t_m, at the time of manufacture shall be calculated from an equation in ASME B16.34, with minimum flow diameter (d) per ASME B16.34 for applicable valve DN or NPS and pressure class. Thickness requirements of butt-welding valve ends shall be in accordance with 5.1.3.

5.1.2 Additional metal thickness needed for assembly stresses, stress concentrations, and shapes other than circular shall be determined by individual manufacturers, since these factors vary widely.

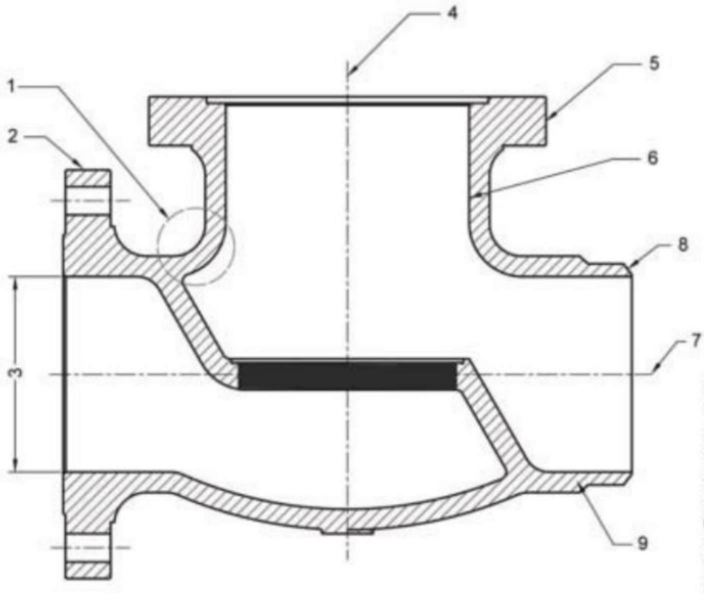

Figure 1—Identification of Terms

Table 1—Minimum Wall Thickness for Body and Bonnet

Class Designation	150	300	600	900	1500	2500	Class Designation
Nominal Size DN	**Minimum Wall Thickness t_m mm (in.)**						**Nominal Size NPS**
50	8.6 (0.34)	9.7 (0.38)	11.2 (0.44)	13.7 (0.54)	19.1 (0.75)	22.4 (0.88)	2
65	9.7 (0.38)	11.2 (0.44)	11.9 (0.47)	15.5 (0.61)	22.4 (0.88)	25.4 (1.00)	$2^1/_2$
80	10.4 (0.41)	11.9 (0.47)	12.7 (0.50)	19.1 (0.75)	23.9 (0.94)	30.2 (1.19)	3
100	11.2 (0.44)	12.7 (0.50)	16.0 (0.63)	21.3 (0.84)	28.7 (1.13)	35.8 (1.41)	4
150	11.9 (0.47)	16.0 (0.63)	19.1 (0.75)	26.2 (1.03)	38.1 (1.50)	48.5 (1.91)	6
200	12.7 (0.50)	17.5 (0.69)	25.4 (1.00)	31.8 (1.25)	47.8 (1.88)	62.0 (2.44)	8
250	14.2 (0.56)	19.1 (0.75)	28.7 (1.13)	36.6 (1.44)	57.2 (2.25)	67.6 (2.66)	10
300	16.0 (0.63)	20.6 (0.81)	31.8 (1.25)	42.2 (1.66)	66.8 (2.63)	86.6 (3.41)	12
350	16.8 (0.66)	22.4 (0.88)	35.1 (1.38)	46.0 (1.81)	69.9 (2.75)	—	14
400	17.5 (0.69)	23.9 (0.94)	38.1 (1.50)	52.3 (2.06)	79.5 (3.13)	—	16
450	18.3 (0.72)	25.4 (1.00)	41.4 (1.63)	57.2 (2.25)	88.9 (3.50)	—	18
500	19.1 (0.75)	26.9 (1.06)	44.5 (1.75)	63.5 (2.50)	98.6 (3.88)	—	20
600	20.6 (0.81)	30.2 (1.19)	50.8 (2.00)	73.2 (2.88)	114.3 (4.50)	—	24

5.1.3 The weld end preparation in butt-welding end valves (see 5.3.2) shall not reduce the body wall thickness to less than the values specified in 5.1.1 within a region closer than t_m to the outside surface of the body neck, measured along the run direction. The transition to the weld preparation shall be gradual and the section shall be

Cu is weight % copper

V is weight % vanadium

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

5.3.3 Body Seat

5.3.3.1 The inside diameter of the seat opening shall not be less than that specified in Table 4 for the nominal pipe size and pressure class.

5.3.3.2 Integral seats with overlays per Table 8 are permitted. Integral body seats (without overlays) are permitted in austenitic stainless steel and other Group 2 and Group 3 material bodies. An austenitic stainless steel or a hardfacing material may be weld-deposited either directly on the valve body or on a separate body seat ring.

5.3.3.3 Finished thickness of any facing material shall be not less than 1.6 mm (0.06 in.). Where a separate seat ring is provided, it shall be shoulder- or bottom-seated, and either threaded and seal welded or inserted and seal welded in place. Threaded seat rings shall be seal welded; tack welding or stitch welding is not permitted.

5.3.3.4 Body and disc seating surfaces shall be designed to prevent galling.

5.3.3.5 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.

Table 2—Minimum Wall Thickness for Bonnet Neck Extension

Class Designation	150	300	600	900	1500	2500
Bonnet Neck Extension Inside Diameter mm (in.)	Minimum Wall Thickness mm (in.)					
32 (1.25)	4.8 (0.189)	4.8 (0.189)	4.8 (0.189)	6.5 (0.256)	8.7 (0.343)	13.5 (0.531)
35 (1.38)	4.8 (0.189)	4.8 (0.189)	5.1 (0.201)	7.1 (0.280)	9.9 (0.382)	14.6 (0.575)
38 (1.50)	4.8 (0.189)	4.8 (0.189)	5.7 (0.224)	7.5 (0.295)	10.2 (0.402)	15.9 (0.625)
45 (1.75)	5.3 (0.210)	5.6 (0.220)	6.1 (0.240)	7.9 (0.310)	11.2 (0.440)	19.1 (0.750)
48 (1.88)	5.3 (0.210)	5.6 (0.220)	6.1 (0.240)	7.9 (0.310)	11.2 (0.440)	19.1 (0.750)
51 (2.00)	5.6 (0.220)	6.4 (0.250)	6.4 (0.250)	7.9 (0.310)	11.7 (0.460)	20.1 (0.790)
57 (2.25)	5.6 (0.220)	6.4 (0.250)	6.6 (0.260)	8.6 (0.340)	12.7 (0.500)	22.2 (0.875)
60 (2.38)	5.6 (0.220)	6.4 (0.250)	6.9 (0.268)	8.9 (0.346)	13.5 (0.530)	23.2 (0.913)
63.5 (2.50)	5.6 (0.220)	6.4 (0.250)	7.1 (0.280)	9.1 (0.362)	14.2 (0.560)	24.1 (0.950)
67 (2.62)	5.6 (0.220)	6.6 (0.260)	7.1 (0.280)	9.5 (0.375)	15.0 (0.590)	25.4 (1.000)
73 (2.87)	5.6 (0.220)	6.9 (0.272)	7.6 (0.300)	10.5 (0.412)	15.9 (0.625)	27.8 (1.093)
82.5 (3.25)	6.1 (0.240)	7.1 (0.280)	8.1 (0.320)	11.2 (0.440)	17.5 (0.687)	30.9 (1.218)
89 (3.50)	6.4 (0.250)	7.5 (0.295)	8.6 (0.340)	11.9 (0.472)	19.1 (0.750)	32.8 (1.290)
92 (3.62)	6.4 (0.250)	7.5 (0.295)	9.1 (0.362)	12.2 (0.480)	19.1 (0.750)	34.0 (1.340)
95 (3.75)	6.4 (0.250)	7.6 (0.300)	9.4 (0.370)	12.5 (0.490)	19.8 (0.780)	34.9 (1.375)
98 (3.87)	6.4 (0.250)	7.6 (0.300)	9.4 (0.370)	12.7 (0.500)	20.6 (0.812)	36.1 (1.420)
108 (4.25)	6.4 (0.250)	8.1 (0.320)	9.9 (0.390)	13.5 (0.528)	21.8 (0.860)	38.4 (1.510)

Table 2—Minimum Wall Thickness for Bonnet Neck Extension (Continued)

Class Designation	150	300	600	900	1500	2500
Bonnet Neck Extension Inside Diameter mm (in.)	Minimum Wall Thickness mm (in.)					
111 (4.38)	6.4 (0.250)	8.1 (0.320)	10.5 (0.412)	14.2 (0.560)	23.2 (0.912)	40.4 (1.590)
118 (4.63)	6.6 (0.260)	8.4 (0.330)	10.7 (0.420)	14.7 (0.580)	24.4 (0.960)	42.8 (1.687)
130 (5.12)	7.1 (0.280)	8.9 (0.346)	11.4 (0.445)	16.3 (0.638)	26.4 (1.043)	47.0 (1.846)
133 (5.25)	7.1 (0.280)	8.9 (0.346)	11.4 (0.445)	16.5 (0.650)	27.2 (1.070)	48.0 (1.890)
137 (5.38)	7.1 (0.280)	9.1 (0.362)	11.7 (0.460)	16.8 (0.660)	27.8 (1.093)	49.2 (1.937)
140 (5.50)	7.1 (0.280)	9.1 (0.362)	11.9 (0.472)	17.3 (0.680)	28.6 (1.125)	50.0 (1.976)
159 (6.25)	7.4 (0.290)	9.9 (0.382)	13.1 (0.515)	19.3 (0.760)	32.0 (1.260)	56.9 (2.240)
168 (6.62)	7.4 (0.290)	10.2 (0.400)	14.2 (0.560)	20.6 (0.810)	34.5 (1.360)	61.5 (2.420)
187 (7.38)	7.6 (0.300)	10.9 (0.430)	15.2 (0.600)	22.1 (0.870)	37.1 (1.460)	66.7 (2.625)

Table 3—Postweld Heat Treatment of Flange-to-Body Weld

Material	Thickness [a] t mm (in.)	Temperature Range °C (°F)	Holding Time min/mm (hr./in.)	Weld Hardness HBN Max
Carbon steels	t > 19 (0.75)	593 to 649 (1100 to 1200)	2.4 (1) (minimum 1 hr.)	—
Alloy steels: $^1/_2$ % < Cr ≤ 2 %	t > 13 (0.50)	704 to 746 (1300 to 1375)	2.4 (1) (minimum 2 hr.)	225
$2^1/_4$ % ≤ Cr ≤ 10 %	All	704 to 760 (1300 to 1400)	2.4 (1) (minimum 2 hr.)	241
Nickel alloy steels	t > 19 (0.75)	593 to 635 (1100 to 1175)	1.2 ($^1/_2$) (minimum 1 hr.)	—
Austenitic steels [a, b]	All	solution anneal per the material specification		
Other materials	All	per the material specification		

[a] Thickness, t, is the greater thickness of the pieces being joined by welding.

[b] Except when materials being welded are L-Grades or stabilized grades.

Table 4—Minimum Seat Diameter

Class Designation	150		300		600		900		1500		2500		Class Designation
Nominal Size DN	Minimum Seat Diameter mm (in.)												Nominal Size NPS
50	42	(1.65)	42	(1.65)	42	(1.65)	42	(1.65)	42	(1.65)	38	(1.50)	2
65	56	(2.20)	56	(2.20)	56	(2.20)	52	(2.07)	52	(2.07)	47	(1.87)	2 1/2
80	69	(2.71)	69	(2.71)	69	(2.71)	69	(2.71)	63	(2.48)	57	(2.25)	3
100	90	(3.54)	90	(3.54)	90	(3.54)	90	(3.54)	83	(3.26)	73	(2.87)	4
150	135	(5.31)	135	(5.31)	135	(5.31)	132	(5.18)	123	(4.85)	111	(4.37)	6
200	182	(7.17)	182	(7.17)	182	(7.17)	172	(6.76)	160	(6.31)	146	(5.75)	8
250	224	(8.82)	224	(8.82)	222	(8.74)	215	(8.45)	200	(7.88)	184	(7.25)	10
300	275	(10.81)	275	(10.81)	250	(9.84)	250	(9.84)	238	(9.38)	219	(8.62)	12
350	303	(11.93)	303	(11.93)	294	(11.59)	Unlisted		Unlisted		Unlisted		14
400	349	(13.73)	349	(13.73)	Unlisted		Unlisted		Unlisted		Unlisted		16
450	396	(15.60)	Unlisted		Unlisted		Unlisted		Unlisted		Unlisted		18
500	444	(17.47)	Unlisted		Unlisted		Unlisted		Unlisted		Unlisted		20
600	539	(21.21)	Unlisted		Unlisted		Unlisted		Unlisted		Unlisted		24
NOTE Unlisted seat diameter shall be in agreement between the manufacturer and the purchaser.													

5.4 Bonnet

5.4.1 When designing the stem, gland, lantern ring or spacer ring (if supplied), and backseat, the manufacturer shall take into account stem guiding and the prevention of packing extrusion.

5.4.2 The bonnet shall include a conical stem backseat in one of the following forms:

— a bushing positively secured by tab, tack, or seal welding against coming loose, i.e. not relying on friction;

— an integral surface in the case of an austenitic stainless steel valve;

— an austenitic stainless steel or hardfaced weld deposit that is a minimum of 1.6 mm (0.06 in.) thick.

5.4.3 Bonnets shall be one-piece castings or forgings. For cryogenic or cold service, the bonnet construction shall be in accordance with MSS SP-134, unless otherwise specified by the purchaser.

5.4.4 The gland bolting shall be secured to the bonnet so that the bolting is retained during repacking. When eyebolts are used, the eyebolt pin shall be anchored on both sides of the eyebolt. The anchors shall not include open slotted holes or be attached by fillet welds.

5.5 Bonnet-to-body Joint

5.5.1 The bonnet-to-body joint shall be a flange and gasket type.

5.5.2 The bonnet-to-body joint shall be one of the following types, as illustrated in ASME B16.5:

— raised face;

— tongue and groove;

— spigot and recess;

— ring joint.

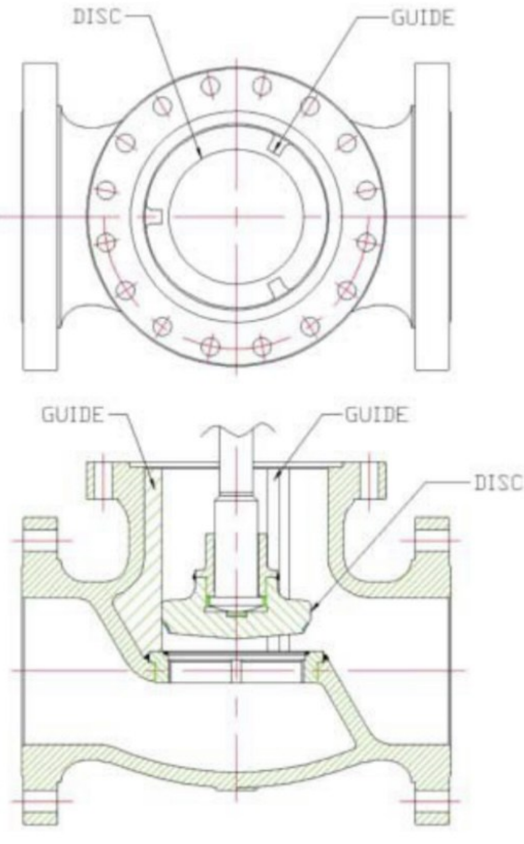

Figure 2—Typical Disc and Guiding

5.6.5 A hardened wear pad may be provided between the disc and stem to prevent wear and galling. The wear pad may be either a separate thrust plate or an integrally welded pad.

5.7 Yoke

5.7.1 The yoke may be either an integral part of the bonnet or a separate part. The yoke shall retain the yoke bushing for rising and rotating stem valves or the stem nut for nonrotating rising stem globe valves.

5.7.2 Yokes that are separate shall have yoke-to-bonnet mating surfaces machined so as to assure a proper bearing assembly interface.

5.7.3 Where used, the yoke-to-stem nut bearing surfaces shall be machined flat and parallel. A lubricating fitting shall be provided for the bearing surfaces.

5.7.4 If the nonrotating stem feature is accomplished by using flat guiding surfaces on the yoke these surfaces shall be machined to provide proper guiding without galling.

5.8 Stem, Stem Nut, and Yoke Bushing

5.8.1 The minimum stem diameter, d_s, shall be as given in Table 5. The minimum stem diameter applies to the stem along the surface area that comes into contact with the packing and to the major diameter of the trapezoidal stem thread. However, the major diameter of the stem thread may be reduced, at the manufacturer's option, by no more than 1.6 mm (0.06 in.). The stem surface area in contact with the packing shall have a surface finish, Ra, of 0.80 µm (32 µin.) or smoother. The actual stem diameter shall take into account the valve design details and the stem material strength characteristics. Note that the stem strength shall be considered when calculating the maximum input force from the handwheel and gear box (if equipped) in accordance with MSS SP-91 or in accordance with maximum rim pull when specified by the purchaser.

5.8.2 Stems shall have a disc attachment means at one end and an external trapezoidal style thread form at the other. A yoke bushing on rising and rotating stems or a stem nut on nonrotating rising stems shall be provided.

Table 5—Minimum Stem Diameter

Class Designation	150		300		600		900		1500		2500		Class Designation
Nominal Size DN	Minimum Stem Diameter d_s mm (in.)												Nominal Size NPS
50	19	(0.75)	19	(0.75)	22	(0.88)	25	(1.00)	29	(1.13)	38	(1.50)	2
65	22	(0.88)	22	(0.88)	25	(1.00)	35	(1.38)	35	(1.38)	41	(1.62)	$2^1/_2$
80	25	(1.00)	25	(1.00)	29	(1.13)	35	(1.38)	38	(1.50)	44	(1.75)	3
100	29	(1.13)	29	(1.13)	32	(1.25)	44	(1.75)	48	(1.88)	51	(2.00)	4
150	32	(1.25)	35	(1.38)	48	(1.88)	57	(2.25)	70	(2.75)	79	(3.12)	6
200	35	(1.38)	44	(1.75)	64	(2.50)	73	(2.88)	89	(3.50)	102	(4.00)	8
250	38	(1.50)	57	(2.25)	83	(3.25)	89	(3.50)	108	(4.25)	124	(4.88)	10
300	44	(1.75)	67	(2.62)	86	(3.38)	105	(4.12)	127	(5.00)	146	(5.75)	12
350	48	(1.88)	73	(2.88)	98	(3.88)	Unlisted		Unlisted		Unlisted		14
400	57	(2.25)	86	(3.38)	Unlisted		Unlisted		Unlisted		Unlisted		16
450	64	(2.50)	Unlisted		Unlisted		Unlisted		Unlisted		Unlisted		18
500	70	(2.75)	Unlisted		Unlisted		Unlisted		Unlisted		Unlisted		20
600	89	(3.50)	Unlisted		Unlisted		Unlisted		Unlisted		Unlisted		24

NOTE Unlisted minimum stem diameter shall be in agreement between the manufacturer and the purchaser.

5.8.2.1 The yoke bushing shall be threaded internally to engage the stem, and it shall be threaded or otherwise suitably fitted into the yoke. The bushing shall be secured in place using either a lock weld or a positive mechanical lock. Locking by simple metal upsetting such as peening or staking is not permitted.

5.8.3 The stem-to-bushing or stem-to-stem nut threads shall be of trapezoidal form as specified in ASME B1.5 or ASME B1.8, with nominal dimensional variations allowed. Stem threads shall be oriented so that a direct operated handwheel rotated in a clockwise direction closes the valve, regardless of whether the valve is equipped with yoke bushing or with stem nut.

5.8.4 The stem shall be one-piece wrought material. A stem that is a welded fabrication or threaded assembly shall not be provided.

5.8.5 Out of straightness of the entire length of the stem shall not exceed 0.001 mm/mm (0.001 in./in.).

5.8.6 The stem-to-disc connection (except for stop-check valves) shall be designed to prevent disengagement of the stem from the disc in any position of the disc or orientation of the valve. The bottom of the stem shall be contoured with a radial curvature large enough to allow contact with the closure element through any misalignment.

5.8.7 The stem, yoke bushing/stem nut, disc connection, and bonnet shall be designed to withstand the closing of the valve against the full rated pressure under the disc and to withstand the opening of the valve against the full rated pressure with flow over the disc.

5.8.8 The one-piece stem shall include a conical or spherical raised surface that seats against the bonnet backseat when the valve is at its full open position. Alternatively, the backseat may be integral to the disc retainer.

Table 6—Nominal Radial Width of Packing

Nominal Stem Diameter d_n mm (in.)	Nominal Radial Width of the Packing w mm (in.)	Packing Box Clearance Factor y mm (in.)
$19 < d \leq 27$ ($3/4 < d \leq 1$)	6.4 (1/4)	0.4 (1/64)
$27 < d \leq 37$ ($1 < d \leq 1\,3/8$)	7.9 (5/16)	0.4 (1/64)
$37 < d \leq 49$ ($1\,3/8 < d \leq 1\,7/8$)	9.5 (3/8)	0.4 (1/64)
$49 < d \leq 56$ ($1\,7/8 < d \leq 2\,1/8$)	11.1 (7/16)	0.8 (1/32)
$56 < d \leq 74$ ($2\,1/8 < d \leq 2\,7/8$)	12.7 (1/2)	0.8 (1/32)
$74 < d < 92$ ($2\,7/8 < d \leq 3\,5/8$)	14.3 (9/16)	0.8 (1/32)
$92 < d < 108$ ($3\,5/8 < d \leq 4\,1/4$)	15.9 (5/8)	0.8 (1/32)
$108 < d < 124$ $4\,1/4 < d \leq 4\,7/8$)	17.5 (11/16)	0.8 (1/32)
$124 < d < 146$ ($4\,7/8 < d \leq 5\,3/4$)	20.6 (13/16)	0.8 (1/32)

5.9.3 The nominal bore (inside diameter) of the packing box shall be the sum of the nominal valve stem diameter plus twice the nominal packing width plus a clearance factor, y, i.e. equal to $d_n + 2w + y$. See Table 6 for the required values.

5.9.4 A gland and a separate gland flange shall be provided for packing compression. The gland flange shall have two holes to receive the gland bolting. Slots for gland flange bolts shall not be used. The gland and gland flange shall be self-aligning. The gland shall have a shoulder at its outer edge so as to prevent complete entry of the gland into the packing box.

5.9.5 A lantern ring shall be provided only if so specified by the purchaser. To accommodate the lantern ring, the packing box depth shall be at least equivalent to that of a minimum of three uncompressed rings of packing above the lantern ring and three uncompressed rings of packing below the lantern ring plus the length of the lantern ring. The clearance between the packing box bore (inside diameter) and the outside diameter of the gland and the spacer ring (see Figure B.1) shall be nominally less than the diametrical clearance between the inside diameter of the gland and the stem diameter. The clearance between the spacer ring and the stem shall be sufficient to prevent galling.

5.10 Bolting

5.10.1 Bolting shall be standard inch series bolting, except if the purchaser specifies metric series bolting. Bolting for the bonnet-to-body joint shall be continuously threaded stud bolts with heavy hexagon nuts that are in accordance with ASME B18.2.6M or ASME B18.2.6.

5.10.2 Body-to-bonnet bolting materials shall meet the requirements of ASME B16.34.

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

5.10.4 Gland bolts, with hexagonal nuts, shall be hinged eyebolts, headed bolts, stud bolts, or studs.

5.10.5 Bolting with diameters 25 mm (1 in.) and smaller shall have coarse (UNC) threads or the most nearly corresponding metric threads. Bolting with diameters larger than 25 mm (1 in.) shall be 8-thread series (8UN) or the most nearly corresponding metric threads. Bolt threads shall be Class 2A and nut threads shall be Class 2B, in accordance with ASME B1.1. Studs used for gland bolting shall use a Class 5 interference fit conforming to ASME B1.12. When metric bolting is used, metric bolt threads shall be tolerance Class 6g and nuts tolerance Class 6H in accordance with ASME B1.13M.

Annex B
(informative)

Identification of Valve Terms

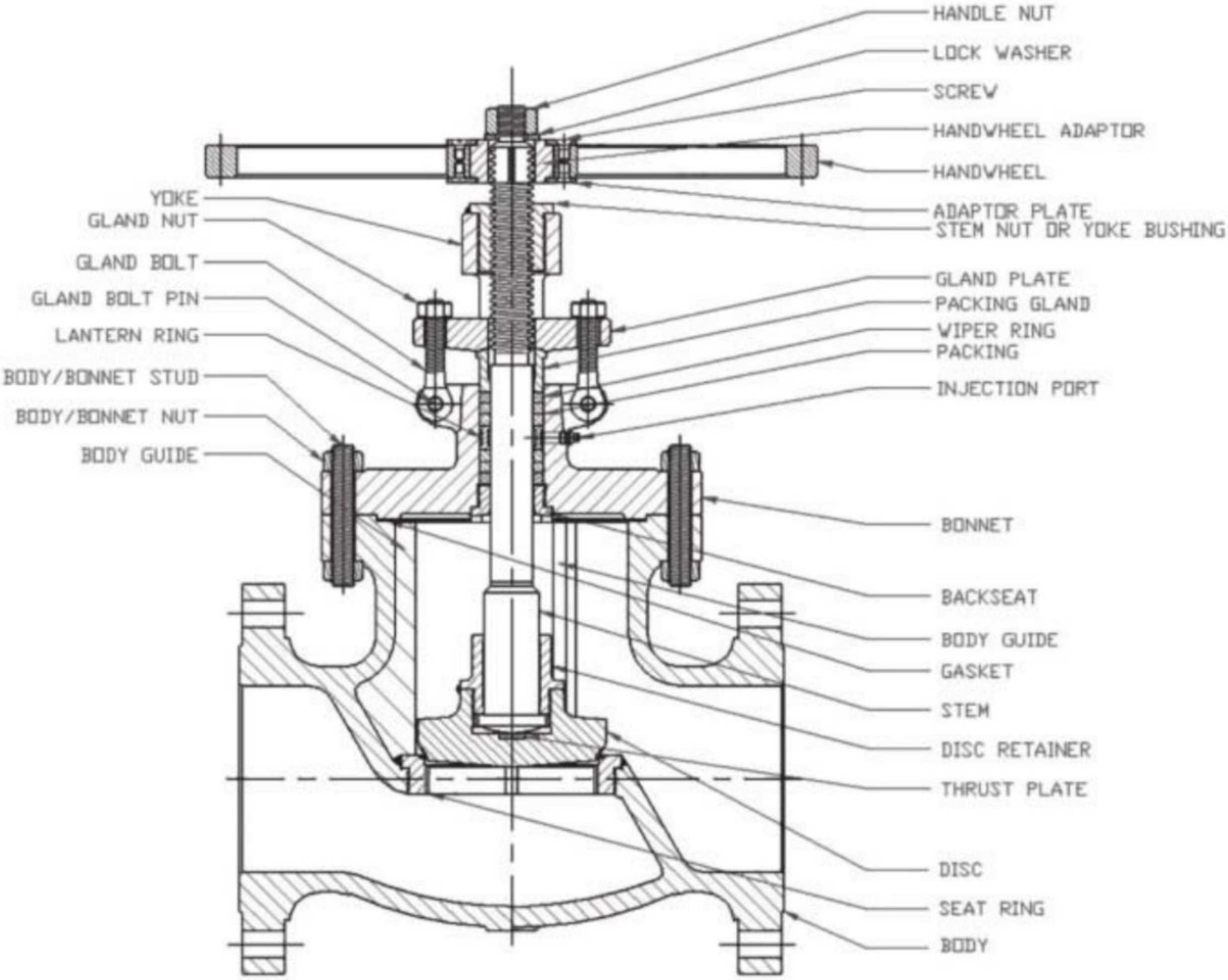

Figure B.1—Valve Nomenclature