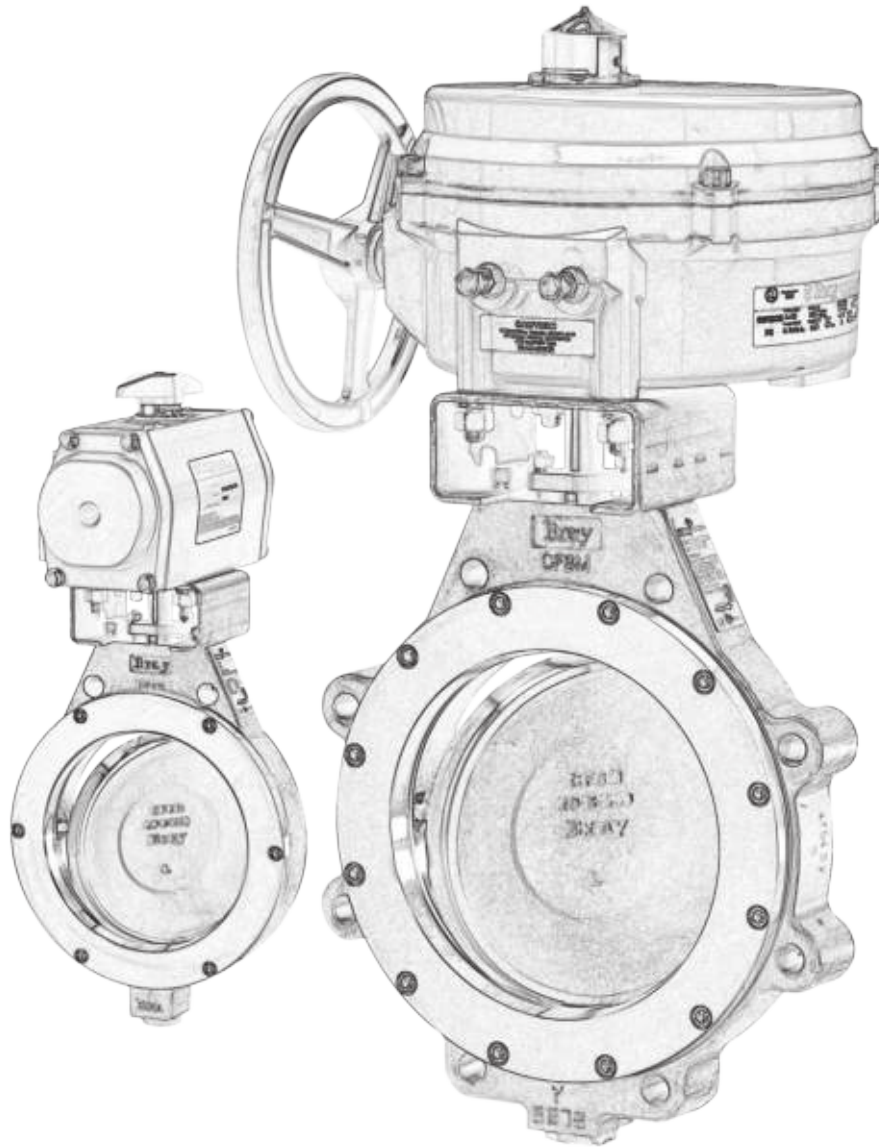


BRAY/McCANNALOK

DOUBLE OFFSET BUTTERFLY VALVE

Installation, Operation and Maintenance Manual



 **Bray**[®]

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THE HIGH PERFORMANCE COMPANY



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Read and Follow These Instructions Save These Instructions

DEFINITION OF TERMS

 WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
 CAUTION	Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.
NOTICE	Used without the safety alert symbol indicates a potential situation which, if not avoided, may result in an undesirable result or state, including property damage.

INTRODUCTION

The Bray/McCannalok high performance butterfly valve combines the advantages of trunnion type ball valves with the easy operation, light weight and low cost of butterfly valves. One basic design is suitable for a wide range of services, including oxygen, chlorine, sour gas, vacuum and steam applications.

Features Include:

- Bubble tight shutoff provided throughout a wide range of operating conditions.
- Suitable for both modulating and on/off services, the Bray/McCannalok butterfly valve is easily automated with your choice of manual operators, electric and pneumatic actuators, positioners and controls.
- The Bray/McCannalok is available in a Fire Safe model qualified to API 607 6th Edition and BS 6755 Part 2.
- The Bray/McCannalok is also available in a Metal Seated only model providing IEC 60534-4 Class IV bidirectional leakage rates through full pressure range.

For additional information about Bray/McCannalok butterfly valves – including application data, engineering specifications and actuator selection visit www.bray.com or contact your Bray distributor or sales representative.

INSTALLATION

Special instructions for Fire Safe and Metal Seated valves appear on page 5.

1. The Bray/McCannalok valve is designed to be mounted between ANSI flanges. When the valve is open, the disc will extend into the pipe on both sides of the valve (further on the body side than the seat retainer side of the valve). Piping must be large enough to allow the disc to clear the pipe. Tables 1 and 2 show the minimum pipe ID allowable and standard pipe IDs. In

general, Class 150 valves will clear Schedule 40 pipe and Class 300 valves will clear Schedule 80 pipe. Class 600 will clear Schedule 80 pipe in sizes 3, 4 and 6 and Schedule 100 pipe in sizes 8, 10, 12, 14 and 16.


CAUTION

If handle or actuator has been removed do not rotate disc beyond full open or closed position as this could cause damage to sealing surfaces.

NOTE: Bray/McCannalok valves are equipped with travel limiters to prevent over closure. The valve is opened by turning the shaft counterclockwise, closed by turning the shaft clockwise. The double “D” flats or keyway at the top of the stem is parallel to the disc edge.

NOTICE

For maximum service life, install the valve with the seat retainer upstream. Positive shutoff will be obtained with the valve in either position; however, installation with the seat retainer upstream will give longer service life, especially in erosive services.

2. With the disc in the closed position, carefully center the valve between the flanges. Guide holes (wafer pattern valve) or tapped holes (lugged valves), which match the ANSI pipe flange holes assist in positive alignment.
3. Use standard torques when bolting valve into the line. The seat is sufficiently compressed by the seat retainer and additional force from flange bolting is not required.
4. Gaskets should conform to the requirements of API 601 3rd Edition for ASME B16.5 class flanges. Spiral wound gaskets, such as Flexitallic CG or CGI series, conforming to ASME B16.20 are acceptable.

MAINTENANCE

1. Reasonable precautions should be taken before beginning work on the valve. Protective clothing, as required by the specific line fluid, should be worn.



WARNING

Before removing handle or the actuator from the valve, or before removing seat retainer from a valve in dead end service, close the valve and depressurize the line.

2. The eccentric design of the Bray/McCannalok may allow line pressure to open the valve if the handle/actuator is not in place while the valve is under pressure.



WARNING

Do not pressurize the line without a handle or actuator on the valve.

3. The Bray/McCannalok valve must be in the closed position to be removed from the line.
4. Begin all work on a valve that has been removed from the line by cleaning the valve, removing any grit or scale.



CAUTION

When handling the valve, care should be taken not to scratch the disc edge or seat.

5. Replacement seats, seals and other parts are available from authorized distributors. Contact your distributor or sales representative for details on price and delivery.

LONG TERM STORAGE

1. If valves are to be stored before installation, storage must be carried out in a controlled manner as follows:
 - a. Valves must be stored in a closed, clean and dry environment.
 - b. Valve disc to be in closed position and the body end faces must be covered with appropriate flange protection.
 - c. Periodically, the valves should be checked to ensure the above conditions are maintained.
2. These are general guidelines for valve storage. Please consult the factory for information regarding specific requirements.

HANDLING REQUIREMENTS

Packed Valves

1. **Crates:** Lifting and handling of the packed valves in crates will be carried out by a fork lift truck, by means of the appropriate fork hitches.
2. **Cases:** The lifting of packed valves in cases will be carried out in the lifting points and in the center of gravity position which has been marked. The transportation of all packed material must be carried out safely and following the local safety regulations.

Unpacked Valves

1. Lifting and handling of valves should be carried out by using appropriate means and observing the carrying limits. Handling must be carried out on pallets, protecting all machined surfaces to avoid any damage.
2. With large bore valves, rigging the load must be carried out by using the appropriate tools to prevent the valve from falling or moving during the lifting and handling.



CAUTION

For valve handling and/or lifting, the lifting equipment (fasteners, hooks, etc.) must be sized and selected while taking into account the valve weight indicated in our packing list and/or delivery note. Lifting and handling must be made only by qualified personnel.

Fasteners must be protected by plastic covers in sharp corner areas.

Caution must be taken during the handling to avoid this equipment passing over workers or over any other place where a possible fall could cause injury or damage. In any case, local safety regulations must be respected.

STEM SEAL REPLACEMENT

Refer to Standard Bray/McCannalok Parts Diagram for part identification.

1. If required, remove handle assembly. Remove socket head cap screws (25) and lock washers (24). Remove mounting bracket (21). For actuated valves, unbolt mounting bracket from body and lift actuator assembly off stem.

NOTICE

Note assembly positions before removal.

2. Remove gland retainer nuts (20) and lock washers (19). Remove gland retainer (18) anti-blowout retaining ring or split ring (17) (depending on size) and gland ring (16). Table 3 shows the correct number of stem seals to install in each valve.

NOTICE

The Class 600 valves have stem seal sets located at the upper and lower portions of the shaft. These instructions apply to both the upper and lower stem seals.

3. Remove the grounding washer (14) if present. Remove stem seals (13). Do not remove thrust washer (12) unless further valve disassembly is required.



CAUTION

When handling stem seals, care should be taken not to scratch stem or body stuffing box bore.

4. Examine body stuffing box bore and stem, clean as necessary to remove any corrosion or foreign matter before installing new stem seals.
5. Install new stem seals in body stuffing box one at a time, TFE (white) stem seals first, with the carbon fiber ring at the top. Stagger stem seal joints 180° apart when installing. Tamp each stem seal to bottom before installing next stem seal. Table 3 shows the correct number of stem seals to install in each valve.

NOTICE

On the larger valves it will be necessary to compress each stem seal before adding the next.

6. Install a new grounding washer (14) if required. Slide gland ring (16) over stem on top of seals (13). Install anti-blowout retaining ring or split ring (17) (depending on valve size). Slide gland retainer (18) over stem and onto gland studs (15). Place lockwashers (19) and hex nuts (20) on studs (15) and tighten finger tight. Tighten gland nuts (20) evenly and alternately to the proper torque value given in Table 4.

7. Remount actuator, or mounting bracket (21) with lock washers (24) and cap screws (25), or handle assembly. Ensure that mounting bracket cap screws are tightened to the correct torque per Table 7.
8. Operate valve open and closed several times to check for binding and to set the stem seals. Loosen gland nuts (20) and retighten to torque value given in Table 4.

SEAT REPLACEMENT

Refer to Standard Bray/McCannalok Parts Diagram for part identification.

1. With the disc in the closed position, remove the valve from the line.
2. Lay the valve down with the disc in the closed position and the seat retainer side facing up.
3. Remove the socket head cap screws (22), the seat retainer (5) and seat (4).
4. Carefully clean the seat area in the body and seat retainer. Remove foreign material, dirt, etc. Check disc seating area for nicks or scratches.
5. With the disc in the CLOSED position, place the new seat (4) on disc (2), carefully centering it in the recess in the body.



CAUTION

Do not shift the retainer in order to align holes. It may shift the seat from its correct position.

6. Align the holes in the seat retainer (5) with matching holes in body and carefully place in position on top of seat (4).

Lightly grease cap screw (22) threads and bearing areas.

Step 6.1: Install the cap screws and tighten all cap screws finger tight.

Step 6.2: Tighten the cap screws to approximately 30% of the torque value listed in Table 4 in a crisscross pattern.

Step 6.3: Repeat Step 6.2, increasing the torque value to approximately 60% of the final torque value.

Step 6.4: Repeat Step 6.3, increasing the torque value to the final required torque value.

Step 6.5: Open the disc. Re-torque all cap screws to the final required torque value given in Table 4.

7. A final tightening should be performed/checked prior to installation. Operate valve several times and examine seat for any damage before reinstalling the valve in the line.

DISC AND STEM REPLACEMENT

Refer to Standard Bray/McCannalok Parts Diagram for part identification.

NOTICE

Stem and disc are supplied as a matched set with taper pins and are to be replaced as a set.

1. For handle-operated valves remove handle assembly. Remove socket head cap screws (25) and lock washers (24). Remove mounting bracket (21). For actuated valves, unbolt mounting bracket from body and lift actuator assembly off stem.

NOTICE

Note assembly positions before removal.

2. Remove gland retainer nuts (20) and lock washers (19). Remove gland retainer (18), anti-blowout retaining ring or split ring (17) (depending on valve size) and gland ring (16). Remove grounding washer (14) if present.
3. Remove stem seals (13).



CAUTION

Take care not to scratch stem or stuffing box bore.

4. Remove locating plug or bottom plate (6) and gasket (7).
5. Remove cap screws (22), seat retainer (5) and seat (4).
6. Turn disc (2) to the full open position and drill out tack welds on large end of taper pins (23).



CAUTION

Take care to support valve so that disc surfaces are not scratched.

7. Drill sizes to remove tack welds as given in Table 5. Use center-punch to dimple center of tack welds prior to drilling.
8. Place valve in flat position, with flat face of disc up. Support disc and body on wooden blocks to protect disc and body surfaces. Disc will rest in partially open position.
9. Knock out taper pins (23) using a rod or punch on small end of pin (opposite tack weld). It may be necessary to lift body and rotate disc slightly to do this. Make sure disc is resting on wood block since it will swing freely on stem with pins removed. When pins (23) are out, lay body down so disc and body are evenly supported on flat surface.

10. Using a brass bar or drift punch, knock stem (3) loose and pull from body. After long or severe service this may take considerable force.



CAUTION

Be careful not to damage bearings (8), spacers (9) or body (1).

11. Disc spacers (9) are used at top and bottom of disc to properly position disc in body. Proper spacers were selected at initial assembly and rarely require replacement. The location of these spacers should be noted and the spacers marked at disassembly so that they are reinstalled in the same positions, top and bottom.
12. Separate body from disc and remove thrust washer (12) from packing bore.
13. Examine stem bearings (8) for excessive wear. If removed from body, **note position and mark to reinstall in same location**. If bearing liner is worn through to the shell, or severe damage is evident they should be replaced. Replacement is rarely needed.
14. Clean body thoroughly to remove all dirt, foreign matter, rust, etc.
15. Place the body (1) flat, seat retainer side up and support it on wooden blocks sufficiently above the work surface as to facilitate insertion of the new disc (2) in open position. Lower the disc into position, aligning the bores in body and disc.
16. Insert new stem (3) in body (1) with large end of the taper pin holes toward the top. Assemble disc spacers (9) as stem (3) is inserted, making sure that spacers are returned to original locations as marked.
17. Align taper pin holes in disc and stem and install taper pins (23). Drive pins in tightly with rod or punch and tack weld each pin (23) to disc (2) at large end of pin.
18. Install new gasket (7) on locating plug (6a) or bottom plate (6b) and install plug or plate in body. See Table 7 for locating plug and bottom plate torques.
19. Install new stem seals, following instructions in "Stem Seal Replacement" section. (See page 3)
20. Install new seat, following instructions in "Seat Replacement" section. (See page 3)
21. Remount handle assembly or actuator and operate valve several times to verify proper operation. Examine disc (2) and seat (4) for any damage before reinstalling in line. Ensure mounting bracket cap screws (25) are tightened to torques listed in Table 7.

SPECIAL INSTRUCTIONS FOR BRAY/MCCANNALOK FIRE SAFE AND METAL SEATED INSTALLATION

The **Bray/McCannalok Fire Safe** valve will provide fire safe shutoff with flow in either direction, meeting API 607 and British Standard 6755 part 2 criteria, as well as bubble-tight shutoff in either direction in normal service. However, installation with the seat retainer upstream provides maximum protection to the soft seat and will increase seat life, especially in erosive services.

The **Bray/McCannalok Metal Seated** valve has been extensively performance tested in our state-of-the-art technology center and test laboratory. The Inconel® 718 metal seat has been contoured to provide control, strength and flexibility in high temperature applications.

Installation bolting information given for the standard Bray/McCannalok valves is also applicable to the Fire Safe and Metal Seated versions.

Stem Seal Replacement

The procedure for replacement on page 3 also applies to Metal Seated valves that use TFE (white) seals. For Fire Safe and Metal Seated valves that use graphite stem seals, use the following exceptions:

- Graphite stem seals are used in the Fire Safe valves and as an option for Metal Seated valves. The arrangement of the two types of stem seals when installed is:
 - bottom seal - carbon fiber braided ring
 - center seals - graphite rings
 - top seal - carbon fiber braided ring.
- Table 3 shows graphite only stem seal quantities for class 150 and 300 valves.
- Table 6 shows gland nut torques to be used for graphite only stem seal sets.

Seat Replacement

- Fire Safe valves will have both a soft seat (4) and metal seat (26) while the Metal Seated valves have only a metal seat (26). Ignore soft seat instructions for Metal Seated valves.
- With the disc in the closed position, remove the valve from the line.



WARNING

Verify line is depressurized prior to removal.

- Lay the valve down with the disc in the closed position and the seat retainer side facing up.
- Remove socket head cap screws (22), seat retainer (5), metal seat (26), gaskets (27) and soft seat (4).
- Carefully remove graphite gaskets (27) from metal seat (26). Do not bend or crimp metal seat. All traces of the old gaskets must be removed.
- Clean seat retainer (5) and body (1) surfaces to remove any adhering gasket material, corrosion, or other foreign

material. Examine disc seating surfaces for damage and examine seating surface of metal seat and soft seat for wear or damage. Replace if damaged.

- Place new soft seat (4) on disc (2), carefully centering in body recess.



CAUTION

Handle the graphite gaskets (27) carefully as they are thin and are easily torn or scratched.

- Place new graphite gasket (27) on the body. Position metal seat (26) over the disc, lip facing out, on top of the soft seat (4). Place another graphite gasket (27) on top of the metal seat. Graphite gaskets can be first attached to the metal seat to simplify the assembly. Spray a suitable adhesive, like 3M Super 77 general purpose adhesive or similar, in 3 or 4 spots on both sides of the metal seat to hold the gaskets in position.



CAUTION

Be careful that seat does not shift when retainer is installed.

- Align holes in seat retainer (5) with holes in body (1) and seat and carefully place seat retainer in position, on top of seat.

Lightly grease cap screw threads and bearing areas.

Step 9.1: Install the cap screws and tighten all cap screws finger tight.

Step 9.2: Tighten the cap screws to approximately 30% of the torque value listed in Table 4 in a crisscross pattern.

Step 9.3: Repeat Step 2, increasing the torque value to approximately 60% of the final torque value.

Step 9.4: Repeat Step 3, increasing the torque value to the final required torque value.

Step 9.5: Open the disc. Re-torque all cap screws to the final required torque value given in Table 4.

- Lubricate the disc (2) edge with molybdenum disulfide spray or similar lubricant, if available. As a minimum, lubricate the disc edge with light machine oil or light grease. Operate valve several times and examine seat for damage before reinstalling in line.

Disc and Stem Replacement

The same procedures apply to Fire Safe and Metal Seated valves as to the Standard valves, with the addition of the special requirements for stem seal and seat replacement.

FIELD ADJUSTMENTS – ALL VALVES

Stem Seal Leakage – Should leakage occur at the stem seals, it may be stopped by retightening the gland retainer nuts (20) to the values specified in Table 4 or Table 6. Class 600 valves have both an upper and lower stem seal set.

NOTICE

Do not overtighten gland nuts (20), as this may cause increased operating torque and improper valve operation or closure.

If the leakage cannot be stopped by this action, the stem seals require replacement.

Adjusting Valve Closure – Valves with gear operators or electric/pneumatic actuators may require adjustment of the travel stops in the actuator to properly close valve for tight shut off. The following procedure should be followed to set travel or limit stops. (It is recommended that the valve be removed from line for this procedure and actuator mounting).

1. Using a straight-edge and vernier or depth caliper, measure the distances from the face of the seat retainer to the disc (valve closed) face at the 3 o'clock and 9 o'clock positions (stem is at 12 o'clock position). The measurements must agree within 1/16" (0.062").
2. If they do not agree, disc must be rotated in the direction of the larger dimension. If the 3 o'clock dimension is larger, the disc is not fully closed and must be rotated in the "close" direction more. If 9 o'clock dimension is larger, disc is over-closed and must be opened slightly.
3. The valve disc is at the full open position when the disc is perpendicular to the body. Set the "open" actuator stop for this position.



CAUTION

Do not allow the valve to over open as this may damage the disc seating surfaces by hitting body or attached piping.

4. On gear operators, loosen and adjust the closing stop screw to permit proper disc positioning. Adjust and lock down when disc closure is within measured tolerance in Step 1. Open and close valve; recheck measurements before reinstalling in line.

NOTICE

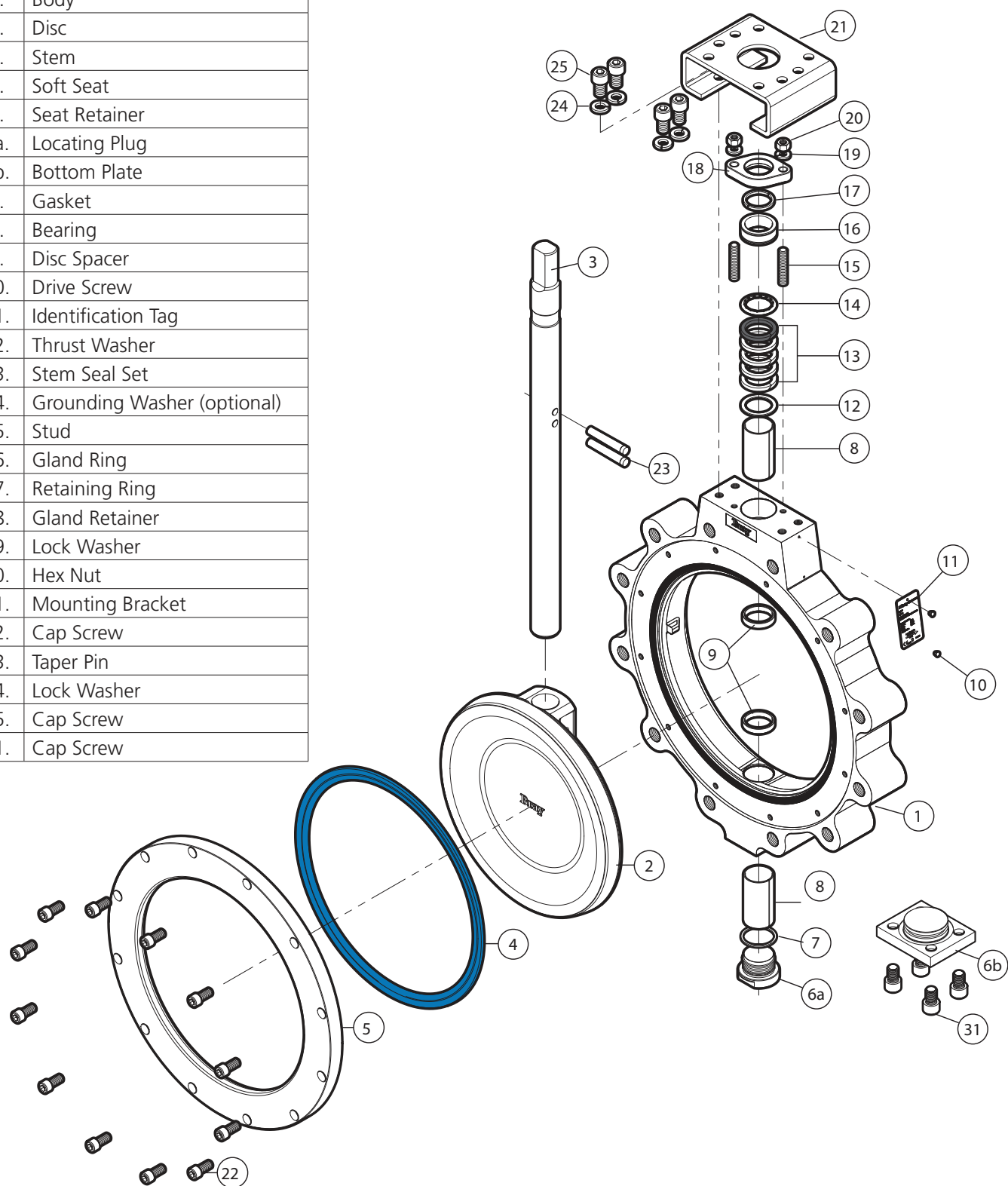
The setting of the actuation device's close travel stop is important. The valve has an internal travel limiter to ensure valve disc cannot be over closed. To ensure that the valve travel limiter is not damaged, the actuator close travel stop bolt must be at a position just before valve disc contacts its travel limiter.

5. For other power actuators, consult the manufacturer's instructions for setting travel stops, as these vary with actuator model and type.
6. If removing the valve from the line is not practical, as a crude remedy the disc can be placed into a position in the seat at which the leakage stops and travel stops are adjusted to this position.

APPENDIX A - PARTS DIAGRAMS

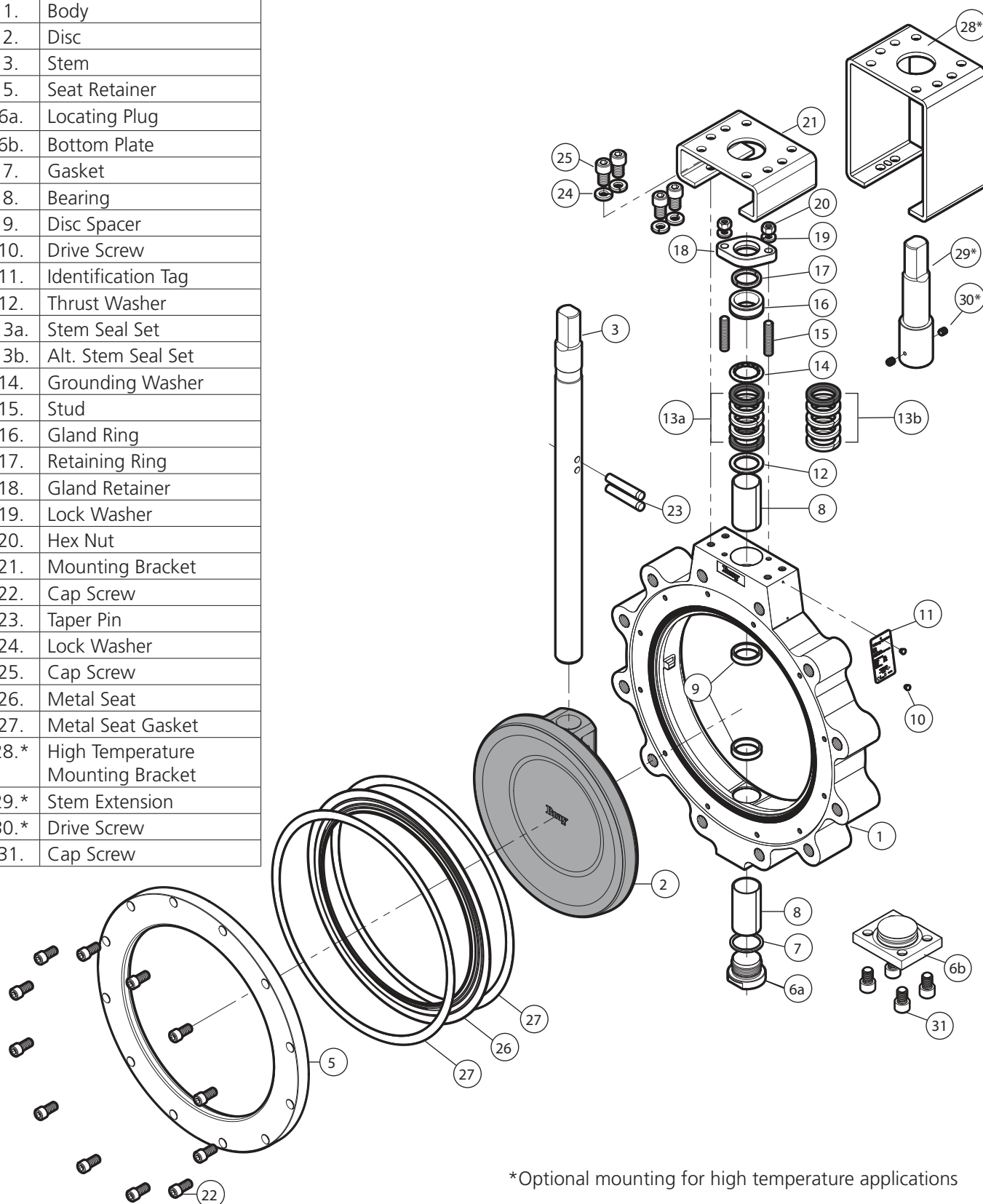
Standard Bray/McCannalok

No.	Description
1.	Body
2.	Disc
3.	Stem
4.	Soft Seat
5.	Seat Retainer
6a.	Locating Plug
6b.	Bottom Plate
7.	Gasket
8.	Bearing
9.	Disc Spacer
10.	Drive Screw
11.	Identification Tag
12.	Thrust Washer
13.	Stem Seal Set
14.	Grounding Washer (optional)
15.	Stud
16.	Gland Ring
17.	Retaining Ring
18.	Gland Retainer
19.	Lock Washer
20.	Hex Nut
21.	Mounting Bracket
22.	Cap Screw
23.	Taper Pin
24.	Lock Washer
25.	Cap Screw
31.	Cap Screw



Metal Seated Bray/McCannalok

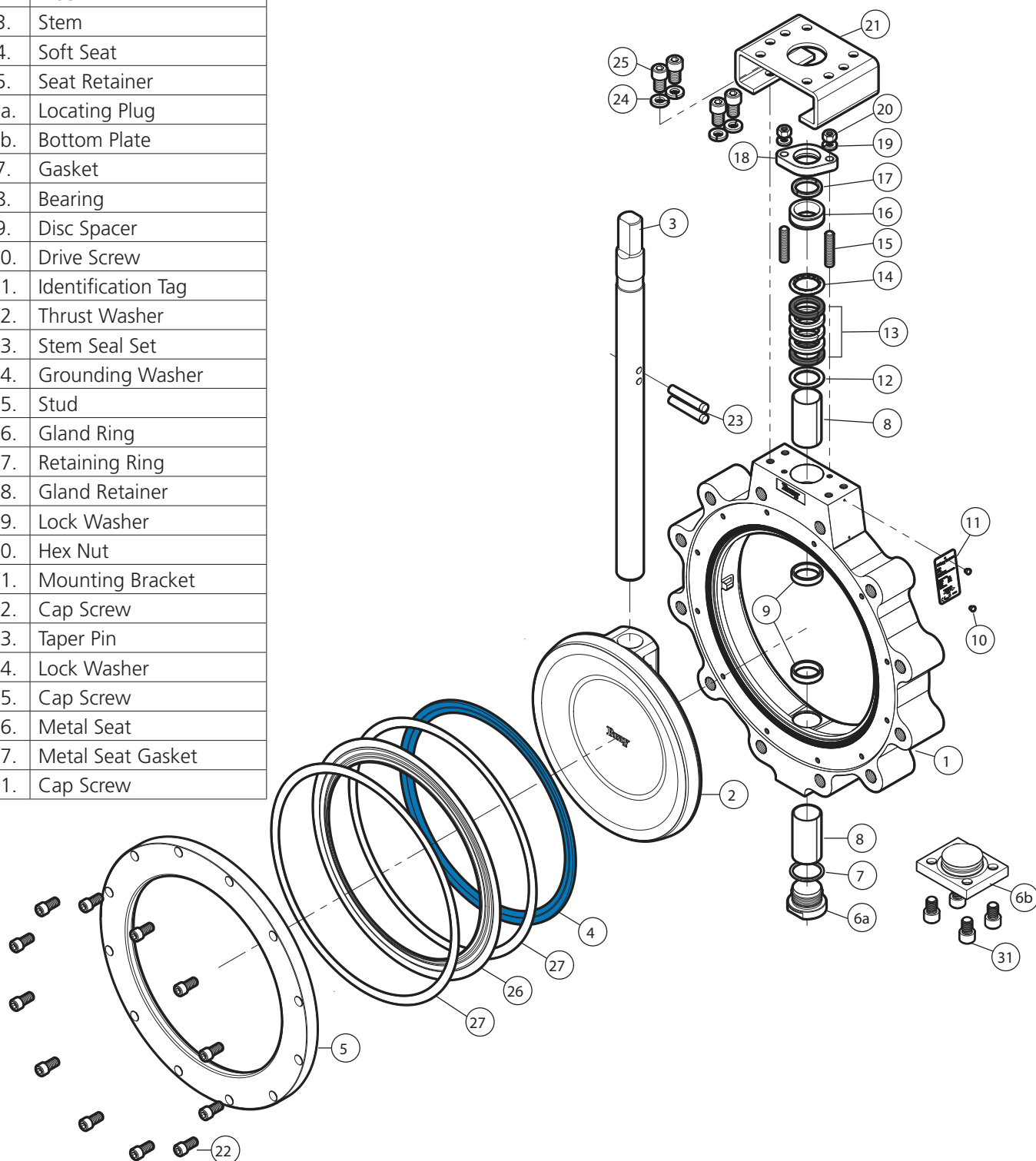
No.	Description
1.	Body
2.	Disc
3.	Stem
5.	Seat Retainer
6a.	Locating Plug
6b.	Bottom Plate
7.	Gasket
8.	Bearing
9.	Disc Spacer
10.	Drive Screw
11.	Identification Tag
12.	Thrust Washer
13a.	Stem Seal Set
13b.	Alt. Stem Seal Set
14.	Grounding Washer
15.	Stud
16.	Gland Ring
17.	Retaining Ring
18.	Gland Retainer
19.	Lock Washer
20.	Hex Nut
21.	Mounting Bracket
22.	Cap Screw
23.	Taper Pin
24.	Lock Washer
25.	Cap Screw
26.	Metal Seat
27.	Metal Seat Gasket
28.*	High Temperature Mounting Bracket
29.*	Stem Extension
30.*	Drive Screw
31.	Cap Screw



*Optional mounting for high temperature applications

Fire Safe Bray/McCannalok

No.	Description
1.	Body
2.	Disc
3.	Stem
4.	Soft Seat
5.	Seat Retainer
6a.	Locating Plug
6b.	Bottom Plate
7.	Gasket
8.	Bearing
9.	Disc Spacer
10.	Drive Screw
11.	Identification Tag
12.	Thrust Washer
13.	Stem Seal Set
14.	Grounding Washer
15.	Stud
16.	Gland Ring
17.	Retaining Ring
18.	Gland Retainer
19.	Lock Washer
20.	Hex Nut
21.	Mounting Bracket
22.	Cap Screw
23.	Taper Pin
24.	Lock Washer
25.	Cap Screw
26.	Metal Seat
27.	Metal Seat Gasket
31.	Cap Screw



APPENDIX B - TABLES

TABLE 1
NOMINAL INSIDE DIAMETER OF PIPE

Valve Size in (mm)	Pipe Schedule		
	40	80	100
2.5	2.469	2.323	
(65)	(63)	(59)	
3	3.068	2.900	
(80)	(78)	(74)	
4	4.026	3.826	
(100)	(102)	(97)	
5	5.047	4.813	
(125)	(128)	(122)	
6	6.065	5.761	
(150)	(154)	(146)	
8	7.981	7.625	7.439
(200)	(203)	(194)	(189)
10	10.020	9.564	9.314
(250)	(255)	(243)	(237)
12	11.938	11.376	11.064
(300)	(303)	(289)	(281)
14	13.124	12.500	12.126
(350)	(333)	(318)	(308)
16	15.000	14.314	13.938
(400)	(381)	(364)	(354)
18	16.876	16.126	
(450)	(429)	(410)	
20	18.814	17.938	
(500)	(478)	(456)	
24	22.626	21.564	
(600)	(575)	(548)	

NOTES:

1. Minimum ID of pipe with recommended clearances (per API 609) have been calculated by adding the minimum ID with zero clearance to a minimum recommended diametric clearance for each pipe size.
2. These charts assume that the pipe is on the body side of the valve and that the pipe is perfectly centered. The seat retainer side of the valve will always have more clearance than the body side.
3. A minimum of 1/16" thick gasket is used between the pipe flange and valve body face.
4. When using a pipe whose ID is smaller than the recommended minimum inside diameter of pipe with adequate clearance, a chamfer of 45° should be provided on the end of the pipe so that it clears the disc.

TABLE 2
MINIMUM INSIDE DIAMETER OF PIPE WITH THE RECOMMENDED CLEARANCE

Valve Size in (mm)	Class		
	150	300	600
2.5	2.28	2.28	
(65)	(58)	(58)	
3	2.86	2.86	2.75
(80)	(73)	(73)	(70)
4	3.72	3.72	3.56
(100)	(95)	(95)	(90)
5	4.80	4.80	
(125)	(122)	(122)	
6	5.88	5.75	5.38
(150)	(149)	(146)	(137)
8	7.80	7.56	6.88
(200)	(198)	(192)	(175)
10	9.78	9.44	8.50
(250)	(248)	(240)	(216)
12	11.74	11.31	10.12
(300)	(298)	(287)	(257)
14	12.90	11.38	10.88
(350)	(328)	(289)	(276)
16	14.68	14.31	12.62
(400)	(373)	(364)	(321)
18			14.40
(450)			(366)
20			15.86
(500)			(403)
24	22.50	20.68	
(600)	(572)	(525)	
30	28.55	27.06	
(750)	(725)	(687)	
32	30.69		
(800)	(780)		
36	34.50	33.63	
(900)	(876)	(854)	
40	37.55	36.59	
(1000)	(954)	(929)	
42	39.55	38.67	
(1050)	(1005)	(982)	
44		38.67	
(1100)		(982)	
48	46.59	45.13	
(1200)	(1183)	(1146)	
54	52.95		
(1350)	(1345)		
60	58.25		
(1500)	(1480)		

TABLE 3
TOTAL NUMBER OF STEM SEALS

Valve Size In (mm)	Class 150		Class 300		Class 600	
	Material CF/TFE	Material CF/G	Material CF/TFE	Material CF/G	Material CF/TFE	Material CF/G
2.5	(65)	1 / 3	2 / 2	1 / 3	2 / 2	
3	(80)	1 / 3	2 / 2	1 / 3	2 / 2	2 / 10
4	(100)	1 / 3	2 / 2	1 / 3	2 / 2	2 / 10
5	(125)	1 / 3	2 / 2	1 / 3	2 / 2	
6	(150)	1 / 3	2 / 2	1 / 3	2 / 2	2 / 14
8	(200)	1 / 4	2 / 3	1 / 4	2 / 3	2 / 14
10	(250)	1 / 4	2 / 3	1 / 4	2 / 3	0 / 18
12	(300)	1 / 4	2 / 3	1 / 4	2 / 3	0 / 18
14	(350)	0 / 6	2 / 4	0 / 6	2 / 6	0 / 18
16	(400)	0 / 6	2 / 4	0 / 9	2 / 7	0 / 16
18	(450)	0 / 9	2 / 7	0 / 10	2 / 8	0 / 16
20	(500)	0 / 10	2 / 7	0 / 11	2 / 10	0 / 18
24	(600)	0 / 10	2 / 8	0 / 8	2 / 6	4 / 16
30	(750)	0 / 8	2 / 6	0 / 9	2 / 7	
32	(800)	0 / 8	2 / 6			
36	(900)	0 / 8	2 / 6	0 / 9	2 / 9	0 / 16
40	(1000)	0 / 9	2 / 7	0 / 9		
42	(1050)	0 / 9	2 / 7	0 / 9		
44	(1100)			0 / 9		
48	(1200)	0 / 9	2 / 7	0 / 9		
54	(1350)	0 / 9	2 / 7			
60	(1500)	0 / 9	2 / 7			

CF = Carbon Fiber G = Formed Graphite

TABLE 4
GLAND RETAINER NUT
(PTFE STEM PACKING) AND SEAT RETAINER
SCREW TORQUES lb-in (N-m)

Valve Size in (mm)	Gland Nut			Seat Retainer Screws		
	150	300	600	150	300	600
2.5	60	100		100	100	
(65)	(7)	(11)		(11)	(11)	
3	60	100	80	100	100	100
(80)	(7)	(11)	(9)	(11)	(11)	(11)
4	60	100	100	175	175	175
(100)	(7)	(11)	(11)	(20)	(20)	(20)
5	80	100		100	175	
(125)	(9)	(11)		(11)	(20)	
6	80	120	140	100	175	300
(150)	(9)	(14)	(16)	(11)	(20)	(34)
8	80	140	200	175	175	300
(200)	(9)	(16)	(23)	(20)	(20)	(34)
10	110	190	200	175	300	300
(250)	(12)	(21)	(23)	(20)	(34)	(34)
12	130	220	200	300	300	300
(300)	(15)	(25)	(23)	(34)	(34)	(34)
14	130	200	240	300	300	500
(350)	(15)	(23)	(27)	(34)	(34)	(56)
16	150	220	300	300	300	750
(400)	(17)	(25)	(27)	(34)	(34)	(85)
18	150	220	400			1500
(450)	(17)	(25)	(45)			(169)
20	190	220	480			1500
(500)	(210)	(25)	(54)			(169)
24	190	240	550	500	500	
(600)	(21)	(27)	(62)	(56)	(56)	
30	210	310	600	500	750	
(750)	(24)	(35)	(67)	(56)	(85)	
32	210	310	600	750		
(800)	(24)	(35)	(67)	(85)		
36	240	360		500	1500	
(900)	(27)	(41)		(56)	(169)	
40	280	420		500	1500	
(1000)	(32)	(47)		(56)	(169)	
42	280	420		500	1500	
(1050)	(32)	(47)		(56)	(169)	
44	280	420			1500	
(1100)	(32)	(47)			(169)	
48	300	600		750	1500	
(1200)	(34)	(68)		(85)	(169)	
54	360				1500	
(1350)	(41)				(169)	
60	500				1500	
(1500)	(56)				(169)	

TABLE 5
DRILL SIZE TO REMOVE TAPER PIN in (mm)

Valve Size in (mm)	Class		
	150	300	600
2.5	15/64	15/64	
(65)	(6)	(6)	
3	15/64	15/64	1/4
(80)	(6)	(6)	(6)
4	15/64	15/64	9/32
(100)	(6)	(6)	(7)
6	15/64	15/64	11/32
(150)	(6)	(6)	(9)
8	15/64	15/64	19/32
(200)	(6)	(6)	(15)
10	15/64	15/64	45/64
(250)	(6)	(6)	(18)
12	15/64	15/64	45/64
(300)	(6)	(6)	(18)
14	15/64	15/64	45/64
(350)	(6)	(6)	(18)
16	19/32	15/64	11/32
(400)	(15)	(6)	(26)
18	45/64	45/64	11/32
(450)	(18)	(18)	(26)
20			1 1/4
(500)			(32)
24	45/64	1 1/32	
(600)	(18)	(26)	
30	1 1/32	1 1/4	
(750)	(26)	(32)	
32	1 1/32		
(800)	(26)		
36	1 1/32	1 1/4	
(900)	(26)	(32)	
40	1 1/4	1 17/32	
(1000)	(32)	(39)	
42	1 1/4	1 17/32	
(1050)	(32)	(39)	
44		1 17/32	
(1100)		(39)	
48	1 1/4	1 17/32	
(1200)	(32)	(39)	
54	1 17/32		
(1350)	(39)		
60	1 17/32		
(1500)	(39)		

TABLE 6
GLAND NUT
(GRAPHITE STEM PACKING) TORQUE lb-in (N-m)

Valve Size in (mm)		Class 150		Class 300		Class 600	
2.5	(65)	35	(4)	45	(5)		
3	(80)	35	(4)	45	(5)	60	(8)
4	(100)	35	(4)	45	(5)	90	(10)
5	(125)	45	(5)	65	(7)		
6	(150)	45	(5)	65	(7)	110	(12)
8	(200)	45	(5)	80	(9)	150	(17)
10	(250)	65	(7)	100	(11)	130	(15)
12	(300)	65	(7)	100	(11)	130	(15)
14	(350)	80	(9)	125	(14)	180	(20)
16	(400)	100	(11)	150	(17)	180	(20)
18	(450)	100	(11)	150	(17)	200	(23)
20	(500)	100	(11)	150	(17)	240	(27)
24	(600)	150	(17)	200	(23)	300	(34)

TABLE 7
LOCATING PLUG, BOTTOM PLATE AND
MOUNTING BRACKET CAP SCREW TORQUE lb-in (N-m)

Valve Size in (mm)	Locating Plug		Bottom Plate		Mounting Bracket Cap Screws		
	150	300	150	300	150	300	600
2.5	480	540			175	175	
(65)	(54)	(61)			(20)	(20)	
3	480	540			175	175	300
(80)	(54)	(61)			(20)	(20)	(34)
4	480	540			175	175	300
(100)	(54)	(61)			(20)	(20)	(34)
5	720	780			300	300	
(125)	(81)	(88)			(34)	(34)	
6	720	940			300	300	750
(150)	(81)	(106)			(34)	(34)	(85)
8	840	1080			300	750	1500
(200)	(95)	(122)			(34)	(85)	(169)
10	960	1200			750	750	2600
(250)	(108)	(136)			(85)	(85)	(294)
12	1080	1440			750	1500	2600
(300)	(122)	(163)			(85)	(169)	(294)
14	1200			750	1500	2600	6444
(350)	(136)			(85)	(169)	(294)	(723)
16			750	1500	2600	2600	6444
(400)			(85)	(169)	(294)	(294)	(728)
18			750	1500	2600	6444	23148
(450)			(85)	(169)	(294)	(728)	(2615)
20			1500	1500	2600	6444	23148
(500)			(169)	(169)	(294)	(728)	(2615)
24			1500	1500	6444	23148	23148
(600)			(169)	(169)	(728)	(2615)	(2615)
30			1500	2600	23148	23148	
(750)			(169)	(294)	(2615)	(2615)	
32			1500		23148		
(800)			(169)		(2615)		
36			2600	2600	23148	23148	23148
(900)			(294)	(294)	(2615)	(2615)	(2615)
40			2600	4400	23148	23148	
(1000)			(294)	(497)	(2615)	(2615)	
42			2600	4400	23148	23148	
(1050)			(294)	(497)	(2615)	(2615)	
44							
(1100)							
48			2600	6444	23148	23148	
(1200)			(294)	(728)	(2615)	(2615)	
54			4400	6444	23148	23148	
(1350)			(497)	(728)	(2615)	(2615)	
60			6444		23148		
(1500)			(728)		(2615)		



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