FLOWSERVE

Worcester Controls

09015-G

Metal Characterized Seated Control Valve

½"-2" CPT 94, Three-Piece Ball Valves, ½"-4" CPT 94 150/300, 1"-2" CPT 94 600 Flanged One-Piece Ball Valves

Installation, Operation and Maintenance Instructions

CAUTION: Flowserve recommends that all product which must be stored prior to installation be stored indoors, in an environment suitable for human occupancy. Do not store product in areas where exposure to relative humidity above 85%, acid or alkali fumes, radiation above normal background, ultraviolet light, or temperatures above 120˚F or below 40˚F may occur. Do not store within 50 feet of any source of ozone.

I. INSTALLATION

A. CPT 94 Series three-piece and flanged one-piece valves may be installed for flow in either direction. Use care to exclude pipe sealants from the valve cavity.

B. When installing CPT 94 flanged one-piece valves, use standard gaskets suitable for the specific service. Tighten flange bolts or studs evenly. Follow ANSI standards for flange bolt torque.

C. For Weld End Valves (SW, BW):

NOTES: *Prior to welding, THOROUGHLY CLEAN ALL JOINT SURFACES to prevent contamination. Valves with "PG", "RG", "XG", "AG" and "GG" seat/body seal combinations and V67 option code are compatible with welding temperatures. Therefore, these valves are weld-as-is and do not have to be disassembled to be welded inline. A red welding tag will be attached to the valve. If these valves are disassembled, the graphite coated stainless steel gasket body seals (Code "G"), and the seat back seals (used with "A" or "G" seats only) must be replaced. When welding these valves, the valve must be open to prevent adhesion of weld spatter to the ball. Use STICK or MIG welding, allow valve and joint to cool to the touch between passes.*

For All Other Weld End Valves:

1. Tack weld the valve in place.
2. Remove all four body nuts and bolts, and place the valve in the open position. Remove center section from between pipe ends by separating the pipe ends from the body by at least ⅛" to allow locating diameter on the back of the metal characterized seat (inserted into oversized pipe end bore) to clear pipe end flange. With valve in closed position, remove seats, seat back seal(s), body seals and ball.
3. Return the body to its original position and temporarily secure it with two bolts diagonally opposite each other.
4. Weld valve inline. If gas welding is used, do not play flame on valve body.
5. Allow valve to cool. Remove body and with stem in the closed position, replace ball, seats and install new seat back seal(s), which are shipped separately from valve. Do not reuse old seat back seal(s). The characterized seat has a "V" or "Slot" cut in it for improved flow control, and must be properly oriented to function. A locating pin is provided in the body, and a groove in the seat, to assure that proper alignment is accomplished. The seat must fit properly and not jam on the pin. The opposite seat has a standard round port in it.
6. Open the valve and replace body seals, or add new body seals, if they were shipped separately from the valve.

   Temporary Buna body seals, if found in the valve as received, are not to be reused. If coated stainless steel "S" gasket body seals are used (Code M or G), install them with wide flange facing the body (see view A-A on page 7). Before putting the center section between the pipe ends, make sure that the seat back seal is centered on the back of the seat. If it is not, it could be damaged or cause the valve to leak.
7. Place center section between pipe ends by separating the pipe ends from the body by at least ⅛" to allow locating diameter on the back of the metal characterized seat (for insertion into oversized pipe end bore) to clear pipe end flange. Replace actuator and body bolts and nuts. Tighten and torque the body bolts evenly and diagonally opposite each other, alternating in a criss-cross pattern to the figures on the following page.

D. CAUTION

The fluoropolymer body seals (code T) and the coated stainless steel gaskets (codes M & G) make excellent seals. However, some points of caution in their use need emphasizing:

1. No coated stainless steel gasket body seal, graphite seat back seal or fluoropolymer part (except a seat) is reusable. Upon disassembly of the valve, they should be discarded and replaced with new parts.

CARBON STEEL BOLTS			STAINLESS STEEL & ALLOY 20 BOLTS			
Bolt Diameter	**In.-Lbs.**	**Ft.-Lbs.**	**Bolt Diameter**	**In.-Lbs.**	**Ft.-Lbs.**	***NOTE:** Stainless steel bolts and nuts are used in all three-piece valves with stainless steel bodies and also valves with "GG" seats and body seals.*
¼"	96-120	8-10	¼"	72-94	6-8	
5/16"	155-204	13-17	5/16"	120-144	10-12	
⅜"	216-262	18-22	⅜"	192-216	16-18	
7/16"	480-540	40-45	7/16"	336-384	28-32	
½"	720-780	60-65	½"	504-552	42-46	

2. Avoid scratching or damaging the fluoropolymer seals or the coating of the stainless steel gaskets during installation. Light lubrication of these seals can help to prevent damage.
3. "S" gaskets are installed with the wide flange against the valve body (see View A-A on page 6).
4. Care must also be taken when handling graphite seat back seals, stem seals, thrust bearings, and body seals. These parts can be easily damaged by squeezing the O.D. Parts should be handled on the flat surfaces rather than the O.D. These parts will not work if they are cracked or broken. Light flaking of the material is acceptable.
5. The ball used in CPT valves is round to special tolerances. To ensure proper contact with the seat, do not drop, dent or scratch the ball during handling. These balls also have an anti-galling coating; DO NOT use uncoated balls with CPT valves.

II. OPERATION

A. The operation of the valve consists of turning the stem ¼ turn clockwise to close and ¼ turn counter-clockwise to open. When the stem flats (½"-2") or groove (3" and 4") are in line with the pipeline, the valve is open. These valves are designed to be automated.

B. CPT 94 Series valves meet the leakage rates of ANSI B16.104 Class VI.

C. As shipped from the factory, valves contain a silicone-based lubricant. This is for break-in purposes and may be removed if it is objectionable for a particular application by disassembling and solvent washing. Lacquer thinner will remove the lubricant. Replace with a non-silicone based lubricant. CPT valves should not be operated without a break-in lubricant.

D. Media that can solidify, crystallize or polymerize should not be allowed to stand in ball valve cavities.

E. Torque Requirements: Operating torque requirements will vary depending on the length of time between cycles, media in the system, line pressure and type of valve seats. The figures in the following table are based on laboratory tests with clean tap water as the media. They are measured at WOG rated pressure, 70˚F, after 24 hours. For a more detailed analysis of valve torque requirements, see the Worcester Actuator Sizing Manual.

Valve Size -	½"	¾"	1"	1½"	2"	3"	4"
Maximum Expected - Breakaway (In.-Lbs.)	240	265	360	550	850	2100	3500

***NOTE:** Media that contain fine powders (25 microns or less) will significantly raise ball valve torque requirements.*

III. MAINTENANCE

For maximum stem seal life, proper packing adjustment procedure must be followed.

A. Tighten packing gland bolts to the torque values in the table below. Alternate between the two gland bolts when tightening to maintain the alignment of the gland plate with the top of the valve body. Some rocking of the gland plate can be tolerated; however, excessive misalignment may cause premature failure of the stem packing.

IV. REBUILDING

This manual contains exploded views of the valves covered by the text. They have been included to aid in the rebuilding of the valves. Please refer to them when following the written instructions.

⚠ WARNING: BALL VALVES CAN TRAP PRESSURIZED FLUIDS IN THE BALL CAVITY WHEN CLOSED.

***NOTE:** Special handling and cleaning procedures are necessary for oxygen and vacuum service valves. Refer to industry practices when overhauling these units.*

If the valve has been used to handle hazardous media, it must be decontaminated before disassembly. It is recommended that the following steps be taken for safe removal and disassembly:

- Relieve the line pressure. Operate the valve prior to attempting removal from line.
- Place the valve in half-open position and flush the line to remove any hazardous material from the valve body.

VALVE SIZE	GLAND BOLT TORQUE (In.-Lbs.) "T" PACKING	GLAND BOLT TORQUE (In.-Lbs.) "G" PACKING	
½"	40-45	90-110	***NOTE:*** *After adjustments, packing creep will occur over several hours. Bolt torque measured then will be less.*
¾"	40-45	90-110	
1"	65-70	120-140	
1½"	85-95	210-230	
2"	85-95	210-230	
3"-4"	175-200	270-295	

- All persons involved in the removal and disassembly of the valve should wear the proper protective clothing such as a face shield, gloves, apron, etc.

A. A standard repair kit can be ordered for the CPT 94 Series valve containing all the necessary parts for standard valve rebuilding; seats, seat back seal(s) (used with "A" and "G" filled metal seats only), body seals, split thrust bearing, split ring, all non-metallic stem packing parts, and Belleville washers. To order, specify the valve size and series, the material of the seats and body seals, the characterized seat configuration, and the "R" number (Revision Number) or for non-standard valve, the "P" number, "T" number, "C" number, or similar number. This information is found on the nameplate on the valve body.

Repair Kit Ordering Examples:

1" CPT RK94 PM A06 R0
1" CPT RK94 GG G30 R0
3" CPT RK94 PT G60 R0
3" CPT RK94 RZ A30 R0
2" CPT RK94 AG G60 T0726

CAUTION: If the seats and seals installed differ from those removed, the valve nameplate MUST be replaced or re-marked to indicate the altered materials and ratings or valve tagged to so indicate.

B. TO DISASSEMBLE ½"-2" THREE-PIECE VALVES:

1. Remove actuator and place valve in open position. Remove all four body bolts and nuts and remove center section from between the pipe ends by separating the pipe ends from the body by at least ⅛" to allow locating diameter on the back of the metal characterized seat (inserted into oversized pipe end bore) to clear pipe end flange.
2. Close the valve. Remove the seats, seat back seal(s), ball and body seals.
3. Remove the gland bolts, Bellevilles, gland plate and follower from the top of the valve.
4. Remove the stem and packing from the valve:
   a. Push the stem down into the body cavity.
   b. Remove the split ring and split thrust bearing from the recessed diameter above the stem tang.
   c. Remove the stem from the top of the body. This may require considerable force. The flats on the stem can be clamped in a vise or other fixture to aid in removal. Avoid damaging the stem flats. The packing will be removed with the stem by the shoulder on the end of the stem.

CAUTION: Use care to avoid scratching the surface of the stem and packing chamber.

   d. Remove the packing from the stem.

TO DISASSEMBLE ½"-2" FLANGED ONE-PIECE VALVES:

5. Place valve in closed position, remove actuator from valve and remove valve from line.
6. Unscrew end plug and remove. If required, end plug disassembly tools are available from your supplier or from Flowserve Corporation.
7. Remove body seal, ball, seats and seat back seal(s).
8. Remove the gland bolts, Belleville washers, gland plate and follower from the top of the valve.
9. Remove the stem and packing from the valve:
   a. Push the stem down into the body cavity.
   b. Remove the split ring and split thrust bearing from the recessed diameter above the stem tang.
   c. Remove the stem from the top of the body. This may require considerable force. The flats on the stem can be clamped in a vise or other fixture to aid in removal. Avoid damaging the stem flats. The packing will be removed with the stem by the shoulder on the end of the stem.

CAUTION: Use care to avoid scratching the surface of the stem and packing chamber.

   d. Remove the packing from the stem.

TO DISASSEMBLE 3"-4" FLANGED ONE-PIECE VALVES:

10. Place valve in closed position. Remove actuator from valve and remove valve from line.
11. Remove end plug retaining screws. Remove end plug. If necessary, drive end plug from valve, using wooden drift applied to face of ball. Be certain the ball is fully closed.
12. Remove body seal, ball, seats, seat back seal(s), and seat insert (if used).
13. Remove the gland bolts, Belleville washers, gland plate and follower from the top of the valve.
14. Push the stem down into the body cavity and remove.
15. Remove the thrust bearing and stem packing from the body.

CAUTION: Use care to avoid scratching the surface of the stem and packing chamber.

C. VISUAL INSPECTION:

1. The ball and surfaces against which the seats and seals are installed should be undamaged, clean, and free of pit marks and scratches. Light marring from the action of the ball against the seats is normal and will not affect the operation of the valve.
   Flaws that can be seen, but barely detected with fingertips, are acceptable.
2. The stem and body surfaces that the stem seals and thrust bearing contact should be clean, undamaged and free of pit marks and scratches.

D. REASSEMBLY:

Clean all sealing surfaces of the valve including the ball.

For all valves, lightly lubricate the ball, seats, seat back seal(s), body seal(s), split thrust bearing and split ring or one-piece thrust bearing, and stem seals with a lubricant compatible with the media being handled as the parts are used. White petroleum jelly is a good general purpose lubricant. Filled metal seats will be lubricated at the factory. If they are not, they should be lubricated as previously stated. The seat back seals will be pre-assembled to the seat backs. Do not operate a newly rebuilt valve with filled metal seats without lubricant.

If graphite parts are used, they should be handled on the flat surfaces rather than the O.D. These parts can be damaged by squeezing the O.D. and will not work if they are cracked or broken. Light flaking of the material is acceptable.

TO REASSEMBLE ½"-2" THREE-PIECE VALVES:

1. Insert the stem down through the bonnet and into the body.
2. Place the split thrust bearing in the recessed diameter above the stem tang. Place the split ring in the same recessed diameter, under the split thrust bearing (refer to exploded view).
3. Pull the valve up so that the split thrust bearing and split ring are drawn into the stem hole recess in the ball cavity. See instructions 22 through 27 for stem packing and gland plate assembly.
4. With the valve in the closed position (stem flats going across pipeline), replace the ball, seats and seat back seal(s) (used with “A” or “G” filled metal seats only). The characterized seat has a “V” or “slot” cut in it for improved flow control. It must be properly oriented to function and the seat can only fit in the pipe end with an oversized port hole. A locating pin is provided in the body, and a groove in the seat, to assure that proper alignment is accomplished. This valve seat can only be assembled one way and must fit properly, not jam on the pin. The opposite seat has a standard round port in it.
5. Open the valve and add the body seals. For “S” gaskets, see cautions I.D.1 - I.D.5. When seat back seals are used, be certain that they are correctly located on the seat back face before putting the center section between the pipe ends. Damage may occur and leaks or high operating torque may result if the seat back seals are not located correctly.
6. Place center section between pipe ends by separating the pipe ends from the body by at least ⅛" to allow locating diameter on the back of the metal characterized seat (for insertion into oversized pipe end bore) to clear pipe end flange. Replace actuator, the four body bolts and nuts. Tighten finger tight.

TO REASSEMBLE ½"-2" FLANGED ONE-PIECE VALVES:

7. On all sizes except the ½", insert the far (characterized) seat and seat back seal in the body cavity. The seat has a “V” or “slot” cut in it for improved flow control. It must be properly oriented to function. A locating pin is provided in the body, and a groove in the seat, to assure that proper alignment is accomplished. This valve seat can only be assembled one way and must fit properly, not jam on the pin. When seat back seals are used, be certain that they are correctly located on the seat back face before installing the ball and end plug. Damage may occur and leaks or high operating torque may result if the seat back seals are not located correctly.
8. Insert the stem down through the bonnet and into the body.
9. Place the split thrust bearing in the recessed diameter above the stem tang. Place the split ring in the same recessed diameter, under the split thrust bearing (refer to exploded view).
10. Pull the stem up so that the split thrust bearing and split ring are drawn into the stem hole recess in the ball cavity. See instructions 22 through 27 for stem packing and gland plate assembly.
11. Insert the far (characterized) seat and seat back seal into ½" valves per paragraph 7. With the valve in closed position (stem flats going across pipeline), insert the ball into the body so that the stem slot engages the tang on the stem.
12. Install the body seal. Be certain that the body seal rests squarely on the sealing surface in the body. For “S” gaskets, see Cautions I.D.1 - I.D.5.

13. Insert the round port seat and seat back seal (used with "A" or "G" filled metal seats only) in the cavity in the end plug.

14. Install the end plug into the body and tighten until the body and end plug make metal-to-metal contact. The end plug may project up to .009" beyond the surrounding serrated surface. End plug must be fully tightened against machined step in body. If in doubt, assemble end plug without seat and seal, make a witness mark, then reassemble the full assembly.

TO REASSEMBLE 3"-4" FLANGED ONE-PIECE VALVES:

15. Place the thrust bearing on the stem.

16. Insert the stem and thrust bearing into the body through the ball cavity. See instructions 22 through 27 for stem packing and gland plate assembly.

17. Place the far characterized seat insert, seat ("A" or "G" filled metal), or for Revision R1 and later valves only, one-piece characterized seat, and seat back seal in the body cavity. The one-piece characterized seat or seat insert has a "V" cut in it for improved flow control and must be properly oriented to function. To assure that proper alignment is accomplished, Revision R0 valves have a locating pin provided in the body cavity, and a groove in the seat insert. This valve seat insert can only be assembled one way and must fit properly, not jam on the pin. For Revision R1 and later valves, the one-piece seat has a locating nib that aligns with a groove in the body cavity. When seat back seals are used, be certain that they are correctly located on the seat back face before installing the ball and end plug. Damage may occur and leaks or high operating torque may result if the seat back seals are not located correctly.

18. With the valve in closed position (stem groove going across pipeline), insert the ball into the body so that the stem slot engages the tang on the stem.

19. Install the body seal. Be certain that the body seal rests squarely on the sealing surface in the body.

CAUTION: If the body seal is installed on the end plug, it will be damaged.

20. Insert the round port seat and seat back seal (used with "A" or "G" filled metal seats only) in the cavity in the end plug.

21. Assemble the end plug into the body as far as it will go. Secure with end plug retaining screws, tightening each one firmly. The end plug screws only retain the end plug. Flange bolt force is required to compress the body seal and seat the end plug. Proper installation will allow not more than .010" protrusion of the end plug beyond the valve body.

    Upon reinstallation of the valve in the line, retighten the end plug retaining screws after the flange bolts are fully torqued.

THE FOLLOWING INSTRUCTIONS ARE FOR ALL CPT 94 VALVES:

22. ***NOTE:*** *Be certain that the stem seals are lubricated per Section IV.D. prior to assembly.*

    Install the following parts over the stem and into the packing chamber in this order (refer to packing assembly drawings Figures 1 and 2):

    a. For "T" Packing - Filler ring, 629 seal, lantern ring-T, three Chevron packing rings (for ½"-2" 94 three-piece and one-piece valves only, one Chevron ring is of carbon filled fluoropolymer material and black in color and must be positioned as the top ring), follower-T.

    b. For "G" Packing - Two graphite packing rings, lantern ring-G, two graphite packing rings, follower-G.

23. Install gland plate over stem.

24. Valves with "T" and "G" packing both use twelve Belleville washers. The arrangement of the washers is different for each type of packing (refer to packing assembly drawings Figures 1 and 2):

    a. For "T" Packing - Use three sets of two washers on each bolt. Each set consists of two Bellevilles opposing each other with their O.D.s touching.

    b. For "G" Packing - Use three nested Bellevilles opposing three nested Bellevilles on each bolt. The middle two will have their O.D.s touching.

25. Lubricate the gland bolt threads with an anti-galling agent, such as Christo-Lube MCG-111. Install gland bolt/Bellevilles through the gland plate and thread them into the body. Tighten the gland bolts per Section III.A. Be certain that the bolts do not bind - this can result in improper packing loading.

CAUTION: Tightening the gland bolts can cause the stem to be pushed into the ball cavity. The stem must either be fixtured to prevent this, or be worked back into position when assembling the ball and seats into the body.

26. Tighten the body bolts per Section I.C.7. (½"-2" three-piece valves only).

27. Add actuator and restore valve to line.

V. RECOMMENDED SPARES:

When ordering parts, please provide the part name and all the valve code information found on the nameplate on the body: valve size, style, materials, ends and "R" number (Revision Number).

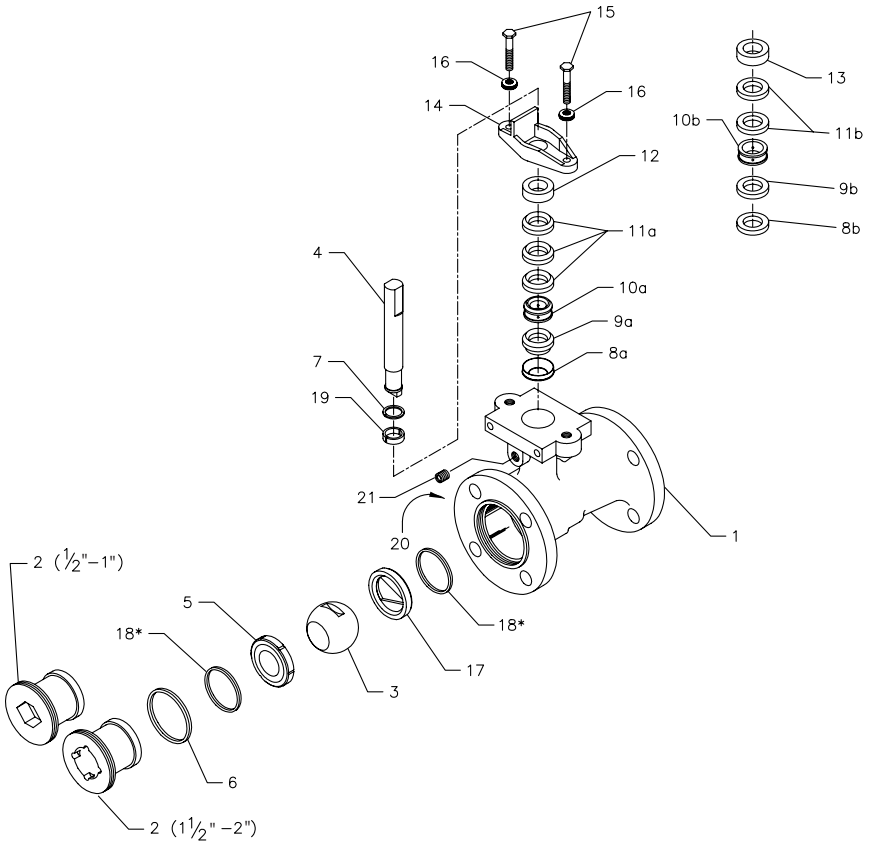
Example: 1" CPT 94 66 AG SE G30 R0 Ball or
3" CPT 94 46 GZ150 G60 R0 Stem

Valves may also be marked with an additional "P", "T", "C", or similar number. These numbers designate non-standard products and must be specified along with the valve code.

Example: 1" CPT 94 66 AG SE A30 P-2933 Ball or
½" CPT 94 66 GZ300 G60 T-1340 Stem

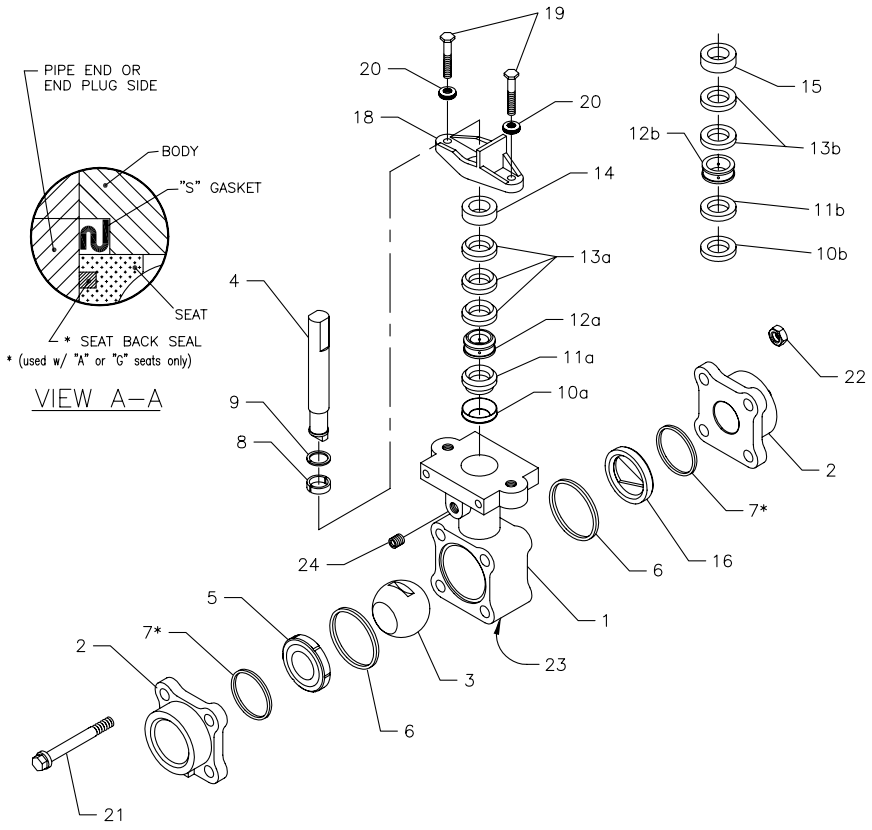
SERIES 94 (½"-2" THREE-PIECE)

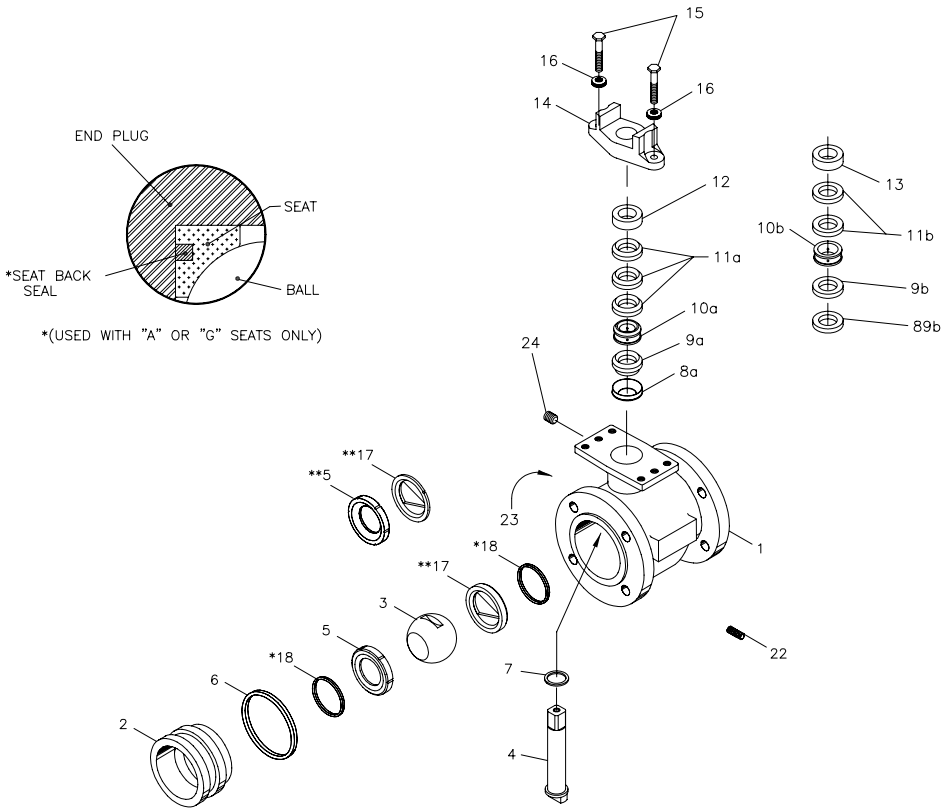
Part No.	Part Name	Qty. Per Valve
1	Body	1
2	Pipe End	2
3	Ball	1
4	Stem	1
5	Seat, Round Port	1
6	Body Seal	2
*7	Seat Back Seal (Metal Seats Only)	1 or 2
8	Split Ring	1
9	Thrust bearing	1
10a	Filler Ring	1
10b	Graphite Ring	1
11a	629 Seal	1
11b	Graphite Ring	1
12a	Lantern Ring T	1
12b	Lantern Ring G	1
13a	Chevron Ring	3
13b	Graphite Ring	2
14	Follower T	1
15	Follower G	1
16	Seat, Characterized	1
17	(Not Used)	
18	Gland Plate	1
19	Gland Bolt	2
20	Belleville Washer	12
21	Body Bolt	4
22	Body Nut	4
23	Name Plate	1
24	⅛" NPT Pipe Plug	1



SERIES 94-150, 94-300 & 94-600 (½"-2" FLANGED)

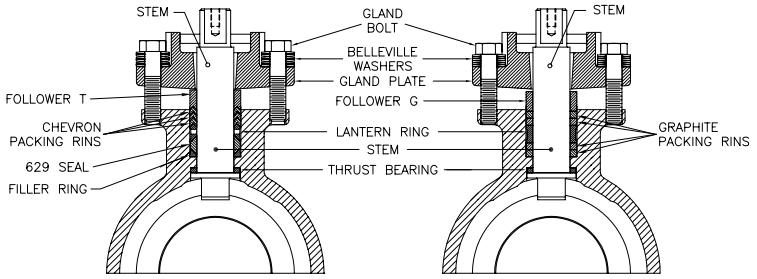
Part No.	Part Name	Qty. Per Valve
1	Body	1
2	End Plug	1
3	Ball	1
4	Stem	1
5	Seat, Round Port	1
6	Body Seal	1
7	Thrust bearing	1
8a	Filler Ring	1
8b	Graphite Ring	1
9a	629 Seal	1
9b	Graphite Ring	1
10a	Lantern Ring T	1
10b	Lantern Ring G	1
11a	Chevron Ring	3
11b	Graphite Ring	2
12	Follower T	1
13	Follower G	1
14	Gland Plate	1
15	Gland Bolt	2
16	Belleville Washer	12
17	Seat, Characterized	1
*18	Seat Back Seal (Metal Seats Only)	1 or 2
19	Split Ring	1
20	Name Plate	1
21	⅛" NPT Pipe Plug	1



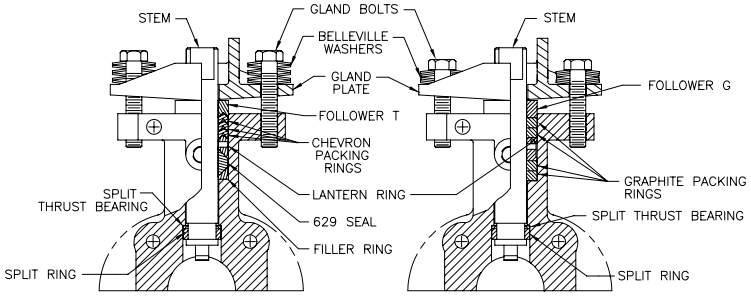


SERIES 94-150 & 94-300 (3"-4" FLANGED)		
Part No.	**Part Name**	**Qty. Per Valve**
1	Body	1
2	End Plug	1
3	Ball	1
4	Stem	1
** 5	Seat, Round Port	1 or 2
6	Body Seal	1
7	Thrust bearing	1
8a	Filler Ring	1
8b	Graphite Ring	1
9a	629 Seal	1
9b	Graphite Ring	1
10a	Lantern Ring T	1
10b	Lantern Ring G	1
11a	Chevron Ring	3
11b	Graphite Ring	2
12	Follower T	1
13	Follower G	1
14	Gland Plate	1
15	Gland Bolt	2
16	Belleville Washer	12
**17	Characterized Seat or Seat Insert	1
**18	Seat Back Seal (Metal Seats Only)	1 or 2
19	(Not Used)	
20	(Not Used)	
21	(Not Used)	
22	End Plug Screw	4-8
23	Name Plate	1
24	⅛" NPT Pipe Plug	1

**Or (1) One-Piece Characterized Seat
(Seat Insert Not Used) and (1) Round Port Seat



3" – 4" FLANGED ONE–PIECE VALVES



$\frac{1}{2}$" – 2" 3–PIECE & FLANGED ONE–PIECE VALVES

T PACKING DETAIL

FIGURE 1

G PACKING DETAIL

FIGURE 2

Flowserve Corporation has established industry leadership in the design and manufacture of its products. When properly selected, this Flowserve product is designed to perform its intended function safely during its useful life. However, the purchaser or user of Flowserve products should be aware that Flowserve products might be used in numerous applications under a wide variety of industrial service conditions. Although Flowserve can (and often does) provide general guidelines, it cannot provide specific data and warnings for all possible applications. The purchaser/user must therefore assume the ultimate responsibility for the proper sizing and selection, installation, operation, and maintenance of Flowserve products. The purchaser/user should read and understand the Installation Operation Maintenance (IOM) instructions included with the product, and train its employees and contractors in the safe use of Flowserve products in connection with the specific application.

While the information and specifications contained in this literature are believed to be accurate, they are supplied for informative purposes only and should not be considered certified or as a guarantee of satisfactory results by reliance thereon. Nothing contained herein is to be construed as a warranty or guarantee, express or implied, regarding any matter with respect to this product. Because Flowserve is continually improving and upgrading its product design, the specifications, dimensions and information contained herein are subject to change without notice. Should any question arise concerning these provisions, the purchaser/user should contact Flowserve Corporation at any one of its worldwide operations or offices.

For more information about Flowserve Corporation, contact www.flowserve.com or call USA 1-800-225-6989.

FLOWSERVE CORPORATION
FLOW CONTROL DIVISION
1978 Foreman Drive
Cookeville, Tennessee 38501 USA
Phone 931 432 4021
Fax 931 432 3105
www.flowserve.com

09015-G 8/03 Printed in USA