

# **Butterfly Valves: Double-flanged, Lug-and Wafer-type**

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## Foreword

This standard is a purchase specification for butterfly valves designed for installation between flanges specified in ASME B16.1, ASME B16.5, ASME B16.24, and ASME B16.42, Classes 125-600; MSS SP-44, Class 150; and ASME B16.47, Series A (was MSS SP-44 except for certain materials) or Series B (was API 605), Class 150 for the NPS sizes defined herein.

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# Butterfly Valves: Double-flanged, Lug-and Wafer-type

## 1 Scope

1.1 This standard covers design, materials, face-to-face dimensions, pressure-temperature ratings, and examination, inspection and test requirements for gray iron, ductile iron, bronze, steel, nickel-based alloy, or special alloy butterfly valves.

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

1.3 The following two categories of butterfly valves are included.

a) Category A—Manufacturer's rated cold working pressure (CWP) butterfly valves, usually with a concentric disc and seat configuration. Sizes covered are NPS 2 to NPS 48 for valves having ASME Class 125 or Class 150 flange bolting patterns.

b) Category B—ASME Class and pressure-temperature rated butterfly valves that have an offset seat and either an eccentric or a concentric disc configuration. These valves may have a seat rating less than the body rating. Sizes covered are listed below.

— For lug and wafer, Class 150: NPS 3 to NPS 48.

— For lug and wafer, Class 300 and Class 600: NPS 3 to NPS 48.

— For double-flanged long pattern, Class 150, 300, and 600: NPS 3 to NPS 36.

— For double-flanged short pattern, Class 150 and Class 300: NPS 3 to NPS 48.

— For double-flanged short pattern, Class 600: NPS 3 to NPS 24.

Information to be specified by the purchaser is shown in Annex B.

1.4 Valve configurations include double flanged, lug- and wafer-type with facings that permits installation between ASME and MSS flanges that conform to the standards and specifications listed in Section 2. Typical valve construction and nomenclature for valve parts are shown in Annex C.

## 2 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies. Text in brackets after a publication title indicates a restriction on the classes to which the publication applies.

API Standard 598, *Valve Inspection and Testing*

API Standard 607, *Fire Test for Quarter-turn Valves and Valves Equipped with Nonmetallic Seats*

ASME B1.1<sup>1</sup>, *Unified Inch Screw Threads* [UN and UNR Thread Form]

ASME B16.1, *Gray Iron Pipe Flanges and Flanged Fittings*

<sup>1</sup> ASME International, 3 Park Avenue, New York, New York 10016-5990, [www.asme.org](http://www.asme.org).

ASME B16.5, *Pipe Flanges and Flanged Fittings* [NPS 1/2 through NPS 24 Metric/Inch Standard]

ASME B16.24, *Cast Copper Alloy Pipe Flanges and Flanged Fittings*

ASME B16.34, *Valves-Flanged, Threaded and Welding End* [Standard Class 150, 300, and 600 only]

ASME B16.42, *Ductile Iron Pipe Flanges and Flanged Fittings* [Class 150 and 300]

ASME B16.47, *Large Diameter Steel Flanges: NPS 26 Through NPS 60*

ASME B31.3, *Process Piping*

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

MSS SP-6<sup>2</sup>, *Standard Finishes for Contact Faces of Pipe Flanges and Connecting-End Flanges of Valves and Fittings*

ANSI/MSS SP-25, *Standard Marking System for Valves, Fittings, Flanges, and Unions*

MSS SP-44, *Steel Pipeline Flanges*

MSS SP-45, *Bypass and Drain Connections*

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

### **3 Terms and Definitions**

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

#### **3.1**

##### **de-rated valves**

Valves which are only able to pass both the required and optional tests per API 598 without permanent deformation or loosening of valve components at pressure lower than specified per API 598.

#### **3.2**

##### **dead-end service**

A condition that may occur after the companion flange and/or piping are removed from one side of a lug type valve with threaded lug-bolt holes or from a double-flanged valve.

#### **3.3**

##### **fully rated valves**

Valves which are able to pass both the required and optional tests per API 598 without permanent deformation or loosening of valve components at the required testing pressure.

### **4 Pressure-temperature Ratings**

#### **4.1 Valve Rating**

Category A valves shall have a CWP rating that is the lesser of its shell rating, seat rating, or differential pressure rating.

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<sup>2</sup> Manufacturers Standardization Society of the Valve and Fittings Industry, Inc., 127 Park Street, NE, Vienna, Virginia 22180-4602, [www.mss-hq.com](http://www.mss-hq.com).



## 4.2 Shell Rating

4.2.1 Category A valve bodies and related pressure boundary elements shall have the CWP rating assigned by the manufacturer.

4.2.2 Category B valve bodies and related pressure boundary elements shall have the pressure-temperature rating as listed in one of the following standards according to the valve’s body material:

- for ductile iron, ASME B16.42;
- for cast copper alloys, ASME B16.24;
- for steel, nickel alloy, or special alloy material, ASME B16.34 (standard class).

## 4.3 Seat Rating

4.3.1 For Category B valves, the valve seat ratings for polytetrafluoroethylene (PTFE) and reinforced polytetrafluoroethylene (RPTFE) shall be at least equal to those listed in Table 1. For seating materials not listed in Table 1, seat ratings shall be established by the manufacturer.

**Table 1—Minimum Seat Pressure-temperature Ratings for Category B Valves with PTFE or RPTFE Seats**

Temperature °C (°F)	Class 150				Class 300				Class 600	
	PTFE		RPTFE		PTFE		RPTFE		RPTFE	
	bar	psig	bar	psig	bar	psig	bar	psig	bar	psig
-29 to 38 (-20 to 100)	19.7	285	19.7	285	51.0	740	51.0	740	102.0	1480
66 (150)	18.8	273	18.8	273	48.8	708	48.8	708	89.6	1300
93 (200)	17.9	260	17.9	260	37.9	550	46.5	675	62.1	900
121 (250)	16.9	245	16.9	245	29.3	425	36.5	530	48.3	700
149 (300)	15.9	230	15.9	230	20.7	300	26.9	390	37.9	550
177 (350)	9.7	140	14.8	215	12.1	175	17.2	250	27.6	400
204 (400)	3.4	50	6.9	100	3.4	50	6.9	100	17.2	250

4.3.2 Valves furnished with internal liners, encapsulation, resilient seating materials, or a combination of these features shall have pressure-temperature limits conforming to the valve manufacturer’s published specifications. Temperature limits shall be marked on the nameplate as required in 8.1.

## 4.4 Differential Pressure Rating

4.4.1 Differential pressure rating shall not exceed the seat pressure rating.

4.4.2 Manufacturer shall qualify de-rated valves’ differential pressure rating through hydrostatic type testing in the desired sealing direction on each applicable size and class per 7.4.

## 5 Design

### 5.1 General

#### 5.1.1 Category B Valves

Valves manufactured in accordance with this standard shall meet the requirements of ASME B16.34 for standard class and any additional requirements as specified in this standard. For materials not listed in ASME B16.34, the applicable requirements and design rules of ASME B16.34 shall be used. In the event of a conflict between ASME B16.34 and this standard, this standard shall prevail.

#### 5.1.2 Fire-tested Valves

If the purchaser specifies fire-tested valves, the valve's design shall be certified to have been tested to, and met, all of the performance requirements of API 607. Supporting documentation shall be made available to the purchaser upon request.

#### 5.1.3 Lockable Device

When specified in the purchase order, valves shall be furnished with a lockable device that accepts a purchaser-supplied lock that enables the valve to be locked in both the open and closed positions. The lockable device shall be designed such that a lock with an 8 mm (<sup>5</sup>/<sub>16</sub> in.) diameter shank, not more than 100 mm (4 in.) long, can be inserted directly through appropriate holes and locked. Provisions for a lockable device are permitted even when it is not specified in the purchase order.

#### 5.1.4 Disc Position Indication

The indication of the position of the disc shall be integral with the valve shaft and shall be aligned with the valve disc. The indication may be accomplished by a mark on the shaft or by a shaft shape. The design shall ensure that a valve (and/or operator) cannot be assembled to falsely indicate the valve's open and closed positions.

#### 5.1.5 Shaft-to-lever Connections

Shaft-to-lever connections shall be designed so that the lever always correctly indicates the disc position. The lever-type handle shall be mounted so that the handle is in parallel with the valve disc.

### 5.2 Body

**5.2.1** The minimum body-wall thickness shall comply with the applicable ASME B16 standard listed in Section 2 based on the body material. If the applicable standard covers fittings for a particular material, the valve minimum wall thickness shall be as specified for fittings. The valve design shall be structurally suitable for its stated pressure and temperature limits, taking into account that localized thinning may be necessary between the shaft bore in the body and the adjacent bolt holes. Such sections shall be designed in accordance with the requirements of ASME B16.34.

**5.2.2** When a wafer-type valve is installed between piping flanges and the disc is in the closed position, the valve shall be self-centering, that is, designed to center itself within the bolt circle by using the valve's outside diameter, or by means of integral or attached alignment devices.

**5.2.3** End flanges for double-flanged valves shall be integrally cast or forged with the body; however, flanges may be attached by full-penetration butt-welding or inertia welding if agreed to by the purchaser. End flanges attached by welding shall conform to ASME B16.5 or ASME B16.47 as applicable and have butt-welding ends for use without backing rings. Welds shall conform to ASME B31.3, as shall qualifications for the welding procedure and the welder or welding operator. The finished weld thickness shall not be less than the minimum body-wall thickness.

5.2.4 If drain or bypass connections are specified by the purchaser, they shall conform to ASME B16.34 or MSS SP-45, as applicable.

### 5.3 Face-to-face Dimensions

5.3.1 Face-to-face dimensions for lug- and wafer-type valves shall be as listed in Table 2 and Table 3A. The as-installed and compressed dimension shall be used for valves that utilize nonmetallic liners, sleeves, or auxiliary seals extending from or over the body contact faces. When valve body liners, sleeves, or O-ring seals act as flange-sealing surfaces, separate gaskets should not be used unless specifically recommended by the manufacturer.

**CAUTION—Over compression of the seat may occur resulting in torque issues or premature failure of the valve.**

5.3.2 Face-to-face dimensions for double-flanged valves shall be as listed in Table 3B for long pattern valves, or Table 3C for short pattern valves.

NOTE Table 3C includes two acceptable variations of face-to-face dimensions for Class 300 category B valves.

5.3.3 Body contact faces of cast iron, ductile iron, and cast copper alloy valves that require separate gaskets shall be finished as specified in MSS SP-6.

**Table 2—Face-to-face Dimensions for Category A Valves (Lug- and Wafer-type)**

Valve Size (NPS)	Face-to-face Dimensions		Maximum Variance ±	
	mm	in.	mm	in.
2	43	1.69	1.5	0.06
2 1/2	46	1.81	1.5	0.06
3	46	1.81	1.5	0.06
4	52	2.06	1.5	0.06
5	56	2.19	1.5	0.06
6	56	2.19	1.5	0.06
8	60	2.38	3.3	0.13
10	68	2.69	3.3	0.13
12	78	3.06	3.3	0.13
14	78	3.06	3.3	0.13
16	102	4.00	3.3	0.13
18	114	4.50	3.3	0.13
20	127	5.00	3.3	0.13
24	154	6.06	3.3	0.13
30	165	6.5	6.4	0.25
36	200	7.88	6.4	0.25
42	251	9.88	6.4	0.25
48	276	10.88	6.4	0.25

NOTE The dimensions listed for NPS 2 through 24 apply to valves for installation between ASME Class 125 or 150 flanges. NPS 30 through 48 are limited to installation between ASME Class 125 and 150 flanges, or MSS SP-44 Class 150 flanges. These dimensions are across body flats (metal-to-metal) (see 5.3.1).

**Table 3A—Face-to-face Dimensions for Category B Valves, (Lug- and Wafer-type)**

Valve Size (NPS)	Class 150		Class 300		Class 600		Maximum Variance ±	
	mm	in.	mm	in.	mm	in.	mm	in.
3	48	1.88	48	1.88	54	2.12	3.3	0.13
4	54	2.12	54	2.12	64	2.50	3.3	0.13
6	57	2.25	59	2.31	78	3.06	3.3	0.13
8	64	2.50	73	2.88	102	4.00	3.3	0.13
10	71	2.81	83	3.25	117	4.62	3.3	0.13
12	81	3.19	92	3.62	140	5.50	3.3	0.13
14	92	3.62	117	4.62	155	6.12	3.3	0.13
16	102	4.00	133	5.25	178	7.00	3.3	0.13
18	114	4.50	149	5.88	200	7.88	3.3	0.13
20	127	5.00	159	6.25	216	8.50	3.3	0.13
24	154	6.06	181	7.12	232	9.13	3.3	0.13
26 to 48	— <sup>a</sup>						6.4	0.25

<sup>a</sup> Dimensions shall be manufacturer's standard or as agreed between purchaser and manufacturer.

**Table 3B—Face-to-face Dimensions for Category B Valves, (Double-flanged Long Pattern)<sup>a</sup>**

Valve Class (NPS)	Class 150		Class 300		Class 600		Maximum Variance ±	
	mm	in.	mm	in.	mm	in.	mm	in.
3	203	8.00	282	11.12	356	14.00	3.3	0.13
4	229	9.00	305	12.00	432	17.00	3.3	0.13
6	267	10.50	403	15.88	559	22.00	3.3	0.13
8	292	11.50	418	16.50	660	26.00	3.3	0.13
10	330	13.00	457	18.00	787	31.00	3.3	0.13
12	356	14.00	502	19.75	838	33.00	3.3	0.13
14	381	15.00	762	30.00	889	35.00	3.3	0.13
16	406	16.00	838	33.00	991	39.00	3.3	0.13
18	432	17.00	914	36.00	1092	43.00	3.3	0.13
20	457	18.00	991	39.00	1194	47.00	3.3	0.13
24	508	20.00	1143	45.00	1397	55.00	4	0.16
26	559	22.00	1245	49.00	1448	57.00	4	0.16
28	610	24.00	1346	53.00	1549	61.00	4	0.16
30	610	24.00	1397	55.00	1651	65.00	4	0.16
32	660	26.00	1524	60.00	1778	70.00	4	0.16
36	711	28.00	1727	68.00	2083	82.00	5	0.19

<sup>a</sup> The dimensions listed agree with ASME B16.10 for flanged gate valves.

**Table 3C—Face-to-face Dimensions for Category B Valves, (Double-flanged Short Pattern)**

Valve Class (NPS)	Class 150 <sup>a</sup> or Class 300 <sup>a</sup>		Class 300 <sup>b</sup>		Class 600 <sup>b</sup>		Maximum Variance ±	
	mm	in.	mm	in.	mm	in.	mm	in.
3	114	4.50	180	7.09	180	7.09	3.3	0.13
4	127	5.00	190	7.48	190	7.48	3.3	0.13
6	140	5.50	210	8.27	210	8.27	3.3	0.13
8	152	6.00	230	9.06	230	9.06	3.3	0.13
10	165	6.50	250	9.84	250	9.84	3.3	0.13
12	178	7.00	270	10.63	270	10.63	3.3	0.13
14	190	7.50	290	11.42	290	11.42	3.3	0.13
16	216	8.50	310	12.20	310	12.20	3.3	0.13
18	222	8.75	330	12.99	330	12.99	3.3	0.13
20	229	9.00	350	13.78	350	13.78	3.3	0.13
24	267	10.50	390	15.35	390	15.35	4	0.16
26	292	11.50	410	16.14	—	—	4	0.16
28	292	11.50	430	16.93	—	—	4	0.16
30	318	12.52	450	17.72	—	—	4	0.16
32	318	12.52	470	18.50	—	—	4	0.16
36	330	12.99	510	20.08	—	—	5	0.19
38	410	16.14	530	20.87	—	—	5	0.19
40	410	16.14	550	21.65	—	—	5	0.19
42	410	16.14	570	22.44	—	—	6	0.24
48	470	18.50	630	24.80	—	—	6	0.24

NOTE See NOTES TO PURCHASER, B.2.1 d).

<sup>a</sup> The dimensions listed agree with ISO 5752 Basic Series 13, EN 558-2 and EN 593.

<sup>b</sup> The dimensions listed agree with ISO 5752 Basic Series 14, EN 558-2 and EN 593.

**5.3.4** Body contact faces of steel or alloy valves that require separate gaskets shall be finished as specified in ASME B16.5.

**5.4 Disc Clearance**

**5.4.1** The manufacturer shall design the valve to provide clearance between the disc and the inside diameter of the connecting pipe or flange as specified in Annex D, in accordance with the ASME class rating for the valve.

NOTE For lug- and wafer-type valves and some double-flanged designs, the disc will protrude beyond the body faces when the valve is opened.

## 5.5 Shaft and Shaft Seals

**5.5.1** The shaft-to-disc connection and all parts of the shaft within the pressure boundary shall, under torsional load, exceed the strength of the shaft that lies outside the pressure boundary by more than 10 %. The determination of shaft strength shall be by calculation or testing.

**5.5.2** The shaft and/or shaft retention shall be designed so that, if failure of the shaft to disc connection or of the shaft occurs, no portion of the shaft can be ejected from the valve as a result of internal pressure. The design shall not rely on actuation components (e.g. gear operators, actuators, levers, etc.) to prevent shaft ejection.

**5.5.3** For Category B valves, the shaft shall have a surface finish of 0.80  $\mu\text{m}$  (32  $\mu\text{in.}$ ) Ra or smoother in the area in contact with the packing, and the stuffing box shall have a surface finish of 3.2  $\mu\text{m}$  (125  $\mu\text{in.}$ ) Ra or smoother. Measurement may be by visual and tactile comparison or by use of a stylus-type surface roughness measuring instrument (refer to ASME B46.1).

**5.5.4** Category B valves shall have adjustable shaft packing. The packing mechanism shall allow packing adjustment while the valve is pressurized with line fluid.

## 5.6 Piping Connection External Bolt Holes

**5.6.1** Unless specified otherwise in the purchase order, lugs of lug-type valves shall be provided with tapped holes for studs or bolts.

**5.6.2** Threaded body-flange holes for bolts 1 in. or less in diameter shall be drilled and tapped in accordance with ASME B1.1, coarse-thread series, Class 2B. For bolts 1 1/8 in. or more in diameter, such holes shall be drilled and tapped in accordance with ASME B1.1, eight-thread series, Class 2B.

**5.6.3** Threaded bolt holes shall allow full thread engagement to a depth at least equal to the nominal bolt diameter; however, when the bolt hole is adjacent to the shaft, engagement to a depth of 67 % of the nominal bolt diameter is acceptable.

**5.6.4** Typical bolting options for lug- and wafer-type valves are shown in Figure 1.

## 5.7 Valve Body Seat Retainer—Category B Valves Only

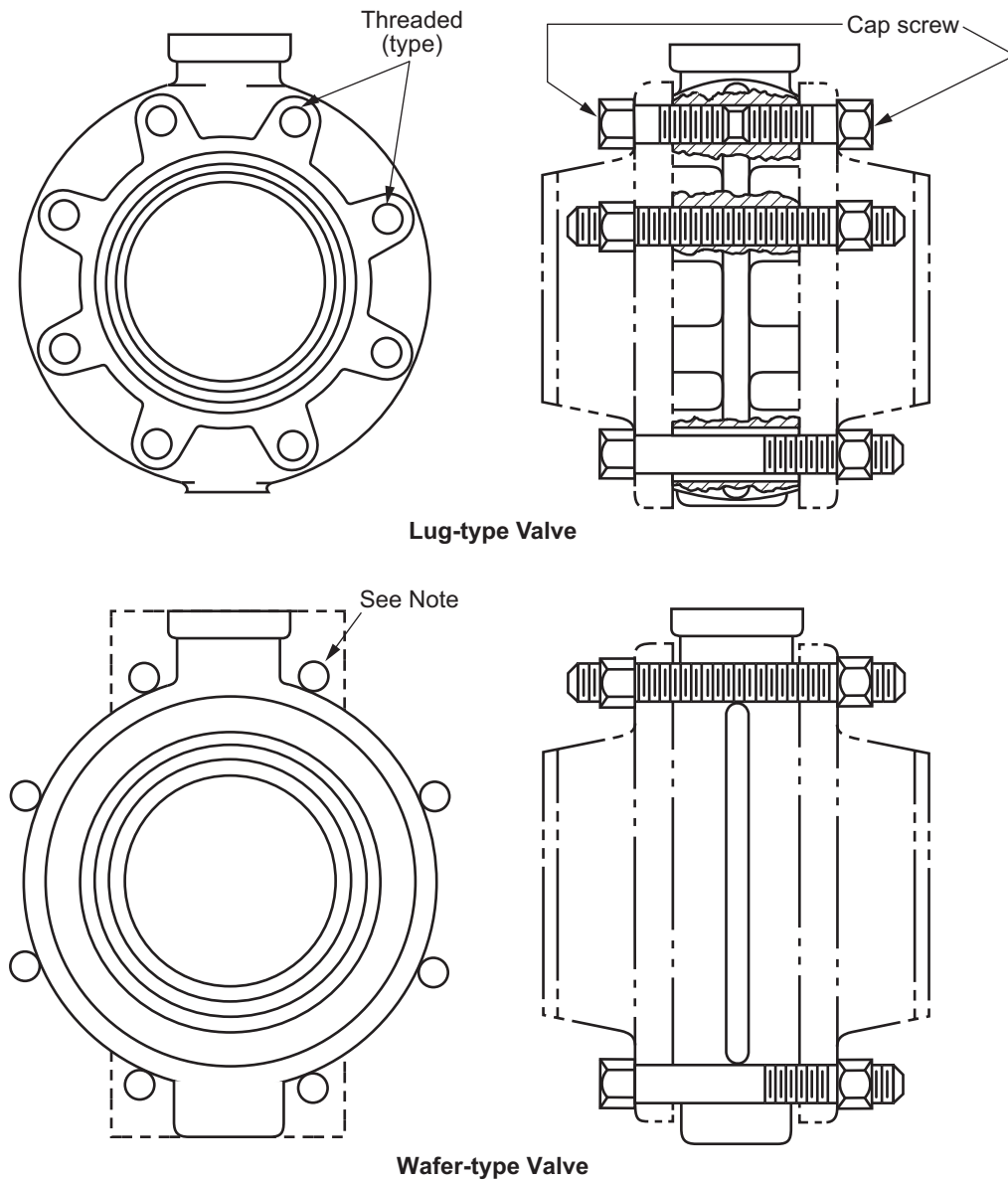
**5.7.1** Seat retainer plates (see Figure 2) are separate plates intended to retain and compress the valve seat and shall be mechanically fastened to the valve body. Retaining fasteners shall be recessed to or below the flange gasket surface. Seat retainer, bolting design, and materials shall comply with ASME B16.34.

**5.7.2** Gasket Seating Surface Interruptions—Interruptions in the seating area of a centered ASME B16.20 spiral-wound gasket for valve sizes NPS 6 through NPS 48 shall not exceed the limitations given in Figure 2. The permissible surface interruptions on smaller size valves shall not exceed 50 % of the gasket seating width.

NOTE The degree of interruption may affect the sealability of a spiral-wound gasket.

**5.7.3** All components of lug-type and double-flanged valves designated as suitable for bidirectional dead-end service shall be designed for the valve's differential pressure rating.

**5.7.4** The seat retainer plate, fasteners, seat and seal of fully rated valves designated as suitable for bidirectional dead-end service shall be designed to withstand, at the minimum, 110 % of the maximum rated differential pressure rating at 38 °C (100 °F).



NOTE May be drilled or tapped on some sizes.

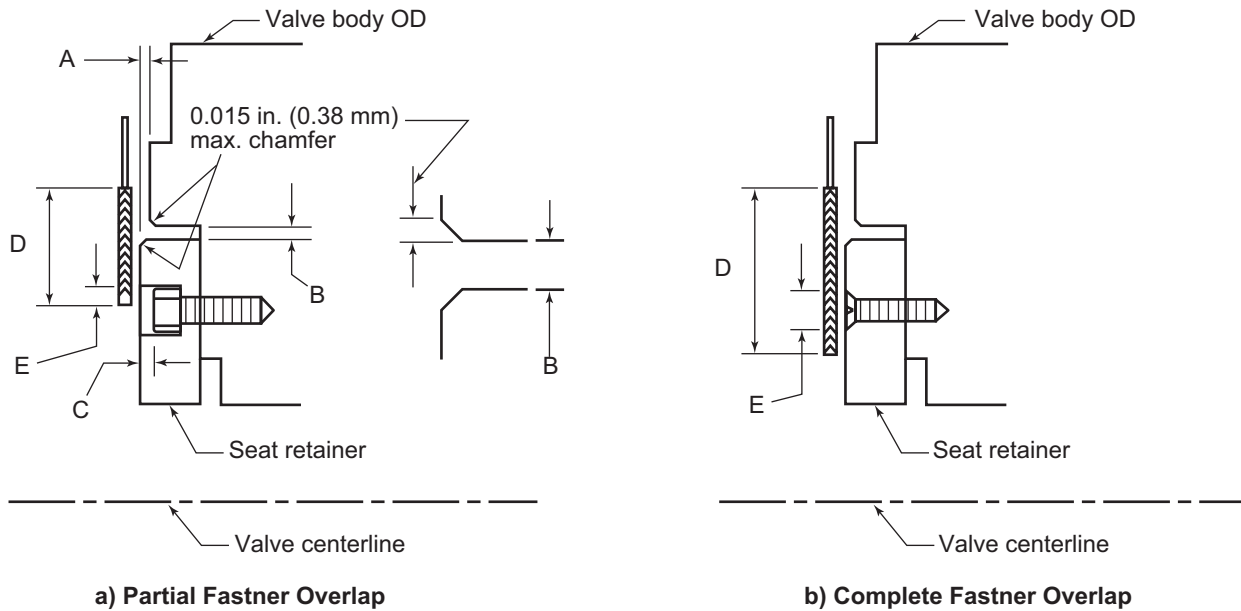
**Figure 1—External Bolting Options for Lug- and Wafer-type Valves**

**WARNING—Lug-type valves may be suitable for dead end service only when installed with the seat retainer plate on the pressurized side. Failure to do so may result in downstream leakage or blow-out into the atmosphere, potentially causing bodily injury.**

## 5.8 Operating Mechanisms

**5.8.1** Levers, gear operators, handwheel, and automatic actuators shall be equipped with provisions to prevent movement of the disc from the desired set position during normal operating conditions. Normal operating conditions include throttling service when specified by the purchaser.

**5.8.2** Valves shall be closed by turning the shaft and attached operating device (such as a handle) in the clockwise direction.



Dimension	Definition	Range, mm	Range, in.
A	Protrusion of seat retainer plate above valve body face (after being compressed by mating flange). Negative value denotes insert below valve body face.	+0.00 to -0.25	+0.000 to -0.010
B	Radial width of annular gap between valve body and seat retainer plate (exclusive of chamfer).	0.76 max.	0.030 max.
C	Distance of screw head below face of seat retainer plate.	0.00 to 1.27	0.000 to 0.050
D	Width of sealing area of spiral-wound gasket for valve's size and rating.	—	—
E	Distance gasket sealing area overlaps fastener opening in face of seat retainer plate (may occur at the ID or OD of the gasket).	35 % of D (max.)	35 % of D (max.)

**Figure 2—Limitations for Flange Face Interruptions that Fall Within the Gasket Seating Area (NPS 6 through NPS 48)**

**5.8.3** The operating mechanism (lever or gear) shall be designed such that the operator input force applied to handle or handwheel required to operate the valve at the manufacturer's published torque requirement, does not exceed the operator input force capability values given in MSS SP-91, using a position multiplier of 0.5. In no case shall the input force exceed 360 N (80 lb).

## 5.9 Electrical Continuity

When specified in the purchase order, valves shall incorporate an electrostatic feature that ensures electrical continuity between the shaft and the body or the shaft, body, and disc. The valve shall have electrical continuity across the discharge path, with a resistance of not more than 10 ohms.

## 5.10 Packing Gland Bolting—Category B Valves Only

**5.10.1** When used, gland bolting shall pass through holes in the gland. The use of open slots is not permitted in the cover flange, cover, adjuster, or gland.

**5.10.2** Packing gland bolts shall be designed so that the bolt stresses shall not exceed one-third ( $1/3$ ) of the minimum ultimate tensile strength of the bolt with a packing stress of 38 MPa (5500 psi) and a gland bolt temperature of 38 °C (100 °F).



## **6 Materials**

### **6.1 Body**

The bodies of double-flanged, lug- and wafer-type butterfly valves shall be made of a material conforming to a purchaser-selected material specification in accordance with the applicable ASME standard listed in Section 2.

### **6.2 Process Wetted Parts**

**6.2.1** All process wetted parts, metallic and non-metallic, shall be the manufacturer's standard unless otherwise agreed upon between the manufacturer and the purchaser.

**6.2.2** Seats in the body and on the disc may be either separate or integral. Facings may be applied to valve bodies, discs, or both as deposited metal, integral metal, mechanically retained metal, or resilient materials.

**6.2.3** Process wetted parts shall not be welded to ductile or cast iron.

**6.2.4** The material selected for the seat retainer plates shall not result in a downgrade of the pressure temperature rating established by Section 4.

### **6.3 Packing or Shaft Seal Materials**

Packing or shaft seal materials shall be suitable for the specified service at the valve's pressure-temperature rating and shall be the manufacturer's choice, unless otherwise specified in the purchase order.

### **6.4 Gland Bolting**

Gland bolts shall be at least intermediate strength as defined in ASME B16.5.

### **6.5 Operating Mechanisms—Category B Valves Only**

Materials for the valve handle or gear box operator position device shall have a melting temperature of 760 °C (1400 °F) or higher.

## **7 Examination, Inspection and Testing**

### **7.1 Examination Requirements**

The manufacturer shall examine all valves as specified in API 598.

### **7.2 Inspection by the Purchaser**

If inspection by the purchaser is specified in the purchase order and a detailed procedure is not included, inspection shall be in accordance with API 598. If inspection is not specified in the purchase order, the valve shall be capable of meeting the inspection requirements described in API 598.

### **7.3 Production Pressure Tests**

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

### **7.4 De-rated Valve Type Testing**

**7.4.1** De-rated valves shall be based upon design calculation and verified through type testing with no size or pressure class qualification range extension.

**7.4.2** The manufacturer shall verify the maximum pressure that produces a leak rate acceptable per API 598 for each sealing direction (or a single flow direction for unidirectional valves) for de-rated valves.

**7.4.3** For bidirectional de-rated valves suitable for dead-end service, the type test shall be performed with the seat retainer side of the test valve fully unrestrained. For unidirectional dead-end service valves, the type test shall be performed with the low-pressure side of the test valve fully unrestrained.

**7.4.4** For bidirectional de-rated valves suitable for dead-end service, the differential rating shall be 90 % of the lower of the two pressures attained in 7.4.2. For unidirectional de-rated valves suitable for dead-end service, the differential rating shall be 90 % of the maximum pressure attained in 7.4.2.

## **7.5 Electrical Continuity Valve Type Testing**

To type test for continuity, a new dry valve shall be cycled at least five times, and the resistance shall have electrical continuity across the discharge path with a resistance not exceeding 10 ohms as measured using a DC power source not exceeding 12 volts (see 5.9).

## **7.6 Repair of Defects**

**7.6.1** When examination, inspection, or testing reveals defects in the body of a steel or alloy valve, the defects shall be repaired in accordance with the ASTM standard specified in the purchase order. If none are specified, the defects shall be repaired as permitted by the most applicable ASTM material specification listed in ASME B16.34.

**7.6.2** When examination, inspection, or testing reveals defects in the body of a nonferrous valve, the defects may be repaired as permitted by the applicable ASTM specification listed in ASME B16.34.

**7.6.3** Welding, brazing, plugging, peening, or impregnation to repair defects in gray iron, ductile iron, or copper alloy castings is not permitted.

## **8 Markings**

**8.1** Category B valves of steel, nickel alloy, or special alloy shall be marked in accordance with the requirements of ASME B16.34. All other butterfly valves shall be marked in accordance with ANSI/MSS SP-25. A nameplate shall be attached to a steel or alloy body by welding or with pins made of a material similar to that permitted for the nameplate. For other valve body materials, a nameplate shall be attached to the body by suitable pins. The nameplate shall be made of an 18Cr-8Ni stainless steel or nickel alloy and shall include the following information:

- a) manufacturer's name;
- b) catalog reference number;
- c) size (NPS);
- d) ASME body pressure class (for Category B valves);
- e) pressure at 38 °C (100 °F);
- f) pressure and temperature at maximum allowable temperature as may be determined by other than the shell rating;
- g) identification of materials, including those used in the body, the stem, disc seating surface, body seating surface, and any internal liner or encapsulation (see 4.3.2);

h) the marking API 609A E8 (category A valves) or API 609B E8 (category B valves) if the valve complies with this standard.

**8.2** Valves not having the same pressure rating from both directions shall be clearly and permanently marked “High Pressure Side” in an appropriate location.

**8.3** Valves not designed for dead-end service (see 5.7) shall be marked “Not for Dead End Service.”

**8.4** Valves designed for dead-end service in only one direction shall be marked “For Unidirectional Dead-end Service Only,” and, on the appropriate side, “High-pressure Side.”

**8.5** De-rated valves shall be marked “maximum differential pressure xxx” where “xxx” is the differential pressure rating qualified through type testing per 7.4.

## **9 Packaging and Shipping**

### **9.1 Coatings**

**9.1.1** Machined surfaces of materials that are not rust resistant shall be coated with easily removable rust preventive.

**9.1.2** Unless otherwise specified in the purchase order, the unmachined exterior surfaces of a tested and inspected valve shall be primed and coated in accordance with the manufacturer’s standard practice. Nonferrous and austenitic stainless steel valves need not be coated.

### **9.2 Shaft Packing**

Valves shall be shipped with the shaft packing installed.

NOTE Adjustment of the packing glands may be required before the valves are placed in service.

### **9.3 Packaging**

**9.3.1** When export packaging is not specified in the purchase order, valves may be shipped loose, palletized, or packed in a box or crate. Valves shall be packaged to prevent damage during shipment.

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

**9.3.3** Valves shipped with mounted actuators shall be packaged to prevent damage during transit.

**9.3.4** Valve ends shall be fully blanked to protect the sealing surfaces and valve internals during shipment and storage. The protective covers shall be wood, wood fiber, plastic, or metal and shall be securely attached to the valve ends by bolting, steel straps, steel clips, or suitable friction-locking devices. Covers shall not be of pressed cardboard (hardboard). Covers shall be designed so that the valves cannot be installed without the complete removal of the covers. Valves packaged in close-fitting corrugated cartons do not require additional end protection.

### **9.4 Spare Parts**

When specified in the purchase order, the vendor shall submit a complete list of spare parts. The list shall include cross-sectional or assembly-type drawings for the purpose of part number identification.

## **10 Purchase Order Information**

Purchase Order Information Items listed in Annex B paragraph B.2.1 are considered an integral part of this standard, and should be specified by the purchaser.

## **Annex A** (informative)

### **Use of API Monogram by Licensees**

#### **A.1 Scope**

The API Monogram® is a registered certification mark owned by the American Petroleum Institute (API) and authorized for licensing by the API Board of Directors. Through the API Monogram Program, API licenses product manufacturers to apply the API Monogram to new products which comply with product specifications and have been manufactured under a quality management system that meets the requirements of API Q1. API maintains a complete, searchable list of all Monogram licensees on the API Composite List website ([www.api.org/compositelist](http://www.api.org/compositelist)).

The application of the API Monogram and license number on products constitutes a representation and warranty by the licensee to API and to purchasers of the products that, as of the date indicated, the products were manufactured under a quality management system conforming to the requirements of API Q1 and that the product conforms in every detail with the applicable standard(s) or product specification(s). API Monogram program licenses are issued only after an on-site audit has verified that an organization has implemented and continually maintained a quality management system that meets the requirements of API Q1 and that the resulting products satisfy the requirements of the applicable API product specification(s) and/or standard(s). Although any manufacturer may claim that its products meet API product requirements without monogramming them, only manufacturers with a license from API can apply the API Monogram to their products.

Together with the requirements of the API Monogram license agreement, this annex establishes the requirements for those organizations who wish to voluntarily obtain an API license to provide API monogrammed products that satisfy the requirements of the applicable API product specification(s) and/or standard(s) and API Monogram Program requirements.

For information on becoming an API Monogram Licensee, please contact API, Certification Programs, 1220 L Street, N. W., Washington, DC 20005 or call 202-682-8145 or by email at [certification@api.org](mailto:certification@api.org).

#### **A.2 Normative References**

API Specification Q1, *Specification for Quality Management System Requirements for Product Manufacturing for the Petroleum and Natural Gas Industry*

#### **A.3 Terms and Definitions**

For purposes of this annex, the following terms and definitions apply:

##### **A.3.1**

##### **API monogramable product**

Product that has been newly manufactured by an API licensee utilizing a fully implemented API Q1 compliant quality management system and that meets all the API specified requirements of the applicable API product specification(s) and/or standard(s).

##### **A.3.2**

##### **API specified requirements**

Requirements, including performance and licensee-specified requirements, set forth in API Q1 and the applicable API product specification(s) and or standard(s).

NOTE Licensee-specified requirements include those activities necessary to satisfy API specified requirements.

**A.3.3****API product specification**

Prescribed set of rules, conditions, or requirements attributed to a specified product which address the definition of terms; classification of components; delineation of procedures; specified dimensions; manufacturing criteria; material requirements, performance testing, design of activities; and the measurement of quality and quantity with respect to materials; products, processes, services, and/or practices.

**A.3.4****licensee**

Organization that has successfully completed the application and audit process and has been issued a license by API.

**A.3.5****design package**

Records and documents required to provide evidence that the applicable product has been designed in accordance with API Q1 and the requirements of the applicable product specification(s) and/or standard(s).

**A.4 Quality Management System Requirements**

An organization applying the API Monogram to products shall develop, maintain, and operate at all times a quality management system conforming to API Q1.

**A.5 Control of the Application and Removal of the API Monogram**

Each licensee shall control the application and removal of the API Monogram in accordance with the following:

- a) Products that do not conform to API specified requirements shall not bear the API Monogram.
- b) Each licensee shall develop and maintain an API Monogram marking procedure that documents the marking/monogramming requirements specified by this annex and any applicable API product specification(s) and/or standard(s). The marking procedure shall:
  - 1) define the authority responsible for application and removal of the API Monogram;
  - 2) define the method(s) used to apply the Monogram;
  - 3) identify the location on the product where the API Monogram is to be applied;
  - 4) require the application of the licensee's license number and date of manufacture of the product in conjunction with the use of the API Monogram;
  - 5) require that the date of manufacture, at a minimum, be two digits representing the month and two digits representing the year (e.g. 05-12 for May 2012) unless otherwise stipulated in the applicable API product specification(s) or standard(s); and
  - 6) require application of the additional API product specification(s) and/or standard(s) marking requirements.
- c) Only an API licensee may apply the API Monogram and its designated license number to API monogramable products.
- d) The API Monogram license, when issued, is site-specific and subsequently the API Monogram shall only be applied at that site specific licensed facility location.

- e) The API Monogram may be applied at any time appropriate during the production process but shall be removed in accordance with the licensee's API Monogram marking procedure if the product is subsequently found to be out of conformance with any of the requirements of the applicable API product specification(s) and/or standard(s) and API Monogram Program.

For certain manufacturing processes or types of products, alternative API Monogram marking procedures may be acceptable. Requirements for alternative API Monogram marking are detailed in the API Policy, *API Monogram Program Alternative Marking of Products License Agreement*, available on the API Monogram Program website at <http://www.api.org/alternative-marking>.

## **A.6 Design Package Requirements**

Each licensee and/or applicant for licensing must maintain a current design package for all of the applicable products that fall under the scope of each Monogram license. The design package information must provide objective evidence that the product design meets the requirements of the applicable and most current API product specification(s). The design package(s) must be made available during API audits of the facility.

In specific instances, the exclusion of design activities is allowed under the Monogram Program, as detailed in *Advisory # 6*, available on API Monogram Program website at <http://www.api.org/advisories>.

## **A.7 Manufacturing Capability**

The API Monogram Program is designed to identify facilities that have demonstrated the ability to manufacture equipment that conforms to API specifications and/or standards. API may refuse initial licensing or suspend current licensing based on a facility's level of manufacturing capability. If API determines that additional review is warranted, API may perform additional audits (at the organization's expense) of any subcontractors to ensure their compliance with the requirements of the applicable API product specification(s) and/or standard(s).

## **A.8 API Monogram Program: Nonconformance Reporting**

API solicits information on products that are found to be nonconforming with API specified requirements, as well as field failures (or malfunctions), which are judged to be caused by either specification deficiencies or nonconformities with API specified requirements. Customers are requested to report to API all problems with API monogrammed products. A nonconformance may be reported using the API Nonconformance Reporting System available at <http://compositelist.api.org/ncr.asp>.

## **Annex B** (informative)

### **Information to be Specified by Purchaser**

#### **B.1 Deviating Requirements**

If the purchaser needs a butterfly valve that deviates from this standard, the deviating requirements shall be stated in the purchase order.

#### **B.2 Purchase Order**

##### **B.2.1 General**

If no exceptions are to be taken to this standard, the purchase order need only refer to API 609 and specify the items listed in B.2.2 and any optional items listed in B.2.3.

##### **B.2.2 Required on the Purchase Order**

The following items are required on the purchase order:

- a) valve size and class (see 1.3);
- b) valve Category: A or B (see 1.3);
- c) type of body style (double-flanged, lug- or wafer-type) (see 1.3 and 5.2.1 to 5.2.3);  
NOTE for double-flanged valves; long pattern or a short pattern (see Table 3B, Table 3C).
- d) Class 300 short pattern has two sets of dimensions. Purchaser shall specify which is required.
- e) unidirectional or bidirectional flow and pressure shutoff requirement (see 5.7.3);
- f) dead-end service;
- g) operator type: lever or other (see 5.8);
- h) materials of construction, including those for process wetted parts and those for packing or shaft seals (see Section 6).

##### **B.2.3 Items That May be Specified**

The following items may be specified on the purchase order:

- a) conformance with API 607 for applications where a fire-tested valve is required (see 5.1.2);
- b) lockable device (see 5.1.3);
- c) end flanges attached by welding (see 5.2.3);
- d) drain or bypass connections (see 5.2.4);
- e) through drilling or special tapping of lug-bolt holes (see 5.6);



- f) anti-static feature (see 5.9);
- g) on-off or throttling service (see 5.8.1);
- h) operating conditions including maximum operating temperature, flow rate or line velocity, maximum pressure drop, fluid media, and specific gravity;
- i) packing or shaft seal materials (see 6.4);
- j) inspection by the purchaser (see 7.2);
- k) export packaging (see 9.3);
- l) special external coating (see 9.1);
- m) recommended spare parts information (see 9.4);
- n) type of mating flange (slip-on, welding-neck, or other), mating flange specification, and flange bore or pipe inside diameter, as applicable;
- o) special tagging/marketing requirements;
- p) additional documentation requirements to be shipped with order such as MTR's, Certificate of Conformance or other;
- q) use of welded on body extensions;
- r) Face-to-face dimensions for category B lugged or wafer valves larger than NPS 24 (see Table 3A).

### **B.3 Additional Items**

Refer to API 598 for additional items that may need to be specified, including supplementary examination, the extent of inspection by the purchaser, the inspector's address, and optional high-pressure closure test.

## Annex C (informative)

### Typical Butterfly Valve Construction and Nomenclature

The following figures show various typical types of constructions as well as nomenclatures for valve parts and critical dimensions. All figures share generic key indicating features that are common to all butterfly valves; additional parts may be listed in each figure to aid the user in specifying material of construction.

Generic Figure Key:

Parts of Construction

1. Gland
2. Packing Set
3. Body
4. Shaft/Stem
5. Disc

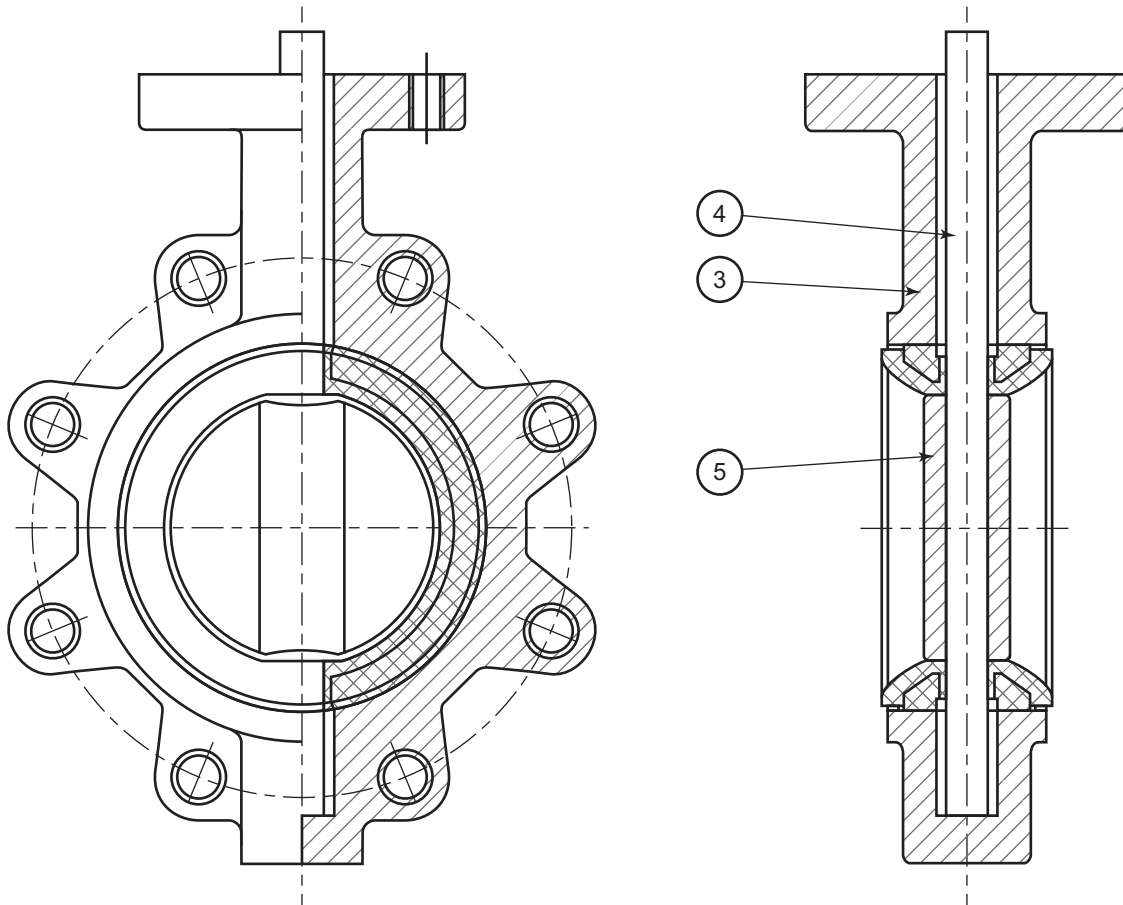


Figure C.1—Typical Concentric-type

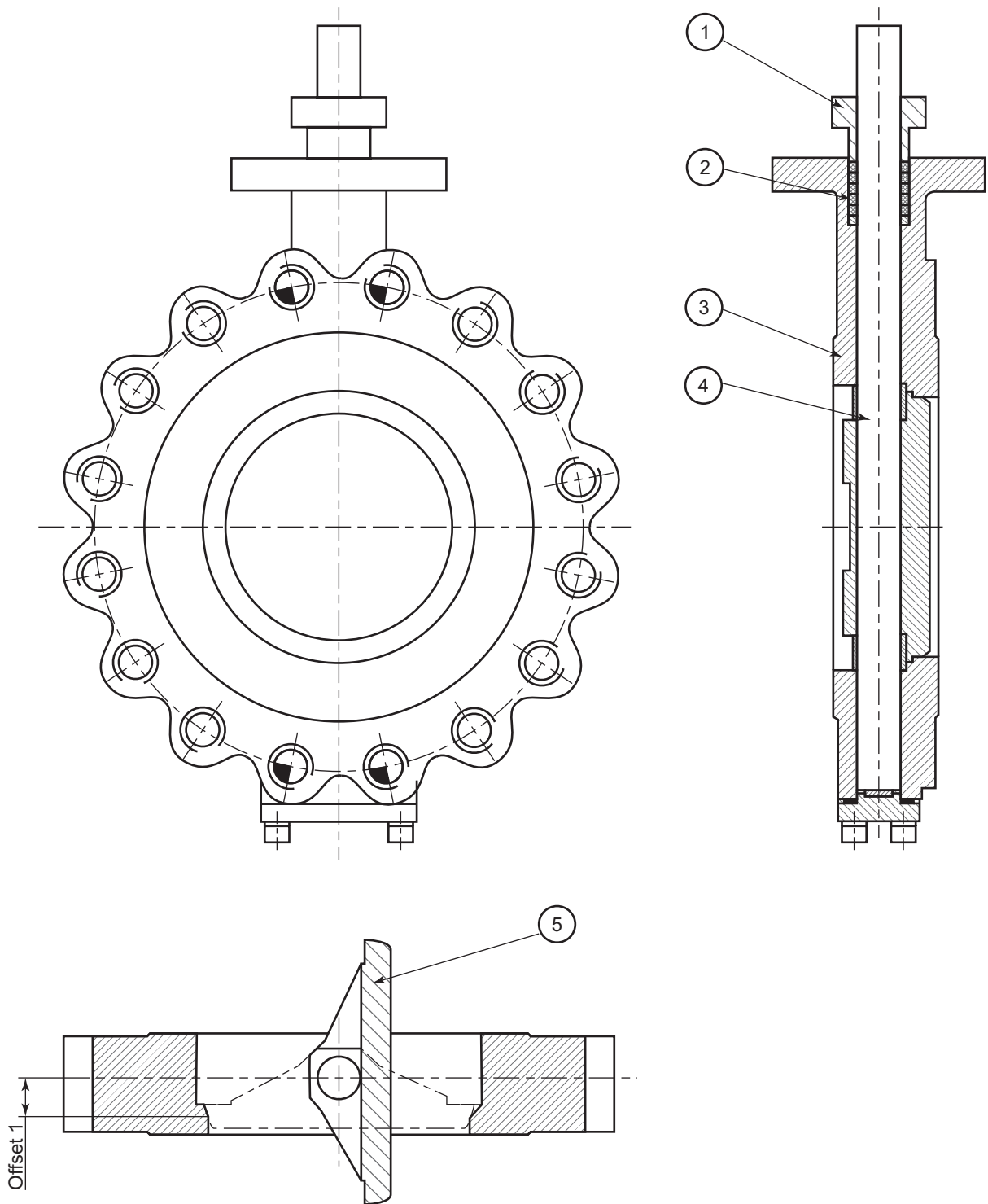


Figure C.2—Typical Single Offset-type Construction (Category B)

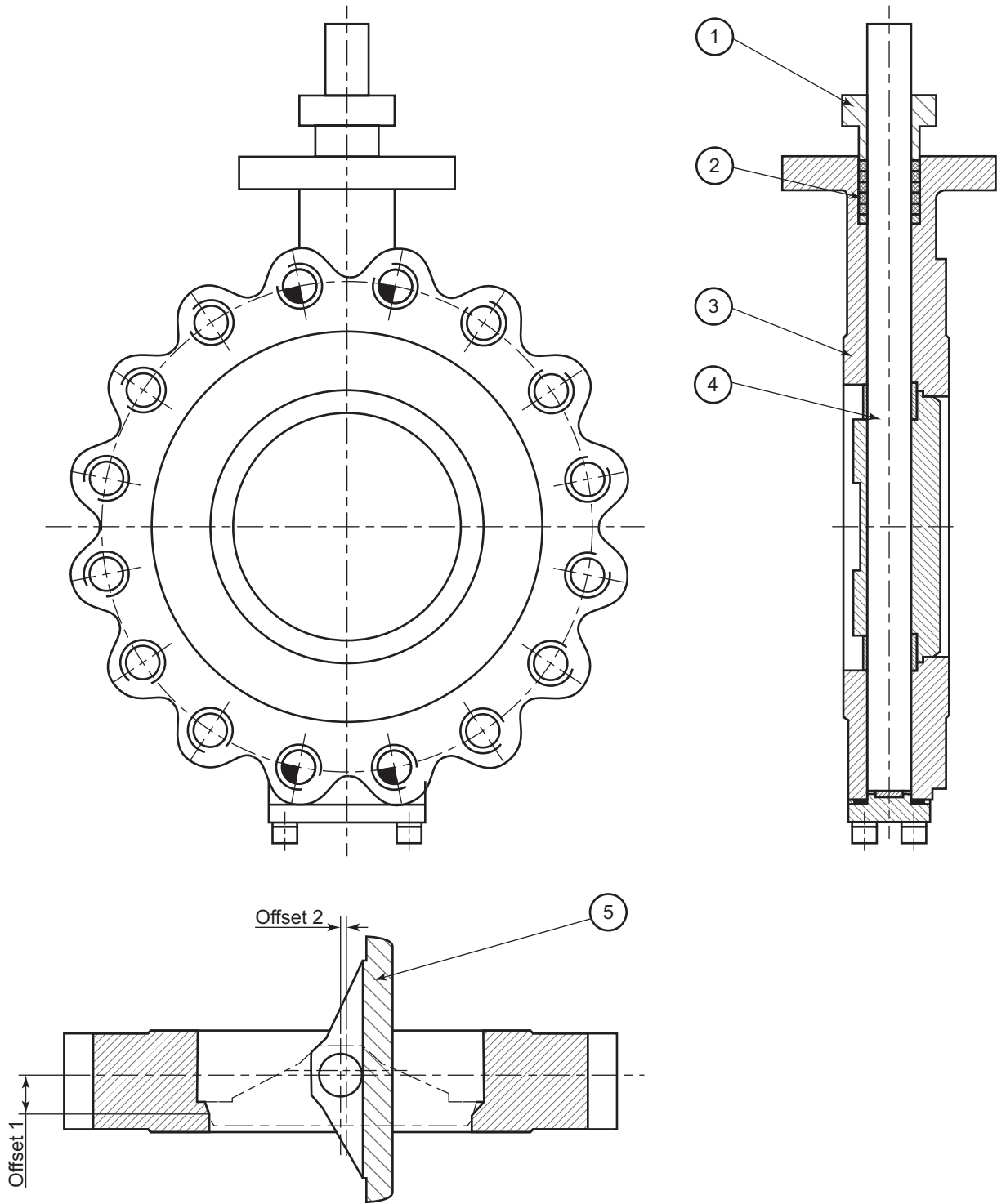


Figure C.3—Typical Double Offset-type Construction (Category B)

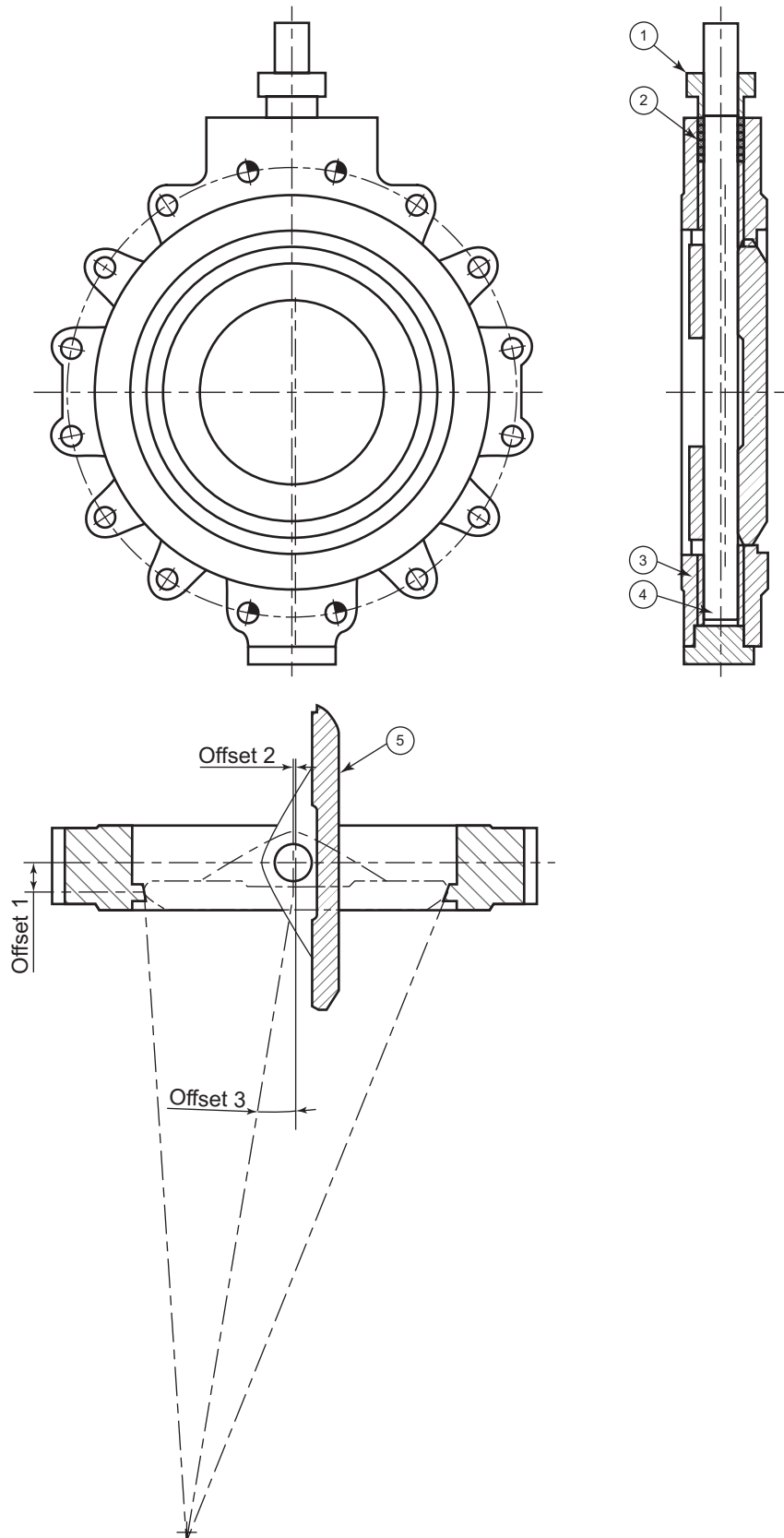


Figure C.4—Typical Triple Offset-type Construction (Category B)

## Annex D (normative)

### Disc-to-pipe Clearances

The maximum diameter of a concentric-type disc for a given size of valve and a given inside diameter of the connecting pipe or flange shall be determined as follows.

First, calculate the chord of the disc with the following equation:

$$a = d - 2c$$

Then use the result to determine the maximum disc diameter with the following equation:

$$D = \sqrt{W^2 + a^2}$$

where

- a* is the chord of the disc in an open position, in millimeters (inches), as determined by the intersection of a plane through the installed face of the valve body (see Figure A.1).
- c* is the nominal radial clearance between the disc and the inside of the pipe or flange, in millimeters (inches), when the disc and valve are concentrically located (see Table A.1 and Figure A.1).
- d* is the inside diameter of the connecting pipe or flange, in millimeters (inches), see Figure A3. (The inside diameter of the steel pipe may be determined by subtracting twice the nominal wall thickness from the outside diameter, using the appropriate dimensions listed in ASME B36.10M.)
- D* is the maximum disc diameter, in millimeters (inches).
- W* is the minimum installed face-to-face dimension of the valve, in millimeters (inches).

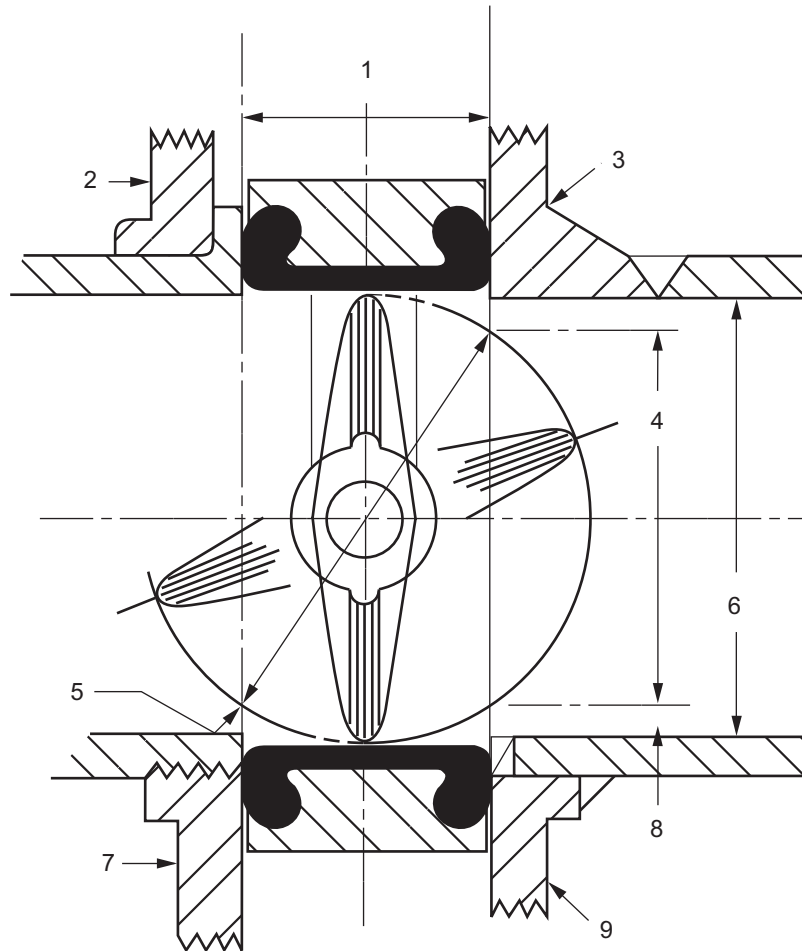
The calculation above assumes concentric location of the disc and shaft in the valve body. Equivalent nominal radial clearances shall be provided for eccentric or offset shaft construction at all angles of disc rotation.

Figure A.1 shows dimensional location for concentric-type construction. Figure A.2 shows the nomenclature for and explains offset-seat-type construction. Table A.2 indicates the relationship of unlined steel pipe schedules to valve category, size, and ASME class.

**CAUTION—Purchaser shall ensure the proper disc-to-pipe clearance when a greater pipe wall thickness and/or an internal lining is being used. Failure to do so may cause the disc edge to come into contact with the pipe causing damage to the disc and pipe.**

**Table D.1—Nominal Radial Clearances**

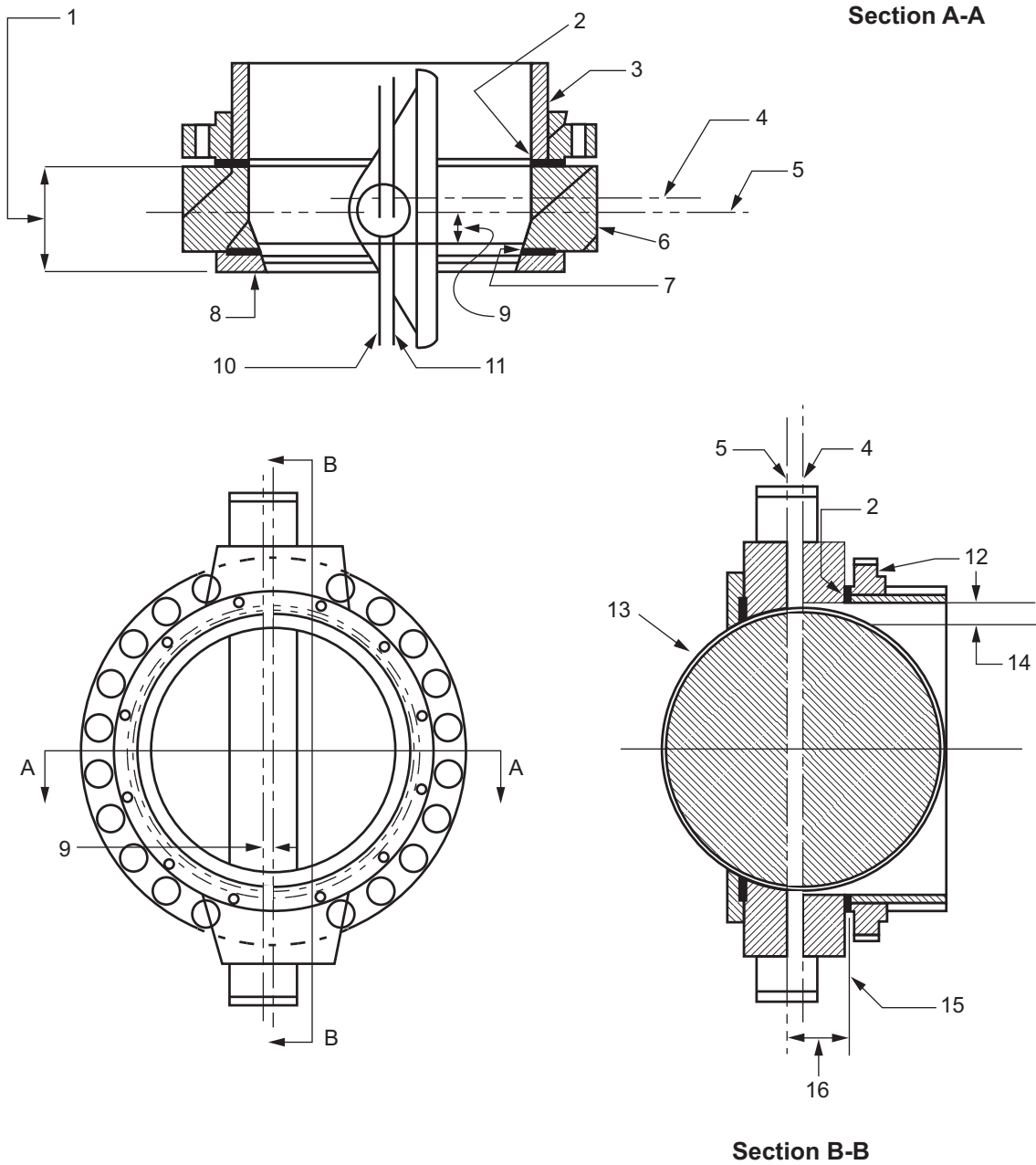
Valve Size (NPS)	Nominal Radial Clearance ( <i>c</i> )	
	mm	in.
2 to 6	1.5	0.06
8 to 20	3.0	0.12
24 to 48	6.4	0.25



**Key**

- 1 minimum installed face-to-face dimension, *W*
- 2 lap-joint flange
- 3 welding-neck flange
- 4 chord of disc, *a*
- 5 maximum disc diameter, *D*
- 6 pipe inside diameter, *d*
- 7 threaded flange
- 8 nominal radial clearance, *c*
- 9 slip-on flange

**Figure D.1—Typical Concentric-type Construction (Category A)**



**Key**

- |  |   |
|--|---|
| <ul style="list-style-type: none"> <li>1 valve face-to-face dimension (metal)</li> <li>2 flange gasket</li> <li>3 pipe</li> <li>4 disc centerline</li> <li>5 shaft centerline</li> <li>6 body</li> <li>7 seat</li> <li>8 seat retainer plate</li> <li>9 seat offset</li> </ul> | <ul style="list-style-type: none"> <li>10 shaft centerline (axis of rotation)</li> <li>11 pipe centerline</li> <li>12 flange</li> <li>13 disc</li> <li>14 nominal radial clearance (c) in the fully open disc position (see note to this appendix)</li> <li>15 flange face</li> <li>16 distance of shaft centerline to flange face</li> </ul> |
|--|---|

**Figure D.2—Typical Eccentric-type Construction (Category B)**



**Table D.2—Relationship of Unlined Steel Pipe Schedule to Valve Category, Size, and ASME Class**

Valve Size (NPS)	Category A	Category B			
		Class 150	Class 300	Class 600	
2 to 2.5	Standard weight	Not applicable			
3 to 4		Standard weight	Extra strong	Extra strong	
5		Not applicable			
6		Standard weight	Standard weight	Extra Strong	Extra strong
8 to 14					Schedule 40
16					
18 to 24					
26 to 38		Extra strong	Extra strong	a	a
40 to 48	a	a	a	a	

NOTE This table considers full flange rating for ASTM A106 Grade B pipe with a mill tolerance of -12.5 % and a corrosion allowance of 3.175 mm (0.125 in.) except as noted below.

<sup>a</sup> There are no standard pipe schedules available for the required wall thickness. Pipe wall thicknesses are calculated for actual operating conditions rather than the full flange rating.

## Bibliography

- [1] ASME B16.10, *Face-to-Face and End-to-End Dimensions of Valves*
- [2] ASME B16.20, *Metallic Gaskets for Pipe Flanges—Ring-Joint, Spiral-Wound, and Jacketed*
- [3] ASME B46.1, *Surface Texture (Surface Roughness, Waviness, and Lay)*
- [4] BS EN 558-1, *Industrial valves. Face-to-face and centre-to-face dimensions of metal valves for use in flanged pipe systems. Class-designated valves.*
- [5] BS EN 593, *Industrial valves. Metallic butterfly valves*
- [6] ISO 5752<sup>3</sup>, *Metal valves for use in flanged pipe systems—Face-to-face and center-to-face dimensions*
- [7] MSS SP-44, *Steel Pipeline Flanges*
- [8] MSS SP-68, *High Pressure Butterfly Valves with Offset Design*

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<sup>3</sup> International Organization for Standardization, 1, ch. de la Voie-Creuse, Case postale 56, CH-1211, Geneva 20, Switzerland, [www.iso.org](http://www.iso.org).





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