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Check Valves: Flanged, Lug, Wafer, and Butt-welding

API STANDARD 594
SEVENTH EDITION, SEPTEMBER 2010



AMERICAN PETROLEUM INSTITUTE



Check Valves: Flanged, Lug, Wafer, and Butt-welding

Downstream Segment

API STANDARD 594
SEVENTH EDITION, SEPTEMBER 2010



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Check Valves: Flanged, Lug, Wafer, and Butt-welding

1 Scope

This international standard covers design, material, face-to-face dimensions, pressure-temperature ratings, and examination, inspection, and test requirements for two types of check valves.

- Type 'A' check valves are short face-to-face as defined in Table 3 and Table 4 and can be: wafer, lug, or double flanged; single plate or dual plate; gray iron, ductile iron, steel, nickel alloy, or other alloy designed for installation between Classes 125 and 250 cast iron flanges as specified in ASME B16.1, between Classes 150 and 300 ductile iron flanges as specified in ASME B16.42, between Classes 150 and 2500 steel flanges as specified in ASME B16.5, and between Classes 150 and 600 steel pipeline flanges as specified in MSS SP-44 or steel flanges as specified in ASME B16.47.
- Type 'B' bolted cover swing check valves are long face-to-face as defined in 5.1.2 and can be: flanged or butt-welding ends of steel, nickel alloy, or other alloy material. End flanges shall be as specified in ASME B16.5 or ends shall be butt-welding as specified in ASME B16.25.

This standard covers the following ranges:

- Type 'A' valves:
 - a) Classes 125 and 250, $50 \leq DN \leq 1200$ ($2 \leq NPS \leq 48$) (excluding DN 90 [NPS 3¹/₂]);
 - b) Classes 150 and 300, $50 \leq DN \leq 1200$ ($2 \leq NPS \leq 48$)*;
 - c) Class 600, $50 \leq DN \leq 1050$ ($2 \leq NPS \leq 42$)*;
 - d) Classes 900 and 1500, $50 \leq DN \leq 600$ ($2 \leq NPS \leq 24$)*;
 - e) Class 2500, $50 \leq DN \leq 300$ ($2 \leq NPS \leq 12$)*;
- Type 'B' valves:
 - a) Classes 150 through 1500, $50 \leq DN \leq 600$ ($2 \leq NPS \leq 24$)*;
 - b) Class 2500, $50 \leq DN \leq 300$ ($2 \leq NPS \leq 12$)*.

NOTE *Valve sizes DN 90 and DN 125 (NPS 3¹/₂ and 5) are non-preferred sizes whose usage is discouraged.

- Sizes:

NPS: 2, 2 ¹/₂, 3, 4, 6, 8, 10, 12, 14, 16, 18, 20, 24, 30, 36, 42, 48;

corresponding to nominal pipe sizes DN:

DN: 50, 65, 80, 100, 150, 200, 250, 300, 350, 400, 450, 500, 600, 750, 900, 1050, 1200.

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

The standard nomenclature for valve parts is shown in Annex B. Figure B.1, Figure B.2, Figure B.3, and Figure B.4 illustrate typical Type 'A' check valves and Figure B.5 illustrates a typical Type 'B' check valve. These figures show typical designs only and are not to be construed as precluding other available designs that comply with the

requirements of this standard. The only purpose of these figures is to identify part names. The construction of a valve is acceptable only when it complies with this standard in all respects.

2 Normative References

The following standards contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication of this standard, the editions of record are valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

API Standard 598, *Valve Inspection and Testing*

API Standard 600, *Bolted Bonnet Steel Gate Valves for Petroleum and Natural Gas Industries*

ASME B1.1¹, *Unified Inch Screw Threads (UN and UNR Thread Form)*

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

ASME B16.5, *Pipe Flanges and Flanged Fittings*

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

ASME B16.11, *Forged Fittings, Socket-Welding and Threaded*

ASME B16.14, *Ferrous Pipe Plugs, Bushings, and Locknuts with Pipe Threads*

ASME B16.20, *Metallic Gaskets for Pipe Flanges—Ring Joint, Spiral-wound, and Jacketed*

ASME B16.25, *Butt-welding 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*

ASME B18.15, *Forged Eyebolts*

ASME B18.2.1, *Square and Hex Bolts and Screws*

ASME BPVC, Section VIII

ASTM A182², *Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service*

ASTM A217, *Steel Castings, Martensitic Stainless and Alloy, for Pressure-Containing Parts Suitable for High-Temperature Service*

ASTM A351, *Castings, Austenitic, Austenitic-Ferritic (Duplex), for Pressure Containing Parts*

ASTM A494, *Castings, Nickel and Nickel Alloy*

ASTM B473, *UNS N08020, UNS N08024, and UNS N08026 Nickel Alloy Bar and Wire*

¹ ASME International, 3 Park Avenue, New York, New York 10016-5990, www.asme.org.

² ASTM International, 100 Barr Harbor Drive, West Conshohocken, Pennsylvania 19428, www.astm.org.

ASTM B564, *Nickel Alloy Forgings*

AWS A5.9³, *Corrosion-Resisting Chromium and Chromium-Nickel Steel Bare and Composite Metal Cored and Stranded Welding Electrodes and Welding Rods*

AWS A5.13, *Solid Surfacing Welding Rods and Electrodes*

MSS-SP-6⁴, *Standard Finishes for Contact Faces of Pipe Flanges and Connecting-End Flanges of Valves and Fittings*

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

MSS-SP-44, *Steel Pipe Line Flanges*

3 Terms and Definitions

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

3.1

class

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

3.2

dimension number

DN

An alpha 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.

3.3

nominal pipe size

NPS

An alpha numeric 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 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 American Welding Society, 550 NW LeJeune Road, Miami, Florida 33126, www.aws.org.

⁴ Manufacturers Standardization Society of the Valve and Fittings Industry, Inc., 127 Park Street, NE, Vienna, Virginia 22180-4602, www.mss-hq.com.

4 Pressure-temperature Ratings

4.1 Valve Rating

4.1.1 The pressure-temperature rating of the valve for various body materials shall be as follows:

— Type 'A' valves only:

- a) gray iron: the pressure-temperature rating for the applicable flange class as specified in ASME B16.1;
- b) ductile iron: the pressure-temperature rating for the applicable flange class as specified in ASME B16.42.

— Type 'A' and Type 'B' valves:

- a) steel, nickel alloy, and other alloy: The pressure-temperature rating shall be in accordance with Standard Class ratings of ASME B16.34, Table 2, for the applicable Group 1, 2, or 3 material of ASME B16.34, Table 1.
- b) special materials: The pressure-temperature rating for materials not covered by ASME B16.34 shall be determined by the procedures in ASME B16.34, Appendix B.

4.2 Temperature Restrictions

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

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

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

5 Design

5.1 Body and Cover

5.1.1 The minimum body wall thickness for various materials shall be as follows:

— Type 'A' valves only:

- a) gray iron: as shown in Tables 1 and 2 for Class 125 and Class 250 only;
- b) ductile iron: as shown in Tables 1 and 2 for Class 150 and Class 300 only.

— Type 'A' and Type 'B' valves:

- a) steel and chrome-moly steels per ASME B16.34, Table 1, Group 1: as shown in Table 1 and Table 2, for Classes 150, 300, 600, 900, 1500, and 2500;

b) corrosion resistant steels per ASME B16.34, Table 1, Group 2 and Nickel-based alloys per ASME B16.34, Table 1, Group 3: as shown in ASME B16.34, Table 3. Other wall thickness shall be as agreed between purchaser and manufacturer.

c) special materials: The minimum body wall thickness for materials not covered by ASME B16.34 shall be as agreed between the purchaser and manufacturer.

5.1.2 The face-to-face dimensions shall be as follows: Type 'A' valves (including valves with ring-joint facings) shall conform to those shown in Table 3 and Table 4. Type 'B' valves shall conform to ASME B16.10. Short pattern or special lengths are not permitted unless by agreement between purchaser and manufacturer.

5.1.3 The purchase order shall specify for Type 'A' valves whether the body type shall be wafer, lug or double flanged and for Type 'B' valves whether the body type shall be flanged or butt-welding. Type 'A' double-flanged valves will only be supplied where nut space between flanges is adequate. End and cover flanges of steel, nickel alloy and other alloy 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. Flanges shall conform to ASME B16.5 and have butt-welding ends for use without backing rings. Flanges for iron valves shall only be the integral type.

Table 1—Minimum Body-wall Thickness by Class

Dimensions in mm

| Valve Size DN (NPS) | Class | | | | | | | |
|------------------------|-------|------|------|------|------|------|-------|------|
| | 125 | 250 | 150 | 300 | 600 | 900 | 1500 | 2500 |
| 50 (2) | 6.9 | 9.9 | 8.6 | 9.7 | 11.2 | 19.1 | 19.1 | 22.4 |
| 65 (2½) | 6.9 | 10.9 | 9.7 | 11.2 | 11.9 | 22.4 | 22.4 | 25.4 |
| 80 (3) | 8.4 | 12.4 | 10.4 | 11.9 | 12.7 | 19.1 | 23.9 | 30.2 |
| 100 (4) | 10.9 | 13.7 | 11.2 | 12.7 | 16.0 | 21.3 | 28.7 | 35.8 |
| 125 (5) | 10.9 | 15.2 | — | — | — | — | — | — |
| 150 (6) | 12.4 | 16.5 | 11.9 | 16.0 | 19.1 | 26.2 | 38.1 | 48.5 |
| 200 (8) | 13.7 | 18.0 | 12.7 | 17.5 | 25.4 | 31.8 | 47.8 | 62.0 |
| 250 (10) | 16.5 | 20.8 | 14.2 | 19.1 | 28.7 | 36.6 | 57.2 | 67.6 |
| 300 (12) | 18.0 | 22.4 | 16.0 | 20.6 | 31.8 | 42.2 | 66.8 | 86.6 |
| 350 (14) | 19.6 | 24.9 | 16.8 | 22.4 | 35.1 | 46.0 | 69.9 | — |
| 400 (16) | 22.4 | 27.7 | 17.5 | 23.9 | 38.1 | 52.3 | 79.5 | — |
| 450 (18) | 23.6 | 30.7 | 18.3 | 25.4 | 41.4 | 57.2 | 88.9 | — |
| 500 (20) | 24.9 | 33.3 | 19.1 | 26.9 | 44.5 | 63.5 | 98.6 | — |
| 600 (24) | 27.7 | 36.1 | 20.6 | 30.2 | 50.8 | 73.2 | 114.3 | — |
| 750 (30) | 32.0 | 44.5 | 23.1 | 35.1 | 60.5 | — | — | — |
| 900 (36) | 36.1 | 52.8 | 25.4 | 39.9 | 70.4 | — | — | — |
| 1050 (42) | 40.1 | 61.2 | 27.7 | 44.7 | 80.0 | — | — | — |
| 1200 (48) | 44.5 | 69.3 | 30.2 | 49.5 | — | — | — | — |

NOTE The wall thickness shown for Class 125 and Class 250 conform to those in ASME B16.1, except for DN 900, 1050, and 1200 (NPS 36, 42, and 48), Class 250, which have been extrapolated. The wall thicknesses shown for Class 150 to 2500 for sizes through DN 600 (NPS 24) conform to those in API Standard 600. The wall thicknesses for DN 750 to DN 1200 (NPS 30 to NPS 48) are extrapolations of the values in API Standard 600.

Table 2—Minimum Body-wall Thickness by Class

Dimensions in inches

| Valve Size DN (NPS) | Class | | | | | | | |
|------------------------|-------|------|------|------|------|------|------|------|
| | 125 | 250 | 150 | 300 | 600 | 900 | 1500 | 2500 |
| 50 (2) | 0.27 | 0.39 | 0.34 | 0.38 | 0.44 | 0.75 | 0.75 | 0.88 |
| 65 (2½) | 0.27 | 0.43 | 0.38 | 0.44 | 0.47 | 0.88 | 0.88 | 1.00 |
| 80 (3) | 0.33 | 0.49 | 0.41 | 0.47 | 0.50 | 0.75 | 0.94 | 1.19 |
| 100 (4) | 0.43 | 0.54 | 0.44 | 0.50 | 0.63 | 0.84 | 1.13 | 1.41 |
| 125 (5) | 0.43 | 0.60 | — | — | — | — | — | — |
| 150 (6) | 0.49 | 0.65 | 0.47 | 0.63 | 0.75 | 1.03 | 1.50 | 1.91 |
| 200 (8) | 0.54 | 0.71 | 0.50 | 0.69 | 1.00 | 1.25 | 1.88 | 2.44 |
| 250 (10) | 0.65 | 0.82 | 0.56 | 0.75 | 1.13 | 1.44 | 2.25 | 2.66 |
| 300 (12) | 0.71 | 0.88 | 0.63 | 0.81 | 1.25 | 1.66 | 2.63 | 3.41 |
| 350 (14) | 0.77 | 0.98 | 0.66 | 0.88 | 1.38 | 1.81 | 2.75 | — |
| 400 (16) | 0.88 | 1.09 | 0.69 | 0.94 | 1.50 | 2.06 | 3.13 | — |
| 450 (18) | 0.93 | 1.21 | 0.72 | 1.00 | 1.63 | 2.25 | 3.50 | — |
| 500 (20) | 0.98 | 1.31 | 0.75 | 1.06 | 1.75 | 2.50 | 3.88 | — |
| 600 (24) | 1.09 | 1.42 | 0.81 | 1.19 | 2.00 | 2.88 | 4.50 | — |
| 750 (30) | 1.26 | 1.75 | 0.91 | 1.38 | 2.38 | — | — | — |
| 900 (36) | 1.42 | 2.08 | 1.00 | 1.57 | 2.77 | — | — | — |
| 1050 (42) | 1.58 | 2.41 | 1.09 | 1.76 | 3.15 | — | — | — |
| 1200 (48) | 1.75 | 2.73 | 1.19 | 1.95 | — | — | — | — |

NOTE The wall thicknesses shown for Classes 125 and 250 conform to those in ASME B16.1, except for DN 900, 1050, and 1200 (NPS 36, 42, and 48), Class 250, which have been extrapolated. The wall thicknesses shown for Class 150 to Class 2500 for sizes through DN 600 (NPS 24) conform to those in API Standard 600. The wall thicknesses for DN 750 to DN1200 (NPS 30 to NPS 48) are extrapolations of the values in API Standard 600.

Table 3—Type 'A' Valve Face-to-Face Dimensions by Class

Dimensions in mm

| Valve Size DN (NPS) | Class | | | | | | | |
|------------------------|-------|-----|-----|-----|-----|-----|------|------|
| | 125 | 250 | 150 | 300 | 600 | 900 | 1500 | 2500 |
| 50 (2) | 54 | 54 | 60 | 60 | 60 | 70 | 70 | 70 |
| 65 (2½) | 60 | 60 | 67 | 67 | 67 | 83 | 83 | 83 |
| 80 (3) | 67 | 67 | 73 | 73 | 73 | 83 | 83 | 86 |
| 100 (4) | 67 | 67 | 73 | 73 | 79 | 102 | 102 | 105 |
| 125 (5) | 83 | 83 | — | — | — | — | — | — |
| 150 (6) | 95 | 95 | 98 | 98 | 136 | 159 | 159 | 159 |
| 200 (8) | 127 | 127 | 127 | 127 | 165 | 206 | 206 | 206 |
| 250 (10) | 140 | 140 | 146 | 146 | 213 | 241 | 248 | 254 |

Table 3—Type 'A' Valve Face-to-Face Dimensions by Class (Continued)

Dimensions in mm

| | | | | | | | | |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|
| 300 (12) | 181 | 181 | 181 | 181 | 229 | 292 | 305 | 305 |
| 350 (14) | 184 | 222 | 184 | 222 | 273 | 356 | 356 | — |
| 400 (16) | 191 | 232 | 191 | 232 | 305 | 384 | 384 | — |
| 450 (18) | 203 | 264 | 203 | 264 | 362 | 451 | 468 | — |
| 500 (20) | 213 | 292 | 219 | 292 | 368 | 451 | 533 | — |
| 600 (24) | 222 | 318 | 222 | 318 | 438 | 495 | 559 | — |
| 750 (30) | 305 | 368 | 305 | 368 | 505 | — | — | — |
| 900 (36) | 368 | 483 | 368 | 483 | 635 | — | — | — |
| 1050 (42) | 432 | 568 | 432 | 568 | 701 | — | — | — |
| 1200 (48) | 524 | 629 | 524 | 629 | — | — | — | — |

NOTE The face-to-face tolerance shall be as specified in ASME B16.10 for sizes through DN 600 (NPS 24) and shall be ± 3 mm (0.125 in.) for sizes larger than DN 600 (NPS 24).

Table 4—Type 'A' Valve Face-to-Face Dimensions by Class

Dimensions in inches

| Valve Size DN (NPS) | Class | | | | | | | |
|------------------------|-------|-------|-------|-------|-------|-------|-------|-------|
| | 125 | 250 | 150 | 300 | 600 | 900 | 1500 | 2500 |
| 50 (2) | 2.12 | 2.12 | 2.38 | 2.38 | 2.38 | 2.75 | 2.75 | 2.75 |
| 65 (2½) | 2.38 | 2.38 | 2.62 | 2.62 | 2.62 | 3.25 | 3.25 | 3.25 |
| 80 (3) | 2.62 | 2.62 | 2.88 | 2.88 | 2.88 | 3.25 | 3.25 | 3.38 |
| 100 (4) | 2.62 | 2.62 | 2.88 | 2.88 | 3.12 | 4.00 | 4.00 | 4.12 |
| 125 (5) | 3.25 | 3.25 | — | — | — | — | — | — |
| 150 (6) | 3.75 | 3.75 | 3.88 | 3.88 | 5.38 | 6.25 | 6.25 | 6.25 |
| 200 (8) | 5.00 | 5.00 | 5.00 | 5.00 | 6.50 | 8.12 | 8.12 | 8.12 |
| 250 (10) | 5.50 | 5.50 | 5.75 | 5.75 | 8.38 | 9.50 | 9.75 | 10.00 |
| 300 (12) | 7.12 | 7.12 | 7.12 | 7.12 | 9.00 | 11.50 | 12.00 | 12.00 |
| 350 (14) | 7.25 | 8.75 | 7.25 | 8.75 | 10.75 | 14.00 | 14.00 | — |
| 400 (16) | 7.50 | 9.12 | 7.50 | 9.12 | 12.00 | 15.12 | 15.12 | — |
| 450 (18) | 8.00 | 10.38 | 8.00 | 10.38 | 14.25 | 17.75 | 18.44 | — |
| 500 (20) | 8.38 | 11.50 | 8.62 | 11.50 | 14.50 | 17.75 | 21.00 | — |
| 600 (24) | 8.75 | 12.50 | 8.75 | 12.50 | 17.25 | 19.50 | 22.00 | — |
| 750 (30) | 12.00 | 14.50 | 12.00 | 14.50 | 19.88 | — | — | — |
| 900 (36) | 14.50 | 19.00 | 14.50 | 19.00 | 25.00 | — | — | — |
| 1050 (42) | 17.00 | 22.38 | 17.00 | 22.37 | 27.61 | — | — | — |
| 1200 (48) | 20.62 | 24.75 | 20.62 | 24.75 | — | — | — | — |

NOTE The face-to-face tolerance shall be as specified in ASME B16.10 for sizes through DN 600 (NPS 24) and shall be ± 3 mm (0.125 in.) for sizes larger than DN 600 (NPS 24).

5.1.3.1 Welding a flange to a valve body shall be by full penetration butt-welding. The welding procedure and the welder or welding operator shall be qualified in accordance with ASME-BPVC, Section IX. Valves having flanges attached by welding shall meet the requirements of paragraph 2.1.6 of ASME B16.34.

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

5.1.4 Type 'A' valves larger than DN 600 (NPS 24) in Classes 150, 300, and 600 shall have body-flange bolt patterns suitable for the lug or double-flanged type, outside diameters suitable for the wafer type, and gasket surface dimensions compatible with the flange standards specified in the purchase order.

5.1.5 Flange faces with ring-joint grooves shall conform to the dimensions shown in either ASME B16.5 or ASME B16.47, as applicable.

5.1.6 Flange facing finishes shall be:

- Type 'A' valves only: gray iron and ductile iron valves shall be finished as specified in MSS SP-6;
- Type 'A' and Type 'B' valves: steel, nickel-alloy, and other alloy valves shall be finished as specified in ASME B16.5.

5.1.7 Auxiliary connections are required only when specified by the purchaser:

- Type 'A' valves only: For gray iron and ductile iron valves the size, type, and location of auxiliary connections shall be the manufacturer's standard unless otherwise agreed by the manufacturer and the purchaser.
- Type 'A' and Type 'B' valves: For steel, nickel alloy and other alloy valves auxiliary connections shall comply with the requirements of ASME B16.34, Section 6.3. The location and designation of auxiliary connections shall be manufacturer's standard for Type 'A' valves and per ASME B16.34, Figure 1(b) for Type 'B' valves.

5.1.8 The valve may have either an integral or a removable seat ring. Sealing compounds or greases shall not be used when assembling seat rings; however, a light lubricant having a viscosity no greater than kerosene may be used to prevent galling of mating threaded surfaces.

5.1.9 Tapped test openings are permitted only if specified in the purchase order. If a tap is made in the body for testing the valve, the tap shall not be larger than DN 15 (NPS 1/2). After testing, the tapped hole shall be fitted with an ASME B16.11 or ASME B16.14 threaded solid round or hex-head plug. The test tap may require a boss to provide the minimum thread engagement, as specified in ASME B16.34.

5.1.10 For Type 'A' valves a tapped blind hole shall be provided in the body of valves which are either NPS 10 or larger, or which weigh more than 50 lb (23 kg), for attachment of an eye bolt or equivalent lifting device. The hole shall be tapped with a coarse (UNC) Class 2B thread, conforming to ASME B1.1. If an eyebolt is specified in the purchase order, it shall conform to ASME B18.15.

5.1.11 Unless otherwise specified in the purchase order, for Type 'A' valves the lugs of lug type valves and flanges of double-flanged type valves shall be provided with non-threaded (drilled) bolt clearance holes.

5.1.12 Butt-welding ends shall conform to the requirements of ASME B16.25 for the bore specified for use without backing rings.

5.1.13 Conversion of a flanged end to a butt-welding end is not permitted except by agreement between the purchaser and manufacturer.

5.1.14 Type 'B' valves shall have a bolted cover design that meets the requirements of ASME BPVC, Section VIII, flat covers shall conform to UG 34 and dished covers shall conform to Appendix I-6. Cover and cover flanges shall be circular except DN 50 and DN 65 (NPS 2 and NPS 2¹/₂) may be of non-circular design. Body-to-cover joint shall be flanged with a flat face (Class 150 only), raised face, tongue and groove, spigot and recess, or ring joint per ASME B16.5.

5.1.15 The body-to-cover joint of Type 'B' valves shall have at least four through type bolts of the following minimum sizes:

- 3/8 in. when $50 \leq DN \leq 65$ ($2 \leq NPS \leq 2\frac{1}{2}$);
- 1/2 in. when $80 \leq DN \leq 200$ ($3 \leq NPS \leq 8$);
- 5/8 in. when $250 \leq DN$ ($10 \leq NPS$).

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

5.1.16 When valve design utilizes a stem that extends beyond the pressure boundary, stem retention shall be in accordance with Paragraph 6.5.1 of ASME B16.34. The design shall not rely on actuation components (e.g. gear operators, actuators, levers, etc.) to prevent ejection.

5.1.17 Type B swing check valves shall be equipped with single contact stop point, to prevent the possibility of disc getting stuck in the open position.

5.2 Plates and Disc

5.2.1 Valves are classified as follows.

- A single-plate valve has a plate or disc that closes the valve when flow reversal or gravity forces the plate or disc against the valve-body seat. This closure may be aided by the use of springs or other devices.
- A dual-plate valve has plates that close the valve with the assistance of one or more springs when flow reversal forces the plates against the valve-body seat.

5.2.2 For Type 'A' single-plate valves and Type 'B' valves, when a nut is used to assemble the disc or plate to the hinge arm, the nut shall be positively secured to prevent separation of the connecting parts; the use of a single tack weld, lock washer or lock nut are not acceptable means. The closure assembly materials and design shall not limit the overall corrosion resistance of the valve.

5.2.3 The disc assembly design shall limit disc rotation to less than 360 degrees.

5.3 Seating Surfaces

5.3.1 The body and plate or disc seating surfaces may be of deposited weld metal, integral metal, mechanically retained metal, or a resilient material. On Type 'A' single-plate valves and Type 'B' valves, a resilient seal ring may be fitted either to the body or plate or disc seat as specified by the purchaser. The resilient seal ring shall be designed to give a full metal to metal seal if the resilient seal is inoperative or removed.

5.3.2 Welding is not permitted on cast iron or ductile iron.

5.3.3 Brazing is permitted on cast iron and ductile iron only for attaching seating surfaces to the body or the plate and only if agreed to by the purchaser and the manufacturer. Furnace brazing is the only type of brazing permitted and may be used only if the parts are heated under closely controlled conditions, in a uniform manner, and to a temperature no higher than the lower critical temperature of the base material. Cooling shall be in the furnace or in still air.

5.4 External Bolts and Threaded Holes

5.4.1 Bolts and threaded holes with a diameter 1 in. or smaller shall have coarse (UNC) threads. Those larger than 1 in. diameter shall be of the eight-thread series (8 UN). Bolt threads shall be Class 2A, and nut threads shall be Class 2B. Threads shall conform to ASME B1.1.

5.4.2 For bolts 1 in. diameter or smaller, threaded body-flange bolt holes shall be drilled and tapped according to the requirements for coarse thread series Class 2B in ASME B1.1. For bolts larger than 1 in. diameter, such holes shall be drilled and tapped according to the requirements for eight-thread series Class 2B in ASME B1.1.

5.4.3 For Type 'B' valves, cover flange bolts shall be continuously threaded stud bolts with heavy, semifinished hexagon nuts conforming to the requirements of ASME B18.2.2. Hex bolts or cap screws conforming to ASME B18.2.1 may also be used for DN 65 (NPS 2^{1/2}) and smaller valves. Hex bolts and cap screws shall be suitable for external wrenching only.

5.5 Flow Indication

The valve body shall be furnished with a clearly visible cast, forged, machined-in, or die-stamped arrow to indicate the direction of flow through the valve.

5.6 Gasket Surface

Fasteners in the flange seating surface shall be recessed to or below the flange gasket level. Interruptions in the seating area of a centered ASME B16.20 spiral-wound gasket for valve sizes DN 150 (NPS 6) and larger shall not exceed the limitations given in Figure 1. The permissible surface interruptions on smaller size valves shall be as agreed between purchaser and manufacturer but shall not exceed 50 % of the gasket seating width.

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

6 Material

6.1 Body and Cover

The body of Type 'A' valves and the body and cover of Type 'B' valves shall be made of a material conforming to a purchaser selected material specification listed in the applicable ASME standard as referenced in 4.1.

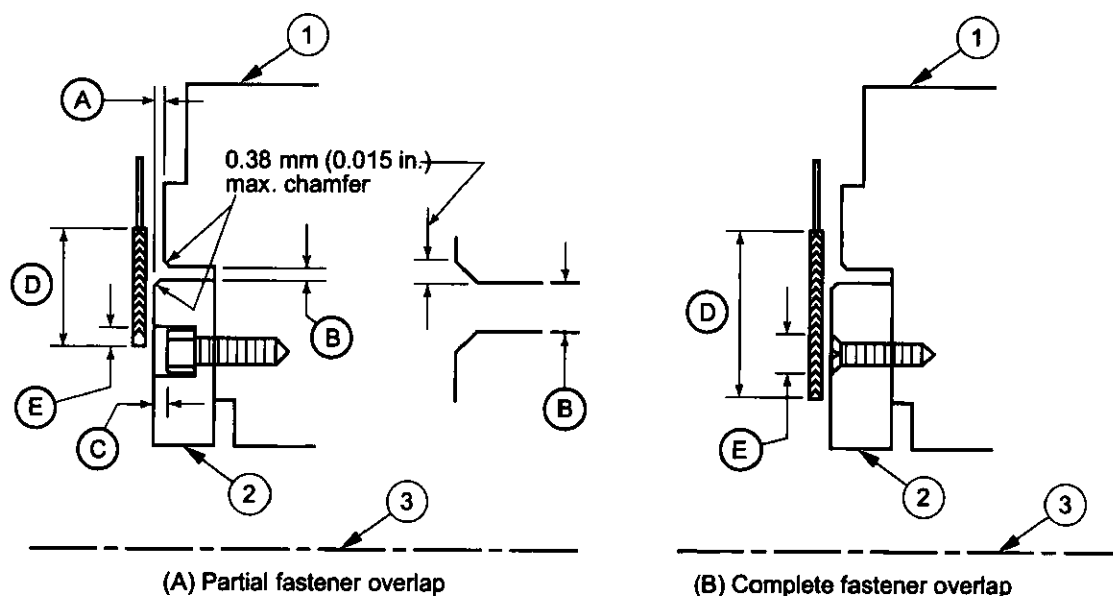
6.2 Plate and Disc

Plate or disc shall be made of a material whose corrosion resistance is greater than or equal to that of the valve body.

6.3 Cover Gasket (Type 'B' Valves)

6.3.1 The cover flange gasket shall be:

- solid metal, corrugated or flat;
- filled metal jacketed, corrugated or flat;
- metal ring joint;
- spiral-wound metal gasket with filler and a centering/compression ring;
- spiral-wound metal gasket with filler, to be used in a body to cover joint design that provides gasket compression control.



| Dimension | Definition | Range, in. | Range, mm |
|-----------|--|-----------------|----------------|
| A | Protrusion of retainer above valve body face (after being compressed by mating flange). Negative value denotes insert below valve body face. | +0.00 to -0.010 | +0.00 to -0.25 |
| B | Width of annular gap between valve body and retainer (exclusive of chamfer). | 0.030 max. | 0.76 max. |
| C | Distance of screw head below face of retainer. | 0 - 0.050 | 0 - 1.27 |
| 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 retainer (may occur at the ID or OD of the gasket). | 35 % of D max. | 35 % of D max. |

Key

- 1 valve body outer diameter (OD)
- 2 retainer
- 3 valve centerline

Figure 1—Limitations for Flange Face Interruptions That Fall Within the Gasket Seating Area

For Class 150, the following are also acceptable:

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

6.3.2 The metallic portion of the gasket exposed to the service environment shall be made of a material that has corrosion resistance at least equal to the body.

6.3.3 Unless otherwise specified in the purchase order, the gasket shall be suitable for the pressure rating of the valve within a valve design temperature range from $-29\text{ }^{\circ}\text{C}$ ($-20\text{ }^{\circ}\text{F}$) to $538\text{ }^{\circ}\text{C}$ ($1000\text{ }^{\circ}\text{F}$).

6.4 Trim

6.4.1 The trim includes the following:

- body seating surfaces;
- plate or disc seating surfaces.

6.4.2 Metallic seating surface material shall be manufacturer's standard which may be the same as the body material. Where specific trim is requested, it shall be as shown in Table 5. The typical specifications in Table 4 represent some acceptable grades. Ni-Cr materials (Trim 5A) shall have manufacturer's standard hard facing with a maximum iron content of 25 %.

6.4.3 Resilient seat material, when required shall be specified by the purchaser and if located in the body there shall not be an overlay in the seat area unless otherwise specified in the purchase order.

Table 5—Seating-surface Nominal Trim Material

| Trim No. | Nominal Trim | Material Type | Typical Specification (Grade) | | |
|----------|-------------------------|-----------------------------|--|--|--|
| | | | Cast | Forged | Welded |
| 1 | 13Cr | 11-13Cr | ASTM A 217 (CA15) | ASTM A 182 (F6) | AWS A5.9 (ER410) |
| 2 | Type 304 | 18Cr-8Ni | ASTM A 351 (CF8) | ASTM A 182 (F304) | AWS A5.9 (ER308) |
| 5 | Hard-faced | Co-Cr-A | Manufacturer's standard | Manufacturer's standard | AWS A5.13 (E or R Co-Cr-A) |
| 5A | Hard-faced | Ni-Cr | Manufacturer's standard | Manufacturer's standard | Manufacturer's standard |
| 8 | 13Cr and Hard-faced | 11-13Cr Co-Cr-A | ASTM A 217 (CA15) Manufacturer's standard | ASTM A 182 (F6) Manufacturer's standard | AWS A5.9 (ER410) AWS A5.13 (E or R Co-Cr-A) |
| 9 | Ni-Cu | Ni-Cu alloy | ASTM A 494 (M-35-1) | ASTM B 564 (UNS N04400) | Manufacturer's standard |
| 10 | Type 316 | 18Cr-8Ni-Mo | ASTM A 351 (CF8M) | ASTM A 182 (F316) | AWS A5.9 (ER316) |
| 12 | Type 316 and Hard-faced | 18Cr-8Ni-Mo Trim 5 or 5A | ASTM A 351 (CF8M) | ASTM A 182 (F316) | AWS A5.9 (ER316) Trim 5 or 5A |
| 13 | Alloy 20 | 19Cr-29Ni | ASTM A 351 (CN7M) | ASTM B 473 | AWS A5.9 (ER320) |
| 14 | Alloy 20 and Hard-faced | 19Cr-29Ni Trim 5 or 5A | ASTM A 351 (CN7M) | ASTM B 473 | AWS A5.9 (ER320) Trim 5 or 5A |
| AA | Bronze | Bronze | Manufacturer's standard | Manufacturer's standard | — |

6.5 Internal Wetted Parts

Internal wetted parts shall be the manufacturer's standard unless otherwise specified in the purchase order. The term "wetted parts" shall include, but not be limited to, stem or shaft, hinges, pins, bolts, bearings, and any other part in contact with the fluid medium other than the body, cover, plates or disc, trim, springs, and pipe plugs.

6.6 Body Seat Rings

If the body seat ring material is different from the seating-surface material, its corrosion resistance shall be greater than or equal to that of the valve-body material.

6.7 Springs

Unless otherwise specified in the purchase order, the spring material shall be as follows:

- for design temperatures 315 °C (600 °F), and above, spring material shall be Nickel-chromium alloy UNS N07750;
- for temperatures below 315 °C (600 °F), the spring material shall be the manufacturer's standard.

6.8 Pipe Plugs (Pin Retainers)

Any pipe plugs used shall be solid and shall have the same nominal chemical composition and material properties as the valve body.

6.9 Nameplate

The nameplate shall be austenitic stainless steel or nickel alloy and shall be attached to the valve body by pins or welding. The pin material used for attachment shall be similar to the nameplate.

7 Inspection, Examination, Testing, and Repair

7.1 Inspection and Examination

7.1.1 Each valve shall be visually examined by the manufacturer in accordance with API 598.

7.1.2 When inspection by the purchaser is specified by the purchase order, it shall be in accordance with API 598.

7.2 Pressure Tests

Each valve shall be pressure tested in accordance with API 598.

7.3 Repair of Defects

7.3.1 Defects in the body and cover of a cast or forged, carbon or alloy steel valve may be repaired as permitted by the most nearly applicable ASTM cast or forged material specification listed in ASME B16.34.

7.3.2 The repair of defects in cast iron or ductile iron castings, by methods such as welding, brazing, plugging, or impregnation, is not permitted.

8 Marking

Nameplates (see 6.9) of valves made in compliance with this standard shall be marked "API 594" and shall be additionally marked as follows:

8.1 For a valve in accordance with ASME B16.34, the markings shall be in accordance with that standard.

8.2 For a valve made of other materials, marking shall be in accordance with MSS SP-25.

8.3 Where valve rating is limited by construction details or material considerations as described in 3.3, such limited rating shall be marked on the nameplate.

9 Shipment

9.1 Coatings

9.1.1 Unless otherwise specified in the purchase order, the external surfaces of valve bodies shall be painted with the following colors:

- carbon and low-alloy steel—aluminum,
- ductile iron—green,
- cast iron—black,
- nonferrous and austenitic stainless steel—none.

9.1.2 The machined surfaces of materials that are not rust resistant shall be coated with easily removable rust preventive.

9.1.3 All coatings and/or paints shall not contain lead.⁵

9.2 Valve Openings

9.2.1 Except for the ends of small, individually packaged valves, valve ends shall be covered to protect the gasket surfaces and valve internals during shipment and storage. The protective covers shall be wood, wood fiber, plastic, or metal and securely attached to the valve ends by bolts, steel straps, or suitable friction locking devices. The covers shall be no smaller than the outside diameter of the valve ends and designed so that the valves cannot be installed without complete removal of the covers.

9.2.2 All threaded connections in the valve body shall be fitted with solid, fully tightened plugs conforming to ASME B16.11, or ASME B16.14. Gray iron or malleable iron plugs shall only be used on gray iron or ductile iron valves respectively.

9.2.3 Type B Check valves shall be shipped with the disc secured or supported during transport. A warning label shall be attached to the protective cover with instructions to remove, prior to installation, material from inside the valve that secures or supports the disc.

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 the purchase order specifies export packaging, valves shall be shipped in wooden boxes or crates, individually or collectively, and packed to prevent their shifting within the package. (The shipping agent representing the purchaser will normally provide detailed instructions.)

10 Recommended Spare Parts

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

⁵ Lead-free is defined by the Consumer Product Safety Act, CPSA 15 USC 2057-8, 1978, as less than 0.06 % (600 ppm by dry weight).

Annex A (informative)

Information to be Specified by the Purchaser

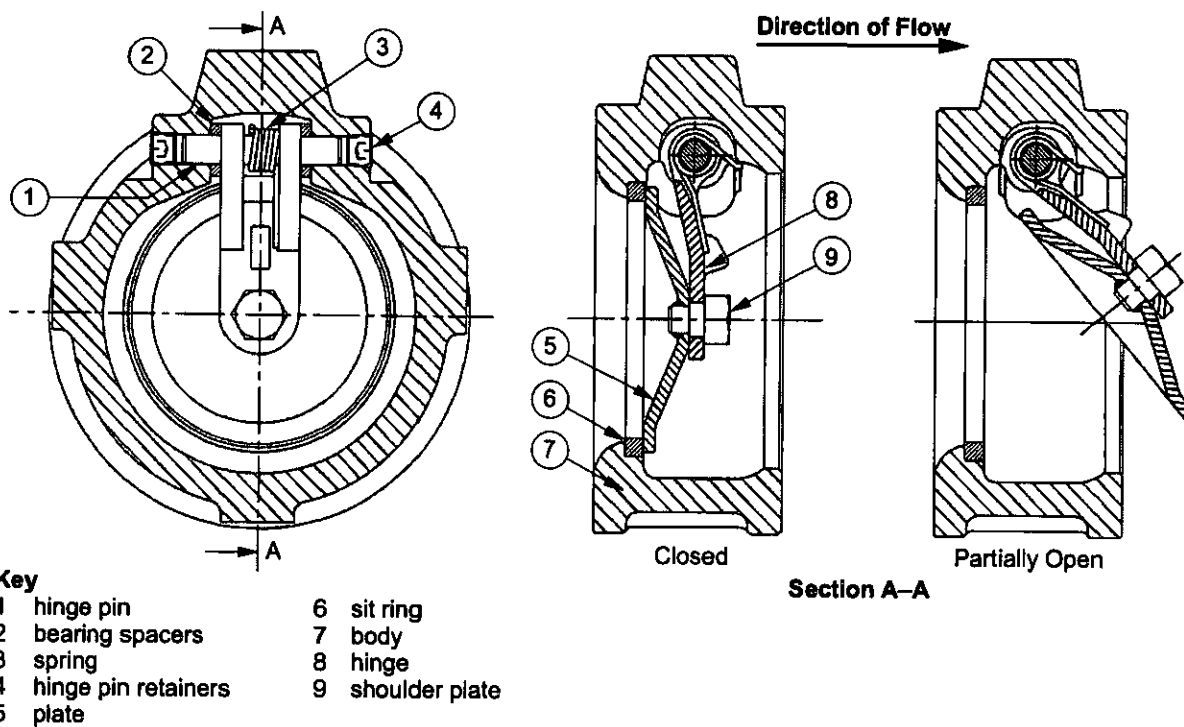
NOTE Numbers in brackets are references to clauses or subsections of this standard.

- 1) Supplemental requirements of this standard shall be specifically stated in the purchase order.
- 2) If no supplemental requirements are to be taken to this standard, the purchase order just needs to refer to API 594 and to specify the items in the following list that are marked with an asterisk (*). The items listed below without an asterisk are options that may also be specified:
 - a) valve size *; [Section 1, (Scope)];
 - b) pressure class *; [Section 1, (Scope)];
 - c) wafer, lug, double flange, flanged, or butt-welding body type *; [5.1.3];
 - d) auxiliary connections and openings; [5.1.7];
 - e) flange standard for NPS 26 and larger*; [5.1.4];
 - f) tapped test openings; [5.1.9];
 - g) bonnet gasket and/or bonnet flange facing; [6.3];
 - h) lifting eyebolts; [5.1.10];
 - i) type A, single plate or dual plate*; [5.2];
 - j) facing requirements, flanged, ring joint, or butt-weld*; [5.1.5, 5.1.6, 5.1.12];
 - k) integral seating or removable seat ring; [5.1.8];
 - l) seating surface material*; [6.4.2];
 - m) flange bolt holes drilled through; [5.1.11];
 - n) design temperature for proper spring selection*; [6.7];
 - o) material of the valve shell *; [6.1];
 - p) nominal trim material *; [6.4.1];
 - q) any required exceptions to manufacturer's permissible options (e.g., NACE MR 0103);
 - r) welded plug, pin retainers; [6.8];
 - s) inspection by purchaser; [7.1.2];
 - t) color and coatings; [9.1];

-
- u) recommended spare parts list; [Section 10];
 - v) supplementary examination and testing; [Section 7];
 - w) export packaging; [9.3];
- 3) Items where agreement with the manufacturer is required:
- a) gasket surface interruptions, for $50 \leq DN \leq 125$ ($2 \leq NPS \leq 5$); [5.6];
 - b) welded flanges; [5.1.3.1];
 - c) special materials; [4.1d];
 - d) short pattern or special length; [5.1.2].

Annex B
(informative)

Standard Nomenclature for Valve Parts



NOTE The optional configuration of a full flange or lug flange (similar to that shown in Figure 3) and of a double-flanged type (similar to that of Figure 4) shall be the manufacturer's standard unless otherwise specified in the purchase order. All notes on Figure 3 and Figure 4 apply.

Figure B.1—Typical Type 'A' Single-plate Wafer Check Valve

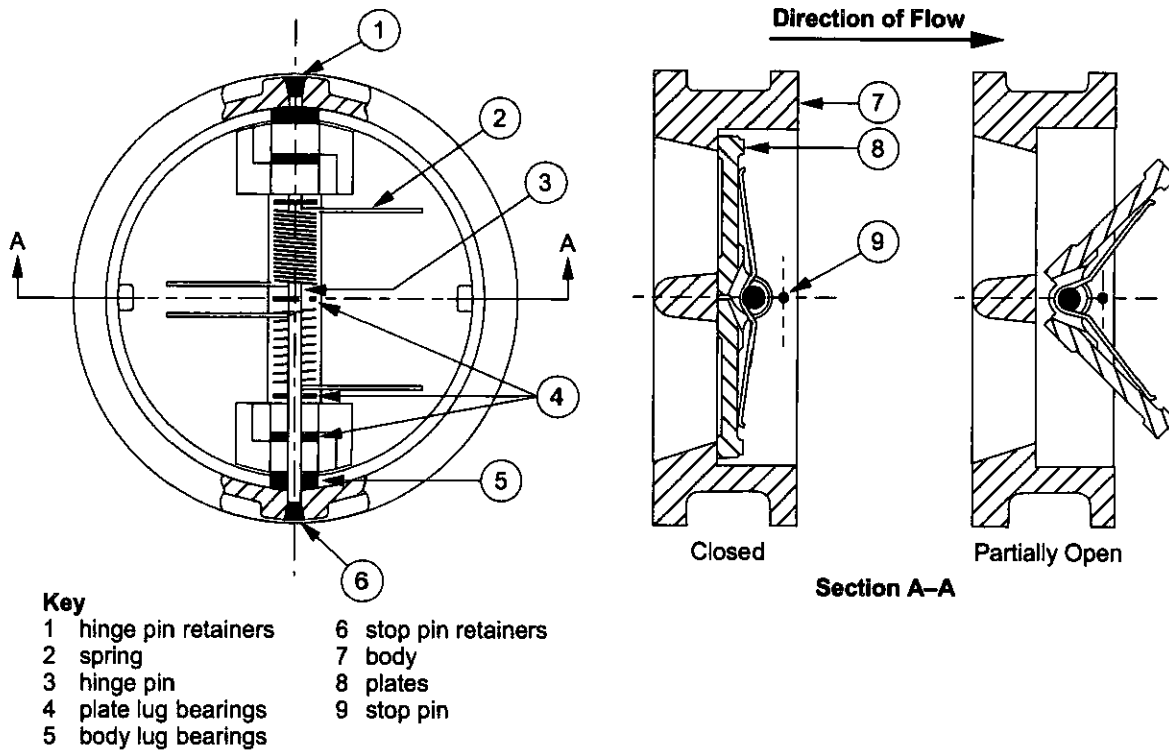
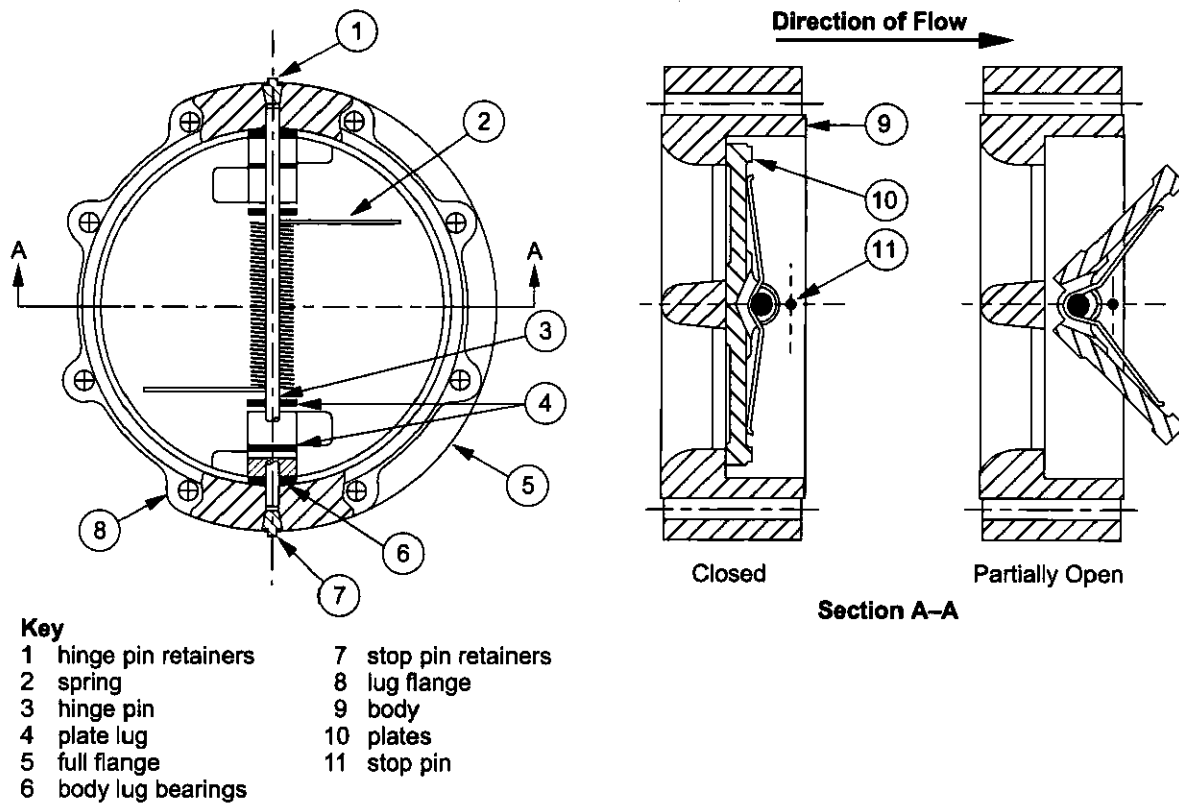


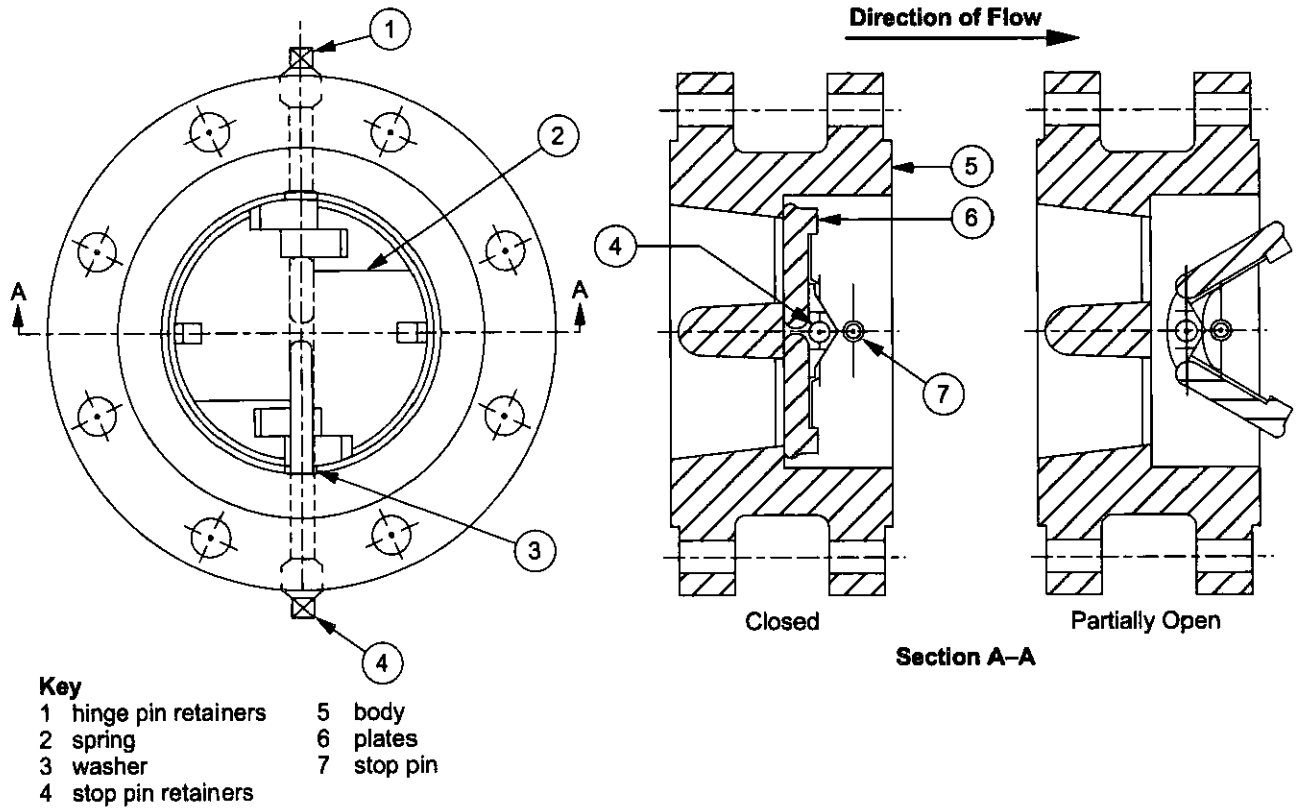
Figure B.2—Typical Type 'A' Dual-plate Wafer Check Valve



NOTE 1 The optional configuration of a full flange or lug flange shall be the manufacturer's standard unless otherwise specified by the purchaser.

NOTE 2 Unless otherwise specified in the purchase order, the bolt holes will be through-drilled.

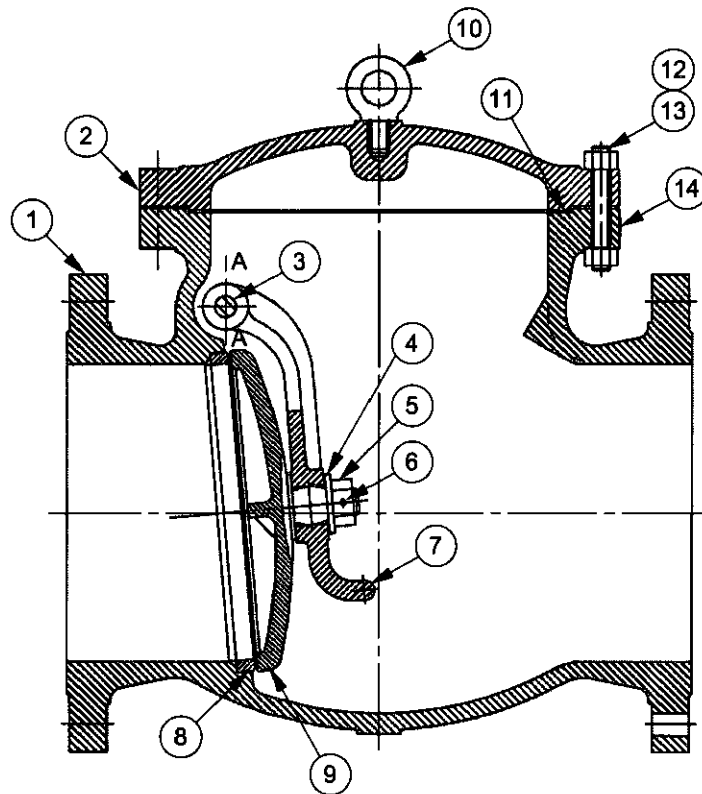
Figure B.3—Typical Type 'A' Dual-plate Lug Check Valve



NOTE 1 Double-flanged valves shall only be supplied where nut space between flanges is adequate.

NOTE 2 Unless otherwise specified in the purchase order, the bolt holes will be through-drilled (see 5.1.11).

Figure B.4—Typical Type 'A' Dual-plate Double-flanged Check Valve

**Key**

| | |
|-----------------|---------------|
| 1 body | 8 seat |
| 2 bonnet | 9 disc |
| 3 hinge pin | 10 eye bolt |
| 4 disc washer | 11 gasket |
| 5 disc nut | 12 cover stud |
| 6 spring cotter | 13 cover nut |
| 7 arm | 14 name plate |

Figure B.5—Typical Type 'B' Flanged Swing Check Valve

