

87/88 Series

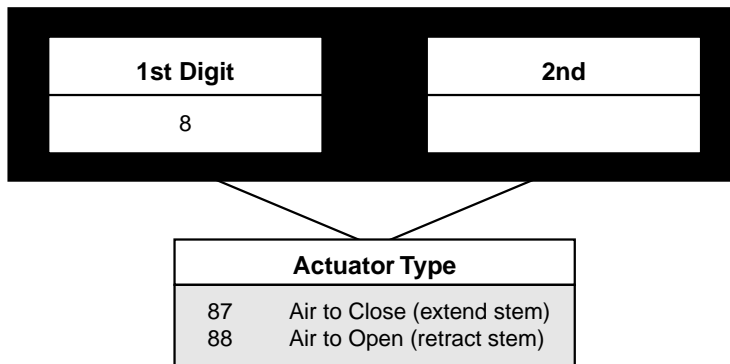
Spring Diaphragm Actuator



TABLE OF CONTENTS

1. Introduction	2	8. Actuator Range	9
2. General	2	9. Air Action Changes	12
3. Actuator Description	2	10. Valve Mounting	16
4. Unpacking	2	Parts Reference Tables	17 - 21
5. Air Piping	2		
6. Actuator Removal	3		
7. Maintenance	4		

The following instructions should be thoroughly reviewed and understood prior to installing, operating or performing maintenance on this equipment. Throughout the text, safety and/or caution notes will appear and must be adhered to strictly; otherwise, serious injury or equipment malfunction could result.



1. INTRODUCTION

The following instructions are designed to assist maintenance personnel in performing most of the maintenance required on the Model 87/88 actuator. Masoneilan has highly skilled service engineers available for start-up, maintenance and repair of our actuators and component parts. In addition, a regularly scheduled training program is conducted at the Training Center to train customer service and instrumentation personnel in the operation, maintenance and application of our control valves and instruments. Arrangements for these services can be made through your Masoneilan Representative or Sales Office. When performing maintenance, use only Masoneilan replacement parts. Parts are available through your local Masoneilan Representative or Sales Office. When ordering parts, always include Model and Serial Number of the unit being repaired.

2. GENERAL

These installation and maintenance instructions apply to the Masoneilan Model 87/88 actuator regardless of the valve body on which it is used. Actuator part numbers and recommended spare parts required for maintenance are listed in the Parts Reference Tables on pages 18 and 19. The model number and action of the actuator are shown as part of the model number listed on the identification tag located on the actuator.

3. ACTUATOR DESCRIPTION

The Model 87/88 is a pneumatic spring diaphragm actuator which features field reversibility (with no additional parts). The multiple spring design configuration provides four standard spring ranges are achieved by varying spring quantity and placement. A molded rolling diaphragm and deep cases minimize area change, resulting in a linear relationship between travel and air pressure.

Caution: For full automatic operation, the handwheel must be placed in the neutral position. Travel will be limited if the handwheel is not in the neutral position.

4. UNPACKING

Care must be exercised when unpacking the equipment to prevent damage to the accessories and component parts. Should any problems arise, contact your Masoneilan Representative or District Office.

5. AIR PIPING

The Model 87/88 actuator is designed to accept 1/4" NPT air supply connections. Accessories supplied with the actuator are mounted and connected at the factory.

Caution: Do not exceed pressure indicated on identification tag.

6. ACTUATOR REMOVAL

Maintenance on the valve body normally requires removal of the valve actuator. The steps in removal of the actuator are different depending on whether the actuator is air to close or air to open.

Note: Actuator action may be checked by referring to the valve identification tag. Model 87 indicates unit is air to close and Model 88 indicates unit is air to open.

6.1 Air to close (Model 87), size 3 (Figure 8), and size 6 (Figure 2), with or without handwheel

- A. Shut off air supply to actuator and rotate handwheel to the neutral position. [No force exerted on the stem connector or stem flange.]
- B. Disconnect air piping from diaphragm case.
- C. Check the stem position against the travel scale (9) to insure that the plug is up (off the seat).
Note: No air pressure is required to the actuator since the spring force acts to open the valve.
- D. Loosen stem lock nuts (1).
- E. Re-tighten lock nuts (1) against each other so they will lock at a point that is not against the stem connector stem flange (2).

Caution: At this time provisions must be made to support and lift the actuator off the body using recommended lift supports and procedures.

- F. Loosen and remove drive nut.

Caution: Depending on stem length, it may be required to raise the actuator off the body slightly to enable the plug stem to disengage from the actuator stem. The actuator must be raised straight off the body to prevent side loading the plug stem.

- G. Turn the stem lock nut (1) counterclockwise and loosen the plug stem until it disengages from the actuator stem (10).

Note: Do not allow the valve plug to drop or turn against the seat ring, as this could damage the seat and plug.

- H. Remove actuator from the valve body.

Caution: Care should be taken in handling the actuator to prevent damage to gauges, tubing, and component parts.

6.2 Air to open (Model 88), sizes 3 and 6, with handwheel

Caution: The stem connector or stem flange (2) on these sizes are not fixed to the actuator stem and are loose parts with the plug stem removed. For safety, the handwheel must be in a free position and the actuator removed from the valve using procedure 6.3 Air to Open without handwheel.

6.3 Air to open (Model 88), size 3 (Figure 9) and size 6 (Figures 2 and 4) without handwheel

Since removal of the valve plug stem from the actuator stem connector requires that the valve plug be off the seat, special provisions are necessary to assure that the valve is in the opened position. Proceed as follows for an actuator without a handwheel.

Note: Since air supply piping connected to the actuator is normally rigid, it is required that a manual loading panel with suitable flex tubing be used or some suitable type of flex connections be made between the supply piping and the actuator connection to accommodate movement of the actuator.

Caution: High stress placed on rigid piping could cause breaking of the air supply line. A flex connector is required.

- A. Shut off air supply to the actuator.
- B. Disconnect air supply piping to the actuator.
- C. Connect manual loading panel tubing to the lower diaphragm case or yoke (size 3) tubing connector.
- D. Apply required air pressure through the manual loading panel to open the valve as is indicated by the stem position relative to the travel indicator scale (9).

Caution: Do not exceed pressure indicated on the tag (63) on the diaphragm case.

- E. Loosen stem lock nuts (1).
- F. Re-tighten stem lock nuts (1) against each other so they will lock at a point that is not against the actuator stem connector or stem flange (2).

Caution: At this time provisions must be made to support and lift the actuator off the body using recommended lift supports and procedures.

- G. Loosen and remove drive nut.

Caution: Depending on stem length, it may be required to raise the actuator off the body slightly to enable the plug stem to disengage from the actuator stem. The actuator must be raised straight off the body to prevent side loading on the plug stem.

- H. Turn the upper stem lock nut (1) counterclockwise and unscrew the valve plug stem until disengaged from the actuator stem (10).

Note: Do not allow the plug to drop or turn against the seat ring, as this could damage the seat and plug.

- I. Remove actuator from the valve body and shut off air supply pressure.

Caution: Care should be taken in handling the actuator to prevent damage to gauges, tubing, and component parts. In addition, since a flex connection is made between the actuator and air piping, care must be taken not to exert pressure on the flex tubing or air piping.

6.4 Air to close (Model 87), sizes 10, 16 and 23, with and without handwheel (Figure 3)

- A. Shut off air supply to actuator and rotate handwheel to the neutral position.
- B. Disconnect air piping from diaphragm case.
- C. Check the travel indicator (7) against the travel scale (9) to insure that the plug is up (off the seat).

Note: No air pressure is required to the actuator since the spring pressure tends to open the valve.

- D. Loosen stem lock nut (1).
- E. Remove cap screws (5) from stem connector (2, 4).

Note: Do not allow the valve plug to drop or turn against the seat ring, as this could damage the seat and plug.

Caution: At this time provisions must be made to support and lift the actuator off the body using recommended lift supports and procedures.

- F. Loosen and remove drive nut.

Caution: Progressively raise actuator off the body to enable the top stem connector (4) to disengage the bottom stem connector (2). The actuator must be raised straight off the body to prevent stress on the plug stem.

- G. Remove bottom stem connector parts (1, 2, 6) from plug stem.
- H. Remove actuator from the valve.

6.5 Air to open (Model 88), sizes 10, 16 and 23, with or without handwheel (Figure 4)

Since removal of the valve plug stem from the actuator stem connector requires that the valve plug be off the seat, special provisions are necessary to assure that the valve is in the opened position. Proceed as follows:

Note: Since air supply piping connected to the actuator is normally rigid and the actuator will be moved, it is required that a manual loading panel with suitable flex tubing be used or some suitable type of flex connections be made between the supply piping and the actuator connection.

Caution: Unreasonably high stress placed on rigid piping could cause breaking of the air supply line. A flex connector is required.

- A. Shut off air supply to the actuator and rotate handwheel to the neutral position.
- B. Disconnect air supply piping to the actuator.
- C. Connect manual loading panel tubing to the lower diaphragm case tubing connector.
- D. Apply required air pressure through the manual loading panel to open the valve as is indicated by the travel indicator (7) and stroke scale (9).

Caution: Do not exceed pressure indicated on the tag (63) on the diaphragm case.

- E. Loosen stem lock nuts (1).

- F. Remove cap screws (5) from stem connector (2, 4).

Note: Do not allow the valve plug to drop or turn against the seat ring, as this could damage the seat and plug.

Caution: At this time provisions must be made to support and lift the actuator off the body using recommended lift supports and procedures.

- G. Loosen and remove drive nut.

Caution: Progressively raise actuator off the body to enable the top stem connector (4) to disengage the bottom stem connector (2). The actuator must be raised straight off the body to prevent stress on the plug stem.

- H. Remove bottom stem connector parts (1, 2, 6) from plug stem.
- I. Remove actuator from the valve and shut off air supply pressure.

7. MAINTENANCE

Caution: It is recommended that the actuators are placed in an upright position for all disassembly or assembly operations.

7.1 Replacing diaphragm air to open actuators (Model 88) with or without handwheel (Figure 4 and Figure 9).

- A. Shut off air supply to the actuator, isolate the control valve process pressure to eliminate the valve from moving with spring tension removed.
- B. If valve is equipped with a handwheel, rotate handwheel to a neutral position.
- C. Remove diaphragm case cap screws and nuts (20 and 19). Tension bolts (27, 28 and 56) must be removed last.

Note: Size 3 actuator – remove four diaphragm case cap screws and nuts (27 and 28) leaving the other four tension bolts equally spaced around the case.

Caution: Diaphragm case is under spring tension and is equipped with tension bolts which must be removed last.

- D. Remove tension bolts (27, 28 and 56) in multiple steps to relieve spring tension gradually. Remove upper diaphragm case (24).
- E. Note position of springs (21) and spring spacers (18) [if equipped] in the diaphragm plate (26) before you remove these parts.
- F. Remove hex nut (23) [size 3], cap screw (23) [size 6], or jam nut (23) [all other sizes]. Also remove spacer (2) [size 3] and diaphragm washer (22) [all other sizes].
- G. Remove diaphragm plate (26) and diaphragm (25).

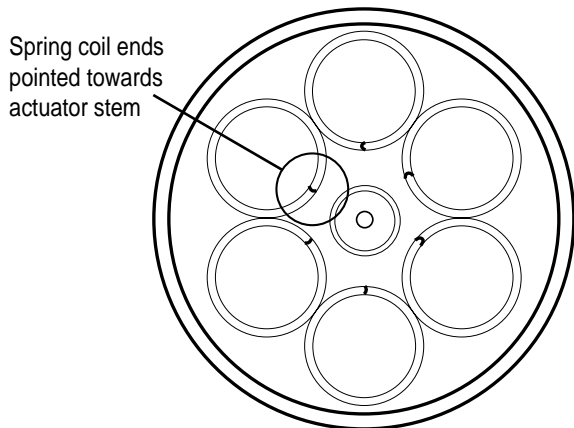


Figure 1

- H. Replace the new diaphragm (25) on the diaphragm plate (26).
- I. Size 3 actuator, coat the threads of hex nut (23) and the surfaces of the spacer (22) with Chesterton 725 nickel compound or equivalent. Size 6 actuator, coat the threads of cap screw (23) and the surfaces of washer (22) with Dupont Sealant Compound III or equal. All other sizes, coat the actuator stem threads (10) and the surfaces of washer (22) with Dupont Sealant Compound III or equal.
- J. Check placement of spacers (14 and 22), reassemble diaphragm (25), diaphragm plate (26), and washer (22) then tighten fastener (23) in proper locations.
- K. Position springs (21) and spring spacers (18) [if used] in the diaphragm plate.
Note: Arrange springs so that the coil ends are pointed toward the actuator stem as shown in Figure 1. This step assures best actuator performance.
- L. Replace upper diaphragm case (24) and tension bolts.
Note: Tension bolts should be spaced equally around the bolt circle of the case.
- M. Tighten the tension bolts in equal steps until the cases meet. Replace the remaining cap screws and nuts.

Caution: Tighten cap screws and nuts evenly. Do not over tighten as this could possibly warp the diaphragm cases. See Table 3 and Table 7 for torque values.

- N. If so equipped, rotate handwheel to the desired position.

7.2 Replacing diaphragm air to close actuator (Model 87), with handwheel (Figures 2, 3, 7, 8, 10 and 11)

Caution: The handwheel assembly can hold spring tension in the actuator when the diaphragm case is removed. To prevent possible injury, remove handwheel per the following procedures.

- A. Shut off air supply to the actuator, isolate the control process pressure to eliminate the valve plug from moving with spring tension removed.
- B. Rotate the handwheel (41) to a neutral position.
- C. For size 3 actuator, remove one of the two retaining rings (46) which are mounted on lever pin (45).

Caution: Removing the lever pin (45) will disconnect the handwheel assembly from the actuator. Support the handwheel assembly to avoid possible injury.

For all other sizes, remove two handwheel pivot pins (33) which are mounted through the yoke and secure the handwheel pivot (36) in place (see Figure 7).

- D. For size 3 actuator, remove lever pin (45) and secure the handwheel holder (40) in place (see Figures 10 and 11).

For all other sizes, let the complete handwheel assembly swing down and out of the way of the top stem connector (4) [bottom stem connector (2) on size 6 actuator].

- E. Proceed with the instructions for air to close actuators without handwheel (7.3).

7.3 Replacing diaphragm air to close actuator (Model 87), size 3, without handwheel (Figures 8, 10 and 11)

- A. Shut off air supply to the actuator and remove air piping from the upper diaphragm case (24).
- B. Check the travel indicator on stem connector (2) against the travel scale (9) to insure that the plug is up (off the seat).

Note: No air pressure is required to the actuator since the spring pressure tends to open the valve.

- C. Loosen stem lock nuts (1).
- D. Re-tighten lock nuts (1) against each other so they will lock at a point that is not against the stem flange (2).
- E. Turn the stem lock nut (1) counterclockwise and loosen the plug stem until it disengages from the actuator stem (10).

Note: Depending on stem length, it may be required to separate the size 3 actuator off the valve body, as indicated in Section 6.1.

Note: Do not allow the valve plug to drop or turn against the seat ring, as this could damage the seat and plug.

- F. Remove four diaphragm case cap screws and nuts (27 and 28) leaving the other four installed on the case equally spaced.

Caution: Diaphragm case is under spring tension. The remaining four screws and nuts are tension bolts.

- G. Remove tension bolts (four remaining 27 and 28) in multiple steps to relieve spring tension gradually. Remove upper diaphragm case (24).
- H. Remove hex nut (23) and spacer (14).
- I. Replace new diaphragm (25) on the diaphragm plate (26).
- J. Coat the threads of hex nut (23) and the surfaces of the spacer (14) with Chesterton 725 nickel compound or equal. Install spacer (14) and tighten hex nut (23) per Table 3.
- K. Replace upper diaphragm case (24) and tension bolts (four cap screws and nuts 27 and 28).

Note: Tension bolts should be spaced equally around the bolt circle of the case.

- L. Tighten the tension bolts (27 and 28) in equal steps until the cases meet. Replace the remaining cap screws (27) and nuts (28).

Caution: Tighten cap screws and nuts evenly. Do not over tighten as this could possibly warp the diaphragm cases. See Table 3 for torque values.

- M. Screw the plug stem back into the actuator stem (10) thru the stem flange (2) and recalibrate the seated position of the valve.

Note: If the actuator has been removed from the valve body, reinstall it as indicated in Section 10.2.

Note: If the actuator has a handwheel (Section 7.2), continue with the following steps:

- N. Hold the handwheel holder (40) in position between the yoke legs and slide the lever pin (45) through the hole in the yoke and lever. Be sure that the levers (44) are above the stem flange (2).
- O. Secure the lever pin (45) with the second retaining ring (46).

7.4 Replacing diaphragm air to close actuator (Model 87), sizes 6, 10, 16 and 23 without handwheel (Figures 2, 3 and 7)

- A. Shut off air supply to the actuator and remove air piping from the upper diaphragm case (24).
- B. Remove the two socket head cap screws (5) which hold the top and bottom stem connector (2 and 4) together.

Note: The size 6 actuator only has a bottom stem connector. For diaphragm replacement, the stem lock nuts (1) must be loosened. The plug stem is turned out at the actuator stem (10) in order to allow the actuator stem to rise with release of spring tension. Depending on stem length, it may be required, to allow this step, to separate the size 6 actuator off the valve body, as indicated in Section 6.1.

- C. Remove diaphragm case cap screws and nuts (20 and 19).

Caution: Diaphragm case is under spring tension and is equipped with tension bolts (27, 28 and 56) which must be removed last.

- D. Remove tension bolts (27, 28 and 56) in multiple steps to relieve spring tension gradually. Remove upper diaphragm case (24).
- E. Remove cap screw (23) [size 6] or jam nut (23) [all other sizes] and diaphragm washer (22) [all sizes].
- F. Replace new diaphragm (25) on the diaphragm plate (26).
- G. Size 6 actuator, coat the threads of cap screw (23) and the surfaces of washer (22) with Dupont Sealant Compound III or equal. All other sizes, coat the actuator

stem threads (10) and the surfaces of washer (22) with Dupont Sealant Compound III or its equivalent. Install washer (22) and tighten fastener (23).

- H. Replace upper diaphragm case (24) and tension bolts (27, 28 and 56).

Note: Tension bolts should be spaced equally around the bolt circle of the case.

- I. Tighten the tension bolts (27, 28 and 56) in equal steps until the cases meet. Replace the remaining cap screws (20) and nuts (19).

Caution: Tighten cap screws and nuts evenly. Do not over tighten as this could possibly warp the diaphragm cases. See Table 3 for torque values.

- J. Position top and bottom stem connectors (2 and 4) and replace the two socket head cap screws (5) and recalibrate the seated position of the valve (Section 10.2).

Note: Size 6 actuator - Screw the plug stem back into the actuator stem (10) thru the bottom stem connector and recalibrate the seated position of the valve. If the actuator has been removed from the valve body, re-install it as indicated in Section 10.2).

Note: If the actuator has a handwheel (Section 7.2), continue with the following steps:

- K. Swing handwheel assembly back up into place.
- L. Install the two pivot pins (33) in the yoke and engage them into the handwheel pivot (36).

7.5 Replace or repack handwheel bearing, size 3 actuator (Figures 10, 11 and 12)

- A. Rotate handwheel to a free position.
- B. Remove handwheel cap screw (20) and washer (42).
- C. Remove handwheel (41) and key (47).
- D. Remove one of the two retaining rings (46) which are mounted on lever pin (45).

Caution: Removing the lever pin (45) will disconnect the handwheel assembly from the actuator. Support the handwheel assembly to avoid possible injury.

- E. Remove lever pin (45) and secure the handwheel holder (40) in place.
- F. Remove the complete handwheel assembly from the actuator.
- G. Remove both cover cap screws (20) and handwheel cover (57).
- H. Remove retaining ring (38), handwheel pivot (36) and bushing (37) to release the bearing.
- I. Remove single row ball and shaft ring bearing (34) from handwheel stem (39) and bearing ball housing ring from the handwheel pivot (36).
- J. Replace or clean to repack bearing (34) with new grease.

- K. Bearing should be packed with Mobilux No. 2 grease or equivalent.

Note: It is important that the bearing is packed with grease, and not just coated.

- L. To reassemble, reverse removal procedures from step (I) through (B).

7.6 Replace or repack handwheel bearing, size 6 and 10 actuators (Figures 5 and 7)

- A. Rotate handwheel to a free position.
- B. Remove handwheel cap screw (20) and washer (42).
- C. Remove handwheel (41) and lock nut (43).
- D. Remove pivot pins (33) from the yoke which hold the handwheel pivot (36).
- E. Remove snap rings (46) and remove lever pin (45) to release handwheel assembly.
- F. Turn handwheel stem (39) until it clears traveling nut (40).
- G. Remove snap ring (38) and bearing ring (37) to release the handwheel stem (39) from the bearing.
- H. Remove snap ring (35) to release bearing (34).
- I. Replace or clean to repack bearing (34) with new grease.
- J. Bearing should be packed with Mobilux No. 2 grease or equal.

Note: It is important that the bearing is packed with grease, and not just coated.

- K. To reassemble, reverse removal procedures from step (H) through (B).

7.7 Replace or repack handwheel bearing size 16 and 23 actuators (Figures 6 and 7)

- A. Rotate handwheel to a free position.
- B. Remove pivot pins (33) which engage the handwheel pivot (36) thru the yoke.
- C. Remove snap rings (46) and remove lever pin (45) to release complete handwheel assembly.
- D. Remove snap ring (35) and slide the handwheel pivot (36) off the bearing (34).
- E. Remove cap screw (38) and end flange (37). This will release the bearing (34).
- F. Replace or clean to repack the bearing with new grease.
- G. Pack bearing (34) with Mobilux No. 2 grease or equal.

Note: It is important that the bearing is packed with grease, and not just coated.

- H. For remounting, reverse removal procedures from step (E) through (B).

7.8 Replace diaphragm seal and stem seal, air to open actuator (Model 88), size 3 (Figure 9)

- A. Shut off air supply to the actuator, isolate the control valve process pressure to eliminate the valve from moving with spring tension removed.
- B. If valve is equipped with a handwheel, rotate handwheel to a free position.
- C. Remove four diaphragm case cap screws and nuts (27 and 28) leaving the other four installed on the case equally spaced.

Caution: Diaphragm case is under spring tension. The remaining four screws and nuts are tension bolts.

- D. Remove tension bolts (four remaining 27 and 28) in multiple steps to relieve spring tension gradually. Remove upper diaphragm case (24).
- E. Note position of springs (21) and spring spacers (18) [if equipped] in the diaphragm plate (26), before you remove these parts.
- F. Remove springs (21) and spring spacers (18) if used.
- G. Loosen lock nuts (1). Re-tighten lock nuts against each other so they will lock at a point that is not against the stem flange (2). By means of a wrench, hold the nuts (1) and plug stem. Turn the actuator stem (10) subassembly until it disengages from the plug stem and remove completely from actuator.
- H. Remove case cap screws (16) and spring guide (29).
- I. Remove lower diaphragm case (17) to gain access to O-ring (13).
Note: Mark orientation of the case to the yoke.
Note: If diaphragm case O-ring (13) replacement is the only maintenance, proceed to Step N.
- J. Remove stem wiper (11) and O-rings (12).
- K. Clean stem wiper and O-ring grooves of the yoke (31).
- L. Apply a generous coating of Dupont Compound III (or equivalent) to a new O-ring (12) and insert it into the yoke (31).
- M. Insert a new stem wiper (11) into the lower groove of the yoke (31).
- N. Clean cap screws (16) and their threaded holes on the yoke (31).
- O. Coat a new O-ring (13) and the stem bushing (30) and O-ring (12) in the yoke with Dupont Compound III (or equivalent).
- P. Install new O-ring (13) in the yoke groove.
- Q. Place the diaphragm case (17) on the yoke.
- R. Apply Never-Seez (anti-seize compound or equivalent) to cap screw threads (16).
- S. Assemble spring guides (29) and cap screws (16).
- T. Re-install the actuator stem (10) subassembly into the yoke bushing. Turn actuator stem on the plug stem after installing the stem flange (2). Turn until stem spacer (14) contacts the lower diaphragm case (17).

- U. Lock the stem flange (2) and the two nuts (1) against the lower part of the actuator stem.
- V. Position springs (21) and spring spacers (18) [if used] in the diaphragm plate.

Note: Arrange springs so that the coil ends are pointed toward the actuator stem as shown in Figure 1. This step assures best actuator performance.

- W. Replace upper diaphragm case (24) and tension bolts (four cap screws and nuts 27 and 28).
Note: Tension bolts should be spaced equally around the bolt circle of the case.
- X. Tighten the tension bolts (27 and 28) in equal steps until the cases meet. Replace the remaining cap screws (27) and nuts (28).

Caution: Tighten cap screws and nuts evenly. Do not over tighten as this could possibly warp the diaphragm cases. See Table 3 for torque values.

- Y. If necessary, recalibrate the seated position of the valve (Section 10.1).

7.9 Replace diaphragm seal and stem seal, air to open (Model 88) actuators (Figure 2 or 4)

- A. Shut off air supply to the actuator, isolate the control valve process pressure to eliminate the valve from moving with spring tension removed.
- B. If valve is equipped with a handwheel, rotate handwheel to a free position.
- C. Remove diaphragm case cap screws and nuts (20 and 19).

Caution: Diaphragm case is under spring tension and is equipped with tension bolts (27, 28 and 56) which must be removed last.

- D. Remove tension bolts (27, 28 and 56) in multiple steps to relieve spring tension gradually. Remove upper diaphragm case (24).
- E. Note position of springs (21) and spring spacers (18) [if equipped] in the diaphragm plate (26).
- F. Remove springs (21) and spring spacers (18) if used.

On size 6 actuator:

- G. Loosen lock nuts (1). Re-tighten lock nuts against each other so they will lock at a point that is not against the stem connector (2). By means of a wrench, hold the nuts (1) and plug stem. Turn the actuator stem (10) subassembly until it disengages from the plug stem and remove completely from actuator.

On size 10, 16 and 23 actuators:

- G. Loosen lock nut (32) on actuator stem (10). Hold the connector device (2, 4, 6). Turn the actuator stem (10) subassembly and remove it when it clears the connector insert (6), (on size 6), or the top stem connector (4), (on sizes 16 and 23).

On sizes 6, 10, 16 and 23:

- H. Remove case cap screws (16) to gain access to seal washers (15).

Note: If seal washers (15) replacement is the only maintenance, proceed to Step N.

- I. Remove lower diaphragm case (17) and stem bushing (30).

Note: Mark orientation of the case to the yoke.

- J. Replace stem wiper (11) and O-rings (12 and 13).
- K. Coat O-rings (12 and 13) and inside of stem bushing (30) with Dupont Compound III (or equivalent).
- L. Install stem bushing (30) in the yoke with new O-rings (12 and 13).

- M. Place the diaphragm case (17) on the yoke.

- N. Coat the surface of the spring guides (29) in contact with the diaphragm case with Dupont Sealant Compound III or equivalent. Assemble spring guides (29), new seal washers (15), and cap screws (16) in this order.

- O. Re-install the actuator stem (10) subassembly into the yoke bushing. Turn actuator stem into insert (6), (size 10), or into the top stem connector (4), (sizes 16 and 23). In case of size 6 actuator, turn actuator stem on the plug stem after installing the stem connector (2). Turn until stem spacer (14) contacts the lower diaphragm case (17).

- P. Tighten lock nut (32) against connector insert (6), (size 10), or against the top stem connector (4), (on sizes 16 and 23). In case of size 6 actuator, lock the stem connector (2) and the two nuts (1) against the lower part of actuator stem.

- Q. Position springs (21) and spring spacers (18) [if used] in the diaphragm plate.

Note: Arrange springs so that the coil ends are pointed toward the actuator stem as shown in Figure 1. This step assures best actuator performance.

- R. Replace upper diaphragm case (24) and the tension bolts (27, 28 and 56).

Note: Tension bolts should be spaced equally around the bolt circle of the case.

- S. Tighten the tension bolts (27, 28 and 56) in equal steps until the cases meet. Replace the remaining cap screws (20) and nuts (19).

Caution: Tighten cap screws and nuts evenly. Do not over tighten as this could possibly warp the diaphragm cases. See Table 3 for torque values.

- T. If necessary, recalibrate the seated position of the valve (Section 10.1).

8. ACTUATOR RANGE

8.1 Actuator range change, air to open (Model 88)

- A. Shut off air supply to the actuator, isolate the control valve process pressure to eliminate the valve from moving with spring tension removed.
- B. If valve is equipped with a handwheel, rotate handwheel to a free position.
- C. Remove diaphragm case cap screws and nuts (20 and 19). Tension bolts (27, 28 and 56) must be removed last.

Note: Size 3 actuator – Remove four diaphragm case cap screws and nuts (27 and 28) leaving the other four tension bolts equally spaced around the case.

Caution: Diaphragm case is under spring tension and is equipped with tension bolts which must be removed last.

- D. Remove tension bolts (27, 28 and 56) in multiple steps to relieve spring tension gradually. Remove upper diaphragm case (24).
- E. Position springs (21) [and spring spacers (18) if new range uses them] in the diaphragm plate.
- F. Refer to Tables 1, 2 and 4 for spring information :

- a. For 11 and 21 psi (0.759 and 1.448 bar) initials, the springs are placed directly on the upper pedestals in the diaphragm plate (26).

Size 3 actuator - For 11 and 21 psi (0.759 and 1.448 bar) initials, the springs are installed with spring spacers (18). The spring spacers (18) are placed as shown in the cross sectional view, Figure 9.

- b. For 3 and 6 psi (0.207 and 0.414 bar) initials, the springs are placed in the bottom cavity in the diaphragm plate.

Size 3 actuator - For 3 and 6 psi (0.207 and 0.414 bar) initials, the springs are installed without spring spacers.

- c. For 11 and 21 psi (0.759 and 1.448 bar) initials **and travel ranges larger than 0.8" (20 mm)**, the spring spacers (18) are placed as shown in the cross sectional view, Figure 4.

Note: Spring spacers (18) are not required for the No. 6 actuator.

Note: Arrange springs so that the coil ends are pointed toward the actuator stem as shown in Figure 1. This step assures best actuator performance.

- G. Replace upper diaphragm case (24) and tension bolts (27, 28 and 56).

Note: Tension bolts should be spaced equally around the bolt circle of the case.

- H. Tighten the tension bolts (27, 28 and 56) in equal steps until the cases meet. Replace the remaining cap screws (20) and nuts (19) [Screws (27) and nuts (28) for size 3].

Caution: Tighten cap screws and nuts evenly. Do not over tighten as this could possibly warp the diaphragm cases. See Table 3 for torque values.

- I. If so equipped, rotate handwheel to the desired position.

8.2 Actuator range change, air to close (Model 87), sizes 6, 10, 16 and 23

Note: If actuator is equipped with a handwheel, please follow steps 7.2 A, B, C and D to disengage this assembly.

- A. Shut off air supply to the actuator and remove air piping from the upper diaphragm case (24).
- B. Remove the two socket head cap screws (5) which hold the top and bottom stem connector (2 and 4) together.

Note: The size 6 actuator only has a bottom stem connector (2). For access to springs, the stem lock nuts (1) must be loosened. The plug stem is turned out at the actuator stem (10) to allow the actuator stem to rise with release of spring tension. Depending on stem length, it may be required, to allow this step, to separate the size 6 actuator off the valve body, as indicated in Section 6.1.

- C. Remove diaphragm case cap screws and nuts (20 and 19).

Caution: Diaphragm case is under spring tension and is equipped with tension bolts (27, 28 and 56) which must be removed last.

- D. Remove tension bolts (27, 28 and 56) and compression nuts (28) in multiple steps to relieve spring tension gradually. Remove upper diaphragm case (24).
- E. Remove cap screw (23) [size 6] or jam nut (23) [all other sizes] and diaphragm washer (22).
- F. Remove diaphragm plate (26) and diaphragm (25).
- G. Place springs (21) over the spring guides (29).
- H. Refer to Tables 1, 2 and 4 for spring information:

- a. For 11 and 21 psi (0.759 and 1.448 bar) initials, the springs are placed directly on the upper pedestals in the diaphragm plate (26).

- b. For 3 and 6 psi (0.207 and 0.414 bar) initials, the springs are placed in the bottom cavity in the diaphragm plate.

- c. For 11 and 21 psi (0.759 and 1.448 bar) initials **and travel ranges larger than 0.8" (20 mm)**, the spring spacers (18) are placed as shown in the cross sectional view, Figure 4.

Note: Spring spacers (18) are not required for 0.8" (20 mm) travel ranges.

Note: Arrange springs so that the coil ends are pointed toward the actuator stem as shown in Figure 1. This step assures best actuator performance.

- I. Replace the diaphragm plate (26) on the actuator stem (10) and over the springs. To ensure the springs are properly located, check the view hole in the diaphragm plate. A spring should be visible.
- J. Install the diaphragm (25).
- K. For size 6 actuator, coat the threads of cap screw (23) and the surfaces of washer (22) with Dupont Sealant Compound III or equivalent. For all other sizes, coat the actuator stem threads (10) and the surfaces of washer (22) with Dupont Sealant Compound III or equivalent.
- L. Replace upper diaphragm case (24) and the tension bolts (27, 28 and 56).
Note: Tension bolts should be spaced equally around the bolt circle of the case.
- M. Tighten the tension bolts (27, 28 and 56) in equal steps until the cases meet. Replace the remaining cap screws (20) and nuts (19).

Caution: Tighten cap screws and nuts evenly. Do not over tighten as this could possibly warp the diaphragm cases. See Table 3 for torque values.

- N. Position top and bottom stem connectors (2 and 4) and replace the two socket head cap screws (5) and recalibrate the seated position of the valve (Section 10.2).

Note: Size 6 actuator - Screw the plug stem back into the actuator stem (10) thru the bottom stem connector (2) and recalibrate the seated position of the valve. If the actuator has been removed from the valve body, re-install it as indicated in Section 10.2).

Note: If the actuator has a handwheel (Section 7.2) continue with the following steps:

- O. Swing handwheel assembly back up into place.
- P. Install the two pivot pins (33) in the yoke and engage them into the handwheel pivot (36).

TABLE 1

ACTUATOR TRAVEL in. (mm)	SPRING COLOR
0.8 (20)	RED
1.5 (38)	BLUE
2.0 (51)	GREEN
2.5 (64)	YELLOW

TABLE 2

SPRING RANGE psi (bar)	NO.OF SPRINGS REQUIRED	SPRING SPACER (18) REQUIRED
3-15 (0.207-1.034)	3	NO
6-30 (0.414-2.069)	6	NO
11-23 (0.759-1.586)	3	YES*
21-45 (1.448-3.103)	6	YES*

* A spring spacer (18) is required on Size 10 for 1.5 in. (38mm) travel only, and on Sizes 16 and 23, for 1.5 in. (38mm), 2.0 in. (51mm) and 2.5 in. (64mm) travels.

TABLE 3 - ACTUATOR ASSEMBLY TORQUES

REF. NO.	DESCRIPTION	ACTUATOR SIZE									
		3		6		10		16		23	
		ft-lbs	N-m	ft-lbs	N-m	ft-lbs	N-m	ft-lbs	N-m	ft-lbs	N-m
1	Hex Nut .500 - 20 UNF	25	34	25	34	25	34	25	34	25	34
	Hex Nut .625 - 18 UNF					55	74	55	74	55	74
	Hex Nut .750 - 16 UNF					95	129	95	129	95	129
	Hex Nut 1.00 - 14 UNS							150	203	150	203
5	Socket Head Cap Screw			35*	47*	35	47	125	169	125	169
16	Hex Head Cap Screw	22	30	37	50	37	50	59	80	59	80
19,20,27,28	Case Bolting or Tension Bolting	22	30	21	28	25	34	30	40	31	42
23	Jam Nut, Hex Nut	48	65	37	50	66	90	95	129	150	203
32	Stem Lock Nut					55	74	95	129	150	203
33	Pivot Pin			60	81	60	81	80	108	80	108
20	Handwheel Cap Screw	53**	6	25	34	25	34	66	90	66	90
38	Handwheel Stem Cap Screw							300	407	300	407

* Torque shown is for size 6 actuator with Bellows Seal design requiring Stem Connector Option.

** Torque value in units of in-lbs.

Listed values are nominal torques. Tolerance is +/- 10%.

Actuator No.	Travel & Color Code	Range (psi)	Qty.	Springs Position
3	0.8" (20mm) Red	3-15	3	A
		6-30	6	B
		11-23	3	E
		21-45	6	F
6	0.8" (20mm) Red	3-15	3	A
		6-30	6	B
		11-23	3	C
		21-45	6	D
10	0.8" (20mm) Red	3-15	3	A
		6-30	6	B
		11-23	3	C
		21-45	6	D
	1.5" (38mm) Blue	3-15	3	A
		6-30	6	B
		11-23	3	E
		21-45	6	F
16	0.8" (20mm) Red	3-15	3	A
		6-30	6	B
		11-23	3	C
		21-45	6	D
	1.5" (38mm) Blue	3-15	3	A
		6-30	6	B
		11-23	3	E
		21-45	6	F
	2.0" (51mm) Green	3-15	3	A
		6-30	6	B
		11-23	3	E
		21-45	6	F
2.5" (64mm) Yellow	3-15	3	A	
	6-30	6	B	
	11-23	3	E	
	21-45	6	F	
23	0.8" (20mm) Red	3-15	3	A
		6-30	6	B
		11-23	3	E
		21-45	6	F
	1.5" (38mm) Blue	3-15	3	A
		6-30	6	B
		11-23	3	E
		21-45	6	F
	2.0" (51mm) Green	3-15	3	A
		6-30	6	B
		11-23	3	E
		21-45	6	F
2.5" (64mm) Yellow	3-15	3	A	
	6-30	6	B	
	11-23	3	E	
	21-45	6	F	

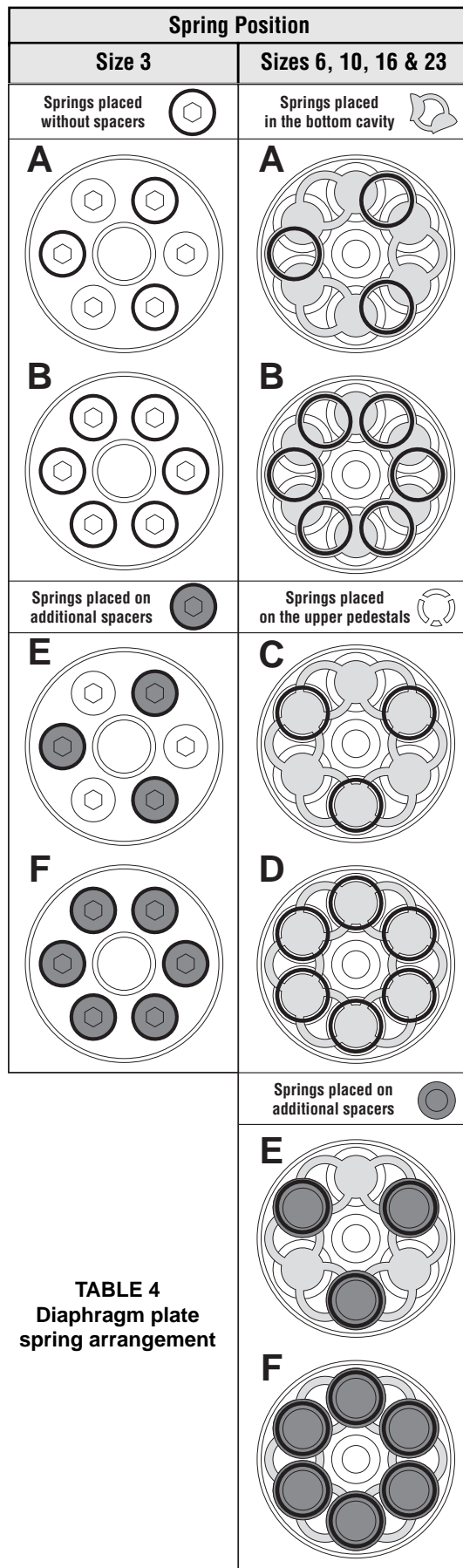


TABLE 4
Diaphragm plate
spring arrangement

8.3 Actuator range change, air to close (Model 87), size 3

Note: If actuator is equipped with a handwheel, please follow steps 7.2 A, B, C and D to disengage this assembly.

- A. Shut off air supply to the actuator and remove air piping from the upper diaphragm case (24).
- B. Check the travel indicator on stem flange (2) against the travel scale (9) to insure that the plug is up (off the seat).

Note: No air pressure is required to the actuator since the spring force acts to open the valve.

- C. Loosen stem lock nuts (1).
- D. Re-tighten lock nuts (1) against each other so they will lock at a point that is not against the stem flange (2).
- E. Turn the stem lock nut (1) counterclockwise and loosen the plug stem until it disengages from the actuator stem (10).

Note: Depending on stem length, it may be required to separate the size 3 actuator off the valve body, as indicated in Section 6.1.

Note: Do not allow the valve plug to drop or turn against the seat ring, as this could damage the seat and plug.

- F. Remove four diaphragm case cap screws and nuts (27 and 28) leaving the other four installed on the case equally spaced.

Caution: Diaphragm case is under spring tension. The remaining four screws and nuts are tension bolts.

- G. Remove tension bolts (four remaining 27 and 28) in multiple steps to relieve spring tension gradually. Remove upper diaphragm case (24).
 - H. Remove hex nut (23) and spacer (14).
 - I. Remove diaphragm (25) and diaphragm plate (26).
 - J. Place springs (21) over the spring guides (29).
 - K. Refer to Tables 1, 2 and 4 for spring information:
 - a. For 11 and 21 psi (0.759 and 1.448 bar) initials, the springs are installed with spring spacers (18). The spring spacers (18) are placed as shown in the cross sectional view, Figure 8.
 - b. For 3 and 6 psi (0.207 and 0.414 bar) initials, the springs are installed without spring spacers.
- Note: Arrange springs so that the coil ends are pointed toward the actuator stem as shown in Figure 1. This step assures best actuator performance.*
- L. Replace the diaphragm plate (26) on the actuator stem (10) and over the springs.
 - M. Install the diaphragm (25).
 - N. Coat the threads of hex nut (23) and the surfaces of the spacer (14) with Chesterton 725 nickel compound or equivalent. Install spacer (14) and tighten hex nut (23) per Table 3.

- O. Replace upper diaphragm case (24) and tension bolts (four cap screws and nuts 27 and 28).

Note: Tension bolts should be spaced equally around the bolt circle of the case.

- P. Tighten the tension bolts (27 and 28) per Table 3 in equal steps until the cases meet. Replace the remaining cap screws (27) and nuts (28) and tighten per Table 3.

Caution: Tighten cap screws and nuts evenly. Do not over tighten as this could possibly warp the diaphragm cases. See Table 3 for torque values.

- Q. Screw the plug stem back into the actuator stem (10) thru the bottom stem flange and recalibrate the seated position of the valve.

Note: If the actuator has been removed from the valve body, reinstall it as indicated in Section 10.2.

Note: If the actuator has a handwheel (Section 7.2) continue with the following steps:

- R. Hold the handwheel holder (40) in position between the yoke legs and slide the lever pin (45) through the hole in the yoke and lever. Be sure that the levers (44) are above the stem flange (2).
- S. Secure the lever pin (45) with the second retaining ring (46).

9. AIR ACTION CHANGES

9.1 Air to open to air to close (Model 88 to Model 87), sizes 6, 10, 16 and 23

- A. Shut off air supply to the actuator, isolate the control valve process pressure to eliminate the valve from moving with spring tension removed.
- B. If valve is equipped with a handwheel, rotate handwheel to a neutral position.
- C. Remove snap rings (46) and remove lever pin (45) to allow handwheel assembly to swing away from the stem connector (2-4).
- D. Remove the two socket head cap screws (5) which hold the top and bottom stem connector (2 and 4) together.

Note: The size 6 actuator only has a bottom stem connector (2). For changing of action, the stem lock nuts (1) must be loosened. The plug stem is turned out at the actuator stem (10) in order to allow the actuator stem to rise with springs installed in the Model 87. Depending on stem length, it may be required to separate the size 6 actuator off the valve body, as indicated in Section 6.3.

- E. Remove diaphragm case cap screws and nuts (20 and 19).

Caution: Diaphragm case is under spring tension and is equipped with tension bolts (27, 28 and 56) which must be removed last.

- F. Remove tension bolts (27, 28 and 56) in multiple steps to relieve spring tension gradually. Remove upper diaphragm case (24). Remove springs (21) and spacer (18) if equipped.
- G. Remove cap screw (23) [size 6] or jam nut (23) [all other sizes] and diaphragm washer (22) [all sizes].
- H. Remove diaphragm plate (26) and diaphragm (25).
- I. Place springs (21) over the spring guides (29).
- J. Refer to Tables 1, 2 and 4 for spring information. Refer also to Section 8.1 F.

Note: Spring spacers (18) are not required for 0.8" (20 mm) travel ranges.

Note: Arrange springs so that the coil ends are pointed toward the actuator as shown in Figure 1. This step assures best actuator performance.

- K. Invert and replace the diaphragm plate (26) on the actuator stem (10) and over the springs.

Note: To ensure the springs are properly located, check the view hole in the diaphragm plate. A spring should be visible.

- L. Install the diaphragm (25).
- M. For size 6 actuator, coat the threads of cap screw (23) and the surfaces of washer (22) with Dupont Sealant Compound III or equivalent. For all other sizes, coat the actuator stem threads (10) and the surfaces of washer (22) with Dupont Sealant Compound III or equivalent.
- N. Replace upper diaphragm case (24) and tension bolts (27, 28 and 56).
Note: Tension bolts should be spaced equally around the bolt circle of the case.
- O. Tighten the tension bolts (27, 28 and 56) in equal steps until the cases meet. Replace the remaining cap screws (20) and nuts (19).

Caution: Tighten cap screws and nuts evenly. Do not over tighten as this could possibly warp the diaphragm cases. See Table 3 for torque values.

- P. Position top and bottom stem connectors (2 and 4) and replace the two socket head cap screws (5) and recalibrate the seated position of the valve (Section 10.2).

Note: Size 6 actuator - Screw the plug stem back into the actuator stem (10) thru the bottom stem connector (2) and recalibrate the seated position of the valve. If the actuator has been removed from the valve body, re-install it as indicated in Section 10.2.

Note: If the actuator has a handwheel, continue with the following steps:

- Q. Swing handwheel assembly back up into place. The handwheel (41) may have to be turned in order to position the lower pivot pins (33).
- R. With the pivot pins positioned on top of the stem connector (2 and 4), replace the lever pin (45) and snap rings (46).

9.2 Air to close to air to open, (Model 87 to Model 88), sizes 6, 10, 16 and 23 with handwheel

Caution: The handwheel assembly can hold spring tension in the actuator when the diaphragm case is removed. To prevent possible injury, remove handwheel per the following procedure.

- A. Shut off air supply to the actuator, isolate the control process pressure to eliminate the valve from moving with spring tension removed.
- B. Rotate the handwheel (41) to a neutral position.
- C. Remove snap rings (46) and lever pins (45).
- D. The complete handwheel assembly can now swing out of the way of the top stem connector (2 and 4) [bottom stem connector (2) on the size 6 actuator].
- E. Proceed with the instructions for actuators without handwheel (9.3 Step B).

9.3 Air to close to air to open (Model 87 to Model 88), sizes 6, 10, 16 and 23 without handwheel

- A. Shut off air supply to the actuator and remove air piping from the upper diaphragm case (24).
- B. Remove the two socket head cap screws (5) which hold the top and bottom stem connector (2 and 4) together.

Note: The size 6 actuator only has a bottom stem connector. For changing of action, the stem lock nuts (1) must be loosened. The plug stem is disconnected from the actuator stem (10) in order to allow the actuator stem to rise with release of spring tension during disassembly.

Depending on stem length, it may be required to separate the size 6 actuator off the valve body, as indicated in Section 6.1.

- C. Remove diaphragm case cap screws and nuts (20 and 19).

Caution: Diaphragm case is under spring tension and is equipped with tension bolts (27, 28 and 56) which must be removed last.

- D. Remove tension bolts (27, 28 and 56) in multiple steps to relieve spring tension gradually. Remove upper diaphragm case (24).
- E. Remove cap screw (23) [size 6] or jam nut (23) [all other sizes] and diaphragm washer (22) [all sizes].
- F. Remove the diaphragm (25), diaphragm plate (26), springs (21) and spring spacers (18) if used.
- G. Invert the diaphragm (25) and diaphragm plate (26).
- H. For size 6 actuator, coat the threads of cap screw (23) and the surfaces of washer (22) with Dupont Sealant Compound III or equivalent. For all other sizes, coat the actuator stem threads (10) and the surfaces of washer (22) with Dupont Sealant Compound III or equivalent.

- I. Checking placement of spacer (14) reassemble diaphragm (25), diaphragm plate (26), and washer (22), then tighten fastener (23) in proper locations.
- J. Position springs (21) and spring spacers (18) [if used] in the diaphragm plate.
- K. Refer to Tables 1, 2 and 4 for spring information. Refer also to Section 8.1 F.

Note: Spring spacers (18) are not required for 0.8" (20 mm) travel ranges.

Note: Arrange springs so that the coil ends are pointed toward the actuator stem as shown in Figure 1. This step assures best actuator performance.

- L. Replace upper diaphragm case (24) and tension bolts (27, 28 and 56).
Note: Tension bolts should be spaced equally around the bolt circle of the case.
- M. Tighten the tension bolts (27, 28 and 56) in equal steps until the cases meet. Replace the remaining cap screws (20) and nuts (19).

Caution: Tighten cap screws and nuts evenly. Do not over tighten as this could possibly warp the diaphragm cases. See Table 3 for torque values.

- N. Position top and bottom stem connectors (2 and 4) and replace the two socket head cap screws (5) and recalibrate the seated position of the valve (Section 10.1).
Note: Size 6 actuator - Screw the plug stem back into the actuator stem (10) thru the bottom stem connector (2) and recalibrate the seated position of the valve. If the actuator has been removed from the valve body, reinstall it as indicated in Section 10.1.
Note: If the actuator has a handwheel, continue with the following steps:
- O. Swing the handwheel assembly back into place.
- P. It may require turning the handwheel (41) to position the lower pivot pins (33) under the stem connector (2-4), [bottom stem connector (2) on the size 6 actuator].
- Q. Install the lever pin (45) and snap rings (46).

9.4 Air to open to air to close (Model 88 to Model 87), size 3

- A. Shut off air supply to the actuator, isolate the control valve process pressure to eliminate the valve from moving with spring tension removed.
- B. If valve is equipped with a handwheel, please follow steps 7.2 B, C and D to disengage this assembly.
- C. Check the travel indicator on stem connector (2) against the travel scale (9) to insure that the plug is up (off the seat).

Note: No air pressure is required to the actuator since the spring force acts to open the valve.

- D. Loosen stem lock nuts (1).
- E. Re-tighten lock nuts (1) against each other so they will lock at a point that is not against the stem flange (2).

- F. Turn the stem lock nut (1) counterclockwise and loosen the plug stem until it disengages from the actuator stem (10).

Note: Depending on stem length, it may be required to separate the size 3 actuator off the valve body, as indicated in Section 6.1.

Note: Do not allow the valve plug to drop or turn against the seat ring, as this could damage the seat and plug.

- G. Remove four diaphragm case cap screws and nuts (27 and 28) leaving the other four installed on the case equally spaced.

Caution: Diaphragm case is under spring tension. The remaining four screws and nuts are tension bolts.

- H. Remove tension bolts (four remaining 27 and 28) in multiple steps to relieve spring tension gradually. Remove upper diaphragm case (24).
- I. Remove hex nut (23) and spacer (22), Figure 9.
- J. Remove diaphragm plate (26), diaphragm (25), and spacer (14), Figure 9.
- K. Place springs (21) [and spring spacers (18) if new range uses them] over the spring guides (29), Figure 8.
- L. Refer to Tables 1, 2 and 4 for spring information. Refer also to Section 8.3 K.

Note: Arrange springs so that the coil ends are pointed toward the actuator as shown in Figure 1. This step assures best actuator performance.

- M. Install spacer (22) on the actuator stem (10).
- N. Invert and replace the diaphragm plate (26) on the actuator stem (10) and over the springs.
- O. Install the diaphragm (25).
- P. Coat the threads of hex nut (23) and the surfaces of the spacer (14) with Chesterton 725 nickel compound or equivalent. Install spacer (14) and tighten hex nut (23) per Table 3.
- Q. Replace upper diaphragm case (24) and tension bolts (four cap screws and nuts 27 and 28), and tighten per Table 3.

Note: Tension bolts should be spaced equally around the bolt circle of the case.

- R. Tighten the tension bolts (27 and 28) per Table 3 in equal steps until the cases meet. Replace the remaining cap screws (27) and nuts (28), and tighten per Table 3.

Caution: Tighten cap screws and nuts evenly. Do not over tighten as this could possibly warp the diaphragm cases. See Table 3 for torque values.

- S. Screw the plug stem back into the actuator stem (10) thru the bottom stem flange and recalibrate the seated position of the valve.

Note: If the actuator has been removed from the valve body, reinstall it as indicated in Section 10.2.

Note: If the actuator has a handwheel, continue with the following steps:

- T. Hold the handwheel holder (40) in position between the yoke legs as shown in Figure 11 and slide the lever pin (45) through the hole in the yoke and lever. Be sure that the levers (44) are above the stem flange (2).
- U. Secure the lever pin (45) with the second retaining ring (46).

9.5 Air to close to air to open (Model 87 to Model 88), size 3 with handwheel

Caution: The handwheel assembly can hold spring tension in the actuator when the diaphragm case is removed. To prevent possible injury, remove handwheel per the following procedure.

- A. Shut off air supply to the actuator, isolate the control process pressure to eliminate the valve plug from moving with spring tension removed.
- B. Rotate the handwheel (41) to a neutral position.
- C. Remove one of the two retaining rings (46) which are mounted on lever pin (45), Figure 11.

Caution: Removing the lever pin (45) will disconnect the handwheel assembly from the actuator. Support the handwheel assembly to avoid possible injury.

- D. Remove lever pin (45) and secure the handwheel holder (40) in place (see Figures 10 and 11). The handwheel assembly will be disconnected from the actuator.
- E. Proceed with the instructions for actuators without handwheel (9.6 Step B).

9.6 Air to close to air to open (Model 87 to Model 88), size 3 without handwheel

- A. Shut off air supply to the actuator and remove air piping from the upper diaphragm case (24).
- B. Check the travel indicator on stem connector (2) against the travel scale (9) to insure that the plug is up (off the seat).
- C. Loosen stem lock nuts (1).
- D. Re-tighten lock nuts (1) against each other so they will lock at a point that is not against the stem flange (2).
- E. Turn the stem lock nut (1) counterclockwise and loosen the plug stem until it disengages from the actuator stem (10).

Note: Depending on stem length, it may be required to separate the size 3 actuator off the valve body, as indicated in Section 6.1.

Note: Do not allow the valve plug to drop or turn against the seat ring, as this could damage the seat and plug.

- F. Remove four diaphragm case cap screws and nuts (27 and 28) leaving the other four installed on the case equally spaced.

Caution: Diaphragm case is under spring tension. The remaining four screws and nuts are tension bolts.

- G. Remove tension bolts (four remaining 27 and 28) in multiple steps to relieve spring tension gradually. Remove upper diaphragm case (24).
- H. Remove hex nut (23) and spacer (14), Figure 8
- I. Remove the diaphragm (25), diaphragm plate (26), spacer (22), springs (21) and spring spacers (18) if used, Figure 8.
- J. Install spacer (14) on the actuator stem (10), Figure 9.
- K. Invert the diaphragm (25) and diaphragm plate (26), Figure 9.
- L. Coat the threads of hex nut (23) and the surfaces of the spacer (22) with Chesterton 725 nickel compound or equivalent.
- M. Check placement of spacers (14 and 22), reassemble diaphragm (25), diaphragm plate (26), and spacer (22) then tighten hex nut (23) per Table 3.
- N. Position springs (21) and spring spacers (18) [if used] in the diaphragm plate.
- O. Refer to Tables 5, 6 and 8 for spring information. Refer also to Section 8.3.
Note: Arrange springs so that the coil ends are pointed toward the actuator as shown in Figure 1. This step assures best actuator performance.
- P. Replace upper diaphragm case (24) and tension bolts (four cap screws and nuts 27 and 28).
Note: Tension bolts should be spaced equally around the bolt circle of the case.
- Q. Tighten the tension bolts (27 and 28) in equal steps until the cases meet. Replace the remaining cap screws (28) and nuts (28).

Caution: Tighten cap screws and nuts evenly. Do not over tighten as this could possibly warp the diaphragm cases. See Table 3 for torque values.

- R. Screw the plug stem back into the actuator stem (10) thru the bottom stem flange and recalibrate the seated position of the valve.
Note: If the actuator has been removed from the valve body, reinstall it as indicated in Section 10.1.
Note: If the actuator has a handwheel, continue with the following steps:
- S. Hold the handwheel holder (40) in position between the yoke legs as shown in Figure 11 and slide the lever pin (45) through the hole in the yoke and lever. Be sure that the levers (44) are below the stem flange (2).
- T. Secure the lever pin (45) with the second retaining ring (46).

10. VALVE MOUNTING

These installation and plug stem adjustment procedures are for mounting of the 87/88 Actuators on most metal seated reciprocating valves. Refer to the specific valve instructions for other trim types, such as pilot operated valves (41405) and soft seat designs.

Caution: The stem connector (2) on the size 3 is not fixed to the actuator stem and is a loose part with the stem nuts (1) backed off. For safety reasons, adjustments should only be made pneumatically.

10.1 Air to open (Model 88)

- A. Connect manual loading panel tubing to the lower diaphragm case or yoke connection (size 3).
- B. Apply required air pressure through the manual loading panel to completely retract the actuator stem (10).
- C. Install actuator on the valve body with drive nut.
- D. Position top and bottom stem connectors (2 and 4) and replace the two socket head cap screws (5). Turn the plug stem as far as possible into lower part of the stem connector (2 or 6). Refer to Figure 13 and Figure 15 for stem connector positioning.

Note: Size 3 and Size 6 actuator - Screw the plug stem into the actuator stem (10) thru the bottom stem connector or flange (2). Depending on stem length, it may be required to progressively lower the actuator towards the body while screwing the plug stem into the actuator stem. Refer to Figure 13 for size 6 stem connector positioning.

- E. Release air pressure, then ensure that the actuator stem is fully extended.
- F. Using the stem lock nuts (1), unscrew the plug stem until the plug touches the seat.

Caution: DO NOT TURN the plug against the seat as damage to the parts can occur.

- G. Pneumatically or with the handwheel, stroke the actuator to raise the plug off the seat. Unscrew the plug stem one full turn and lock the stem in place with the lock nut(s) (1) against the stem connector or flange (2 or 6).
- H. Line up the stroke scale (9) with the pointer and check actuator for proper operation.

10.2 Air to close (Model 87)

- A. Install actuator on the valve body with drive nut.
- B. Position top and bottom stem connectors (2 and 4) and replace the two socket head cap screws (5). Turn the plug stem as far as possible into lower part of the stem connector (2 or 6). Refer to Figure 14 and Figure 16 for stem connector positioning.

Note: Size 3 and Size 6 actuator - Screw the plug stem into the actuator stem (10) thru the bottom stem connector or flange (2). Depending on stem length, it may be required to progressively lower the actuator towards the body while screwing the plug stem into the actuator stem. Refer to Figure 14 for size 6 stem connector positioning.

- C. Pneumatically or with the handwheel, stroke the actuator to the rated spring range or stroke (if using the handwheel).
- D. Using the stem lock nuts (1) unscrew the plug stem until the plug touches the seat.

Caution: DO NOT TURN the plug against the seat as damage to the parts can occur.

- E. Release the pressure in the actuator or back off the handwheel to raise the stem.
- F. Unscrew the stem 1/2 turn and lock the stem in place by tightening the stem nuts (1) against the stem connector (2 or 6).

Note: Size 3 actuator - Lock the plug stem in place by tightening the stem nuts (1) against the stem flange (2).

- G. Line up the stroke scale (9) with the pointer (7) and check actuator for proper operation.

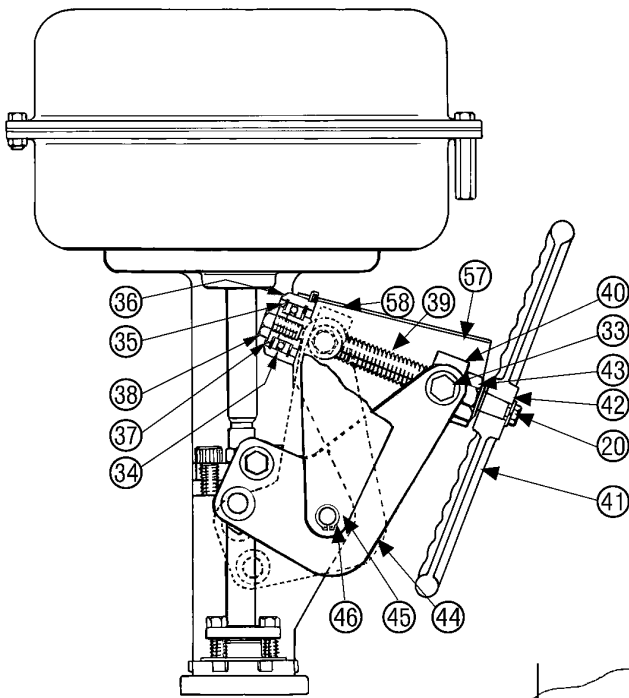


Figure 5
Size 6 and 10 Actuators
with optional Handwheel

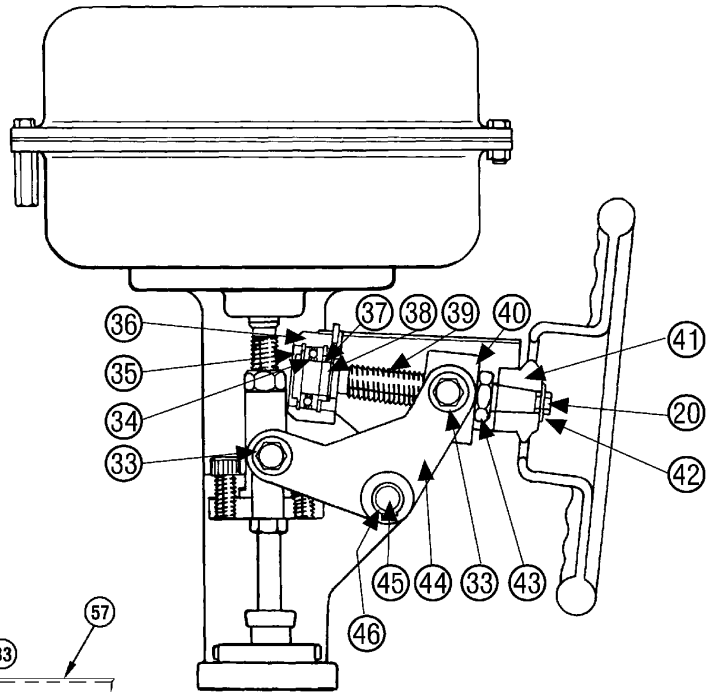


Figure 6
Size 16 and 23 Actuators
with optional Handwheel

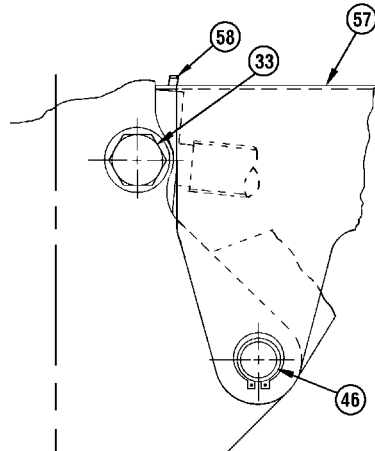


Figure 7
Handwheel Cover

Parts Reference Table

Ref. No	Description	Ref. No	Description	Ref. No	Description
1	Hex Nut	19	Hex Nut	▲37	End Flange
2	Stem Connector, bottom	20	Cap Screw, Hex head	▼38	Cap Screw, Hex head
3	Cap Screw, Hex head	21	Spring	39	Handwheel Stem
★ 4	Stem Connector, top	22	Washer	40	Traveling Nut
★ 5	Cap Screw, soc. head	23	Nut, Jam	41	Handwheel
★ 6	Connector Insert	24	Upper Diaphragm Case	42	Washer, Flat
7	Pointer	●25	Diaphragm	43	Lock Nut
8	Screw, Pan head	26	Diaphragm Plate	44	Handwheel Lever Assembly
9	Scale - Travel	27	Cap Screw, Hex head	45	Lever Pin
10	Actuator Stem	28	Compression Nut	46	Retaining Ring
●11	Stem Wiper	29	Spring Guide	56	Warning Plate
●12	O-Ring	30	Stem Bushing	57	Handwheel Cover
●13	O-Ring	31	Yoke, machining	58	Groove Pin
14	Spacer	★32	Lock Nut	59	1/4" NPT Plug
●15	Seal Washer	33	Pivot Pin	61	Serial Plate (Not Shown)
16	Cap Screw, Hex head	34	Thrust Bearing	62	Drive Screw (Not Shown)
17	Lower Diaphragm Case	35	Retaining Ring	63	Caution Tag
★18	Spring Spacer	36	Handwheel Pivot		

● Recommended Spare Parts
★ Not provided for Size 6 Actuator
■ Hex Head Cap Screw on Size 6 Actuator

● Not provided for .8 in. (21 mm) travel
Underlined: Optional Handwheel Only

▲ Bearing Ring on Sizes 6 and 10
▼ Retaining Ring on Sizes 6 and 10

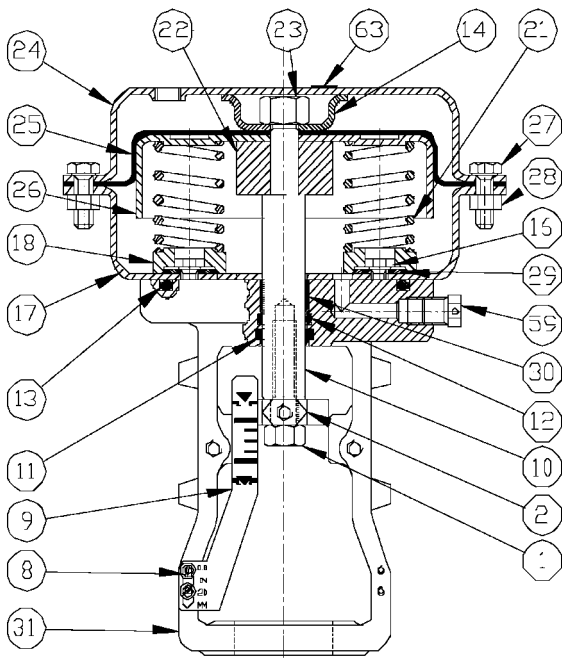


Figure 8
Size 3 Actuator Air to Close
(Model 87)

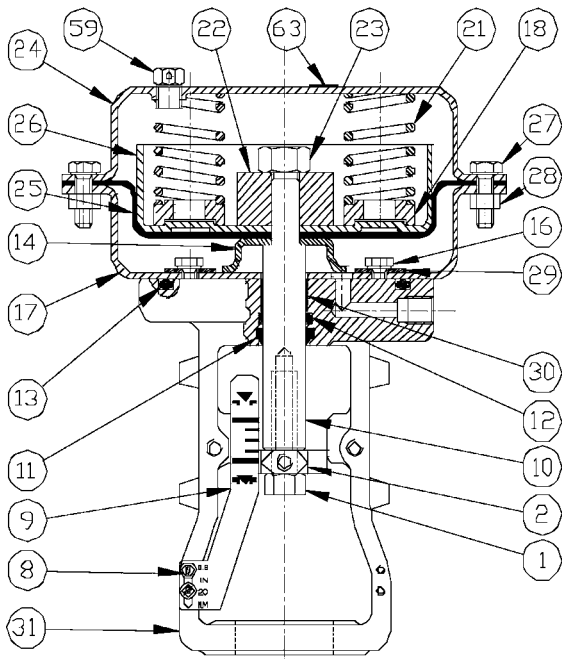


Figure 9
Size 3 Actuator Air to Open
(Model 88)

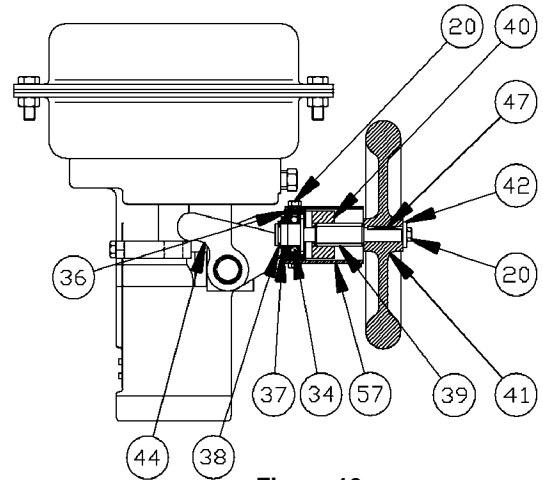


Figure 10
Size 3 Actuator Air to Close
with optional Handwheel

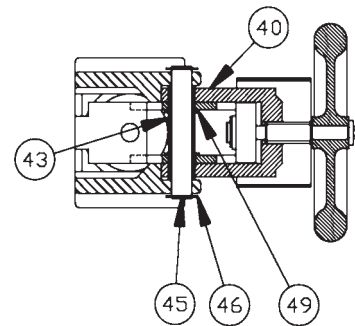


Figure 11
Size 3 Actuator Handwheel
sectional view

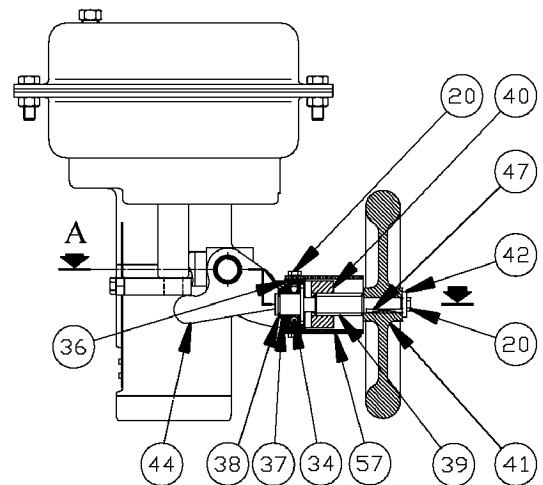


Figure 12
Size 3 Actuator Air to Open
with optional Handwheel

Parts Reference Table – Size 3

Ref. No	Description	Ref. No	Description	Ref. No	Description	Ref. No	Description
2	Stem Flange	28	Hex Nut	38	Retaining Ring	44	Handwheel Lever
20	Cap Screw, Hex head	30	D.U. Bushing	40	Handwheel Holder	47	Key
22	Spacer	37	Bushing	43	Lever Assembly	49	Retaining Ring
23	Hex Nut						

Underlined: Optional Handwheel Only

Note: All other Ref. Numbers and Descriptions are the same as listed for the other sizes.

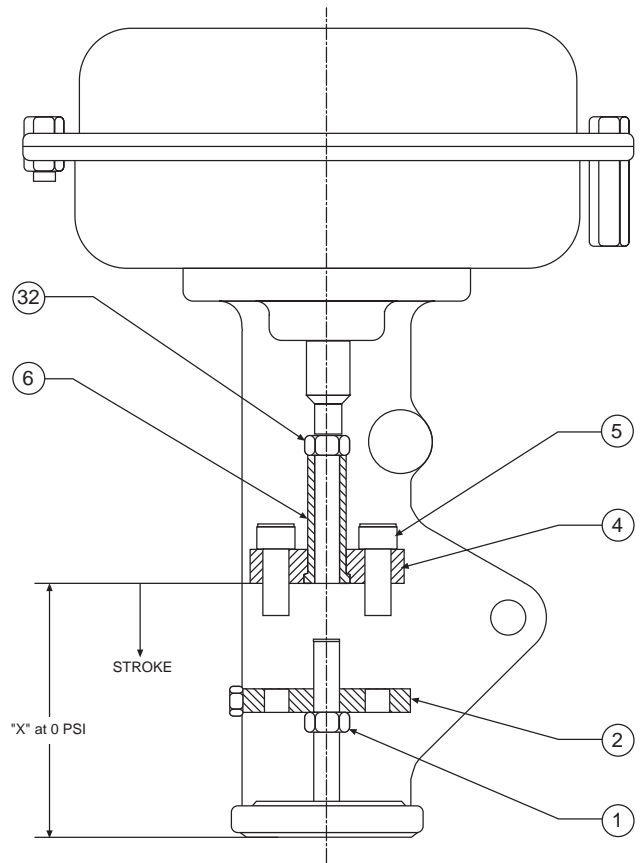
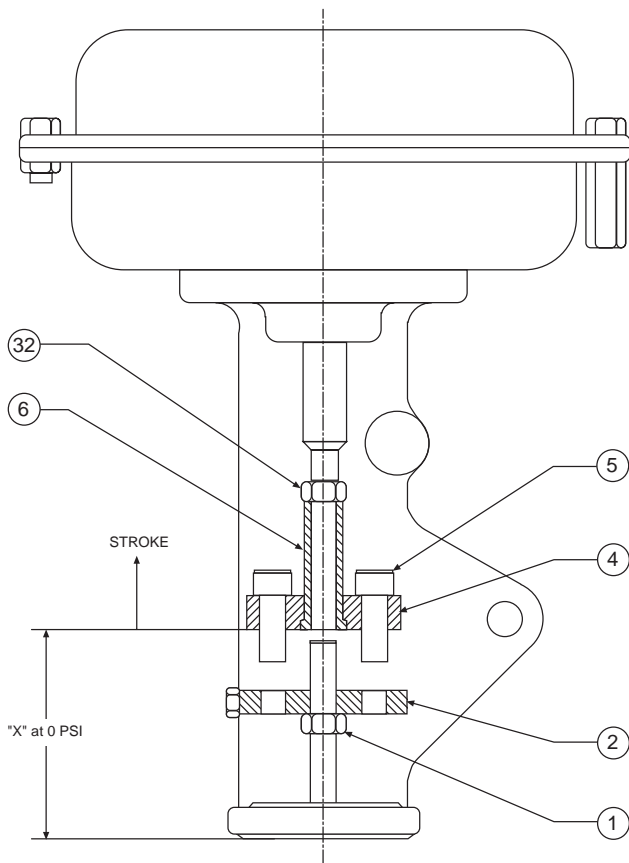
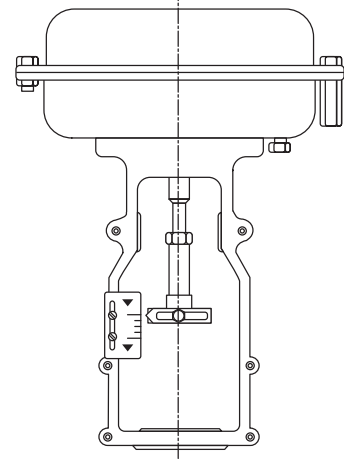
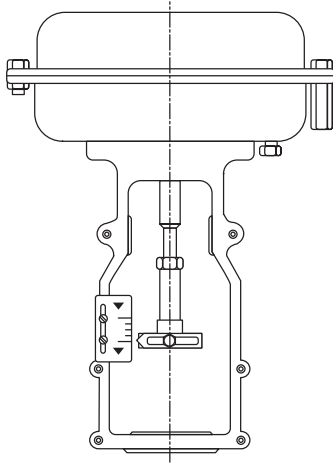


FIGURE 13
MODEL 88 ACTUATOR
AIR TO RETRACT (OPEN)

ACTUATOR SIZE	STROKE	"X"
6	0.8" (20mm)	3.76" (95.5mm)
10	0.8" - 1.5" (20 - 38mm)	4.62" (117.4mm)

FIGURE 14
MODEL 87 ACTUATOR
AIR TO EXTEND (CLOSE)

ACTUATOR SIZE	STROKE	"X"
6	0.8" (20mm)	4.82" (122.5mm)
10	0.8" (20mm)	5.12" (130.0mm)
	1.5" (38mm)	5.44" (138.2mm)

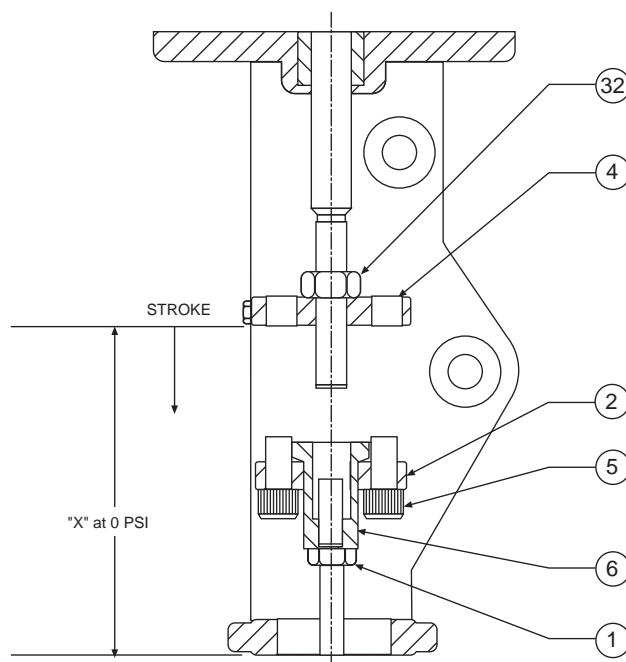
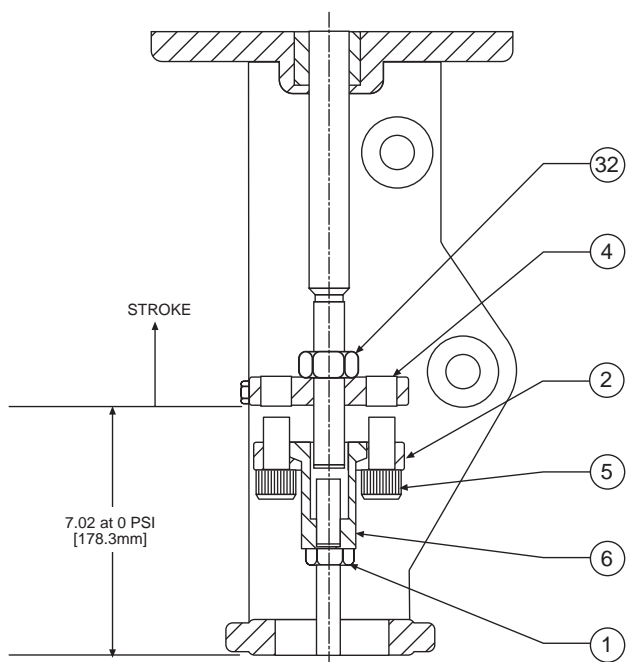
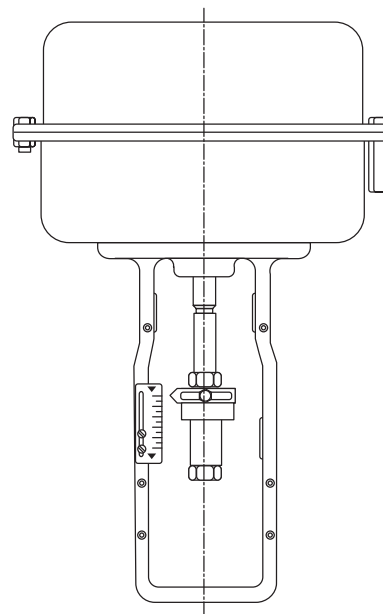
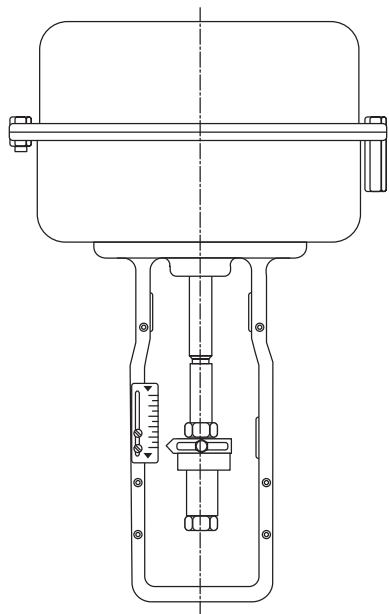


FIGURE 15
MODEL 88 ACTUATOR - REVERSE
AIR TO RETRACT (OPEN)

ACTUATOR SIZE	STROKE
16 & 23	0.8" - 2.5" (20 - 64mm)

FIGURE 16
MODEL 87 ACTUATOR - DIRECT
AIR TO EXTEND (CLOSE)

ACTUATOR SIZE	STROKE	"X"
16	0.8" (20mm)	8.00" (203.2mm)
	1.5" (38mm)	8.50" (215.9mm)
	2.0" (51mm)	9.28" (235.7mm)
	2.5" (64mm)	9.50" (241.3mm)
23	0.8" (20mm)	8.25" (209.5mm)
	1.5" (38mm)	8.62" (219.0mm)
	2.0" (51mm)	9.12" (231.7mm)
	2.5" (64mm)	9.59" (243.6mm)

DIRECT SALES OFFICE LOCATIONS

BELGIUM

Phone: +32-2-344-0970
Fax: +32-2-344-1123

BRAZIL

Phone: 55-11-2146-3600
Fax: 55-11-2146-3610

CANADA

Ontario
Phone: 905-335-3529
Fax: 905-336-7628

CHINA

Phone: +86-10-8486-4515
Fax: +86-10-8486-5305

FRANCE

Courbevoie
Phone: +33-1-4904-9000
Fax: +33-1-4904-9010

GERMANY

Viersen
Phone: +49-2162-8170-0
Fax: +49-2162-8170-280
Frankfurt
Phone: +49-69-439350
Fax: +49-69-4970802

INDIA

Mumbai
Phone: +91-22- 8354790
Fax: +91-22-8354791

New Delhi

Phone: +91-11-2-6164175
Fax: +91-11-5-1659635

ITALY

Phone: +39-081-7892-111
Fax: +39-081-7892-208

JAPAN

Chiba
Phone: +81-43-297-9222
Fax: +81-43-299-1115

KOREA

Phone: +82-2-2274-0748
Fax: +82-2-2274-0794

KUWAIT

Phone: +965-9061157
Fax: +965-3987879

MALAYSIA

Phone: +60-3-2161-0322
Fax: +60-3-2163-6312

MEXICO

Phone: 52-5-310-9863
Fax: 52-5-310-5584

THE NETHERLANDS

Phone: +31-10-438-4122
Fax: +31-10-438-4443

RUSSIA

Veliky Novgorod
Phone: +7-8162-15-7898
Fax: +7-8162-15-7921

Moscow

Phone: +7 495-585-1276
Fax: +7 495-585-1279

SAUDI ARABIA

Phone: +966-3-341-0278
Fax: +966-3-341-7624

SINGAPORE

Phone: +65-6-6861-6100
Fax: +65-6-6861-7172

SOUTH AFRICA

Phone: +27-11-452-1550
Fax: +27-11-452-6542

SOUTH & CENTRAL AMERICA AND THE CARIBBEAN

Phone: 832-590-2303
Fax: 832-590-2529

SPAIN

Phone: +34-93-652-6430
Fax: +34-93-652-6444

UNITED ARAB EMIRATES

Phone: +971-4-8838-752
Fax: +971-4-8838-038

UNITED KINGDOM

Uxbridge
Phone: +44-1895-454-900
Fax: +44-1895-454-919

UNITED STATES

Massachusetts
Phone: 508-586-4600
Fax: 508-427-8971

Corpus Christi, Texas
Phone: 361-881-8182
Fax: 361-881-8246

Dresser Direct

Deer Park, Texas
Phone: 281-884-1000
Fax: 281-884-1010

(Contractor Sales)

Houston, Texas
Phone: 832-590-2303
Fax: 832-590-2529

California

Phone: 562-941-7610
Fax: 562-941-7810

Aftermarket Value Services

Dresser - Masoneilan, a leading manufacturer of automated process control solutions, offers world-class global aftermarket services. Consistent and high quality services executed through a network of fully authorized and certified third party service centers, as well as company owned facilities include: Valve Repair, Technical Training, Field Support, Spare Parts Supply, Complete Equipment Replacement and Comprehensive Diagnostics.

About Dresser, Inc.

Dresser, Inc. is a leader in providing highly engineered infrastructure products for the global energy industry. The company has leading positions in a broad portfolio of products including valves, actuators, meters, switches, regulators, piping products, natural gas-fueled engines, retail fuel dispensers and associated retail point of sale systems and air and gas handling equipment.

Leading brand names within the Dresser portfolio include Dresser Wayne® retail fueling systems, Waukesha® natural gas-fired engines, Masoneilan® control valves, Mooney® regulators, Consolidated® pressure relief valves, and Roots® blowers and rotary gas meters. It has manufacturing and customer service facilities located strategically worldwide and a sales presence in more than 100 countries. The company's website can be accessed at www.dresser.com.

Dresser Masoneilan

85 Bodwell Street
Avon, MA 02322-1190
Tele: 508-586-4600 / Fax: 508-941-5497
Email: sales@masoneilan.com

Dresser Masoneilan

With its breadth of products, unequalled global presence and advanced process control expertise, Dresser Masoneilan is uniquely positioned to be the leading provider of flexible, best fit control valve solutions.

Supported by an integrated network of sales offices, Dresser Masoneilan provides the widest range of valve solutions and services for virtually every process control application.

