MODEL 2296
ALL SIZES

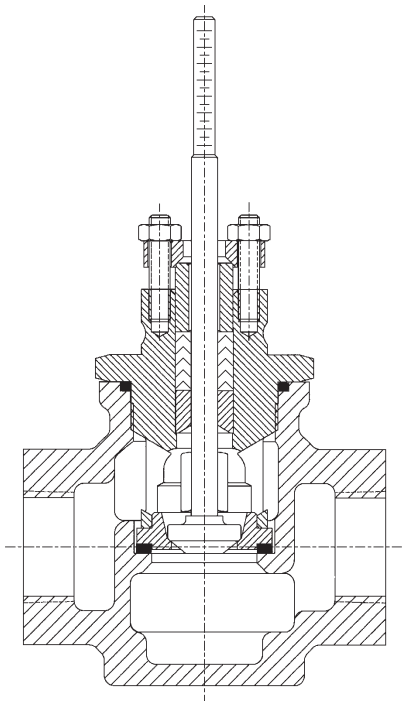
GLOBE-STYLE PNEUMATIC CONTROL VALVE BODY

SECTION I

I. DESCRIPTION AND SCOPE

The Model 2296 is a pneumatically actuated, globe-style control valve with cast SST body. It is available in sizes 1/2" - 2" (DN15 - DN50). Sizes 1/2" – 1-1/2" (DN15-DN40) utilize Model 25D/R actuators; size 2" (DN50) utilizes Model 55D/R actuators. Internal design is a “push down to close” arrangement. Failure position is determined by actuator.

The valve is designed primarily for moderately corrosive applications, but may be applied as a general service or cryogenic control valve. End connections are NPT.



1-1/2" Model 2296 Body

SECTION II

II. REFERENCES

Refer to Technical Bulletin 2296-TB for technical specifications of a Model 2296 Control Valve.

Refer to the following IOM's for actuators or accessory devices mounted to a Model 2296 Control Valve:

ACTUATORS
Cashco – IOM-25
Cashco – IOM-55/75/115

POSITIONERS
IOM-991, PS2 (I/P)
IOM-9540L (P/P)

ABBREVIATIONS

ATC–FO	–	Air–to–Close, Fail Open
ATO–FC	–	Air–to–Open, Fail Close
CCW	–	Counter Clockwise
CW	–	Clockwise
D	–	Direct Acting
DIR	–	Direct Acting
IAS	–	Instrument Air Supply
IOM	–	Installation, Operation, and Maintenance Manual
LOAD	–	Positioner Output Air Pressure
R	–	Reverse Acting
REV	–	Reverse Acting
SIG	–	Output Signal from Instrument
SST	–	Cast or Wrought 316 Stainless Steel
V	–	Vent

SECTION III

III. INSTALLATION

A. Orientation:

1. Recommended orientation when installed in a horizontal pipeline is with the stem vertical. Valves may also be installed in vertical pipelines with stems horizontal.

2. Outdoors, all installations may be oriented any angle from horizontal-to-vertical.

3. Model 2296 valves are not recommended for installation with the actuator oriented downwards.

B. Piping System:

1. It is recommended that the control valve unit be installed with a double-block and bypass as indicated in Figure 1. This arrangement is recommended especially where maintenance will be done on the valve body while still installed in the pipeline.

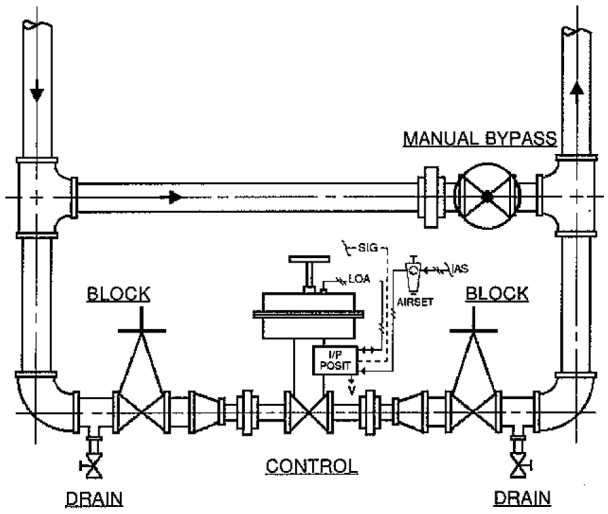


Figure 1: Typical Control Valve Station

2. Pipe unions are recommended for NPT screwed installations to allow complete removal from system.

3. If pipe reducers are located before and/or after the valve body, keep the reducers as close as practical to the valve body; this is especially important where the reducers are more than one line size larger than the valve body size, which is common in gaseous service.

4. Clean the piping of all foreign debris, including chips, weld scale, weld spatter, oil, grease, sand or dirt prior to installing the control valve. This is an absolute requirement for valves supplied with composition soft seats. System start-up strainers, for removal shortly after initial start-up, are recommended.

5. Field hydrostatic testing the completed piping system to 1-1/2 x CWP in psig indicated on the nameplate, including the 2296, is acceptable. If hydro test pressure exceeds the 1-1/2 x CWP limit, the 2296 must be removed for such testing. Before pressurization, the valve plug should be lifted from the seat if of ATO-FC action. Tighten packing as required.

6. In placing thread sealant on pipe ends prior to engagement, ensure that excess material is removed and not allowed to enter the valve upon start-up.

7. Flow Direction: Install so the flow direction matches the arrow marked on the valve body.

8. For best performance, install in well drained horizontal pipe, properly trapped if a steam service application.

9. Valves are not to be direct buried underground.

10. Insulation may be applied as indicated in Figure 2. Drainage away from the packing area must be ensured when fully installed, sealed and lagged for outdoors installation.

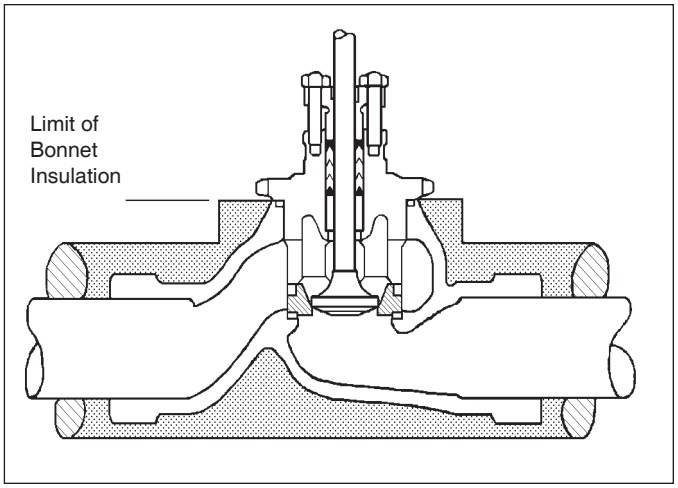


Figure 2: Body Insulation

11. Undue piping stress/strain or bending torques may not be transmitted through the control valve body. One pipe (inlet or outlet) should be anchored rigidly for piping that is "hot" or "cold" with respect to ambient temperature; the remaining pipe (inlet or outlet) should be supported and guided to ensure unidirectional expansion/contraction.

SECTION IV

IV. MAINTENANCE

WARNING

SYSTEM UNDER PRESSURE. Prior to performing any maintenance, isolate the valve/actuator from the system and relieve all pressure. Failure to do so could result in personal injury.

A. General:

1. **Maintenance procedures hereinafter are based upon removal of the valve/actuator unit from the pipeline where installed.**

2. Owner should refer to Owner's procedures for removal, handling and cleaning of nonreusable parts, i.e. gaskets, suitable solvents, etc.

3. Valves supplied from the factory use a gasket sealant, Federal Process Company, PLS2, or equal. Owner may use such aids provided the aids are compatible with the Owner's fluid. (See below for "oxygen cleaned" valves.)

4. Valves originally supplied in accordance with Option-55 require special cleaning procedures. Refer to Cashco Specification No. S-1134 for details. When in compliance with Spec. #S-1134, the valve is suitable for oxygen service. Sealants and lubricants used in reassembly of a valve unit for use in oxygen service MUST be suitable for O_2 service. Cleaned parts to be reused MUST be suitably cleaned for O_2 service similar to requirements of Cashco Cleaning Spec. #S-1134.

5. All indicated Item Numbers that are with respect to the actuator portion of a Model 2296 are in parenthesis and underscored; i.e. (20). All Item Numbers that are with respect to the body portion of a Model 2296 are not underscored; i.e. (32).

6. Special care must be exhibited when rotating the stem (4.6) of the valve to not mar that portion of the surface of the stem (4.6) where it contacts with the packing (10). To rotate the stem (4.6), use soft-jawed pliers.

7. Place matchmarks between the bonnet (2) flange and the yoke (1) of 2" (DN50) size with Model 55 actuator, or lower case/yoke (2) for all other sizes with Model 25 actuator to assist in final orientation when the body is disassembled and/or the actuator moved.

B. Actuator Removal and Replacement:

1. Reference the actuator's IOM to remove actuator subassembly (AA) from body subassembly (BA):

   Sizes 1/2" - 1-1/2" (DN15-DN40) – IOM-25
   Size 2" (DN50) – IOM-55/75/115

   Reference same to reinstall actuator subassembly (AA).

C. Trim/Packing Removal and Replacement:

NOTE: This Subsection assumes that the actuator subassembly (AA) has been already removed per Subsection B. previous.

1. Secure body subassembly (BA) in a vise with the valve stem (4) pointing upwards. Place matchmarks between the body (1) and bonnet (2).

2. Pull stem (4) upwards. Hold stem (4) up if necessary using soft-jawed locking pliers.

3. Sizes 1/2" – 1-1/2" (DN15-DN40):
   a. Using a smooth jaw wrench, loosen bonnet (2) from the body (1) by rotating CCW (viewed from above). It may be necessary to hammer-rap the wrench to break loose the bonnet (2). Rotate bonnet (2) to disengage from body (1).
   b. Lift the bonnet (2) (with integral cage for sizes 1/2" – 1-1/2" (DN15-DN40)), stem assembly (4), stem guide bushing (12), and all the stem packing components (10, 11, 20, 21, 23) directly upwards and out of the body (1) cavity, ensuring not to damage the threaded portion of the body (1)-to-bonnet (2) joint. Lay this partial assembly aside.

⚠ CAUTION

It sometimes occurs that the seat ring (3) and its gasket (5) will "stick" to the lower (cage) portion of bonnet (2), and pull out with parts of this step above. DO NOT ALLOW SEAT RING (3) TO DROP and do personal injury or deform seat ring (3)!

c. Remove o-ring/gasket (6).

4. Size 2" (DN50):
   a. Loosen all four bonnet bolt nuts (28) approximately one revolution. Remove all nuts (28).
   b. Wiggle stem (4) side-to-side to break loose bonnet (2) from body (1) and cage (19). Lift the bonnet (2) directly upwards along with stem assembly (4), stem guide bushing (12), and all the stem packing components (10, 11, 20, 21, 23). Lay this partial assembly aside.

⚠ CAUTION

It sometimes occurs that the seat ring (3), cage (19), and seat ring gasket (5) will "stick" to the bonnet (2) or cage (19), and pull out with parts of this step above. DO NOT ALLOW THE SEAT RING (3) OR CAGE (19) TO DROP and do personal injury or deform parts (3, 19)!

   c. Remove cage (19) from body (1) cavity by lifting upwards.
   d. Remove bonnet gasket (6) and discard.

5. Remove seat ring (3) from body (1) cavity.

6. Remove seat ring gasket (5) and discard.

7. Remove body (1) from vise and place in cleaning solvent.

8. Place the valve bonnet (2) partial assembly (4, 10, 11, 12, 20, 21, 23) into the vise with stem (4) directed upwards. NOTE: Soft-jawed locking pliers are still clamped to stem (4). Locate the bonnet (2) with respect to the vise such that the plug (4) end of the stem (4) can prevent the stem (4) assembly from falling out once the locking pliers are removed. Remove the soft-jawed locking pliers.
9. Remove both packing stud nuts (21). Lift upwards to remove the packing flange (23). Lift upwards to remove the packing follower (11).

10. While holding the stem (4) assembly with your fingers to keep it from dropping, reorient the bonnet (2) within the vise to allow the stem (4) to be withdrawn out the bottom of the bonnet (2).

11. Using a pick-end tool, pull out each packing ring (10) from within the bonnet's (2) packing box; discard each packing ring (10). NOTE: Six packing rings per packing set (10) for sizes 1/2" – 1" (DN15-25); five packing rings for sizes 1-1/2" and 2" (DN40 and 50).

12. Rotate packing stud nuts (21) over end of packing studs (20) to prevent impact damage.

13. Remove bonnet (2) with guide bushing (12) still in packing box from vise. Turn bonnet (2) upside down and allow guide bushing (12) to slide out. NOTE: Guide bushing (12) is not "pressed" into its location. If stuck in place, use a tool on the guide bushing's (12) bottom end to push the guide bushing (12) out.

14. Place all metallic parts (2, 3, 4,11, 12, 19, 20, 21, 23) in cleaning solvent and soak for 15-20 minutes. Remove parts and allow to dry or wipe clean. Dispose of solvent or solvent soaked rags/towels according to Owner's procedures.

15. Using a micrometer, measure the stem (4, 4.6) OD and the guide bushing (12) ID in the portions exposed to wear. Replace all parts showing wear or axial scratches/grooves on the stem (4, 4.6). It is recommended that the guide bushing (12) also be replaced if the stem (4, 4.6) shows scratches/grooves.

16. Metal-Seated Trim:
   a. Examine plug head (4) at location where plug (4) seats to seat ring (3). Closely examine these parts (3, 4) for any wire-drawing. Replace both plug-stem (4) and seat ring (3) whenever one or the other shows any signs of wear.
   b. Using a suitable seat lapping compound, hand-lap the plug (4) to the seat (3).
   c. If significant plug (4) or seat ring (3) wear is present, replace trim.

17. Composition (Soft) Seated Trim (See Fig. 3):
   a. Place stem (4.6) threaded portion in the vise in a horizontal position, clamping with leaded jaws.
   b. Remove SST cotter pin (4.4) and discard.

c. Remove castle nut (4.5) by rotating CCW (viewed from nut (4.5) end).
d. Slide both adapters (4.1, 4.3) with soft seat (4.2) off nut-end of stem (4.6). Discard soft seat (4.2). Examine adapters (4.1, 4.3) and seat ring (3) for wear; replace all significantly worn parts. Clean adapters (4.1, 4.3) to be reused.
e. Place a properly oriented soft seat (4.2) between the upper adapter (4.3) and lower adapter (4.1). Press together; full contact should be made between the parts (4.1, 4.2, 4.3). Slide these parts with upper adapter end (4.3) first over the nut-end of stem (4.6) until upper adapter (4.3) properly shoulders onto stem (4.6) ledge.
f. Rotate castle nut (4.5) onto end of stem (4.6). Wrench-tighten until the castle nut (4.5) is firmly in place. Continue tightening castle nut (4.5) until a castle nut (4.5) notch aligns with the cotter pin (4.4) hole thru the stem (4.6).
g. Insert new SST cotter pin (4.4) and spread ends apart in opposite directions.

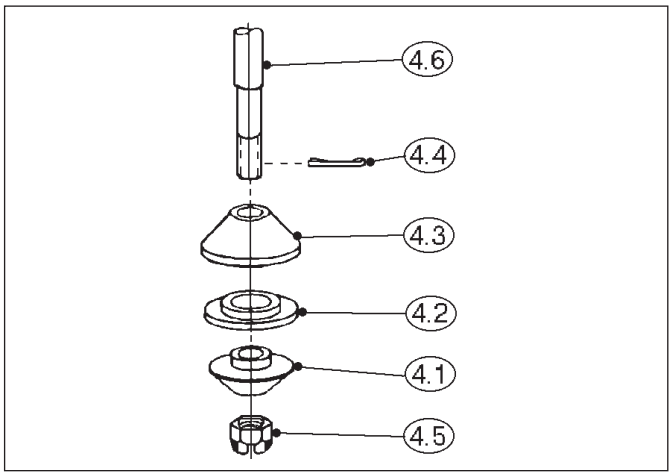


Figure 3
Composition Seat Arrangement Sub-assembly (4)

18. Recondition interior surface portion of bonnet's (2) packing box where the OD of the packing rings (10) contacts to a 16 Ra finish.

19. Place guide bushing (12) back into the bonnet properly oriented; see Fig. 6A and 6B.

20. Place bonnet (2) into a vise positioned to allow bottom insertion of stem (4) assembly.

21. Put TFE thread sealant tape over upper end of stem (4). Insert stem (4) assembly upwards thru the bonnet (2) until the plug-end (4) or upper adapter (4.3) touches the bonnet (2). Loosen vise and reposition bonnet (2) to prevent stem (4) assembly from dropping out the bottom of the bonnet (2). Retighten vise.

22. See Figure 4 for proper packing (10) orientation; DO NOT INVERT PACKING RINGS (10). Insert lower ring (10.3) over upper end of stem (4) and push into bonnet's (2) packing box. Use a hollow tool or packing follower (11) to press the lower ring (10.3) fully into place. Repeat for all four/three of the packing v-rings (10.2) and the upper ring (10.1).

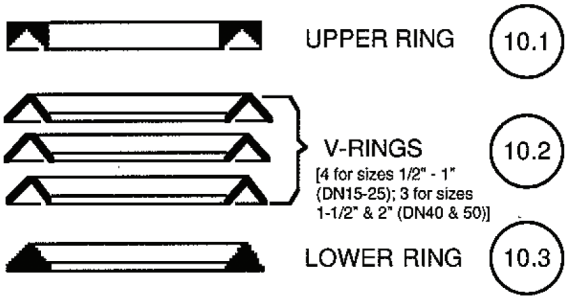


Figure 4 : Packing

23. Place the packing follower (11) properly oriented over the stem (4) upper end and down to the packing upper ring (10.1).

24. Remove both packing stud nuts (21).

25. Place the packing flange (23) properly oriented over the stem (4) upper end and down to the packing follower (11) and over the packing studs (20).

26. Replace the packing stud nuts (21) onto the packing studs (20) and finger-tighten the nuts (21) evenly down to the packing flange (23) such that the packing flange (23) is level with respect to the valve body (1). Using a torque wrench, tighten packing stud nuts (21) to approximately 9.0 ft.-lbs. (12.2 N-m).

27. Remove the partial assembly of article 26. above from the vise and lay aside.

28. Place body (1) into vise with cavity on top side.

29. Place seat ring gasket (5) into body (1) cavity.

30. See Figures 6A and 6B for proper seat ring (3) orientation into body (1) cavity.

31. 1/2" – 1-1/2" Body Sizes
    a. Place bonnet o-ring/gasket (6) into its body (1) recess.
    b. Place thread lubricant/sealant Bostik Never Seez®, or equal, onto threaded portion of bonnet (2).
    c. Lift stem (4) upwards as far as possible. Packing (10) friction should hold the stem (4) up.
    d. Engage threaded male end of bonnet (2) into female threaded joint of body (1) cavity, ensuring not to cross-thread. Bonnet assembly should be rotated easily by hand; DO NOT FORCE ENGAGEMENT WITH A WRENCH.
    e. When the bonnet (2) is approximately 1/4" (6mm) from the body (1), firmly press the stem (4) downwards to touch the seat ring (3). Lift stem (4) upwards and out of the seat ring (3) a minimum of 3/8" (10 mm).
    f. Continue engagement of bonnet (2)-to-body (1) until it is necessary to use a wrench to fully tighten. Hammer-rap the bonnet (2) tightening tool. Matchmarks of article A.7. should align, and bonnet (2) should be touching body (1) with no gap at joint.

32. 2" Body Size
    a. Place cage (19) properly oriented into body (1) cavity and ensure that cage (19) lower end shoulders onto seat ring (3) properly.
    b. Place bonnet o-ring/gasket (6) into its body (1) recess.
    c. Lift stem (4) upwards as far as possible. Packing (10) friction should hold the stem (4) up.
    d. Observing location of matchmarks of article A.7., align bonnet (2) over the body studs (27) and lower the bonnet assembly downwards to the body (1). As the bonnet (2) reaches to within 1/4" (6mm) of the body (1), push the stem (4) downwards until the plug end of the stem (4) assembly pushes against the seat ring (3). Continue lowering the bonnet (2) until the bonnet (2) is evenly near the body (1), with only bonnet gasket (6) compression creating a gap between bonnet (2) and body (1).
    e. Rotate all four body stud nuts (28) to finger-tight. In an alternating, cross-pattern, and in 1/2 revolution increments, torque wrench tighten nuts (28) to 30-32 ft.-lbs. (40.6-43.4 N-m). Body (1)-to-bonnet (2) joint should be drawn together with no gap.

33. Remove TFE thread sealant tape of article 21. above.

34. Connect a temporary gaseous pressure supply at a minimum of 100 psig (6.8 Barg) to both inlet and outlet body (1) connections simultaneously. Move stem (4) end up and down manually a few times. Using leak-detection solution, check body (1)-to-bonnet (2) joint and stem packing (10) for leakage. Again, move stem in and out while observing for leakage.

D. Cryogenic Construction-Opt.-36 (See Fig. 7):

1. Maintenance of a cryogenic construction – Option-36 – is similar to that of a standard unit, except that a cryogenic unit includes internally live-loaded packing (10) using a spring (25) with a flat washer (26) on top of spring, and a wiper ring (24) is provided with the packing follower (11). See typical details in Fig. 7 for all body sizes.

2. Both spring (25) and washer (26) must be inserted prior to insertion of packing rings (10).

3. Wiper ring (24) is located in the groove of the cryogenic packing follower (11), oriented on outer end of follower (11).

4. The packing stud nuts (21) should be evenly tightened with a torque wrench to approximately 9.0 ft.- lbs. (12.2 N-m).

SECTION V

V. CALIBRATION – 1/2" thru 1-1/2" Body Sizes with Model 25 Actuator

A. General:

1. This section covers calibration of the 1/2" thru 1-1/2" Model 2296 control valve units with Model 25 actuators. Calibration consists of adjusting stroke length only. To change bench range setting requires that the actuator assembly (AA) be partially disassembled and calibrated as indicated in IOM-25.

2. Positioner, if installed, requires reference to the specific positioner model IOM for proper calibration procedure.

3. All indicated Item Numbers that are with respect to IOM-2296 and are part of the "body" will be in single parenthesis; i.e. (2). Those that are part of the actuator IOM will be in single parenthesis and underscored; i.e. (2).
   Those that are part of the positioner IOM will be in double parenthesis; i.e. ((AP)).

4. Following procedures assume assembled valve unit has been removed from the pipeline where installed and all maintenance has been completed per instructions of Section IV preceding.

5. This procedure only accounts for setting proper combined stem (4, 19) stroke length. IT ASSUMES THAT THE ACTUATOR ASSEMBLY (AA) HAS BEEN PROPERLY ADJUSTED FOR –
   a. bench set range.
   b. uptravel stop.

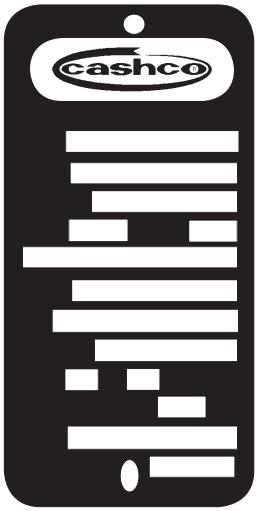
6. Place body (1) in a vise with actuator (AA) directed upwards.

7. Connect a temporary air supply with an in-line adjustable airset regulator with gauge to the actuator (AA) topworks connection.

B. Procedure — Reverse Action, ATO-FC:

1. Grasp valve stem (4) just below threaded portion of upper end with soft-jawed locking pliers. Loosen lower jam nut (17) by rotating CCW (viewed from plug-end) downwards to the root of the threads of the valve stem (4). Loosen upper jam nut (17) down to lower jam nut (17). DO NOT ROTATE STEM (4) WHILE PLUG (4) IS PUSHING AGAINST SEAT RING (3).

2. Loosen position indicator screws (22) and position the indicator plate (21) at "CLOSE"; tighten screws (22) to secure indicator plate (21). NOTE: Set the indicator plate (21) at the flat horizontal edge of the actuator stem (19) that is painted red.



3. Reference the nameplate (18) attached to the actuator's (AA) upper case (1) or handwheel bonnet (29). Determine the bench setting of the installed range spring (24) from the nameplate (18); i.e. 5-15 psig (.34-1.03 Barg), or 11-30 psig (.76-2.07 Barg).

4. Pressurize the actuator (AA) to a pressure that equals the upper pressure level of the bench set range; i.e. for 5-15 psig (.34-1.03 Barg), pressurize to 15 psig (1.03 Barg); i.e. for 11-30 psig (.76-2.07 Barg), pressurize to 30 psig (2.07 Barg). Observe the position on the indicator plate (21) of the actuator stem (19). The following can be concluded from the indication:

   a. Travel Short of Full "OPEN". Combined stem (4, 19) is too long; rotate valve stem (4) into actuator stem (19) a distance approximately the distance of undertravel of the stem (19) away from the "OPEN" position.

   b. Travel Beyond Full "OPEN". Combined stem (4, 19) is too short; disengage valve stem (4) from actuator stem (19) a distance approximately the distance of overtravel of the stem (19) away from the "OPEN" position.

   c. Travel at Full "OPEN". This indicates that combined stem (4, 19) length is acceptable.

5. Repeat procedure of article 2.-thru-4., until combined stem (4, 19) length is correct.

6. Tighten upper jam nut (17) to actuator stem (19); repeat for lower jam nut (17).

7. Test the bench set range performance. For ATO-FC units, the lower value of the bench set range must be equal or greater than the lower value given on the nameplate (18). If the actual lower value is less than the stated lower value, it would be necessary to disassemble the actuator (AA) and properly adjust the bench set range and uptravel stop.

8. Remove unit from vise.

C. Procedure — Direct Action, ATC-FO:

1. Loosen lower jam nut (17) by rotating CCW (viewed from plug end) downwards to the root of threads of the valve stem (4). Loosen upper jam nut (17) down to lower jam nut (17).

2. Loosen position indicator screws (22) and position the indicator plate (21) at "OPEN"; tighten screws (22) to secure indicator plate (21). NOTE: Set the indicator plate (21) at the flat horizontal edge of the actuator stem (19) that is painted red.

3. Reference the nameplate (18) attached to the actuator's (AA) upper case (1) or handwheel bonnet (29). Determine the bench setting of the installed range spring (24) from the nameplate (18); i.e. 3-13 psig (0.21-0.90 Barg), or 6-25 psig (0.41-1.72 Barg).

4. NOTE: DO NOT ROTATE STEM (4) WHILE PLUG (4) IS PUSHING AGAINST THE SEAT RING. Pressurize the actuator (AA) to a pressure that equals the upper pressure level of the bench set range; i.e. for 3-13 psig (0.21-0.90 Barg), pressurize to 13 psig (0.90 Barg); i.e. for 6-25 psig (0.41-1.72 Barg), pressurize to 25 psig (1.72 Barg). Observe the position on the indicator plate (21) of the actuator stem (19). The following can be concluded from the indication:
   a. Travel Short of Full "Close". Combined stem (4, 19) is too long. Measure amount of undertravel. Release pressure in actuator to about mid-stroke (50% travel). Engage valve stem (4) into actuator stem (19) approximately the same distance as the measured amount of undertravel.
   b. Travel Beyond Full "Close". Combined stem (4, 19) is too short. Measure amount of overtravel. Release pressure in actuator to about mid-stroke (50% travel). Disengage valve stem (4) from actuator stem (19) approximately the same distance as the measured amount of overtravel.
   c. Travel at Full "Close". This indicates that combined stem (4, 19) length is acceptable.

5. Repeat procedure of article 2.-thru-4., until combined stem (4, 19) length is correct.

6. Tighten upper jam nut (17) to actuator stem (19); repeat for lower jam nut (17).

7. Test the bench set range performance. For ATC-FO units, the upper value of the bench set range must be at least equal or slightly greater than the upper value given on the nameplate (18). If the actual upper value is less than the stated upper value, it would be necessary to disassemble the actuator (AA) and properly adjust the bench set range and uptravel stop.

SECTION VI

8. Remove unit from vise.

VI. CALIBRATION – 2" Body Size with Model 55 Actuator

A. General:

1. This section covers calibration of the 2" Model
   2296 valve unit with a Model 55D or 55R actuator.

2. Positioner if installed, requires reference to the specific positioner model IOM for proper calibration procedure.
3. All indicated Item Numbers that are with respect to IOM-2296 and are part of the "body" will be in single parenthesis; i.e. (2). Those that are part of the actuator IOM will be in single parenthesis and underscored; i.e. (2). Those that are part of the positioner IOM will be in double parenthesis; i.e. ((AP)).

4. Following procedures assume assembled valve unit has been removed from the pipeline where installed and all maintenance has been completed per instructions of Section IV preceding.

B. Procedure — Reverse Action, ATO-FC:

1. Place body (1) in a vise with actuator (AA) directed upwards.

2. Connect a temporary air supply with an in-line adjustable airset regulator with gauge to the actuator topworks connection.

3. Loosen lower stem jam nut (17) by rotating CCW (viewed from plug end) 2-3 revolutions. Using upper stem jam nut (17), firmly locate the indicator disc (20) up against the actuator stem (19) bottom.

4. Loosen screws (22) and position the indicator plate (21) at "S" (for shut); tighten screws (22) to secure indicator plate (21). NOTE: Set the indicator plate (21) at the top edge of the indicator disc (20).

5. Reference nameplate (12) attached to the actuator yoke (1). Determine the bench setting of the installed range spring (6) from the nameplate (12); i.e. 5-15 psig (.34-1.03 Barg), or 11-30 psig (.76-2.07 Barg).

6. Pressurize the actuator to a pressure level 2-3 psig (0.14-0.21 Barg) above the upper pressure level of the bench setting; i.e. for 5-15 psig (.34-1.03 Barg) range, set pressure at 17-18 psig (1.17-1.24 Barg).

7. Observe the position of the indicator disc (20) on the scale of the indicator plate (21), making sure to use the "top edge" of the indicator disc (20) as the reference point. If the position indicated is not exactly at "O" (for "open"), then the valve plug & stem subassembly (4)-to-actuator stem (19) combined length is incorrect, and must be adjusted.

8. a. If travel stops above the "O" position, the combined stem (4) (19) length is short. Loosen jam nut (17) holding the indicator disc (20) against actuator stem (19).
   b. Increase combined stem (4) (19) length by rotating the valve plug & stem subassembly (4) CCW (viewed from plug end) a distance equal to the amount of undertravel. Retighten jam nut (22).

9. a. If travel stops (below) the "O" position, the combined stem (4) (19) length is long. Loosen jam nut (17) holding the indicator disc (20) against actuator stem (19).
   b. Decrease combined stem (4) (19) length by rotating the valve plug & stem subassembly (4) CW (viewed from plug end a distance equal to the amount of overtravel. Retighten jam nut (17).

10. Confirm that the position of the indicator disc (20) aligns with the indicator plate (21) at the "O" position.

11. Release air pressure in actuator allowing valve plug & stem subassembly (4) to travel to the closed or "S" position. Check the position indicated on the indicator plate (21).

12. If the "S" closed position is not correct, repeat steps 8 through 11 until the combined stem (4) (19) length is correct.

13. Pressurize the actuator to a pressure level corresponding to the lower pressure level of the bench setting; i.e. for 5-15 psig (.34-1.03 Barg) range, set pressure at 5 psig (.34 Barg). Do the pressurization slowly while observing the indicator disc (20) and indicator plate (21) simultaneously.

14. The proper calibration of the actuator/valve unit will occur when, at the lower pressure level of bench setting, the valve plug & stem subassembly's (4) plug will just begin to travel from the closed position.

    Pressurize actuator slowly. If plug & stem subassembly (4) begins travel before reaching the lower pressure level of bench setting, then increase the actuator's range spring (6) compression by wrench tightening spring adjustor (4) CW (viewed from plug end) in 1/2 revolution increments until desired bench setting is reached.

    Pressurize actuator slowly. If plug & stem subassembly (4) begins travel after surpassing the lower pressure level of bench setting, then reduce the actuator's range spring (6) compression by wrench loosening spring adjustor (4) CCW (viewed from plug end) in 1/2 revolution increments until desired bench setting is reached.

15. Increase pressure to actuator up to the upper level of bench setting and observe valve plug & stem subassembly (4) position at the indicator plate (21). The valve plug & stem subassembly (4) should be within ±8% (of full "stroke") of the "O" (for "open") position of the indicator plate (21). ("Stroke" length is indicated on the nameplate (12), and is the distance between the "S" and "O" points of the indicator plate (21).)

16. Record here the theoretical and actual pressure levels of paragraphs 14 and 15.

Theoretical Bench Setting from Nameplate	_____	psig
	_____	Barg
Setting at "S" Position	_____	psig
	_____	Barg
Setting at "O" Position	_____	psig
	_____	Barg

17. Tighten second stem jam nut (17).

C. Procedure — Direct Action, ATC-FO:

1. Place body (1) in a vise with actuator assembly (AA) directed upwards.

2. Connect a temporary air supply with an in-line adjustable airset regulator with gauge to the actuator topworks connection.

3. Loosen lower stem jam nut (17) by rotating CCW (viewed from plug end) 2-3 revolutions. Using upper stem jam nut (17) firmly locate the indicator disc (20) up against the actuator stem (19) bottom. With no pressure in the actuator, the upwards travel is halted by the actuator's internal upstop mechanism.

4. Loosen screws (22) and position the indicator plate (21) at "O" (for Open); tighten screws (22) to secure indicator plate (21). NOTE: Set the indicator plate (21) at the top edge of the indicator disc (20).

5. Reference the nameplate (12) attached to the actuator yoke (1). Determine the bench setting of the installed range spring (6) from the nameplate (12); i.e. 3-13 psig (0.21-0.90 Barg), or 6-25 psig (0.41-1.72 Barg).

6. Pressurize the actuator to a level 2-3 psig (0.1-0.21 Barg) above the upper pressure level of the bench setting; i.e. for 3-13 psig (0.21-0.90 Barg) range, set pressure at 15-16 psig (1.03-1.10 Barg).

7. Observe the position of the indicator disc (20) and the indicator plate (21), making sure to use the "top edge" of the indicator disc (20) as the reference point. If the position indicated is not exactly at "S" (for "shut"), then the valve plug & stem subassembly (4) – to – actuator stem (19) combined length is incorrect, and must be adjusted.

8. a. If travel stops above the "S" position, the combined stem (4) (19) length is long. Loosen jam nut (17) holding the indicator disc (20) against actuator stem (19).
   b. Release 6-8 psig (0.41-0.55 Barg) of pressure level in the actuator. This step will ensure that when the combined stem (4) (19) length is decreased, the plug & stem subassembly (4) will not be mistakenly rotated while seated.
   c. Decrease combined stem (4) (19) length by rotating the valve plug & stem subassembly (4) CW (viewed from plug end) a distance equal to the amount of undertravel. Retighten jam nut (17).

9. a. If travel stops below the "S" position, the combined stem (4) (19) length is short. Loosen jam nut (17) holding the indicator disc (20) against actuator stem (19).
   b. Release 6-8 psig (0.41-0.55 Barg) of pressure level in the actuator. This step will assure that when the combined stem (4) (19) length is increased, the plug & stem subassembly (4) will not be mistakenly rotated while seated.
   c. Increase combined stem (4) (19) length by rotating the valve plug & stem subassembly (4) CCW (viewed from plug end) a distance equal to the amount of undertravel. Retighten jam nut (17).

10. Repressurize the actuator to the level of Step 6 above. If the "S" closed position is not correct, repeat Steps 8 and 9 until the combined stem (4) (19) length is correct.

11. Pressurize the actuator to a pressure level corresponding to the level of Step 6. Do the pressurization slowly while observing the indicator disc (20) and indicator plate (21) simultaneously.

12. The proper calibration of the actuator/valve unit will occur when, at the upper pressure level of bench setting, the plug & stem subassembly's (4) plug will just begin to travel from the closed position.

Depressurize actuator slowly. If plug & stem subassembly (4) begins travel before reaching the upper pressure level of bench setting, release all air pressure, then decrease the actuator's range spring (6) compression by wrench loosening spring adjustor (4) CCW (viewed from plug end) in 1/2 revolution increments. Repeat this procedure until desired bench setting is reached.

Depressurize actuator slowly. If plug & stem subassembly (4) begins travel after surpassing the upper pressure level of bench setting, release all air pressure, then increase the actuator's range spring (6) compression by wrench tightening spring adjustor (4) CW (viewed from plug end) 1/2 revolution increments. Repeat this procedure until desired bench setting is reached.

13. Decrease pressure to actuator down to the lower level of bench setting and observe valve plug & stem subassembly (4) position at the indicator plate (21). The valve plug & stem subassembly (4) should be with ±8% (of full stroke) of the "S" (for "shut") position of the indicator plate (21). ("Stroke" length is indicated on the nameplate (12), and is the distance between the "S" and "O" points of the indicator plate (21).)

14. Record here the theoretical and actual pressure levels of paragraphs 12 and 13:

Theoretical Bench Setting from Nameplate	_____	psig
	_____	Barg
Setting at "S" Position	_____	psig
	_____	Barg
Setting at "O" Position	_____	psig
	_____	Barg

SECTION VII

15. Tighten second stem jam nut (17).

VII. STARTUP

A. General:

1. Ensure that the Model 2296 unit has been properly adjusted and calibrated, including the positioner if installed.

2. Recommend startup to be in a "manual" mode. This procedure assumes double block (isolation) and bypass valves for the "control valve station". See Figure 5.

3. Start with either of the two block valves closed, with the other open. The bypass valve should be closed. Pressurize system if possible/ practical.

4. Back out the airset's adjusting screw until loose.

5. Turn on air supply pressure.

6. Adjust the air supply airset (filter-regulator) to the proper level as indicated in IOM-55/75/115,

DO NOT STROKE THE CONTROL VALVE WITH AN AIR SUPPLY PRESSURE SETTING GREATER THAN RECOMMENDED MAXIMUM PRESSURE!

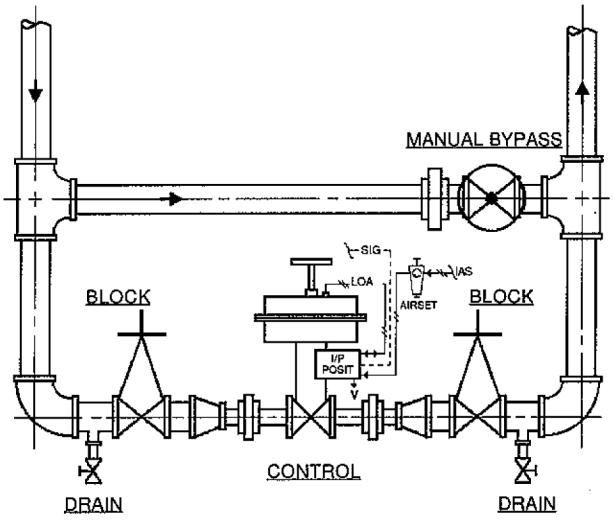


Figure 5: Double-block and Bypass Arrangement

IOM-25 or the technical bulletin 2296-TB.

7. Place loop controller into "manual" mode. Vary setting from minimum – mid-range – maximum SIG output. Observe response of control valve unit to these changes of input SIG. The valve should fully stroke at the variation from minimum SIG to maximum SIG; the mid-range SIG should have the valve stem travel at/near 1/2 open.

8. Confirm the action of controller and positioner – direct or reverse – are producing the desired response in the control unit. Confirm that the control valve "fail" position is as required.

9. Hereafter, the procedure assumes that actual fluid flow may be established. This may not be practical/possible in all cases; if so, vary procedure as required.

   Always "heat" or "cool" down the system piping SLOWLY by opening the control valve station

   bypass valve in small increments.

NOTE: DO NOT WALK AWAY AND LEAVE A MANUALLY CONTROLLED CONTROL VALVE UNATTENDED!

10. With one of the control valve station block valves still closed, and the loop controller still in "manual" mode, open bypass valve and vary flow rate manually to observe the response of the controller and control valve unit together.

11. Attempt to develop manual control of the loop by opening/closing the manual bypass as required, or by manually controlling mainstream flow as required.

12. When the control valve is partially open, crack open slowly the closed block valve while simultaneously closing the bypass valve. Continue this procedure until the bypass is closed and the block valves are both fully open. The system is still under "manual" mode control, but all flow is passing thru the control valve.

13. Vary controller "manual" SIG output until matching the "automatic" SIG output, then change the mode of the controller over to "automatic", and the loop will experience a minimum of upset conditions, and will be in

SECTION VIII

VIII. TROUBLE-SHOOTING GUIDE:

1. Valve is "jumpy" in stroking.

Possible Cause	Remedy
A. Excess packing friction.	A1. Realign body–stem–actuator. A2. Packing follower too tight. A3. Install positioner. A4. Increase bench set by changing to stiffer actuator range spring. Will require positioner if not installed. May require different airset.
B. Installed backwards.	B. Install per flow arrow.

2. Valve makes "screeching" noise.

Possible Cause	Remedy
A. Excess pressure drop.	A. Bring pressure drop within design limits.
B. Lower guide bushing wear.	B. Replace guide bushing and stem.
C. Misalignment.	C. Realign body–stem–actuator.

3. Valve exhibits “excess” vibration.

Possible Causes	Remedy
A. Excess pressure drop.	A. Bring pressure drop within design limits.
B. Lower guide bushing wear.	B. Replace guide bushing and stem.
C. Excessive cavitation in liquid service.	C1. Change operation parameters to relieve causes of cavitation. C2. Replace valve with valve equipped for cavitation control.
D. High outlet velocity.	D1. Reduce flow rate and/or pressure drop. D2. Use multiple valves in series or parallel. D3. Increase outlet pipe size.

4. Valve exhibits “excess” seat leakage.

Possible Cause	Remedy
A. Excess pressure drop.	A1. Reduce pressure drop conditions. A2. Convert to reduced trim.
B. Improper actuator bench setting.	B1. Calibrate actuator-to-valve. B2. Assure proper engagement of actuator stem-to-valve stem. Adjust as calibration dictates.
C. Metal seat design instead of composition seat design.	C. Convert valve to composition seat design.
D. Excess wear.	D1. Oversized valve operating too close to seat; go to reduced trim. D2. Remove particulate. D3. Possible excess cavitation in liquid service. Change operation parameters. D4. Re-lap plug-seat surface.
E. Misalignment.	E. Realign body–stem–actuator.
F. Composition seat failure	F1. Replace soft seat. F2. Remove “dirty” portion of fluid causing failure.
G. Seat ring gasket failure.	G. Replace seat ring gasket.

5. Premature packing leakage.

Possible Cause	Remedy
A. Over-temperature.	A1. Bring process temperature to 400°F (205°C) or less. A2. Remove insulation along bonnet; allow direct contact with ambient air.
B. Misalignment.	B. Realign body–stem–actuator.
C. Wear.	C1. Remove dirt/grit from fluid. C2. Reduce cyclic travel.
D. Improper design for applied service.	D. Install alternate packing design.
E. Corrosion of stem.	E. Consider use of Model 988/989.

6. Bonnet gasket leaking.

Possible Cause	Remedy
A. Loose threaded bonnet.	A. Properly tighten bonnet to required torque level.
B. Improper bonnet bolting draw down.	B. Replace gasket and draw down bolting evenly in a cross-pattern. Torque bolting.
C. Corrosion.	C. Consider use of Model 988/989.
D. Warped bonnet and/or body flange.	D. Replace body and/or bonnet and bonnet gasket. Draw down bonnet bolting evenly in a cross-pattern.

SECTION IX

IX. PARTS ORDERING INFORMATION:

There are three methods to obtain parts ordering information/numbers. These methods are listed below, in order of ease of entering. The least expensive method is to utilize parts in kits where possible.

METHOD A – USE OF PRODUCT CODE.

Step 1. If available, obtain the 18 character product code number from the Bill of Materials sheet attached herein.

□□□–□□□**7**–□□□□□□□□□□

Step 2. Identify which kits or parts are desired from the Bill of Materials sheet or refer to the cross-sectional drawings.
NOTE: Kit "A" contains packing, seals and gasket(s). Kit "B" contains trim replacement parts plus packing, seals and gasket(s).

Step 3. Contact your local Cashco, Inc., Sales Representative and specify the product code number and any part numbers not included in desired kits. Costs of required parts can be given by the Sales Representative.

METHOD B – NO PRODUCT CODE AVAILABLE – DISASSEMBLED VALVE.

Step 1. Determine all available information from valve's metal tag.
a. Serial number.
b. Valve "Type" or "Model" number.
c. Size (may have to observe body tap).
d. Body material.
e. Fail position.
f. Trim designation number (if available).
g. Cv or port size
h. Bench set.

Step 2. Determine construction of trim (metal or composition (soft) seat).

Step 3. With the information from Steps 1 and 2 above, contact your local Cashco, Inc., Sales Representative.

Step 4. Sales Representative will contact the factory to determine the original internal construction. Factory will relay information to the Sales Representative.

Step 5. Await the Sales Representative's return contact with the proper part numbers and cost.

METHOD C – NO PRODUCT CODE AVAILABLE – ASSEMBLED VALVE IN SERVICE.

Step 1. Determine all available information from valve tag using Step 1, Method B.

Step 2. Contact your local Cashco, Inc., Sales Rep with the above information.

Step 3. Sales Representative will contact the factory to determine the original internal construction. Factory will relay information to the Sales Representative.

Step 4. Await the Sales Representative's return contact with the proper part numbers and cost.

MODEL 2296
STANDARD CONSTRUCTION (TFE V-RING PACKING)
PARTS KIT NUMBERS
(Kit Nos. Shaded)

Trim Desig. No., & Characteristic - Full Port Only	Kit Abbr.	BODY SIZE		
		1/2" – 1"	1-1/2"	2"
S1, S3	A	**46A-000K-0AA**	**46D-000K-0AA**	**46E-000K-0AA**
S1 – Equal %	B	**46A-1A1K-0BA**	**46D-1A1K-0BA**	**46E-1A1K-0BA**
S1 – Linear	B	**46A-1C1K-0BA**	**46D-1C1K-0BA**	**46E-1C1K-0BA**
S3 – Equal %	B	**46A-5A1K-0BA**	**46D-5A1K-0BA**	**46E-5A1K-0BA**
S3 – Linear	B	**46A-5C1K-0BA**	**46D-5C1K-0BA**	**46E-5C1K-0BA**

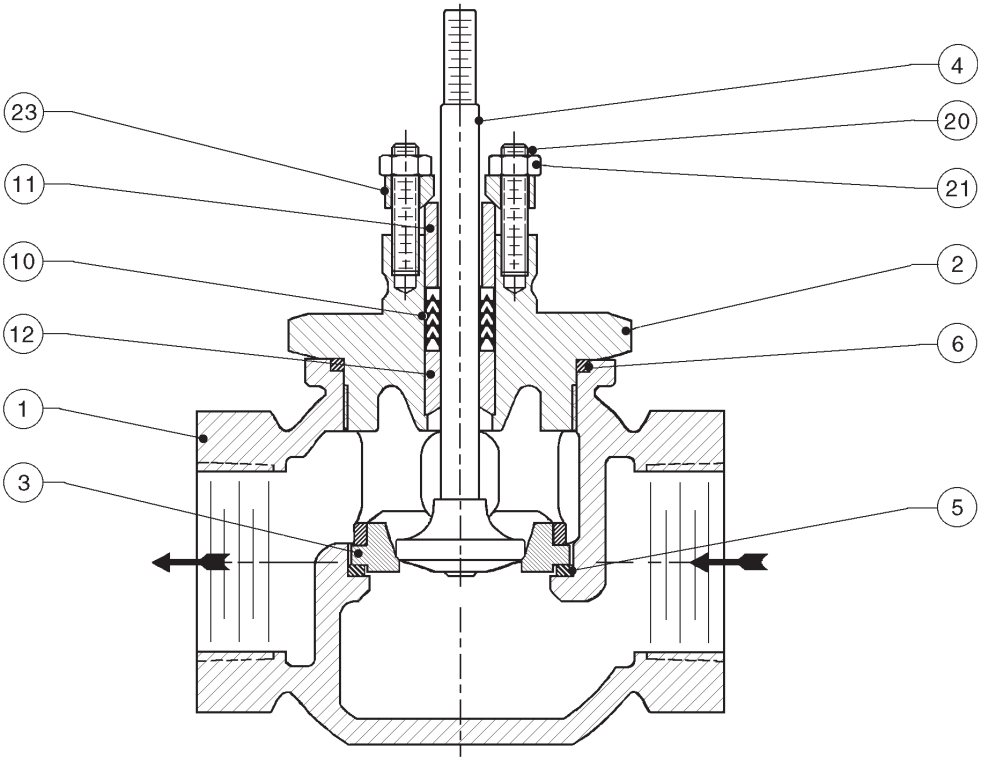


Figure 6A
1/2" – 1-1/2" Model 2296:
ATC-FO Action, Metal Seat Design.

Item No.	Description
1	Body
2	Bonnet Or Extension Column
3	Seat Ring
4	Plug & Stem Subassembly
	4.1 Lower Seat Adapter
	4.2 ValveSeat
	4.3 Upper Seat Adapter
	4.4 Cotter Pin
	4.5 Castle Nut
	4.6 Stem
5	Seat Ring Gasket
6	Body O-Ring Or Body Gasket
10	Packing
11	Packing Follower
12	Stem Guide Bushing
15	Yoke Nut
19	Cage
20	Packing Stud
21	Packing Stud Nut
23	Packing Flange
24	Wiper Ring
25	Spring (Packing)
26	Washer (Packing)
27	Body Stud
28	Body Stud Nut

For Composition Seat Detail:
See Figure 3 on page 5.

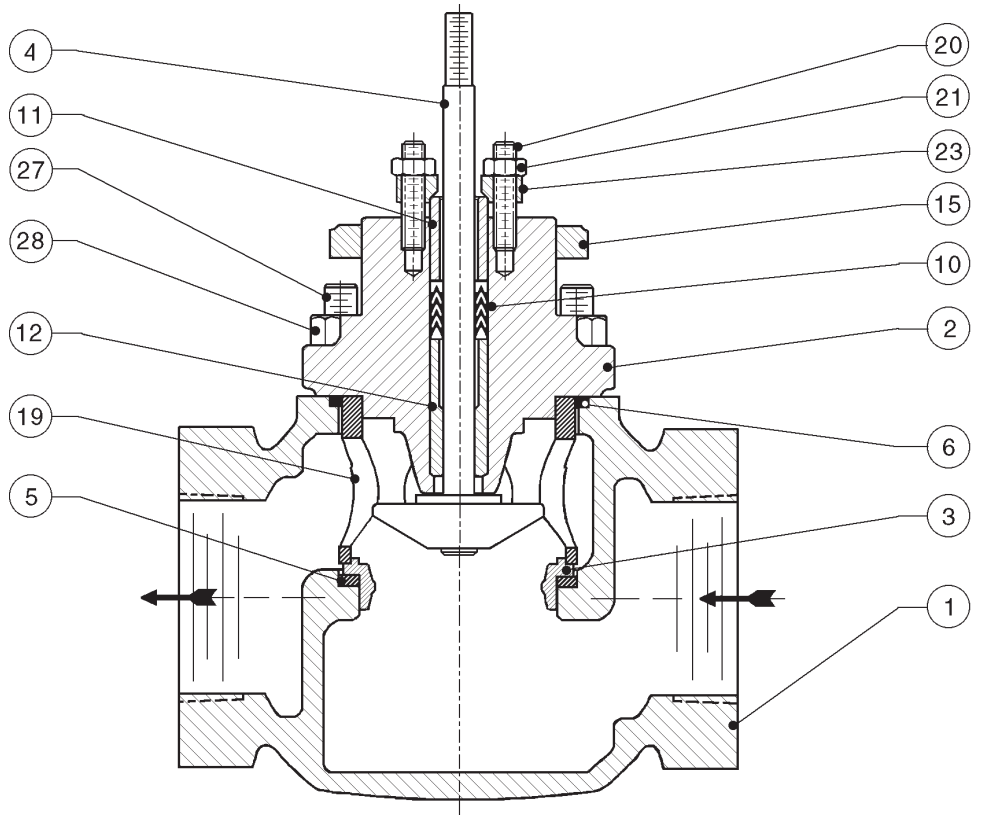


Figure 6B
2" Model 2296:
ATO-FC Action, Metal Seat Design.

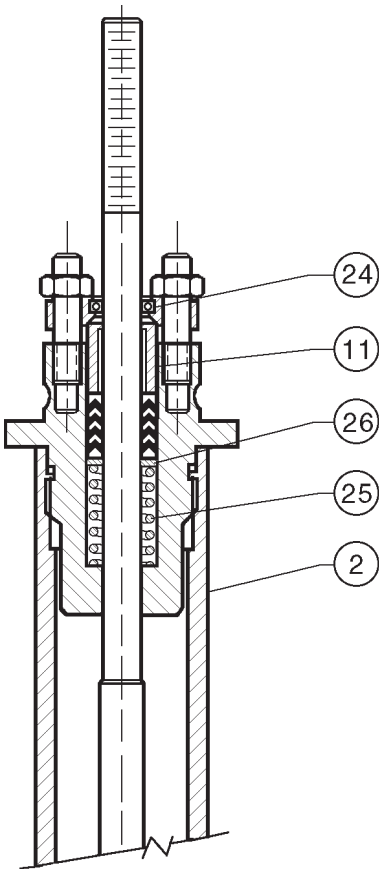


Figure 7
Cryogenic Extension Column

Item No.	Description
2	Bonnet Or Extension Column
11	Packing Follower
24	Wiper Ring
25	Spring (Packing)
26	Washer (Packing)

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