MODEL 987

GLOBE-STYLE PNEUMATIC CONTROL VALVE BODY IOM

SECTION I

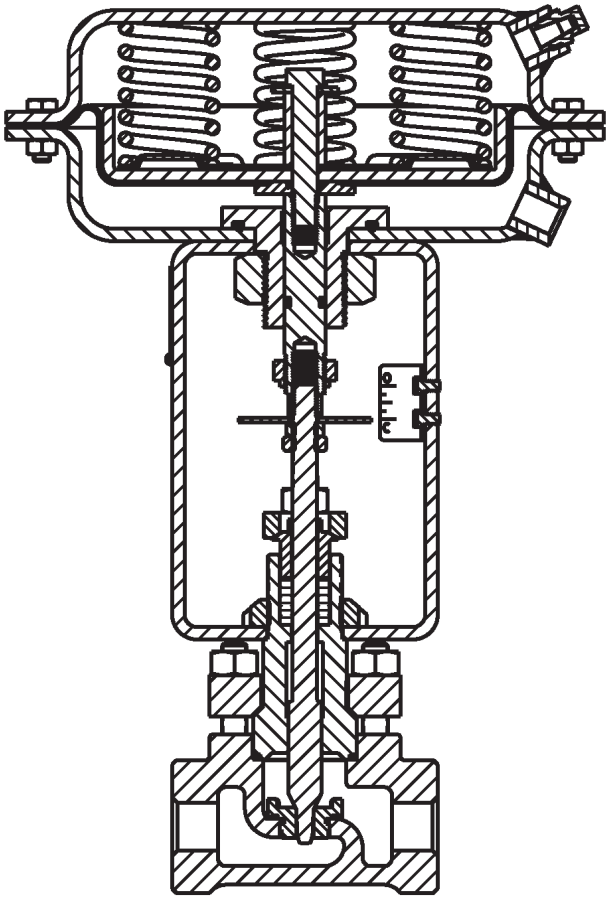
I. DESCRIPTION AND SCOPE

The Model 987 is a pneumatically actuated, sliding stem globe-style control valve. Available sizes 1/2" - 1" (DN15 - 25). Internal design is a “push down to close” arrangement.

Failure position is determined by actuator.
"D" = Direct action; on increasing air loading pressure, the actuator stem extends. Fail-safe position is with the stem retracted.

"R" = Reverse action; on increasing air loading pressure, the actuator stem retracts. Fail-safe position is with the stem extended.

This valve is designed to control moderate to severe corrosive applications but may be applied in general service applications also.



Model 987
with ATO - FC Actuator

SECTION II

II. REFERENCE

Refer to Technical Bulletin 987-TB for complete technical specifications of a Model 987 coupled with either Cashco Actuator Model C27 or C53.
www.cashco.com/techbulletin/987.pdf

Refer to following Installation, Operation & Maintenance Manuals (IOM’s) for either actuator and/or devices that maybe mounted to a Model 987:

Actuators: www.cashco.com/iom/C27-C53.pdf

ABBREVIATIONS

ATC–FO	–	Air–to–Close, Fail Open
ATO–FC	–	Air–to–Open, Fail Close
CCW	–	Counter Clockwise
CW	–	Clockwise
D or DIR	–	Direct Acting
IAS	–	Instrument Air Supply
LOAD	–	Positioner Output Air Pressure
R or REV	–	Reverse Acting
SIG	–	Output Signal from Instrument
V	–	Vent

SECTION III

III. INSTALLATION

A. Orientation:

⚠ CAUTION

For welded installations, all internal trim parts and seals must be removed from body prior to welding into pipeline. The heat of fusion welding will damage non-metallic parts if not removed. NOTE: This does not apply to units equipped with extended pipe nipples.

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. Valves are not recommended for installation with the actuator oriented downwards.

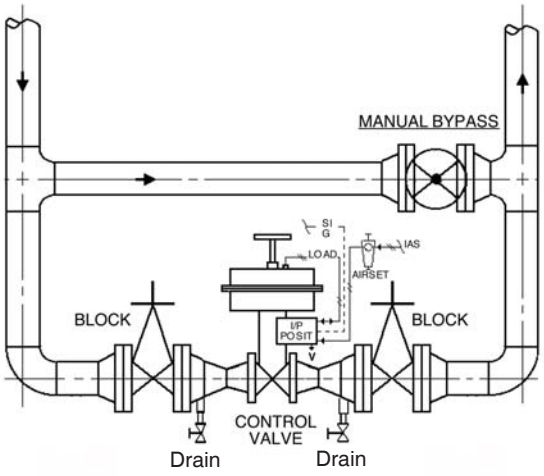


Figure 1: Typical Control Valve Station

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.

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. For flangeless installation, body (1) must be machined with serrations on each end of body.

⚠ WARNING

DO NOT attempt to install a body machined for NPT end connections as a flangeless installation. Failure to heed could cause fluid leakage.

Model 987 bodies with flangeless end connections may be installed as below:

TABLE 1
PIPING FLANGES & FLANGELESS VALVE CONNECTIONS

Basic Flange Size	Flange Pressure Class		
	150#	300#	600#
1/2"	N/A	N/A	N/A
3/4"	N/A	√	√
1"	√	√	√
1" x 1/2" Reducing	√	√	√
1" x 3/4" Reducing	√	√	√
√ Available			

5. Opt-32 Extended Pipe Nipples should be used for socket welding or butt welding. Standard end preparation is for socket welding. If butt welding is desired, weld end preparations must be done in field with suitable tools.

6. 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.

7. Field hydrostatic testing the completed piping system to 1-1/2 x CWP in psig indicated on the nameplate, including the 987, is acceptable. If hydro test pressure exceeds the 1-1/2 x CWP limit, the 987 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.

8. 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.

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

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

11. Valves are not to be direct buried underground.

12. 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.

13. 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.

C. Air Supply:

1. Use a desiccant dried, instrument quality air supply. Such a supply is recommended for outdoor installations, and is required in areas of freezing weather conditions.

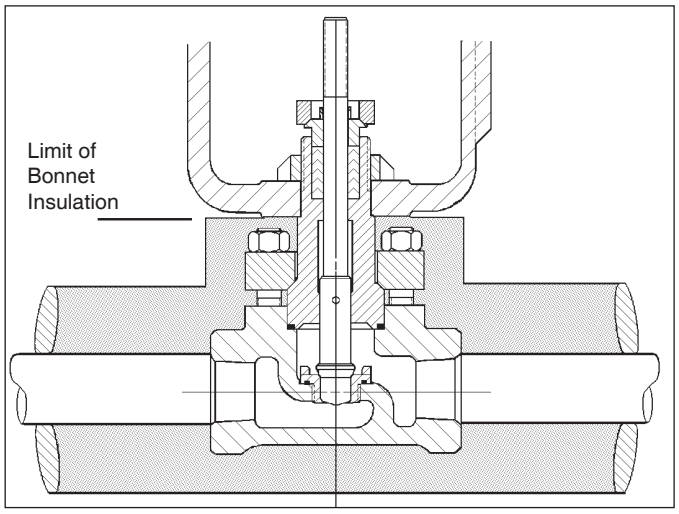


Figure 2: Body Insulation

2. If air supply contains moisture and /or lubricating oil, the air should be filtered with a coalescing type of filter prior to use in stroking the actuator.

3. Failure to remove moisture will cause corrosion to the internals of the actuator casings.

4. Connections for the air supply are 1/4" female NPT. Use a suitable pipe thread sealant when installing the pipe or tube fitting. **DO NOT** allow sealant to enter the tube/pipe.

SECTION IV

IV. STARTUP

A. General:

1. Ensure that the Model 987 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 1.

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 as follows:

Bench Setting		Airset Output	
psig	(Barg)	psig	(Barg)
5–15	(.34–1.0)	20	(1.4)
15–60	(1.0–4.1)	75	(5.2)

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.

⚠ CAUTION

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

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.

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 automatic control.

SECTION V

V. 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. General service valves supplied from the factory do not require use of any gasket sealant.(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.

5. All indicated Item Numbers that are with respect to the actuator assembly (AA) are in parenthesis and underscored; i.e. (20). All Item Numbers that are with respect to the body assembly (BA) are not underscored; i.e. (32). Reference with respect to the positioner is in double parentheses; i.e. ((AP)).

6. **Special care must be exhibited when rotating the plug stem (4) in the body to not mar that portion of the surface of the stem (4) where it contacts with the packing (10).** To rotate the stem (4) use the jam nuts or grasp stem with soft-jawed pliers. ***NOTE:*** *When using the jam nuts (17) to rotate the stem (4), use the upper jam nut to rotate the stem CW, and the lower jam nut to rotate the stem CCW, when viewed from above the valve stem.*

7. Hereafter, whenever text has the following notation, "(**Note PA.)**", the following text is to be applied:

   "For ATO-FC units ONLY, connect a temporary air source to the actuator and pressurize to a level sufficient to initiate travel to approximately mid-stroke."

8. Hereafter, whenever text has the following notation, **"(Note RP.)",** the following text is to be applied:

"For ATO-FC units ONLY, release all temporary air pressure."

B. Actuator Removal:

1. Secure the body assembly (BA) in a vise with the actuator assembly (AA) oriented vertically. Place matchmarks between the body (1), bonnet flange (7) and the yoke (3) to assist in final orientation when the body is disassembled and/or the actuator removed.

2. **(Note PA.)** Using a blunt end tool, hammer rap the tool to loosen yoke nut (15) turning CCW (viewed from above) approximately 2 revolution. Secure the actuator stem (6). Loosen the stem jam nuts (17) by rotating CW (viewed from above) one-at-a-time until rotation stops.

3. Fully loosen any accessory devices that are connected to the stem (6) or (4), such as accessory plate ((AP)) for positioner.

4. Loosen stem packing (10) by removing packing stud nuts (21) CCW. **(Note RP.)**.

NOTE: *To fully disengage the actuator stem (6) from the valve stem (4) is a two-step procedure. Be aware of the valve's stroke length as indicated on the nameplate (40) before beginning disengagement. During the disengagement, measure the distance extended, and stay at least 1/8" (3 mm) away from the full stroke length. Count and record the number of revolutions for each step in the box below:*

No. of revolutions to disengage valve stem from actuator stem:	
Step A. _____	Step B. _____
TOTAL: _____	

5. **For ATO-FC Reverse Action Units:**

   a. **(Note PA.)**

   b. Step A. Rotate valve stem (4) CW (viewed from above) to disengage the actuator stem (6) from the valve stem (4), while holding the actuator stem (6). Count and record the number of valve stem revolutions for Step A above. When the disengagement reaches about 50% of full stroke travel Step A is completed. **(Note RP.)**

   c. Step B. Support the actuator assembly (AA) from above. Fully loosen yoke nut (15). Lift the actuator assembly (AA) upwards approximately 1/4"-3/8" (6-8 mm). Again, rotate valve stem (4) CW (viewed from above) to disengage the actuator stem (6) from the valve stem (4) while holding the actuator stem (6). Count and record the number of valve stem revolutions for Step B above. This should allow the stems (6) (4) to fully disengage.

NOTE: *Take notice of the parts "dangling loosely" about the stem (4), the order of their location, and their proper orientation.*

   d. Fully raise the actuator assembly (AA) from the valve body assembly (BA). Remove cautiously to prevent the dangling parts - packing flange (23), position indicating washer (16), accessory plate ((AP)), yoke nut (15) - from falling.

6. **For ATC-FO Direct Action Units:**

   a. Step A. Rotate valve stem (4) CW (viewed from above) to disengage the actuator stem (6). Do not rotate the stem (4) down into the seating surface. Count and record the number of valve stem (4) revolutions for Step A above. When the disengagement reaches about 75% of full stroke travel, Step A. is completed.

   b. Step B. Support the actuator assembly (AA) from above. Fully loosen yoke nut (15). Lift the actuator assembly (AA) upwards approximately 1/4" - 3/8" (6-8 mm). Again, rotate valve stem (4) CW (viewed from above) to disengage the actuator stem (6) from the valve stem (4), while holding the actuator stem (6). Count and record the number of valve stem revolutions for Step B. This should allow the stems (6) (4) to fully disengage.

NOTE: *Take notice of the parts "dangling loosely" about the stem (4), the order of their location, and their proper orientation.*

   c. Fully raise the actuator assembly (AA) from the valve body assembly (BA). Remove cautiously to prevent the dangling parts – packing flange (23), position indicating washer (16), accessory plate ((AP)), yoke nut (15) - from falling.

C. Actuator Replacement:

1. Secure body assembly (BA) in a vice with the valve stem (4) oriented vertically. Push plug/stem (4) down until the plug touches the seating surface in the body (1).

2. Secure the actuator assembly (AA) from above. Use matchmarks from B.1. previous to assist with (BA) and (AA) alignment.

3. This procedure assumes that the bonnet (2) has been installed to the body (1), with stem jam nuts (17) on the valve stem (4).

4. Lower actuator assembly (AA) until the valve stem (4) penetrates the opening in the yoke (3). Reposition the "dangling parts" - packing flange (23), yoke nut (15), accessory plate ((AP)) and indicating washer (16) - over the body stem (4). Continue to lower the actuator assembly (AA) until there is approximately 1/4" (6 mm) space between the two stems (6) (4).

5. **For ATC-FO:** Connect a temporary air supply hose that has an adjustable airset and gauge to the actuator inlet to allow pressurization. Slowly pressurize actuator to bring the actuator stem (6) to be within 1/8" (3 mm) of contacting the valve stem (4).

6. With hand, lift stem (4) up to touch actuator stem (6). Rotate valve stem (4) CCW (viewed from above) to engage w/ actuator stem (6). Use the total number of revs engagement recorded in Step V.B.4. as the guide to control engagement of the stems (6) (4). While engaging the stems, rotate yoke nut (15) as able to help stabilize topworks, continue to pressurize the actuator in 2-3 psi (.15-.20 Bar) increments in an alternating sequence with the distance engaged until the total number of revs engaged is reached.

7. Hand-tighten yoke nut (15) until fully positioned with the yoke (3) sitting on the bonnet (2).

8. Secure "dangling parts" - accessory plate ((AP)) and indicator washer (16) - to actuator stem (6) with stem jam nuts (17).

9. Hammer rap yoke nut (15) until tight. (Release temporary air source.)

10. Install nuts (21) on studs (20). Use torque wrench to tighten to 25-30 in-lbs.

D. Trim/Packing Removal and Replacement:

NOTE: *This Subsection assumes that the actuator assembly (AA) has been already removed per Sub-section B. previous.*

1. Secure (BA) in a vise with the valve stem (4) pointing upwards.

2. Pull stem (4) upwards. Hold stem (4) up if necessary using soft-jawed locking pliers. Loosen four bonnet flange nuts (9) and remove.

⚠ CAUTION

It sometimes occurs that the stem (4) will "stick" within the bonnet (2) and pull out with parts of this step above. DO NOT ALLOW THE STEM (4) TO DROP and do personal injury or damage stem (4)!

3. Carefully wiggle stem (4) side-to-side to break loose bonnet (2) from body (1). Lift the bonnet (2) directly upwards along with stem (4),bonnet flange (7) and all the packing components (10,11). Lay the group of parts on a flat work surface. Ensure that the bonnet (2) will not "roll".

4. Remove bonnet flange (7) from bonnet (2).

5. Remove packing follower (11) over threaded end of stem (4).

6. Push stem (4) threaded-end into bonnet (2) as far as possible using fingers while holding bonnet (2) with other hand. Grasp plug-end of plug/stem subassembly (4) and withdraw from the bonnet (2) and thru the packing rings (10). Set plug/stem subassembly (4) aside.

7. Place bonnet (2) into a leaded-jaw vise with packing-end upwards. Using a pick-type tool, remove the five packing rings (10). Inspect rings (10) for signs of damage and then discard.

8. Place all bonnet-area removed parts (2,4,7,11) into a suitable cleaning solvent.

9. Remove bonnet O-ring seal (6) from body (1). Inspect O-ring (6) for signs of failure to seal, then discard.

10. If body (1) includes a screwed-in seat ring (3), use a sufficiently wide piece of 1/4" thick steel bar to remove the seat ring (3) by rotating seat ring (3) CCW (viewed from above) to removal.

11. Remove seat ring O-ring seal (5) from seat ring (3). Inspect O-ring (5) for signs of failure to seal, then discard.

12. Remove body (1) from vise and place body (1) and seat ring (3) into a suitable cleaning solvent.

13. For valves equipped with Opt-27 Viscous Service Bonnet, ensure that the two equalizing passageways located in bonnet (2) are fully open.

14. For valves equipped with a composition seat as a part of the plug/stem subassembly (4), the parts are mechanically pressed together such that the composition seat is non-replaceable. A new plug/stem subassembly (4) must be supplied in order to replace the composition seat.

15. After soaking, remove all parts (1,2,3,4,7,11) and inspect for any signs of wear or corrosion; replace all worn parts with new parts. Bonnet (2) packing box and stem (4) sealing zones must be finished to a $16R_a$ surface or better.

16. Place body (1) into a vise with bonnet-zone on topside.

17. Place a new O-ring seal (5) onto the seat ring (3). Reinstall the seat ring (3) into the body (1) by rotating the seat ring (3) CW (viewed from above). Using the steel bar tool, firmly tighten the seat ring (3). ***NOTE:*** *Do not over-tighten the seat ring (3) to prevent galling of threads.*

18. Place a new O-ring seal (6) into the bonnet's (2) recess in the body (1).

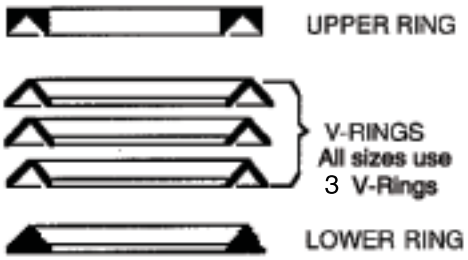
19. Place TFE sealant tape over threaded-end of stem (4), covering all the peaks.

20. Place plug/stem subassembly (4) with the plug-end into the seat ring (3), and the threaded-end directed upwards. Place lower end of bonnet (2) over threaded end of stem (4) and fully lower bonnet (2) until properly aligned in body (1) recess.

21. Place bonnet flange (7) over bonnet (2) and down over the bonnet studs (8), align match marks.

22. Install bonnet flange nuts (9) and finger-tighten.

23. See Figure 5. Place a lower adapter packing ring (10.1) over the stem-end (4) and press it into the bonnet (2) packing box using the packing follower (11). Repeat for the three middle packing v-rings (10.2). Press upper adapter ring (10.3) into the box; leave the packing follower (11) in position.



Packing Orientation

24. Wiggle stem (4) around to align parts (2,3,4,7,10) as much as possible. Wrench-tighten bonnet flange nuts (9) equally with a 1/4 turn revolution each, in alternating, cross-pattern. Using a torque wrench, tighten the nuts (9) to 25 - 30 ft-lbs (33.8 - 40.6 N•m).

25. Using hand pressure, push plug/stem (4) assembly down into the body (1) until the plug touches the seating surface in the body. Remove TFE tape from threaded end of stem (4).

26. Raise Model C27or C53 actuator (AA) above the threaded end of the stem assembly. Use matchmarks from B.1. previous to assist with (BA) and (AA) alignment.

27. Lower actuator assembly (AA) until the valve stem (4) penetrates the opening in the yoke (3). Reposition the “dangling parts” - packing flange (23), yoke nut (15), accessory plate ((AP)) and indicating washer (16) - over the body stem (4). Continue to lower the actuator assembly (AA) until there is approximately 1/4" (6 mm) space between the two stems (6) (4).

28. **For ATC-FO:** Connect a temporary air supply hose that has an adjustable airset with gauge to the actuator inlet to allow pressurization. Slowly pressurize actuator to bring the actuator stem (6) to be within 1/8" (3 mm) of contacting the valve stem (4).

29. With hand lift stem (4) up to touch actuator stem (6). Rotate valve stem (4) CCW (viewed from above) to engage w/ actuator stem (6).

Use the total number of revs engagement recorded in Step V.B.4. as the guide to control engagement of the stems (6) (4). While engaging the stems, rotate yoke nut (15) as able to help stabilize topworks, continue to pressurize the actuator in 2-3 psi (.15-.20 Bar) increments in an alternating sequence with the distance engaged until the total number of revs engaged is reached.

30. Hand-tighten yoke nut (15) until fully positioned with the yoke (3) sitting on the bonnet (2).

31. Secure "dangling parts" - accessory plate ((AP)) and indicator washer (16) - to actuator stem (6) with stem jam nuts (17).

32. Hammer rap yoke nut (15) until tight. (Release temporary air source.)

33. Install nuts (21) on studs (20). Use torque wrench to tighten to 25-30 in-lbs.

SECTION VI

VI. CALIBRATION

A. General:

1. This section only covers calibration of the control valve with Actuator Models C27/C53.

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

3. All indicated items numbers that are with respect to IOM-C27-C53 will be in parenthesis and underscored; i.e. (20); those that reference the positioner IOM will be in double paranthesis; i.e. ((AP)). All item numbers that are with respect to this IOM-987 are not underscored; i.e. (3).

B. Procedure - Reverse Action, ATO-FC:

1. Reference the nameplate (40) attached to the actuator yoke (3). Determine the bench setting of the installed range springs (10) from the nameplate (40); i.e. 5-15 psig (.34 -1.0 Barg), or 15-60 psig (1-4.1 Barg).

2. Connect a temporary air supply with an in-line adjustable airset regulator and gauge to the lower actuator connection. See Section IV.A.6 for appropriate supply pressure. **DO NOT LOAD** with any air pressure at this point.

3. To determine when stem/plug (4) begins to lift out of the seat, touch the stem below the jam nuts with one finger. (Stem will move when actuator pressure exceeds the spring load.)

4. Slowly pressurize the actuator to a pressure equal to the lower pressure level of the bench setting; i.e. for a 5-15 psig (.34 -1.0 Barg) range, set pressure at 5 psig (.34 Barg). Take note of the pressure reading when the stem first begins to move.

5. If the loading pressure for the start of stem movement **is below the lower end** of the desired bench setting, then the combined stem (4, 6) length is too short.
   a. Rotate both jam nuts (17) down to base of threads on stem (4) and tighten together.
   b. Increase pressure in the actuator to approximately mid range of the bench setting.
   c. Rotate upper jam nut CW to increase the combined stem length. **DO NOT** allow actuator stem (6) to rotate in the actuator.
   d. Rotate upper jam nut CCW to hold indicating washer (16) up against stem (6).
   e. Release all pressure from the actuator and repeat Step 4 previous.

6. If the loading pressure for the start of stem movement **is above the lower end** of the desired bench setting, then the combined stem (4, 6) length is too long.
   a. Rotate both jam nuts (17) down to base of threads on stem (4) and tighten together.
   b. Increase pressure in the actuator to approximately mid range of the bench set.
   c. Rotate lower jam nut CCW to shorten the combined stem length. **DO NOT** allow actuator stem (6) to rotate in the actuator.
   d. Rotate upper jam nut CCW to hold indicating washer (16) up against stem (6).
   e. Release all pressure from the actuator and repeat Step 4 previous.

7. After the opening set point pressure has been established, rotate lower jam nut (17) CCW up tight under the upper jam nut.

8. Release all pressure from the actuator.

9. Observe the location of the indicating washer

(16) to the "C" mark on the indicator plate (23), making sure to use the “top edge” of the indicating washer (16) as the reference point. Adjust indicator plate as needed.

10. Increase pressure in the actuator until the indicating washer (16) is in alignment with the "O" mark on the indicator plate.

11. To limit the up travel at the desired stroke length, rotate the travel stop nut (52) CW and secure to bottom of the attachment hub (4). ***NOTE:*** *Secure the actuator stem (6) by the flats when rotating the travel stop nut.* ***NOTE:*** *“Stroke” length is indicated on the nameplate (40), and is the distance between the “C” and “O” marks of the indicator plate (23).*

NOTE: *The proper calibration of the actuator/ valve unit will occur when at the lower pressure level of bench setting, the valve plug (4) will just begin to travel from the "C" position. At the upper level of the bench set, the actuator pressure should be within ± 8% of the upper bench setting for the designed stroke length.*

12. Release all pressure from actuator.

C. Procedure - Direct Action, ATC-FO:

1. Reference the nameplate (40) attached to the actuator yoke (3). Determine the bench setting of the installed range springs (10) from the nameplate (40); i.e. 5-15 psig (.34-1.0 Barg), or 15-60 psig (1.-4.1 Barg).

2. Connect a temporary air supply with an in-line adjustable airset regulator and gauge to the upper actuator connection. See Section IV. A. 6. for appropriate supply pressure. **DO NOT LOAD** with any air pressure at this point.

3. To determine when stem/plug (4) makes contact with the seat and travel stops, touch the stem above the packing studs with one finger. (Stem movement will stop when the plug engages the seat.)

4. Slowly pressurize the actuator to a pressure equal to the upper pressure level of the bench setting; i.e. for a 5-15 psig (.34 -1.0 Barg) range, set pressure at 15 psig (1.0 Barg). Take note of the pressure reading when stem travel stops.

5. If the loading pressure, when the stem movement stops, **is below the upper end** of the desired bench setting, then the combined stem (4, 6) length is too long.
   a. Rotate both jam nuts (17) down to base of threads on stem (4) and tighten together.
   b. Decrease pressure in actuator to approximately mid range of the bench setting.
   c. Rotate lower jam nut CCW to shorten the combined stem length. **DO NOT** allow actuator stem (6) to rotate in the actuator.
   d. Rotate upper jam nut CW to hold indicating washer (16) up against stem (6).
   e. Release all pressure from the actuator and repeat Step 4 previous.

6. If the loading pressure when the stem movement stops **is above the upper end** of the desired bench setting, then the combined stem (4, 6) length is too short.
   a. Rotate both jam nuts (17) down to base of threads on stem (4) and tighten together.
   b. Decrease pressure in the actuator to approximately mid range of the bench setting.
   c. Rotate upper jam nut CW to increase the combined stem length. **DO NOT** allow actuator stem (6) to rotate in the actuator.
   d. Rotate upper jam nut CCW to hold indicating washer (16) up against stem (6).
   e. Release all pressure from the actuator and repeat Step 4 previous.

7. After the closed set point pressure has been established, rotate lower jam nut (17) CCW up tight under the upper jam nut.

8. Increase pressure in the actuator to the upper pressure level of the bench setting.

9. Observe the location of the indicating washer (16) to the "C" mark on the indicator plate (23), making sure to use the “top edge” of the indicating washer (16) as the reference point. Adjust indicator plate as needed.

10. Decrease pressure in the actuator until the indicating washer (16) is in alignment with the "O" mark on the indicator plate.

11. To limit the up travel at the desired stroke length, rotate travel stop nut (52) CW and secure to bottom of attachment hub (4).

NOTE: *Secure the actuator stem (6) by the flats when rotating the travel stop nut.*
NOTE: *"Stroke" length is indicated on the nameplate (40), and is the distance between the "C" and "O" marks of the indicator plate.*
NOTE: *The proper calibration of the actuator/valve unit will occur when at the upper pressure level of bench setting, the valve plug (4) will be in the "C" position. At the lower level of bench set the actuator pressure should be within ± 8% of the lower bench setting for the designed stroke length.*

12. Release all pressure from actuator.

SECTION VII

VII. 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.
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. Bushing wear.	B. Replace bushing and stem.
C. Misalignment.	C. Realign body-stem-actuator.

3. Valve exhibits "excess" vibration.

Possible Cause	Remedy
A. Excess pressure drop.	A. Bring pressure drop within design limits.
B. Bushing wear.	B. Replace 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 in 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 act.stem to valve stem.
C. Metal seat design instead of composition seat design.	C. Convert valve to composition seat.
D. Excess wear.	D1. Oversized valve operating too close to seat, convert 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 o-ring.

5. Premature packing leakage.

Possible Cause	Remedy
A. Over-temperature.	A1. Bring process temperature to 450° F (232° 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 or 989 or 2296.

6. Bonnet gasket leaking.

Possible Cause	Remedy
A. Improper bonnet bolting draw down.	A. Replace bonnet o-ring and draw down bolting evenly.
B. Corrosion.	B. Consider use of Model 988 or 989 or 2296.
C. Over-temperature.	C. Bring process temperature to 450° F (232° C) or less.

SECTION VIII

VIII. ORDERING INFORMATION
NEW REPLACEMENT UNIT vs PARTS "KIT" FOR FIELD REPAIR

To obtain a quotation or place an order, please retrieve the Serial Number and Product Code that was stamped on the metal name plate and attached to the unit. This information can also be found on the Bill of Material ("BOM"), a parts list that was provided when unit was originally shipped. (Serial Number typically 6 digits). Product Code typical format as follows: (last digit is alpha character that reflects revision level for the product).

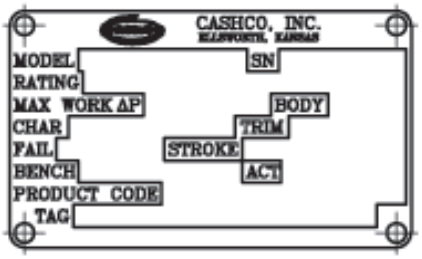
□□□-□□□7-□□□□□□□□□

NEW REPLACEMENT UNIT:

Contact your local Cashco, Inc., Sales Representative with the Serial Number and Product code. With this information they can provide a quotation for a new unit including a complete description, price and availability.

⚠ CAUTION

Do not attempt to alter the original construction of any unit without assistance and approval from the factory. All purposed changes will require a new name plate with appropriate ratings and new product code to accommodate the recommended part(s) changes.



PARTS "KIT" for FIELD REPAIR:

Contact your local Cashco, Inc., Sales Representative with the Serial Number and Product code. Identify the parts and the quantity required to repair the unit from the "BOM" sheet that was provided when unit was originally shipped.

NOTE: *Those part numbers that have a quantity indicated under "Spare Parts" in column "A" reflect minimum parts required for inspection and rebuild, - "Soft Goods Kit". Those in column "B" include minimum trim replacement parts needed plus those "Soft Goods" parts from column "A".*

If the "BOM" is not available, refer to the cross-sectional drawings included in this manual for part identification and selection.

A Local Sales Representative will provide quotation for appropriate Kit Number, Price and Availability.

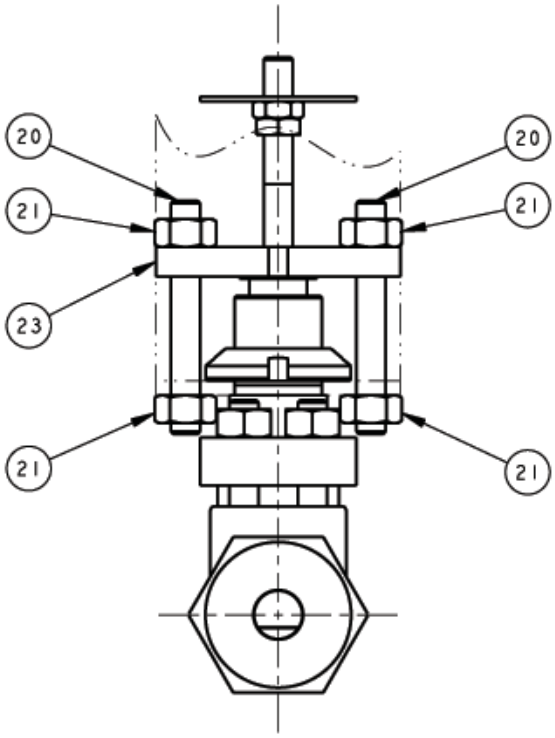


Figure 3
Representative of 1/2" – 1" Sizes
Metal Seat Design.

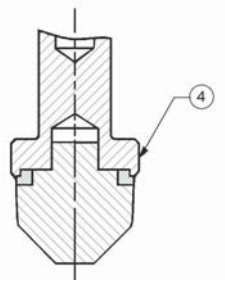


Figure 4
Composition Seat Design

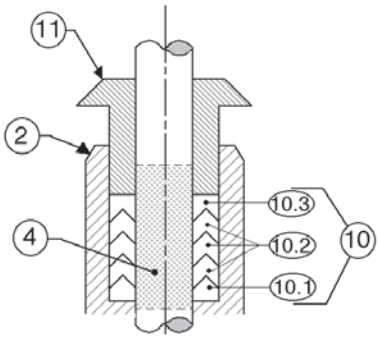
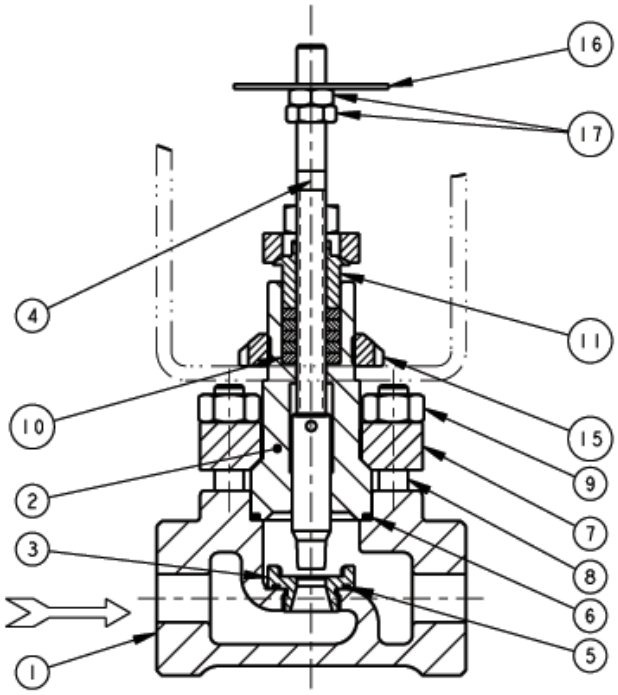


Figure 5
Packing Design

Critical Finish Zone



Item No.	Description	
1	Body	
2	Bonnet	
3	Seat Ring	
4	Plug & Stem Subassembly	
5	Seat Ring O-Ring	‡
6	Bonnet O-Ring	‡
7	Bonnet Flange	
8	Bonnet Stud	
9	Flange Nut	
10	Packing	‡
11	Packing Follower	
13	Nut	
14	Stud	
15	Yoke Nut	
16	Indicating Washer	
17	Stem Jam Nut	
20	Packing Stud	
21	Packing Stud Nut	
23	Packing Flange	

‡ Recommended replacement parts.

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