MODEL 964

GLOBE-STYLE PNEUMATIC CONTROL VALVE UNIT (BODY AND ACTUATOR) 2" & 3" SIZES ONLY

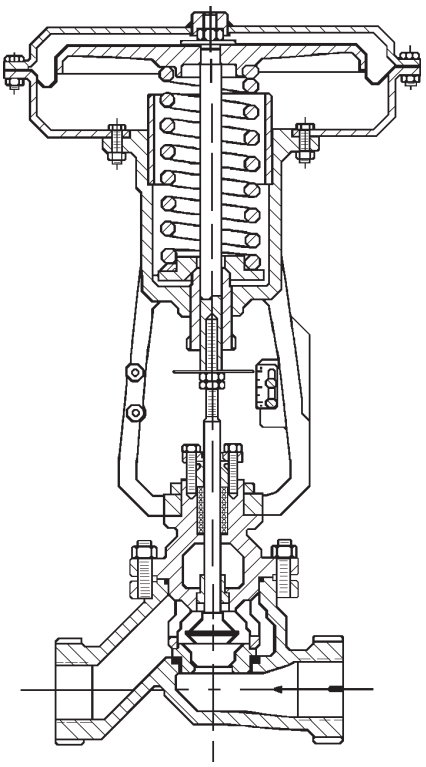
SECTION I

I. DESCRIPTION AND SCOPE

The Model 964 is a pneumatically actuated, globe-style control valve, complete with the actuator mounted. Available sizes - 2" & 3" (DN50 & 80) in cast iron and cast steel body materials. Model 110 Actuator is mounted to the body. Actuator is direct action; i.e. actuator stem extends on increase in loading pressure. Unit is field reversible by changing relative positions of plug-to-seat ring with respect to each other (see Figures 6 and 7).

The valve is designed primarily for general service or utility applications such as steam, air, oil, gas and water.

The body is available with integral flanges — 125# FF or 250# FF — or (NPT 2" size only) end connections for Ductile Iron (DI) material or with separable flanges —150# or 300# RF —, (NPT or socket weld 2" size only) end connections for steel (CS) material.



2" (DN50) Model 964
ATC-Fail Open

SECTION II

II. REFERENCES

Refer to Technical Bulletin 964-2" & 3" TB for technical specifications of a Model 964 Control Valve.

Refer to the following IOM's for devices/accessories mounted to a Model 964 Control Valve:

Positioners: P/P: P5 or I/P: D20 or D3 go to
http://www.pmv.nu/products.aspx?pathlocator
PS2 I/P: http://www.automation.siemens.com/sc-static/catalogs/catalog/pi/fi01/en/fi01_en_kap05.pdf

ABBREVIATIONS

ATC-FO	—	Air-to-Close, Fail Open
ATO-FC	—	Air-to-Open, Fail Closed
CCW	—	Counter Clockwise
DI	—	Ductile Iron
CS	—	Cast Carbon Steel
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

⚠ CAUTION

For welded installations, all internal trim parts, seals and diaphragm(s) must be removed from regulator 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.

A. Orientation:

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

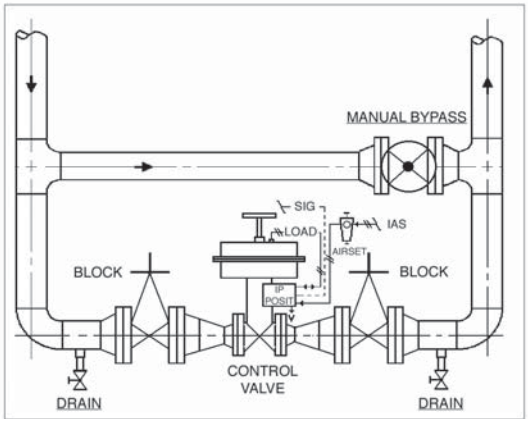


Figure 1: Typical Control Valve Station

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

3. Model 964 valves should not be installed with the stem oriented below horizontal/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.

2. Pipe unions are recommended for NPT screwed or socket welded installations to allow complete removal from system. If removal for maintenance is by cutting torch for socket welded valves, leave sufficient pipe nipple space between the 964 body and the next piping component up or downstream to allow socket weld couplings for re-installation.

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 964, is acceptable. If hydro test pressure exceeds the 1-1/2 x CWP limit, the 964 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 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.

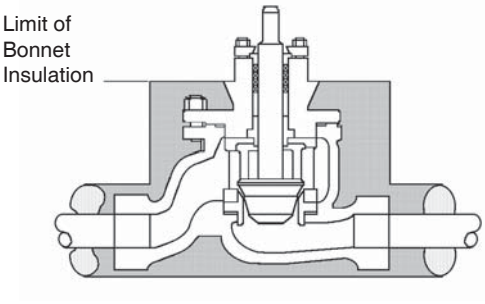


Figure 2: Body Insulation

11. Undue piping stress/strain or bending torques may not be transmitted thru 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 non-reusable 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.

4. All indicated Item Numbers that are with respect to the actuator portion of a Model 964 are in parenthesis and underscored; i.e (20). All Item Numbers that are with respect to the body portion of a Model 964 are not underscored; i.e. (32). All Item Numbers that are with respect to positioners are in double parentheses; i.e. ((9)).

5. **Special care must be exhibited when rotating the stem (3) of the valve to not mar that portion of the surface of the stem (3) where it contacts with the packing (6).** To rotate the stem (3), use the jam nuts (18) or soft-jawed pliers. ***(NOTE:*** *When using the jam nuts (18) to rotate the stem (3), use the upper jam nut (18) to rotate the stem CW, and the lower jam nut (18) to rotate the stem CCW, when viewed from above valve stem (3)).*

6. Place matchmarks between the body (1) bonnet flange, the bonnet (2) flange, and the yoke (1) to assist in final orientation when the body is disassembled and/or the actuator moved.

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

   "For ATO-FC reverse action units, connect a temporary air source to the actuator and pressurize to a level sufficient to initiate travel to approximately mid-stroke. (This procedure is not required for ATC-FO direct action units.)"

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

   "For ATO-FC reverse action units, release all temporary air pressure. (This procedure is not required for ATC-FO direct action units.)"

B. Actuator Removal:

1. Secure the body (1) in a vise with the actuator assembly (AA) oriented vertically.

2. **(Note PA.)** Using blunt end tool, hammer rap the tool to loosen yoke nut (17) turning CCW (viewed from above) approximately 1 revolution. Secure the actuator stem (19). Loosen the stem jam nuts (18) 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 (19) or (3) such as accessory plate ((AP)) for limit switch or positioner.

4. Loosen packing (6) by turning nuts (15) CCW 2-3 revolutions. **(Note RP.)**.

NOTE: To fully disengage the actuator stem (19) from the valve stem (3) is a two-step procedure. Be aware of the valve's stroke length as indicated on the nameplate (12) 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 that follows:

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 (3) CW (viewed from above) to disengage the actuator stem (19) from the valve stem (3), while holding the actuator stem (19). Record the number of valve stem revolutions for Step A above. When the disengagement reaches about 50% of full stroke travel, **(Note RP)**. Step A is completed.

   c. Step B. Support the actuator assembly (AA) from above. Fully loosen yoke nut (17) and remove. Lift the actuator assembly (AA) upwards approximately 1/4"-3/8" (6-8 mm). Again, rotate valve stem (3) CW (viewed from above) to disengage the actuator stem (19) from the valve stem (3) while holding the actuator stem (19). Record the number of valve stem (3) revolutions for Step B above. This should allow the actuator stem (19) to fully disengage from the valve stem (3).

   NOTE: *Take notice of the parts "dangling loosely" about the stem (3), 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 - position indicating disc (20), accessory plate ((AP)), yoke nut (17) - from falling.

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

   a. Step A. Rotate valve stem (3) CW (viewed from above) to disengage the actuator stem (19). Do not rotate the stem (3) into the seat (11). Record the number of valve stem (3) 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 (17) and remove. Lift the actuator assembly (AA) upwards approximately 1/4" - 3/8" (6-8 mm). Again, rotate valve stem (3) CW (viewed from above) to disengage the actuator stem (19) from the valve stem (3), while holding the actuator stem (19). Record the number of valve stem revolutions for Step B. This should allow the stem (19) (3) to fully disengage.

   NOTE: *Take notice of the parts "dangling loosely" about the stem (3), 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 – position indicating disc (20), accessory plate ((AP)), yoke nut (17) - from falling.

C. Actuator Replacement:

1. Secure body assembly (BA) in a vise with the valve stem (3) oriented vertically. Push plug/stem (3) down until the plug (3) touches the body (1) for ATO-FC actions, or seat ring (11) for ATC-FO action.

2. Secure the actuator assembly (AA) from above.

3. This procedure assumes that the bonnet (2) has been bolted to the body (1), with stem jam nuts (18) on the valve stem (3).

4. Lower actuator assembly (AA) until the valve stem (3) penetrates the opening in the yoke (1). Reposition the "dangling parts" - yoke nut (17), accessory plate ((AP)) and indicating disc (20) - over the body stem (3). Continue to lower the actuator assembly (AA) until there is approximately 1/4" (6 mm) space between stems (19) (3).

5. Connect a temporary air supply hose that has an adjustable airset with gauge to the actuator inlet to allow pressurization.

6. Slowly pressurize actuator to bring the actuator stem (19) to within 1/8" (3 mm) of reaching the valve stem (3).

7. Hand lift valve stem (3) up to touch actuator stem (19). Rotate valve stem (3) CCW (viewed from above) to engage with actuator stem (19). Use the total number of revs engagement recorded in Step IV.B. as the guide to control engagement of the stems (19) (3). While engaging, rotate yoke nut (17) 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.

8. Hand-tighten yoke nut (17) until fully positioned with the yoke (1) sitting on the bonnet (2).

9. Secure "dangling parts" - accessory plate ((AP)) and indicator disc (20) - to actuator stem (19) with stem jam nuts (18).

10. Properly position the actuator yoke (1) with respect to the body (1), and hammer rap yoke nut (17) until tight. (Release temporary air source.)

11. Calibrate actuator-to-valve per Section V.

D. Trim Removal and Replacement:

1. Secure body (1) assembly (BA) in a vise with actuator assembly (AA) directed upwards. Place match marks between the body (1) and the bonnet (2).

2. Secure the actuator assembly (AA) with an overhead support capable of vertically hoisting.

3. **(Note PA.)** Loosen all bonnet stud nuts (17).

4. Ensure actuator support is "taut"; i.e. holding weight of actuator.

5. Remove all bonnet bolting nuts (17).

6. Lift the actuator assembly (AA), together with bonnet (2) and stem assembly (3) vertically out of the valve body (1). ***NOTE:*** *For ATO-FC action units, the removal will also pull the seat ring (11) out simultaneously. Lay the topworks assembly down onto a work bench horizontally. For ATC-FO action units, remove the seat ring (11) from the body (1) cavity.*

7. Turn attention to the removed topworks assembly. Loosen the stem jam nuts (18) by rotating CCW (viewed from plug end) while securing the actuator stem (19) with soft-jawed pliers.

8. Loosen stem packing (6) by turning nuts (15) CCW to a point just short of disengagement of threads.

9. While securing the actuator stem (19) by soft-jawed pliers, rotate the valve stem assembly (3) CCW (viewed from plug end). Record the number of revolutions of disengagement in the box below:

Number of revolutions to disengage valve stem assembly from actuator stem. _____

10. Remove packing flange nuts (15) with CCW rotation.

11. Partially withdraw stem/plug assembly (3). Remove position indicator disc (20), both jam nuts (18), packing flange (4), packing follower (5), and accessory plate ((AP)), if installed.

12. Fully withdraw stem/plug assembly (3).

13. Using a sharp, hooked-end, pick-type tool, hook and pull the packing rings (6) up and out of the bonnet's (2) stuffing box individually. Examine for proper orientation (see Figure 4). Discard old packing (6).

⚠ CAUTION

Take extreme care to not mar internal wall surface of the bonnet (2).

14. Using a sharp pointed tool, remove packing washer (23) and packing spring (24).

15. Solvent clean all loose parts with suitable solvent and let dry.

16. Inspect guide bushing (8) in-place, as the bushing (8) is a press fit into the bonnet (2). If worn or "scored:

    a. Remove bonnet (2) by removing yoke nut (17).

    b. Remove snap-ring (9).

    c. Hydraulically press guide bushing (8) "out"; press "in" new guide bushing (8) into bonnet (2).

    d. Replace snap-ring (9).

    e. Reinstall bonnet (2) back together with actuator yoke (1), securing with yoke nut (17).

17. Examine seat ring (11), composition seat (3.4), stem (3.1) or plug (3) or adapters (3.3) (3.5) for wear. Replace all worn parts. Refer to Figure 3 for correct composition seat arrangement.

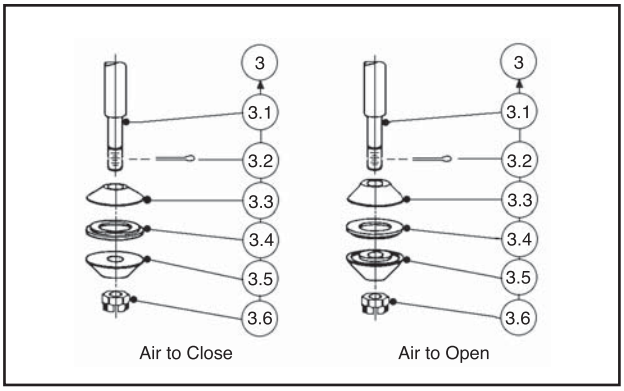


Figure 3: Composition Seat Arrangement

a. Examine stem (3) in critical finish zone where contact is made with the packing (6). It is desirable to restore the surface of the stem (3) to a #8 Ra µ-in surface finish; metal removal should not exceed 0.001-inch material. A deeply scratched or pitted stem (3) should be replaced.

b. Plug head of stem (3) assembly for metal seated design may be hand lapped using suitable lapping compound. If hand lapping will not restore surface finish to an acceptable degree, the replacement of stem (3) assembly and seat ring (11) is recommended.

c. For composition seated design, the TFE valve seat (3.4) can be replaced if the adapters (3.3/3.5), cotter pin (3.2) and castle nut (3.6) are not wear damaged. Grip stem (3.1) in vise (using protective covering (directly above (3.3/3.5) adapter). Remove cotter pin (3.2), castle nut (3.6), adapter (3.3 or 3.5) and valve seat (3.4). Insert new valve seat (3.4) and reassemble to desired seat arrangement. See Figure 3.

18. Examine the inner surface of the bonnet's (2) stuffing box. It is desirable to restore the surface of stuffing box to a #16 Ra µ-in surface finish; metal removal should not exceed 0.001-inch material. A deeply scratched or pitted bonnet (2) should be replaced.

19. Examine packing follower (5) for corrosion. Replace if significantly corroded:

    a. Remove follower bushing (25) from inside of packing follower (5) and replace with new.

20. Remove gaskets (12) (13), clean gasket facing surfaces and replace with new gaskets (12) (13).

21. For ATO-FC action units, place seat ring (11) over end of stem (3) in proper orientation, and insert the stem (3) until it appears thru the top side of the bonnet (2). See Figure 6.

22. For ATC-FO action units, place seat ring (11) into the body (1) cavity. Insert the stem (3) until it appears thru the top side of the bonnet (2). See Figure 7.

23. Lower packing spring (24) into bonnet (2) packing box.

24. Lower packing washer (23) into bonnet (2) packing box. Ensure that washer (23) is resting flat on the packing spring (24).

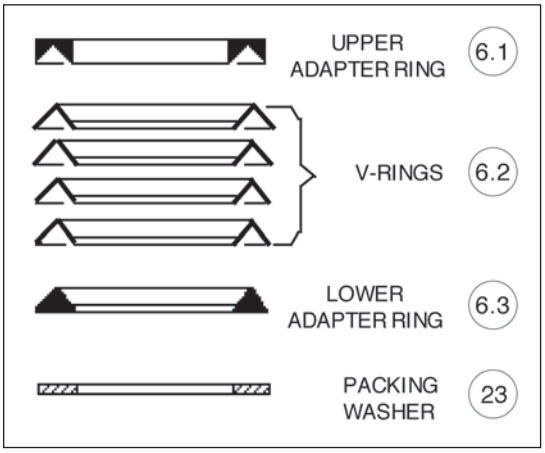


Figure 4: Packing Orientation

25. See Figure 4 for proper packing orientation.

    a. Carefully place lower adapter (6.3) of packing ring set (6) over stem's (3) end, properly oriented. Using the packing follower (5), push the lower adapter into the bonnet's (2) stuffing box.

    b. Carefully place a packing ring (6.2) properly oriented over the stem's (3) end and push into the stuffing box similar to the adapter (6.3). Repeat to each of the four rings (6.2).

    c. Carefully place upper adapter (6.1) over the stem's (3) end.

26. Slide packing follower (5) with new follower bushing (25) over end of stem.

27. Place packing flange (4) over end of stem (3) and over packing studs (14).

28. Slide position indicator disc (20) and accessory plate ((AP)), in installed, over end of stem (3).

29. Engage valve stem (3) into actuator stem (19) the same number of revolutions recorded in Step 9.

30. Tighten both jam nuts (18) up against position indicator plate (20).

31. Tighten packing nuts (15) evenly in ½ revolution increments, until the packing flange (4) is resting evenly on the upper edge of the bonnet (2) at the stuffing box. Snug both nuts (15) tightly.

32. Raise actuator assembly (AA). **(Note RP.)** Lower into body (1) over bonnet studs/bolts (16). Align with match marks.

33. For ATO-FC action units, wiggle the actuator assembly (AA) to assist in alignment.

34. For ATC-FO action units, pressurize actuator to the "higher" number of the bench set range indicated on nameplate (12) plus 2 psig (.14 Barg); for 3-13 psig (.21-.90 Barg) bench setting, pressurize to 15 psig (1.03 Barg). This should "lift" the bonnet (2) and "seat" the plug (3) firmly into the seat ring (11) for alignment purposes. Wiggle the actuator assembly (AA) to assist in alignment.

35. Wrench-tighten the bonnet bolting (16) (17) in an alternating cross-pattern in 1/4 revolution increments. Torque bonnet bolting to 50-55 ft/lbs (66-73 N-M).

36. For ATC-FO action units, release actuator pressure.

37. Hammer rap yoke nut (17) tight. It was loosened in Step 16a.

38. Calibrate unit per Section V.

E. Diaphragm Replacement:

1. Place valve's body (1) in a vise with the actuator assembly (AA) directed upwards.

2. Release all air pressure loaded into the actuator's upper casing (2).

⚠ WARNING

SPRING UNDER COMPRESSION! Prior to removing actuator casings' bolting, relieve spring compression by backing out the spring adjustor. Failure to do so may result in flying parts that could cause personal injury.

3. Rotate spring adjustor (4) CCW (viewed from plug end) until actuator's range spring (6) is fully relaxed. Record the number of revolutions required to loosen; record in the following box:

Number of revolutions required to relax actuator range spring: _____

4. Fully remove all casing bolting (10) (11), except for two sets of bolting (10) (11) that are 180° across from each other. Loosen these final sets of bolting (10) (11) in alternating sequence one revolution of the nut (11) at a time. If the casings (2) (3) pull apart on their own, the spring adjustor (4) may require more loosening. Go back to 3 above.

5. Remove upper casing (2). Lift diaphragm (7) from lower casing (3) flange. A putty knife or similar device may be required to help separate.

6. Place a wrench on the lower stem jam nut (18) and loosen diaphragm washer nut (9) CCW (viewed from above) to removal. Remove diaphragm washer (8); use putty knife if necessary to pry away.

7. Remove diaphragm (7) and examine for possible cause of failure. Discard used diaphragm (7).

8. Clean diaphragm plate (5), if necessary. Place new diaphragm (7) into position, aligning bolt holes of diaphragm (7) with lower casing (3) holes.

9. Apply a silicone rubber adhesive/sealant similar to Dow-Corning "Silastic" #732RTV at the juncture of the diaphragm plate (5) and the actuator stem (19). Place diaphragm washer (8) into position. Tighten diaphragm washer nut (9) to 35 ft/lbs. (47 N-M) torque using torque wrench.

10. Reposition upper casing (2) with lower casing (3) flange with diaphragm (7) between flanges.

11. Reinstall diaphragm bolting cap screws (10) and nuts (11); wrench-tighten firmly in alternating crossing pattern. Final-tighten bolting (10) (11) to 20-25 ft/lbs (27-34 N-M) torque using torque wrench.

12. Reapply compression to the range spring (6) by rotating the spring adjustor (4) CW (viewed from plug end) the same number of revolutions recorded in box of Step 3, this sub-section.

F. Manual Handwheel Seal Replacement:

1. Remove upper case (2) per section IV. E. steps 1 thru 4.

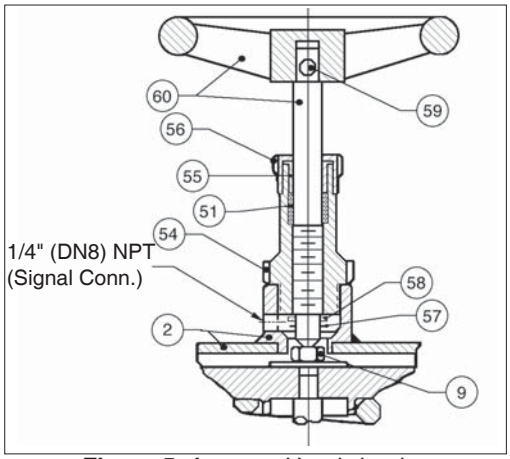


Figure 5: Actuator Handwheel

a. Place a wrench on the hex surface of packing box (54), and hammer rap the wrench CCW (viewed from top) to loosen. Fully remove packing box (54) and handwheel subassembly (60).

b. Remove grooved pin (57) from lower end of handwheel sub-assembly stem (60) and washer (58).

c. Loosen packing nut (56) by rotating CCW (viewed from above) to disengagement.

d. Remove handwheel sub-assembly (60) fully out by rotating CCW (viewed from above). Lift out packing gland (55).

e. Remove old packing rope (51) from packing box (54) recess and discard. Solvent clean all removed parts (60) (54) (55) (56).

f. Lightly lubricate the threaded portion of the handwheel sub-assembly (60), place packing nut (56) and packing gland (55) over the end of the stem (60) properly oriented. Insert the handwheel subassembly (60) back into the packing box (54). Replace washer (58) on end of stem (60) and reinsert grooved pin (57).

g. Lubricate the packing rope (51) with lithium grease and feed and press the packing (51) into the packing box (54) recess.

h. Lubricate both of the exterior threaded portions of the packing box (54). Reinsert the packing box (54) with handwheel subassembly (60) back into the connection of upper casing (2). Wrench-tighten and hammer rap the packing box (54).

i. Hand-tighten packing nut (56). Rotate the handwheel (60) in and out several times. Wrench-tighten packing nut (56) only 1/4 of a revolution once the packing (51) is properly pressed into position.

G. Reversing Unit Action:

1. Place body (1) into vise with actuator assembly (AA) directed upwards. Place matchmarks between the bonnet (2) and body (1).

2. Secure actuator assembly (AA) with an overhead support capable of vertically hoisting.

3. Rotate spring adjustor (4) CCW (viewed from plug end) until actuator's range spring (6) is fully relaxed. Record the number of revolutions required to loosen in the following box :

Number of revolutions required to relax actuator range spring: _____

4. Loosen all bonnet stud/bolt nuts (17) to removal.

5. Lift actuator assembly (AA) upwards approximately 8 inches (200 mm), and lay horizontally on a work bench.

NOTE: *When changing unit action, consideration should be given to replacement of packing rings (6). Bonnet gasket (12) and seat ring gasket (13) are recommended for replacement once the bonnet (2) and seat ring (11) have been removed; re-use of gaskets (12) (13) may allow fluid leakage upon reassembly and pressurization.*

6. Remove bonnet gasket (12) from body (1) recess. Remove seat ring gasket (13) from body (1) recess. Clean gasket facing surfaces in body (1) and on bonnet (2).

NOTE: *The changing of unit action from direct ATC-FO or from reverse ATO-FC action is accomplished not in the actuator, but in the body by reversing the orientation of the plug (3) with respect to the seat ring (11). See Figures 6 and 7.*

7. **From ATO-FC to ATC-FO Action:**

a. With this action, the seat ring (11) is retracted from the body (1) when the actuator assembly (AA) is removed.

b. Loosen jam nuts (18). Loosen packing flange nuts (15).

NOTE: *Take notice of the parts "dangling loosely" about the stem (3), the order of their location and their proper orientation.*

c. Using soft-jawed pliers, grasp the stem (3) just below/at the threaded portion, and rotate the stem/plug assembly (3) CCW (viewed from plug end) to removal. Record the number of revolutions required to disengage in box below:

Number of revolutions to disengage valve stem from actuator stem: _____

d. Partially withdraw the stem/plug assembly (3) from the bonnet (2), taking care not to drop the seat ring (11), position indicating disc (20) and accessory plate ((AP)), if installed.

e. Remove jam nuts (18). Fully withdraw stem/plug assembly (3) from the bonnet (2).

f. Clean gasket facing surfaces and install a new seat ring gasket (13) in the body (1) cavity. Set the seat ring (11) into the body (1) cavity in an inverted orientation from the way removed.

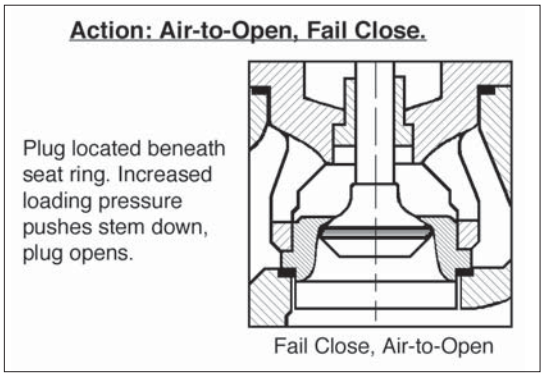


Figure 6: ATO-FC Action

g. Place a new bonnet gasket (12) in the body (1) recess.

h. Remove and replace packing rings (6) as directed elsewhere in this sub-section, if desired.

i. Insert the stem/plug assembly (3) back into the bottom of the bonnet (2). Screw both jam nuts (18) back onto stem (3), and locate at the root of the thread portion. Replace all the "loose dangling" parts back in their proper order and orientation.

NOTE: *Reference the IOM for the positioner, as the orientation/location of the ((AP)) may change. If the action of the positioner does not change when the valve unit's action is changed, the location of the positioner unit will change from the right side of the actuator yoke (1) to the left side, or vice versa. This requires that the actuator be rotated 180° from the beginning body-to-bonnet orientation, and that the positioner be removed and reoriented to an opposite position.*

j. Engage valve stem (3) with the actuator stem (19) with the number of revolutions recorded in Step 7.c, plus the number of revs indicated in Table 1.

TABLE 1	
No. of Stem Revs to Add/Subtract	
ATO-FC to ATC-FO	**ATC-FO to ATO-FC**
+ 6	- 6

k. Tighten one jam nut (18) into position.

l. Lift actuator assembly (AA) and lower into the body (1) cavity, aligning over bonnet studs (16). Rest the bonnet (2) onto the bonnet gasket (12).

m. Install nuts (17) onto bonnet bolting (16). Hand tighten; loosen one revolution.

n. Replace compression to actuator range spring (6) by rotating spring adjustor (4) CW (viewed from plug end) the number of revs indicated in the table of Step 3 previous.

o. Slowly pressurize the actuator casing (2) to the higher level of the bench set indicated in Table 2.

TABLE 2					
ATO-FC CONVERTED TO ATC-FO					
Bench Set Indicated on Nameplate		**New Bench Set to be Utilized**		**Loading Pressure for Step 7.p.**	
psig	**(Barg)**	**psig**	**(Barg)**	**psig**	**(Barg)**
5-15	(.34-1.0)	3-13	(.21-.90)	13	(.90)
9-30	(.62-20.7)	6-27	(.41-1.9)	27	(1.9)

p. Observe that the bonnet (2) rises as the plug head (3) pushes against the seat ring (11).

q. Wiggle the actuator assembly (AA) to align all the moving parts. Wrench-tighten the bonnet bolting nuts (17) in alternating cross-pattern and in 1/2 revolution increments until fully tightened.

r. Release air pressure in actuator and proceed to Step 9.

8. **From ATC-FO to ATO-FC Action:**

   a. With this action, the seat ring (11) remains in the body (1) when the actuator assembly (AA) is removed.

   b. Loosen jam nuts (18). Loosen packing flange nuts (15).

   NOTE: *Take notice of the parts "dangling loosely" about the stem (3), the order of their location and their proper orientation.*

   c. Using soft-jawed pliers, grasp stem (3) just below/at the threaded portion, and rotate the stem/plug assembly (3) CCW (viewed from plug end) to removal. Record number of revolutions required to disengage and record in the following box:

Number of revolutions to disengage valve stem from actuator stem: _____

   d. Partially withdraw the stem/plug assembly (3) from the bonnet (2), taking care not to drop the "dangling parts" - position indicator disc (20) and ((AP)), if installed.

   e. Remove jam nuts (18). Fully withdraw the stem/plug assembly (3) from the bonnet (2).

   f. Lift out the seat ring (11) from the body cavity. Remove the seat ring gasket (13). Clean gasket facing surfaces and install new seat ring gasket (13) and new bonnet gasket (12) into body (1) recesses.

   g. Remove and replace packing rings (6) as directed elsewhere in this sub-section.

   h. Place the seat ring (11) over the end of the stem (3) in an inverted orientation from the way removed.

   i. Insert the stem/plug assembly (3) back into the bottom of the bonnet (2). Screw both jam nuts (18) back onto stem (3), and locate at the root of the thread portion. Replace all the "loose dangling" parts back in their proper order and orientation.

NOTE: *Reference the IOM for the positioner, as the orientation/location of the ((AP)) may change. If the action of the positioner does not change when the valve unit's action is changed, the location of the positioner unit will change from the right side of the actuation yoke (1) to the left side, or vice versa. This requires that the actuator be rotated 180° from the beginning body-to-bonnet orientation, and that the positioner be removed and re-oriented to an opposite position.*

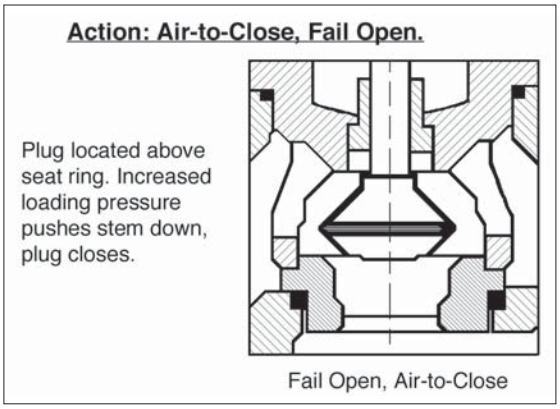


Figure 7: Air-to- Close Action

   j. Reengage the valve stem (3) with the actuator stem (19). Engage the number of revolutions recorded in Step 8.c., minus the number of revs indicated in Table 1.

   k. Tighten one jam nut (18) into position.

   l. Replace compression to actuator range spring (6) by rotating spring adjustor (4) CW (viewed from plug end) the number of revs indicated in the box of Step 3 previous. As the plug (3), and seat ring (11) are "drawn together", make sure that pieces are properly aligned.

   m. Lift actuator assembly (AA) and lower into the body (1) cavity, aligning over bonnet studs (16)). Rest the bonnet (2) onto the bonnet gasket (12).

   n. Install nuts (17) onto bonnet bolting (16). Wiggle the actuator assembly (AA) to align all the moving parts. Wrench tighten the bonnet bolting nuts (17) in alternating cross-pattern and in 1/2 revolution increments until fully tightened.

9. Record changes on unit's nameplate (12). Remove indicator plate screws (22) and rotate indicator plate (21) top to bottom. Replace indicator plate screws (22).

TABLE 3

ATC-FO CONVERTED TO ATO-FC

Bench Set Indicated on Nameplate		New Bench Set to be Utilized	
psig	**(Barg)**	**psig**	**(Barg)**
3-13	(.21-.90)	5-15	(.34-1.0)
6-27	(.41-1.9)	9-30	(.61-2.1)

10. Modify flow direction arrow located on body. (Valve-Actuator Unit is always designed with

the flow tending to push the plug open - FTO, regardless as to ATO-FC or ATC-FO actions.)

11. Wrench tighten packing to a minimum of 12 ft/lbs (16 N-M) torque. ***(NOTE:*** *Field tightening may be required to seal leakage.)*

12. Tighten second jam nut (18).

H. Packing Replacement:

1. This requires that the actuator stem (19) be separated from the valve stem (3) to replace packing (6).

2. Follow procedure in Steps IV. D.1 through IV. D. 15., and Steps IV. D. 24. through 39.

3. The number of packing rings (6) is as recorded in Table 4 below:

TABLE 4		
Body Size		Number of Packing Rings
inches	(DN)	
2	(50)	9
3	(80)	9

SECTION V

V. CALIBRATION

A. General:

1. This section covers calibration of the control valve unit. Calibration consists of adjusting stroke length and bench setting.

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-964 and are part of "body" will be in single parenthesis; i.e (2). Those that are part of the 964 actuator will be in single parenthesis and underscored; (2). Those that are part of the positioner IOM will be in double parenthesis; i.e. ((AP)).

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

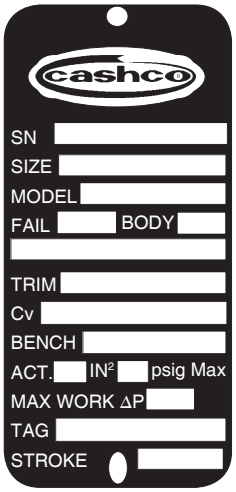
B. Procedure – Reverse Action, ATO-FC:

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 (18) by rotating CCW (viewed from plug end) 2-3 revolutions. Using upper stem jam nut (18), 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 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. 5-15 psig (.34-1.0 Barg), or 9-30 psig (.62-2.1 Barg).

6. Pressurize the actuator to a pressure level 2-3 psig (0.1-0.2 Barg) above the upper pressure level of the bench setting: i.e. for 5-15 psig (.34-1.0 Barg) range, set pressure at 17-18 psig (1.2-1.3 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 stem (3)-to-actuator stem (19) combined length is incorrect, and must be adjusted.

8. a. If travel indicator stops above the "O" position, the combined stem (3, 19) length is short. Loosen jam nut (18) holding the indicator disc (20) against actuator stem (19).

b. Increase combined stem (3, 19) length by rotating the valve stem (3) CCW (viewed from plug end) a distance equal to the amount of overtravel. Retighten jam nut (18).

9 a. If travel indicator stops below the "O" position, the combined stem (3,19) length is long. Loosen jam nut (18) holding indicator disc (20) against actuator stem (19).

b. Decrease combined stem (3, 19) length by rotating the valve stem (3) CW (viewed from plug end) a distance equal to the amount of undertravel. Retighten jam nut (18).

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

11. Release air pressure in actuator allowing valve stem (3) 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 (3,19) 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 (.34-1.0 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 stem assembly's (3) plug will just begin to travel from the closed position.

    Pressurize actuator slowly. If plug (3) 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 (3) 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 (3) position at the indicator plate (21). The valve plug (3) 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 (18).

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 top works connection.

3. Loosen lower stem jam nut (18) by rotating CCW (viewed from plug end) 2-3 revolutions. Using upper stem jam nut (18), 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 (.20-.90 Barg), or 6-27 psig (.41-1.9 Barg).

6. Pressurize the actuator to a level 2-3 psig (0.1-0.2 Barg) above the upper pressure level of the bench setting; i.e. for 3-13 psig (.20-.90 Barg) range, set pressure at 15-16 psig (1.0-1.1 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 stem (3)-to-actuator stem (19) combined length is incorrect, and must be adjusted.

8. a. If travel indicator stops **above** the "S" position, combined stem (3, 19) length is long. Loosen jam nut (18) holding indicator disc (20) against actuator stem (19).

   b. Release 6-8 psig (0.4-0.6 Barg) of pressure from the actuator. This step will ensure that when the combined stem (3, 19) length is decreased, the plug will not be mistakenly rotated while seated.

   c. Decrease combined stem (3,19) length by rotating valve stem (3) CW (viewed from plug end) a distance equal to the amount of undertravel. Retighten jam nut (18).

9. a. If travel indicator stops **below** the "S" position, combined stem (3,19) length is short. Loosen jam nut (18) holding indicator disc (20) against actuator stem (19).

   b. Release 6-8 psig (0.4-0.6 Barg) of pressure level in the actuator. This step will ensure that when the combined stem (3, 19) length is increased, the plug will not be mistakenly rotated while seated.

   c. Increase combined stem (3, 19) length by rotating tvalve stem (3) CCW (viewed from plug end) a distance equal to the amount of undertravel. Retighten jam nut (18).

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 (3, 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 valve stem assembly's (3) plug will just begin to travel from the closed position.

    Depressurize actuator slowly. If plug (3) 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 (3) 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) in 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 (3) position at the indicator plate (21). The valve plug (3) 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).

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

15. Tighten second stem jam nut (18).

SECTION VI

VI. START-UP

A. General:

1. Ensure that the Model 964 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 in the following table.

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

Bench Setting		Airset Output	
psig	(Barg)	psig	(Barg)
5-15	(.34-1.0)	20	(1.4)
3-13	(.21-.90)		
9-30	(.61-2.1)	35	(2.4)
6-27	(.41-1.9)		

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 that 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.

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.

⚠ CAUTION

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

9. 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 main-stream flow as required.

12. When 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 through 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 VII

VII. TROUBLE - SHOOTING GUIDE

1. Valve is "jumpy" in stroking.

Possible Causes	Remedies
A. Excess packing friction.	A1. Realign body - stem - actuator. A2. Packing follower too tight for optional packing designs. A3. Install positioner. A4. Increase bench set by changing to stiffer actuator range A5. 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 Causes	Remedies
A. Excess pressure drop.	A. Bring pressure drop within design limits.
B. Guide bushing wear.	B. Replace guide bushing.
C. Misalignment.	C. Realign body-stem-actuator.

3. Valve exhibits “excess” vibration.

Possible Causes	Remedies
A. Excess pressure drop.	A. Bring pressure drop within design limits.
B. Guide bushing wear.	B. Replace guide bushing.
C. Excessive cavitation in liquid service.	C1. Change operation parameters to relieve causes of cavitation. C2. Replace valve with valve equipped for cavitational 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 Causes	Remedies
A. Excess pressure drop.	A. Reduce pressure drop conditions.
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. Incorporate stellite trim. D2. Remove particulate. D3. Possible excess cavitation in liquid service. Change operation D4. parameters. Re-lap plug-seat surface. D5.
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 Causes	Remedies
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.	D1. Install alternate packing design.

6. Bonnet gasket leaking.

Possible Causes	Remedies
A. Improper bonnet bolting draw down.	A1. Replace gasket and draw down bolting evenly in a cross-pattern.

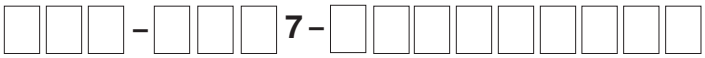
7. Body flange leakage.

Possible Causes	Remedies
A. Over-tightening flange bolting.	A1. Loosen bolting, replace gasket, reinstall new flange bolting. A2. Replace warped flanges.
B. Improper pipe supports and anchors.	B. Provide piping anchors and guides at control valve station. Restrain bending movements.

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).



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.

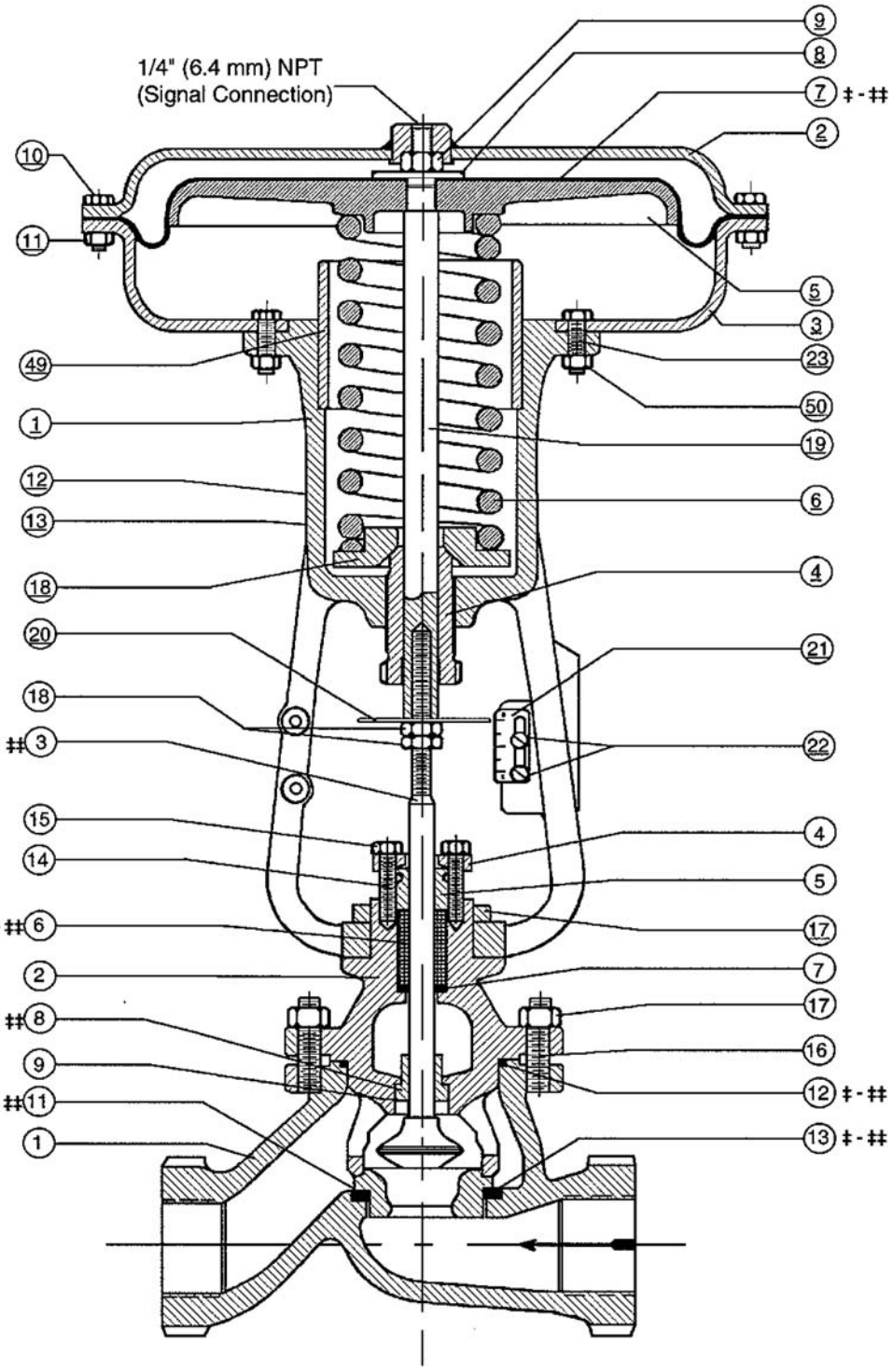
NOTE: *Those part numbers that have a quantity indicated under "Spare Parts" in column "A" reflect minimum parts required for inspection and rebuild, - "Soft Goods Kit". Those in column "B" include minimum trim replacement parts needed plus those "Soft Goods" parts from column "A".*

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.

2" – 3" (DN50 – 80) MODEL 964
with Model 110 Actuator
ATC-FO ACTION

Item No.	Description	Repair Parts Kit A	Kit B
1	Yoke		
2	Upper Case Subassembly		
3	Lower Case		
4	Spring Adjustor		
5	Diaphragm Plate		
6	Range Spring		
7	Diaphragm	‡	‡‡
8	Diaphragm Washer		
9	Diaphragm Washer Nut		
10	Case Bolt		
11	Case Bolt Nut		
12	Name Plate		
13	Name Plate Screw		
17	Yoke Nut		
18	Spring Seat		
19	Actuator Stem		
20	Travel Indicator		
21	Indicator Plate		
22	Indicator Plate Screw		
23	Yoke Bolt		
49	Travel Stop		
50	Yoke Bolt Nut		
1	Body		
2	Bonnet or Extension Column		
3	Plug & Stem Subassembly (Metal & Composition Seat)		‡‡
3.1	Stem (Composition Seat)		
3.2	Cotter Pin (Composition Seat)		‡‡
3.3	Adapter (Composition Seat)		
3.4	Seat (Composition Seat)		‡‡
3.5	Adaptor (Composition Seat)		
3.6	Nut Castle (Composition Seat)		
4	Packing Flange		
5	Packing Follower		
6	Packing	‡	‡‡
7	Packing Stop		
8	Guide Bushing		‡‡
9	Snap Ring		
10	Cage		
11	Seat Ring		‡‡
12	Gasket or O-Ring (Body)	‡	‡‡
13	Seat Ring Gasket	‡	‡‡
14	Packing Flange Stud		
15	Packing Flange Nut		
16	Bonnet Stud or Bolt		
17	Bonnet Stud/Bolt Nut		
18	Stem Jam Nut		
	Not Shown:		
19	Flange (Body 150# & 300#)		
20	Split Ring (For Flanged Body)		
22	Machine Screw		
43	Drive Screw		
44	Plate (Flow Arrow)		



NOTES:

1. See Figure 3 for item numbers for composition seat design.
2. See Figure 7 for item numbers for manual handwheel operator.

* Model 70 Actuator available on 2" size. Reference to 1-1/2" size 964 schematic on previous page for Actuator item numbers.

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