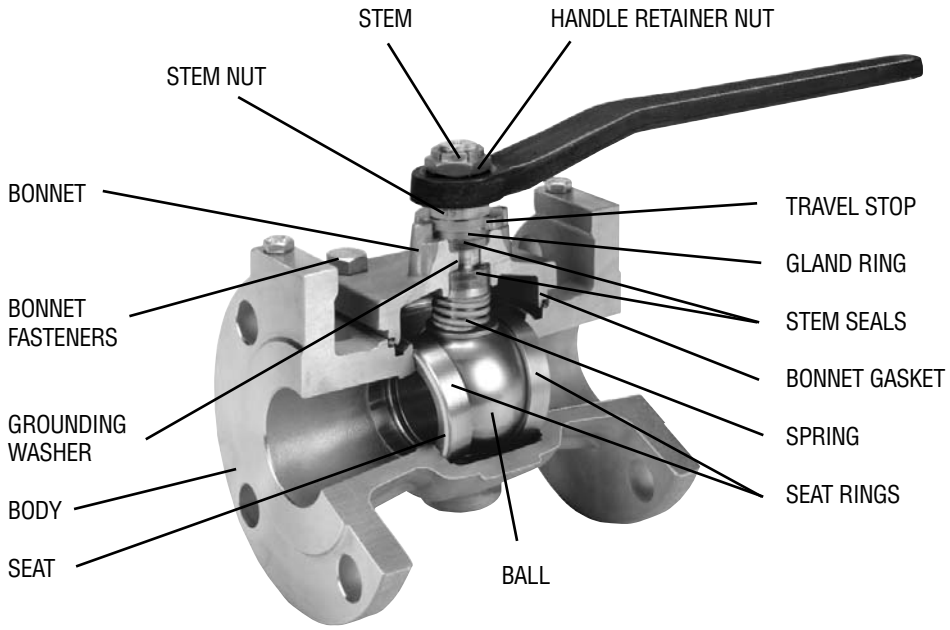
FLOWSERVE

McCANNA/MARPAC Valves

MMAIM2007
Part MV 570

McCannaseal® Ball Valves

Installation, Operation and Maintenance Instructions



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Installation

1. General

A. McCannaseal valves may be installed in any position without affecting valve operation or performance. Pipeline flow may be in either direction, unless otherwise indicated. Installation methods and procedures should follow good industry practice, such as contained in MSS-SP-92, or similar document.

CAUTION

Check stem nut and bonnet fastener torques prior to testing or installation, and re-tighten as needed (see TABLES 3, 4, 5 & 6). These fasteners, may loosen during shipment, which could result in external leakage. For valves operating at temperatures above 400°F (204°C) bonnet bolting and stem nut torques should be re-checked and tightened as necessary after the valve has been in operation 2–3 days.

WARNING

Do not attempt any maintenance of these valves while in operation or under pressure. Actuated valve air and/or electrical power supplies must be locked off and isolated prior to any maintenance work. To do otherwise may result in significant equipment damage, hazardous material discharge, or serious personal injury.

2. Flanged End Valves:

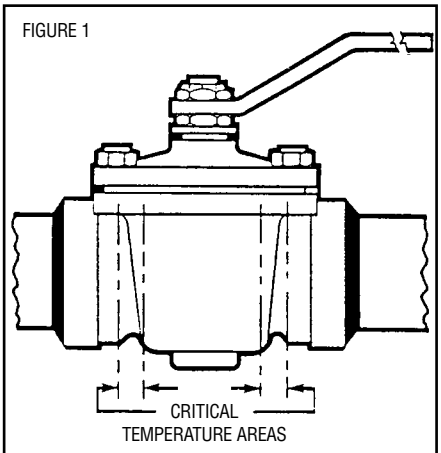
These valves are to be bolted in line to companion flanges of the same pressure class and facing as the valve flanges, using the proper size and pressure class flange gaskets. Flowserve does not furnish companion flanges or flange gaskets. Flange bolt torquing should follow proper tightening sequence.

3. Weld End Valves:

A. Before installing weld end valves in line, remove bonnet, ball, and seats. Protect parts from dirt or damage while out of valve, especially the seating surfaces in the body. Metal, carbon-graphite or ceramic seats are lapped sets matched to the valve, and must be re-installed exactly as removed. Be very careful to avoid heat distortion of the valve body during welding. A spare bonnet gasket has been provided and should replace the original gasket during reassembly.

B. If necessary, valves supplied with graphite, metal, or ceramic seats, and certain plastic seats, may be welded in line without disassembly, however special precautions must

FIGURE 1



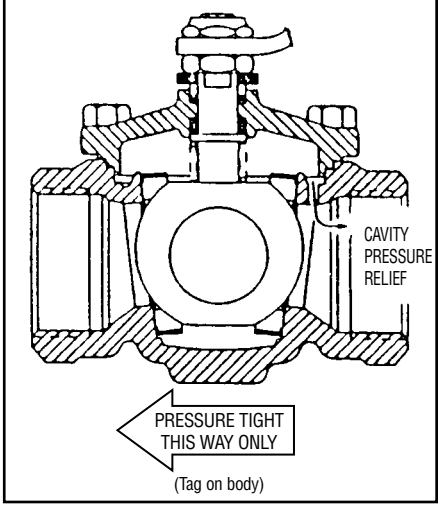
be taken. The valve should be in the open position during welding and remain open until it cools to ambient temperature. Welding procedures should be followed by qualified personnel and in accordance with Section IX of ASME Boiler Pressure Vessel Code. The critical temperature areas (shown in FIGURE 1) should not exceed 350° F.

C. When more than one weld is required for each end, the weld passes should alternate from end to end until the welds are completed. After the valve has cooled, the bonnet fasteners must be retorqued to the recommended torque value (shown in TABLE 5 and 6 on page 7). When possible, a final seat test should be performed before placing the valve into service.

4. Valves with Vented Cavity Relief:

A. Install vented valves with the arrow on the body pointed in the direction of normal flow as (shown in FIGURE 2 below).

FIGURE 2



Periodic Inspection and Adjustment

1. General

A. Good operating and maintenance procedures includes periodic inspection of valves and other piping system components, to ensure that they are operating properly. Inspection schedules must be determined by individual user, but as a minimum should consist of visually examining valves for external leakage, and making adjustments as necessary.

WARNING

Do not attempt any maintenance of these valves while in operation or under pressure. Actuated valve air and/or electrical power supplies must be locked off and isolated prior to any maintenance work. To do otherwise may result in significant equipment damage, hazardous material discharge, or serious personal injury.

2. Stem Seal Adjustment

A. Stem seal leakage must be stopped immediately to avoid damage to the valve stem seals, stem or bonnet, as well as possible contamination of the surrounding area. Tightening the stem nut (see FIGURE 5 on page 4) can most often eliminate stem seal leakage. Remove handle retainer nut and handle (if necessary for wrench clearance), and tighten stem nut by turning clockwise 1/4 turn at a time until the torque value (given in TABLE 3 or 4 on page 6) is reached.

B. Valves size 6 and larger do not require handle removal except for convenience. Bend out lock washer tabs from stem nut and tighten nut as described before, using a pin spanner. When retightened, bend tabs back to lock nut in place.

C. If stem leakage continues, disassemble valve and replace stem seal set (see Disassembly/Reassembly sections).

CAUTION

Do not overtighten the stem nut. Packing friction may increase excessively, making the valve difficult or impossible to operate.

3. Bonnet Gasket Bolting Re-tightening

A. Bonnet gasket leakage must be stopped immediately to avoid damage to the valve body/bonnet joint surfaces, contamination of the surrounding area. Tighten bonnet bolting to the torque values specified (in TABLES 5 and 6) following the sequence (shown in FIGURE 8). (If leakage continues, remove valve bonnet and replace bonnet gasket (see Disassembly/ Reassembly sections).

B. Valves which become difficult to operate or stuck, or show excessive seat (through valve) leakage, should be disassembled and inspected for internal damage from corrosion or wear, and repaired as necessary (see Disassembly/Reassembly sections).

4. Correcting Through Leakage – Soft Seated Valves

A. The wedge seat design permits soft-seated valves to be self-adjusting for seat wear, and thereby extend service life. In many instances where through-leakage is discovered, it may be corrected by simply cycling the valve open to closed several times, to allow the seats to "snug down" into the wedge. Soft seats are also more prone to damage from trash or abrasives in the flow stream. When through leakage cannot be reduced or eliminated by cycling, the valve should be taken out of service and disassembled for inspection and possible replacement of seats (see Disassembly/ Reassembly sections).

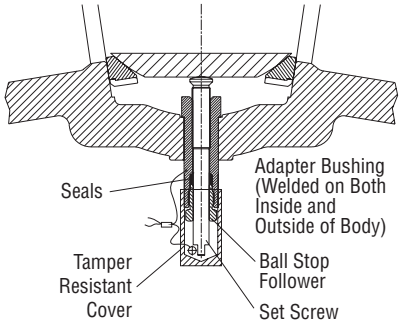
5. Correcting Through Leakage – Graphite, Metal, or Ceramic Seated Valves

A. A ball stop is used in all valves with metal and ceramic seats and in valves with carbon graphite seats for temperatures over 500°F. In time, the carbon-graphite seats may wear to a point where the ball stop should be reset in a lower position. Operating conditions will vary the period of time required for the setting change. Metal or ceramic seats may never need a ball stop setting change.

NOTE: Ball stop adjustments in this manual are basic factory settings. Service experience may require different adjustment.

B. Ball Stop Adjustment (in-line): Verify the valve is safe for maintenance to be performed. Remove locking wire and tamper-resistant cover. (see FIGURE 3). Loosen the ball stop follower by turning counterclockwise approximately 2 turns while holding the setscrew. Do not remove follower, turn the setscrew counterclockwise until it no longer contacts the ball, and turns freely. Carefully turn the setscrew clockwise until contact with the ball is felt (do this by hand or using the smallest wrench possible). Repeat this step as needed to ensure setscrew just touches ball.

FIGURE 3
Ball Stop Installation With Tamper resistant Cover



CAUTION

Do not force set screw movement in either direction, or use other than the smallest wrench possible while adjusting to prevent damage to the ball stop assembly.

For valves with carbon graphite seats, back off set screw (turn counterclockwise) 1/4 to 1/3 turn. For valves with metal or ceramic seats, turn in (turn clockwise) setscrew 1/4 to 1/3 turn. Lock set screw position by tightening follower to 15 ft-lb which holding setscrew to prevent movement. Re-install tamper cover and lockwire, and re-seal.

C. If through valve leakage is not satisfactorily reduced or eliminated by ball stop adjustment, ball, seal, or body sealing surfaces may be damaged, and disassembly for inspection/repair is required. (see Disassembly/ Reassembly sections).

6. Valve With Self-relieving Seats

CAUTION

There must be no line pressure on the valve when adjusting for normal wear.

A. To adjust for normal wear, close valve, remove handle nut and travel stop.

B. Using the handle as a wrench, turn stem 180° only in a clockwise direction. This will allow the ball to drop 1/64". In 3/4" and 1" valves the ball may not drop readily. A light tap on the body boss directly under the ball will allow the ball to drop into the proper position after adjustment.

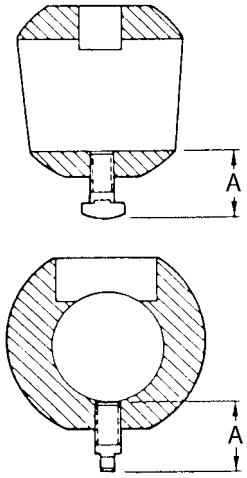
C. Replace travel stop, stem nut and handle. Test for seat tightness at normal line pressure. If seats still leak, repeat steps A and B.

D. It is important that seats be adjusted to the minimum tightness that will retain line pressure without leakage. The adjustments, therefore, should only be made in 180° steps as outlined above.

E. This adjustment for wear may be performed several times during the life of the seats. In the event that three 180° adjustments at any one time fail to eliminate leakage, it is likely that the internal parts are worn or bound by pipeline scale. The valve must then be disassembled and cleaned. Any worn or damaged parts must be replaced to restore the valve to good operating condition.

NOTE: Standard McCannaseal seats will not self relieve. Special seats for this purpose must be ordered from the factory.

FIGURE 4
SELF RELIEVING SEAT: BALL ADJUSTMENT



VALVE SIZE	A
3/4" - 1"	.610 to .625
1-1/2"	.696 to .711
2"	.923 to .938
3"	1.077 to 1.092
4"	1.317 to 1.332
6"	1.970 to 1.985
8"	2.250 to 2.265

"A" dimension to be established before ball/seat assembly is installed.

7. Other Specially Prepared Valves

Some valves with special preparation such as for Oxygen, Chlorine, Vacuum or other special services may have special maintenance instructions. See any special instructions which were supplied with the valve shipment.

NOTE: These instructions may be obtained from your McCANNA distributor.

Dissasembly

WARNING

Do not attempt any maintenance of these valves while in operation or under pressure. Actuated valve air and/or electrical power supplies must be locked off and isolated prior to any maintenance work. To do otherwise may result in significant equipment damage, hazardous material discharge, or serious personal injury.

1. Disassembly Instructions:

A. Refer to McCannaseal Parts Identification (FIGURE 5 at right) for this section.

B. Make sure valve is in full open position, and remove actuation assembly (handle, gear, or power actuator).

CAUTION

Do not try to remove ball while in closed position. Damage to ball sealing surfaces will be the result if this is attempted.

1. Loosen handle retainer nut and remove handle.

2. Remove bonnet nuts (or capscrews if supplied). Loosen evenly; bonnet will lift due to internal spring.

3. Remove bonnet assembly, spring, and bonnet gasket. Also remove spacer washer (under spring) on Fireseal valves. Place bonnet assembly on clean work surface.

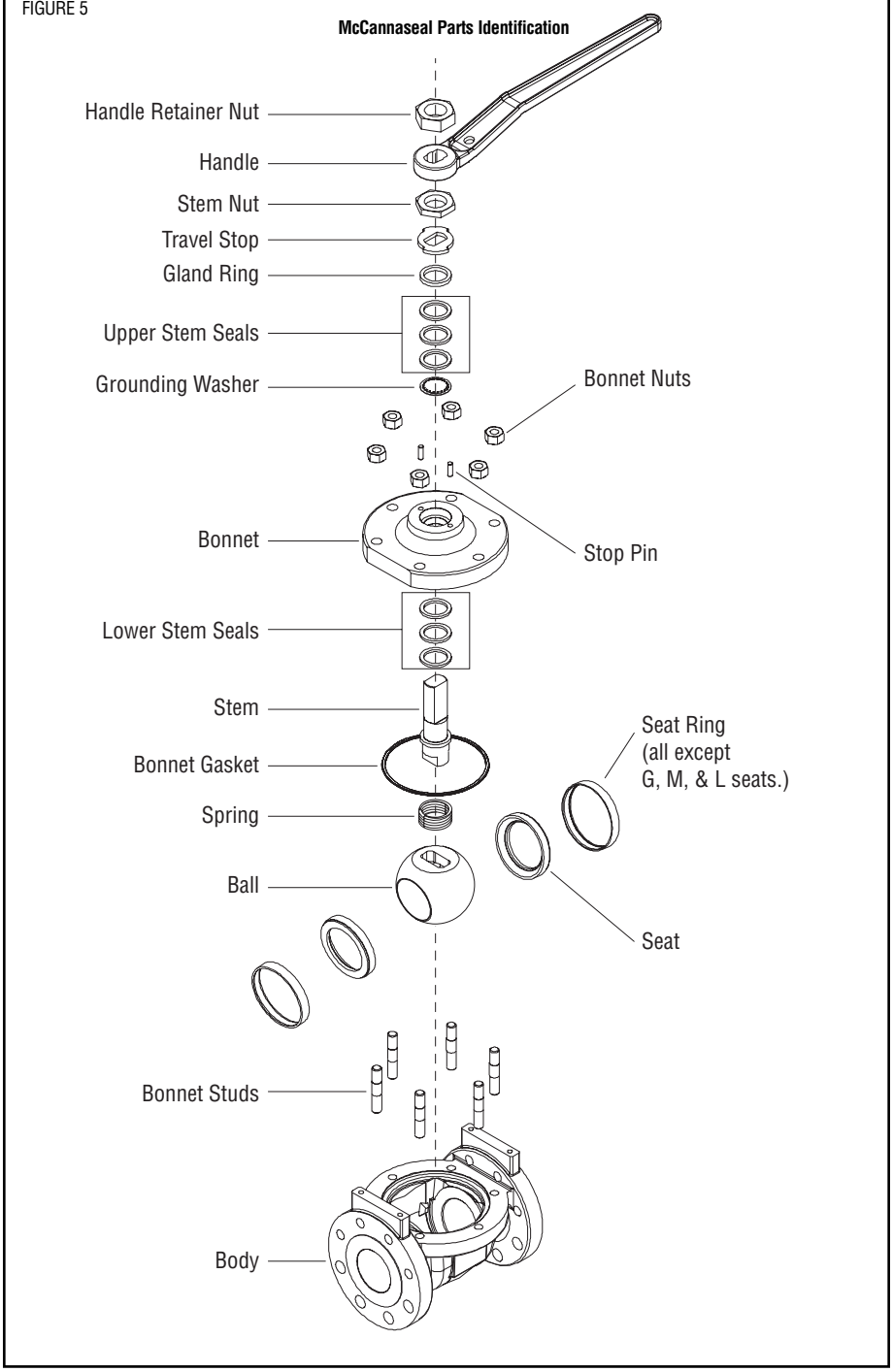
4. Remove stem nut or retainer nut , travel stop and gland ring.

5. Slide stem out through the inner side of the bonnet. Do not force stem out of bonnet. Severe damage may result.

NOTE: Stem has a shoulder which prevents blowout under pressure.

6. Remove upper stem seals and grounding washer from bonnet taking care not to scratch the bonnet bore surface.

FIGURE 5



NOTE: Valves supplied with flexible graphite stem seals will not have a grounding washer.

7. Insert a large screwdriver or similar tool into the oval slot of the ball and loosen by moving the screwdriver in a direction 90° to the pipe line until the screwdriver rests against the valve body (cover only gassket edge).

8. Carefully lift ball and seats upward by pushing down on the screwdriver until they can be removed by hand. Avoid marring bonnet gasket surfaces or ballsurfaces.

NOTE: Be careful not to mar the bonnet gasket surface.

9. Clean and inspect all parts for wear or damage. Pay particular attention to gasket and seating surfaces, ball surface, travel stop and soft parts.

If ball stop is installed and needs repair, disassemble by removing lockwire, cover, and follower, and turn setscrew clockwise until it can be withdrawn from the adapter from inside the body. Remove ball stop packing and discard.

NOTE: Valves equipped with hard seats such as carbon graphite or metal must be lapped to the ball. The preferred procedure is to use a matched set from the factory. Hard seats must be lapped to the valve body for optimum sealing.

Under normal circumstances, ceramic balls do not have to be lapped to seats but ceramic seats should be lapped to the valve body.

2. Cleaning, Inspection, Lubrication Instructions:

A. After disassembly, discard bonnet gasket and stem seals (if removed) and ball stop packing (if removed). Gaskets and seals are not re-useable. Carefully clean and inspect all parts for wear or damage, paying particular attention to seating/sealing surfaces on ball and seats, stem journal and bonnet bore, and body/bonnet gasket areas.

B. Damaged or badly worn parts should be replaced using only parts or repair kits supplied by Flowserve. For valves of certain sizes and/or materials, this may not be desirable. Valve parts considered for repair should be evaluated by an Authorized McCANNA Repair Center to determine if repair is possible.

NOTE: Carbon-graphite, ceramic, and metal seats are lapped flat on the body side, and match-lapped to the ball as a set, and must be replaced as a set. Body seat surfaces for hard seated valves are lapped flat, and must be checked for flatness and cleanliness before reassembly. If re-lapping is required, contact the nearest Authorized McCANNA Repair Center.

C. Lubrication of valve parts to aid assembly and initial operation is recommended, when permitted by service and operating conditions. The lubricant used must be compatible with the intended service (see TABLE 1 below for recommended lubricants). If necessary, valve internal wetted parts may be assembled without lubrication.

D. Lubricants are to be applied sparingly; a thin wipe is sufficient. Do not apply lubricants with a brush or other means. Excessive lubricant on the ball, seat, or in the stem bore can affect valve performance and should be removed from the valve. If lubricant build-up or caking is visible on the ball or seats, too much has been used.

Reassembly

1. Reassembly Instructions:

A. Refer to McCannaseal Parts Identification (FIGURE 5 on previous page) for this section.

NOTE: Lubricating this valve during assembly is recommended as described in prceeding step 2C and 2D. Assembly will be easier, the valve operating torque will be lower and the valve seal will be tighter. The lubricant selected must be compatible with the intended valve service. It is also possible to assemble without the use of lubricants if required by the service conditions.

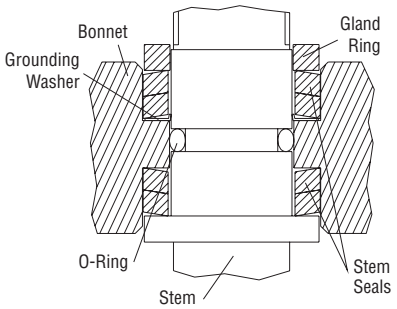
2. Standard Valves

1. Lightly lubricate the stem and stem seals.

2. Slide the correct number of stem seals for the lower location (see TABLE 2 page 6) on the stem to the shoulder. Plastic stem seals are made in a conical or “dished” shape for better sealing. The lower seals should be installed on the stem with the “dished” sides facing upward (see FIGURE 6 above).

FIGURE 6

STEM SEAL ASSEMBLY FOR PLASTIC MATERIALS



3. Flexible graphite stem seals are not sided, and may be installed either side up.

4. Install O-ring seal in groove on stem, if required in assembly.

5. Insert stem into bonnet from lower side.

6. Insert grounding washer into upper stem seal bore in bonnet with the fingers pointing upward. Note that where flexible graphite seals are used, the grounding washer is normally omitted.

7. Slide the required number of stem seals for the upper location (see TABLE 2 page 6) on the stem and into the bonnet bore. Seals may be tamped into place using the gland ring, or a suitable size length of pipe.

8. Install gland ring above stem seals, and install travel stop above gland ring. Travel stop is to be installed so that a clockwise rotation of the stem will close the valve. If clockwise movement is not possible, remove travel stop, invert, and reinstall.

9. Run stem nut (or tab washer and locknut) on stem and tighten to the proper torque value (specified in TABLES 3 or 4).

TABLE 1
Lubricants

RECOMMENDED LUBRICANTS
Fluorolube GR-362 or other grades is considered the standard lubricant on all T, R, U, and W seated valves. This also applies to TFE and RTFE based stem seals. PCL can also be used on seats in these valves.
Kerosene or Dow Corning DC-33 may be used on valve seats in G seated valves.
Kerosene or Fluoropolymer Slip Spray may be used on valve seats in M seated valves.
Carbon graphite stem seals should be lubricated with a mixture of graphite flake and DC-33 silicone grease.
Never -Seez should be used on all bonnet fasteners.

TABLE 2

Stem Seal Assembly Quantities

Regular Port Valve Size	Full Port Valve Size	Plastic Seal Materials	Carbon -Graphite or Other Fire-Seal Materials
1/2 through 1-1/2 (all classes)	1/2 through 1 (all classes)	1 upper 2 lower	1 upper 2 lower
2 (150/300)	1-1/2 (150/300)	1 upper 2 lower	1 upper 2 lower
2 (600 and higher)	1-1/2 (600 and higher)	3 upper 3 lower	3 upper 3 lower
3 through 6 (all classes)	2 through 6 (all classes)	3 upper 2 lower	3 upper 2 lower
8 and up (all classes)	6 and up (all classes)	3 upper 3 lower	3 upper 3 lower

TABLE 3

Minimum Stem Nut Torque Requirements for Plastic Seal Materials (ft.-lb.)

Regular Port Valve Size	Full Port Valve Size	Class 150/300	Class 600
1/2, 3/4, & 1	1/2, & 3/4	10 (10)	15 (25)
1-1/2	1	15 (25)	15 (25)
2	1-1/2	15 (25)	20 (30)
3	2	15 (25)	15 (25)
4	3	20 (40)	20 (40)
6	4	35 (50)	35 (50)
8 and up	6 and up	50 (95)	50 (95)

Notes: *First numbers are for fluoropolymer stem seals (TFE, PTFE, FEP, PFA). Numbers in parenthesis( ) are for harder seal materials (PEEK, UHMWP, etc.).*

TABLE 4

Minimum Stem Nut Torque Requirements for Flexible Graphite Seals (ft.-lb.)

Regular Port Valve Size	Full Port Valve Size	Class 150/300	Class 600	Class 900	Class 1500
1/2, 3/4, & 1	1/2, & 3/4	5	10	15	15
1-1/2	1	10	10	20	20
2	1-1/2	10	15	25	25
3	2	25	25	35	35
4	3	35	35	60	60
6	4	60	60	95	100[2]
8	6	95	95	100[2]	100[2]
10	10	100[2]	100[2]	100[2]	100[2]
12	12	100[2]	100[2]	100[2]	100[2]
14	—	100[2]	100[2]	100[2]	100[2]
16	—	100[2]	100[2]	100[2]	100[2]
18	—	100[2]	100[2]	100[2]	100[2]

Notes: *[1] Torque requirements set to give a minimum of 5% compression of seal stack height. Smaller sizes will experience 10% or more compression (2" RP and under).*
[2] These valves should be assembled with this torque initially, and then during shell testing, the stem nut should be torqued to this requirement as the lower packing set will be compressed additionally by the test pressure.

10. Assemble plastic seats into seal rings (N/A for metal. Graphite, or ceramic seats). Lightly lubricate ball sealing surface and both sides of each seat.

11. Place seats in position on ball so that seats are aligned with the ball flow passage, with the ball slot facing upwards. Holding ball and seats in position, lift as a unit and carefully lower into valve body, lining up seat backs with body seat surfaces. Carefully align the ball stem slot so that it is perpendicular to the body flow passage, and the top flat of the ball is parallel to the bonnet flange.

12. Lubricate bonnet fasteners (studs & nuts or capscrews) (per TABLE 1 on page 5).

13. Place a new bonnet gasket in the machined groove in the body. Place spring on ball, centered on stem slot.

14. Place bonnet assembly on body, aligning stem tang with spring and ball slot, and bonnet bolt holes with body studs (or threaded holes). Carefully press down on bonnet, making sure bonnet gasket register is properly aligned with body bore. Spring resistance will be felt; this is normal. Continue pressing down, taking care not to damage gasket, until studs extend through the bonnet enough to engage nuts, or capscrews can engage body bolt holes. Holding bonnet in place, thread nuts on to studs, or insert capscrews and tighten finger tight. Follow the bolt tightening sequence (shown in FIGURE 8).

15. Tighten bonnet bolting evenly to the torque values (given in TABLES 5 or 6) following the bolt tightening sequence (shown in FIGURE 8). Note that in Class 150, 300, and 600 regular port valves, the bonnet and body flanges may not be in contact after assembly. This is normal, provided bolting torques and sequences have been followed. Manually cycle valve several times to verify proper operation. Testing before reinstallation is recommended.

CAUTION

Do not over-tighten bonnet bolting. Doing so may damage the bolting or distort the bonnet flange, resulting in gasket leakage.

See Inspection and Adjustment section for adjustment procedures.

3. Hard Seated Valves, Metal, Carbon-Graphite or Ceramic

Follow the general assembly steps for standard valves. And see Inspection and Adjustment section for adjustment procedures.

4. Fireseal Type Valves – Special Instructions:

For Fireseal type valves in sizes 6" and smaller a washer with a double flatted hole is used in the assembly. This is to be placed on the flatted surface of the ball, aligned so that the tang of the stem will pass through the washer and then into ball slot (see FIGURE 7 at right). The spring will be in contact with the washer rather than the ball surface. The number of lower stem seals will vary with size (see TABLE 2 page 6).

NOTE: Place ball and seat set in body cavity, with non-marring mallet, give ball a firm hit to set ball/seats prior to attaching bonnet.

CAUTION

Care must be exercised when installing ball/seat into body. Lightly lubricate seat seal to make sure it remains in seal groove at installation of ball/seat.

FIGURE 7

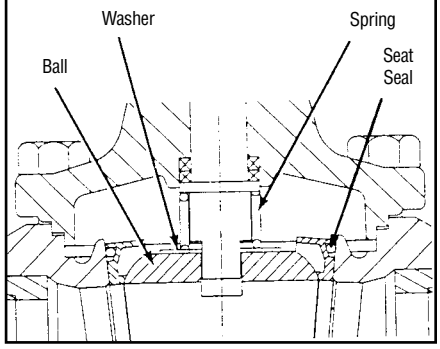


TABLE 5

Bonnet Bolting Torques For Use with Gaskets Made of All Plastics and Flexible Graphite

Minimum[2] Torque — Lb.- Ft.				
Regular Port Valve Size	**Full Port[2] Valve Size**	**Class 150**	**Class 300**	**Class 600**
1/2, 3/4, 1	1/2, 3/4	4	6	15
1-1/2	1	6	15	15
2	1-1/2	15	30	30
3	2	30	75	75
4(4 BOLT)	3	75	180	NA
4	NA	30	75	135
6	4	75	180	270
8	6	180	420	700
10	NA	135	300	NA
12	NA	135	420	NA
14	NA	180	420	NA

Notes: *NA = Non-Applicable*
All torques shown are for lubricated fasteners.

TABLE 6

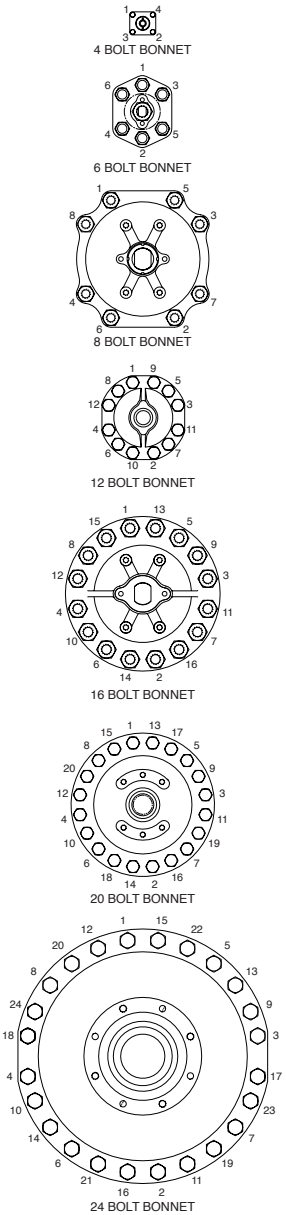
Bonnet Bolting Torques For Use with Spiral Wound Gaskets

Torque — Lb.- Ft.						
Regular Port Valve Size	**Full Port Valve Size**	**Class 150**	**Class 300**	**Class 600**	**Class 900**	**Class 1500**
1/2, 3/4, 1	1/2, 3/4	10	10	15	75	110
1-1/2	1	15	15	15	90	150
2	1-1/2	30	30	30	150	240
3	2	75	75	75	240	580
4 (4 BOLT)[1]	3(1)	160	160	NA	NA	NA
4(1)	NA	60	60	80	270	550
6(1)	4(1)	150	150	170	800	800
8(1)	6(1)	220	220	550	1000	1300
10	NA	NA	NA	525	NA	1350
NA	8	270	270	525	NA	NA
NA	10	350	350	800	NA	NA
12	NA	NA	NA	NA	NA	NA
14	NA	NA	NA	NA	NA	NA
16	12	550	550	1350	NA	NA
18	14	775	775	NA	NA	NA

Notes: *NA = Non-Applicable*
[1] For Titanium (TI) valves with spiral wound gaskets, the plastic/homogenous graphoil torque is to be used for these sizes.

FIGURE 8

BONNET BOLTING SEQUENCE



Addendum 1

Seat and Seal Materials

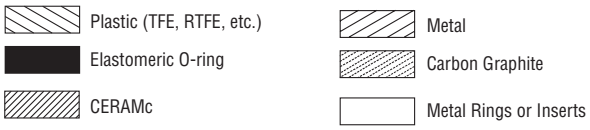
Most of the soft stem seals are non memory materials. This means that materials such as fluoropolymer do not retain their original shape once they have been compressed or deformed in some manner. Care should be taken when tightening these seals so that they do not lose their extended service life.

Flowserve offers two standard ball surface finishes. Balls used with soft seats have a standard high gloss finish and are well suited to most polymeric materials. These balls should not be used with hard seats which require a special ball capable of being lapped to the hard seats. The special ball carries a (G-1) mark stamped in the stem slot area. G-1 balls are used with hard seats such as carbon-graphite, ceramic, Stellite® and Waukesha 88®. They may also be used with PEEK, Zymaxx and other polymeric seats that have hard surface finishes. G-1 balls, like standard balls may be made from any metal or ceramic material (see CHART 1 for a description of seat materials).

CHART 1
Seat Configurations

 Standard Soft Seat (Model "B") Manufactured: 1966 to Present	 Fire-Seal Seat (Model "E") Manufactured: 1988 to Present Used in "Z" Figure Valves	 Fire-Seal Seat (Model "F") For Valve Sizes 6" & Larger FP 8" & Larger RP Used in "Y" Figure Valves	 "G" Seat Carbon Graphite (Available Only As Matched Set of 1 Ball and 2 Seats)	 Metal Seat (Available Only As Matched Set of 1 Ball and 2 Seats)
 CERAMc Seat	 Self Relieving Seat	 Block and Bleed Seat Manufactured: 1964 to Present	Obsolete  Standard Soft Seat (Model "A") Manufactured: 1958 to 1966	Obsolete  Fire-Seal Seat (Model "A") Manufactured: 1960 to 1966
Obsolete  Fire-Seal Seat (Model "B") Manufactured: 1966 to 1972	Obsolete  Fire-Seal Seat (Model "C") Manufactured: 1971 to 1987	Obsolete  Fire-Seal Seat (Model "D") Manufactured: 1981 to 1988 Used in "A" Figure Valves	Obsolete  Block and Bleed Seat Manufactured: 1961 to 1964	

Materials of Crosshatched Parts are as Follows:



NOTES:
1. All crosshatched items to be replaced as part of valve repair.
2. Designs noted as obsolete, do not have seal kits available. Replace metal parts as well as soft parts with current configuration.

NOTICE
McCANNA Valves are designed and manufactured using good workmanship and materials, and they meet all applicable industry standards. Flowserve Corp. is anxious to avoid injuries and property damage which could result from misapplication of the product. Proper valve selection is imperative. Examples of the misapplications or misuse of a valve include but are not limited to use in a service in which the pressure/temperature rating is exceeded or in a chemical service incompatible with the valve materials; use of undersized valve actuators; use of extremely fast valve actuation and/or continuous valve cycling on standard valves; making modifications of the product of any kind; failure to use caution in operating valves in high temperature, high pressure, or highly hazardous services; and the failure to maintain valves as recommended. The right is reserved to change or modify product design or construction without prior notice and without incurring any obligation to make such changes and modification on products previously or subsequently sold.

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.

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Printed in USA 12/03

MMAIM2007 (Part V570-11)