

# Corrosion-Resistant, Bolted Bonnet Gate Valves—Flanged and Butt-Welding Ends

API STANDARD 603  
SIXTH EDITION, MAY 2001



**Helping You  
Get The Job  
Done Right.<sup>SM</sup>**



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**Downstream Segment**

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## FOREWORD

This standard is a purchase specification for corrosion-resistant gate valves with flanged or butt-welding ends. This standard is for the convenience of purchasers and manufacturers who order, fabricate, or install these gate valves.

This standard requires the purchaser to specify certain details and features. Although it is recognized that the purchaser may desire to modify, delete, or amplify sections of this standard, it is strongly recommended that such modifications, deletions, and amplifications be made supplementing this standard, rather than by rewriting or incorporating sections thereof into another complete standard.

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Asbestos is specified or referenced for certain components of the equipment described in some API standards. It has been of extreme usefulness in minimizing fire hazards associated with petroleum processing. It has also been a universal sealing material, compatible with most refining fluid services.

Certain serious adverse health effects are associated with asbestos, among them the serious and often fatal diseases of lung cancer, asbestosis, and mesothelioma (a cancer of the chest and abdominal linings). The degree of exposure to asbestos varies with the product and the work practices involved.

Consult the most recent edition of the Occupational Safety and Health Administration (OSHA), U.S. Department of Labor, Occupational Safety and Health Standard for Asbestos, Tremolite, Anthophyllite, and Actinolite, 29 *Code of Federal Regulations* Section 1910.1001; the U.S. Environmental Protection Agency, National Emission Standard for Asbestos, 40 *Code of Federal Regulations* Sections 61.140 through 61.156; and the U.S. Environmental Protection Agency (EPA) rule on labeling requirements and phased banning of asbestos products (Sections 763.160-179).

There are currently in use and under development a number of substitute materials to replace asbestos in certain applications. Manufacturers and users are encouraged to develop and use effective substitute materials that can meet the specifications for, and operating requirements of, the equipment to which they would apply.

SAFETY AND HEALTH INFORMATION WITH RESPECT TO PARTICULAR PRODUCTS OR MATERIALS CAN BE OBTAINED FROM THE EMPLOYER, THE MANUFACTURER OR SUPPLIER OF THAT PRODUCT OR MATERIAL, OR THE MATERIAL SAFETY DATA SHEET.

## NOTES TO PURCHASER

1. If the purchaser needs a corrosion resistant gate valve that deviates from the specifications of this standard, the deviations shall be specifically stated in the purchase order.
2. If no exceptions are to be taken to this standard, the purchase order just needs to refer to API Standard 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 facing; or welding ends, including bore (see 4.1.5 and 4.1.6).
- d. Auxiliary connections and openings (see 4.1.7 and 4.1.8).
- \*e. Wedge gate or double-disc gate; also type of wedge, if required (see 4.3).
- f. Lantern ring, if required (see 4.7.4).
- g. Chainwheel and chain, if required (see 4.9.2).
- h. Gear operation, if required, including type and arrangement, and the design maximum pressure differential across the valve (see 4.9.3).
- i. Power operation, if required, including type of power and power unit, and the design maximum pressure differential across the valve (see 4.9.4).
- j. Bypass, if required. Specify either flanged or welded bonnet bypass valve (see 4.10).
- \*k. Material of the valve shell and trim (see 5.1 and 5.9.3).
- l. Safety shield, if required (see 4.11 and 5.13).
- m. Bonnet gasket and/or bonnet flange facing (see 4.2.3, and 5.3).
- n. Alternate stem packing material, if required (see 5.10).
- o. Bonnet bolting material (see 5.11).
- p. Inspection by the purchaser, if required (see 6.1).
- q. High pressure closure test, if required (see 6.2).
- r. Export packaging, if required (see 8.5.2).
- s. Handwheels (see 5.6.1).

3. Refer to API Standard 598 for additional items that may have to be specified, such as the extent of inspection, the inspector's address, and the optional high-pressure closure test.

# Corrosion-Resistant, Bolted Bonnet Gate Valves—Flanged and Butt-Welding Ends

## 1 Scope

**1.1** This standard covers corrosion-resistant bolted bonnet gate valves with flanged or butt-weld ends in sizes NPS  $\frac{1}{2}$  through 24, corresponding to nominal pipe sizes in ASME B36.10M, and Classes 150, 300, and, 600, as specified in ASME B16.34.

**1.2** This standard covers requirements for corrosion resistant gate valves for use in process piping applications. Covered are requirements for outside-screw-and-yoke (OS&Y) valves with rising stems, non-rising hand-wheels, bolted bonnets, and various types of gate configurations.

**1.3** Figure 1 illustrates a bolted bonnet gate valve for the purpose of establishing standard nomenclature for valve parts.

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

## 2 Referenced Publications

The most recent edition or revision of the following standards, codes, or specifications shall, to the extent specified, form a part of this standard:

### API

Std 598	<i>Valve Inspection and Testing</i>
Std 600	<i>Steel Gate Valves—Flanged and Butt-Welding Ends, Bolted and Pressure Seal Bonnets</i>
Std 602	<i>Compact Steel Gate Valves—Flanged, Threaded, Welding, and Extended Body Ends</i>

### ASME<sup>1</sup>

B1.1	<i>Unified Inch Screw Threads (UN and UNR Thread Form)</i>
B1.5	<i>Acme Screw Threads</i>
B1.8	<i>Stub Acme Screw Threads</i>
B1.12	<i>Screw Threads—Class 5 Interference-Fit Thread</i>
B16.5	<i>Pipe Flanges and Flanged Fittings</i>
B16.10	<i>Face-to-Face and End-to-End Dimensions of Valves</i>
B16.11	<i>Forged Steel Fittings, Socket-Welding and Threaded</i>
B16.25	<i>Butt-Welding Ends</i>
B16.34	<i>Valves—Flanged, Threaded, and Welding End</i>
B18.2.2	<i>Square and Hex Nuts (Inch Series)</i>
B31.3	<i>Process Piping</i>

<sup>1</sup>ASME International, 3 Park Avenue, New York, New York 10016-5990

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

### ASTM<sup>2</sup>

A 193	<i>Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service</i>
A 194	<i>Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service</i>

### AWS<sup>3</sup>

A5.13	<i>Specification for Solid Surfacing Welding Rods and Electrodes</i>
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## 3 Pressure-Temperature Ratings

**3.1** Pressure-temperature ratings for valves covered by this standard shall be those listed for the appropriate material under Standard Class in ASME B16.34. Each pressure rating is the maximum allowable sustained non-shock pressure at the corresponding tabulated temperature. Linear interpolation is permitted.

## 4 Design

### 4.1 BODY

**4.1.1** The wall thickness of the body shall not be less than that shown in Table 1A or 1B.

**4.1.2** The face-to-face dimensions of raised face flanged end valves and end-to-end dimensions of butt-welding end valves shall conform to the requirements of ASME B16.10. Short pattern butt-welding end bolted bonnet valves are not permitted.

**4.1.3** Body seats may be separate or integral with the body. When hard facing is furnished, it shall be applied as a weld overlay of CoCr-A and shall have a minimum finished thickness of 0.06 in. (1.6 mm).

Separate seat rings may be shoulder seated or bottom seated. They may be threaded, rolled, pressed, or welded in. Threaded seat rings shall be provided with lugs or slots to facilitate removal. A light lubricant, not heavier than kerosene, may be used to facilitate assembly of threaded, rolled, or pressed seat rings, but the use of sealing compound or grease is prohibited.

The seating surfaces of the seat rings shall have a corner break, chamfer, or radius at the outside and inside diameters.

<sup>2</sup>American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, Pennsylvania 19428-2959

<sup>3</sup>American Welding Society, 550 N.W. LeJeune Road, Miami, Florida 33135

Table 1A—Minimum Thickness of Shell Wall and Minimum Diameter of Stem, in Inches

Valve Size NPS	Class					
	150		300		600	
	Shell Wall Thickness	Stem Diameter	Shell Wall Thickness	Stem Diameter	Shell Wall Thickness	Stem Diameter
1/2	0.11	7/16	0.12	1/2	0.13	1/2
3/4	0.12	7/16	0.15	1/2	0.16	1/2
1	0.16	1/2	0.19	5/8	0.19	5/8
1 1/4	0.19	1/2	0.19	5/8	0.19	5/8
1 1/2	0.19	9/16	0.19	3/4	0.22	3/4
2	0.22	5/8	0.25	3/4	0.25	3/4
2 1/2	0.22	5/8	0.25	3/4	0.28	7/8
3	0.22	3/4	0.28	7/8	0.31	1
4	0.25	7/8	0.31	1	0.38	1 1/8
6	0.28	1	0.38	1 1/4	0.50	1 1/2
8	0.31	1 1/8	0.44	1 3/8	0.62	1 5/8
10	0.34	1 1/4	0.50	1 1/2	0.75	1 7/8
12	0.38	1 3/8	0.56	1 5/8	0.91	2
14	0.41	1 5/8	0.62	1 3/4	0.97	2 1/4
16	0.44	1 3/4	0.69	1 7/8	1.09	2 3/8
18	0.47	1 7/8	0.75	2	1.22	2 1/2
20	0.50	2	0.81	2 1/8	1.34	2 3/4
24	0.57	2 1/4	0.94	2 1/2	1.59	3

Note: The shell comprises the body and the bonnet. The diameters listed are for the stem in the packing area and for the major diameter of the operating threads. An undertolerance is permitted as shown in Table 4. For dimensions in millimeters, see Table 1B.

Table 1B—Minimum Thickness of Shell Wall and Minimum Diameter of Stem, in Millimeters

Valve Size NPS	Class					
	150		300		600	
	Shell Wall Thickness	Stem Diameter	Shell Wall Thickness	Stem Diameter	Shell Wall Thickness	Stem Diameter
1/2	2.8	11.1	3.0	12.7	3.3	12.7
3/4	3.0	11.1	3.8	12.7	4.1	12.7
1	4.0	12.7	4.8	15.9	4.8	15.9
1 1/4	4.8	12.7	4.8	15.9	4.8	15.9
1 1/2	4.8	14.3	4.8	19.1	5.6	19.1
2	5.6	15.9	6.4	19.1	6.4	19.1
2 1/2	5.6	15.9	6.4	19.1	7.1	22.2
3	5.6	19.1	7.1	22.2	7.9	25.4
4	6.4	22.2	7.9	25.4	9.7	28.6
6	7.1	25.4	9.7	31.8	12.7	38.1
8	7.9	28.6	11.2	34.9	15.8	41.3
10	8.6	31.8	12.7	38.1	19.0	47.6
12	9.7	34.9	14.2	41.3	23.1	50.8
14	10.4	41.3	15.7	44.5	24.6	57.2
16	11.2	44.5	17.5	47.6	27.7	60.3
18	11.9	47.6	19.1	50.8	31.0	63.5
20	12.7	50.8	20.6	54.0	34.0	69.9
24	14.5	57.2	23.9	63.5	40.4	76.2

Note: The shell comprises the body and the bonnet. The diameters listed are for the stem in the packing area and for the major diameter of the operating threads. An undertolerance is permitted as shown in Table 4. For dimensions in inches, see Table 1A.

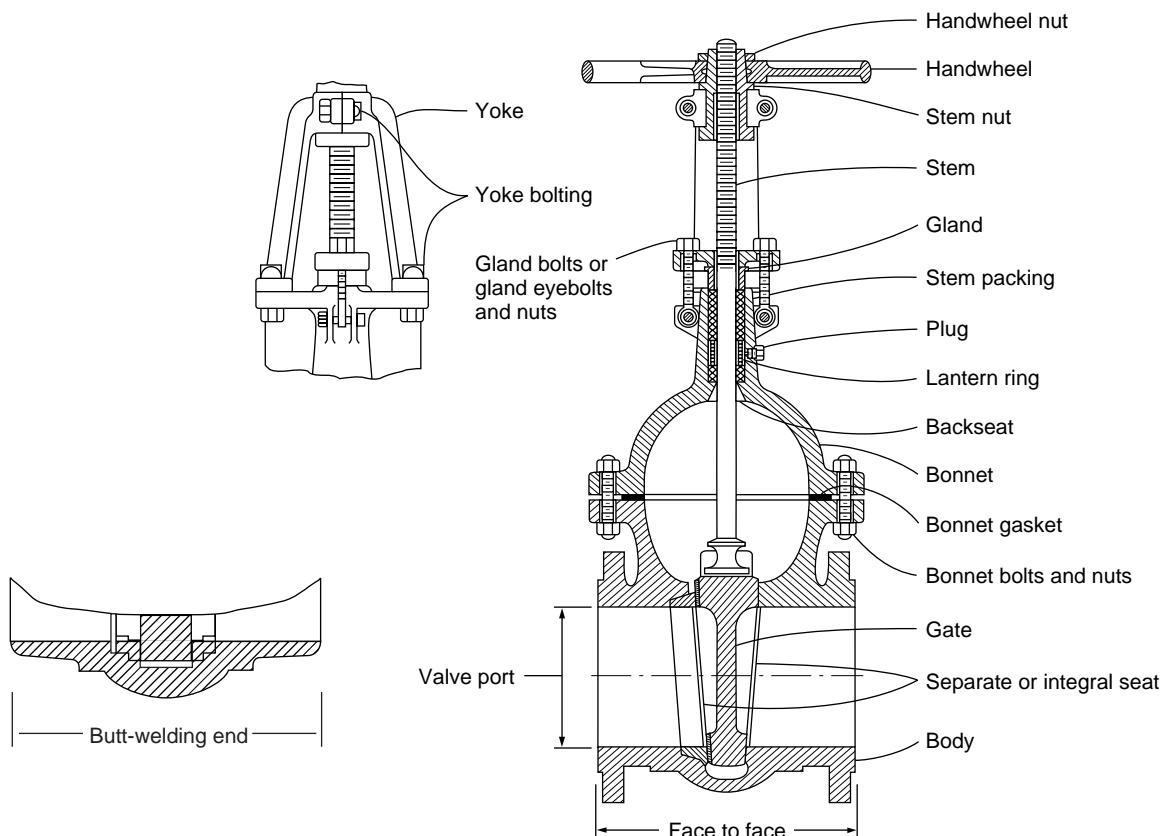


Figure 1—Typical Bolted Bonnet Gate Valve Nomenclature

Rolled or pressed-in seat rings shall be limited to use in valves NPS 2 and smaller.

**4.1.4** The nominal bore diameter in inches, including the diameter of end ports and body seat openings, shall not be less than that specified in Annex A of ASME B16.34 for the nominal pipe size and pressure class.

**4.1.5** End and bonnet flanges shall be cast or forged integrally with the body. The body and end flanges shall be in accordance with the specifications of ASME B16.5. When a more (or less) restrictive facing finish is required, it shall be specified in the purchase order.

**4.1.6** 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 end valve is not permitted except by agreement between the purchaser and manufacturer.

**4.1.7** Auxiliary connections to the body, such as drains, shall be furnished only if specified in the purchase order. The design and construction of the joint and the piping for auxiliary connections shall conform to the requirements of ASME B31.3. When required for a valve NPS 2 or larger, auxiliary connections shall be sized and located as specified in ASME

B16.34. The size and location of auxiliary connections shall be indicated in the purchase order.

**4.1.8** Tapped test openings are permitted only if specified in the purchase order. Test taps, when provided, shall meet the requirements for auxiliary connections in ASME B16.34.

**4.1.9** The body shall have guide surfaces to minimize wear of the 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.

## 4.2 BONNET

**4.2.1** The minimum wall thickness of the bonnet, except for the bonnet neck above the backseat, shall be as specified in Table 1A or 1B. Above the backseat, the bonnet neck shall conform to the design requirements for valve body necks as specified in ASME B16.34.

**4.2.2** The body-to-bonnet joint shall be flanged, with a raised-face joint, male-and-female joint, tongue-and-groove joint, or a ring joint. A Class 150 valve, however, may have a flat face joint. The gasket in any of these joints shall not extend beyond the inner edge of the bolt holes.

**4.2.3** Bonnet flanges shall be cast or forged integrally with the bonnet and shall be circular for Class 300 and higher valves, NPS 3 and larger. Bonnet flanges shall meet the spot-facing requirements of ASME B16.5.

**4.2.4** The bonnet joint shall have a minimum of four bolts/cap screws of the size listed in Table 2. For valves NPS 1 and larger, through-bolts shall be used in the bonnet joint. For valves NPS  $\frac{3}{4}$  and smaller, through-bolts, headed bolts, or cap screws may be used. Cap screws, if used, shall be suitable for external wrenching only. The total cross-sectional area of the bolting shall be in accordance with the requirements of ASME B16.34.

**4.2.5** 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 hard facing with a minimum finished thickness of 0.06 in. (1.6 mm).

**4.2.6** The stem hole in the bonnet shall be designed with proper clearance to guide the stem and to prevent extrusion of the packing.

Table 2—Minimum Size of Bonnet-Flange Bolting

Valve Size (NPS)	Minimum Bolt Size	
	Inches	Metric Size
$\frac{1}{2}$ to $2\frac{1}{2}$	$\frac{3}{8}$	M10
3 to 8	$\frac{1}{2}$	M12
10 to 24	$\frac{5}{8}$	M16

**4.2.7** Tapped test openings are permitted only if specified in the purchase order.

**4.2.8** The means to secure the gland eyebolts to the bonnet shall not include a stud-weld or filet-weld attachment, nor slotted brackets.

### 4.3 GATE

**4.3.1** The types of gates are illustrated in Figure 2 and are classified as follows:

- Wedge gate, including one-piece solid wedge, one-piece flexible wedge, and two-piece split wedge.
- Double-disc gate.

**4.3.2** Unless otherwise specified in the purchase order, the gate shall be a wedge gate. The fully open gate shall completely clear the valve seat openings.

**4.3.3** If a wedge gate is used, a one-piece solid or flexible gate shall be furnished unless a split-wedge gate is specified in the purchase order.

**4.3.4** A one-piece wedge gate may be fabricated by welding. It may be either a solid-wedge with a trapezoidal or I-shaped cross section or a flexible-wedge with a tapered cross

section. If the purchase order does not specify the particular type of one-piece wedge gate, either type may be furnished.

**4.3.5** A split-wedge gate is a two piece gate. The positioning of the two pieces of the gate is at the option of the manufacturer. The valve shall be designed so that the pieces cannot become separated, regardless of the gate position or valve orientation.

**4.3.6** A double-disc gate valve shall have parallel seats and an internal spreading device (For example, a wedging device or spring) that will force the discs firmly against the body seats when the gate reaches the closed position.

**4.3.7** The 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 stem in all orientations. 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 gate guide surfaces.

**4.3.8** Gate seating surfaces shall be integral with the gate or disc. When hard facing is furnished, it shall be applied as a weld overlay of CoCr-A and shall have a minimum finished thickness of 0.06 in. (1.6 mm).

**4.3.9** For a wedge gate valve, the seating design shall provide for adequate seating width of the seating surfaces both before and after wear. This shall be accomplished by proportioning the width of the body and gate seats so that, by seating the new gate high on the body seats, the gate seats will still completely contact the full effective seating width of the body seats after the gate in the closed position has traveled down (because of seat wear) by a distance (wear travel) not less than that listed in Table 3. Wear travel of a wedge gate is illustrated in Figure 3.

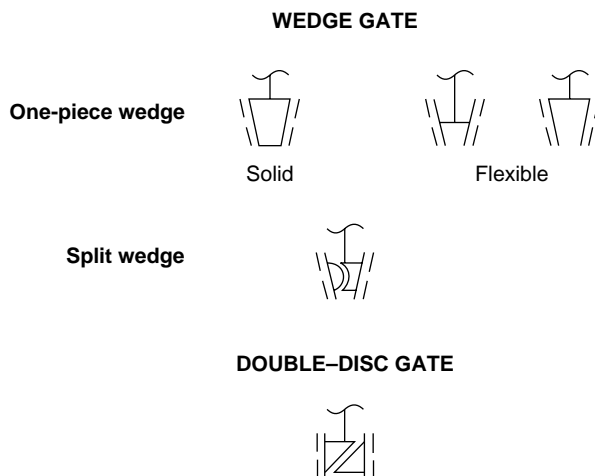


Figure 2—Types of Gates

## 4.4 YOKE

The yoke may be either integral with or separate from the bonnet. In both cases, the design shall be such that the stem nut can be replaced, with the stem secured, without affecting the pressure retaining capability of the bonnet assembly. However, replacement under pressure is not recommended. In both cases, the yoke-to-stem nut bearing surfaces shall be machined, and a lubrication fitting shall be provided for them. If the yoke is separate, the yoke-to-bonnet joint shall be machined, and the yoke shall be bolted to the bonnet with through bolts.

## 4.5 HANDWHEEL AND HANDWHEEL NUT

**4.5.1** The handwheel for a direct handwheel-operated valve shall have a spoke-and-rim design, with no more than six spokes. Clockwise rotation of the handwheel shall close the valve.

Table 3—Wear Travel

Valve Size (NPS)	Minimum Wear Travel	
	Inches	Millimeters
1/2 to 2	0.09	2.3
2 1/2 to 6	0.13	3.3
8 to 12	0.25	6.4
14 to 18	0.38	9.7
20 to 24	0.50	12.7

Note: Wear travel of a wedge gate is illustrated in Figure 3.

**4.5.2** The handwheel rim shall have the word “open” and an arrow pointing in the direction in which the valve opens, unless rim size or design make them impracticable.

**4.5.3** The handwheel shall be fixed to the stem nut by a threaded, hexagonal or octagonal, handwheel nut.

## 4.6 STEM AND STEM NUT

**4.6.1** The minimum stem diameter, measured at the section that passes through the packing, shall be in accordance with Table 1A or 1B. The tabulated minimum stem diameters are not to be assumed to be the required stem diameters. They are instead inspection minimum stem diameters. Strength levels of stem materials can vary significantly. The determination of the required stem diameters, taking into account the valve design details and the stem material strength characteristics, is the responsibility of the manufacturer. To allow the use of standard diameter round bars, an undertolerance is permitted in accordance with Table 4.

**4.6.2** The stem connection to a one-piece wedge gate shall be a T-head that is integral (without welding or weld build-up) with the stem. The stem connection to a split wedge or a

double-disc gate may be threaded. The stem connection shall prevent the stem from turning or disengaging from the gate while the valve is in service. The stem train (stem, gate, stem nut, handwheel, and handwheel nut) shall be designed to fail outside the pressure boundary in the event of the application of excessive handwheel torque to overcome a locked gate. The strength of the stem (in tension) outside the pressure boundary shall not be less than the calculated (theoretical) failure load based on the external thread root area and the specified minimum ultimate tensile strength of the stem material. The strength (in tension) of the stem-to-gate connection and of all parts of the stem within the pressure boundary shall be greater than the strength at the root of the external threads.

**4.6.3** Valves shall have a stem operated by a rotating stem nut mounted at the top of the yoke. The stem nut shall have a hexagonal shank, a round shank with a keyway, or another drive of equivalent strength and durability for attachment to the handwheel. For valves larger than NPS 6 in Class 150, NPS 4 in Class 300 or NPS 2 in Class 600 the stem nut arrangement shall be designed to:

- permit the removal of the handwheel, without allowing the stem and gate to drop into the closed position, if the handwheel is removed when the valve is in the open position.
- allow the stem nut to be replaced, with the stem secured, without affecting the pressure retaining capability of the bonnet assembly.

**However, replacement under pressure is not recommended.** When a threaded bushing is used to retain the stem nut, the bushing shall be retained by a weld or other suitable means to ensure that there is no movement during operation of the valve. Metal peening (staking) is not permitted.

**4.6.4** The threads of the stem and stem nut shall be Acme type conforming to ASME B1.5 or stub threads conforming to ASME B1.8 (minor modifications are permitted for either thread). The Acme thread major diameter may be less by a maximum of 1/16 in. (1.6 mm) than the diameter of the stem that passes through the packing. On direct handwheel-operated valves, these threads shall be left-handed threads. (Clockwise rotation of the handwheel shall close the valve.)

**4.6.5** Stem threads shall project outside the stem nut on a new closed valve by a distance that is at least equal to the required wear travel distance. The maximum projection distance of the stem thread shall be five times the wear travel distance for valves NPS 6 and smaller and three times the wear travel distance for valves NPS 8 and larger.

**4.6.6** The stem shall have an integral conical or spherical backseat surface to seat against the bonnet backseat when the gate is fully open.

**4.6.7** The stem shall have a surface finish Ra of 32  $\mu$  in. (0.80  $\mu$  m) or smoother in the area in contact with the packing.

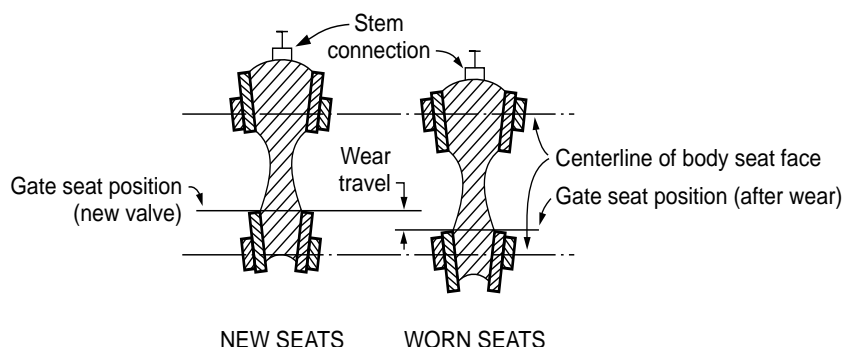


Figure 3—Wear Travel of a Wedge Gate

Table 4—Permitted Undertolerance

Minimum (in.)		Minimum (mm)	
Diameter	Undertolerance	Diameter	Undertolerance
$\leq 5/8$	0.012	$\geq 15.9$	0.31
$> 5/8$ to $7/8$	0.013	$> 15.9$ to 22.2	0.33
$> 7/8$ to 1	0.014	$> 22.2$ to 25.4	0.36
$> 1$ to $1 1/8$	0.015	$> 25.4$ to 28.6	0.38
$> 1 1/8$ to $1 1/4$	0.016	$> 28.6$ to 31.8	0.41
$> 1 1/4$ to $1 3/8$	0.017	$> 31.8$ to 34.9	0.43
$> 1 3/8$ to $1 1/2$	0.019	$> 34.9$ to 38.1	0.48
$> 1 1/2$ to $1 5/8$	0.021	$> 38.1$ to 41.3	0.53
$> 1 5/8$ to 2	0.026	$> 41.3$ to 50.8	0.66
$> 2$ to $3 1/4$	0.030	$> 50.8$ to 82.6	0.76

**4.6.8** All contact surfaces between the stem nut and the yoke shall be flat and parallel. Ball or roller bearings shall be furnished for all valves NPS 6 and larger in Class 600.

#### 4.7 STUFFING BOX, PACKING, AND LANTERN RING

**4.7.1** The stuffing box dimensions shall meet those specified in Table 5. The stuffing box depth shall accommodate a minimum of five uncompressed rings of square packing, except as specified in 4.7.4. The stuffing box shall have a finish Ra of 125  $\mu$  in. (3.2  $\mu$ m) or smoother.

**4.7.2** The packing gland shall be a two-piece self-aligning design consisting of a gland proper and a separate gland flange. The gland proper shall have a shoulder on its outer end to prevent complete entry of the gland into the stuffing box. The gland flange shall have holes (not slots) for two gland bolts.

**4.7.3** The nominal packing size shall be as specified in Table 5 (see 8.4).

**4.7.4** A lantern ring shall be furnished only if specified in the purchase order. The lantern ring shall have two holes spaced 180 degrees apart on each end for its removal. These holes shall be either through-holes for use with a

hook, or threaded holes of the  $1/2$ -coarse-thread series (No. 5-40 UNC), as specified in ASME B1.1. If a lantern ring is furnished, the stuffing box shall be tapped opposite the center of the installed lantern ring and shall be fitted with a threaded solid round- or hex-head plug greater than or equal to NPS  $1/4$ . The plug shall be in accordance with the requirements of ASME B16.11. The stuffing box shall have a boss as specified in ASME B16.34. When a lantern ring is furnished, 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.

#### 4.8 BOLTING

**4.8.1** Bonnet and yoke bolting shall be headed bolts or continuously threaded stud bolts with heavy semi-finished hexagonal nuts conforming to the requirements of ASME B18.2.2. When headed bolts are used they shall be limited to class 150 in sizes NPS 8 and smaller and class 300 in sizes NPS 6 and smaller. Bonnet bolting for valves NPS  $3/4$  and smaller may utilize cap screws (see 4.2.4).

**4.8.2** Gland bolting shall be headed bolts, hinged eyebolts, or studs with hexagonal nuts.

**4.8.3** Bolting that is 1 inch in diameter or smaller shall have coarse (UNC) threads. Bolting larger than 1 inch shall be 8-thread series (8 UNC). Bolt threads shall be Class 2A and nut threads Class 2B in accordance with ASME B1.1. However, studs used for gland bolting shall be secured with a Class 5 interference-fit in accordance with ASME B1.12.

#### 4.9 OPERATION

**4.9.1** Unless otherwise specified in the purchase order, the valve shall be operated directly by a handwheel.

**4.9.2** If chainwheel operation is required, the type of chainwheel and chain required shall be specified in the purchase order.

Table 5—Stuffing Box and Packing Dimensions

Stem Outside Diameter		Nominal Packing Width		Stuffing Box Dimensions			
				Nominal Bore		Minimum Depth	
Inches	Millimeters	Inches	Millimeters	Inches	Millimeters	Inches	Millimeters
7/16	11.1	5/32	4.0	3/4	19.0	25/32	19.8
1/2	12.7	3/16	4.8	7/8	22.2	15/16	23.8
9/16	14.3	3/16	4.8	15/16	23.8	15/16	23.8
5/8	15.9	1/4	6.4	1 1/8	28.6	1 1/4	31.7
11/16	17.5	1/4	6.4	1 5/16	30.2	1 1/4	31.7
3/4	19.1	1/4	6.4	1 1/4	31.8	1 1/4	31.7
7/8	22.2	1/4	6.4	1 3/8	35.0	1 1/4	31.7
1	25.4	1/4	6.4	1 1/2	38.1	1 1/4	31.7
1 1/8	28.6	5/16	7.9	1 3/4	44.4	1 9/16	39.6
1 1/4	31.8	5/16	7.9	1 7/8	47.6	1 9/16	39.6
1 3/8	34.9	5/16	7.9	2	50.8	1 9/16	39.6
1 1/2	38.1	3/8	9.5	2 1/4	57.2	1 7/8	47.6
1 5/8	41.3	3/8	9.5	2 3/8	60.3	1 7/8	47.6
1 3/4	44.5	3/8	9.5	2 1/2	64.3	1 7/8	47.6
1 7/8	47.6	3/8	9.5	2 5/8	66.7	1 7/8	47.6
2	50.8	7/16	11.1	2 7/8	73.0	2 3/16	55.6
2 1/4	57.2	1/2	12.7	3 1/4	82.6	2 1/2	63.5
2 3/8	60.3	1/2	12.7	3 3/8	85.7	2 1/2	63.5
2 1/2	63.5	1/2	12.7	3 1/2	89.7	2 1/2	63.5
3	76.2	9/16	14.3	4 1/8	105.6	2 13/16	71.4

Note: For stem diameters not listed, the packing width and stuffing box bore shall be in proportion to those shown.

**4.9.3** If gear operation is required, the purchase order shall specify the type of gears and their arrangement, the design maximum differential pressure across the valve, and the maximum force (rim-pull) to operate the valve. (The last shall be the force exerted on the outer circumference of the hand-wheel.)

**4.9.4** If power operation is required, the type of power, the power unit, and the design maximum differential pressure across the valve shall be specified in the purchase order.

#### 4.10 BYPASS

**4.10.1** A bypass shall not be furnished unless specified in the purchase order.

**4.10.2** Unless otherwise specified in the purchase order, any bypass that is furnished shall be of the valve external type and of a size that is specified in ASME B16.34. The bypass shall be located on the side of the valve connecting either the A-B or the E-F locations shown in ASME B16.34. The bypass valve stem shall have the same general orientation as the primary valve stem.

**4.10.3** Unless otherwise specified in the purchase order, the bypass valve shall be an outside-screw-and-yoke rising stem globe valve with a flanged or welded bonnet. The

bypass valve shall be of a class at least equal to that of the primary valve, and shall conform to the applicable requirements of API Standard 602.

**4.10.4** Bypass piping shall conform to the requirements of 4.1.7.

#### 4.11 SAFETY SHIELD

**4.11.1** When specified in the purchase order, a safety shield to protect the operator shall be furnished.

**4.11.2** When a safety shield is furnished, it shall be mounted on the stem nut under the handwheel or between the top of the yoke and the stem-nut retaining nut, or cap. The safety shield shall have an outside diameter not less than that of the handwheel. The shield shall have one of the two alternative shapes shown in Figure 4.

### 5 Material

#### 5.1 SHELL

The body and bonnet shall be cast or forged of a material specified in the purchase order, using a material listed under Group 2 or 3 materials in ASME B16.34.

## 5.2 BODY SEAT RINGS

When separate body seat rings are used, they shall be of the same nominal chemical composition as the shell (see 5.9.3).

## 5.3 BONNET GASKET

**5.3.1** The bonnet flange gasket shall be a) corrugated or flat solid metal; b) corrugated or flat filled metal jacketed; c) metal ring joint; d) in Class 150 only, flexible graphite sheet reinforced with flat, tanged or corrugated metal insert; e) in round bonnets only, filled spiral wound metal; or f) other gasketing material specified in purchase order. A filled spiral wound metal gasket is acceptable provided the gasket incorporates a centering/compression control ring or the body-to-bonnet joint design provides inherent compression control to bring about the proper seating of the gasket.

**5.3.2** The metallic portion of the gasket exposed to the service environment shall be made of a material with corrosion resistance at least equal to that of the shell. Filler material in spiral wound gaskets shall be flexible graphite unless specified otherwise in purchase order.

**5.3.3** Lubricants, sealing compounds or grease shall not be used to facilitate the makeup of metal gasketed joints.

## 5.4 GATE

Solid- and flexible-wedge gates and discs for split wedge or double-disc gates shall be of the same nominal chemical composition as the shell (see 5.9.3).

## 5.5 YOKE

If the yoke is separate from the bonnet, it shall be made of carbon steel, or a material similar to that of the shell.

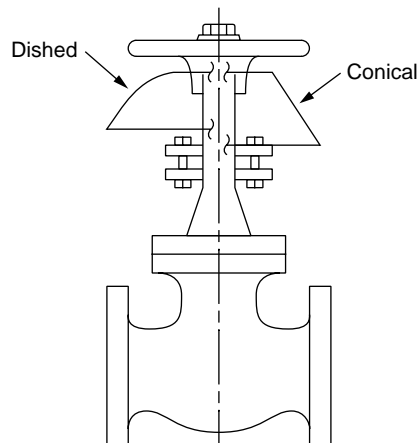
## 5.6 HANDWHEEL, CHAINWHEEL, AND NUT

**5.6.1** Handwheels and chainwheels shall be made of carbon steel, ductile iron, or malleable iron. Unless otherwise specified in the purchase order, they shall be a) cast or forged; or b) fabricated from other carbon steel product forms that provide strength and toughness comparable to those provided by casting or forging. All handwheels shall be free of burrs and sharp edges.

**5.6.2** The handwheel or chainwheel nut shall be made of a nonferrous copper alloy, a 13Cr steel, austenitic stainless steel, malleable iron, ductile iron, or carbon steel. Chains shall be made of steel.

## 5.7 STEM NUT

The stem nut shall be made of nonferrous copper alloy, 13Cr steel, austenitic stainless steel, or austenitic ductile iron (ASTM A 439 Type D-2 or Type D-2C); shall have a mini-



Note: The design of the safety shield shall permit repacking of the valve without removal of the shield.

Figure 4—Alternative Designs of the Safety Shield

imum melting point of 1750°F (954°C); and shall have a suitable bearing quality.

## 5.8 GLAND FLANGE AND GLAND

The gland proper shall be of the same nominal chemical composition as the shell. The gland flange shall be made of steel, austenitic stainless steel, or a material of the same nominal chemical composition as the shell.

## 5.9 TRIM

**5.9.1** The term trim includes the following parts:

- Stem.
- Body-seating surface.
- Gate-seating surface.
- Hard facing for the backseat.
- Small internal parts that normally contact the service fluid.

**5.9.2** The stem shall be made of a wrought material with the same nominal chemical composition as the valve body and bonnet material

**5.9.3** The hard facing of gate, body seat, and backseat shall be in accordance with AWS A5.13 E or R, classification CoCr-A, unless other materials are specified in the purchase order. If hardfacing is not used, all seating surfaces shall be of the same nominal chemical composition as the shell.

**5.9.4** Small parts of the trim shall be of the same nominal chemical composition as the shell and include the following:

- Stem connection.
- Internal pins or screws.
- Spreading mechanism of a double-disc valve.

- d. Plugs for the test or drain taps in the bonnet and body.
- e. Lantern ring and plug in stuffing box tap.

## 5.10 STEM PACKING

Unless otherwise specified in the purchase order, the stem packing shall be flexible graphite. Graphite packing, when used, shall contain a corrosion inhibitor.

## 5.11 BOLTING

**5.11.1** Unless otherwise specified in Purchase Order, bonnet bolting shall be ASTM A 193 Grade B8 bolts with ASTM A 194 Grade 8 nuts, ASTM A 193 Grade B8C bolts with ASTM A 194 Grade 8C nuts, or ASTM A 193 Grade B8M bolts with ASTM A 194 Grade 8M nuts. The intermediate strength class of bolts (Class 2) shall be used unless otherwise specified.

**5.11.2** Gland bolts and nuts shall be made of 18Cr-8Ni steel.

## 5.12 BYPASS

When specified, the bypass valve and its piping shall be of the same nominal chemical composition as the shell.

## 5.13 SAFETY SHIELD

When specified, the safety shield shall be made of 18Cr-8Ni steel unless otherwise specified.

## 5.14 NAMEPLATE

The nameplates for valves NPS 6 and larger shall be made of austenitic stainless steel or nickel alloy. The nameplate shall be attached to the valve with pins made of similar material, or by welding. For valve sizes NPS 4 and smaller, nameplates and method of attachment shall be manufacturer's standard, using an austenitic stainless steel or nickel alloy.

# 6 Examination, Inspection, and Testing

## 6.1 INSPECTION

When inspection by the purchaser is specified in the purchase order, inspection shall be in accordance with API Standard 598. The manufacturer shall examine each valve produced in accordance with API Standard 598.

## 6.2 PRESSURE TESTS

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

## 6.3 REPAIR OF DEFECTS

Defects in the shell of a cast or forged valve that are revealed by inspection or testing may be repaired as permitted

by the most nearly applicable ASTM material specification listed in ASME B16.34.

# 7 Marking

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

# 8 Shipment

## 8.1 PAINTING

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

## 8.2 OPENINGS

**8.2.1** Valve end flanges and butt-welding ends shall be blanked to protect the gasket surfaces, welding ends, and valve internals during shipment and storage. The protective covers shall be made of wood, wood fiber, or plastic and shall be securely attached to the valve ends by bolting, steel straps, steel clips, or suitable friction locking devices. The design of the protective cover shall ensure that the valve cannot be installed without complete removal of the cover.

**8.2.2** Tapped connections shall be fitted with fully tightened threaded plugs. Thread sealant shall not be used.

## 8.3 GATE POSITION AND LUBRICANT

Valves shall be shipped with the gates closed and with the stem threads lubricated.

## 8.4 STEM PACKING

Valves shall be shipped with the lantern ring (if specified) and packing installed and ready for operation. The remaining adjustment length of the packing gland at the time of shipment, with the gland tight, shall be greater than 1.5 times the packing width specified in Table 5.

## 8.5 PACKAGING

**8.5.1** If export packaging is not specified in the purchase order, valves may be shipped loose, palletized, or packed in boxes or crates.

**8.5.2** If 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.



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