

CAST STEEL VALVES

MAINTENANCE MANUAL,

Bolted Bonnet Gate, Globe, Parallel Slide and Check Valves

2–60", (50–1500 mm)



2.1 RECEIVING INSPECTION

All valves must be examined for signs of damage that may have occurred during transportation. Any damage should be analyzed and a report should be issued. Serious damage should be reported to your local Velan representative or to the Customer Service Manager so that a suitable arrangement for repairs can be made without delay.

2.2 QUALITY CONTROL INFORMATION

For valves purchased with Quality Control (QC) certification, check the package of documents to see that the Quality Control certificates are complete as per the purchase order.

2.3 STORAGE

Valves should be stored in a suitably sheltered place to prevent contamination by weather, dirt or dampness. The valve is shipped with end protectors on the inlet and outlet which should stay on the valve until it is ready for installation.

NOTE: If actuators are involved, please refer to the applicable manufacturer's instructions for storage.

2.4 HANDLING AND PREPARATION

On large valves, a hoist is needed to assist installation. A sling should be placed under the valve body or around the valve yoke so that the unit can be lifted vertically to its final destination. End protectors must be removed from all types of valves and connections must be checked for cleanliness. Any visible foreign matter must be removed from end connections on weld-end valves. The weld-end preparation must be cleaned properly with a suitable solvent such as acetone or alcohol. Do not use solvents containing chloride or fluoride.

WARNING: During installation, welding and construction stage the valve mid-section around the packing flange and stem should be protected at all times; as foreign debris from welding, grinding, etc. can fall in between the

tapered area of the packing flange and stem that can cause extensive damage to stem and associated parts during valve cycling. In any case, prior to cycling, the area between the stem, packing flange and gland bushing must be thoroughly cleaned off of all foreign matter.

2.5 INSTRUCTIONS FOR GATE VALVES

The flow through gate valves can be from either end. There may be exceptions to this if bypass piping is welded to the valve body or if a pressure relief hole is drilled in one side of the valve gate. Check your piping layout drawing to ensure correct position and direction of flow. Gate valves should be installed and welded into the pipeline with the wedge or disc in the fully closed position. If the valve is left open or partially open, it could distort and leak during operation. Also, leaving the valve in a fully closed position helps prevent weld spatter from falling directly onto the mating faces of the seats.

The preferred orientation of a gate valve is upright. The valve may be installed in other orientations, but any deviation from vertical is a compromise. Installation upside down is not recommended because of possible dirt build-up in the bonnet. It is best to consult Velan Engineering department during quotation review process as to remedial measures required (hardfacing of guides) when valves over 12" (300 mm) are tilted beyond 45° from the stem vertical orientation.

NOTE: Gate valves should not be used for throttling to control the flow, they are normally fully open or fully closed. If left in partially open position could result in severe damage to body seats, wedge, stem & guide rails.

II RECEIVING AND PREPARATION FOR INSTALLATION

2.6 INSTRUCTIONS FOR GLOBE VALVES

Globe valves are usually installed with the inlet below the valve seat. This must be checked carefully to prevent incorrect installation. If throttling service is particularly severe, Velan recommends that the valve be installed so that the flow enters over the top of the seat and goes down through it. This maintains the valve in a more stable condition. The amount of wear is minimized and there is less external noise. Valve operation also becomes easier because less torque is required to close the valve.

Globe type valves should be installed and welded with the disc in a fully closed position to prevent damage to the valve during installation. Leaving the disc in a fully closed position also prevents weld spatter from falling directly onto the mating faces of the seat and disc.

The preferred orientation of a globe valve is upright. The valve may be installed in other orientations, but any deviation from vertical is a compromise. Installation upside down is not recommended because of possible dirt build-up in the bonnet.

PRECAUTION: Allow time for welding to cool before trying the valve for the first time in the pipeline.

2.7 INSTRUCTIONS FOR CHECK VALVES

All Velan inclined piston check and stop-check valves without springs, when installed in vertical or near vertical line, should have fluid flow upward and the angle of incline of the line not more than 5° past the vertical in the direction of the bonnet. When installed in horizontal or near horizontal lines, the valve bonnet should be up and the angle of incline of the line should be not more than 5° below the horizontal. See figure 2.7 for incline and roll angle allowable. Consult your Velan representative concerning installation other than that mentioned above.

CAUTION: Velan 90° piston check and stop check valves without springs should be installed with the bonnet up, and the angle of incline of the line should be no more than 45° from horizontal. Also, the roll angle of the valve bonnet should be no more than 45° from side to side.

NOTE: All check valves should be installed at least ten pipe diameters away from upstream pumps, elbows, fittings or equipment. If closer installation is required, please consult the Velan Customer Service Manager (see Fig. 2.7A & 2.8B).

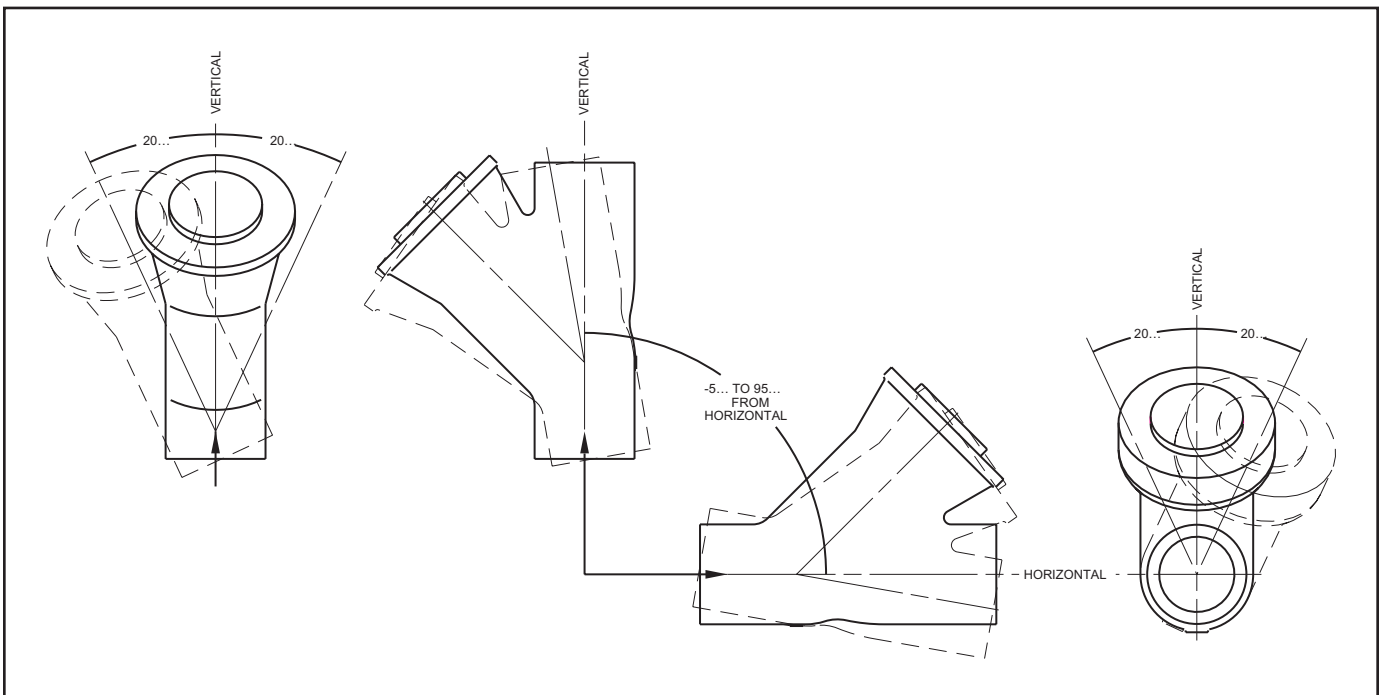


Figure 2.7A Inclined check valve: Angle of incline and roll angle

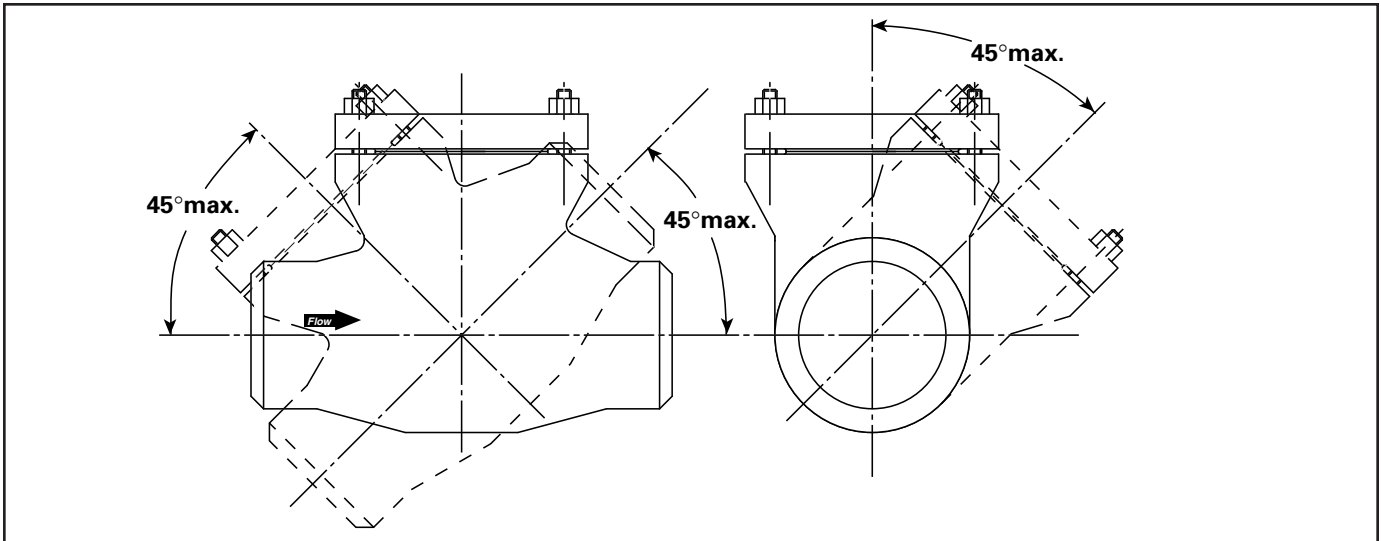


Figure 2.7B 90° check valve: Angle of incline and roll angle

All check valves must be installed with the inlet in direction of arrow. This must be checked carefully before installing the valve. Placing a check valve in the opposite direction to the flow will prevent the disc from swinging free and will therefore prevent normal operation of the valve.

2.8 INSTRUCTIONS FOR TILTING DISC CHECK VALVES

Tilting disc check valves can be installed horizontally or vertically according to the design specifications and with the inlet in the direction of the arrow. Placing a check valve in the opposite direction to the flow will prevent the disc from swinging free and will therefore prevent normal operation of the valve

NOTE: All check valves should be installed at least ten pipe diameters away from upstream pumps, elbows, fittings or equipment. If closer installation is required, please consult the Velan Customer Service Manager.

2.9 RECHECK FOR BOLT TIGHTNESS WITH OR WITHOUT LINE PRESSURE

After valve installation, recheck and retighten the bolts including gland bolts as necessary to the valves given as follows:

Gasket bolts: body-bonnet, use *Table 4.5A*
 Packing bolts: gate and parallel slide valves, use *Table 5.1A* and for globe valves, use *Table 5.1B*.
 All other bolts: use *Table 5.3A*

The tightness of the joint bolt tension and gland bolts should be checked at approximately one year intervals thereafter. Use bolt tightening procedure as follows:

1. Remove one nut at a time, lubricate stud and nut flats thoroughly with an approved anti-seize compound and torque to recommended values shown in *Table 4.5A*.
2. Remove opposite nut and repeat procedure until all nuts have been retorqued.
3. Re-check bolt torque by going once around clockwise.

NOTE: If gasket must be replaced, follow *Section 4.5 Body/Bonnet (or Cover) Torquing Procedure*.

2.9.1 Seat Cleaning-Flushing

After installation prior to system test and start-up, it is recommended to clean the valve by flushing line debris matter that may have accumulated inside the valve and between the valve seating surfaces during Plant construction and valve installation. Open the valve fully, flush as deemed necessary, then close and open the valve while flushing. If seat leakage is noted after flushing repeat the procedure. If the leakage still persists, it must be assumed the seating surface maybe damaged.

NOTE: If seat must be repaired, follow *Section 5.2.3 Seat Leakage*.

IV GENERAL MAINTENANCE

4.2 OPERATION

4.2.1 General

All valves require examination before being put into operation. Additionally, valves should be inspected regularly during operation and should receive prompt attention when trouble arises. As a general rule, valves should be subjected to scheduled maintenance.

4.2.2 Smoothness of Operation

Stem threads, gearing and other working components outside the fluid area should be lubricated frequently and at least once every six months. Specific lubricants and frequency of application are shown in the recommended lubrication *Table of Section 4.3*. Valves that are not operated frequently and which may remain open or closed for long periods of time should be worked (even if only partially) about once a month.

IMPORTANT: Excessive handwheel effort can indicate the following:

1. Improperly lubricated or damaged valve stem.
2. Valve packing compression too tight (check torque *Table 5.1A*).
3. Faulty or damaged valve parts.
4. Foreign particle matter on threads and on stem-packing flange area.

4.3 RECOMMENDED LUBRICATION

Table 4.3 Recommended lubrication

PART	LUBRICATION	APPLICATION	FREQUENCY
Stem threads	Exxon: Ronex MP, Castrol MP or equivalent MP group (up to 650°F) Ronex Extra duty 2 (above 650°F)	Directly to threads	When threads appear dry
Yoke nut	Exxon: Ronex MP, Castrol MP or equivalent MP group (up to 650°F) Ronex Extra duty 2 (above 650°F)	Inject through grease fitting at hub of yoke	Concurrently with stem thread lubrication
All threaded parts except stem and yoke nut	- Anti-seize compound No. 425-A (Crane) or equivalent - Nickel Anti-Seize to MIL-A-90TE or MOLYKOTE P37	Thin coat on threads	On valve assembly only

Recommended lubricant subject to change without notice.

4.4 GENERAL ASSEMBLY INFORMATION

1. The most important fact to be considered is the cleanliness of all parts. All rust and dirt should be removed from all parts with a wire brush or emery cloth. Oil and grease should be removed with suitable solvents.
2. All threaded parts (capscrews, nuts and studs) must be well relubricated. The stem and yoke nut threads should be cleaned of all old grease before new grease is applied to the threads. All recommended lubricants can be found in *Section 4.3*. Use correct lubricant for each individual part.
3. Repaired or replacement parts must be checked to see if all repair procedures have been done and that all replacement parts (e.g. packing rings, gasket, etc.) have been checked for size so that they will fit into the valve you are servicing.
4. All orientation marks assigned during disassembly must be observed so that correct orientation is maintained. Where applicable, orientation marks should be made on parts near the body serial number (e.g., wedge, disc, seat etc.)

4.5 BODY/BONNET (OR COVER) TORQUING PROCEDURE

4.5.1 General

1. Clean all studs and nuts. Visually inspect all threads to ensure removal of all foreign matter, rust, corrosion, burrs and previous lubricants.
2. Liberally cover the stud threads and the surface under the nut head with FELPRO type C5A Hi-Temp Antiseize compound or approved equivalent. Also, lubricate the female threads of the nuts and nut flats, and wipe off any excess lubricant that may adhere to any of the stainless steel parts with recommended solvents.

Recommended solvents for this work are:
a) unused or redistilled acetone
b) alcohol
3. After tightening bolts by hand, follow the bolt tightening sequence shown in *Fig. 4.5A*. This sequence depends on the quantity of bolts used. The drawing illustrates the tightening sequence of different size and class. The bolts should be torqued to the values in accordance with the table material for stud threads (see *Table 4.5A*).

4.5.2 Application of Torque

When applying the torque to the bolts, each bolt should be torqued in steps of approximately 20% of the final torque.

After the final torque has been applied in sequence. It is recommended that the bolts be rechecked once around in a clockwise rotation.

PRECAUTION:

1. If tightening sequence is not followed, it is possible that the gasket will not be compressed evenly, and may result in gasket leakage.
2. Over-torquing can cause deformation of the body or bonnet flange and can also cause joint leakage.
3. Do not use impacting devices to tighten up the bolting on the body/bonnet (cover). Use suitable mechanical devices for tightening.
4. Use hand torque wrenches. If torque wrenches are not suitable, use standard wrenches and the following guidelines will apply:

BOLT SIZE	LENGTH OF WRENCH	
	inches	mm
3/8"	5"	125
1/2"	6"	150
9/16"	9"	225
5/8"	12"	300
3/4"	18"	450
7/8"	24"	600
1"	30"	750
1 1/8"	36"	900

On sizes of bolts larger than 1 1/8", special torque multipliers with ratios 1:7 or 1:6 should be used for torquing.

IV GENERAL MAINTENANCE

Table 4.5A Body/bonnet bolting torque ft·lb (N·m).

Stud Size	BOLTING MATERIAL					
	B7M/L7M	B7 / B16	660	630	B8M CL.1	B8M CL.2
3/8-16 UNC	15 (20)	20 (27)	20 (27)	20 (27)	15 (20)	20 (27)
7/16-14 UNC	25 (34)	30 (41)	25 (34)	35 (47)	25 (34)	25 (34)
1/2-13 UNC	40 (54)	50 (68)	40 (54)	55 (75)	35 (47)	45 (61)
5/8-12 UNC	55 (75)	70 (95)	60 (81)	80 (108)	55 (75)	65 (88)
3/4-11 UNC	75 (102)	100 (136)	80 (108)	100 (136)	70 (95)	85 (115)
7/8-10 UNC	135 (183)	170 (231)	150 (203)	200 (271)	125 (170)	150 (203)
1-9 UNC	200 (271)	270 (366)	250 (339)	300 (407)	200 (271)	200 (271)
1-8 UNC	350 (475)	400 (542)	350 (475)	450 (610)	300 (407)	350 (475)
1 1/8-8 UN	500 (678)	600 (814)	500 (678)	650 (881)	450 (610)	450 (610)
1 1/4-8 UN	675 (915)	850 (1153)	700 (949)	950 (1288)	650 (881)	650 (881)
1 3/8-8 UN	900 (1220)	1200 (1627)	1000 (1356)	1300 (1763)	900 (1220)	900 (1220)
1 1/2-8 UN	1200 (1627)	1500 (2034)	1300 (1763)	1700 (2305)	1200 (1627)	1200 (1627)
1 5/8-8 UN	1600 (2170)	2000 (2712)	1700 (2305)	2200 (2983)	1500 (2034)	
1 3/4-8 UN	2000 (2712)	2500 (3390)	2100 (2848)	2800 (3797)	1900 (2576)	
1 7/8-8 UN	2500 (3390)	3100 (4204)	2600 (3526)	3500 (4746)	2300 (3119)	
2-8 UN	3000 (4068)	3800 (5153)	3200 (4339)	4200 (5695)	2800 (3797)	
2 1/8-8 UN	3600 (4882)	4500 (6102)	3800 (5153)	5000 (6780)	3400 (4610)	
2 1/4-8 UN	4400 (5966)	5400 (7322)	4600 (6238)	6100 (8272)	4100 (5560)	
2 1/2-8 UN	6000 (8136)	7500 (10170)	6400 (8678)	8500 (11526)	5700 (7729)	

Note:

- (1) Torque tolerance $\pm 10\%$.
- (2) Maximum temperature for 630 is 650°F.
- (3) For temperatures above 750°F (400°C) use 75% of the torque values.
- (4) Above torque values are with the bolts lubricated.

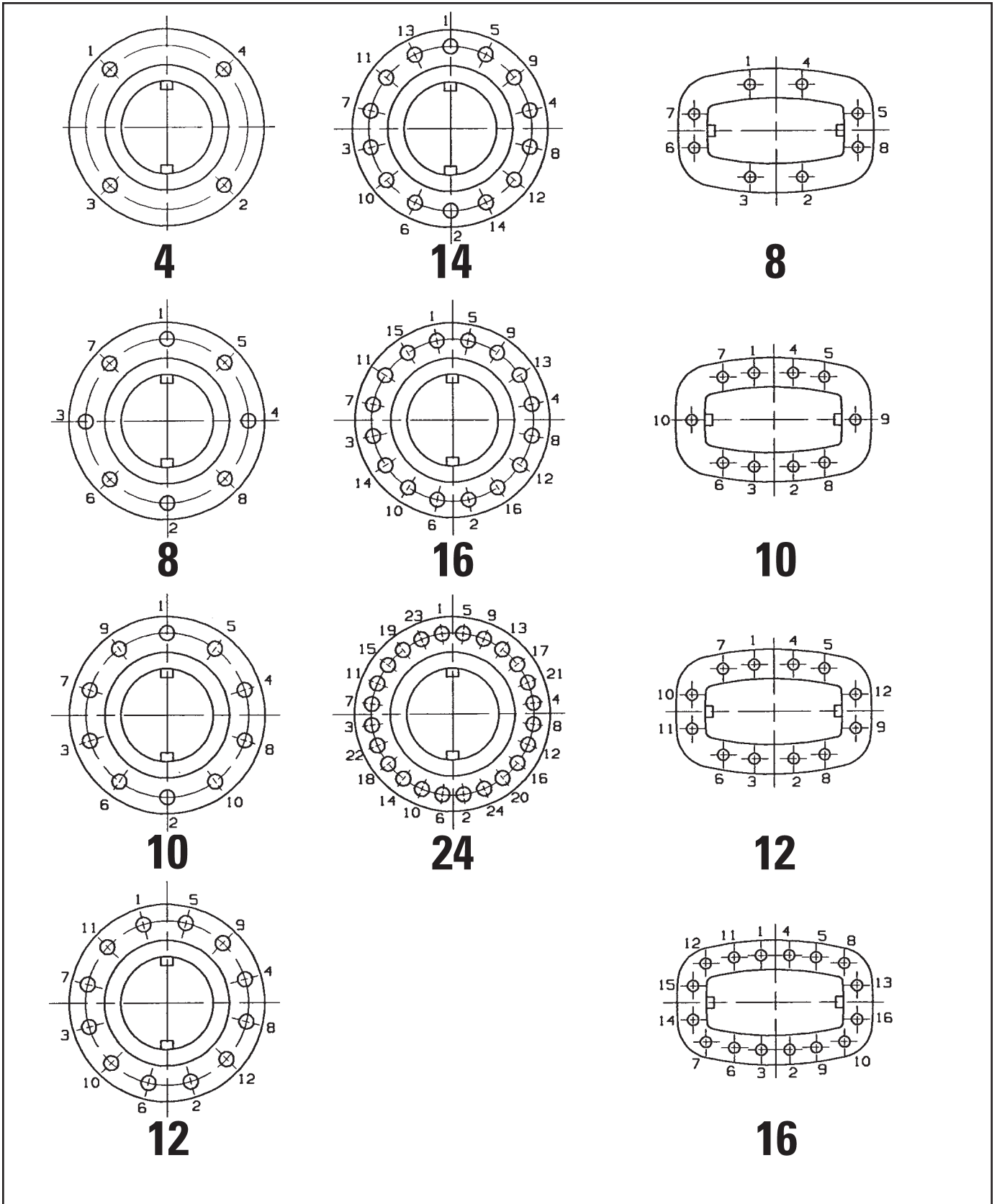


Figure 4.5A Bolt tightening sequence

V INFORMATION PERTINENT TO GATE, GLOBE, CHECK & PARALLEL SLIDE VALVES

5.1 PACKING

NOTE: All Cast Steel Valves having 13SX as the last four digits of the figure number (see p.8) come standard with teflon packings and gasket. These valves may, as an option, come with graphite packings and gasket but this must be requested at time of order, in such a case an orange tag stating graphite packing and gasket will be attached to the valve.

5.1.1 Number of packing rings required

Number of packing rings (Figs 5.1A and 5.1B) required without a leak off connection:

- (1) For cast gate and parallel slide valves up to 12", 5-6 packings are required.
- (2) For cast gate valves 14" and up, 6-7 packings are required.
- (3) For standard cast globe valves, 6-7 packings are required.
- (4) For cast globe valves, non-rotating stem 5-6 packings are required (Fig. 5.1C)

5.1.2 Packing Ring Removal on Line

Follow warning instructions in Section III before replacing packing rings on line.

1. Remove the packing flange nuts and, if fit with live-loading, remove Belleville spring washers.
2. Lift packing flange and gland bushing as high as possible and secure.
3. For braided packing rings: Fig. 5.1C & D use special flexible removal tools (cork screw tip) Fig. 5.1E screw into the packing ring and pull out.



Figure 5.1E Flexible packing removal tool cork screw tip

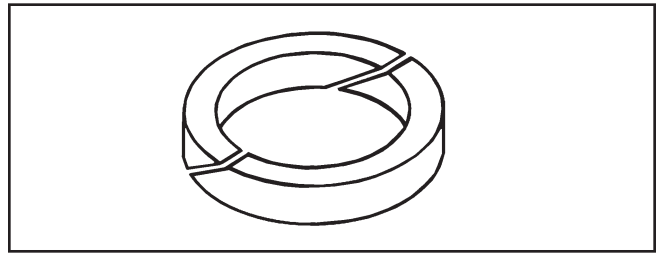


Figure 5.1A Graphite ribbon packing

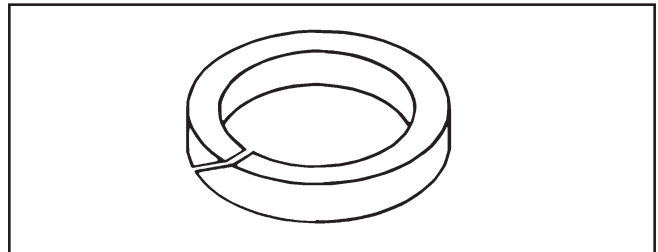


Figure 5.1B Braided graphite packing ring

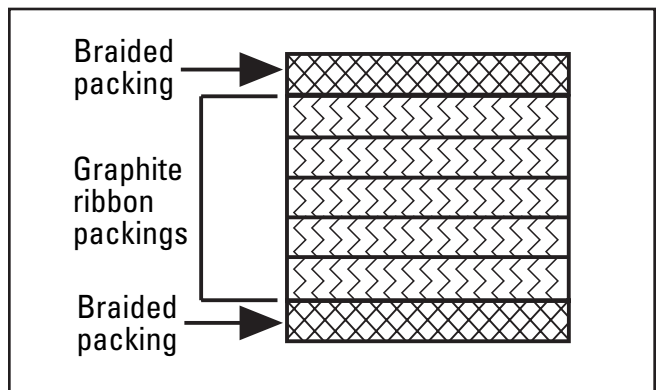


Figure 5.1C Seven packings shown

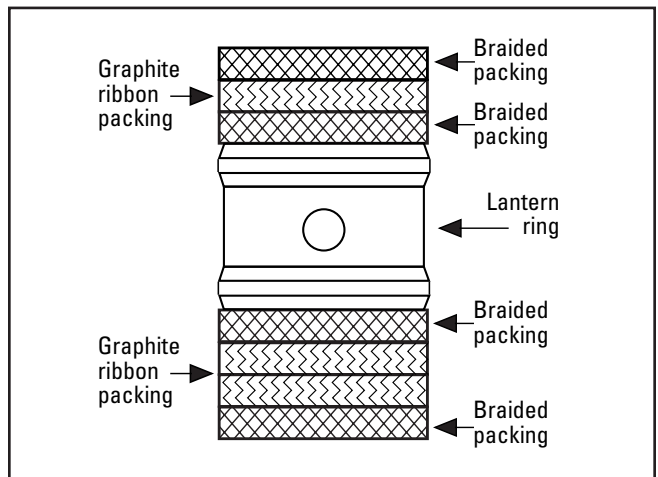


Figure 5.1D Lantern ring configuration

For graphite ribbon packing *Fig 5.1C & D* with special "C"-saw tool *Fig. 5.1F* cut through the packings, apply downward pressure as you work the tool in a back and forth motion. Blow out packing remains using instrument air or suck out with a vacuum cleaner. Care must be taken not to scratch the stem or the walls of the packing chamber during the removal of the packing rings.



Figure 5.1F "C"-saw packing removal tool

4. If the valve is equipped with a leak-off pipe, there is a lantern ring after the third packing ring. To remove the lantern ring, insert two hooks into the holes at the top of the lantern ring or insert screw-in extracting wires where tapped holes are provided. These tapped holes are 6-32 UNC for valves 2½" (65 mm) to 4" (100 mm), and 8-32 UNC for valves 6" (150 mm) and larger.
5. After the lantern ring is lifted, the last four packing rings can be removed using the procedure described in step 3.

5.1.3 Repacking with Graphite Packing Rings for Valves Without Leak-off Connection

1. Before repacking, check the stem and the packing chamber wall for damage.

Packing Chamber: Scratches (damage) no deeper than 0.010" (0.25 mm) per side can be removed by polishing the surfaces with a buffing wheel (120 - 220 grit) or by machining the entire packing chamber surface. The surface finish should be 16 RMS or better.

Stem: Scratches (damage) no deeper than 0.010" (0.25 mm) per side can be removed by machining the entire stem smooth portion up to the back seat. Surface finish should be 16 RMS or better.

2. Insert the first packing ring (braided graphite type, end ring) manually and place as deep into the packing chamber as possible followed by 1 graphite ribbon (intermediate packing ring). Refer to *Fig. 5.1G*.
3. Insert the split packing adapter (*Fig. 5.1H*). Push the packing rings to the bottom of the chamber, making sure that the lap joint is not reversed during the operation.

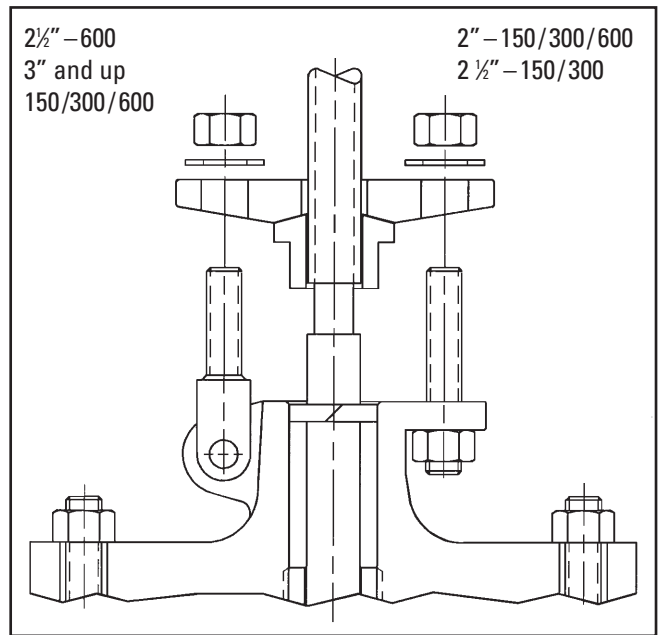


Figure 5.1G Insertion of first packing ring

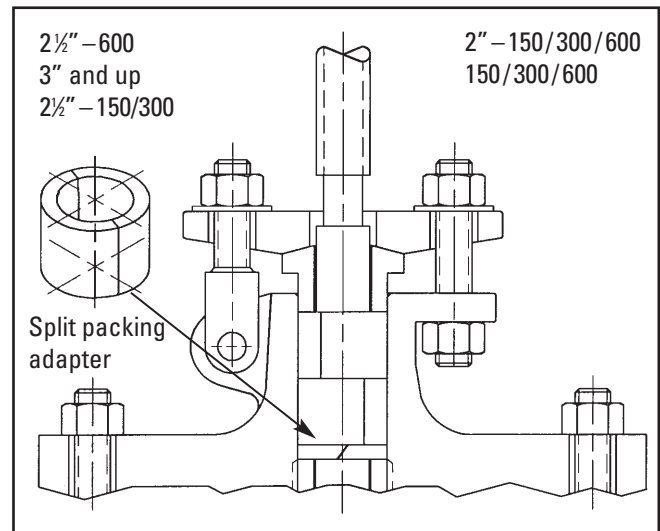


Figure 5.1H Split packing adapter

V INFORMATION PERTINENT TO GATE, GLOBE, CHECK & PARALLEL SLIDE VALVES

4. Place the gland bushing and packing flange into position and compress the bottom packing by tightening the nuts to 130% of the torque value shown in *Table 5.1A & B*.

NOTE: Ensure gland bolts/nuts are well lubricated with anti-seize compound.
5. Remove the nuts and split packing adapters (*Fig. 5.1H*), insert the next graphite ribbon packing and repeat the procedure above until all intermediate graphite ribbon packings have been torqued.

NOTE:

- a) The split lap joints of each consecutive ring should be staggered at approximately 120° so that the fourth ring installed has its lap back at the starting point (*Fig. 5.1*). Subsequent packing rings should be repacked in the same manner until the special packing adapters are no longer required and the standard gland bushing can be used.
 - b) In case valves are equipped with live-loading (Belleville spring washers) remove spring washers during precompression of packing rings, and reinstall at final torque.
6. Remove the nuts and split packing adapter and insert the last end ring (braided graphite type) lower gland bushing and check for bushing positive engagement with packing chamber.

NOTE: As a rule of thumb ¼" (6 mm) min. engagement of the gland bushing inside the packing chamber is required (*Fig. 5.1I*). Lower the gland flange, relubricate the gland studs/nuts using anti-seize compound and torque to values shown in *Table 5.1A or B* and/or project drawing. Cycle the valve once, for approximately the length of the packing chamber, first cycle, open then close and retighten to the appropriate torque value.

7. Repacking valves using "packing consolidation method". When split packing adapters is not available use the following procedure:
 - a) Insert one braided packing ring, followed by intermediate graphite packings and one last braided packing ring refer to *Fig. 5.1C*. Lower the gland bushing and check for bushing positive engagement, see note in step 6.

- b) Torque down the gland bolts to torque values shown in *Table 5.1A & B*.
- c) Cycle the valve approximately the length of the packing chamber. First open then close and retighten the gland bolts to appropriate torque values. Repeat this step approximately four, five times until the packings become fully consolidated (no more loss of torque)

NOTE: For motor operated valves (mov) use mov manual override handwheel to cycle open & close.

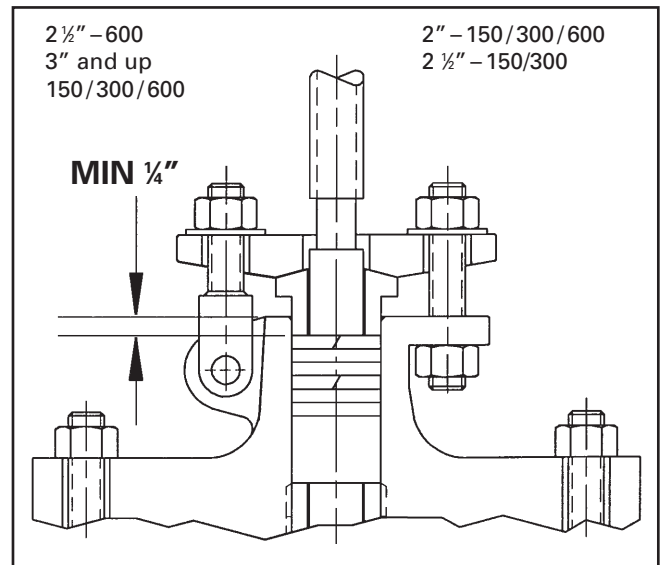


Figure 5.1I Six packings installed

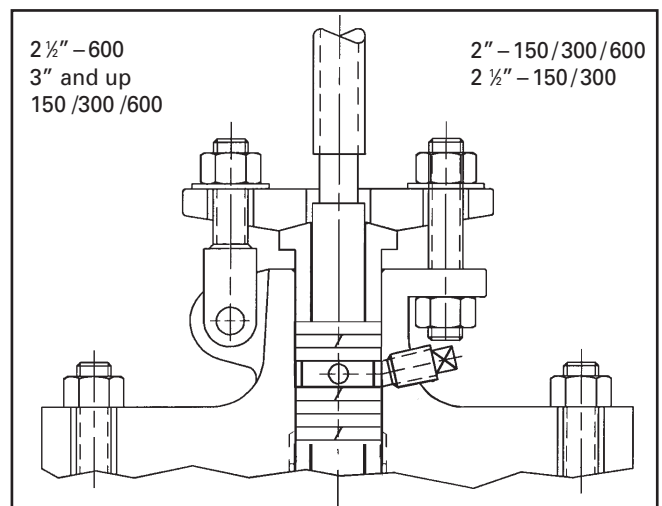


Figure 5.1J Leak off connection

5.1.4 Repacking with graphite rings for valves with leak off connection (Lantern Ring)

Refer to Fig. 5.1J

1. Follow the same procedure as described in steps one through five of the previous section, *Section 5.1.3, Repacking with Graphite Packing Rings for Valves Without Leak-off Connection*.
2. Insert (1) braided graphite packing ring. Lower the lantern ring ensuring that it lines up with the leak-off connection and repeat the procedure above.
3. Place (1) braided and (1) graphite ribbon packing ring above the lantern ring and precompress to 130% of torque value of *Table 5.1A & B*.
NOTE: In case valves are equipped with live-loading (Belleville spring washers) remove spring washers during precompression of packing rings, and reinstall at final torque.
4. Insert (1) last end ring braided graphite type lower gland bushing and check for positive engagement. As a rule of thumb 1/4" (6 mm) engagement inside the packing chamber is required. Carefully align the gland bushing and packing flange. Relubricate gland bolts/nuts and torque down to values shown in *Table 5.1A & B* and/or project drawing. Cycle the valve once, for approximately the length of the packing chamber, first cycle, open then close and retighten to the appropriate torque values.
5. "Packing consolidation method" use the same procedure as described in *Section 5.1.3, step 7* except install four packing rings below the lantern ring and three above, *refer to Fig. 5.1D*.

5.1.5 Packing Torques

Step 1:

Clean all studs and nuts. Visually inspect all threads to ensure removal of all foreign matter, rust, corrosion, burrs and previous lubricants.

Step 2:

Liberally cover the stud threads and female threads of the nuts and nuts flats with an anti-seize compound such as Felpro type CSA Hi-Temp or approved equivalent.

Step 3:

Tighten the packing flange nuts a little at a time on each side, then torque in accordance with valve type, size, pressure class and packing type as shown in *Table 5.1A* (for gate and parallel slide) and *Table 5.1B* (for globe).

NOTE: Values in *Table 5.1A* and *5.1B* are approximate for standard Velan valves. Whenever possible, refer to project engineering drawings for individual valves and their required torques.

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Table 5.1A Packing flange stud/nut torques in ft·lb (N·m) for Graphite and PTFE packings – Gate and Parallel Slide

Valve Size inches (mm)	Stud Dia. inches	API 600 Gate and Parallel Slide									
		150		300		600		900		1500	
		ft·lb	N·m	ft·lb	N·m	ft·lb	N·m	ft·lb	N·m	ft·lb	N·m
2 (50)	3/8	9	12	9	12	9	12				
	5/8							18	25	18	25
2 1/2 (65)	3/8	9	12	9	12						
	1/2					13	18				
3 (80)	1/2	13	18	13	18	15	20				
	5/8							28	39	28	39
4 (100)	5/8	18	25	18	25	20	27				
	3/4							36	49	36	49
6 (150)	5/8	26	36	26	36	41	56				
	3/4							55	75	55	75
8 (200)	5/8	28	39	31	42						
	3/4					52	70			77	105
10 (250)	5/8	31	42								
	3/4			47	64	58	79				
12 (300)	3/4	49	66	52	70	74	100				
14 (350)	3/4			55	75						
	1 1/8					139	189				
16 (400)	3/4	58	79	58	79						
	1 1/8					146	198				
18 (450)	7/8	67	92	85	116						
	1 1/8					152	206				
20 (500)	1	97	132	102	138						
	1 1/4					181	246				
24 (600)	1 1/4	139	189	152	206						
	1 1/4					224	303				
26 (650)	1	131	177	148	200						
28 (700)	7/8	86	117								
30 (750)	1	148	200	148	200						
	1 3/8					154	209				
32 (800)	1	148	200								
36 (900)	1 3/8	262	355	262	355						
	1 1/2					217	294				
42 (1050)	1 1/8	217	294								
48 (1200)	1 1/4	349	474								
60 (1500)											

Note:

- (1) The torque table is based on a packing compression (PC) of 3500 psi. For other PC simply multiply the above torque values by: PC new (psi)/3500
- (2) The torque values listed are for standard Velan valve designs. For other valve sizes and/or stud diameters contact the Velan Customer Service Manager.
- (3) Torque tolerances $\pm 10\%$
- (4) If the packings are installed individually and pre-compressed, use the torque values as in the table.
- (5) If the packings are installed as a set without individual pre-compression, use "packing consolidation method" see step 7, cycle the valve 5 times and ensure that after each cycle the gland bolts are torqued to the 100% value.

V

INFORMATION PERTINENT TO GATE, GLOBE, CHECK & PARALLEL SLIDE VALVES

Table 5.1B Packing Flange Stud/Nut torques in ft·lb (N·m) for Graphite and PTFE Packings–Globe

Valve Size inches (mm)	Stud Dia. inches	API 600 Globe									
		150		300		600		900		1500	
		ft·lb	N·m	ft·lb	N·m	ft·lb	N·m	ft·lb	N·m	ft·lb	N·m
2 (50)	3/8	9	12	9	12	9	12				
	5/8							18	25	18	25
2 1/2 (65)	3/8	9	12	9	12						
	1/2					13	18				
3 (80)	1/2	13	18	13	18	15	20				
4 (100)	5/8	18	25	18	25	26	36				
5 (125)	5/8	28	39								
6 (150)	5/8	28	39	28	39						
	3/4					49	66				
8 (200)	5/8	31	42								
	3/4			52	70						
	1					102	138				
10 (250)	3/4	49	66	52	70						
12 (300)	3/4	58	79	58	79						
14 (350)	3/4	58	79	58	79						
16 (400)	3/4	74	100	74	100						
18 (450)											

Note:

- (1) The torque table is based on a packing compression (PC) of 3500 psi. For other PC simply multiply the above torque values by: PC new (psi)/3500
- (2) The torque values listed are for standard Velan valve designs. For other valve sizes and/or stud diameters contact the Velan Customer Service Manager.
- (3) Torque tolerances ± 10%
- (4) If the packings are installed individually and pre-compressed, use the torque values as in the table.
- (5) If the packings are installed as a set without individual pre-compression, use “packing consolidation method” see step Z, cycle the valve 5 times and ensure that after each cycle the gland bolts are torqued to the 100% value.

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5.1.6 Live-Loading Packings

The basic part necessary for achieving the live-loading on packings consist of longer gland studs/eyebolts, Belleville washers , guide sleeve and guide ring (see Fig. 5.1K)

Installation of the packing rings follows the procedures described in Sections 5.1.3 & 5.1.4 ('without' and 'with' a leak-off connection, respectively). The Belleville washers are not to be used while compressing individual packing into the packing chamber. However, if packing consolidation method is used as described in Section 5.1.3 step 7, the belleville spring washers (live-loading) must be in place prior to compressing the packings.

IMPORTANT: 1/4" (6 mm) engagement of the gland bushing into the packing chamber is essential to ensure that the packing does not blowout. Velan's standard live-loaded packing configuration for bolted bonnet valves is illustrated in Fig. 5.1L.

Assembly Procedure:

1. On each gland stud/eyebolt, place guide ring on the packing flange, a guide sleeve, a stack of Belleville washers (either single or double stack depending on application), and a gland nut.

2. Tighten the gland nuts a little at a time on each side to the torque values indicated in Table 5.1A & B

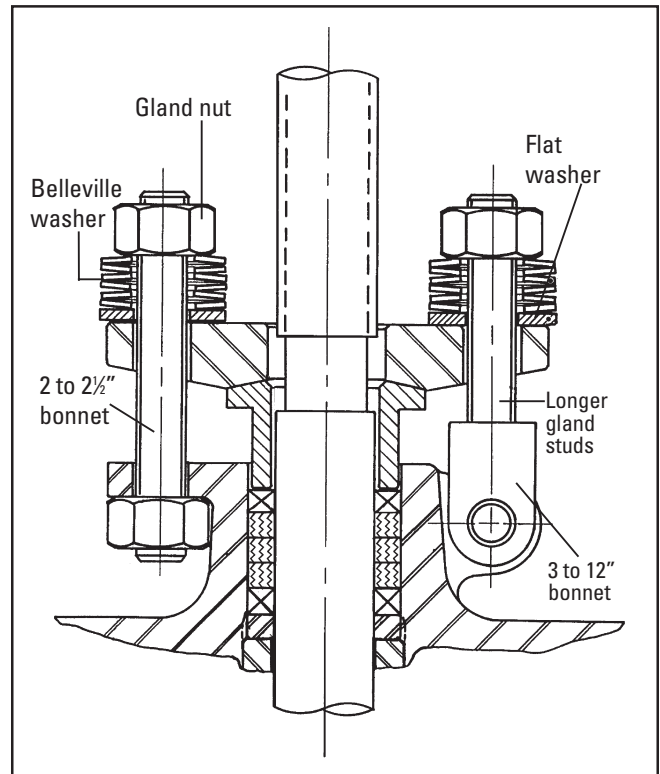


Figure 5.1K Live-loading

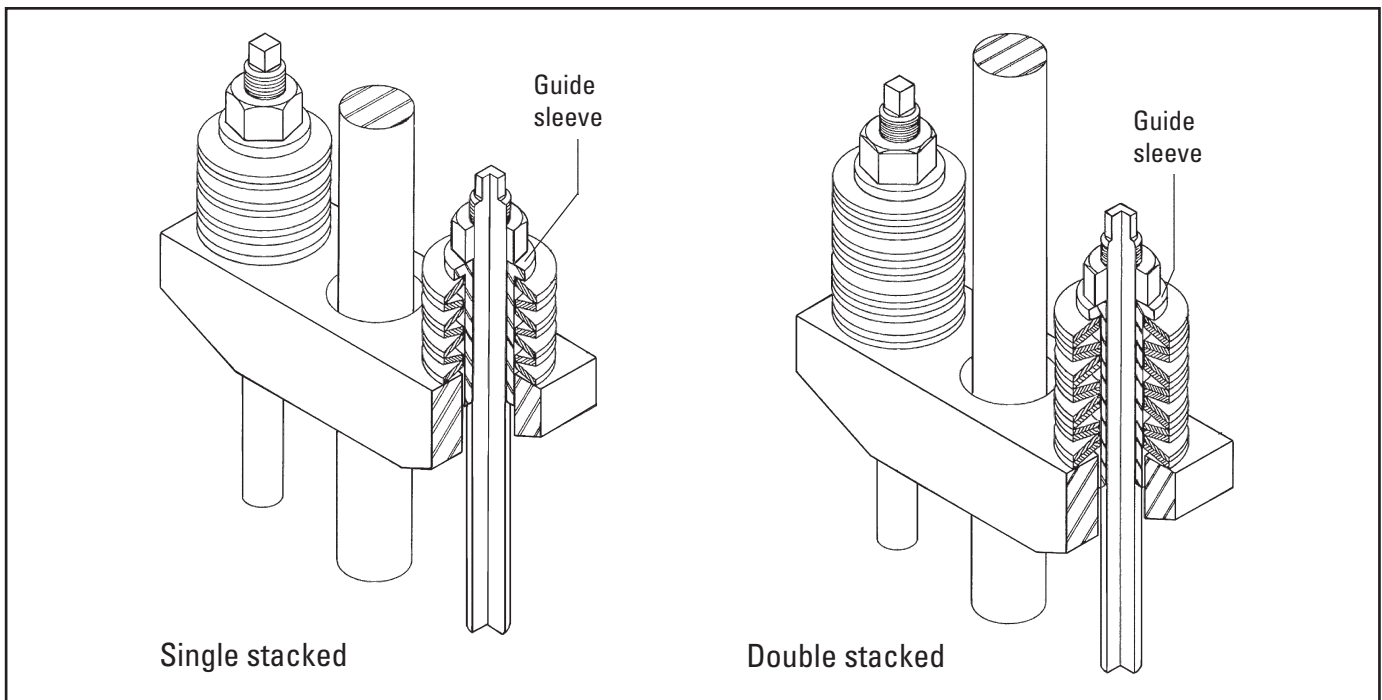


Figure 5.1L Live-loaded packing

5.2 DETAILED MAINTENANCE

5.2.1 Packing Chamber Leakage

If moisture or dripping occurs around the stem of the ID packing chamber, the following points must be investigated before removing the packing:

1. Check if the packing flange is torqued down to the correct torque as shown in *Table 5.1A & B*
2. Check if the live-load arrangement is in correct order. Compare your live-loading arrangement with *Fig. 5.1K*. If it is not correct, open the valve to the backseat position and tighten up on the back seat firmly.

CAUTION: You must determine the effectiveness of the backseat seal as you dismantle the live-loading arrangement. If leakage occurs during disassembly, line pressure must be shut off. Reassemble live-loading arrangement in correct order, then torque down to the correct torque as shown in *Table 5.1A & B*.

3. Check if the gland bushing is binding against the packing chamber wall or stem. If so, fully open the valve and tighten the stem against the backseat firmly. Loosen the packing flange and realign the gland bushing. Tighten up the packing flange a little at a time on each side, then torque down to the correct torque as shown in *Table 5.1A & B*.
4. After retightening, cycle the valve once for approximately the length of the packing chamber, first open then close and retighten nuts to original torque value (*Table 5.1A & B*). If steps 1 through 4 do not stop leakage, proceed with the removal and replacement of the packing rings.

5.2.2 Body/Bonnet (Gasket) Leakage

To maintain the tightness of a factory-tested bolted bonnet valve, it is essential to apply sufficient bolt tension at all times by having the proper torque on the nuts. The original torque might be lost due to vibration, relaxation of material caused by frequent temperature and pressure fluctuations, or by creep in high temperature applications. Gasket bolt tension

should be checked at approximately one-year intervals and if necessary, retighten bolts in accordance with *Section 2.9 Recheck For Bolt Tightness*.

NOTE: Standard gasket material is corrugated steel with graphite in the channels or spiral wound gasket. For alternate gasket materials contact our service department.

5.2.3 Seat Leakage

5.2.3.1 General

An indication of a valve leak is a pressure loss in the high pressure line side after a valve has been properly closed. In the case of hot water or steam lines, note whether the downstream pipe remains hot beyond the usual length of time. This type of leak may be the result of a distorted seat caused by improper welding of the valve into the pipeline or seating damaged caused by foreign particle matter or by stress relieving temperatures that may have been used during installation.

Leaks can also develop from failure to close the valve tightly, resulting in high-velocity flow through a small opening. The hardfacing material (e.g. Stellite 6) is corrosion and erosion-resistant, but grooves, pit marks or other surface irregularities may still form on the mating surfaces. Valves which leak should be repaired as quickly as possible to prevent greater damage caused by high velocity.

5.2.3.2 Wedge and Disc Repairs - Gate and Parallel Slide Valves

1. Disassemble valve as described in *Section 6.4* for gate valves and *Section 8.3* for parallel slide valves, and inspect the wedge or disc for scratches or damage.
2. If seating faces are scratched, the wedge or disc must be lapped. Slight pitting, grooving or indentations no deeper than 0.005" (0.1 mm) can be removed by lapping. If defects cannot be corrected by lapping, wedge or disc should be ground or machined.

For **Wedge Gate** Velan recommends that a maximum of 0.015" (0.4 mm) on each side be removed from a 10-degree seated wedge and 0.010" (0.25 mm) on each side for a 7-degree seated wedge.

For **Parallel Slide Disc Gate** Velan recommends maximum removal of 0.040" (1 mm) per disc.

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NOTE: If more than 0.035" (0.89 mm) total must be removed from both discs and seats of a parallel slide valve, then the retainer plate (45) and or disc groove must also be ground, milled or machined to compensate for gap allowance.

3. For the lapping, a flat plate, preferably cast iron, should be used and an abrasive lapping compound mixed with olive oil should be evenly distributed over the plate as shown in *Fig. 5.2A*. Only light, even pressure should be applied to the plate, lifting the wedge or disc as often as possible to prevent accumulation of particles in one area and to allow for proper distribution of the lapping compound. The lapping plate should be turned slightly every few strokes to maintain a flat surface. The part should be lapped until seating faces are smooth. Velan recommends the use of Clover Compound (silicone carbide) grade "E" medium course and grade "C" fine grit compound for finishing or an approved equivalent.

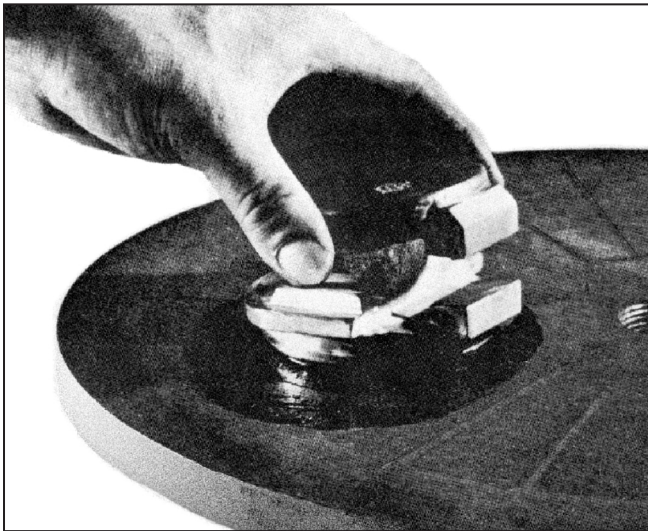


Figure 5.2A *Lapping of wedge*

4. Thoroughly clean off the lapping compound with a suitable cleaning fluid such as acetone or alcohol. Do not use solvents containing chloride or fluoride

NOTE: If lapping cannot be performed the wedge or disc seating surface should be ground using an automatic grinding machine *Fig 5.2B*. For major damage use 60-80 grit, diamond or Micron Alumina stick on abrasive discs and finish with fine grit 180 and up. For minor imperfections use stick on abrasive

medium course 120 grit and finish with 180-220 fine grit.

5.2.3.3 Seat Repairs

5.2.3.3.1 Gate & Parallel Slide Valves

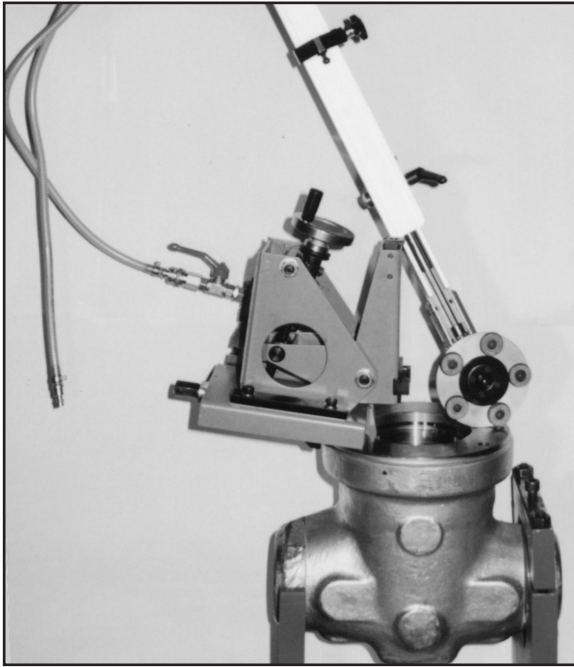
1. If seating faces are damaged, the body seat must be corrected by lapping. Slight pitting, scratches or indentations no deeper than 0.005" (0.1 mm) can be removed by lapping. If defects cannot be corrected by lapping, the seats should be ground using specialized automatic grinding/lapping equipment. Velan recommends a maximum of 0.015" (0.4 mm) per side that can be removed from a 10° seated valve, and 0.010" (0.25 mm) per side on a 7° seated valve.

For parallel slide valves, a maximum of 0.040: (1 mm) per seat can be removed, see "**NOTE**" in *Section 5.2.3.2 step 2*. Grinding the seat using automatic grinding equipment can save considerable time, *refer to Fig. 5.2C*. For major damage use 60-80 grit, diamond or Micron Alumina stick on abrasive discs. For minor damage use 120-180 grit and for finishing, fine grit 220 and up can be used. For details contact our Customer Service Dept.

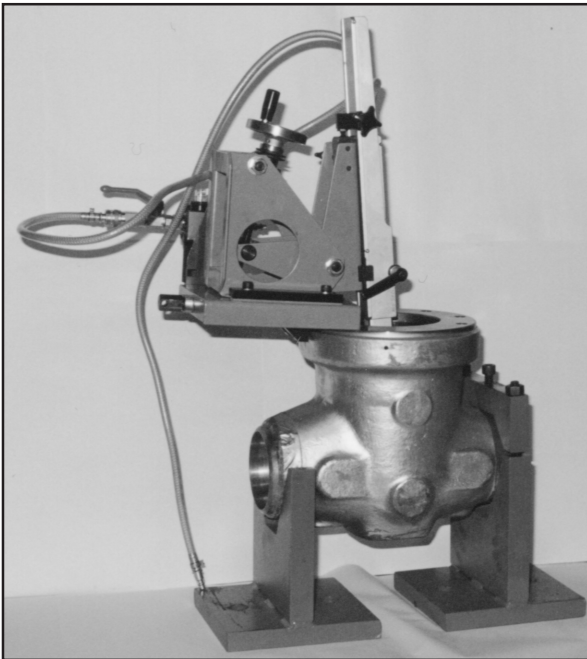
2. In those cases where the automatic grinding and lapping machine is not employed, seat faces must be repaired using a lapping plate. The plate should be made of cast iron if possible and should be large enough to cover the face of the seat (*Fig. 5.2D*). Apply lapping compound mixed with olive oil and distribute



Figure 5.2B *Wedge or disc automatic grinding machine*



View A



View B

Figure 5.2C Automatic grinding lapping machine for gate valve seats and wedges

evenly over the plate. Lap seat by moving lapping plate in a circular motion on seat face. Lift the plate as often as possible to prevent accumulation of particles in one area and to allow for proper distribution of the lapping compound. Lap until both seats have smooth faces and then clean off the lapping compound very thoroughly with a suitable cleaning fluid such as acetone or alcohol.

NOTE: Velan recommend the use of clover compound (silicon carbide) grade "E" medium course for minor imperfections and grade "C" fine grit compound for finishing.

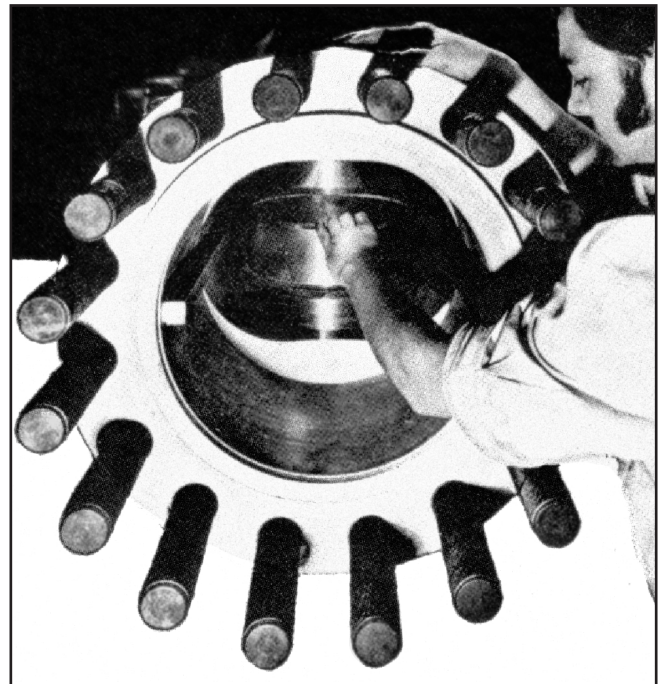


Figure 5.2D Lapping plate

5.2.3.3.2 Globe, Needle, Stop and Piston Check Valves

1. Disassemble the valve as described in Section 7.5.1 for globe valves, stop check valves and piston check valves. Inspect the disc and the seat for scratches, pitting marks or other damage.
2. If there are indentations or pitting marks no deeper than 0.005" (0.1 mm), a cast iron lapping disc (Fig. 5.2E) with the proper seat angle must be used with a suitable lapping compound to roughen the surface first with the use of a new or refurbished original disc

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(Fig 5.2F), use a fine lapping compound to final lap the disc and seat together.

NOTE: For body seat damage exceeding 0.005" (0.12 mm) up to a maximum; for globe B.S. model, needle valve, stop check and piston check having a seat angle of 30°, 0.040" (1 mm) can be removed by grinding with the automatic grinding machines Fig. 5.2G. For major seat damage use 60-80 grit, diamond or micron Alumina stick on abrasive discs, and finish with fine grit 180 and up. For minor imperfections use medium course 120 grit stick on abrasive discs and finish with fine grit, 180 and up.

For the valve disc seating surface damage exceeding 0.005" (0.12 mm), up to maximum of 0.040" (1 mm) can be removed. For globe, B.S. model, needle disc, stop check and piston check with disc angle of 27°. Chuck and center the disc in a lathe machine, remove only as needed up to the maximum indicated above. The repaired disc should be mated fine lapped with the body seat as shown in Fig. 5.2F.

IMPORTANT: A guiding plate for the stem is required to maintain alignment during the lapping operation. Refer to Fig 5.2F. It should be made of wood or any other suitable material to the same gasket dimensions as the bonnet.

The section of the plate where the stem extends through should be made $\frac{1}{64}$ " (0.4 mm) larger than the stem diameter.

3. Place a small quantity of lapping compound mixed with olive oil and evenly distribute on the two mating surfaces.
4. It is important to apply slight pressure when lapping seats and to rotate reciprocally. For best results, use an air or electric hand tool with adjustable speed and reciprocal movement. The lap should be lifted frequently and turned to a new starting position so that the lapping will be rotated over a new area.
5. In order to ensure that the pressure is applied evenly, it is necessary, on some valves, to suspend the disc and stem assembly from a coil spring as shown in Fig. 5.2E.

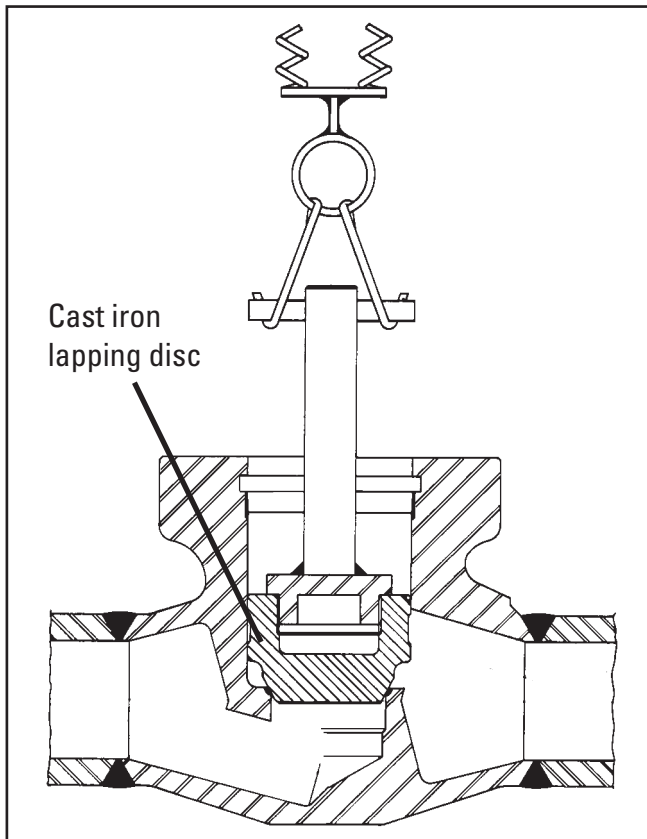


Figure 5.2E Cast iron lapping disc

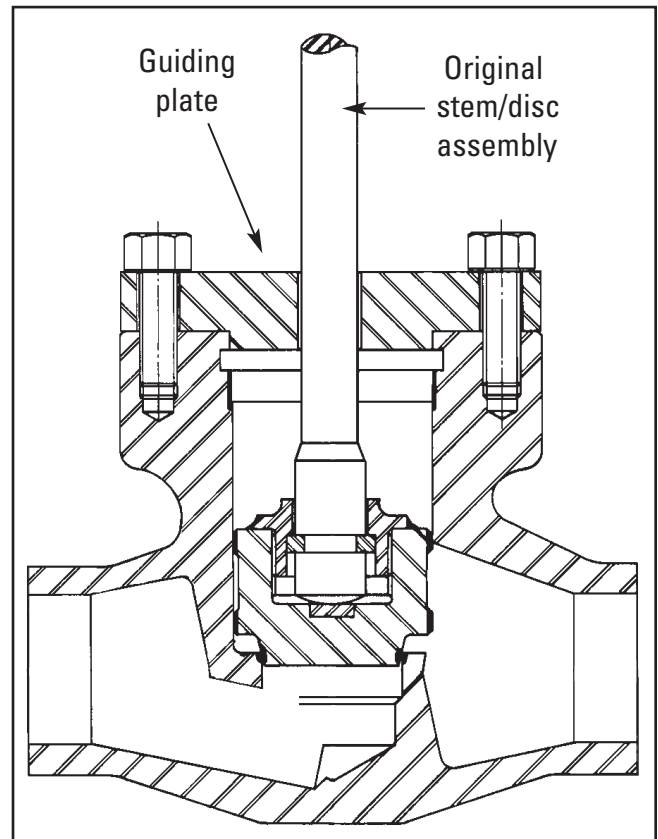


Figure 5.2F Original stem/disc assembly

6. Automatic grinding and lapping of seat faces can be done by specialized equipment *Fig. 5.2G* which is readily available at certain Velan authorized repair facilities. For further details on such operations, contact our Customer Service Manager.

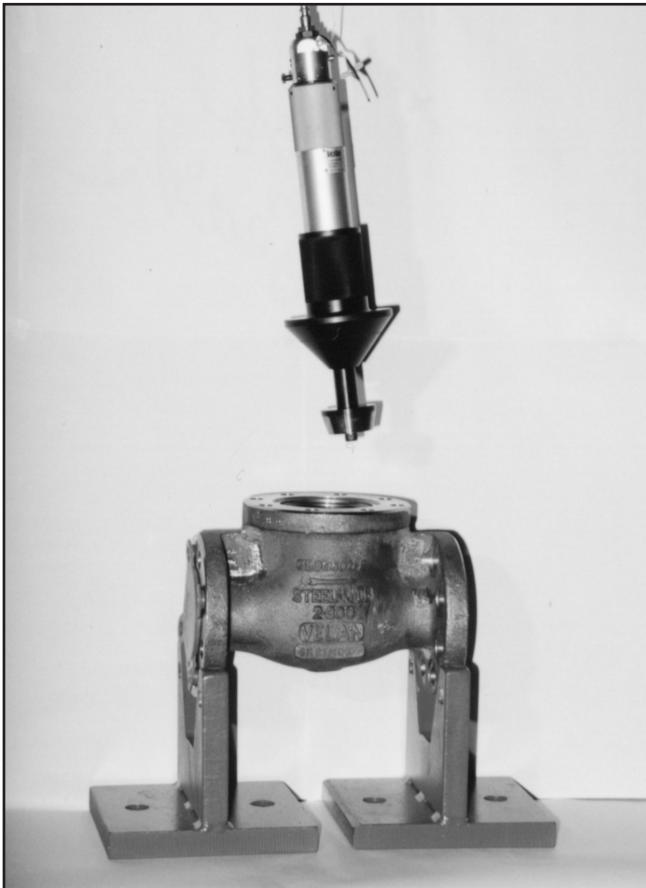


Figure 5.2G Automatic reseater machine for grinding / lapping globe seats



Figure 5.2H Blueing test

5.2.3.4 Fitting of Repaired Parts

5.2.3.4.1 Gate Valves

1. After the seating faces of the wedge, or seats have been relapped and cleaned, a blue ink test is recommended before reassembly. A blueing ink should be distributed smoothly and equally over the full circumferential surface of both sides of the wedge or discs (*Fig. 5.2H*). Place the side of the wedge or disc possessing the body serial number together with the side of the seat also possessing the body serial number (these sides should have been marked-up during valve disassembly in accordance with *Section 4.4, General Assembly Information*). Preassemble the bonnet and stem nut. Engage the stem threads with stem nut. Slide the wedge T-slot into the stem T-head. Using a chain hoist slowly lower the entire yoke bonnet and wedge assembly into the body. Secure the bonnet to body. Close the valve manually using the handwheel and tighten firmly. Release the tension by backing off handwheel a few turns. Lift out of the valve body and check for positive contact.

NOTE: If above procedure cannot be followed use alternate method as follows: slide stem T-head into the wedge T-slot. Slowly lower the stem & wedge into the body. Tap a few times on top of the stem using a plastic, brass or lead hammer. Lift out the stem & wedge and check for positive contact.
2. If a part cannot be repaired, new parts must be fitted and installed. All spare part wedges are supplied slightly oversized. In order to fit, they must be ground or machined followed by a blueing test to confirm 100% seating contact, and then finally lapped. Refer to *Fig. 5.2I*.

NOTE: If the outside diameter of hardface and top and bottom face-to-face dimensions of the old wedge are given to Velan, it is possible that there will be very little or no fitting required at the site when replacing the part.
3. In some cases the seat angle may be lost when the seat is ground in the body. Therefore the wedge must be shimmed while the seat is being ground or machined. Shim only as much as required to obtain a full fit over the full circumference of the seating faces. Determine new wedge dimensions per *Fig. 5.2I*. *Figure 5.2J* illustrates a wedge with a full seating circumference, which is essential whenever fitting a wedge.

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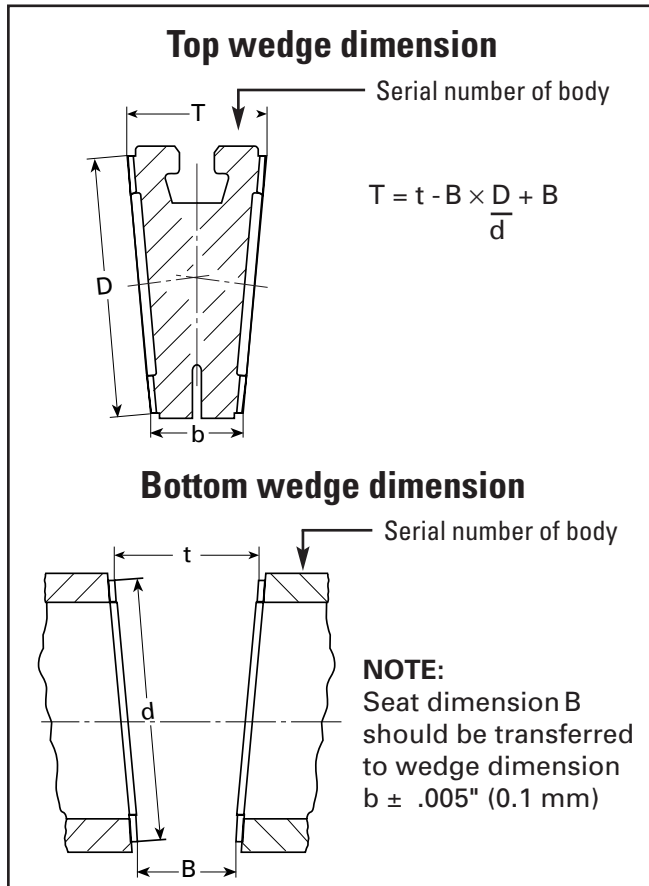


Figure 5.2I Wedge dimensions

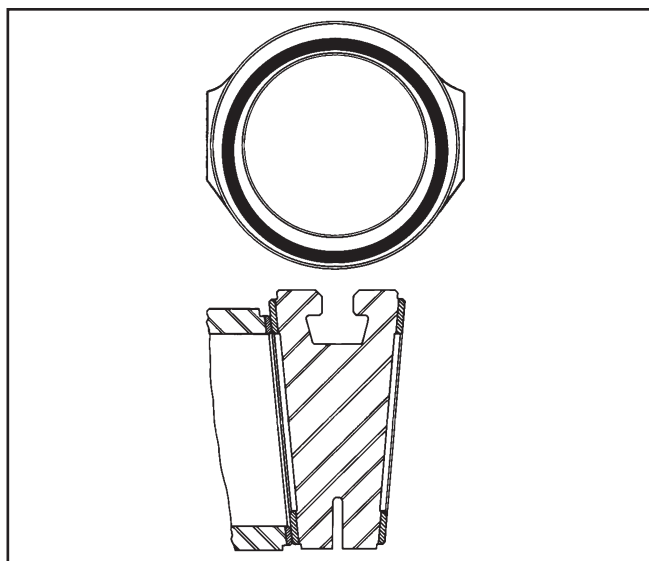


Figure 5.2J Full seating circumference

- When fitting a wedge, it is also important that the clearance between the wedge and the wedge guide slots be checked with a feeler gauge at four locations, as shown in Fig. 5.2K. Ideally, the clearance on both sides should be the same, however, a minimum clearance of 0.005" (0.12 mm) at any position along the length of the guide must be maintained.

5.2.3.4.2 Parallel Slide Valves

- After the seating faces of the disc and seat have been relapped and cleaned with a suitable cleaning fluid such as acetone or alcohol, it is essential that the results be verified using a blue ink test, check for full circumferential contact. A light coating of blue ink should be distributed smoothly and equally over the seating diameter of the disc. To maintain the disc concentric with the seat, place shim stock at the bottom of the valve body and lower the disc. Using a wood disc, a stud and nut and tension against the opposite seat, refer to Fig. 5.2L.
- NOTE:** Ensure that the same match marked disc and seat are being checked.
- Release bolt tension and remove stud and nut, lift out the disc and check for positive contact

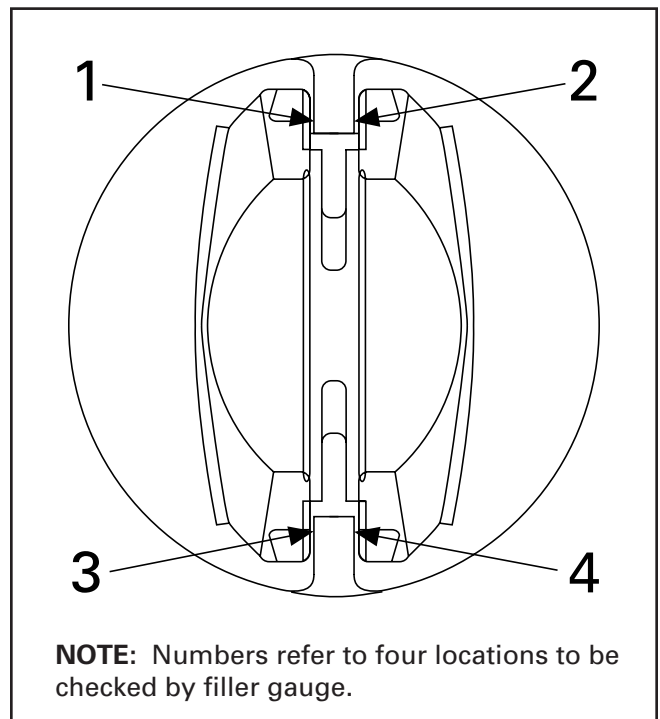


Figure 5.2K Clearance verification

(full seating circumference) *Fig. 5.2M* illustrates a disc with a full seating circumference, which is essential whenever fitting a disc.

NOTE: Damages to the seat and disc exceeding 0.060" (1.5 mm) may require new part to be replaced.

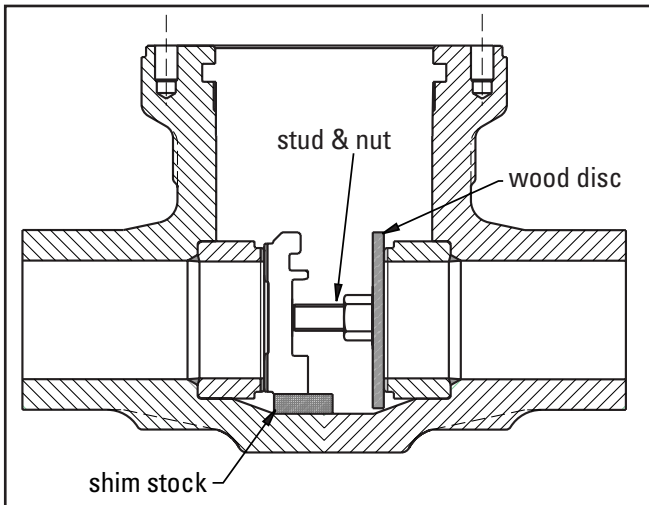


Figure 5.2L Parallel slide
Preparation for blue ink test

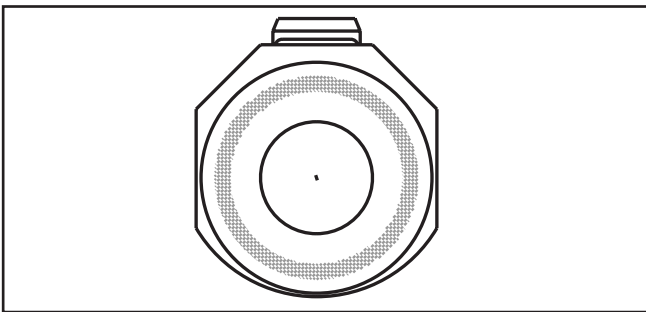


Figure 5.2M Parallel slide
full seating circumference

5.2.3.4.3 Globe, Stop Check and Piston Check Valves

NOTE: Velan globe valves have, in the past, been designed with a flat style disc. In a continuous effort to improve valve design, Velan has more recently adopted a tapered disc as its standard.

1. After the seating faces of the disc and seat have been relapped and cleaned with a suitable cleaning fluid such as acetone or alcohol, it is essential that the results be verified by a blue ink check. For full circumferential contact, a blue ink should be distributed smoothly and equally over the seating diameter of the disc. Slowly lower the part into the body and

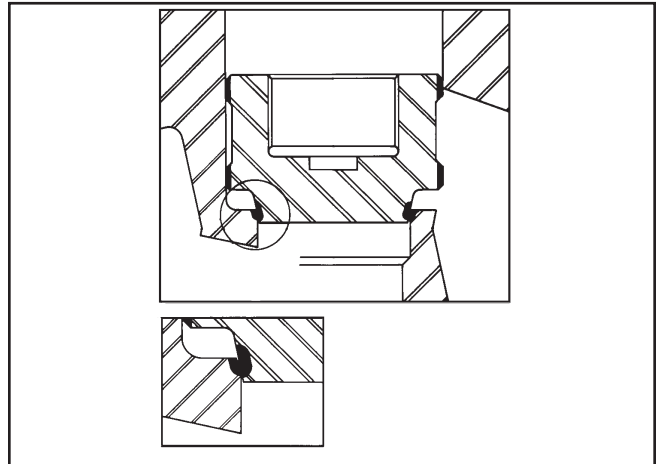


Figure 5.2N Tapered disc – full seating circumference

find the correct mating point of the faces. *Fig. 5.2N* illustrates a disc with a full seating circumference, which is essential whenever fitting a disc.

2. When fitting the disc, it is also important that the body inside diameter be checked for sufficient clearance to allow the disc to move freely up and down. We recommend a visual examination of the body wall. Any grooves or scratches should be polished with a fine emery cloth, or buffing wheel 120-180 grit.
3. Verification of contact between the valve disc and the stem is made by a radius on the end of the valve stem and is designed to give center loading for the disc as closely as possible. A hard thrust pad (*Fig. 5.2O* and *5.2P*), which can be found in some designs, will help prevent galling. On valves without a thrust pad, the bearing surface in the disc

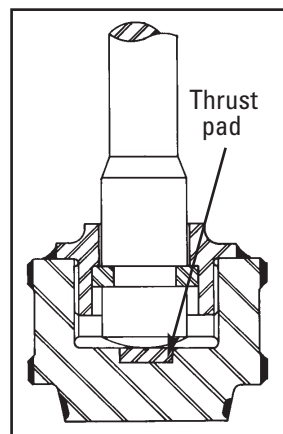


Figure 5.2O
Tapered disc – thrust pad

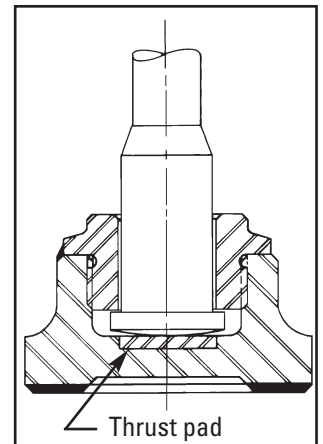


Figure 5.2P
Flat style disc

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has a hardface deposit on it (Fig. 5.2Q).

If particles get caught between the end of the valve stem and the disc, the center of the stem could be destroyed and the disc will not seat tightly. The contact surfaces of the stem and the disc must be checked first in leaky valves in order to ensure that the disc-stem contact is in proper condition.

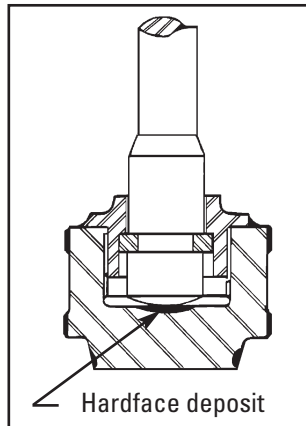


Figure 5.2Q
Tapered disc–
hardface deposit

the pressure differential against which the valve has to be closed or opened.

As a guideline, *Diagram 5.2A* can be used to estimate the torque required to open or close a valve against a given differential pressure. The torque calculated is that torque which has to be applied directly to the valve stem and does not take into account any mechanical advantage such as that achieved with a gear actuator, etc.

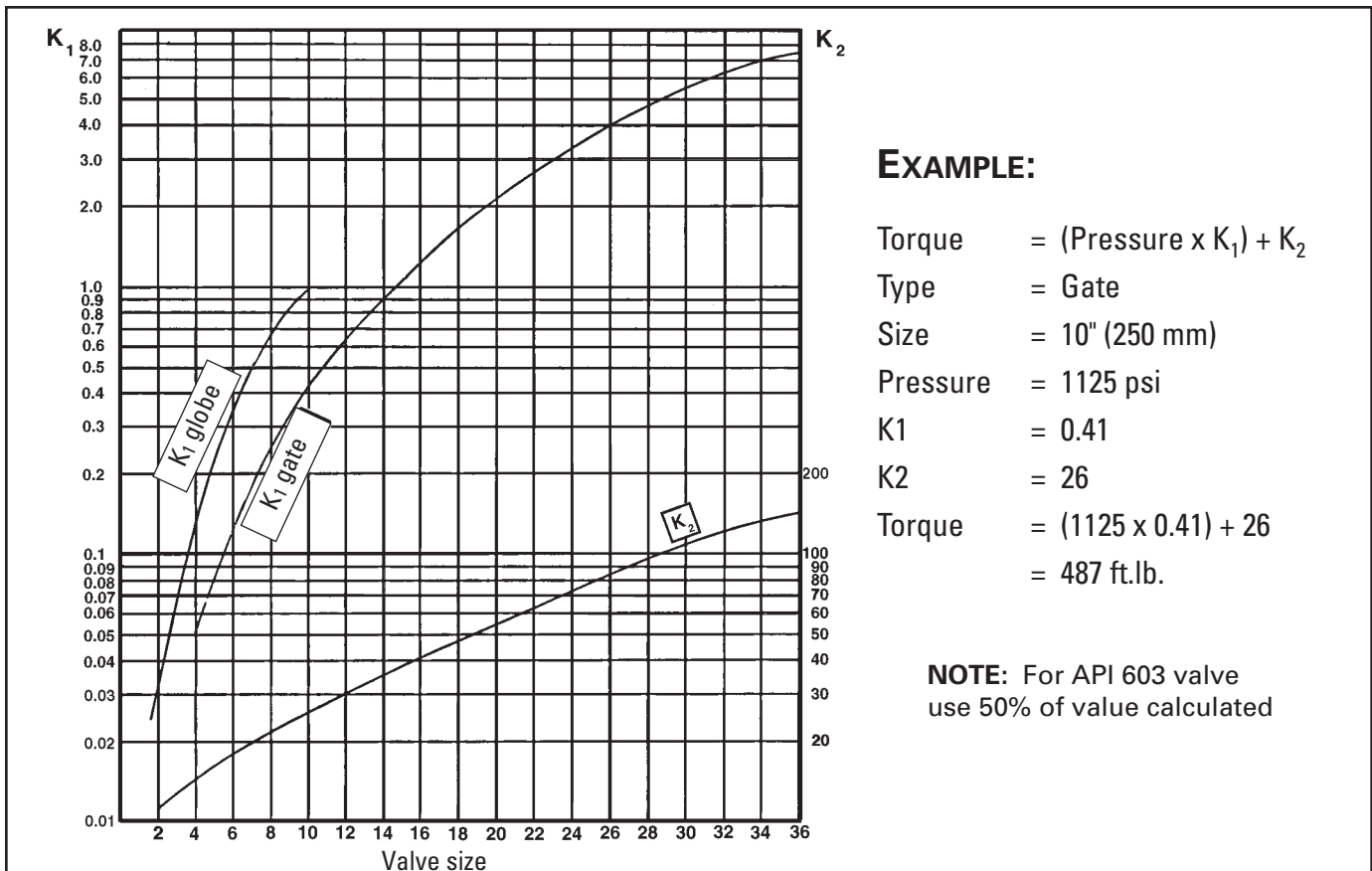
NOTE: *Diagram 5.2A* serves only as a general guide line to determine approximate closing and opening torques required. It is not to be used in e.g. motor actuator, bevel gear or pneumatic actuator sizing.

5.2.4 Seat Tightness—Closing Torques

Even with a brand new valve, seat tightness will only be achieved when sufficient load has been applied to the wedge or disc. This load varies with

CAUTION: The use of wheel wrenches, cheater bars, etc., is quite common. However, it must be emphasized that these devices should be used with discretion, and then only to achieve approximately the torque as calculated from *Diagram 5.2A*.

Diagram 5.2A Closing torques



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5.3 TORQUE VALUES – ACTUATOR, YOKE/BONNET BOLTING

The torque values shown in *Table 5.3A* are for all bolting other than bonnet retaining bolting or packing flange studs.

Table 5.3A Torque Values

THREAD SIZE	BOLTING MATERIAL			
	B7, A-574, 630		B8, B8M	
	ft·lb.	N·m	ft·lb.	N·m
3/8 – 16 UNC	30	41	10	14
7/16 – 14 UNC	45	61	15	20
1/2 – 13 UNC	75	102	25	34
5/8 – 12 UNC	105	142	35	48
5/8 – 11 UNC	145	197	50	68
3/4 – 10 UNC	255	346	85	115
7/8 – 9 UNC	405	549	135	183
1 – 8 UNC	615	834	205	278
1 1/8 – 8 UN	900	1221	300	407
1 1/4 – 8 UN	1270	1723	425	576
1 3/8 – 8 UN	1725	2340	575	780
1 1/2 – 8 UN	2280	3092	760	1031
1 5/8 – 8 UN	2935	3981	980	1329
1 3/4 – 8 UN	3715	5039	1240	1682
1 7/8 – 8 UN	4615	6259	1540	2089
2 – 8 UN	5650	7663	1880	2550

Note:

- (1) Torque tolerance $\pm 10\%$
- (2) For temperatures above 750°F (400°C) use 75% of the values.
- (3) Maximum temperature for 630 is 650°F (345°C)
- (4) Above Torque values are with the bolts lubricated.

6.1 TYPES OF GATE VALVES

PARTS DESCRIPTION

- | | |
|-----------------------------|---------------------|
| 1 - Body | 19 - Gasket |
| 2 - Bonnet | 26 - Key |
| 4 - Stem | 27 - Yoke bushing |
| 5 - Wedge | 29A - Bearing |
| 9 - Seat | 29B - Thrust race |
| 11 - Packing flange | 30 - Handwheel nut |
| 12 - Gland bushing | 33 - Handwheel |
| 13A - Braided packing ring | 34 - Grease fitting |
| 13B - Graphite packing ring | 39 - Groove pin |
| 15A - Gland stud | 55 - Bushing |
| 15B - Body/Bonnet stud | 57 - Washer |
| 16A - Gland nut | 61 - Spring pin |
| 16B - Body/Bonnet nut | 66A - Nameplate |
| 18 - Back seat | 67 - Rivet |
| | 88 - Stem nut |

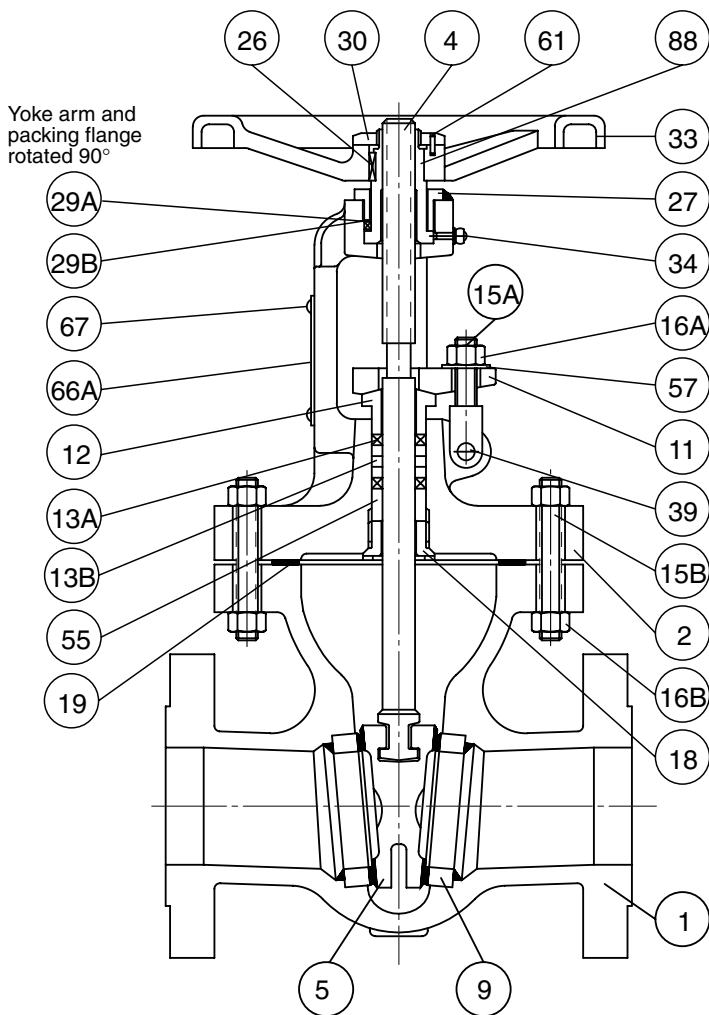


Figure 6.1A Gate valve API 600 cast bolted bonnet 2–12" (50–300 mm). Classes 300 and 600.

PARTS DESCRIPTION

- | | |
|-------------------------------|------------------------|
| 1 - Body | 16B - Body/bonnet nuts |
| 2 - Bonnet | 18 - Backseat |
| 3 - Yoke | 19 - Gasket |
| 4 - Stem | 26 - Key |
| 5 - Wedge | 27 - Yoke bushing |
| 9 - Seat | 29 - Bearings |
| 11 - Packing flange | 30 - Nuts |
| 12 - Gland bushing | 33 - Handwheel |
| 13A - Packing ring (braided) | 38 - Gland eyebolt |
| 13B - Packing ring (graphite) | 39 - Eyebolt pin |
| 15 - Stud | 63 - Spacer ring |
| 16A - Gland nuts | 88 - Yoke nut |

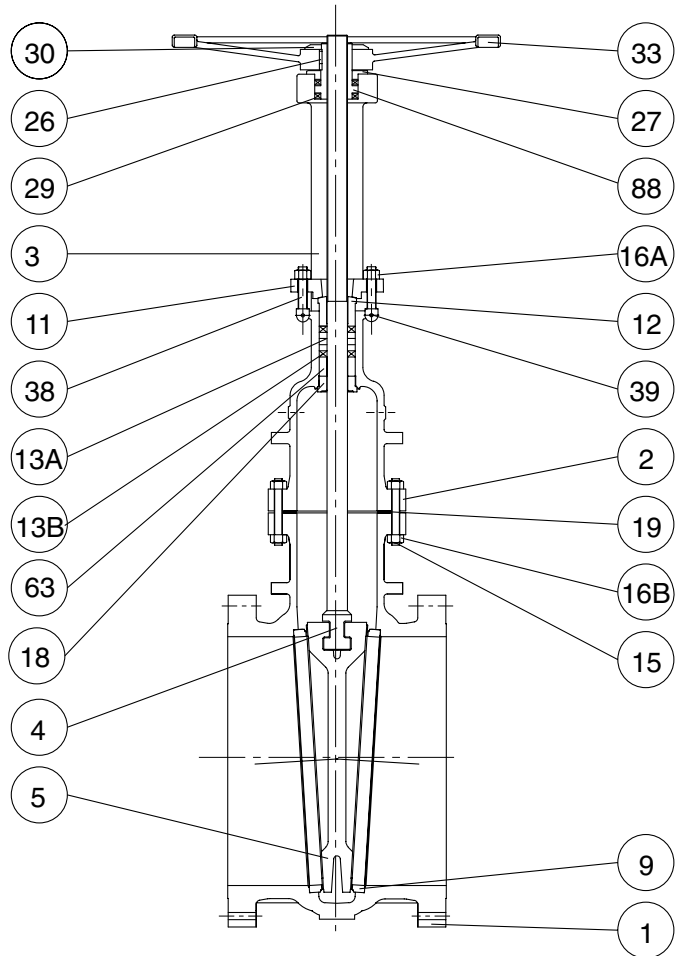


Figure 6.1B Gate valve API 600 cast bolted bonnet 14–24" (350–600 mm). Class 150.

VI GATE VALVES

6.1 TYPES OF GATE VALVES (CONT'D)

NOTE: API 600 cast bolted bonnet gate valves, 30" and up (750 mm and up) are also equipped with gear operators.

PARTS DESCRIPTION

- | | |
|-----------------------------|--------------------------|
| 1 - Body | 15B - Body/Bonnet stud |
| 2 - Bonnet | 15C - Yoke/actuator stud |
| 3 - Yoke | 16A - Gland nut |
| 4 - Stem | 16B - Body/Bonnet nut |
| 5 - Wedge | 16C - Yoke/actuator nut |
| 9 - Seat | 17 - HSH capscrew |
| 11 - Packing flange | 18 - Backseat |
| 12 - Gland bushing | 19 - Gasket |
| 13A - Braided packing ring | 32 - Gear operator |
| 13B - Graphite packing ring | 66 - Nameplate |
| 15A - Gland stud | |

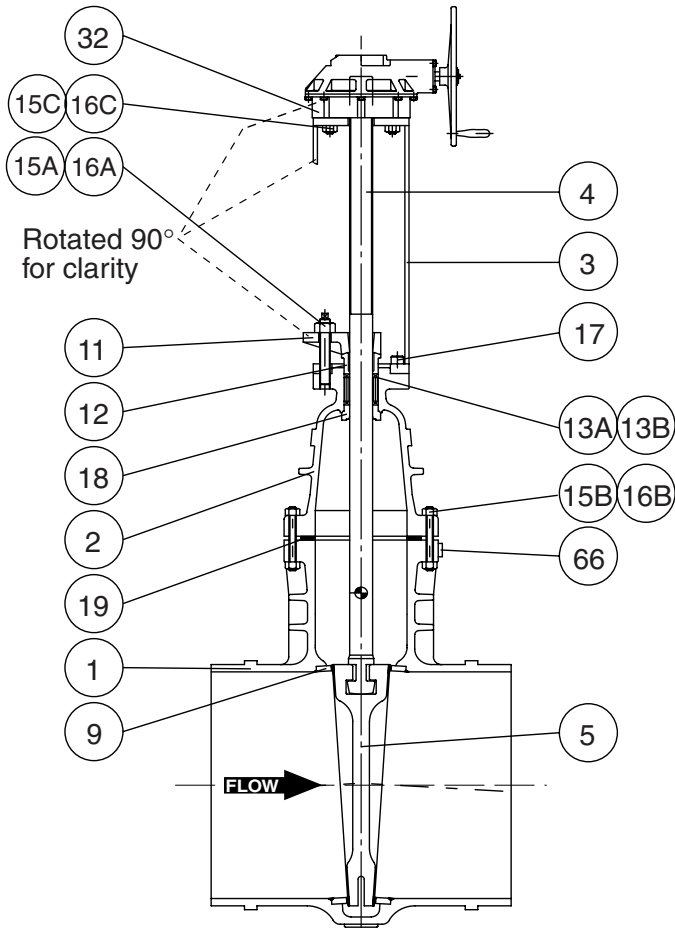


Figure 6.1C Gate valve API 600 cast bolted bonnet 26–28" (650–700 mm). Class 150.

PARTS DESCRIPTION

- | | |
|---------------------|------------------------|
| 1 - Body | 15B - Body/bonnet stud |
| 2 - Bonnet | 16A - Gland nut |
| 4 - Stem | 16B - Body/bonnet nut |
| 5 - Wedge | 19 - Gasket |
| 11 - Packing flange | 27 - Yoke bushing |
| 12 - Gland bushing | 33 - Handwheel |
| 13A - Packing rings | 34 - Grease fitting |
| 13B - Packing rings | 39 - Eye groove pin |
| 15A - Gland stud | 61 - Spring pin |
| | 66A - Nameplate |

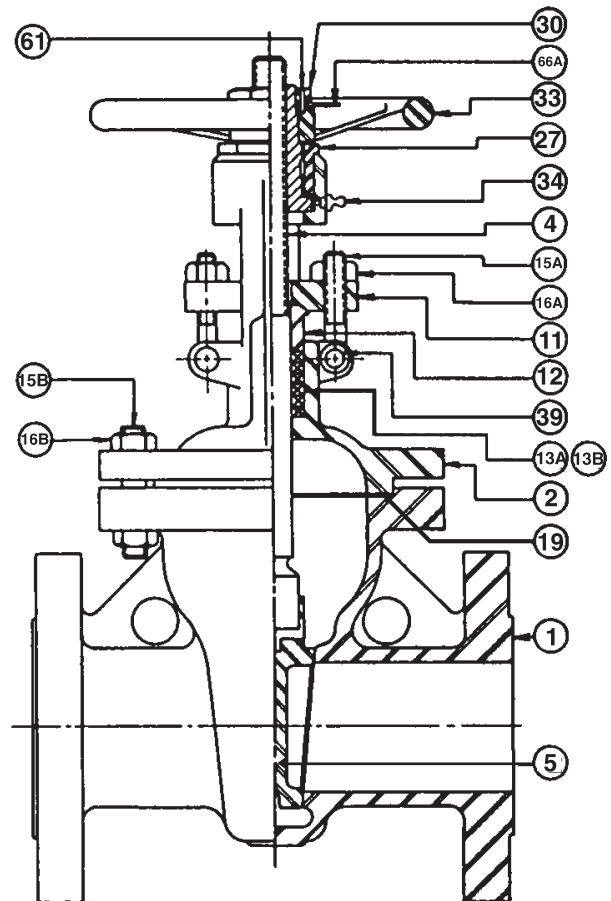
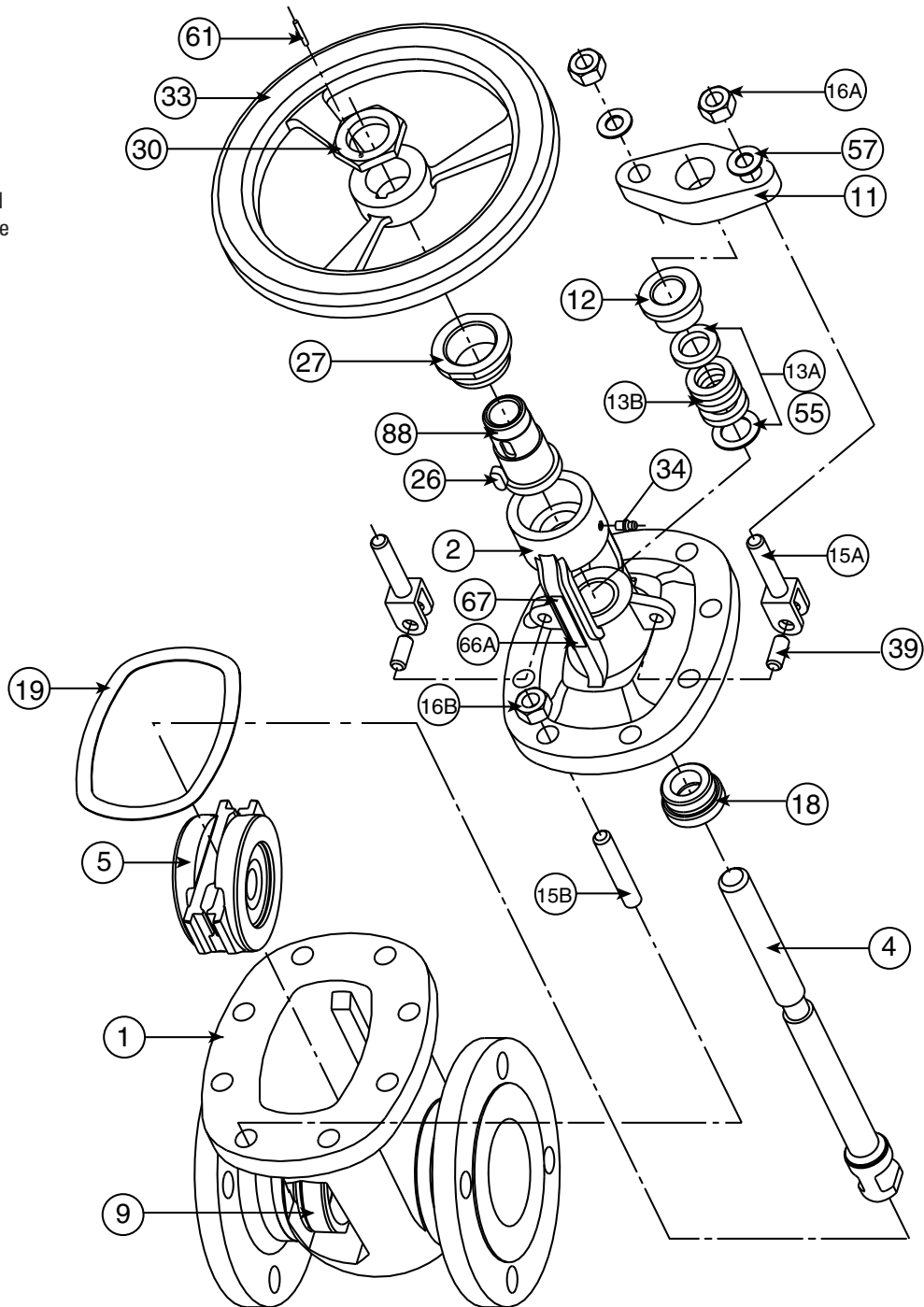


Figure 6.1D Gate valve API 603 stainless steel bolted bonnet, Classes 300, 600 and 900. ½–20" (15–500 mm) Class 150, ½–12" (15–300mm) Class 300, integral seats, N/A in Classes 600/900.

6.2 GATE VALVE: EXPLODED VIEW

PARTS DESCRIPTION

- 1 - Body
- 2 - Bonnet
- 4 - Stem
- 5 - Wedge
- 9 - Seat
- 11 - Packing flange
- 12 - Gland bushing
- 13A - Packing ring braided
- 13B - Packing ring graphite
- 15A - Gland stud
- 15B - Body/Bonnet stud
- 16A - Gland nut
- 16B - Body/Bonnet nut
- 18 - Backseat
- 19 - Gasket
- 26 - Key
- 27 - Yoke bushing
- 30 - Handwheel nut
- 33 - Handwheel
- 34 - Grease fitting
- 39 - Groove pin
- 55 - Bushing
- 57 - Washer
- 61 - Spring pin
- 66A - Nameplate
- 67 - Rivet
- 88 - Stem nut



VI GATE VALVES

6.3 PARTIAL DISASSEMBLY – GASKET REPLACEMENT

Follow warning instructions in *Section III* before beginning disassembly. If valve is equipped with gear or motor actuator, see *Appendix* for disassembly of actuators.

NOTE: Numbers between brackets refer to item numbers in exploded view.

1. Valve should be in partially open position.
2. If the valve is equipped with a leakoff pipe, disconnect it first. Leakoff pipes should be cut approximately six inches from the bonnet.
3. Remove body/bonnet nuts (16B).
NOTE: If a valve has been in high temperature service for extensive periods of time, the nuts may be seized to the studs (15B). Tight nut threads can sometimes be loosened by applying penetrating oil or applying heat to the nut and working it free. As a last resort, a hacksaw, a cutting torch or a grinder can be used to cut the nut away from the stud.
4. Once all the nuts are removed, the entire bonnet assembly can be lifted from the valve body. When lifting the bonnet assembly, care should be taken to prevent the internal parts from disengaging from the stem. It is very important to match-mark the body/bonnet and the wedge (5) in order to maintain proper orientation of these parts at reassembly.
5. Remove used gasket (19).
6. During inspection check the body/bonnet studs for damage. Studs may have been damaged when removing seized nuts. If studs are damaged, replace them.
7. Install new gasket. For corrugated steel with graphite strips gasket and spiral wound gasket, body and bonnet flange surface must be completely cleaned and free of oil and grease.
8. Line up the bonnet assembly with the body and lower onto the body.
9. Apply recommended lubricant (*Table 4.3*) to the body/bonnet studs (15B) and nut flats (16B) then install body/bonnet nuts. Tighten nuts in strict accordance with the body/bonnet torquing procedure *Section 4.5, Table 4.5A*

CAUTION: Do not tighten the body/bonnet nuts when the wedge is in the fully closed position.

10. Mount packing flange nuts and torque down in accordance with *Table 5.1A*.
11. Verify operation by cycling at least three times from fully opened to fully closed position.

6.4 TOTAL DISASSEMBLY

6.4.1 Disassembly of Body/Bonnet and Wedge/Stem

Follow warning instructions in *Section III* before beginning disassembly. If valve is equipped with gear or motor actuator, see *Appendix* for disassembly of actuators.

1. Follow steps 1 through 6 in *Section 6.3 Partial Disassembly - Gasket Replacement*
2. If removing top works, follow steps 1 through 4 in *Section 6.4.2 Disassembly of Top Works*
3. Loosen gland nuts (16A) and then carefully pull stem out through bottom of the bonnet.
4. Unscrew gland nuts from gland studs (15A).
5. Remove packing flange (11).
6. Only if required, remove groove pins (39) in order to remove gland studs.
7. Unscrew the backseat (18) only if necessary.
8. Carefully remove old packing rings (13A,13B). Care should be taken not to scratch the walls of the packing chamber during the removal of the packing rings.

6.4.2 Disassembly of Top Works

There are six basic styles of valve top works for Velan valves. *Style 1* (no bearings), *Style 2* (top and bottom sets of bearings) and *Style 3* (top set of bearings) apply to gate valves, (*Fig. 6.4A*). They are available for various sizes of gate valves as indicated in *Table 6.4A*.

Table 6.4A Top Works Styles – Gate

STYLE	CLASS	API 600	API 603
1	150	2 to 12"	½ to 12"
	300	2 to 8"	½ to 12"
	600	2 to 4"	N/A
	900	2 to 4"	N/A
	1500	2 to 4"	N/A
2	150	14 to 24"	14 to 20"
	300	14 to 16"	14 to 16"
	600	6 to 12"	N/A
	900	6 to 8"	N/A
	1500	6"	N/A
3	150	10 to 12"	N/A
	300	10 to 12"	N/A

The disassembly procedure for each of these styles is described below.

NOTE: The handwheel nut may be secured by set screw or spring pin

1. The spring pin (61) is press fit. To remove the handwheel nut, It will be necessary to snap-off the spring pin by holding firm the handwheel and applying sufficient force on the handwheel nut (counterclockwise) until the spring pin snaps off.
2. Unscrew the handwheel nut (30). Remove the handwheel (33) and the handwheel key (26).
3. After the tack weld is removed, unscrew the yoke bushing (27) from the bonnet (2). For *Style 2* and *Style 3*, remove the top set of bearings.
4. Unscrew the stem nut (88) from the stem (4). For *Style 2*, remove bottom set of bearings.

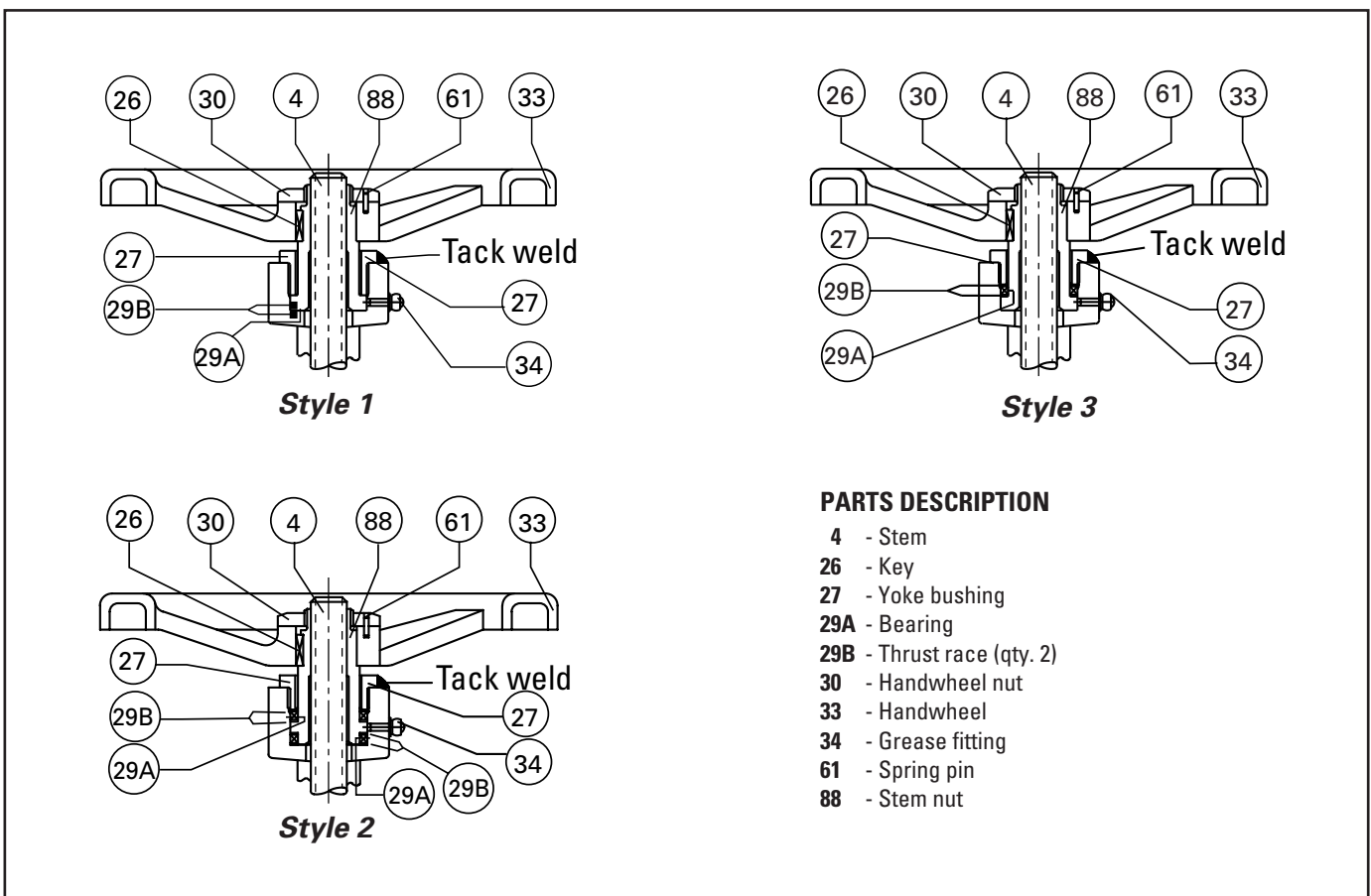


Figure 6.4A Top works styles – gate

7.1 TYPES OF GLOBE VALVES

NOTE: Velan globe valves have in the past been designed with a flat disc configuration. In a continuous effort to improve valve design, Velan has more recently adopted a tapered disc as its standard.

PARTS DESCRIPTION

- | | |
|------------------------|------------------------|
| 1 - Body | 16D - Yoke nut |
| 2 - Bonnet | 17 - Gland washer |
| 4 - Stem | 18 - Backseat |
| 6 - Disc | 19 - Gasket |
| 9 - Seat | 25 - Torque arm |
| 11 - Packing flange | 26 - Key |
| 12 - Gland bushing | 27 - Yoke bushing |
| 13 - Packing ring | 28 - Socket head screw |
| 14 - Junk ring | 30 - Nut Wheel |
| 15A - Gland stud | 33 - Handwheel |
| 15B - Body/bonnet stud | 39 - Groove pins |
| 16A - Gland nut | 40 - Disc union |
| 16B - Body/bonnet nuts | 42 - Disc thrust pad |

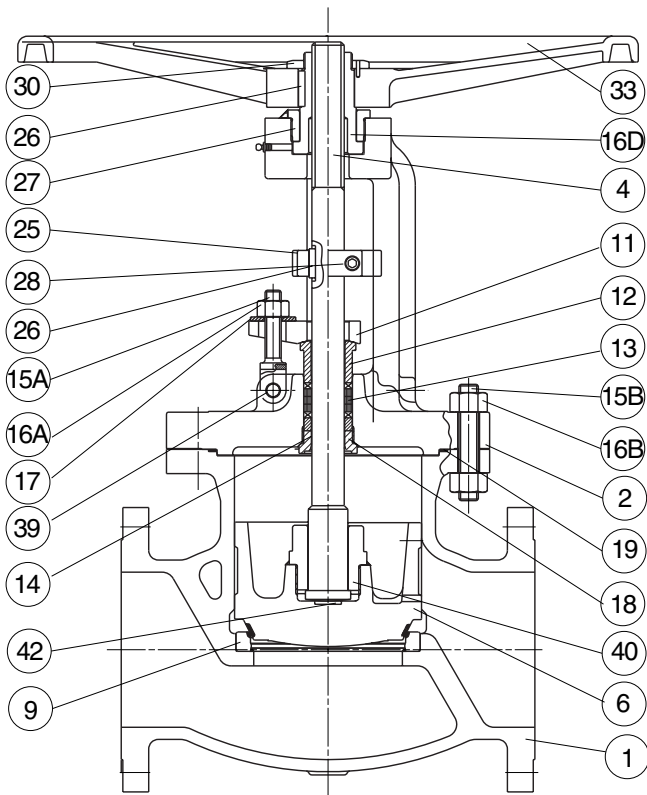


Figure 7.1A *Globe valve cast bolted bonnet non-rotating stem 2–14" (50–350 mm).*

PARTS DESCRIPTION

- | | |
|-------------------------------|---------------------|
| 1 - Body | 16A - Gland nuts |
| 2 - Bonnet | 16B - Stem nut |
| 4 - Stem | 18 - Backseat |
| 6 - Disc | 19 - Gasket |
| 9 - Seat | 27 - Yoke bushing |
| 11 - Packing flange | 33 - Handwheel |
| 12 - Gland bushing | 38 - Gland eyebolt |
| 13A - Packing ring (braided) | 39 - Groove pins |
| 13B - Packing ring (graphite) | 40 - Disc union |
| 15 - Body/bonnet stud | 57 - Washer |
| 16 - Body/bonnet nuts | 63 - Packing spacer |

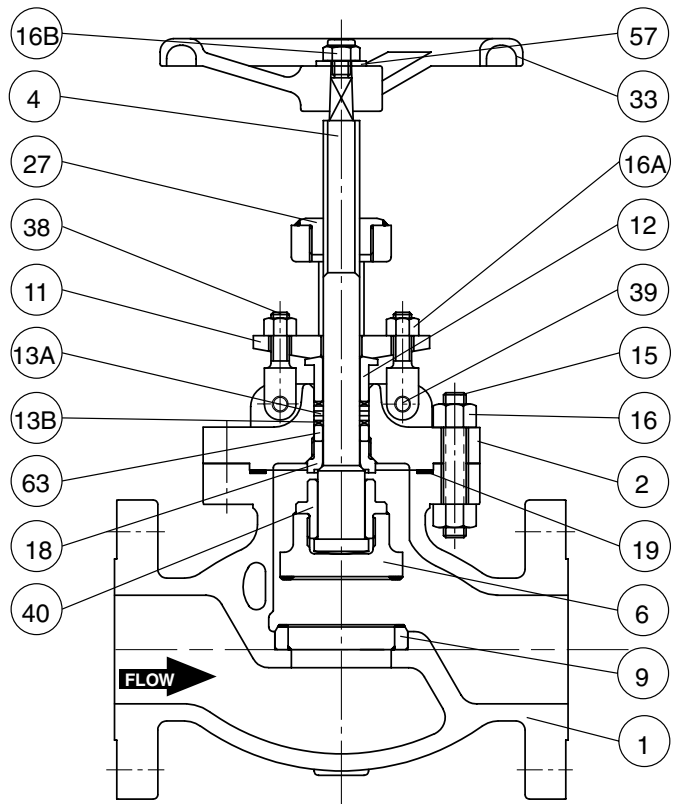


Figure 7.1B *Globe valve cast bolted bonnet 2–12" (50–300 mm). 600 Class.*

VII GLOBE VALVES

7.1 TYPES OF GLOBE VALVES (CONT'D)

PARTS DESCRIPTION

- | | |
|-------------------------------|-------------------------|
| 1 - Body | 16B - Gland nut |
| 2 - Bonnet | 16C - Torque arm nut |
| 4 - Stem | 16D - Yoke/actuator nut |
| 6 - Disc | 18 - Backseat |
| 9 - Seat | 19 - Gasket |
| 11 - Packing flange | 25 - Torque arm |
| 12 - Gland bushing | 26 - Key |
| 13A - Packing ring (braided) | 32 - Gear operator |
| 13B - Packing ring (graphite) | 38 - Gland eyebolt |
| 15A - Body/bonnet stud | 39 - Groove pin |
| 15B - Torque arm stud | 40 - Disc union |
| 15C - Yoke/actuator stud | 41 - Stem collar |
| 16A - Body/bonnet nut | 66 - Name plate |

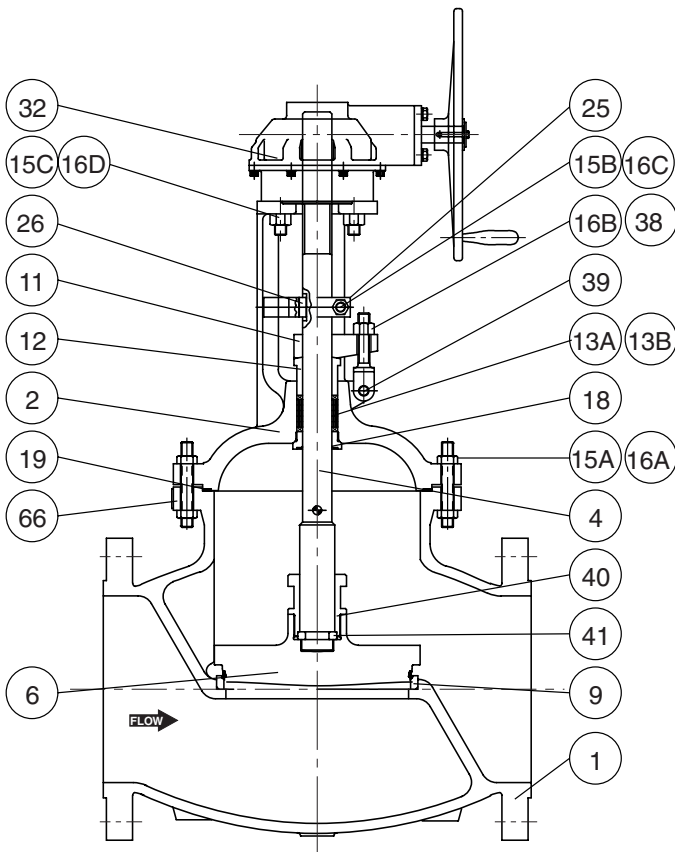


Figure 7.1C *Globe valve cast bolted bonnet 14–16" (350–400 mm). 600 Class.*

PARTS DESCRIPTION

- | | |
|------------------------|-----------------------|
| 1 - Body | 16B - Body/bonnet nut |
| 2 - Bonnet | 18 - Backseat |
| 3 - Yoke | 19 - Gasket |
| 4 - Stem | 27 - Yoke bushing |
| 6 - Disc | 30 - Handwheel nut |
| 9 - Seat | 33 - Handwheel |
| 11 - Packing flange | 39 - Groove pins |
| 12 - Gland bushing | 40 - Disc union |
| 13B - Packing ring | 42 - Disc thrust pad |
| 15B - Body/bonnet stud | 46 - Spring |
| 15A - Gland stud | 57 - Washer |
| 16A - Gland nut | |

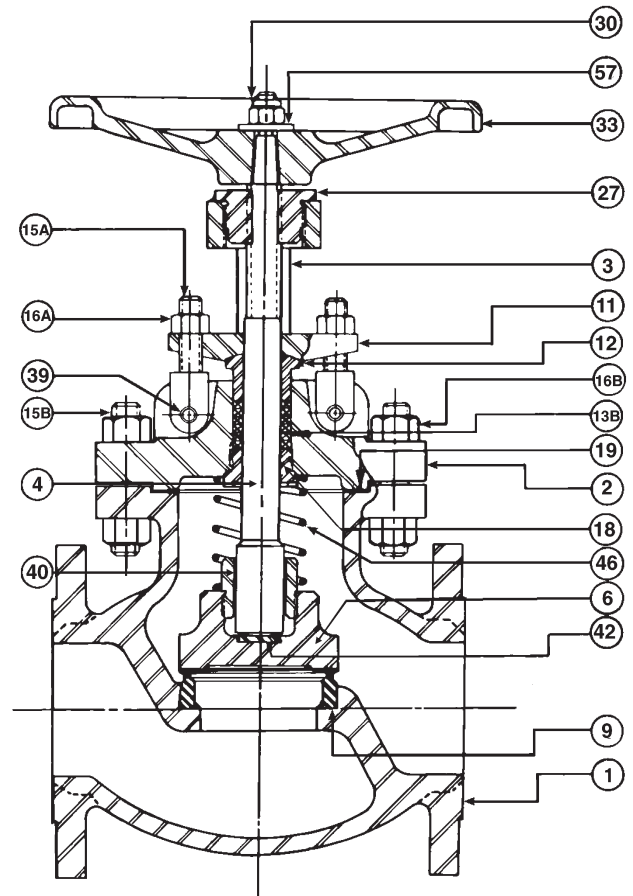


Figure 7.1D *Stop check valve cast bolted bonnet 2–14" (50–350 mm). The hardfaced seat is seal welded.*

7.1 TYPES OF GLOBE VALVES (CONT'D)

PARTS DESCRIPTION

- | | |
|------------------------|-------------------|
| 1 - Body | 16 - Lock nut |
| 2 - Bonnet | 16A - Gland nut |
| 4 - Stem | 16B - Nut |
| 6 - Disc | 19 - Gasket |
| 11 - Packing flange | 27 - Yoke bushing |
| 12 - Gland bushing | 33 - Handwheel |
| 13A - Packing ring | 35 - Set screw |
| 15A - Gland stud | 40 - Disc union |
| 15B - Body/bonnet stud | 66A - Nameplate |

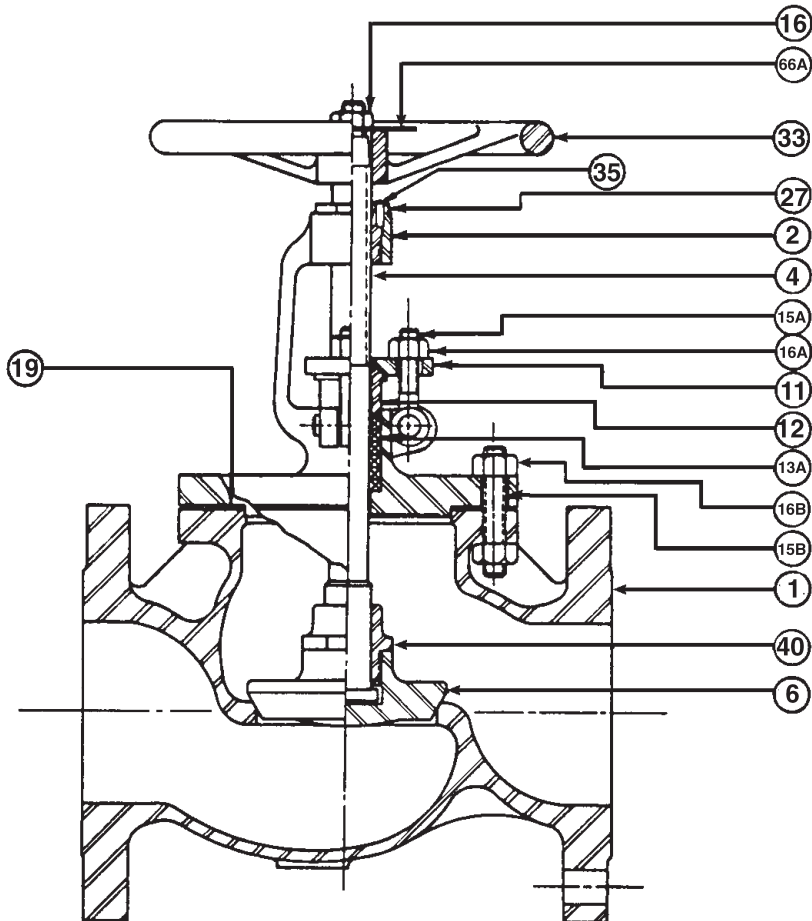
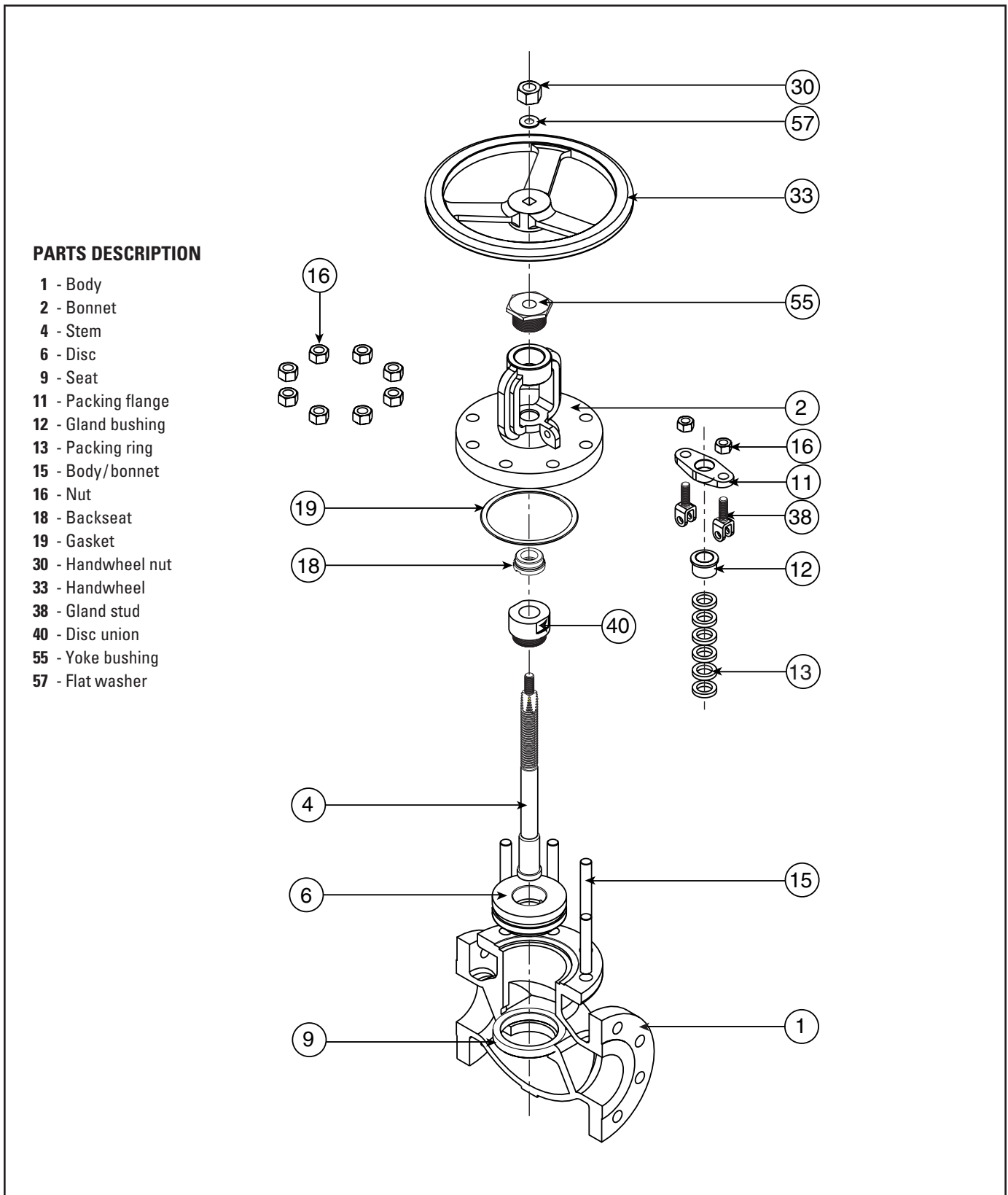


Figure 7.1E *Globe valve stainless bolted bonnet ½–12" (15–300 mm). Integral seats.*

VII GLOBE VALVES

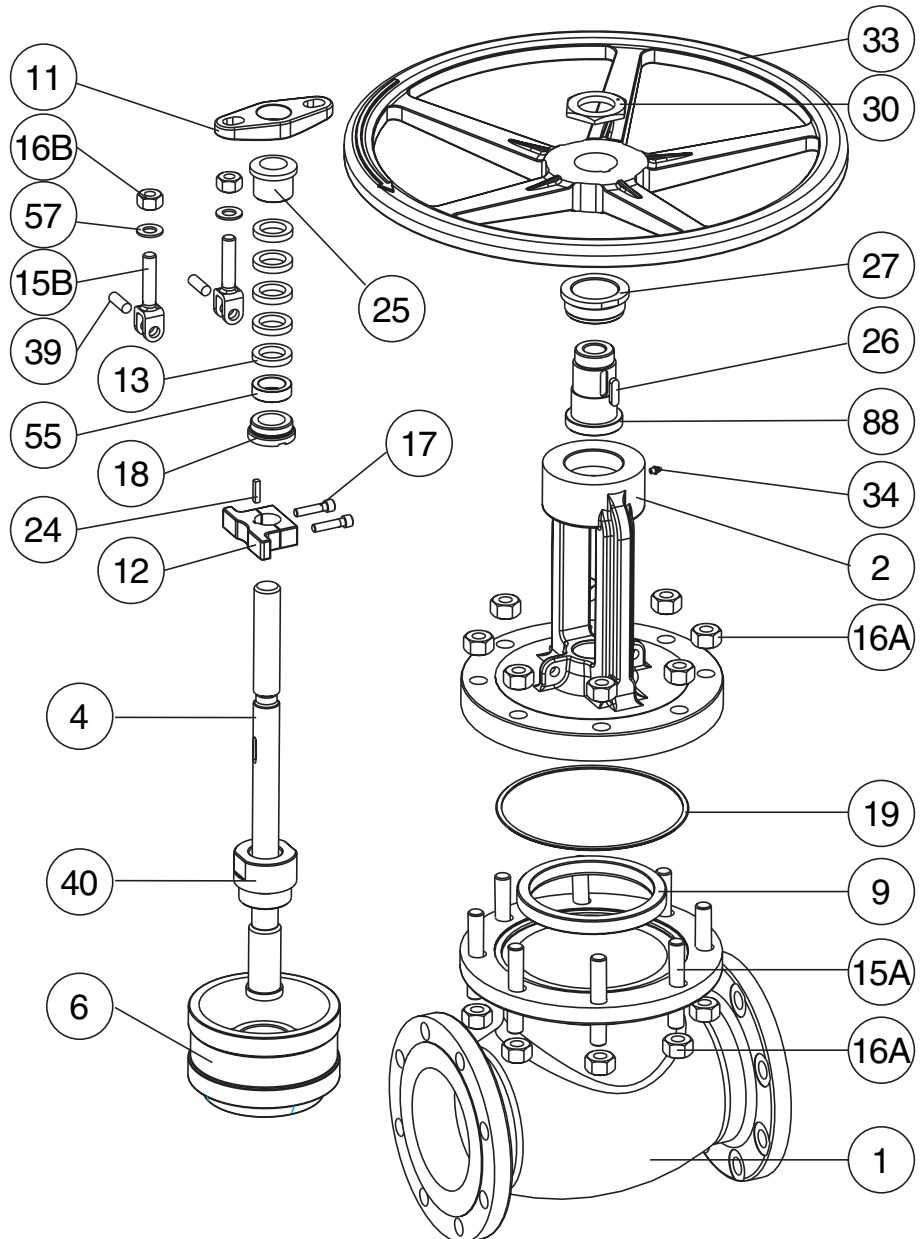
7.2 GLOBE VALVE—ROTATING STEM: EXPLODED VIEW



7.3 GLOBE VALVE–NON-ROTATING STEM: EXPLODED VIEW

PARTS DESCRIPTION

- 1 - Body
- 2 - Bonnet
- 4 - Stem
- 6 - Disc
- 9 - Seat
- 11 - Packing flange
- 12 - Gland bushing
- 13 - Packing ring
- 15A - Body/bonnet stud
- 15B - Gland stud
- 16A - Body/bonnet nut
- 16B - Gland Nut
- 17 - Cap screw
- 18 - Backseat
- 19 - Gasket
- 24 - Key (torque arm)
- 25 - Torque arm
- 26 - Key
- 27 - Yoke bushing
- 30 - Handwheel nut
- 33 - Handwheel
- 34 - Grease fitting
- 39 - Grove pin
- 40 - Disc union
- 55 - Bushing
- 57 - Flat washer
- 88 - Stem nut



VII GLOBE VALVES

7.4 PISTON CHECK VALVES: EXPLODED VIEW

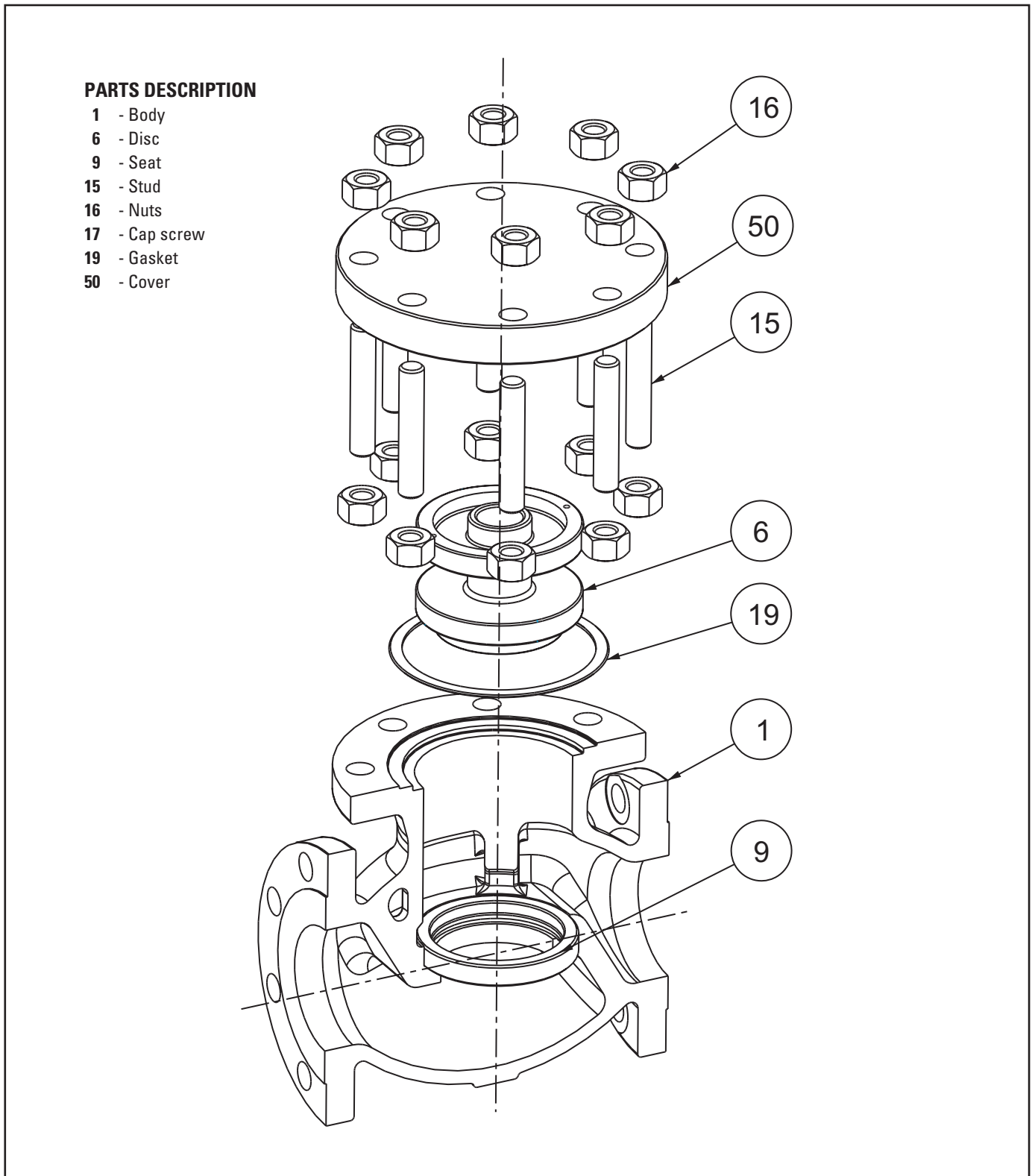


Figure 7.4A Piston check valve API 600 2" (50 mm) and up.

VII GLOBE VALVES

9. For the globe and needle disc valves, after the tack welds are removed, unscrew the disc union (40) from the disc. Check inside the disc for possible damages.
10. Remove top works refer to *Section 7.6.2 Disassembly of Top Works*
11. Remove Torque arm (25) (non-rotating stem). There are four types of torque arms, see *Fig. 7.6A*:

Type I: One piece with bearing,

Type II: One piece without bearing,

Type III: Two piece with bearing,

Type IV: Two piece without bearing.

a) Removal of Types I and II:

Loosen the cap screw (17C) and remove. Slide torque arm (25) up along stem and remove torque arm key (26A) from stem. Torque arm will not come off at this point, but you must make sure that the torque arm slides freely over the stem.

b) Removal of Types III and IV:

Loosen hex nuts (16D), pull torque arm apart and remove torque arm key (26A) from stem. The torque arm will come totally off assembly at this point.

12. Loosen gland nuts (16) and then carefully pull stem out through the bottom of the bonnet.
13. Unscrew gland nuts from gland studs/ eyebolt (15A).

14. Remove packing flange (11) from gland studs/eyebolts.
15. Only if required, remove groove pins (39) in order to remove gland studs/eyebolts.
16. Unscrew the backseat only if necessary (18).
17. Carefully remove old packing rings (13). Care should be taken not to scratch the walls of the packing chamber during the removal of the packing rings.

7.6.2 Disassembly of Top Works

There are six basic styles of valve top works for Velan valves. *Style 2* (top and bottom sets of bearings), *Style 4* (no bearings) and *Style 3* top set of bearings only shown in *Fig. 7.6B*, apply to globe valves. They are available for various sizes of globe valves as indicated in *Table 7.6A*.

The disassembly procedure for each of these styles is described below.

Disassembly Procedure:

Style 2 and 3

NOTE: The handwheel nut maybe secured by set screw or spring pin.

1. The spring pin (61) is press fit, to remove the handwheel nut, it will be necessary to snap-off

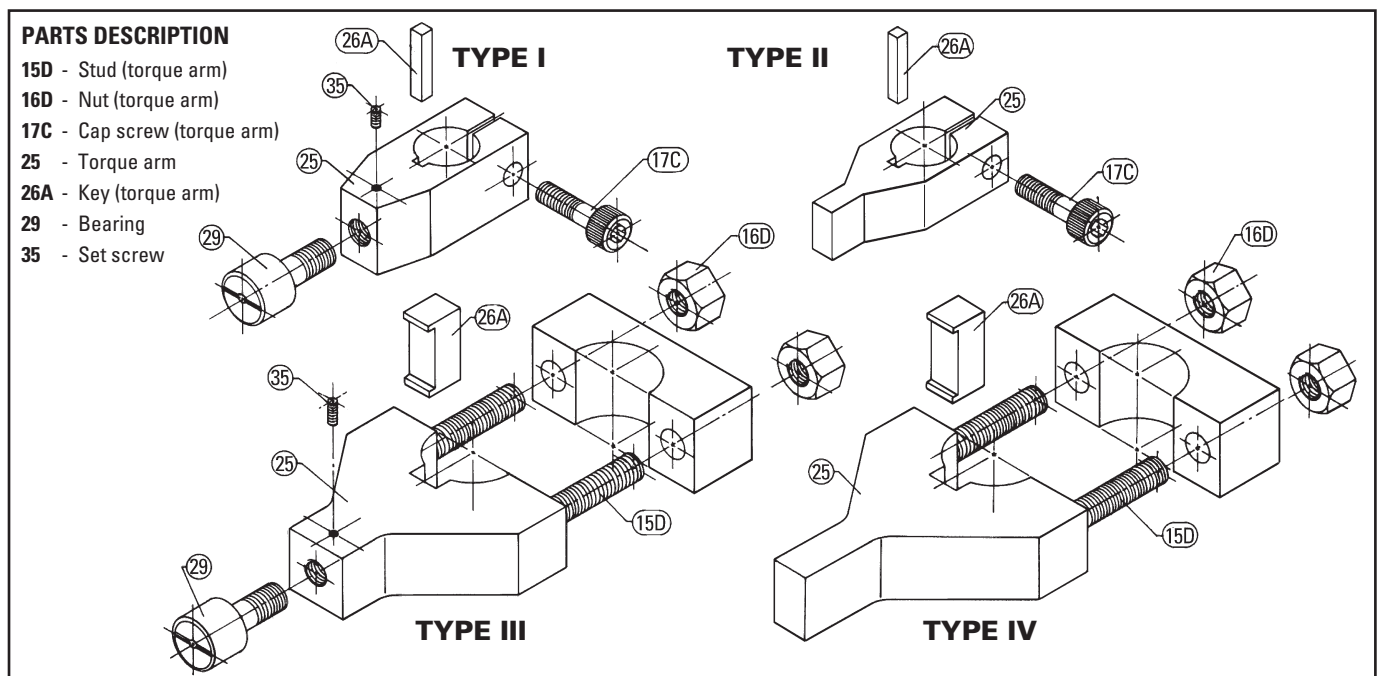


Figure 7.5A Torque arm 4 types

the spring pin by holding firm the handwheel and applying sufficient force on the handwheel nut (counterclockwise) until the spring pin snaps off.

2. Unscrew the handwheel nut (30). Remove the handwheel (33) and the handwheel key (26).
3. After the tack weld is removed, unscrew the yoke bushing (27) from the bonnet. Remove the top set of bearings. (for Style 2 and 3)
4. Unscrew the stem nut (88) from the stem (4). Remove bottom set of bearings. (for Style 2)

Style 4

1. Remove the handwheel nut (30) and handwheel (33).
2. After the tack weld is removed, unscrew the yoke bushing (27) from the bonnet.

Table 7.6A Top works styles – Globe

STYLE	CLASS	WCB	CAST STAINLESS
2	150	12 to 14"	N/A
	300	8 to 14"	N/A
	600	6 to 8"	N/A
	900	2 to 4"	N/A
	1500	2 to 4"	N/A
3	150	8"	N/A
	300	6"	N/A
4	150	2 to 10"	½ to 6"
	300	2 to 6"	½ to 6"
	600	2 to 4"	N/A
	900	2 to 4"	N/A
	1500	2 to 4"	N/A

7.7 TOTAL DISASSEMBLY OF PISTON CHECK VALVE

1. Remove body/cover nuts (16).
2. Once all the nuts are removed, the cover (50) and gasket can be lifted from the valve body as shown in Fig. 7.5A.
3. Lift the disc (6) and spring option (46) from the valve body.

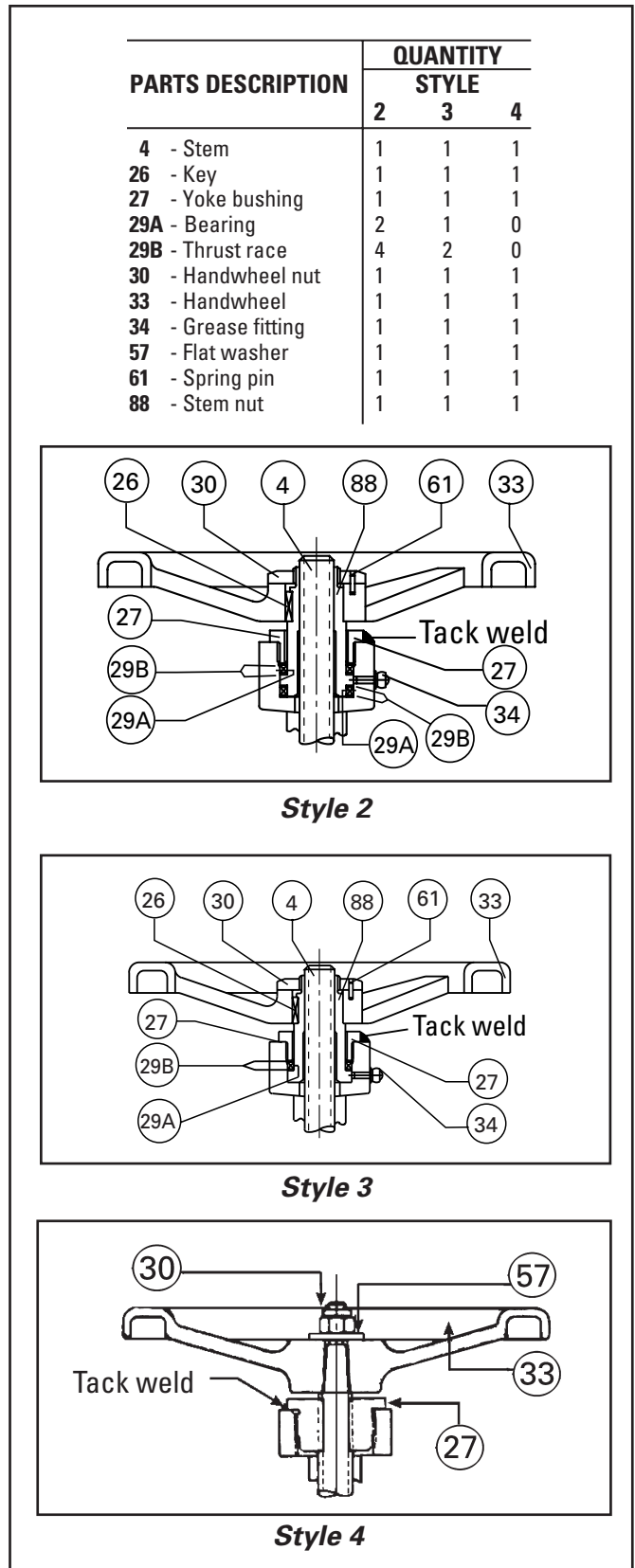


Figure 7.6B Top works styles – Globe

VII GLOBE VALVES

7.8 ASSEMBLY

NOTE: Where *appears refer to lubrication table in *Section 4.3*.

7.8.1 Top Work Assembly

1. *Apply new grease to threaded portion of stem (4).
2. *For *Style 2*, grease and place bottom set of bearings.
3. *Apply new grease to internal thread in stem nut (88).
4. Place stem nut.
5. *For *Style 2* and 3 grease and install top set of bearings.6. Screw in the yoke bushing (27). The yoke bushing must be tack-welded to the bonnet (2), or staked.
7. Insert the handwheel key (26) in the stem nut and mount the handwheel (33).
8. Tighten handwheel nut (30) onto the stem nut and lock with set screw or spring pin (61). If spring pin is used, drill on new location. In absence of set screw and spring pin stake between handwheel and handwheel nut.
9. *Inject more new grease into the top works through the grease fitting (34) on the side of the bonnet.
10. Verify operation by cycling at least once from fully open to fully closed position.

7.8.2 Disc and Bonnet/Body Assembly

1. Insert disc into valve body. Insert spring into disc if so equipped.
Install small thrust pad into disc. Install stem in disc and tighten down with disc union. Check if disc can be rotated. If disc can be rocked, it is correctly installed on stem. The rocking will allow the disc to self-align itself to the seat.
2. Tack weld disc union to disc in three or four places. Check again to see if the disc can rock after tack welding has cooled.
3. *Install new gasket. For corrugated steel with graphite strips gasket and spiral wound gasket, body and bonnet flange surface must be completely cleaned and free of oil and grease.
4. Lift the stem/disc assembly and carefully lower into the body.

NOTE: for 8" valves and up, a chain block or come along should be used. Mount the torque arm (25), wrap a nylon sling around the stem just below the torque arm. Lift and carefully lower the stem/disc assembly

5. Lift the bonnet using a chain block or come along, and partially lower through the stem. Place the junk ring (packing spacer) and lantern ring, if so equipped, followed by the gland bushing, packing flange and torque arm. Completely lower the bonnet. Care should be taken not to damage the gasket while lowering. Install Top Works Assembly in accordance with *Section 7.8.1*
6. *Apply recommended lubricant to the body/bonnet studs (15) and nut flats (16) then install body/bonnet nuts. Tighten nuts in strict accordance with the body/bonnet torquing procedure, *Section 4.5 Table 4.5A*.

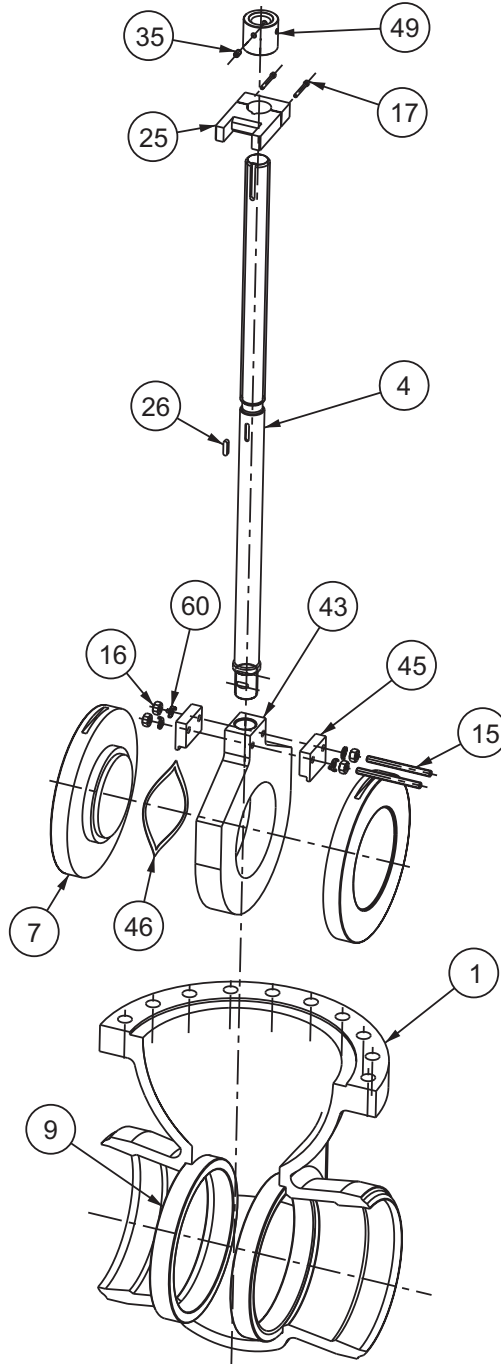
CAUTION: Do not tighten the body/bonnet nuts when the disc is in the fully closed position.

7. Mount packing flange nuts and torque down in accordance with *Table 5.1B*.
8. Verify operation by cycling at least three times from fully open to fully closed position.

8.1 PARALLEL SLIDE VALVE: EXPLODED VIEW

PARTS DESCRIPTION

- 1 - Body
- 4 - Stem
- 7 - Slide discs
- 9 - Seat
- 15 - Stud
- 16 - Nut
- 17 - Torque arm bolting
- 25 - Torque arm
- 26 - Key
- 35 - Limiter set screw
- 43 - Slide disc carrier
- 45 - Slide disc retainers
- 46 - Spring
- 49 - Stroke limiter
- 60 - Tab lock washer



VIII PARALLEL SLIDE VALVES

b) Removal of Types III and IV:

Loosen hex nuts (16D), pull torque arm apart and remove torque arm key (26A) from stem. The torque arm will come totally off assembly at this point.

6. Loosen gland nuts (16A) and then carefully pull stem out through the bottom of the bonnet.
7. Unscrew gland nuts from gland studs (15A).
8. Remove packing flange (11).
9. Only if required, remove groove pins (39) in order to remove gland studs.
10. Unscrew the backseat (18) only if necessary.
11. Carefully remove old packing rings (13A, 13B). Care should be taken not to scratch the walls of the packing chamber during the removal of the packing rings.

Table 8.4A Top Works Styles—Parallel Slide

STYLE	CLASS	SIZES
1	1500	1 - 2"
5	300	10 - 12"
6	300	3 - 8"

8.4.2 Disassembly of Top Works

There are six basic styles of valve top works for Velan valves. *Style 5* (top set of bearings and 1 thrust race at the bottom), *Style 6* (top and bottom thrust race).

The disassembly procedure for each of these styles is described below.

1. Before removing stroke limiter (49) take note of the stroke limiter position in relation to the valve stem as described in *Section 6.4.1 step 2 and 3*.
NOTE: The handwheel nut may be secured by set screw or spring pin.
2. The spring pin (61) is press fit. To remove the handwheel nut, it will be necessary to snap-off the spring pin by holding firm the handwheel and applying sufficient force on the handwheel nut (counterclockwise) until the spring pin snaps off. Unscrew the handwheel nut (30) Remove the handwheel (33) and the handwheel key (26).
3. After the tack weld is removed, unscrew the yoke bushing (27) from the bonnet (2). For Style 5, remove the top set of bearings. For Style 6, remove top thrust race.
4. Unscrew the stem nut (88) from the stem (4). For Style 5 and 6, remove bottom thrust race.

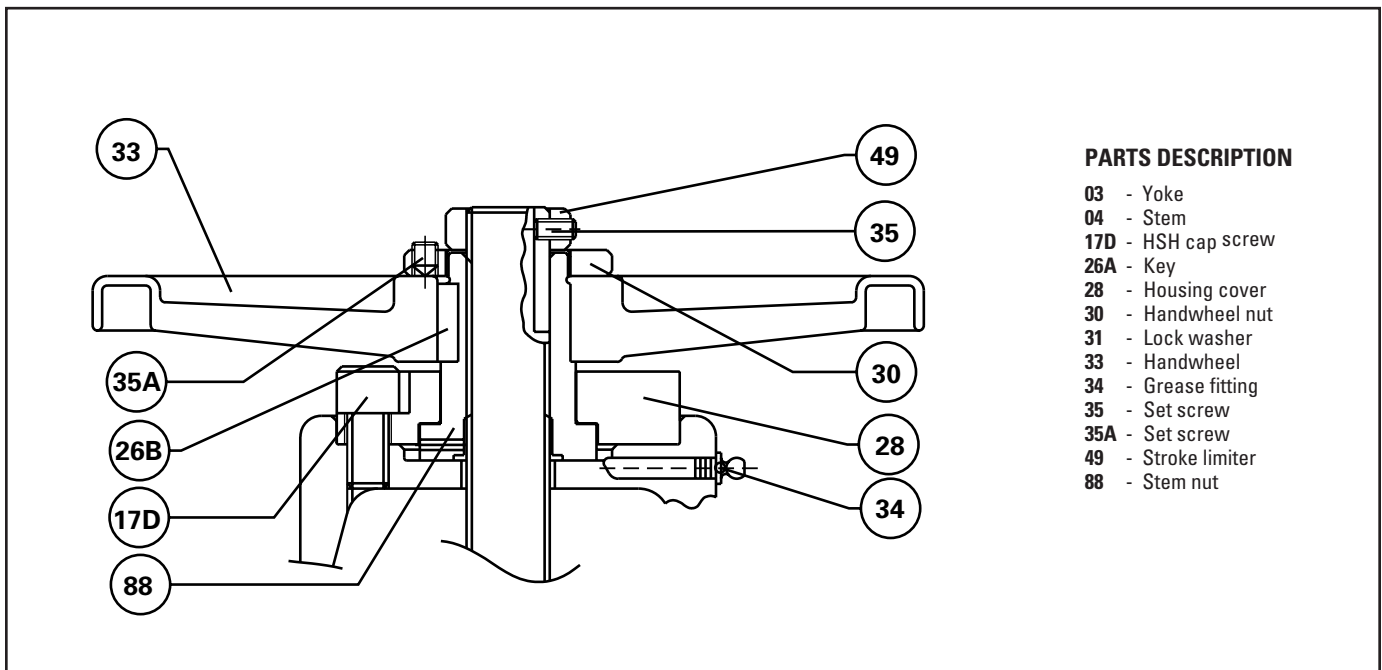


Figure 8.4A Stroke limiter Type II

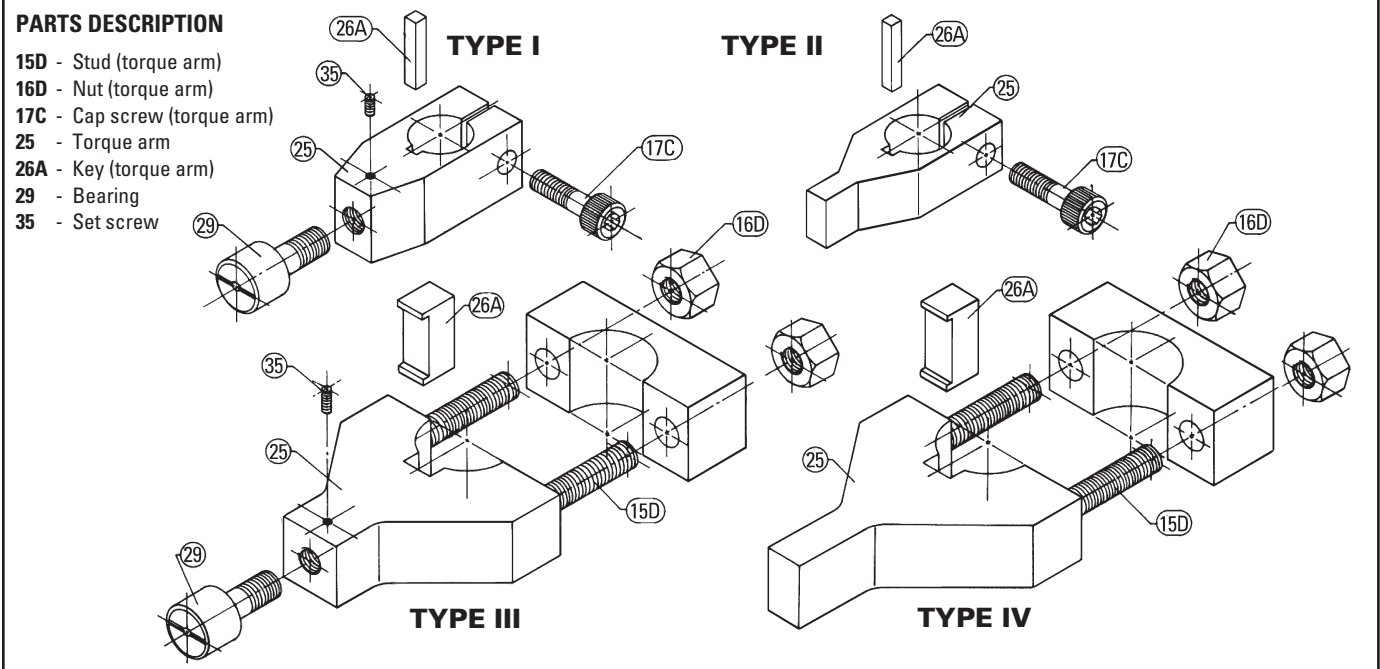


Figure 8.4B Torque arm 4 types

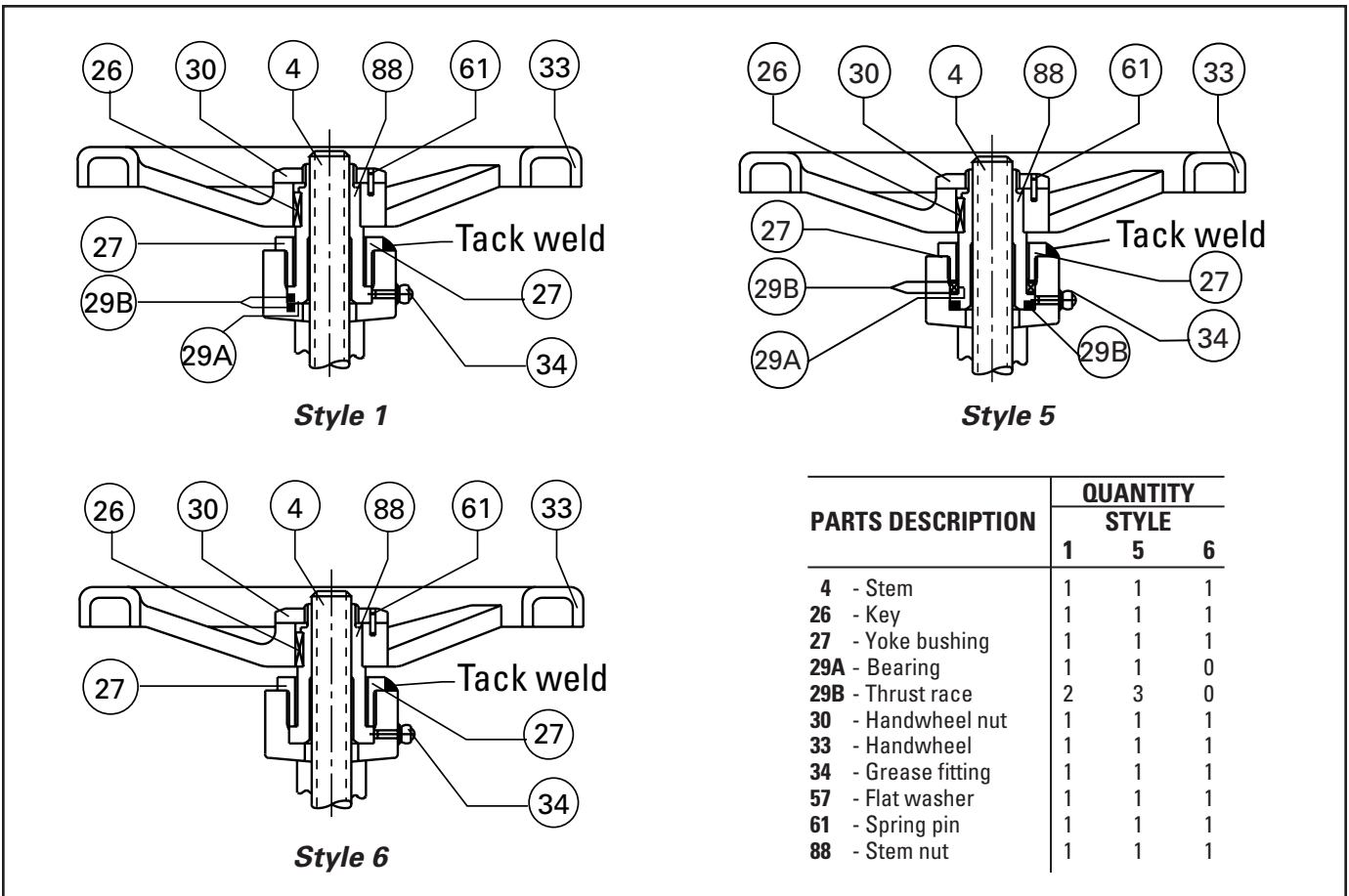


Figure 8.4C Top works style - Parallel Slide

VIII INFORMATION PERTINENT TO GATE, GLOBE, CHECK & PARALLEL SLIDE VALVES

8.5 ASSEMBLY

NOTE: Where * appears refer to lubrication table in *Section 4.3*.

8.5.1 Top works assembly

1. *Apply new grease to threaded portion of stem (4).
2. *For *Style 5 and 6*, grease and place bottom thrust race.
3. *Apply new grease to internal thread in stem nut (88).
4. Place stem nut.
5. *For *Style 5* grease and install top set of bearings. For *Style 6* place top thrust race.
6. Screw in the yoke bushing (27). The yoke bushing must be tack-welded to the bonnet (2) or staked.
7. Insert the handwheel key (26) in the stem nut and mount the handwheel (33).
8. Tighten handwheel nut (30) onto the stem nut and lock with set screw or spring pin (61) if spring pin is used drill on new location. In absence of set screw and spring pin stake between handwheel and handwheel nut.
9. *Inject more new grease into the top works through the grease fitting (34) on the side of the bonnet.
10. Mount stroke limiter and position as noted during disassembly, and secure with set screws.

IMPORTANT: The position of the stroke limiter must be the same as that noted during valve disassembly. If the original position has not been noted, the following procedure should be used:

- a) Open valve fully to its back seated position and mark up with a pen or marker.
- b) Verify applicable valve project drawing for valve "loft" (stroke). Measure from marked up open position and draw a line (mark up) indicating valve closed position.
- c) Close the valve to its marked up closed position and readjust stroke limiter.

For Motor Actuated Valves: It is necessary to readjust open/close limit switch. Open limit switch should be adjusted as a rule of thumb (6 mm) off back seat. Closed limit switch should be adjusted at already established closed position.

CAUTION: To prevent close torque switch trip out, stroke limiter must be backed off by $1/8$ – $1/4$ " (3–6 mm) and set screw secured.

11. Verify operation by cycling at least once from fully open to fully closed position.

8.5.2 Bonnet/Body and Disc/Stem Assembly

1. Thread the stem (4) in the disc carrier (43) and line up with bolt holes. Place one disc half (7) and wave spring (46) into the disc carrier followed by 2nd disc half. Using a disc clamp *Fig. 8.4A* or standard "C" clamp squeeze the two disc halves together. Install disc retainer plates (45) into the disc groove (per side) and line up bolt holes. Install two retainer studs or hex. bolts (56A) connecting the retainer plates disc carrier and stem and tighten firmly.
2. Partially lower stem/disc assembly into the body seats. Remove the disc clamp, and completely lower into the seats.

NOTE: For values 8" and up it may be necessary to mount the torque arm (25) to enable placing a sling under the torque arm and around the stem for lifting and lowering purposes.
3. Check disc/disc carrier/retainer plate for proper gap allowance refer to *Fig. 8.5B*
4. Install new gasket (19). For corrugated steel with graphite strips gasket and spiral wound gasket, body and bonnet flange surface must be completely cleaned and free of oil and grease.
5. Apply recommended lubricant to the body/bonnet studs (15B) and nut flats (16B) then install body bonnet nuts. Tighten nuts in strict accordance with the body/bonnet torquing procedure *Section 4.5, Table 4.5A*.
6. Lift the bonnet using a chain block or come along, and partially lower through the stem. Place the junk ring (packing spacer) and lantern ring if so equipped followed by the gland bushing, packing flange and torque arm. Completely lower the bonnet. Care should be taken not to damage the gasket while lowering. Install top works assembly in accordance with *Section 6.5.1*.
7. Mount packing flange nuts and torque down in accordance with *Table 5.1A*.
8. Verify operation by cycling at least three times from fully open to fully closed position.

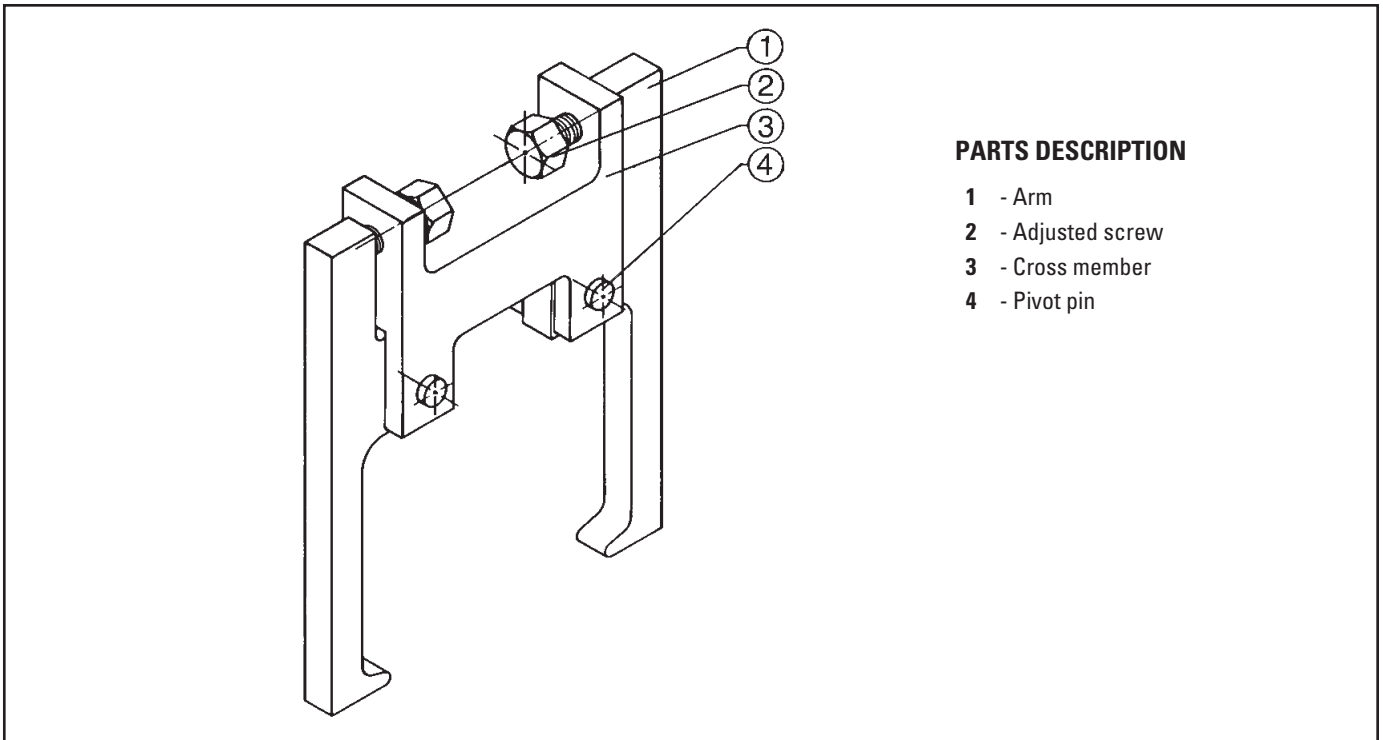


Figure 8.5A Parallel slide disc clamp

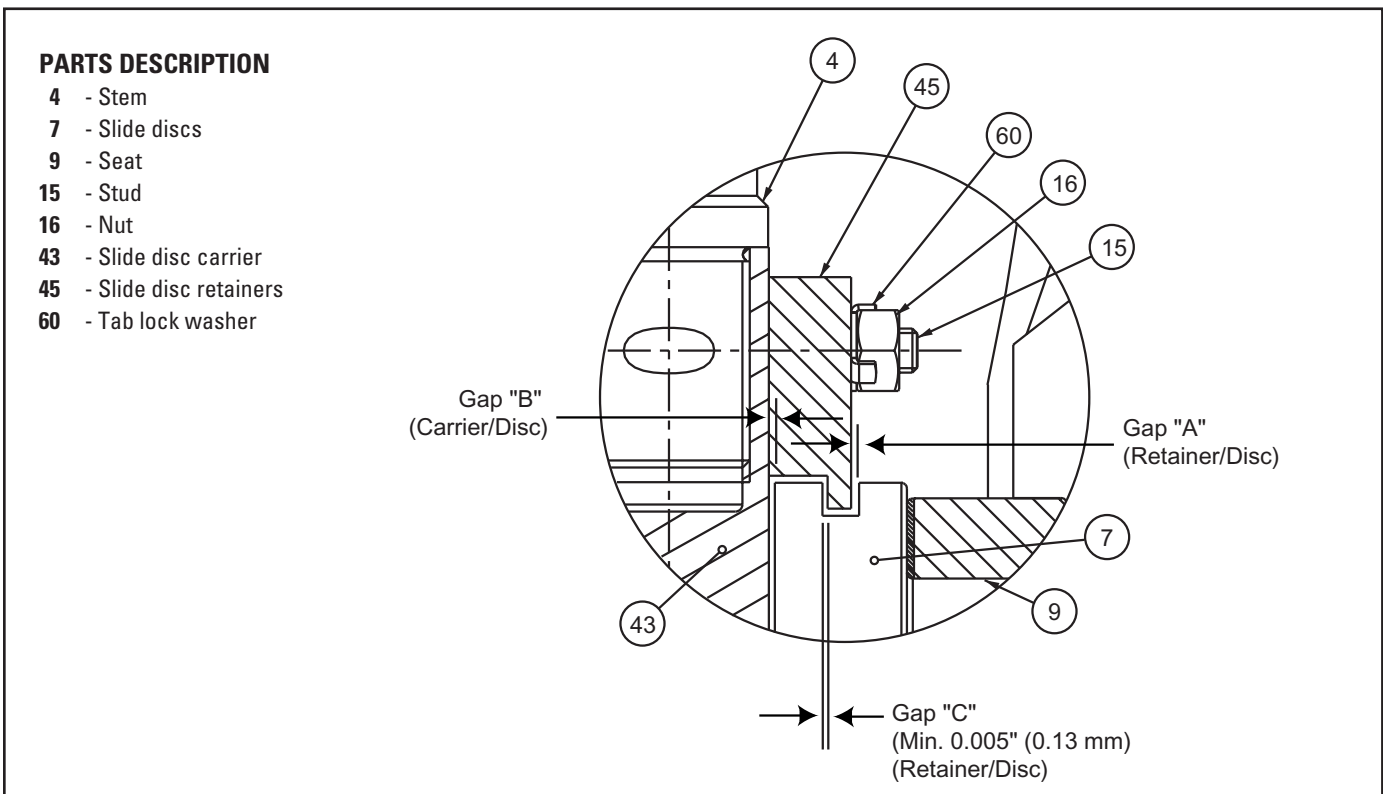


Figure 8.5B Check for gap disc / disc carrier and retainer plate

IX SWING CHECK, TILTING DISC, TESTABLE & BALL CHECK VALVES

9.1 TYPES OF SWING CHECK VALVES

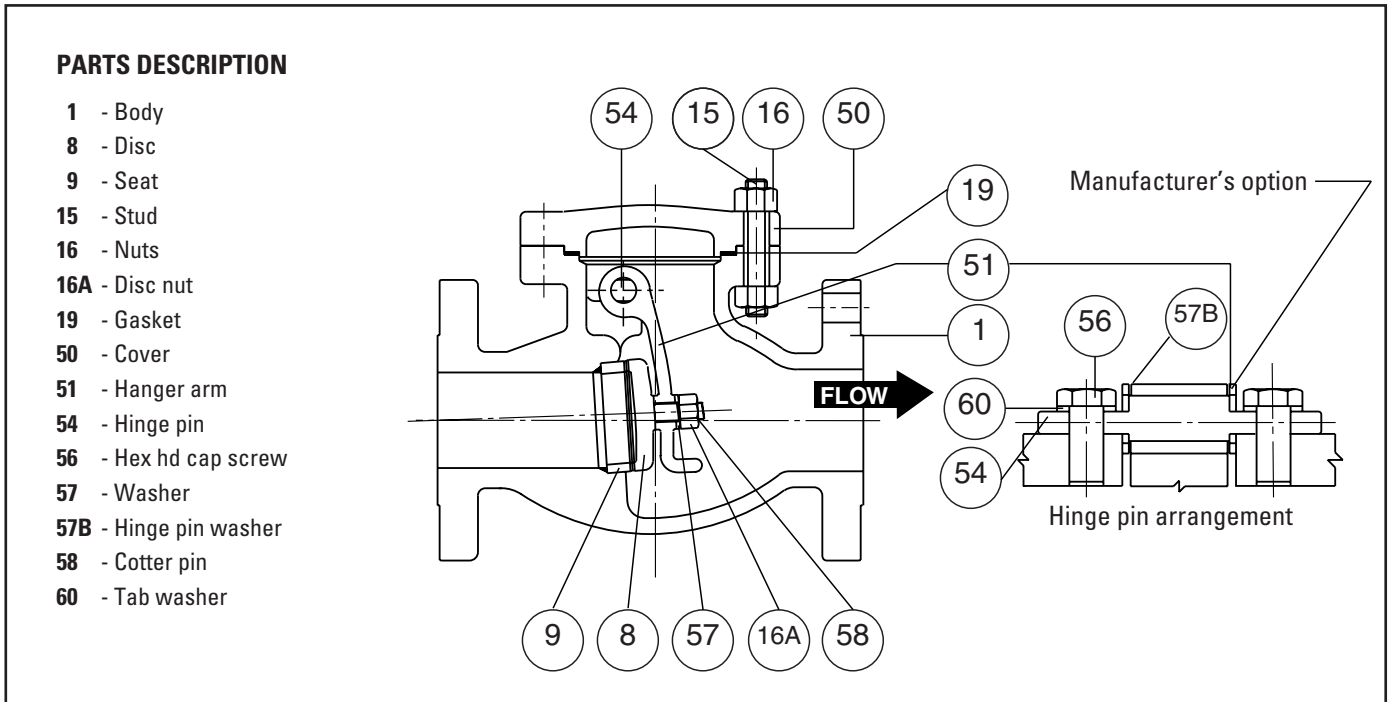


Figure 9.1A Swing check valve API 600 cast bolted cover 2–12" (50-300 mm).
The hardfaced seat is seal welded.

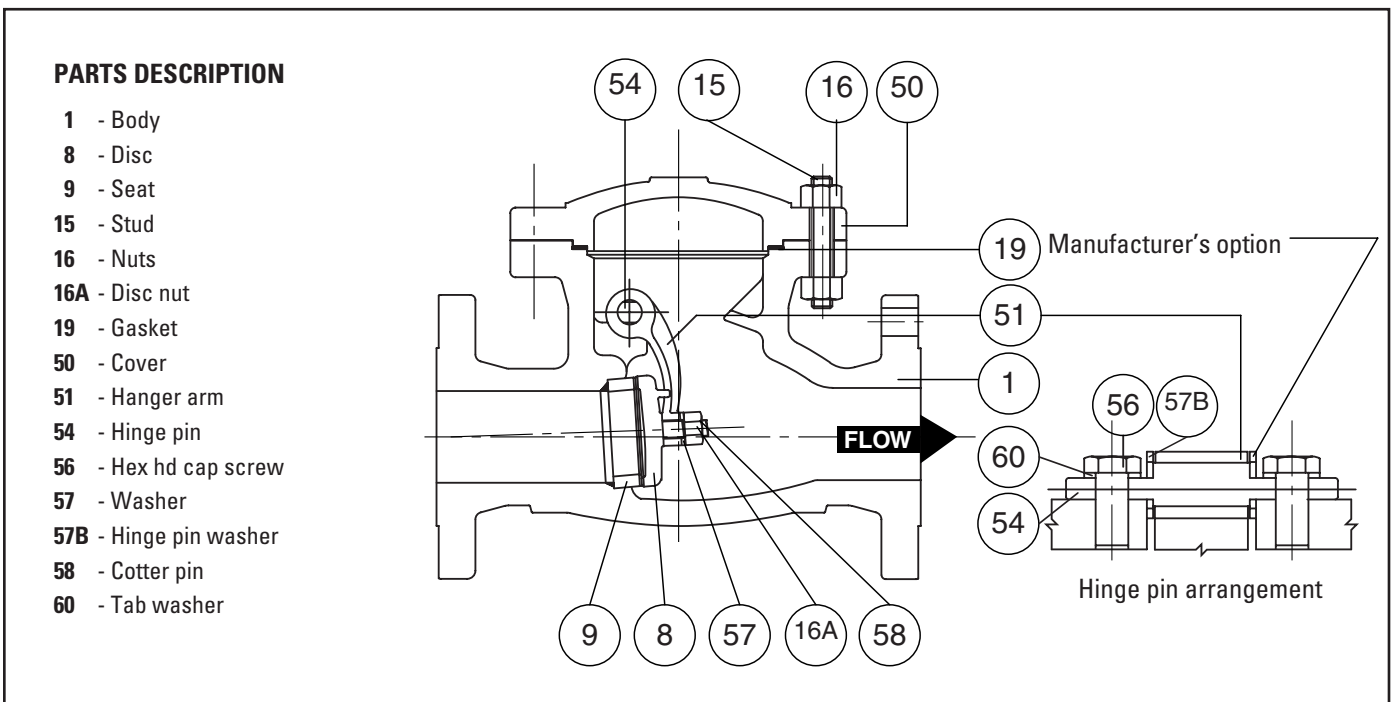


Figure 9.1B Swing check valve API 603 stainless bolted cover 2–24" (50-600 mm)
integral seats.

9.1 TYPES OF SWING CHECK VALVES

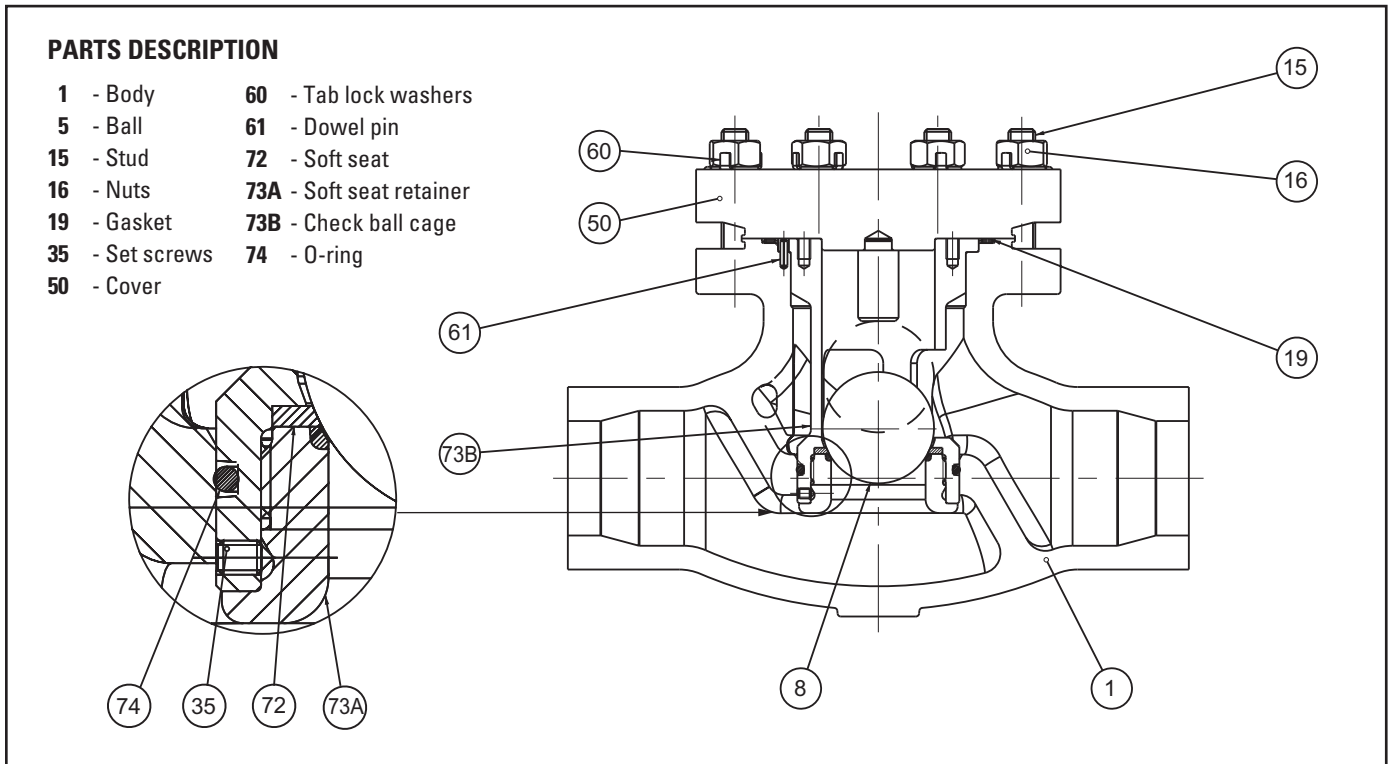


Figure 9.1C Bolted Cover Ball Check Valve

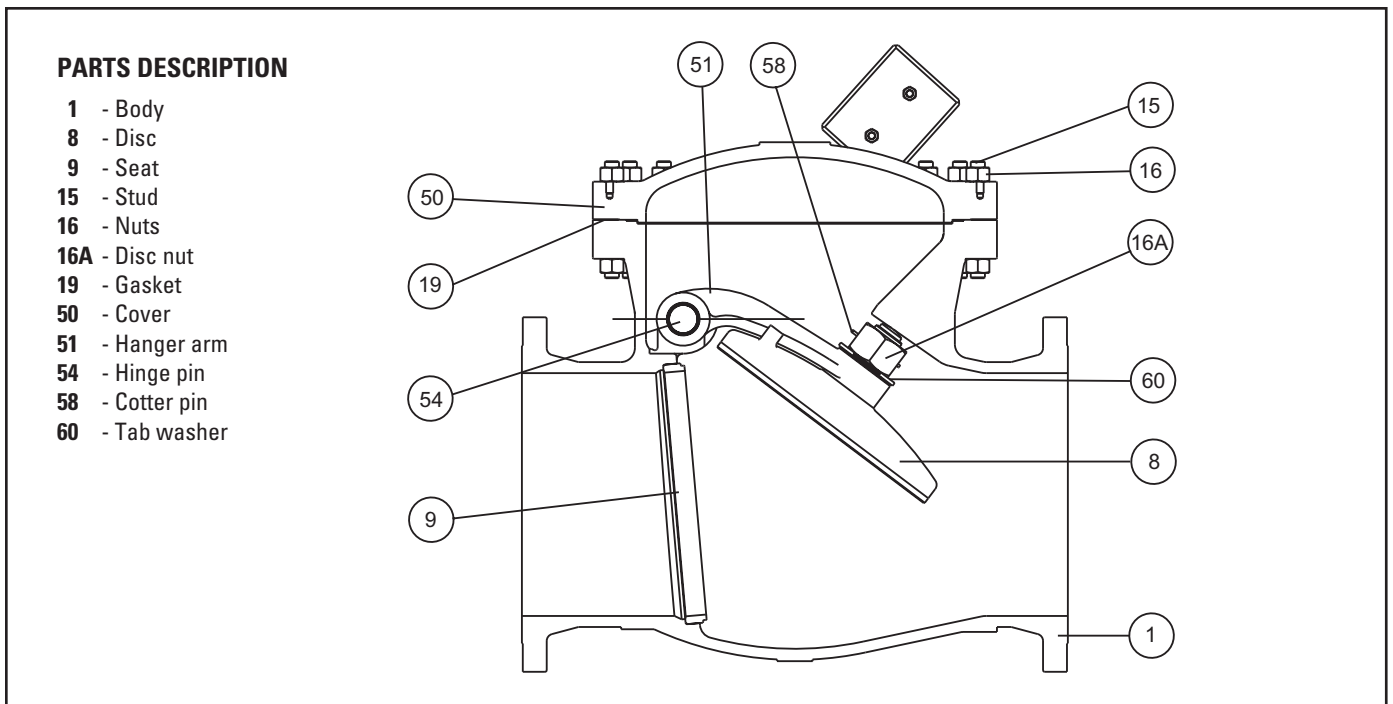


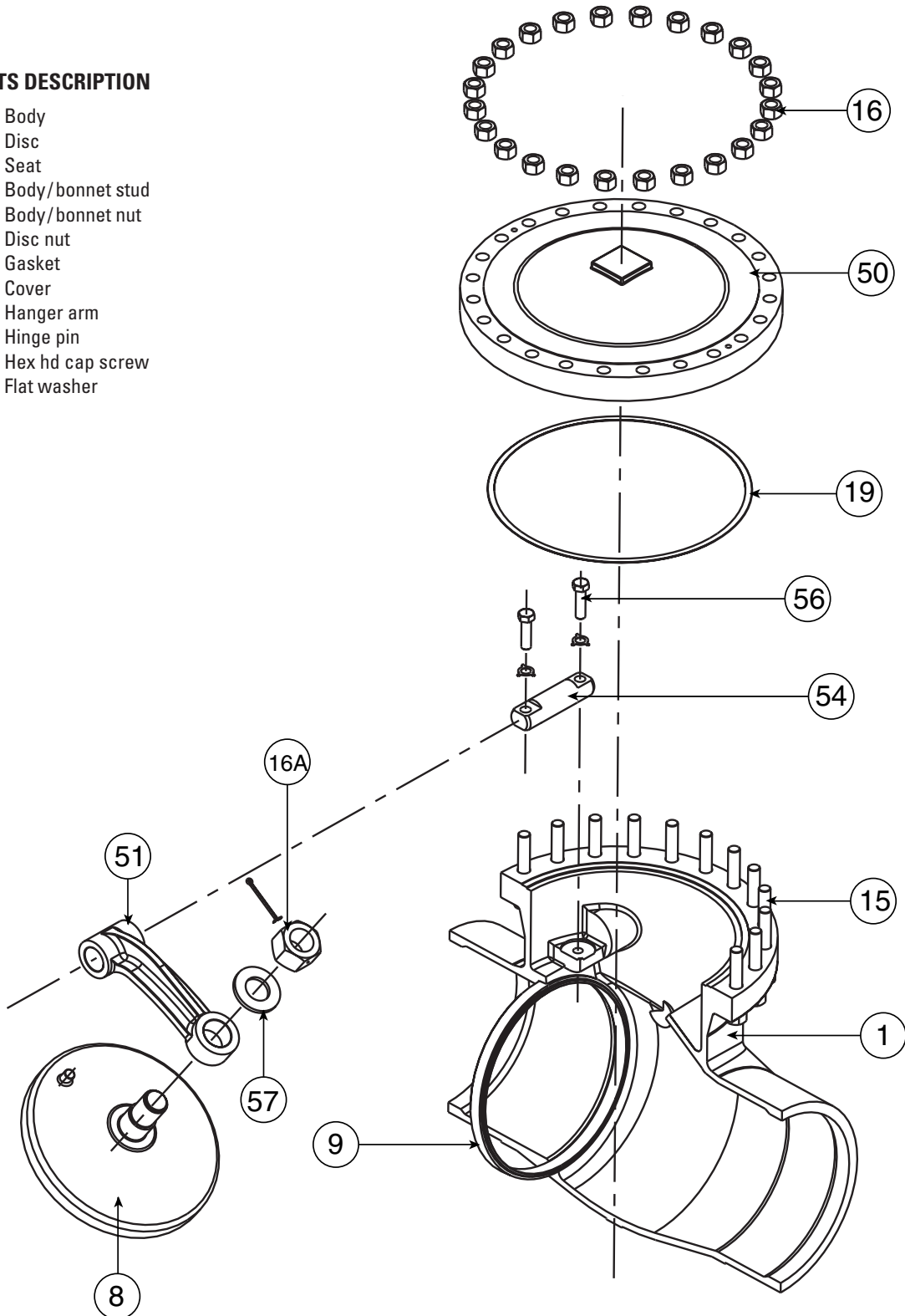
Figure 9.1D Bolted Cover Testable Swing Check Valve

IX SWING CHECK, TILTING DISC, TESTABLE & BALL CHECK VALVES

9.2 SWING CHECK VALVE: EXPLODED VIEW

PARTS DESCRIPTION

- 1 - Body
- 8 - Disc
- 9 - Seat
- 15 - Body/bonnet stud
- 16 - Body/bonnet nut
- 16A - Disc nut
- 19 - Gasket
- 50 - Cover
- 51 - Hanger arm
- 54 - Hinge pin
- 56 - Hex hd cap screw
- 57 - Flat washer



9.3 TYPE OF TILTING DISC CHECK VALVE

PARTS DESCRIPTION

- 1 - Body
- 8 - Disc
- 9 - Seat
- 15 - Body/bonnet stud
- 16 - Body/bonnet nut
- 31 - Lock bracket
- 19 - Gasket
- 50 - Cover
- 52 - Pin bracket
- 54 - Hinge pin
- 56 - Hex hd cap screw
- 61 - Dowel pin

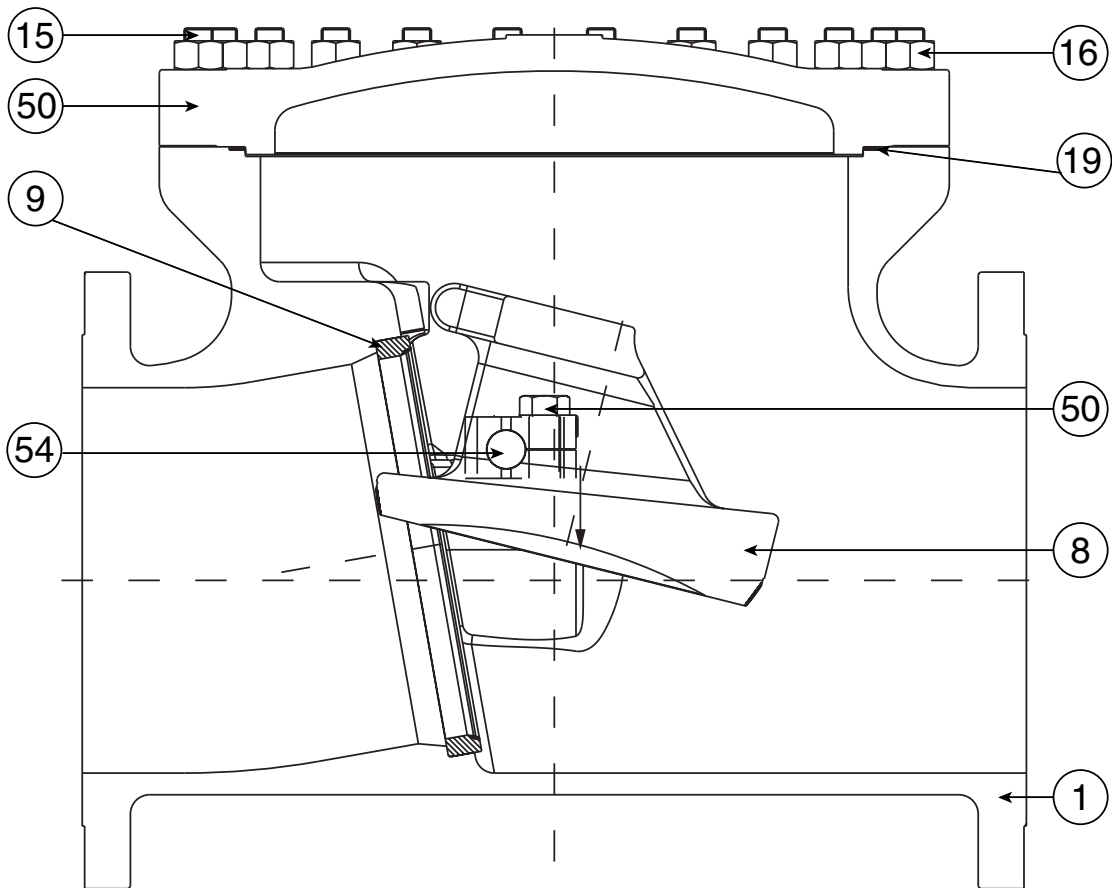
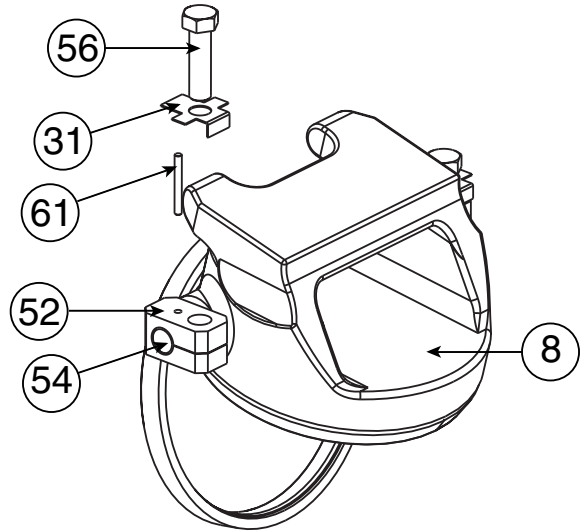


Figure 9.3C Tilting disc check valve 2 1/2–12" (65–300 mm).
The hardfaced seat is sealwelded.

IX SWING CHECK, TILTING DISC, TESTABLE & BALL CHECK VALVES

9.3.1 Tilting Disc Closure Kit Fit-up

(refer to Fig. 9.3D)

The tilting disc (08), swing on the hinge pin (54) which is stationary. The hinge pin is held in place by the hinge pin block (18) which is bolted to the body (01) by a hex bolt (56) and secured with lock washer (60). The hinge pin block hole diameter is oversized by approximately $\frac{1}{16}$ " (1.6 mm) to allow disc adjustment with body seat. Once adjusted, the hinge block, the hinge pin and the body hinge knob a hole is drilled for the dowel pin (17). This is done at assembly and should not be required in the field unless new spare part hinge block, hinge pin and or tilting disc is being replaced. If new parts must be replaced follow tilting disc adjustment procedure *Section 9.7.2 a) and b)*.

9.4 PARTIAL DISASSEMBLY - GASKET REPLACEMENT SWING CHECK AND TILTING DISC VALVES

Follow warning instructions in *Section III* before beginning disassembly.

NOTE: Numbers between brackets refer to item numbers in exploded view.

1. Remove body-cover nuts (16).
2. Once all the nuts are removed, the cover (50) and gasket (19) can be lifted from the valve body.
3. Install new spiral wound flexitalic gasket.
NOTE: If it is a soft iron gasket, apply lubrication (a light coat of oil).
4. Line up the cover with the body (1) and lower onto the body.
5. Apply the recommended lubricant to the body-cover studs and then install the body-cover nuts. Tighten in strict accordance with *Section 4.5, Body/Cover Torquing Procedure*.

9.5 TOTAL DISASSEMBLY - TILTING DISC

Follow warning instructions in *Section III* before beginning disassembly.

Further to steps 1 and 2 in *Section 9.4 Partial Disassembly*, the following steps illustrate total disassembly of the tilting disc valve.

1. The valve is now ready for inspection. At this point in the disassembly procedure, inspect the rotation of the disc (8) on the hinge pin (54) and the alignment between the disc and the seat (9). Ensure that the disc has free movement, is not binding and is not being restricted by any internal part.
2. After inspecting all points mentioned above, remove all internal parts by unfolding the lock washers (60) around the hex hd bolt (56) in body.
3. After hex HD bolts have been removed, the internal assembly can be removed from the body. *Fig. 9.3D* shows internal assembly.
NOTE: It is important to match-mark left and right side of hinge pin, hinge block and body, as these must go back in the same order at reassembly.

9.6 DETAILED MAINTENANCE TILTING DISC VALVE

9.6.1 Body/Cover (Gasket) Leakage

To maintain the tightness of a factory-tested bolted bonnet valve, it is essential to apply sufficient bolt tension at all times by having the proper torque on the nuts or cap screws. The original torque might be lost due to vibration, relaxation of material caused by frequent temperature and pressure fluctuations, or by creep in high temperature applications. Gasket bolt tension should be checked at approximately one-year intervals (see *Section 5.2.3 Gasket bolts retorquing procedure*).

NOTE: Standard gasket material is corrugated steel with graphite in the channels or spiral wound gasket.

For alternate gasket materials contact our service department.

9.6.2 Seat Leakage - Tilting Disc

9.6.2.1 Tilting Disc Repairs - General

If minor damage to disc seating surface is noted, it should be lapped out using a seat ring having an angle of 22°. Place (smear) medium grit lapping compound on seat ring and disc surface and rock seat ring in an up and down motion, with light pressure applied against the disc. If major repairs

become necessary, the disc should be repaired by machining. No more than 0.015" (0.4 mm) should be removed.

NOTE: Disc seating surface is of a Spherical Radius.

9.6.2.2 Tilting Disc Seat Repairs - General

If minor damage to seating surface is noted, up to 0.005" (0.08 mm), it should be lapped out by using original disc. Place (smear) 80-100 medium grit lapping compound on seat and disc surface. Reinstall disc and move back and forth, (open-close) slightly while applying light pressure against seat. Complete lapping with fine compound 220 or higher.

If major seat damage is noted, no greater than 0.015" (0.38 mm), it should be repaired using a cone shaped seat guided disc for hand or machine operation. Use stick on abrasive paper 60-120 grit to remove damage and 220 grit or higher for polishing. If stick on abrasive paper is not available use lapping compound similar grit.

NOTE: Tilting disc seat angle is 22°. A cone shaped disc or ring for hand or machine lapping may have to be fabricated with same seat angle.

9.6.2.3 Bearing Blue or Developer Test (Removal of disc is required)

Prior to reassembly, apply light coating of bearing blue or dye developer on the disc seating surface. Install the disc with hinge pin. Place the disc into the valve body and on the body knob hinge pin location. With one hand keep the disc from contacting the seat. With the other hand insert the dowel pins and hinge block. Secure the hinge block with bolts. Gently release the disc and push firmly against the seat. Remove the hinge block bolts and remove the disc. Verify for 100% seating contact.

Alternate Test Using Feeler Gauge:

Reassemble and install disc as described above. Using a 0.001" (0.025 mm) feeler gauge, with one hand press the disc against the seat, with the other hand check between the disc and seat all around the 360° degrees seating circumference. If the feeler gauge does not penetrate between seats, the disc is properly aligned with 360° degrees circumferential contact.

9.7 ASSEMBLY - TILTING DISC

9.7.1 Disc Assembly Fit-up

1. After completion of all repair work and successful blue ink or dye developer check. Clean the valve and all components thoroughly. Following match marks, insert hinge pin (54) into disc (80) lower the disc with hinge pin into the body (1) and onto the body knob hinge pin location. Insert dowel pins (17) in the holes provided. Install the hinge pin block (18) on top of hinge pin and body knob. Place lock washers (60) and secure tighten with hinge pin bolts (56) use appropriate torque value see torque Table 5.3A. Swing the disc open/close a few times to ensure disc free movement (no interference). Replace with a new gasket (19) and cover (50). Install body cover bolts and torque to appropriate valve in accordance with bolt torque procedure *Section 4.5 Table 4.5A*.

9.7.2 Tilting Disc Adjustment Procedure

1. This procedure is to be used whenever replacing with new spare part tilting disc (8), hinge pin (54), hinge pin block (18) or body seat (9).
 - a) If using new hinge pin and or hinge pin block, the disc must be aligned manually by pressing the disc against the body seat with one hand and then tighten hinge pin block with hinge pin bolts. This will keep the disc aligned. Drill new alignment location holes (dowel pin holes) (one per side).

NOTE: The new location holes must be away from the existing hole in the body knob.
 - b) If using new tilting disc and or body seat, disc alignment should be checked using existing down pin holes. If off align use the same adjustment procedure as described above in *paragraph a*).

IX SWING CHECK, TILTING DISC, TESTABLE & BALL CHECK VALVES

9.8 TOTAL DISASSEMBLY - SWING CHECK

Follow warning instructions in *Section III* before beginning disassembly.

Further to steps 1 and 2 in *Section 9.4 Partial Disassembly*, the following steps illustrate total disassembly of the swing check valve.

1. The valve is now ready for inspection. At this point in the disassembly procedure, inspect the rotation of the disc (8) on the hanger arm (51) and the alignment between the disc and the seat (9). Ensure that the hanger arm has free movement, is not binding and is not being restricted by any internal part.
2. After inspecting all points mentioned above, remove all internal parts by unfolding the tab washers (60) around the hex hd bolt (56) in body.
3. After hex HD bolts have been removed, the internal assembly can be removed from the body. *Fig. 9.8A* shows internal assembly.
4. Velan has two major styles of cast swing checks, (*Fig.9.8B*).

STYLE "A" 2 to 24" (50-600 mm)
150 to 600 C/S cast valves.

STYLE "B" ½ to 24" (15-600 mm)
150 to 300 S/S cast valves.

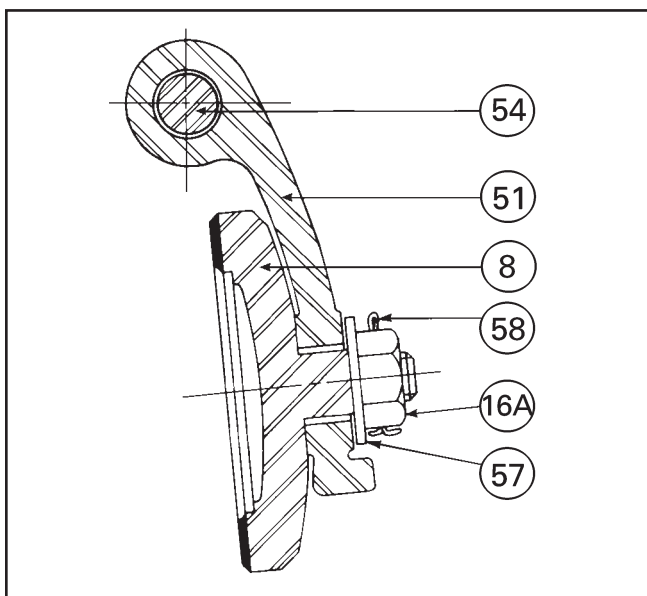


Figure 9.8A Disc unit

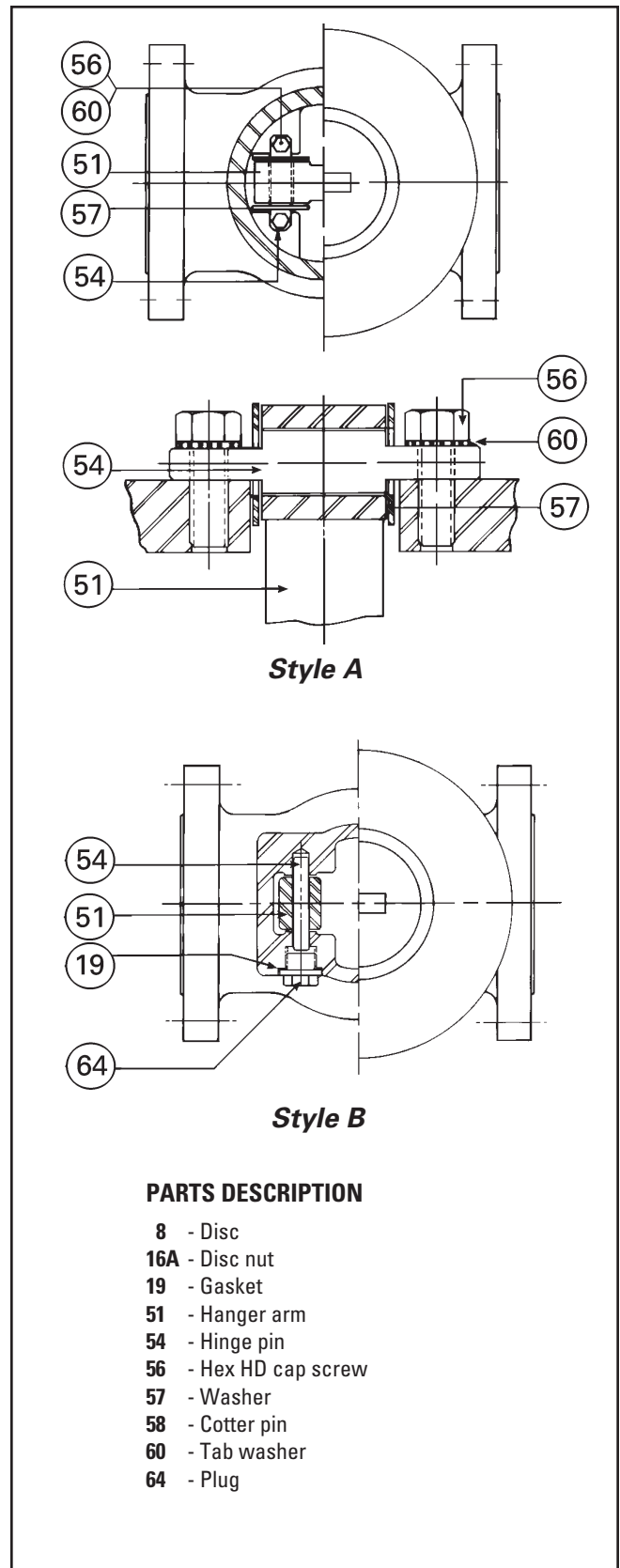


Figure 9.8B Swing check styles

PARTS DESCRIPTION

- 8 - Disc
- 16A - Disc nut
- 19 - Gasket
- 51 - Hanger arm
- 54 - Hinge pin
- 56 - Hex HD cap screw
- 57 - Washer
- 58 - Cotter pin
- 60 - Tab washer
- 64 - Plug

9.9 DETAILED MAINTENANCE SWING CHECK

9.9.1 Body/Cover (Gasket) Leakage

To maintain the tightness of a factory-tested bolted bonnet valve, it is essential to apply sufficient bolt tension at all times by having the proper torque on the nuts or cap screws. The original torque might be lost due to vibration, relaxation of material caused by frequent temperature and pressure fluctuations, or by creep in high temperature applications. Gasket bolt tension should be checked at approximately one-year intervals (see *Section 2.9 Recheck For Bolt Tightness procedure*).

NOTE: Standard gasket material is corrugated steel with graphite in the channels or spiral wound gasket.

For alternate gasket materials contact our service department.

9.9.2 Seat Leakage

9.9.2.1 Disc Repairs

1. Disassemble the valve as described in *Section 9.6*, and inspect the disc and seat for scratches, pitting marks or other damage.
2. If the seating face of the disc is scratched, it must be lapped. Slight pitting, grooving, or indentations no deeper than 0.005" (0.1 mm) can be removed by lapping. If defects cannot be corrected by lapping, the disc can be ground and/or machined. Velan recommends that no more than 0.031" (0.80 mm) be removed. After grinding is completed, lap the disc.
3. For the lapping, a flat plate (preferably made of cast iron) should be used. An abrasive lapping compound should be mixed together with olive oil and evenly distributed over the plate as shown in *Fig. 9.9A*. Only light, even pressure should be applied and the disc should be moved in a figure 8 motion on the plate. Lift the disc as often as possible to prevent accumulation of particles in one area and to allow for proper distribution of the lapping compound. The lapping plate should be turned slightly every few strokes to maintain a flat surface. The part should be lapped until seating faces are smooth.

4. Thoroughly clean off the lapping compound with a suitable cleaning fluid such as acetone or alcohol. Do not use solvents containing chloride or fluoride.



Figure 9.9A Lapping of disc

9.9.3 Seat Repairs

If repairs are required on the seat of a swing check valve, the procedure is the same as described in *Section 5.2.4.3, Seat Repairs – Gate*. The only difference between these seats is the angle of the seat face. They can be repaired with an automatic grinding or lapping machine or by the manual method.

9.9.4 Bearing Blue or Developer Test (Removal of disc is required)

To perform a bearing blue or developer test the disc unit must be preassembled as described in *Section 9.10.1 Disc Assembly Fit-Up*. First, smear or spray a light coating of bearing blue or dye developer over the disc seating circumference. With one hand, hold the disc at its post-disc nut area. With the other hand, secure the hinge pin with hex bolts. Gently release the disc against the seat. Press firmly and at the same time, move the disc partially back and forth.

Examine disc seating area for contact

1. If there is seating contact throughout the whole seating circumference (360°), the disc is well aligned with sufficient disc freedom. This also indicates that the seating surfaces are well mated and free of any damage.
2. If there is contact at the 3 or 9 o'clock position, the disc does not have sufficient freedom of movement in the disc hanger

IX SWING CHECK, TILTING DISC, TESTABLE & BALL CHECK VALVES

arm bore. The disc should be held, but not constrained, by the hanger arm. The disc should be free to find its own seat. This freedom comes from the clearance between the disc post OD and the hanger arm bore ID, and the gap between the hanger arm and the disc nut washer. Confirm that the clearances are adequate (Fig. 9.9B).

3. Whenever replacing with new hanger, hinge pin, or disc, it may be necessary to align the disc to be approximately in centre with the body seat. This may be accomplished by raising or lowering the disc. Refer to Fig. 9.10B
 - a) To raise the disc determine approximate amount the disc needs to be lifted, place shim(s) under the hinge pin as necessary.
 - b) To lower the disc, determine approximate amount the disc needs to be lowered and machine (mill) bottom of hinge pin flats as necessary.

NOTE: This procedure should be done before proceeding with steps 4 and 5.

4. If there is contact at 12 o'clock position (see Fig. 9.9C), the disc needs to be lifted by machining. To determine the amount to be removed, first lift the disc assembly by the hanger back stop then gently and slowly lower the disc. Determine the gap by checking at 6 o'clock with an "L" shaped feeler gauge or shim stock. Equal amount of material must be removed from the base of the disc post and top of the post shoulder, or as necessary to achieve ideal gap between the hanger arm and disc nut washer. Refer to Fig. 9.9B & D.

NOTE: This condition is rare for a valve with its original parts. It sometimes occurs when new seating surfaces have been added, when a new disc has been installed, or if a hanger arm has been replaced or bent (if bent, the hanger arm should be replaced).

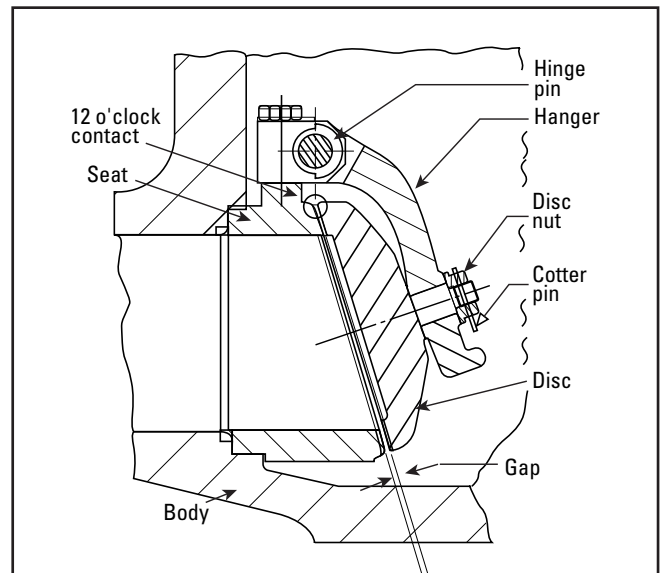


Figure 9.9C Twelve o'clock contact

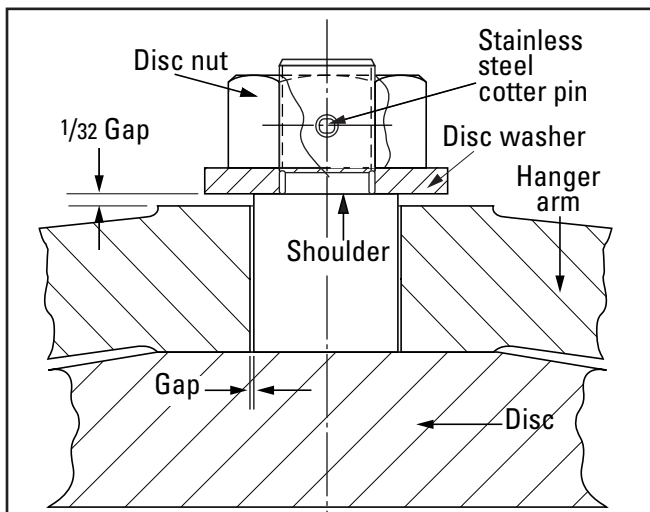


Figure 9.9B Disc assembly clearances

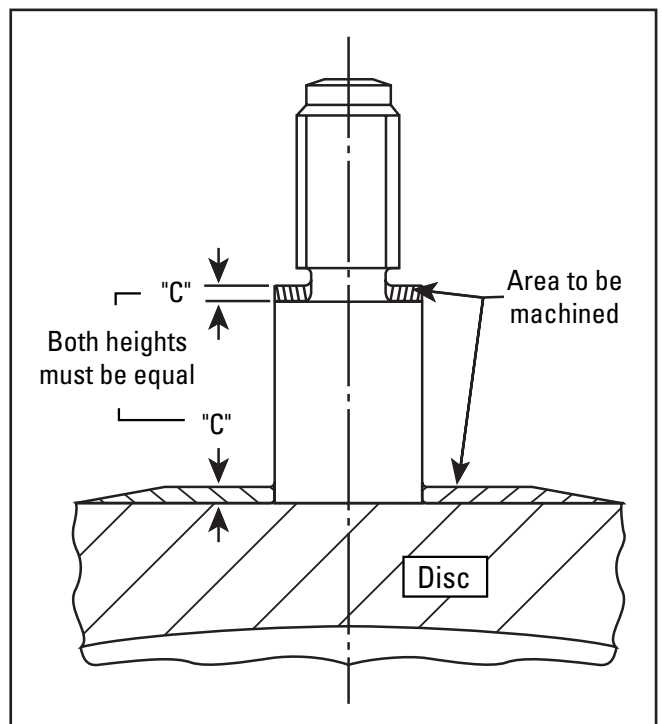


Figure 9.9D Material removal from disc post

5. If there is contact at 6 o'clock (see Fig. 9.9E), the disc is too high in the hanger arm, or the seats are too low. This sometimes happens after extensive lapping. To correct the problem, the disc must be lowered. First, lift the disc assembly by the hanger back stop then gently and slowly lower the disc. Determine the gap at 12 o'clock by checking with feeler gauge. Add a washer of equal thickness to the base of the disc post, as shown in Fig. 9.9F and machine equal amount the top of hanger arm, or as necessary to maintain ideal gap between the hanger arm and disc nut washer (refer to Fig. 9.9B)

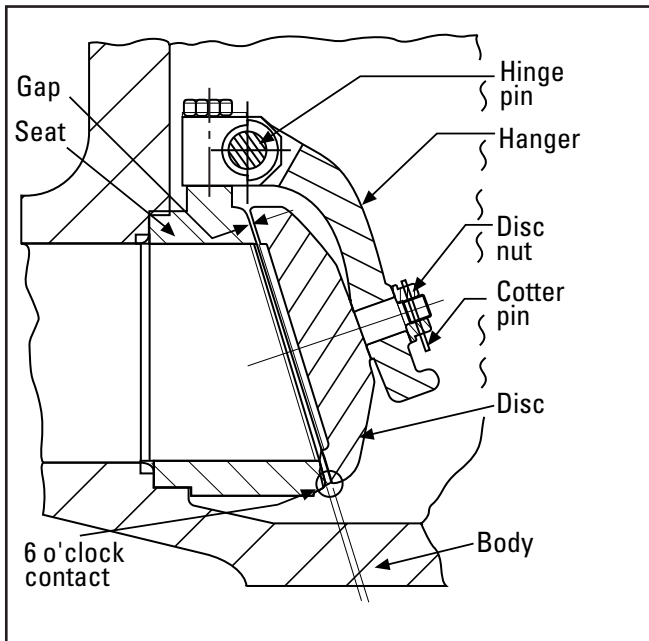


Figure 9.9E Six o'clock contact

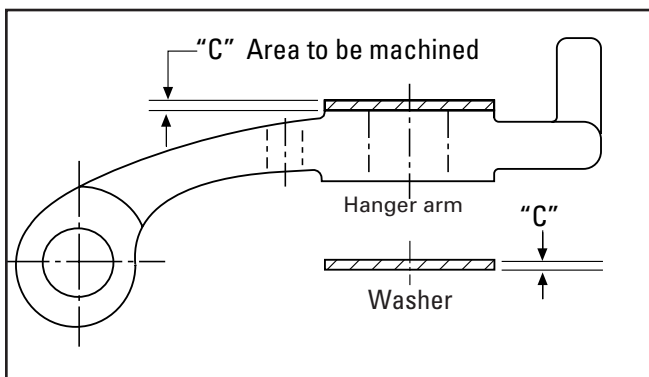


Figure 9.9F Machining of hanger arm

9.9.5 Paper Or Light Test (Removal of disc is not required)

Paper Test

With the disc unit assembled, clean, dry and installed in the valve, conduct a paper test (similar to the bearing blue and developer test). The paper should be 0.001 to 0.002" (0.025 to 0.050 mm) thick, 1" (25 mm) wide and about 8" (200 mm) long. Lift the disc off the seat enough to put the paper between the two seats and gently lower the disc. Pull the paper out with just enough force so that the paper does not rip. Do this test around the disc, taking special note at the top (12 o'clock) position, at the bottom (6 o'clock) position, and at both sides (3 and 9 o'clock). Make a record of where the paper holds and where the paper pulls without ripping.

1. If paper pulls at three o'clock or nine o'clock position, the disc cannot move enough in the disc hanger arm bore. The disc should be free to find its own seat. This freedom comes from the clearance between the disc post OD and the hanger arm ID, and the gap between the hanger arm and the disc nut washer. Confirm that the clearances are adequate (Fig. 9.9B).
2. If the paper pulls at the 12 o'clock position (contact at 6 o'clock) (see Fig. 9.9E), the disc is too high in the hanger arm, or the seats are too low. This sometimes happens with extensive lapping. To correct the problem, the disc must be lowered. The top of the hanger arm should be machined and a washer of equal thickness "C" must be added to the base of the disc post, as shown in Fig. 9.9F. This will lower or "drop" the disc.
3. If the paper pulls at the six o'clock position (contact at 12 o'clock) (see Fig. 9.9C), the disc needs to be lifted by machining. Material must be removed from the top of the disc post and base of the post, as shown in Fig. 9.9D.

NOTE: If paper cannot be used, the same test can be done using shim stock material.

Light Test

Use a small flash light and position it on the up stream side with the light facing the disc. Observe any light indication when disc is closed. Record the position of light (gap) and then proceed with repairs as for paper test above.

IX SWING CHECK, TILTING DISC, TESTABLE & BALL CHECK VALVES

9.9.6 Fitting of New Disc

When damage to the disc seating face cannot be removed by grinding or lapping, the disc must be replaced. All new discs coming from the factory are already ground and should be lapped before installation. See installation procedures in *Section 9.10, Assembly*.

9.10 ASSEMBLY

9.10.1 Disc assembly fit-up

This procedure is to be used when replacement of disc assembly parts or rework is required. Use it after you have made sure that the body and disc seats are clean, smooth, flat and free of any seating surface damage.

1. Preassemble disc unit (*Fig. 9.8A*), making sure that there is sufficient clearance between disc washer and hanger arm, disc post and hanger arm bore (*Fig. 9.9B*). Also ensure that hanger arm rotates freely around hinge pin. The hinge pin should fit comfortably into hanger arm bore and between body recess/spacer washers. A gap up to 0.065" (1.6 mm) is acceptable. A gap exceeding 0.065" (1.6 mm) may be cause for rejection. To determine actual gap, follow these steps (see *Fig. 9.10A*):
 - a) Measure both hinge pin od and hanger arm id bore and record gap, min. gap 0.005" (1.2 mm), max. gap 0.031" (0.8 mm).
 - b) Insert a screwdriver between body recess and hanger arm, or spacer (washer), if so equipped, push everything to one side, and measure the gap with a feeler gauge.
NOTE: Minimum gap required is 0.005" (0.12 mm). If the gap exceeds 0.065" (1.6 mm), a thicker spacer (washer) should be added.
 - c) Measure disc post od and hanger arm id bore and record gap, total gap: min. 0.020" (0.5 mm), ideal gap: 0.031" (0.8 mm), max. gap: 0.065" (1.6 mm).

9.10.2 Internal and Mid-Section Assembly

1. Mount disc on hanger arm, tighten disc nut and lock in place with cotter pin. Check that disc can rotate freely on hanger arm.
2. Place entire assembly carefully back into the body making sure that the hinge pin can move freely in an axial direction.

3. Insert tab washers and tighten down with hex bolts. Lock the bolts by turning up the ears on the tab washers.
4. After installation is finished, check the rotation of the disc on the hanger arm and the alignment between the disc and seat.
5. Install new gasket. On soft iron gaskets, apply lubrication (a light coat of oil).
6. Line up the cover with the body and lower onto the body.
7. Apply the recommended lubricant to the body-cover studs and then install the body-cover nuts. Tighten in strict accordance with *Section 4.5, Body/Cover Torquing*.

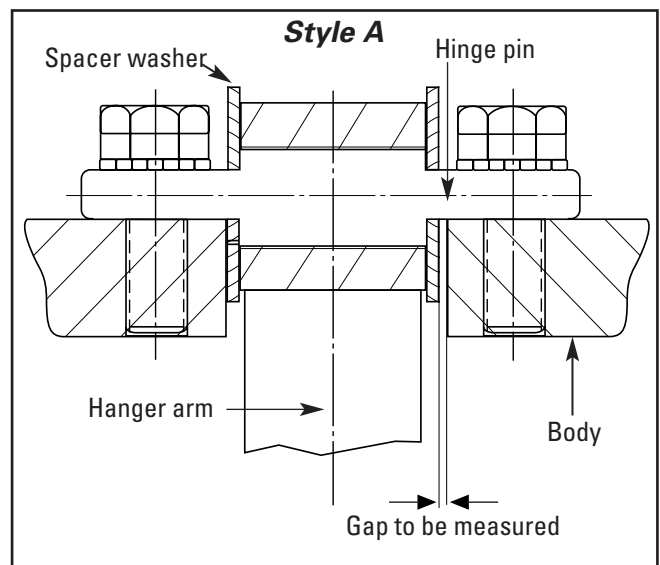


Figure 9.10A Body recess-spacer washer gap

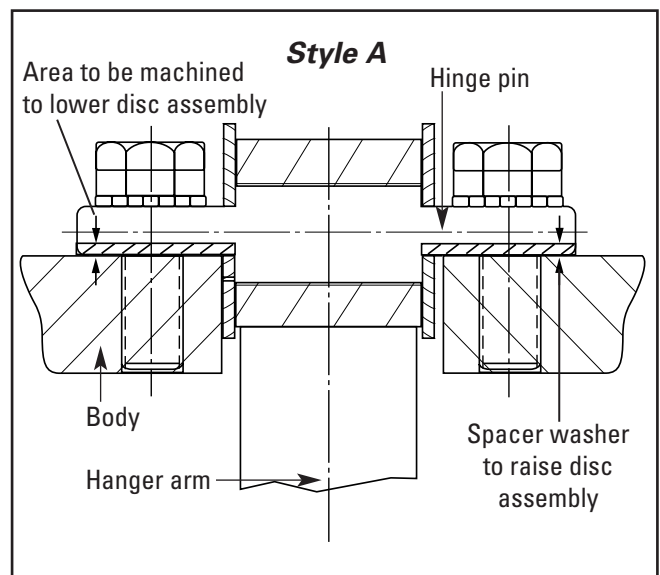


Figure 9.10B To centralize disc with body seat

9.11 DISASSEMBLY AND RE-ASSEMBLY OF BOLTED COVER TESTABLE SWING CHECK VALVE

9.11.1 Disassembly

Refer to section "Swing Check Valves" in Velan Manual VEL-CSVM-2000

1. Remove body cover bolts (15A, 16A & 60A). Place match marks and remove cover (50).
2. Bend-up tab washer ears (60B) and remove hexagonal head bolt (56A).
3. While holding the disc-hanger (8)(51) with one hand, partially pull out hinge pin (54) until disengaged from hinge shaft (4) and lift out complete disc-hanger assembly.
4. To separate the disc from hanger simply remove the cotter pin (58), unscrew the disc nut (16C) and remove disc out of the hanger arm.
5. Remove hexagonal head bolt (56B), tab washer (60C), retaining ring (24) and take off lever (112).
6. Remove packing nuts (16B), packing flange (11), gland bushing (12), Belleville spring washers (36A, 36B & 36C) and packing studs (15B).

CAUTION: Make note of the Belleville washer stacking arrangement, as they must go back in the same order during re-assembly.

7. Pull out the hinge shaft (4) through inside of body.
NOTE: For easier removal the packing may have to be removed first.
8. The valve is now ready for servicing and or parts replacement.

9.11.2 Re-Assembly

Follow warning instructions in Section III before beginning re-assembly

1. After the disc and hanger has been put together, install the hinge shaft (4) through inside of body, insert the hinge pin (54) into hanger (51), the hinge pin should not protrude the hanger, line-up with hinge shaft (4) and push in the hinge pin. Secure hinge pin with hexagonal head bolt (56A) and tab washer (60B) see torque table 5.3A bolt size and material and torque to appropriate value.

NOTE: Ensure the hinge shaft lifting end sits under the hanger lifting block.

2. Replace with new packing rings (13A & 13B), install Belleville spring washers (36A, 36B & 36C), gland bushing (12), the packing flange (11) and nuts (16B).

NOTE: Ensure the Belleville washers are stacked correctly. Torque the packings to value listed in project drawing, use consolidation method listed in manual for gate and globe valves, in this case move hinge shaft open-close and re-tighten packing, do this for approximately 3-4 times until fully consolidated (no more torque loss).

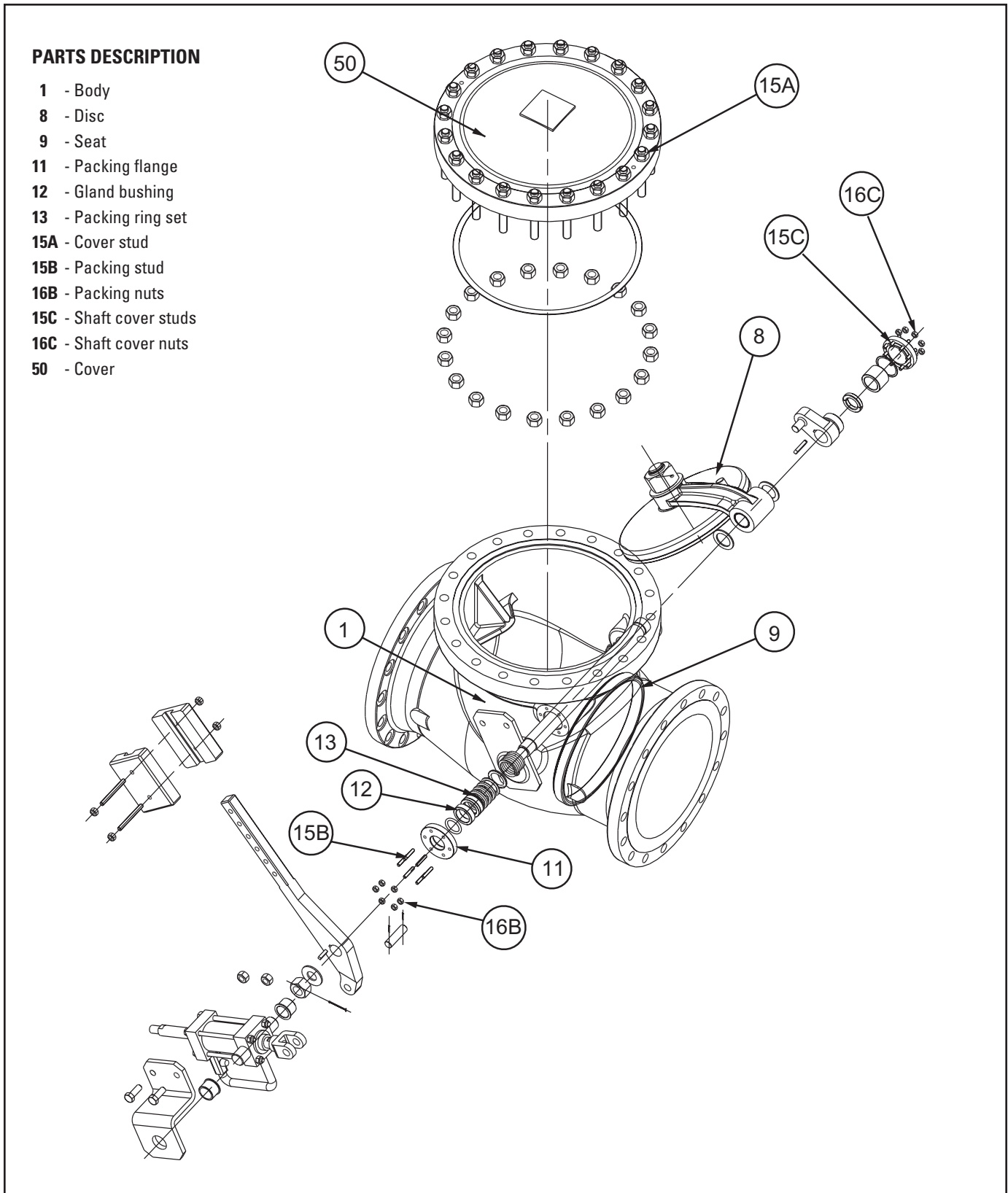
3. Place lever (112) on the hinge shaft square end and secure with retainer ring (24), secure lever with hexagonal head bolt (56B) and tab washer (60C).
4. Replace with new gasket (19), install the cover (50), lubricate the studs and nuts (15A and 16A) and torque to appropriate torque value - see torque table 4.5A in Velan Manual VEL-CSVM-99.

WARNING: Do not attempt to open disc under backpressure.

Do not interchange testable check valve parts from right-hand to left-hand side operation or vice versa. The parts may not fit and could cause operational interference.

IX SWING CHECK AND TILTING DISC VALVES

9.11.3 BOLTED COVER POSITIVE ASSIST SWING CHECK VALVE: EXPLODED VIEW



9.12 DISASSEMBLY AND RE-ASSEMBLY OF BOLTED COVER BALL CHECK VALVE

9.12.1 Disassembly

Refer to section "Swing Check Valves" in Velan Manual VEL-CSVM-2001.

1. Remove body cover bolts (15, 16 & 60). Place match marks and remove cover (50).
2. Match mark Ball cage unit (47) with body (1) using the cage unit pull up holes, screw in two eyebolts and lift out complete cage unit.

NOTE: It may be necessary to use a hoist or come along to lift out the cage unit. Care should be taken while lifting to ensure the cage unit does not become cocked.

3. With the cage unit out of the valve body, remove ball (6), set screw (35) and the seat (9).

NOTE: The seat is screwed in type, to remove, unscrew counter clockwise.

4. Once the seat has been taken out of the cage unit, remove seat insert (72), and if necessary "O" ring (74).

NOTE: Ball stopper (49) is welded to cover, to remove the stopper grind off the welds flush with cover and stopper.

5. Seat insert (72) seating angle is 25° (degrees), in case of damage it must be replaced.
6. The seat (9) stellite surface angle is 30° (degrees). In case of soft seat failure this acts as a secondary seal. Under normal conditions when the ball makes contact with soft seat (seat insert) the secondary stellite seating surface should have a gap of approximately 0.014" (0.35 mm). In case of damage to this surface a maximum of 0.010" (0.25 mm) can be removed by lapping. If damage is in excess of 0.010" (0.25 mm) the seat must be replaced.

9.12.2 Re-Assembly

Follow warning instructions in Section III before beginning re-assembly

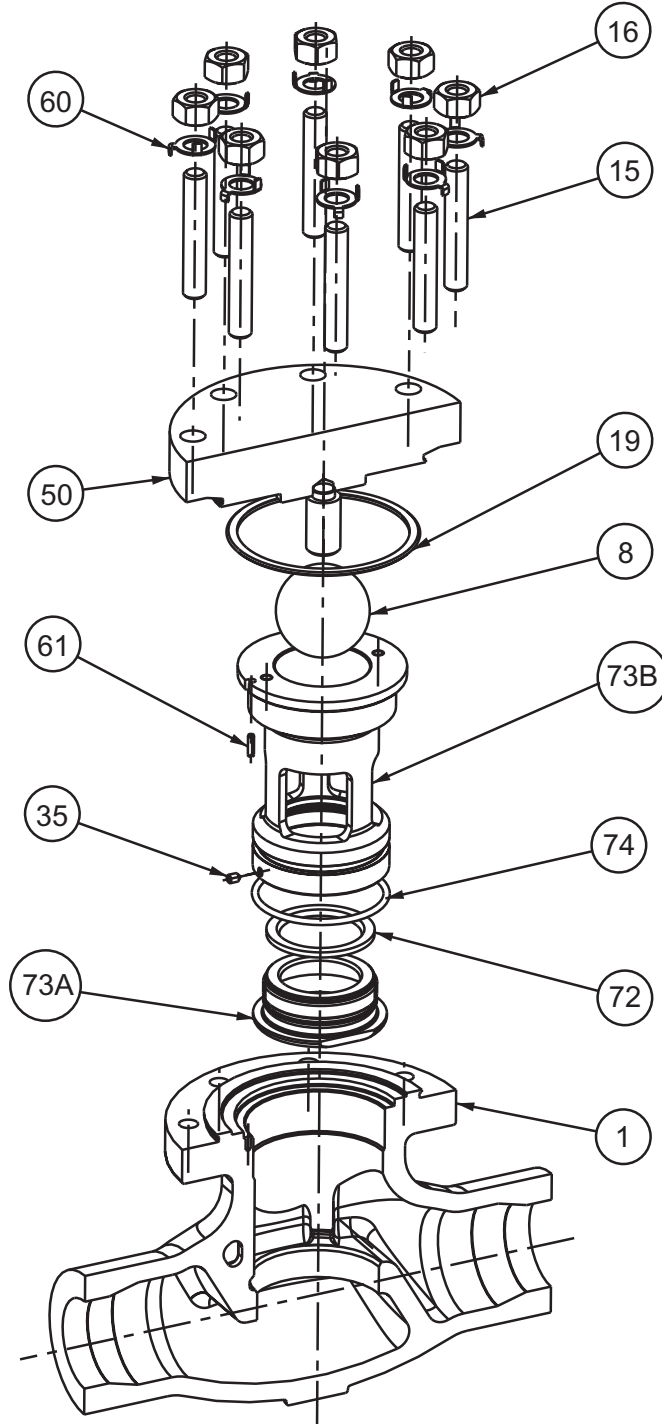
1. Slide in seat insert (72) into cage unit (47), screw in clockwise the seat (9) until metal to metal with bottom of cage unit. Secure seat with set screw (35).
2. Place the ball (6) into cage unit and install O-ring (74).
3. Carefully lower the entire unit into the valve body. Follow match marks and ensure it has engaged with centering pin (61).
4. Replace with new gasket (19). Lubricate with anti-seize compound and install studs (15), install cover (50), place tab washers (60), lubricate stud / nut threads and nut flats and torque in accordance with Velan torquing procedure and torque table 4.5A in Velan Manual VEL-CSVM-2001.
5. Secure nut with tab washer (60) by bending tab ears against the nut flat and cover.

IX SWING CHECK AND TILTING DISC VALVES

9.12.3 BALL CHECK CAGE UNIT: EXPLODED VIEW

PARTS DESCRIPTION

- 1 - Body
- 8 - Ball
- 15 - Stud
- 16 - Nuts
- 19 - Gasket
- 35 - Set screws
- 50 - Cover
- 60 - Tab lock washers
- 61 - Dowel pin
- 72 - Soft seat
- 73A - Soft seat retainer
- 73B - Check ball cage
- 74 - O-ring



10.1 PROCEDURE FOR REMOVING MANUAL GEAR ACTUATOR

Velan valves can be equipped with a variety of manual gear actuators. Actuators of this type come in two main styles: one for applications where only rotary torque is required, and one for applications requiring both rotary torque and linear thrust.

Generally, all pressure must be relieved from both sides of the valve before removal of the manual gear actuator. Exceptions to this rule include valves which have a self-contained unit.

IMPORTANT: Determine the actuator style that is mounted on the valve you are servicing. If it is not possible to determine the style of actuator, refer to the actuator manufacturer's maintenance and instruction manual or contact your local Velan representative for more technical assistance.

10.1.1 Style I (Fig. 10.1A)

1. Valves with *Style 1* manual gear actuators are equipped with a self-contained thrust unit. This actuator can be removed under line pressure.
2. Remove housing actuator bolting (17B).
3. Using a hoist, raise the actuator (32) above the stem (4) and stem nut (88).
4. To repair the actuator, refer to the manufacturer's instruction manual. If there is further work to do on this valve, refer to the appropriate section of this manual.
5. The disassembly of the self-contained thrust unit follows the same procedure as described in *Disassembly Valve Top Works*.

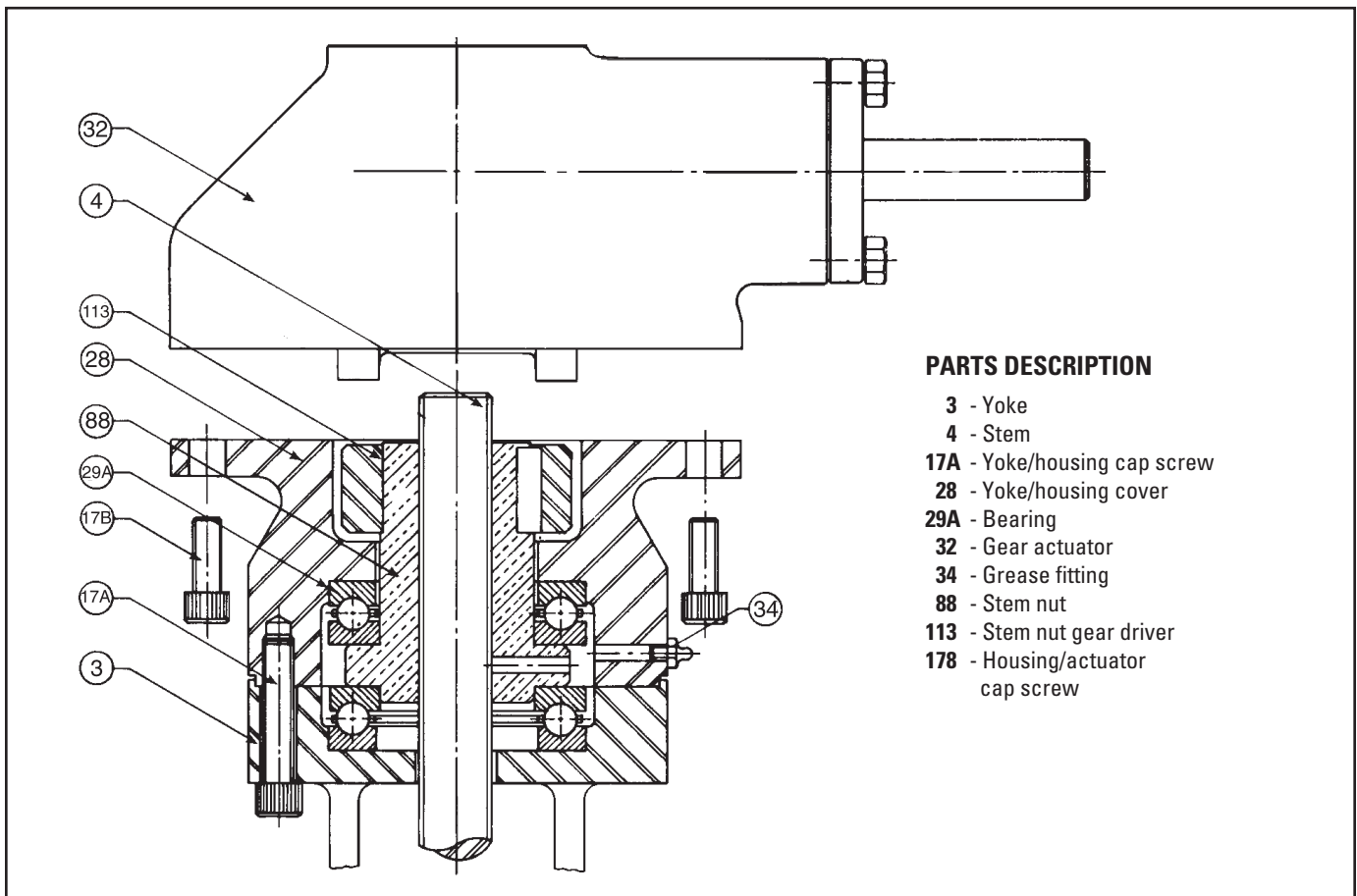


Figure 10.1A Manual gear actuator—Style 1

X APPENDIX

10.1.2 Style 2 (Fig. 10.1B)

1. Valves with a Style 2 manual gear actuator are equipped with a self-contained thrust unit which will be removed with the actuator. Therefore the actuator cannot be removed under line pressure. The pressure must be relieved.
NOTE: In case the valve can be fully opened, then the actuator can be removed under line pressure. Follow steps 3, 4, 5 and 6.
2. The valve should be in a partially open position.
3. Make sure that the packing flange nuts are tight.
4. Remove the yoke-actuator bolting (17B).
5. Turn the actuator handwheel clockwise. This will cause the actuator (32) to rise and unthread from the valve stem. As this takes place, the weight of the actuator should be supported by a hoist to prevent damage to the stem thread or any internal part of the valve.

6. To repair the actuator, refer to the manufacturer's instruction manual. If there is further work to be done on the valve, refer to the appropriate section of this manual.

CAUTION: When reinstalling actuator, the valve should be in a slightly off-seated position (main seat or backseat) for centering purposes.

IMPORTANT: Velan does not recommend interchanging of actuator parts as this may cause parts to be misfitted that could result in actuator damage making the valve inoperable. If parts must be interchanged contact Velan Customer Service Department for instruction.

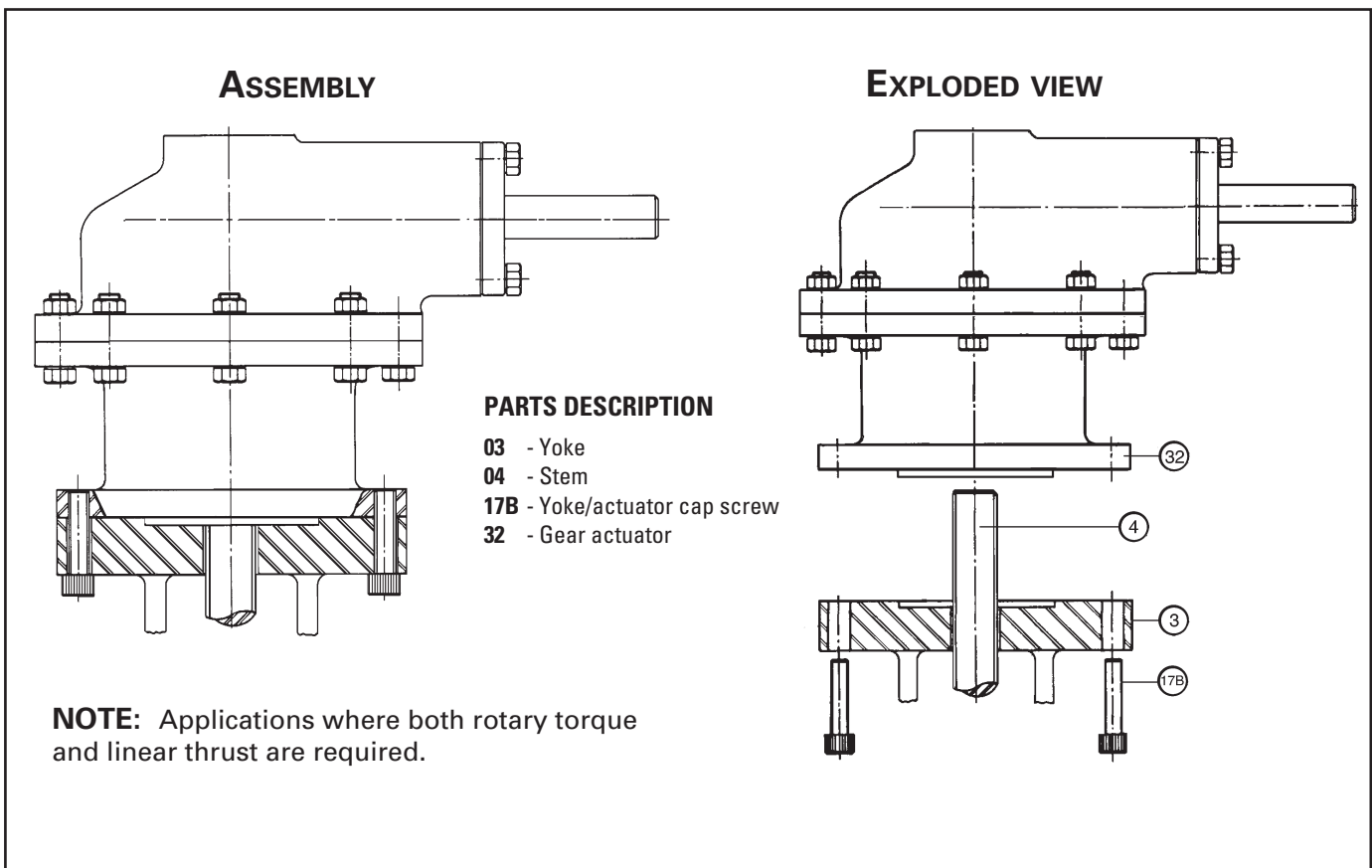


Figure 10.1B Manual gear actuator—Style 2