 ECoCr-A or AWS A 5.21 ERCoCr-A, except as provided in 6.2.2, and shall have a minimum finished thickness of 1.6 mm (0.06 in.).

5.3.3.3 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 $\leq$ 50 (NPS $\leq$ 2) rolled or pressed-in seat rings may be used. Threaded seat rings shall be seal welded and shall be provided with lugs or slots to facilitate removal. The material used for seal welding shall provide corrosion resistance at least equal to the valve body material. Tack welding or stitch welding is not permitted.

5.3.3.4 Welding and any associated post-weld heat treatment shall be performed using qualified welders and established procedures in accordance with ASME Section IX and principles of ASME Section II, Part D.

5.3.3.5 Body seat rings shall have adequate seating area surface and shall have edges equipped with a radius orchamfer as necessary, to prevent galling or any other damage to the gate 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.

5.4 Bonnet

5.4.1 When designing the stem; gland; backseat; and (where supplied) a lantern ring, spacer ring, or combination thereof; the manufacturer shall consider the need for stem guiding, the prevention of packing extrusion, and avoidance of galling.

5.4.2 A machined conical or spherical backseat shall be provided in the bonnet to contact a corresponding seating surface on the valve stem. The backseat shall be either an integral surface or weld-deposited hardfacing with a minimum finished thickness of 1.6 mm (0.06 in.). Weld-deposited hardfacing is permissible as noted in 5.3.3.2 and asagreed upon by purchaser.

5.4.3 Bonnets shall be one-piece castings or forgings unless extended bonnets are required for cryogenic or high-temperature applications. Additional information for cryogenic service valves with bonnet extension can be found in MSS SP-134 and ISO 28921-1,

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 anchors shall not include openslotted 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 designation 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 with graphite covering layers;

— metal ring joint with hardness criteria as specified in ASME B16.20;

— 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 spirals from unwinding or buckling.

For Class 150 valves, the following are also acceptable:

— corrugated metal insert with graphite covering layers;

— 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 valves, the gasket shall not extend beyond the inner edge of the bolt holes.

5.5.6 Except for Class 150 valves and all valve classes in sizes DN 65 (NPS $2^1/_2$) and smaller, the bonnet-to-body flange gasket shall be circular.

5.5.7 Bonnet and body flange nut bearing surfaces shall be parallel to the flange face within $\pm$ 1°. Spot-facing orback-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 bolts/cap screws that provide uniform spacingand load distribution. For valves DN 25 (NPS 1) and larger, through-bolts shall be used in the bonnet joint. For valves DN 20 (NPS $^3/_4$) and smaller, through-bolts, headed bolts, or cap screws may be used. Cap screws, if used, shall besuitable for external wrenching only. The minimum stud bolt size for each valve size shall be as follows:

— M10 or $^{3}/_{8}$ in. when DN ≤ 65 (NPS ≤ $2^{1}/_{2}$);

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

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

5.5.9 The total cross-sectional area of the bolts in valve bonnet bolting shall be in accordance with the requirementsof 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 5.5.9 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.

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

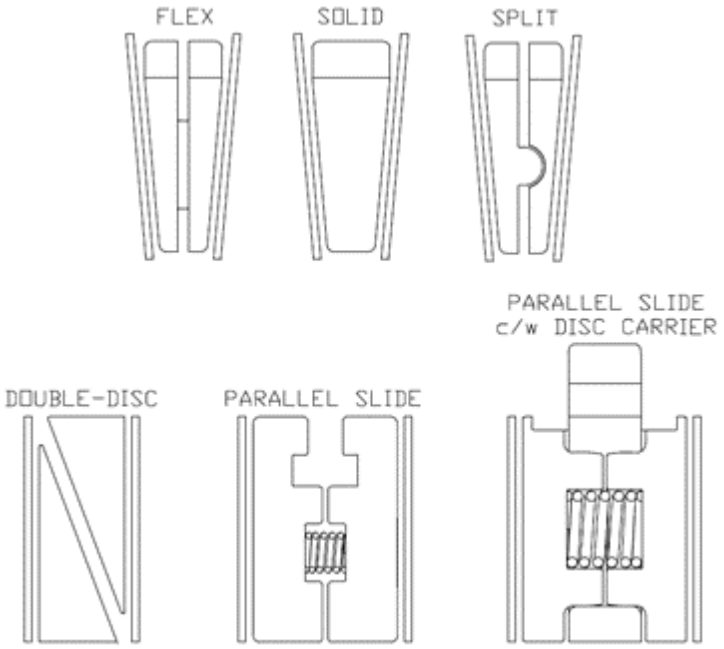


Figure 2—Types of Valve Gates

5.6.3 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 shall have a spreading mechanism (i.e., a wedging device or spring) that forces the two parallel discs to the body seats when closed.

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

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.)

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 by a distance, h, defined as wear travel. Wear travel is in a direction that is parallel with the valve stem (see Figure 3). The required minimum wear travel varies with valve size in accordance with Table 2.

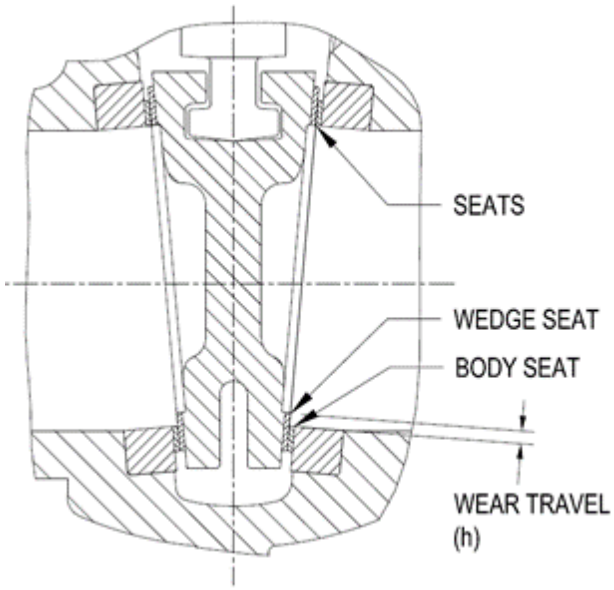


Figure 3—Wear Travel of a Wedge Gate

Table 2—Minimum Wear Travel and Maximum Stem Projection[a]

Valve Size Range, DN (NPS)	Wear Travel, *h* mm (in.)	Maximum StemProjection, mm (in.) [a]
15 ≤ DN ≤ 50 ($1/2$ ≤ 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)
[a] See 5.8.14		

5.6.7 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 alignment of the gate and stemin all orientations, without gate binding or galling. The possible loss of metal due to corrosion, erosion, abrasive wear,or a combination of these factors shall be considered in the design of the body and gate guide surfaces. Wedge guides, body guides, or both need not be hardfaced unless specified in the purchase order, or when required to allowfor proper valve operation in any orientation, including effects of wear or galling.

5.6.8 Wedge and body guides shall not protrude beyond the seat rings into the port area of the valve.

5.7 Yoke

5.7.1 The yoke may be either an integral part of the bonnet or a separate part.

5.7.2 Yokes that are separate shall have yoke-to-bonnet mating surfaces machined so as to assure a proper bearing assembly interface. Separate yokes shall be bolted to the bonnet with through-bolts.

5.7.3 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 The minimum diameter of the stem measured at the section that passes through the packing, d_s, shall be in accordance with Table 1. The actual stem diameter shall take into account the valve design details and the stem materials' strength characteristics. The stem strength shall be considered when calculating the momentary input force in accordance with MSS SP-91, from the handwheel, the chain wheel operator (if equipped) and the gearbox (if equipped). Stem thread root and relief undercut, when utilized, shall be sized appropriately.

5.8.2 The stem 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 handwheel attachment and for driving the operating stem thread. The handwheel- to-stem nut connection shall be secured to prevent loosening.

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 for either thread. The major diameter of the thread may be less than the diameter of the stem that passes through the packing (d_s, as per Table 1) by a maximum of 1.6 mm (0.063 in.). 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 $1^1/_2$ 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 surface area in contact with the packing shall have a surface finish, Ra, of 0.80 µm (32 µin.) or smoother.

5.8.6 Stem straightness of the stem shall be controlled to avoid part contact during operation and maintain low emission performance.

5.8.7 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.

5.8.8 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.

5.8.9 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.

5.8.10 The stem shall include a raised conical or spherical surface that seats against the bonnet backseat or backseat bushing when the gate is at its fully 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.

Warning—Adding or replacing packing while the valve is under pressure is not recommended.

5.8.11 The yoke shall retain the stem nut which links the handwheel to the stem. For valves larger than DN 150 (NPS 6) Class 150, DN 100 (NPS 4) Class 300 or DN 50 (NPS 2) Class 600, the stem nut arrangement shall be designed to:

a) Permit the removal of the handwheel, without allowing the stem and gate to drop into the closed position, if thehandwheel is removed when the valve is in the open position.

b) Allow the stem nut to be replaced, with the stem secured, without affecting the pressure-retaining capability of thebonnet assembly. However, replacement under pressure is not recommended.

5.8.12 Valves shall have a stem operated by a rotating stem nut mounted at the top of the yoke. The stem nut shallhave a hexagonal shank, a round shank with a keyway, or another drive of equivalent strength and durability for attachment to the handwheel.

5.8.13 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.

5.8.14 The closed-position stem thread projection beyond the stem nut on a new handwheel operated valve shall be equal to or greater than the minimum wear travel values listed in Table 2. The maximum stem projection distance shall be as indicated in Table 2.

5.8.15 Valves ≥ DN 150 (NPS 6) and pressure classes ≥ Class 600, shall be furnished with stem nuts having ball or roller bearings.

5.9 Packing and Packing Box

5.9.1 The nominal radial width of the packing shall be in accordance with Table 3. The packing may be square, rectangular, or trapezoidal in cross-section.

Table 3—Packing Box and Packing Dimensions

Packing Box and Packing Dimensions							
Nominal Stem Outside Diameter		Nominal Packing Width		Nominal Bore		Minimum Depth	
mm	in.	mm	in.	mm	in.	mm	in.
10.7	0.42	4.0	0.16	19.0	0.75	19.8	0.78
12.7	0.50	4.8	0.19	22.2	0.87	23.8	0.94
14.3	0.56	4.8	0.19	23.8	0.94	23.8	0.94
15.9	0.63	6.4	0.25	28.6	1.13	31.7	1.25
17.5	0.69	6.4	0.25	30.2	1.18	31.7	1.25
19.1	0.75	6.4	0.25	31.8	1.25	31.7	1.25
22.2	0.87	6.4	0.25	35.0	1.38	31.7	1.25
25.4	1.00	6.4	0.25	38.1	1.5	31.7	1.25
28.6	1.12	7.9	0.31	44.4	1.75	39.6	1.56
31.8	1.25	7.9	0.31	47.6	1.88	39.6	1.56
34.9	1.38	7.9	0.31	50.8	2.0	39.6	1.56
38.1	1.5	9.5	0.378	57.2	2.25	47.6	1.88

Packing Box and Packing Dimensions							
Nominal Stem Outside Diameter		Nominal Packing Width		Nominal Bore		Minimum Depth	
mm	in.	mm	in.	mm	in.	mm	in.
41.3	1.63	9.5	0.38	60.3	2.38	47.6	1.88
44.5	1.75	9.5	0.38	64.3	2.5	47.6	1.88
47.6	1.88	9.5	0.38	66.7	2.63	47.6	1.88
50.8	2.0	11.1	0.48	73.0	2.88	55.6	2.18
57.2	2.25	12.7	0.50	82.6	3.25	63.5	2.5
60.3	2.38	12.7	0.50	85.7	3.38	63.5	2.5
63.5	2.5	12.7	0.50	89.7	3.5	63.5	2.5
76.2	3.0	14.3	0.56	105.6	4.25	71.4	2.81
NOTE For stem diameters not listed, the packing width and packing box bore shall be determined by linear interpolation from those shown.							

5.9.2 The packing box shall meet the following requirements:

a) The nominal depth of the packing box shall accommodate a minimum of five uncompressed rings of packing.

b) The bottom of the packing box shall be flat.

c) The packing box surface area in contact with the packing material shall have a surface finish, Ra, of 4.5 µm (175 µin.) or smoother.

d) 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.

5.10 Packing Gland and Gland Flange

5.10.1 A gland and a separate gland flange shall be provided for packing compression.

5.10.2 The gland flange shall have two holes to receive the gland bolting. Slots for gland flange bolts shall not be used.

5.10.3 The gland and gland flange shall be self-aligning

5.10.4 The gland shall have a shoulder at its outer edge so as to prevent complete entry of the gland into the packing box.

5.10.5 Packing gland assembly (including gland flange, follower, bolting, and anchoring pins) shall have adequate strength to transmit load without permanent deformation

5.10.6 The packing gland length shall be designed to allow a minimum adjustment of one and one-half times the packing width, specified in Table 3, after packing compression

5.11 Lantern Ring

A lantern ring shall be furnished only if specified in the purchase order. In order to accommodate the lantern ring, the stuffing box depth shall be at least equivalent to that of a minimum of three uncompressed rings of packing above the lantern ring and three uncompressed rings of packing below the lantern ring, plus the length of the lantern ring.

5.12 Bolting

5.12.1 Bolting shall be standard inch series bolting, except if the purchaser specifies metric series bolting. Bolting for the bonnet-to-body joint shall be continuously threaded stud bolts with heavy, semi-finished hexagon nuts that are in accordance with ASME B18.2.2 or ASME B18.2.6M. Headed bolts (ASME B18.2.3.5M, ASME B18.2.3.6M) are permitted, but shall be limited to Class 150 in sizes DN 200 (NPS 8) and smaller and Class 300 in sizes DN 150 (NPS6) and smaller. Cap screws may be utilized for bonnet bolting for valves DN 20 (NPS $^3/_4$) and smaller.

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

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

5.12.4 Bolting with diameters M24 (1 in.) and smaller shall have coarse (UNC) threads or the most nearly corresponding metric threads. Bolting with diameters larger than M24 (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 tolerance Class 6H, in accordance with ASME B1.13M.

5.12.5 A minimum of one 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.

5.13 Operation

5.13.1 Unless otherwise specified by the purchaser, the valve shall be supplied with a direct-operated handwheelthat opens the valve when turned in a counter-clockwise direction.

5.13.2 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 fabrication.

5.13.3 Fabricated handwheels shall have strength and toughness characteristics comparable to that of handwheels made as one-piece castings or forgings.

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

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

5.13.6 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:

— the dimension from the centerline of the valve stem or gear input shaft to the bottom of the chain loop (for chainwheel operation only);

— 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;

— maximum rim pull;

— power supply attributes for power actuators (including maximum differential pressure).

5.13.7 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.

5.13.8 The manufacturer shall provide in their installation and operation manual any operational limitation as a result of stem and valve orientation

5.14 Bypasses and Other Auxiliary Connections

Auxiliary connections and tapped test openings to the body, bonnet, or both—such as drains—shall be furnished only ifspecified in the purchase order. The design and construction of the joint and the piping of auxiliary connections shallconform to the requirements of ASME B16.34. When required for valve DN 50 (NPS 2) or larger, auxiliary connections shall be sized and located as specified in ASME B16.34. The size and location of auxiliary connectionsshall be indicated in the purchase order.

5.15 Fugitive Emission Design Requirement

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

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

6 Materials

6.1 Materials Other Than Trim Materials

Materials for body, bonnet, and valve parts other than trim items shall be selected from Table 4 and shall be listed on the valve general arrangement drawing or bill of materials. See Annex C for identification of valve terms.

Table 4—Materials for Parts

Part	Material
Body and bonnet	As selected from ASME B16.34, Group 2 and Group 3.
Gate/disc	Equal in corrosion resistance to that of the body material.
Yoke (separate part)	Carbon steel, austenitic stainless steel or same nominal chemical composition as the body.
Bolting: bonnet-to-body [a]	Unless otherwise specified, heavy hex bonnet bolting shall be ASTM A193 Grade B8 bolts with ASTM A194 Grade 8 nuts, ASTM A193 Grade B8C bolts with ASTM A194 Grade 8C nuts, or ASTM A193 Grade B8M bolts with ASTM A194 Grade 8M nuts.
Bonnet gasket	Unless otherwise specified, the bonnet gasket shall be suitable for a fluid temperature range from –29 °C (–20 °F) to 427 °C (800F). The metallic portion shall be of a material that has a corrosion resistance at least equal to that of the body material. Filler material of spiral-wound gasket shall be flexible graphite unless otherwise specified.

Part	Material
Bolting: gland and yoke	Unless otherwise specified, gland bolts and nuts shall be made of 18Cr-8Ni steel or equal in corrosion resistance to that of the body material.
Seat ring	When separate body seat rings are used, they shall be of the same nominal chemical composition as the body or stem. When a hardfacing material is used for the body seat, this material may be weld-deposited directly on the valve body or on separate seat rings.
Gland flange	Steel, austenitic stainless steel or same nominal chemical composition as the body.
Gland	Equal in corrosion resistance to that of the body material.
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. The purchaser may specify alternate material. Note—Effective low emissions performance may be limited to lower temperatures.
Lantern ring or spacer ring	Equal in corrosion resistance to that of the body or stem material.
Stem nut	13Cr steel, austenitic ductile iron (ASTM A439 Type D-2 or Type D-2C), austenitic stainless steel or copper alloy with a melting point above 954 °C (1750 °F).
Handwheel	Unless otherwise specified, the handwheel shall be malleable iron, carbon steel, or ductile iron.
Handwheel nut (retaining)	Carbon steel, malleable iron, ductile iron, 13Cr steel, austenitic stainless steel, or non- ferrous copper alloy.
Plugs for tapped connections	Equal in corrosion resistance to that of the body material.
Bypass piping and valves	Equal in corrosion resistance to that of the body material.
Pin, double-disc stem-to-gate	Equal in corrosion resistance to that of the stem material.
Identification plate	Austenitic stainless steel or nickel alloy. ≥ DN 150 (NPS 6): attached to the valve by corrosion-resistant fasteners or by welding. < DN 150 (NPS 6): method of attachment shall be manufacturer's standard.

[a] Includes carbide solution treated and strain hardened grades.

6.2 Trim

6.2.1 The trim comprises the following:

a) the stem;

b) body seating surface;

c) gate seating surface;

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

e) small internal parts that normally contact the service fluid (i.e., stem connections, internal pins or screws, and thespreading mechanism of a double-disc valve).

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 5 for the trim number specified in the purchase order. The typical specifications included in Table 5 represent some acceptable grades.

a) If a trim number listed in Table 5 is specified, an alternative trim number as shown in Table 6 may be furnished.

b) 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 5.

c) If a combination seating surface material is furnished (e.g., trim 11), the seating surface of the body seat ring shall be made of one of the two types of material shown in Table 5, and the seating surface of the gate shall be made of the other type of material shown.

d) 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 5. The stem shall be a wrought material.

e) 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 5.

f) 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 5.

g) 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.

Table 5—Nominal Seating Surfaces, Stem, or Weld-Deposited Materials and Hardness

Trim No. (CN)	Nominal Trim	Seating Surface Hardness (HB) Minimum [a]	Seating Surface Material Type [b]	Seating Surface Typical Specifications Grade			Stem/Backseat Bushing [p]			Backseat Bushing Hardness (HB)
				Cast	Forged	Welded [m]	Material Type [b]	Typical Specifications Type	Stem Hardness (HB)	
1	F6	TRIM NUMBER 1 IS OBSOLETE								
2	304	Note d	18Cr-8Ni	ASTM A351 (CF8)	ASTM A182 (F304)	AWS A5.9 ER308	18Cr-8Ni	ASTM A276-T304	Note d	Note d
3	F310	Note d	25Cr-20Ni	NA	ASTM A182 (F310)	AWS A5.9 ER310	25Cr-20Ni	ASTM A276-T310	Note d	Note d
4	p									
5	p									
5A	p									
6	p									
7	p									
8	p									
8A	p									
9	Monel	Note d	Ni-Cu Alloy	NA	MFG Standard	NA	Ni-Cu Alloy	MFG Standard	Note d	Note d
10	316	Note d	18Cr-8Ni-Mo	ASTM A351 (CF8M)	ASTM A182 (F316)	AWS A5.9 ER316	18Cr-8Ni-Mo	ASTM A276-T316	Note d	Note d
11	Monel and Hardfaced	Note d 350 i	Ni-Cu Alloy and CoCr-A or Ni-Cr	NA	MFG Standard	NA AWS A5.13 ECoCr-A or AWS A5.21 ERCoCr-A	Ni-Cu Alloy NA	MFG Standard NA	Note d NA	Note n
12	316 and Hardfaced	Note d 350 i	18Cr-8Ni-Mo CoCr-A or Ni-Cr	ASTM A351 (CF8M)	ASTM A182 (F316)	AWS A5.9 ER316 AWS A5.13 ECoCr-A or AWS A5.21 ERCoCr-A	18Cr-8Ni-Mo NA	ASTM A276-T316 NA	Note d NA	Note n
13	Alloy 20	Note d	19Cr-29Ni	ASTM A351 (CN7M)	ASTM B462	AWS A5.9 ER320	19Cr-29Ni	ASTM B473	Note d	Note d

Trim No. (CN)	Nominal Trim	Seating Surface Hardness (HB) Minimum [a]	Seating Surface Material Type [b]	Seating Surface Typical Specifications Grade			Stem/Backseat Bushing [p]			Backseat Bushing Hardness (HB)
				Cast	Forged	Welded [m]	Material Type [b]	Typical Specifications Type	Stem Hardness (HB)	
14	Alloy 20 and Hardfaced	Note d 350 [i]	19Cr-29Ni and CoCr-A or Ni-Cr	ASTM A351 (CN7M) NA	ASTM B473 NA	AWS A5.9 ER320 AWS A5.13 ECoCr-A or AWS A5.21 ERCoCr-A	19Cr-29Ni NA	ASTM B473 NA	Note d NA	Note n
15	Hardfaced	350 [e]	CoCr-A [g]	NA	NA	AWS 5.13 ECoCr-A	18Cr-8Ni	ASTM A276-T304	Note d	Note n
16	Hardfaced	350 [e]	CoCr-A [g]	NA	NA	AWS 5.13 ECoCr-A	18Cr-8Ni-Mo	ASTM A276-T316	Note d	Note n
17	Hardfaced	350 [e]	CoCr-A [g]	NA	NA	AWS 5.13 ECoCr-A	18Cr-10Ni-Cb	ASTM A276-T347	Note d	Note n
18	Hardfaced	350 [e]	CoCr-A [g]	NA	NA	AWS 5.13 ECoCr-A	19Cr-29Ni	ASTM B473	Note d	Note n
19	Nickel [o]	Note d	Ni Alloy	MFG Standard [o]	MFG Standard [o]	MFG Standard	Ni Alloy o	MFG Standard o	Note d	Note d
19A	Alloy 625	Note d	22Cr-58Ni	ASTM A494 (CW6MC)	ASTM B564 UNS N06625	AWS A5.14 ERNiCrMo-3	22Cr-58Ni	ASTM B564 UNS N06625	Note d	Note d
19B	Alloy C276	Note d	15Cr-54Ni	ASTM A494 (CW2M)	ASTM B564 UNS N10276	AWS A5.14 ERNiCrMo-4	15Cr-54Ni	ASTM B564 UNS N10276	Note d	Note d
19C	Alloy 825	Note d	21.5Cr-42Ni	ASTM A494 (CU5MCuC)	ASTM B564 UNS N08825	AWS A5.14 ERNiCrMo-3	21.5Cr-42Ni	ASTM B564 UNS N08825	Note d	Note d
20	Nickel [o] and Hardfaced	Note d	Ni Alloy	MFG Standard [o]	MFG Standard [o]	NA	Ni Alloy [o]	MFG Standard [o]	Note d	Note n
		350 [i]	CoCr-A [g]	NA	NA	AWS 5.13 ECoCr-A AWS 5.21 ERCoCr- A				
20A	Alloy 625 and Hardfaced	Note d	22Cr-58Ni	ASTM A494 (CW6MC)	ASTM B564 UNS N06625	AWS A5.14 ERNiCrMo-3	22Cr-58Ni	ASTM B564 UNS N06625	Note d	Note n
		350 [i]	CoCr-A [g]	NA	NA	AWS 5.13 ECoCr-A AWS 5.21 ERCoCr- A				
20B	Alloy C276 and Hardfaced	Note d	15Cr-54Ni	ASTM A494 (CW2M)	ASTM B564 UNS N10276	AWS A5.14 ERNiCrMo-4	15Cr-54Ni	ASTM B564 UNS N10276	Note d	Note n
		350 [i]	CoCr-A [g]	NA	NA	AWS 5.13 ECoCr-A or AWS 5.21 ERCoCr-A				

Trim No. (CN)	Nominal Trim	Seating Surface Hardness (HB) Minimum [a]	Seating Surface Material Type [b]	Seating Surface Typical Specifications Grade			Stem/Backseat Bushing [p]			Backseat Bushing Hardness (HB)
				Cast	Forged	Welded [m]	Material Type [b]	Typical Specifications Type	Stem Hardness (HB)	
20C	Alloy 825 and Hardfaced	Note d	21.5Cr-42Ni	ASTM A494 (CU5MCuC)	ASTM B564 UNS N08825	AWS A5.14 ERNiCrMo-3	21.5Cr-42Ni	ASTM B564 UNS N08825	Note d	Note n
		350 [i]	CoCr-A [g]	NA	NA	AWS 5.13 ECoCr-A or AWS 5.21 ERCoCr-A				
21	Hardfaced o	350 [e]	CoCr-A [g]	NA	NA	AWS 5.13 ECoCr-A AWS 5.21 ERCoCr-A	Ni Alloy [o]	MFG Standard [o]	Note d	Note n

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

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

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

[c] Body and closure element seating surfaces should be 250 HB minimum with a 50 HB minimum differential between the body and closure element seating surfaces.

[d] Manufacturer's standard hardness.

[e] Differential hardness between the body and closure element seating surfaces is not required.

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

[g] This classification includes such trademark materials as Stellite 6™ *, Stoody 6™ * and Wallex 6™ *, the use of CoCr-E (Stellite 21™ *) or equal is an acceptable substitution for CoCr-A in globe and check valves.

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

[i] Hardness differential between the body and closure element seating surfaces shall be the manufacturer's standard.

[j] Not used.

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

[l] Not used.

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

[n] Per manufacture's standard if no hardfaced, 250 HB minimum if hardfaced

[o] 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.

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

[q] These trims are removed intentionally due to specifying materials of lower corrosion resistance than the standard's base body material

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

Table 6—Trim Numbers and Alternative Trim Numbers

Specified Trim Number	Alternative Trim Number
10	12 or 16
13	14
12	16

7 Testing, Inspection, and Examination

7.1 Inspection and Examination

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

7.1.2 Cast surfaces of pressure boundary parts shall be visually inspected in accordance with MSS SP-55.

7.1.3 Inspection and examination shall be in accordance with API 598.

7.2 Pressure Tests

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

7.3 Repairs of Defects

Defects in the shell of a cast or forged valve that are revealed by inspection or testing shall be repaired as permittedby the most nearly applicable ASTM cast or forged material specification listed in ASME B16.34.

7.4 Supplementary Requirements

Supplementary examination and testing (such as alloy verification [Positive Material Identification], corrosion testing,Nondestructive Examination requirements, or other types) are required when specified in the purchase order.

8 Marking

8.1 General

Valves shall be marked in accordance with the requirements of ASME B16.34, except that the nameplate shall include the designation “API 603” in addition to the designation “ASME B16.34.”

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 have a tag attached indicating the packing material (e.g., “PTFE Packing,” “Graphite Packing”).

9 Preparation for Shipment

9.1 Coatings

Except for the handwheel or non-corrosion resistant material parts, valve parts shall not be painted.

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. The protective cover surface in direct contact with the flange sealing surface shall not be of a porous material which allows moisture to accumulate on the sealing surface. Covers shall be designed so that the valve cannot be installed without the removal of the protective cover.

9.2.2 Tapped connections shall be fitted with fully tightened and sealed threaded solid plugs. The material used for plugs shall comply with Table 4.

9.3 Gate Position

The valve shall be shipped with the gate closed and with the stem threads lubricated.

9.4 Stem Packing

The valve shall be shipped with the lantern ring, if specified, and the packing installed (see 5.9.2). Unless specified otherwise by the purchaser, the packing gland bolts shall be tightened for shipment.

9.5 Packaging

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

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

9.6 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.

Annex A
(informative)

API Monogram Program
Use of the API Monogram by Licensees

The information in this annex has been intentionally removed.

See API Specification Q1 (Annex A) 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

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

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

2) If no supplemental requirements are to be taken, the purchase order just needs to refer to API 603 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 * (see 1.1);

b) pressure class * (see 1.1);

c) flanged ends, including flange facing finish; or welding ends, including bore * (see 5.3.1.1 and 5.3.2.1);

d) auxiliary connections and openings (see 5.12);

e) butt weld end-to-end dimension (see 5.3.2.2);

f) hardfaced seating surfaces (see 5.6.3);

g) stuffing box finish (see 5.9.2);

h) hardfaced backseat (see 5.4.2);

i) additional hard facing of body guides, or wedge guides, or a combination thereof (see 5.6.5);

j) bonnet gasket (see Table 4);

k) tapped openings (see 5.4.5);

l) wedge gate or double-disc gate; also type of wedge, if required * (see 5.6.1.1 and 5.6.1.2);

m) lantern ring (see 5.9.4);

n) metric series bolting (see 5.10.1);

o) gear operation, including type and arrangement, and the design maximum pressure differential across he valve (see 5.11.5 and 5.11.6);

p) power operation, including type of power and power unit, and the design maximum pressure differential across the valve (see 5.11.5 and 5.11.6);

q) bypass—specify either flanged or welded bonnet bypass valve (see 5.12);

r) material of the valve shell * (see Table 4);

s) nominal trim material * (see 6.2.2);

t) handwheels (see 5.11.1 and 5.11.2);

u) alternate stem packing material (see Table 4);

v) bonnet bolting material (see Table 4);

w) inspection by purchaser (see 7.1.2);

x) flow direction marking (see 8.2);

y) supplementary examination and testing (see 7.4);

z) export packaging (see 9.5).

Annex C
(informative)

Identification of Valve Terms

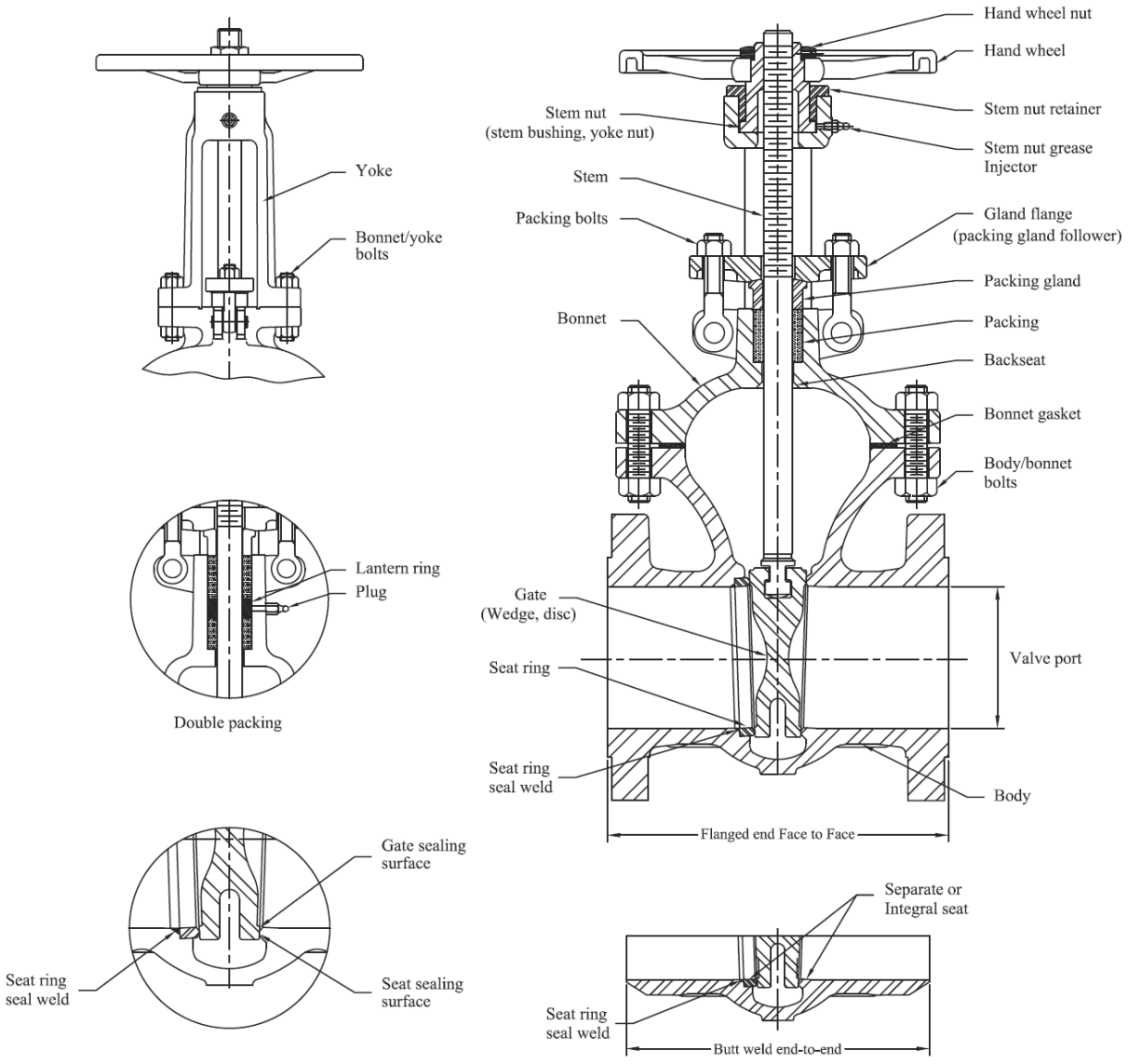


Figure C.1—Valve Nomenclature

Annex D
(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—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	Bonnet-to-Body and Body-to-Cover Bolting ASTM Specification
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	B7/2H, B7M/2HM B7/2H [b] B8M-CL2/8M [b,c,d] B8M-CL2/8M [b,c,d]
1.2	C-Mn-Si C-Mn-Si-V 2 1/2Ni 3 1/2Ni	A216-WCC A352-LCC A350-LF6-CL2 A352-LC2 A352-LC3	8, 8A 8, 8A 10 10 10	B7/2H, B7M/2HM B7/2H, B7M/2HM B8M-CL2/8M [b,c,d] B8M-CL2/8M [b,c,d] B8M-CL2/8M [b,c,d]
1.3	C-Si C-1/2Mo	A352-LCB A217-WC1 A352-LC1	8, 8A 8, 8A 10	B7/2H, B7M/2HM B7/2H, B7M/2HM B8M-CL2/8M [b,c,d]
1.4	C-Mn-Si	A350-LF1	8	B7/2H, B7M/2HM
1.5	C-1/2Mo	A182-F1	8	B7/2H, B7M/2HM
1.7	1/2Cr-1/2Mo NI-1/2Cr-1/2Mo 3/4Ni-3/4Cr-1Mo	A182-F2 A217-WC4 A217-WC5	8	B7/2H, B7M/2HM
1.9	1 1/4Cr-1/2Mo 1 1/4Cr-1/2Mo-Si	A217-WC6 A182-F11-CL2	8	B16/8M [e]
1.10	2 1/4Cr-1Mo	A182-F22-CL3 A217-WC9	8	B16/8M [e]
1.13	5Cr-1/2Mo	A182-F5a or A217-C5	8	B16/8M [e]
1.14	9Cr-1 Mo	A182-F9 or A217-C12	8	B16/8M [e]
1.15	9Cr-1Mo-V	A182-F91-Type1 A217-C12A	8	B16/8M [e]
1.17	1Cr-1/2Mo 5Cr-1/4Mo	A182-F12-CL2 A182-F5	8	B16/8M [e]

NOTE 1 For Table D.1 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.

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

NOTE 1 For bolting materials in accordance with EN 10269, see Table D.4.

NOTE 2 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.

Superscript notes below apply to Table D.1 and Table D.2

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

[b] ASTM A320, Gr L7 bolts and ASTM A194, Gr 7 nuts may also be used.

[c] ASTM A193, Gr B8-CL1, Gr B8A-CL1A, Gr B8M-CL1, Gr B8MA-CL1A, Gr B8M2-CL2B, and Gr B8M3-CL2C bolting is a suitable substitute provided that the requirements of 5.5.8 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—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	Bonnet-to-Body and Body-to-Cover Bolting ASTM Specification [a,b]
3.1	35Ni–35Fe–20Cr–Cb	B462 N08020	13, 14	B473 N08020
3.2	99Ni	B564 N02200	19, 20	B164 N04400 [d]
3.4	67Ni-30Cu 67Ni-30Cu-S	B564 N04400/A494 M-35–1 A494 M-35–2	9, 11	B164 N04400 [d]
3.5	72Ni–15Cr–8Fe	B564 N06600	19, 20	B166 N06600 [c]
3.6	33Ni–42Fe–21Cr	B564 N08800	19, 20	B408 N08800 [e]
3.7	65Ni-28Mo-2Fe 64Ni-29.5Mo-2Cr-2Fe-Mn-W	B462 N10665 B564 N10665 B462 N10675 B564 N10675	19, 20	B335 N10665 [d] B335 N10675 [d]
3.8	54Ni-16Mo-15Cr	B462 N10276	19B, 20B	B574 N10276
	60Ni-22Cr-9Mo-3.5Cb 42Ni-21.5Cr-3Mo-2.3Cu	B564 N06625 B564 N08825	19A, 20A 19C, 20C	B637 N07718 B637 N07718
	55Ni-21Cr-13.5Mo 55Ni-23Cr-16Mo-1.6Cu	B462 N06022 B462 N06200	19, 20 19, 20	B574 N10276 B574 N10276
3.12	46Fe-24Ni-21Cr-6Mo-Cu-N 58Ni-33Cr-8Mo	B462 N08367/A351 CN3MN B462 N06035	19, 20	B637 N07718
3.13	Ni–Fe–Cr–Mo–Cu–Low C	B564 N08031	19, 20	B574 N10276 B574 N06022
3.14	40Ni–29Cr–15Fe–5Mo	B462 N06030	19, 20	
3.15	42Ni–2Fe–21Cr Ni–Mo Ni–Mo–Cr	B564 N08810 A494 N-12MV A494 CW-12MW	19, 20	B408 N08800 [e] B574 N10276
3.17	29Ni–20½Cr–3½Cu–2½Mo	A351 CN7M	19, 20	B574 N10276
3.19	57Ni–22Cr–14W–2Mo–La	B564 N06230	19, 20	B408 N08800 [e]

NOTE 1 If alternative bolting material are used, temperature limitation from Table D.2 is applicable.

NOTE 2 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.

[a] Bolting materials are suggested to help with material selection, ASTM A193, B8M-CL1, and Gr B8M-CL2 bolting are acceptable as agreed between the manufacturer 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. (63.5 mm).

[d] Material specifications have maximum diameter limit of 3.5 in. (88.9 mm).

[e] Materials have yield strength below 50 ksi, alternative higher strength bolting may be required to satisfy joint design requirements.

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

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

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).

200 Massachusetts Avenue, NW
Suite 1100
Washington, DC 20001-5571
USA

202-682-8000

Information about API publications, programs and services is available on the web at www.api.org.

Product No. C60310