

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

API STANDARD 609

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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.

## 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 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 ~~construction~~ configuration. Sizes covered are ~~DN50 to DN1500~~ (NPS 2 to NPS 60) 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~~ ~~construction~~ configuration. Sizes covered are listed below:
  - for lug and wafer, class 150 and 300: ~~DN50 to DN1500~~ (NPS 2 to NPS 60);
  - for lug and wafer, class 600: ~~DN80 to DN1500~~ (NPS 3 to NPS 60);
  - for double-flanged short and long pattern, class 150, 300, and 600: ~~DN80 to DN1500~~ (NPS 3 to NPS 60);
  - For double-flanged short pattern, class 900, DN150 to DN1200 (NPS 6 to NPS 48)
  - for butt-welding ends, class 150, 300 and 600: ~~DN80 to DN1500~~ (NPS 3 to 60);
  - For butt-welding ends, class 900, DN150 to DN1200 (NPS 6 to NPS 48)

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

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

1.4 ~~Users of this standard should refer to API RP 615 for background and further guidance and definitions on API 609 valves.~~

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## 2 Normative References

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any addenda) applies.

API Recommended Practice 615, Valve Selection Guide

API Standard 598, *Valve Inspection and Testing*

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

API Standard 641, *Type Testing of Quarter-turn Valves for Fugitive Emissions*

ASME B1.1<sup>1</sup>, *Unified Inch Screw Threads (UN, UNR, and UNJ Thread Forms)*

ASME B16.1, Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250

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

ASME B16.20, Metallic Gaskets for Pipe Flanges

ASME B16.24, *Cast Copper Alloy Pipe Flanges, Flanged Fittings, and Valves: Classes 150, 300, 600, 900, 1500, and 2500*

ASME B16.25, *Buttwelding Ends*

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

ASME B16.42, *Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300*

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

ASME B31.3, *Process Piping*

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

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<sup>1</sup>~~ASME International~~ The American Society of Mechanical Engineers, Two Park Avenue, New York, New York 10016-5990, [www.asme.org](http://www.asme.org).

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

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

MSS SP-45, *~~Drain and Bypass Connections~~Bypass and Drain Connections, MSS-SP-44 for larger flanges? Normally it is covered under 16.47, Also MSS-SP-67 (discussion for AWWA and other types)*

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

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

*ISO28921-1(refer to the two other places same places where we have MSS-SP-134)*

ANSI/NACE MR0103<sup>3</sup>/ISO 17945, Petroleum, petrochemical and natural gas industries—Metallic materials resistant to sulfide stress cracking in corrosive petroleum refining environments

ANSI/NACE MR0175/ISO 15156, Petroleum and natural gas industries—~~M~~materials for use in ~~h2s~~H<sub>2</sub>S-containing environments in oil and gas production

### 3 Terms and Definitions

For the purpose 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 the letters "Class" followed by a dimensionless whole number. The number following the letters "Class" does not represent a measurable value and is not used for calculation purposes except where specified in this standard. The allowable pressure for a valve having a class number depends on the valve material and its application temperature and is found in tables of pressure-temperature ratings.

#### 3.2

##### **cryogenic service**

Unless a different temperature is specified by the purchaser, valves required to operate at or below -73 °C (-100 °F) are in cryogenic service.

#### 3.3

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

~~A condition that may occur after the companion flange and/or piping are removed from one side of a valve.~~  
A condition that may occur after the companion flange and/or piping are removed from the unpressurized side of a valve.

#### 3.4

##### **NPS**

An alphanumeric designation of size that is common for components used in a piping system, used for reference purposes, comprising the letters "NPS" followed by a dimensionless number indirectly related to

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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, msshq.org.

<sup>3</sup>NACE Association for Materials Protection and Performance (AMPP), 15835 Park Ten Place, Houston, Texas 77084, www.amp~~n~~ace.org.

the physical size of the bore or outside diameter of the end connection as appropriate. The dimensionless number may be used as a valve size identifier without the prefix "NPS". The dimensionless size identification number does not represent a measurable value and is not used for calculation purposes.

### 3.5 DN

A numeric designation of size that is common for components used in a piping system, used for reference purposes, comprising the letters "DN" followed by a dimensionless number indirectly related to the physical size of the bore or outside diameter of the end connection as appropriate. The dimensionless number following "DN" does not represent a measurable value and is not used for calculation purposes except where specified in this standard.

### 3.5.3.6

#### pressure boundary element

Comprises the shell and related bolting that forms a part of the pressure boundary (see Annex C).

### 3.6.3.7

#### Shell

Comprises the body, cover, bonnet, bonnet extension, and seat retainer that constitutes the pressure boundary of an API 609 valve (see Annex C).

### 3.8

#### CWP (cold working pressure)

The maximum fluid pressure at which a valve is allowed to be used at ambient temperature.

~~Hydrogen service...gas or liquid (API 609 valves are used worldwide on hydrogen gas service only)...~~

## 4 Pressure-temperature Ratings

### 4.1 Valve Rating

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

### 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.

### 4.3 Seat Rating

**4.3.1** For Category B valves, the valve seat ratings for polytetrafluoroethylene (PTFE) or modified PTFE and reinforced polytetrafluoroethylene (RPTFE) or modified 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**

Temperature °C (°F)	Class 150				Class 300				Class 600	
	PTFE or modified		RPTFE or modified		PTFE or modified		RPTFE or modified		RPTFE or modified	
	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 8.4.4 f).

#### 4.4—Differential Pressure Rating

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

## 5 Design

### 5.1 General

#### 5.1.1

##### Category A Valves:

Valves manufactured in accordance with this standard shall meet the requirements of MSS SP-67 or the manufacturer's design and any additional requirements as specified in this standard. In the event of a conflict of requirements between the standards, this standard shall prevail.

#### 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

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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 have been type tested and certified to meet all performance requirements of API 607. Fire test report shall be made available to purchaser upon request.

### 5.1.3 Fugitive Emissions Tested Valves

If the purchaser specifies fugitive emission valves, the valve's design shall have been type tested and certified to meet all performance requirements of API 641 for valves upto and including class 600(NPS24) and upto and including class 600, for other valves it shall be as agreed confirming to national or international standard.

~~ISO15848 part 1.~~ Fugitive emission test report shall be made available to purchaser upon request. ~~(ISO15848 part 1 or API641 should be optional?)~~

### 5.1.4 Cryogenic Service

~~Valves required to operate in cryogenic service shall meet the additional requirements specified in (ANSI/MSS-SP-134 (ASME B16.34). ISO28921-1 it has design requirements for the extension (this is a different design?)~~

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Valve specified for cryogenic service shall meet the requirements of ANSI/MSS-SP-134. Alternatively, ISO 28921-1 may be specified.

Meeting ended at 2:43pm on 9April'24.....with comment resolution of Brandon Bounds cl 5.1.4

### 5.1.5 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 (5/16 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. ~~investigate minimum shank length requirements.....and maximum should be taken off.~~

### 5.1.6 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 gearbox and actuator (if installed) shall be provided with a position indicator to indicate the disc position

The design shall ensure that a valve (and/or operator) cannot be assembled to falsely indicate the valve's open and closed positions.

### 5.1.7 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.

### 5.1.8 Pressure Rating by Direction Category B Valves

- a) ~~Bidirectional—Category B valves:~~ Bidirectional valves shall have a pressure rating of equal value in both directions. The pressure rating shall be marked in accordance with 8.1.
- b) ~~Preferred Direction—Category B valves:~~ When specified by the purchaser, the valve may have preferred and nonpreferred sealing direction. The pressure ratings on both the preferred and nonpreferred sealing directions shall be marked in accordance with 8.1.

NOTE:?? Preferred installation direction?

Unless otherwise agreed, valves shall be bi-directional, having the same shut-off pressure rating in both directions. When the shut-off pressure rating is not same in both direction, the pressure rating of each direction shall be marked on the name plate in accordance with 8.4.

### 5.1.9 Dead-end Service

All components of lug-type and double-flanged valves designated for dead-end service by the purchaser (see B.1.3.f) shall pass the API 598 high-pressure closure test at 110 % of the valve's differential pressure rating in each direction. When the seat retainer is on the downstream side, the high-pressure closure test shall be performed with the seat retainer fully unrestrained (i.e. no downstream flange). Valves designed for dead-end service in only one installation direction require additional marking per 8.3.

5.1.10 Add: Removable valve parts and seat rings shall be positively secured against loosening. The application of spring tension pins is not allowed.

5.1.11 Lifting : The manufacturer shall determine the need for and verify suitability of lifting points of the valve. The manufacturer shall provide lifting and handling instructions for safe lifting operations for valves in installation and operation manuals.

## 5.2 Body

**5.2.1** The minimum body-wall thickness shall comply with the applicable ASME B16 standards listed in Section 2 based on the body material. If the applicable standard covers fittings i.e. B16.1, 16.24, 16.42, 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 to the flange bolting pattern, that is, designed to center itself within the bolt



circle. Self-centering may be achieved 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 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** Butt-welding ends shall conform to the requirements of ASME B16.25 with an inside diameter (denoted as "B" in ASME B16.25) tolerance per ASME B16.34.

**5.2.5** 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 use nonmetallic liners, sleeves, or auxiliary seals extending from or over the body contact faces.

NOTE 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.

**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** Face-to-face dimensions for butt-welding end valves shall be the manufacturer's standard.

**Table 2—Face-to-face Dimensions for Category A Valves (Lug- and Wafer-type)** ~~consider adding double flanged design, create a new table and foot notes, different CWPs to be considered?~~

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
50 to 60	— a		6.4	0.25

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

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

Valve Size	Class 150		Class 300		Class 600		Maximum Variance ±	
(NPS)	mm	in.	mm	in.	mm	in.	mm	in.
2	— a						3.3	0.13
2 1/2	48	1.88	48	1.88	— a		3.3	0.13
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 60	— a						6.4	0.25
aDimensions 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)**

Valve class	Class 150 <sup>a</sup>		Class 300 <sup>a</sup>		Class 600 <sup>a</sup>		Maximum Variance ±	
(NPS)	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	419	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	660/711	26/28.00	1524	60.00	1778	70.00	4	0.16
36	711	28.00	1727	68.00	2083	82.00	5	0.19
34, 38 to 60	— b						5	0.19

aDimensions listed agree with ASME B16.10 for flanged gate valves.

bDimensions shall be manufacturer's standard or as agreed between purchaser and manufacturer.

**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	— c	— c	4	0.16
28	292	11.50	430	16.93	— c	— c	4	0.16
30	318	12.52	450	17.72	— c	— c	4	0.16
32	318	12.52	470	18.50	— c	— c	4	0.16
36	330	12.99	510	20.08	— c	— c	5	0.19
38	410	16.14	530	20.87	— c	— c	5	0.19
40	410	16.14	550	21.65	— c	— c	5	0.19
42	410	16.14	570	22.44	— c	— c	6	0.24
48	470	18.50	630	24.80	— c	— c	6	0.24
50 to 60	— c	— c	— c	— c	— c	— c	6	0.24

NOTE See NOTES TO PURCHASER, B.1.3 d).

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

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

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

#### 5.4 Valve Body Flange Facings

**5.4.1** 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.

**5.4.2** Body contact faces of steel or alloy valves that require separate gaskets shall be finished as specified in ASME B16.5 or ASME B16.47 as applicable.

## **5.5 Disc Clearance**

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 open.

## **5.6 Shaft and Shaft Seals**

**5.6.1** 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 %. Determination of the shaft strength and the shaft-to-disc connection strength shall be by calculation or testing.

~~**5.6.2** The design shall ensure that with an unbroken shaft or shaft-to-disc connection, the shaft cannot be removed from the valve by disassembly of gland bolting or actuator mounting hardware.~~

**5.6.2** The design shall ensure that with an unbroken shaft or shaft-to-disc connection, the shaft cannot be removed from the valve by disassembly or removal of the gland bolting, gearbox, actuator, or gearbox/actuator mounting hardware.

**5.6.3** The shaft shall be an anti-blowout design to ensure that if failure of the shaft occurs within the pressure boundary, no portion of the ~~shaftstem~~ can be ejected from the valve by internal pressure. The design may use the gland and gland bolting to retain a broken shaft. The design shall not rely on actuation components (e.g. gear operators, actuators, levers, ~~mounting hardware~~ etc.) to prevent shaft ejection.

~~**5.6.4** For Category B valves, the shaft shall have a surface finish of 0.80 µm (32 µin.) Ra or smoother in the area in contact with the packing, and the stuffing box shall have a surface finish of 3.2 µm (125 µin.) 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).~~

~~**5.6.5** Category B valves shall have adjustable shaft packing. The packing mechanism shall allow packing adjustment while the valve is pressurized with line fluid.~~

## **5.7 Piping Connection External Bolt Holes**

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

**5.7.2** 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.

**5.7.3** 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.

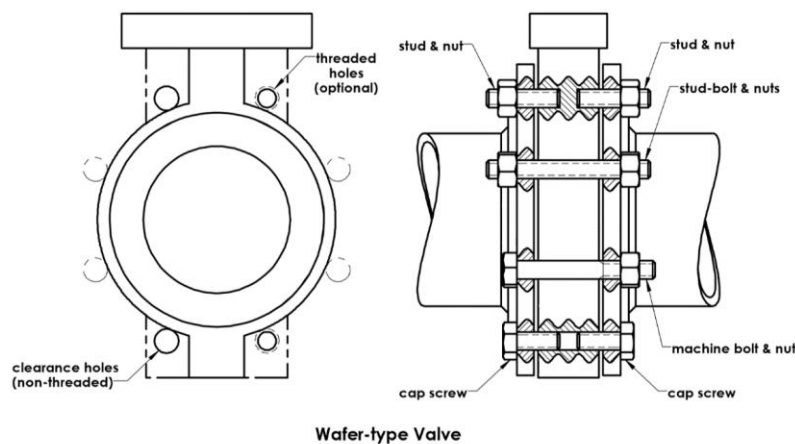
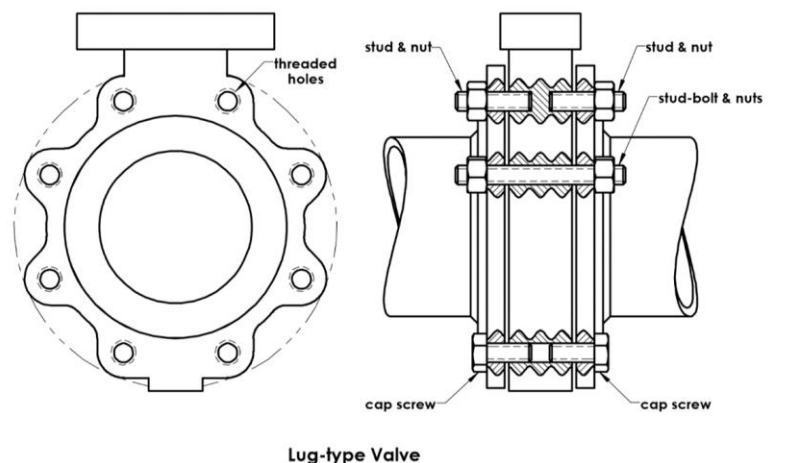
5.7.4 Typical bolting options for lug- and wafer-type valves are shown in Figure 1.

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

5.8.1 Seat retainer plate is a separate part intended to retain and compress the valve seat. When mechanically fastened to the valve body, retaining fasteners shall be recessed to or below the flange gasket surface (see Figure 2). Seat retainer, bolting design, and materials shall comply with ASME B16.34.

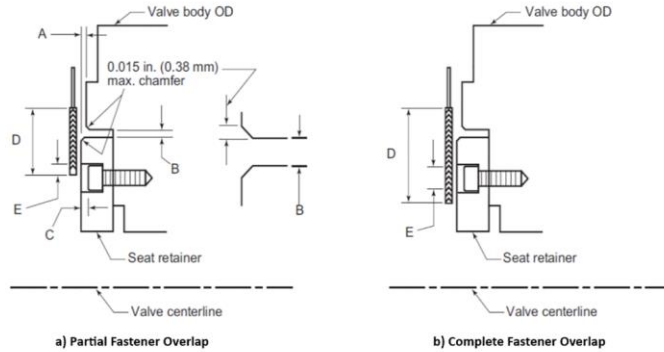
5.8.2 For gasket seating surface interruptions, interruptions in the seating area of a centered ASME B16.20 spiral-wound gasket shall not exceed the limitations given in Figure 2.

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



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

**WARNING** — Some lug-type valves may only be suitable for dead-end service when installed with the seat retainer plate on the pressurized side. Valves with installation limitations for dead-end service are required to be marked by the manufacturer per Section 98. Failure to follow the manufacturer's installation markings may result in downstream leakage or blow-out into the atmosphere, potentially causing property damage and bodily injury.



NOTE: Seat retainer shown with socket head cap screws. Other screw types are permissible.

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).	< NPS 6: < 50 % of D	
		≥ NPS 6: < 35 % of D	

**Figure 2—Limitations for Flange Face Interruptions That Fall Within the Gasket Seating Area**

## 5.9 Operating Mechanisms

**5.9.1** Levers, gear operators, handwheel, and power 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.

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

**5.9.3** 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. For handle lengths and handwheel diameters outside the scope of MSS SP-91, the input force shall not exceed 360 N (80 lb).

## 5.10 Antistatic Design (Electrical Continuity Between Disc, Shaft, and Body)

When specified in the purchase order, valves shall have electric resistance from the disc through the shaft and to the body that does not exceed 10 $\Omega$  when measured using a direct current power source not to exceed 12V.

NOTE See 7.3 for information on optional testing of electrical resistance. incorporate an antistatic feature that ensures electrical continuity between the shaft, body, and disc (see 7.3).

## 5.11 Packing Gland Bolting—Category B Valves Only

5.11.1 ~~When used,~~ Gland bolting shall pass through holes in the gland flange. The use of open slots is not permitted in the cover flange, cover, or gland.

5.11.2 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

~~Bodies of 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.~~

6.1 Bodies of butterfly valves shall be made of a material conforming to a purchaser-selected material specification permitted in ASME B16.1, ASME B16.24, ASME B16.34, or ASME B16.42.

## 6.2 Pressure Boundary Elements

Materials for pressure boundary elements shall have equal or better corrosion resistance as the body. Purchaser may specify materials other than the manufacturer's standard. The design of pressure boundary elements and materials selected shall comply with the body pressure-temperature rating.

## 6.3 Process Wetted Parts

6.3.1 All process wetted parts, metallic and nonmetallic, shall be the manufacturer's standard unless otherwise agreed upon between the manufacturer and the purchaser.

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

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



**6.3.4** When sour service is specified on the purchase order, wetted parts shall meet the requirements of ANSI/NACE MR0103/[ISO 17945](#) or ANSI/NACE MR0175/[ISO 15156](#), whichever is specified by the purchaser.

#### **6.4 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.

#### **6.5 Gland Bolting**

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

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

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

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

#### **7.1 Inspection and Examination**

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

**7.1.2** ~~If inspection by the purchaser is specified in the purchase order, inspection shall be in accordance with API 598. Examination by the manufacturer shall be as specified in API 598.~~

If inspection is specified in the purchase order, inspection shall be in accordance with API 598 and purchase order requirements.

#### **7.2 Pressure Tests**

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

**7.2.2** In addition to pressure testing per 7.2.1, valves for cryogenic service shall also be low temperature tested per ANSI/MSS SP-134/[ISO 28922-1](#) unless otherwise agreed by the purchaser.

~~How about high pressure test?~~

~~Cryogenic test?~~

~~What about 598 test standards that other standards refer to?~~

~~This needs to be addressed?~~

### 7.3 Antistatic Testing Electrical Continuity Test

When specified, antistatic testing shall be performed. If an electrical continuity test is specified  
by the purchaser in the purchase order, 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 5.10).

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### 7.4 Repair of Defects

7.4.1 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.~~

7.4.2 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.

7.4.3 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.

1) ~~8.2~~ 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~~

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8.3 The name plate 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- (ASTM, EN or UNS number), including those used in the body, shaft, disc, seat, disc seating surface, body seating surface, and any internal liner or encapsulation (see 4.3.2);
- h) the marking "API 609A E109" (Category A valves) or "API 609B E109" (Category B valves) if the valve complies with this standard;
- i) the marking "API 641" if the valve is qualified in accordance with API 641.

~~8.2.4~~ Valves having a manufacturer's preferred installation direction in the closed position shall be clearly and permanently marked "High-pressure Side" on the appropriate side, ~~per 8.1~~ in a location that is visible after the valve is installed.

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~~8.3.5~~ Valves designed for dead-end service in only one direction shall be clearly and permanently marked marked "For Unidirectional Dead-end Service Only," and, on the appropriate side, "High pressure Side" ~~per 8.1~~ per 8.4.

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## 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 treated.~~

9.1.2 Unmachined exterior surfaces of a tested and inspected valve of ferrous materials shall be primed and coated in accordance with the manufacturer's standard practice unless otherwise specified.

9.1.3 Nonferrous and austenitic stainless steel valves need not be primed and coated unless otherwise specified.

### 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 Unless otherwise specified by the purchaser, valve ends shall be fully covered 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, straps, 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.

**9.3.2** 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 potential damage during shipment.

**9.3.3** When export packaging is specified in the purchase order, valves shall be packed in a wooden or corrugated cardboard box or crate suitable for overseas transport by ship. Valves shall be packed individually or collectively in a manner that will prevent shifting and potential damage during shipment.

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

#### **9.4 Spare Parts**

When specified in the purchase order, the vendor shall submit a complete list of recommended 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 B.1.3 are considered an integral part of this standard and should be specified by the purchaser.~~

#### **Annex A**

The information in this annex has been intentionally removed.

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

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## Annex B

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### Information to be Specified by Purchaser

#### B.1 Purchase Order

##### B.1.1 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.1.3 and any optional items listed in B.1.4.

##### B.1.2 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.1.3 Required on the Purchase Order

The following items are required on the purchase order:

- a) valve size and class (see 1.2);
- b) valve category: A or B (see 1.2);
- c) type of body style (double-flanged, lug- or wafer-type, or butt-welding) (see 1.2);  
NOTE For double-flanged valves, specify long pattern or short pattern (see Table 3b and Table 3c);
- d) Class 300 short pattern has two sets of dimensions (purchaser shall specify which is required [see Table 3c]);

- e) ~~cryogenic service (see 3.2 and 5.1.4); cryogenic service (see 3.2, 5.1.4, and 7.2.2)~~
- f) ~~dead-end-service-and-installation-direction(s) (see 5.1.8); ) If dead end service is required (refer 5.1.9)~~
- g) operator type: lever or other (see 5.9);
- h) materials of construction, including those for pressure boundary elements, process wetted parts and those for packing or shaft seals (see Section 6).

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#### B.1.4 Optional Items That May can 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) conformance with API 641 for applications where compliance with low fugitive emissions is required (see 5.1.3);
- c) lockable device (see 5.1.5);
- d) end flanges attached by welding (see 5.2.3);
- e) drain or bypass connections (see 5.2.5);
- f) through drilling or special tapping of lug-bolt holes (see 5.7.1);
- g) antistatic feature (see 5.10);
- h) on-off or throttling service (see 5.9.1);
- i) operating conditions including maximum operating temperature, flow rate or line velocity, maximum pressure drop, fluid media, and specific gravity;
- j) materials for wetted parts to be suitable for sour service per ANSI/NACE MR0103/ISO17945 or ANSI/NACE MR0175/ISO15116 (see 6.3.4);
- k) packing or shaft seal materials (see 6.4);
- l) inspection by the purchaser (see 7.1.2);
- m) end protection (see 9.3.1), export packaging (see 9.3.3);
- n) special external coating (see 9.1.2);
- o) recommended spare parts information (see 9.4);
- p) type of mating flange (slip-on, welding neck, or other), mating flange specification, and flange bore or pipe inside diameter, as applicable;
- q) special tagging/marking requirements;
- r) additional documentation requirements to be shipped with order such as MTR's, certificate of conformance or other;
- s) use of welded on body extensions;
- t) ~~face-to-face dimensions for valve sizes not included in Tables 2, 3a, 3b, or 3c (manufacturer's standard or as agreed between purchaser and manufacturer).~~
- t) face-to-face dimension for valve sizes indicated as manufacturer's standard or as agreed between purchaser and manufacturer in Tables 2, 3a, 3b, or 3c.

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- u) 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.

- v) For category B Valves the purchaser may specify type of offset - (single, double, triple, etc) per Annex C

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## Annex C

(informative)

### Typical Butterfly Valve Construction and Nomenclature

Figure C.1 shows the typical construction and part nomenclature for a Category A concentric disc-type butterfly valve. Figure C.2 shows the typical construction and part nomenclature for a Category B offset disc-type butterfly valve. Figure C.3 depicts variations in disc offset constructions from concentric disc with no offset to triple offset.

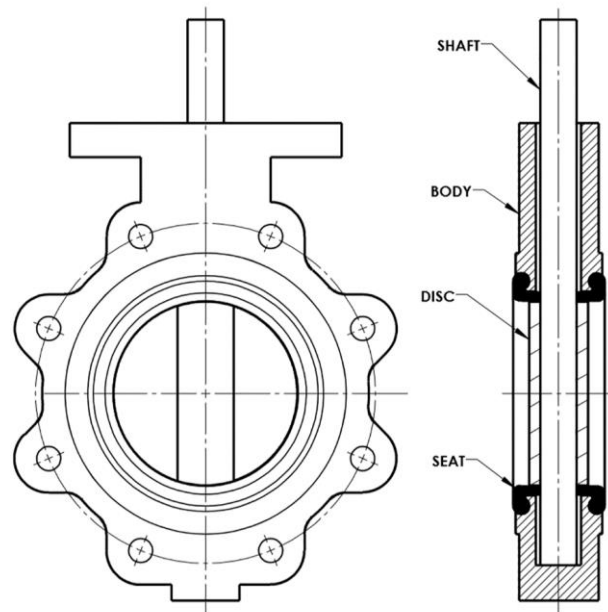


Figure C.1—Typical Part Nomenclature for Category A Concentric Disc Type

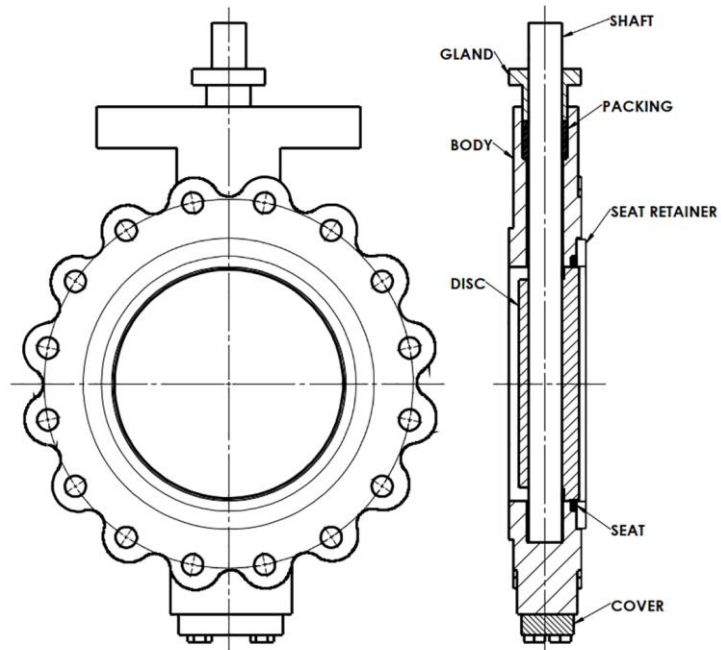


Figure C.2—Typical Part Nomenclature for Category B Offset Disc Type

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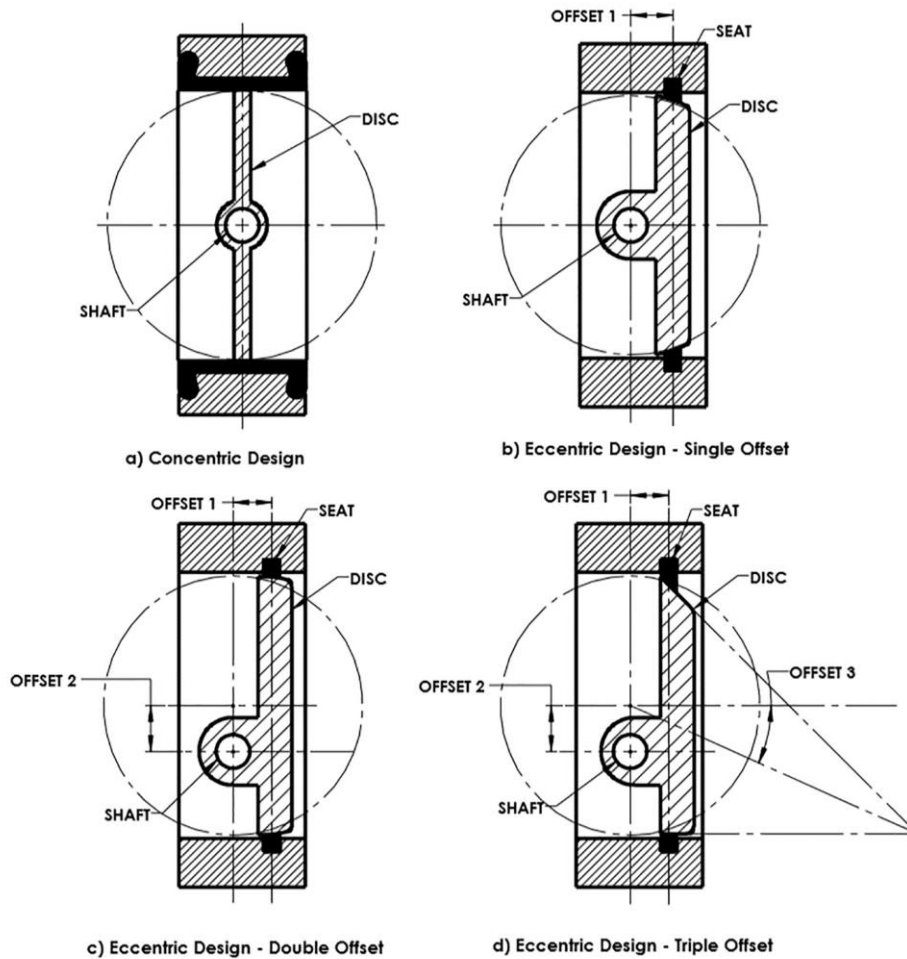


Figure C.3—Typical Offset-type Constructions

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 D.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 D.1 and Figures D.1 and D.2);

$d$  is the inside diameter of the connecting pipe or flange, in millimeters (inches), (see Figure D.1);

NOTE 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), (see Figure D.1);

$W$  is the minimum installed face-to-face dimension of the valve, in millimeters (inches), (see Figure D.1).

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 D.1 shows dimensional location for concentric disc-type construction. Figure D.2 shows the nomenclature and depicts offset disc-type construction. Table D.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 (c)	
	mm	in.
2 to 6	1.5	0.06
8 to 20	3.0	0.12
24 to 60	6.4	0.25

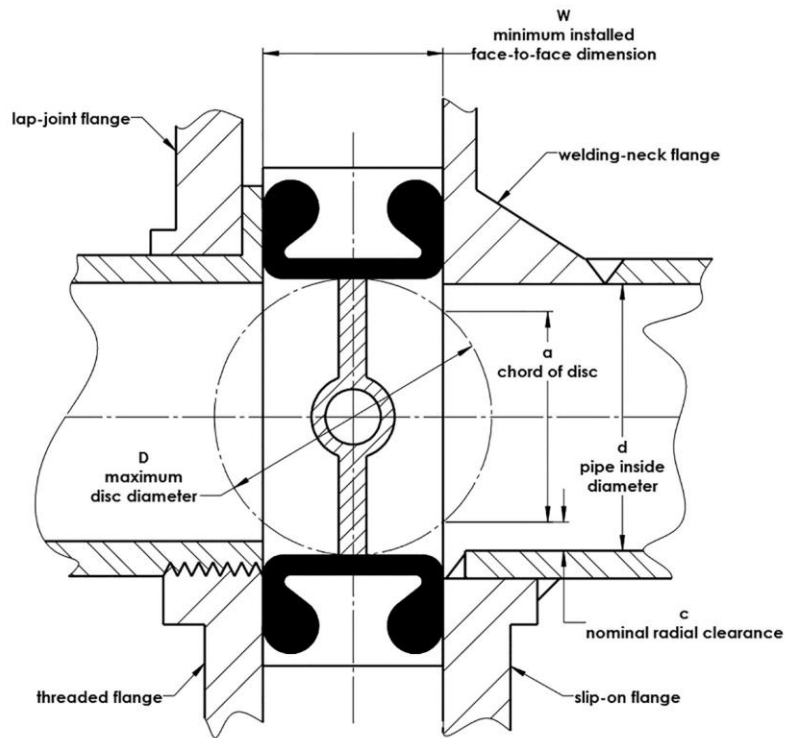


Figure D.1—Disc-to-pipe Clearance for Category A Concentric Disc Type

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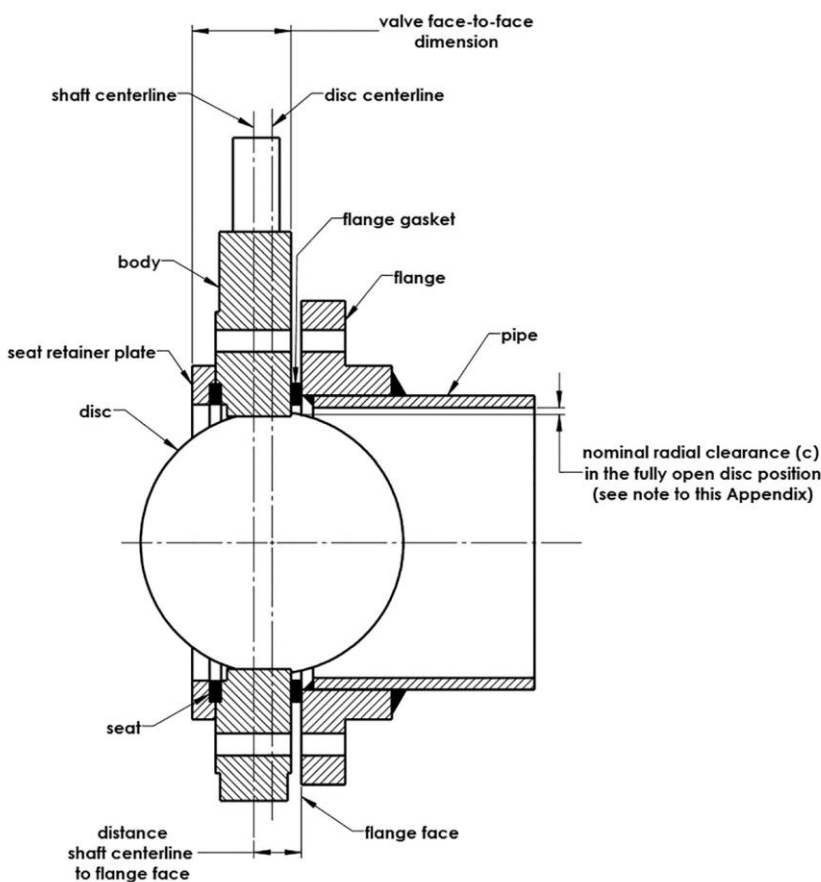


Figure D.2—Disc-to-pipe Clearance for Category B Offset Disc Type

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	Standard weight	Extra strong	Not applicable
3 to 4				Extra strong
5		Not applicable		

6			Extra Strong	Extra strong
8 to 14				Schedule 100
16				
18 to 24				Schedule 40
26 to 38	Extra strong	Extra strong	— <sup>a</sup>	— <sup>a</sup>
40 to 60	— <sup>a</sup>	— <sup>a</sup>	— <sup>a</sup>	— <sup>a</sup>

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 B16.1, Gray Iron Pipe Flanges and Flanged Fittings—Classes 25, 125, and 250*  
*API RP 615, Valve Selection Guide*
- [21] *ASME B16.10, Face-to-Face and End-to-End Dimensions of Valves*
- [32] *ASME B16.20, Metallic Gaskets for Pipe Flanges*
- [43] *ASME B46.1, Surface Texture (Surface Roughness, Waviness, and Lay)*
- [54] EN 558,<sup>4</sup> *Industrial Valves—Face-to-face and Centre-to-face Dimensions of Metal Valves for Use in Flanged Pipe Systems—PN and Class-designated Valves*
- [65] EN 593, *Industrial Valves—Metallic Butterfly Valves for General Purposes*

<sup>4</sup>European Committee for Standardization, CEN-CENELEC Management Centre, Avenue Marnix 17, B-1000 Brussels, Belgium, [www.cen.eu](http://www.cen.eu).

[7] ISO 5752,<sup>5</sup> *Metal valves for use in flanged pipe systems—Face-to-face and center-to-face dimensions*

[8] MSS SP-44, *Steel Pipeline Flanges*

[9] MSS SP-68, *High Pressure Butterfly Valves with Offset Design*

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<sup>5</sup>International Organization for Standardization, ISO Central Secretariat, Chemin de Blandonnet 8, CP 401 – 1214 Vernier, Geneva, Switzerland, [www.iso.org](http://www.iso.org).