Type 667 Diaphragm Actuator
Sizes 30-76 and 87

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Figure 1. Type 667 or 667-4 Actuator Mounted on easy-e® Valve

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### Table 1. Specifications

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<tr>
<th>SPECIFICATION(1)</th>
<th>ACTUATOR SIZE</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>30</td>
</tr>
<tr>
<td>Nominal Effective Area</td>
<td></td>
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<tr>
<td>Sq cm</td>
<td>297</td>
</tr>
<tr>
<td>Sq Inch</td>
<td>46</td>
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<tr>
<td>Yoke Boss Diameter</td>
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<tr>
<td>mm</td>
<td>54</td>
</tr>
<tr>
<td>Acceptable Valve Stem Diameter</td>
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<tr>
<td>mm</td>
<td>9.5</td>
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<tr>
<td>Inch</td>
<td>0.375</td>
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<tr>
<td>Maximum Allowable Output Thrust(4)</td>
<td>N</td>
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<tr>
<td>LB</td>
<td>10,230</td>
</tr>
<tr>
<td>Square Inch</td>
<td>2300</td>
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<td>Maximum Travel(2)</td>
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<td>Standard</td>
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<tr>
<td>Top-Loaded</td>
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<tr>
<td>Inch</td>
<td></td>
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<tr>
<td>Maximum Casing Pressure for Actuator Sizing(4,6)</td>
<td>Bar</td>
</tr>
<tr>
<td>Psig</td>
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</tr>
<tr>
<td>Maximum Excess Diaphragm Pressure(4,5)</td>
<td>Bar</td>
</tr>
<tr>
<td>Psig</td>
<td>55</td>
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<tr>
<td>Maximum Diaphragm Casing Pressure(4,6,7)</td>
<td>Bar</td>
</tr>
<tr>
<td>Psig</td>
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<td>Kg</td>
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</tr>
<tr>
<td>Pounds</td>
<td>34</td>
</tr>
</tbody>
</table>

1. These values also apply to the Type 667-4 actuator construction.
2. Actuator travel may be less than the value listed after connected to the valve.
3. Maximum actuator travel for Type 667-4 is 102 mm (4 inches).
4. See also the Specification portion of the introduction section.
5. Additional pressure may be added when the actuator is at full travel. If the Maximum Excess Diaphragm Pressure is exceeded, damage to the diaphragm or diaphragm casing might result. See the Maximum Pressure Limitation section.
6. Maximum diaphragm casing pressure must not be exceeded and must not produce a force on the actuator stem greater than the maximum allowable actuator output thrust or the maximum allowable stem load. See the Maximum Pressure Limitation section.
7. This maximum casing pressure is not to be used for normal operating pressure. Its purpose is to allow for typical regulator supply settings and/or relief valve tolerances.

### Introduction

**Scope of Manual**

This instruction manual provides information on installation, adjustment, maintenance, and parts ordering for the Type 667 actuator in sizes 30 through 76 and size 87. The Type 667-4 actuator in sizes 70 and 87 is also covered. Refer to separate instruction manuals for information about the valve positioner and other accessories used with these actuators.

No person may install, operate, or maintain a Type 667 actuator (see figure 1) without first being fully trained and qualified in valve, actuator, and accessory installation, operation, and maintenance, and carefully reading and understanding the contents of this manual. If you have any questions about these instructions, contact your Fisher sales office before proceeding.

**Note**

Fisher does not assume responsibility for the selection, use, or maintenance of any product. Responsibility for proper selection, use, and maintenance of any Fisher product remains solely with the purchaser and end-user.

### Description

The Type 667 actuator (figure 1) and the Type 667-4 actuator are reverse-acting, spring-opposed diaphragm actuators. They provide automatic operation of control valves. The Type 667 actuator provides 76 mm (3 inches) maximum actuator travel. The Type 667-4 actuator provides 102 mm (4 inches) maximum actuator travel. Both actuators position the valve plug in response to varying pneumatic loading pressure on the diaphragm. Figure 2 shows the operation of these actuators.
A Type 667 or 667-4 actuator can be furnished with either a top-mounted or a side-mounted handwheel assembly. A top-mounted handwheel assembly is normally used as an adjustable down travel stop. (A down travel stop limits actuator travel in the down direction [when the stem is traveling out of the actuator]. Travel in the up direction is when the stem is traveling into the actuator.) A side-mounted handwheel assembly is normally used as an auxiliary manual actuator. The side-mounted handwheel can also be used as an adjustable up or down travel stop. Casing-Mounted adjustable up or down travel stops are also available on this actuator.

Note

If repeated or daily manual operation is expected, the actuator should be equipped with a side-mounted handwheel rather than a casing-mounted travel stop or top-mounted handwheel. The side-mounted handwheel is designed for more frequent use as a manual operator.

Specifications

Refer to table 1 for Specifications of the Type 667 and 667-4 actuators. See the actuator nameplate for specific information for your actuator.

WARNING

To avoid personal injury or damage to equipment that may result in the malfunction of the control valve or loss of control of the process caused by excessive pressure, do not exceed the Maximum Pressures listed in table 1. Refer to the Maximum Pressure Limitations section below.

Maximum Pressure Limitations

The casing and diaphragm of Type 667 actuators are pressure operated. This air pressure provides energy to compress the spring, to stroke the actuator, and to seat the valve. The following explanations describe the maximum pressure limits for an actuator. Refer to the nameplate or table 1 for maximum values for your actuator.

- **Maximum Casing Pressure for Actuator Sizing:** This is the maximum pressure that can be applied at less than full travel of the actuator. If this stroking pressure is exceeded before the upper diaphragm plate contacts the travel stop, damage to the stem or other parts might result.

- **Maximum Excess Diaphragm Pressure:** Additional pressure may be added when the actuator is at full travel. If the Maximum Excess Diaphragm Pressure is exceeded, damage to the diaphragm or diaphragm casing might result.

Because the actuator has traveled its specified travel, and the diaphragm head is physically stopped from movement, the energy from any additional air pressure is transmitted to the diaphragm and diaphragm casings. The amount of air pressure that can be added once the actuator has traveled to the stops is limited by the resultant adverse effects that may occur. Exceeding this limiting factor could result in leakage or casing fatigue due to the deformation of the upper diaphragm casing.

- **Maximum Diaphragm Casing Pressure:** If the Maximum Diaphragm Casing Pressure is exceeded,
damage to the diaphragm, diaphragm casing, or actuator might result.

## Installation

**WARNING**

Always wear protective gloves, clothing, and eyewear when performing any installation operations. Check with your process or safety engineer for any other hazards that may be present from exposure to process media. If installing into an existing application, also refer to the WARNING at the beginning of the Maintenance section in this instruction manual.

Key number locations are shown in figures 6, 7, and 8, unless otherwise noted. Also, refer to figure 3 for location of parts.

**CAUTION**

To avoid parts damage, do not use an operating pressure that exceeds the Maximum Diaphragm Casing Pressure (table 1) or produces a force on the actuator stem greater than the Maximum Allowable Output Thrust (table 1) or the Maximum Allowable Valve Stem Load.

- **Valve/Actuator Assembly:** If the actuator and valve are shipped together as a control valve assembly, it has been adjusted at the factory, and may be installed in the pipeline. After installing the valve in the pipeline, refer to the Loading Connection procedures.

- **Actuator Mounting:** If the actuator is shipped separately or the actuator has been removed from the valve, it is necessary to mount the actuator on the valve before placing the valve in the pipeline. Refer to the following actuator mounting procedures before placing the valve in service. It is recommended that you perform the Bench Set Spring Adjustment procedures in this section to confirm that the actuator is adjusted correctly for the valve travel.

- **Positioner:** If a positioner is installed, or is to be installed on the actuator, refer to the positioner instruction manual for installation. During the adjustment procedures, it will be necessary to provide a temporary loading pressure to the actuator diaphragm.

- **Handwheel Cap:** If the handwheel cap (key 247, figures 9, 11, or 16) is not in place, install the cap by pushing it on by hand until it snaps into place.
Mounting the Actuator on the Valve

**CAUTION**

The Type 667 actuator spring load pushes the stem down out of the actuator yoke (see figure 2), and it can come in contact with the valve stem during actuator mounting.

If the valve stem is allowed to remain in the up position (towards the actuator) during actuator mounting, it can interfere with the actuator stem during mounting. It is possible to damage valve stem threads or bend the valve stem. Be sure the valve stem is pushed down (into the valve body), away from the actuator while mounting.

It may be necessary to apply a temporary loading pressure to the actuator to move the actuator stem away from the valve during installation.

If it is not possible to provide a temporary loading pressure, be very careful when lowering the actuator over the valve stem to prevent damage to valve stem and threads.

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**WARNING**

When moving the actuator stem with loading pressure applied, exercise caution to keep hands and tools out of the actuator stem travel path. If the loading pressure is accidently disconnected, personal injury and property damage may result if something is caught between the actuator stem and other control valve parts.

1. Provide a vise or some other method of supporting the valve and the weight of the actuator during assembly. For direct or reverse acting valves, push the valve stem down away from the actuator while mounting the actuator.

2. Screw the stem locknuts all the way onto the valve stem. With the concave side of the travel indicator disk (key 34) facing the valve, install the travel indicator disk on the valve stem. (Note: The travel indicator disk is not used with size 87 actuators.)

3. Lift or hoist the actuator onto the valve bonnet:

   a. **For size 87 actuators:** Slowly lower the actuator down onto the valve while guiding the valve stem into the opening in the end of the actuator stem (see figure 4). Once the actuator is
in place, insert the cap screws and tighten the hex nuts, securing the actuator to the bonnet.

b. **For all other size actuators:**

- Slowly lower the actuator down onto the valve. As the yoke passes over the end of the valve stem, place the yoke locknut over the valve stem. (Note: On small size actuators, it may be necessary to remove the indicator disk and re-install it while lowering the actuator onto the valve because the disk will not go through the actuator yoke opening).

- Continue to lower the actuator while guiding the valve stem into the opening in the end of the actuator stem until the actuator is in place (see figure 4).

- Screw the yoke locknut onto the valve bonnet and tighten the locknut.

4. Do not connect the actuator stem to the valve stem at this time. Whenever the actuator is installed on the valve, it is recommended that you perform the Bench Set Spring Adjustment procedures below, to verify that the actuator is still adjusted correctly.

**Discussion of Bench Set**

The bench set pressure range is used to adjust the initial compression of the actuator spring with the valve-actuator assembly “on the bench.” The correct initial compression ensures that the valve-actuator assembly will function properly when it is put into service and the proper actuator diaphragm operating pressure is applied.

The bench set range is established with the assumption that there is no packing friction. When attempting to adjust the spring in the field, it is very difficult to ensure that there is no friction being applied by “loose” packing.

Accurate adjustment to the bench set range can be made during the actuator mounting process by making the adjustment before the actuator is connected to the valve (see the Bench Set Spring Adjustment Procedure).

If you are attempting to adjust the bench set range after the actuator is connected to the valve and the packing tightened, you must take friction into account. Make the spring adjustment so full actuator travel occurs at the bench set range (a) plus the friction force divided by the effective diaphragm area with increasing diaphragm pressure or (b) minus the friction force divided by the effective diaphragm area with decreasing diaphragm pressure.

For an assembled valve-actuator assembly, the valve friction may be determined by following the procedure described below:

1. Install a pressure gauge in the actuator loading pressure line that connects to the actuator diaphragm casing.

   **Note**

   Steps 2 and 4 require that you read and record the pressure shown on the pressure gauge.

2. Increase the actuator diaphragm pressure and read the diaphragm pressure as the actuator reaches its mid-travel position.

3. Increase the actuator diaphragm pressure until the actuator is at a travel position greater than its mid-travel position.

4. Decrease the actuator diaphragm pressure and read the diaphragm pressure as the actuator reaches its mid-travel position.

   The difference between the two diaphragm pressure readings is the change in the diaphragm pressure required to overcome the friction forces in the two directions of travel.

5. Calculate the actual friction force:

   \[
   \text{Friction Force,} = 0.5 \left( \frac{\text{Difference in pressure readings, psig}}{\text{Effective diaphragm area, inches}^2} \right)
   \]

   Refer to table 1 for the effective diaphragm area.

When determining valve friction, you can make diaphragm pressure readings at a travel position other than mid-travel if you desire. If you take readings at zero or at the full travel position, take extra care to ensure that the readings are taken when the travel just begins or just stops at the position selected.

It is difficult to rotate the spring adjustor (key 74, figure 6, 7, and 8) when the full actuator loading pressure is applied to the actuator. Release the actuator loading pressure before adjusting. Then re-apply loading pressure to check the adjustment.

**Bench Set Spring Adjustment**

The term “bench set” means that the actuator is not connected to the valve, or any other loads. Ensure that the actuator diaphragm is at the bottom of its travel as shown in figure 4. (Note: Some spring compression is required to move the diaphragm to the bottom of its travel.)
Also, provide a certified pressure gauge that will accurately read the diaphragm pressure from 0 through the upper bench set pressure marked on the nameplate. Apply loading pressure to the diaphragm.

Stroke the actuator a few times to ensure that the pressure gauge is working correctly, and that the actuator is functioning properly. It is important to be sure that the actuator assembly is not binding or producing any friction on the actuator stem movement.

Key numbers are shown in figures 6, 7, and 8.

For Direct-Acting Valves (PDTC)

1. If not already accomplished, push the valve stem down away from the actuator to the closed position.

2. Set the diaphragm loading pressure to 0.3 bar (5 psig) over the upper bench set pressure. The upper travel stop should be contacting the diaphragm casing.

3. Slowly decrease the pressure towards the upper bench set pressure while checking for the first movement of the actuator stem.

Note

Before turning the spring adjuster on size 70, 76, or 87 actuators, assemble the stem connector around the actuator stem and the anti-rotating lug on the yoke. Mark the actuator stem as a visual reference to verify that stem rotation does not occur. Remove the stem connector before rechecking the bench set.

4. If movement occurs before or after the upper pressure is reached, adjust the spring adjuster (see figure 4). Thread the adjuster up or down on the stem until the actuator stem movement is first detected at the upper bench set pressure. (Note: You may need to lower the loading pressure to reduce spring compression, allowing the spring adjuster to turn.)

5. Be sure the spring adjuster is adjusted to meet the requirements of step 4 above.

6. Apply the lower bench set loading pressure to the diaphragm. This will extend the actuator stem toward the valve. Mark the end of the actuator stem on a nearby surface using tape or some other method.

7. Slowly increase the diaphragm pressure until the upper bench set loading pressure is applied. Again, the travel stop should be against the diaphragm casing.

8. Measure the distance between the mark or tape to the end of the actuator stem. This distance should match the travel span shown on the travel indicator scale (key 32).

9. If the span of travel is correct, bench set is complete. Proceed to the Installing the Stem Connector Assembly subsection.

10. If the travel span is not exact, remember the free-length and load rate tolerances for the spring may produce a slightly different span than specified. Contact your Fisher sales office for assistance.

For Reverse-Acting Valves (PDTO)

1. If not already accomplished, push the valve stem down away from the actuator to the open position. Later, when installing the connector, pull up the valve stem to the closed position.

2. Set the diaphragm loading pressure to a value less than the lower bench set pressure (near zero). The down travel stop should be contacting the yoke.

3. Slowly increase the pressure towards the lower bench set pressure while checking for the first movement of the actuator stem.

Note

Before turning the spring adjuster on size 70, 76, or 87 actuators, assemble the stem connector around the actuator stem and the anti-rotating lug on the yoke. Mark the actuator stem as a visual reference to verify that stem rotation does not occur. Remove the stem connector before rechecking the bench set.

4. If movement occurs before or after the lower pressure is reached, adjust the spring adjuster (see figure 4). Thread the adjuster up or down on the actuator stem until the actuator stem movement is first detected at the lower bench set pressure.

5. Apply the upper bench set loading pressure to the diaphragm. This will retract the actuator stem away from the valve. Mark the end of the actuator stem on a nearby surface using tape or some other method.

6. Slowly decrease the diaphragm pressure until the lower bench set loading pressure is applied. Again, the down-stops should be against the yoke.

7. Measure the distance between the mark or tape to the end of the actuator stem. This distance should...
match the travel span shown on the travel indicator scale (key 32).

8. If the span of travel is correct, bench set is complete. Proceed to the Installing the Stem Connector Assembly subsection.

9. If the travel span is not exact, remember the free-length and load rate tolerances for the spring may produce a slightly different span than specified. Contact your Fisher sales office for assistance.

Installing the Stem Connector Assembly

When installing the stem connector assembly (key 31), the actuator and valve stem threads should engage the threads of the stem connector by a distance equal to the diameter of the stem.

**Note**

Replacement stem connectors are an assembly of two stem connector halves, cap screws, and a spacer between the connector halves. Remove the spacer and discard it, if present, before clamping the actuator and valve stems together.

1. If necessary, push the valve stem down so that the valve plug is touching the seat ring on direct-acting valves. For reverse-acting valves, pull the stem up to the closed position. Always start with the valve plug on the seat.

2. If necessary, screw the valve stem locknuts down, away from the connector location. For all actuators except size 87, ensure that the travel indicator disk (key 34) is on top of the locknuts.

3. Adjust the diaphragm pressure to the lower bench set pressure. (Or, the upper bench set pressure for reverse-acting valves.) This should be the same pressure used in the bench set steps, and it is marked on the nameplate.

4. Place the stem connector half with the threaded holes, approximately half way between the actuator and valve stems. Refer to figures 6, 7, and 8 to help locate the connector position.

5. Install the other half of the stem connector and insert the cap screws and tighten them. If installing a positioner, also attach the feedback bracket at the same time.

6. Screw the valve stem locknuts up until the indicator disk contacts the bottom of the stem connector, or for size 87 actuators, tighten the locknuts against the stem connector. Do not overtighten the locknuts.

7. Slowly increase and then decrease pressure several times, stroking the valve from the lower bench set pressure to the upper pressure.

Be sure that the valve is in the closed position (up or down, depending on valve action). Loosen the screws on the travel scale, and align it with the travel indicator disk. Stroke the valve full travel to ensure that the travel matches the valve travel on the travel indicator plate. If valve travel is not correct, repeat the stem connector procedure.

**Note**

For push-down-to-close valves, the valve plug seat is the limit for downward travel and the actuator up-stop is the limit for upward (away from the valve) movement. For push-down-to-open valves, the actuator down-stop is the limit for downward movement, and the valve seat is the limit for upward (away from the valve) movement. For Type 667 actuators, a down-stop (key 77, figure 6) is installed to limit actuator diaphragm downward movement when the actuator provides the limit.
Deadband Measurement

Deadband is caused by packing friction, unbalanced forces, and other factors in the control valve assembly. Deadband is the range a measured signal can vary without initiating a response from the actuator (see figure 5). Each actuator spring has a fixed spring rate (force). You have verified that the right spring was installed in the actuator by completing the Bench Set Spring Adjustment steps.

Deadband is one factor that affects the control valve assembly operation during automatic loop control. The control loop tolerance for deadband varies widely depending on the loop response. Some common symptoms of the deadband being too wide are no movement, a “jump” movement, or oscillating movements of the actuator during automatic loop control. The following steps are provided to determine the span of deadband. The percent of deadband is helpful in troubleshooting problems with the process control loop.

1. Start at a pressure near the lower bench set pressure, slowly increase pressure until the valve is approximately at mid-travel. Note this pressure reading.

2. Slowly decrease pressure until movement of the valve stem is detected, and note this pressure.

3. The difference between these two pressures is deadband, in psi.

4. Calculate the percent of deadband by:
   
   \[
   \text{Deadband, psi} = \frac{\text{Deadband, psi}}{\text{Bench Set Span, psi}} = \text{nn \%}
   \]

Loading Connection

Key number locations are shown in figures 6, 7, and 8, unless otherwise noted.

The loading pressure connections are made at the factory if the valve, actuator, and positioner come as a unit. Keep the length of tubing or piping as short as possible to avoid transmission lag in the control signal. If a volume booster, valve positioner or other accessory is used, be sure that it is properly connected to the actuator. Refer to the positioner instruction manual or other manuals as necessary. For actuators shipped separately or whenever the actuator pressure connections are installed, use the following steps:

1. Connect the loading pressure piping to the NPT female connection in the side of the yoke (key 73).

2. For size 70 and 87 actuators, if necessary, remove the 0.25 inch NPT bushing if a 0.5 inch NPT female connection is needed to increase connection size. The connection can be made with either piping or tubing.

3. Cycle the actuator several times to be sure that the valve stem travel is correct when the correct pressure ranges are applied to the diaphragm.

4. If valve stem travel appears to be incorrect, refer to the Bench Set Spring Adjustment procedures at the beginning of this section. Do not place the valve in service if it is not reacting correctly to diaphragm loading pressure changes.

Maintenance

Actuator parts are subject to normal wear and must be inspected regularly and replaced when necessary. The frequency of inspection and replacement depends on the severity of service conditions.

Avoid personal injury or property damage from sudden release of process pressure or uncontrolled movement of parts. Before performing any maintenance operations:
Always wear protective gloves, clothing, and eyewear when performing any maintenance operations to avoid personal injury.

Disconnect any operating lines providing air pressure, electric power, or a control signal to the actuator. Be sure the actuator cannot suddenly open or close the valve.

Use bypass valves or completely shut off the process to isolate the valve from process pressure. Relieve process pressure from both sides of the valve. Drain the process media from both sides of the valve.

Vent the power actuator loading pressure and relieve any actuator spring pre-compression.

Use lock-out procedures to be sure that the above measures stay in effect while you work on the equipment.

The valve packing box may contain process fluids that are pressurized, even when the valve has been removed from the pipeline. Process fluids may spray out under pressure when removing the packing hardware or packing rings, or when loosening the packing box pipe plug.

Check with your process or safety engineer for any additional measures that must be taken to protect against process media.

Actuator Disassembly

Isolate the control valve from the line pressure, release pressure from both sides of the valve body, and drain the process media from both sides of the valve. Also shut off all pressure lines to the power actuator, release all pressure from the actuator. Use lock-out procedures to be sure that the above measures stay in effect while you work on the equipment.

1. Remove the tubing or piping from the connection in the top of the yoke (key 73). For a top-loaded construction, also remove the piping or tubing from the connection in the upper diaphragm casing (key 1).

2. Turn the spring adjuster (key 74) counterclockwise (toward the valve body) until all spring compression is relieved.

3. If necessary, remove the actuator from the valve body by separating the stem connector (key 31). Loosen the stem locknuts for the size 87 actuator, and remove the stem connector nuts. For all other sizes, separate the stem connector by loosening the stem locknuts (keys 69 and 75) and unscrewing the two stem connector cap screws.

4. Unscrew the spring adjuster (key 74) from the actuator stem (key 144). Also lift the spring seat and spring (key 19 and 18) out of the yoke.

5. Remove the diaphragm casing cap screws and nuts (keys 13 and 14), and lift off the upper diaphragm casing (key 1).

6. Remove the following connected parts: the diaphragm (key 3), upper diaphragm plate (key 4), spacer (key 2), cap screw (key 12), lower diaphragm plate (key 71), and actuator stem (key 144). Be careful when pulling the threads of the actuator stem through the seal bushing (key 7) to avoid damaging the O-rings (key 8).
7. Remove the cap screw (key 12) to separate the parts of this assembly.

8. To remove the seal bushing, remove the snap ring (key 72), and lift out the bushing. Inspect, and if necessary, replace O-rings (8 and 9).

9. Remove cap screws (key 30), and take off the lower diaphragm casing (key 64) and the gasket (key 70, size 30 through 60 and 76) or O-ring (key 70, size 70 or 87). If necessary, the down travel stops (key 77) can be removed.

**Actuator Assembly**

1. Coat the O-rings (key 70, sizes 70 and 87) with lubricant (key 237 or equivalent). Or, coat the gasket with sealant (key 237 or equivalent). Place a new gasket or O-ring (key 70) on the yoke (key 73). Position the lower diaphragm casing (key 64) on the yoke, align the holes, and insert and tighten the cap screws (key 30). If down travel stops (key 77) were removed, insert and tighten them.

2. Coat the O-rings (keys 8 and 9) with lubricant (key 237 or equivalent) and place the O-rings in the seal bushing (key 7).

3. Fill the seal bushing with lubricant (key 237 or equivalent), slide the bushing into the yoke (key 73), and install the snap ring (key 72).

4. Assemble the actuator stem (key 144), lower diaphragm plate (key 71), diaphragm (key 3), upper diaphragm plate (key 4), and the travel stop cap screw and spacer (keys 12 and 2). Coat the cap screw threads with Lubriplate Mag-1 or equivalent (key 237). Tighten the cap screw (key 12) to 41 N\(\cdot\)m (30 lbf\(\cdot\)ft) torque for size 30 actuators, 68 N\(\cdot\)m (50 lbf\(\cdot\)ft) torque for size 34 and 40 actuators, or 183 N\(\cdot\)m (135 lbf\(\cdot\)ft) torque for size 45 to 76 and 87 actuators. Place this assembly in the actuator. Take care when pushing the actuator stem through the seal bushing so that the threads do not damage the O-rings.

**Note**

When you replace actuator diaphragms in the field, take care to ensure the diaphragm casing bolts are tightened to the proper load to prevent leakage, but not crush the material. Perform the following tightening sequence with a manual torque wrench for size 30-76 and 87 actuators.

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**CAUTION**

Over-tightening the diaphragm cap screws and nuts (keys 13 and 14) can damage the diaphragm. Do not exceed 27 N\(\cdot\)m (20 lbf\(\cdot\)ft) torque.

**Note**

Do not use lubricant on these bolts and nuts. Fasteners must be clean and dry.

5. Install the upper diaphragm casing (key 1), and install the cap screws and nuts (keys 13 and 14). Tighten the diaphragm cap screws and nuts in the following manner.

6. The first four bolts tightened should be diametrically opposed and 90 degrees apart. Tighten these four bolts to 13 N\(\cdot\)m (10 lbf\(\cdot\)ft).

7. Tighten the remaining bolts in a clockwise, criss-cross pattern to 13 N\(\cdot\)m (10 lbf\(\cdot\)ft).

8. Repeat this procedure by tightening four bolts, diametrically opposed and 90 degrees apart, to a torque of 27 N\(\cdot\)m (20 lbf\(\cdot\)ft).

9. Tighten the remaining bolts in a clockwise, criss-cross pattern to 27 N\(\cdot\)m (20 lbf\(\cdot\)ft).

10. After the last bolt is tightened to 27 N\(\cdot\)m (20 lbf\(\cdot\)ft), all of the bolts should be tightened again to 27 N\(\cdot\)m (20 lbf\(\cdot\)ft) in a circular pattern around the bolt circle.

11. Once completed, no more tightening is recommended.

12. Install the actuator spring (key 18) and spring seat (key 19). Apply lubricant (key 239 or equivalent) to the threads of the actuator stem and to the surface of the spring adjuster (key 74) that contacts the spring seat. Thread the spring adjuster onto the actuator stem.

13. Mount the actuator onto the valve in accordance with the procedures in the Installation section.

**Top-Mounted Handwheel Assembly**

(Adjustable Down Travel Stop)

Actuator key numbers are shown in figures 6, 7, and 8. And, top-mounted handwheels are shown in figures 9, 11, and 12.
Note

If repeated or daily manual operation is expected, the actuator should be equipped with a side-mounted handwheel rather than a casing-mounted travel stop or top-mounted handwheel. The side-mounted handwheel is designed for more frequent use as a manual operator.

A top-mounted handwheel assembly (figures 9, 11, and 12) is usually used as an adjustable down travel stop to limit full extension of the actuator stem. Turning the handwheel counterclockwise pulls the extension rod (key 150, figures 9, 11, and 12) up, retracting the actuator stem.

Instructions are given below for complete disassembly and assembly. Perform the disassembly only as far as necessary to accomplish the required maintenance; then, begin the assembly at the appropriate step.

Disassembly for Top-Mounted Handwheel

1. Bypass the control valve, reduce loading pressure to atmospheric, and remove the tubing or piping from the connection in the top of the yoke (key 73, figures 6, 7, and 8).
2. Turn the handwheel (key 58) clockwise so that the handwheel assembly is not causing any spring compression.
3. Turn the actuator spring adjuster (key 74) to relieve all the compression from the spring (key 18).
4. If servicing just the thrust bearing, races, and handwheel screw (keys 180, 181, and 160), use the following steps:
   - Remove the cap and take out the cotter pin. Remove the castle nut, bearing retainer, thrust bearing, and races (keys 247, 167, 166, 180, and 181).
   - Use the handwheel to remove the handwheel screw (key 160) from the handwheel body (key 148).
   - If necessary, remove the extension rod (key 150) at this time. Most maintenance procedures do not require the rod to be removed.
   - Clean and inspect all parts or replace parts as necessary. Upon re-assembly, lubricate handwheel threads, bearings, and races with Never-Seez Nickel Special (key 239) or equivalent.
5. For size 30 through 60 and 76 actuator handwheels (figures 9 and 11):
   - Remove the cap screws (key 161). Make sure that the guide plate can turn between the handwheel body and the mounting plate (keys 157, 148 and 158).
   - Remove the cap (key 247) and cotter pin (key 167). Remove the castle nut (key 166) and, if necessary, unscrew the extension rod (key 150). Remove the rod, the handwheel body (key 148), and the attached parts.
   - Remove the hex nuts and cap screws (keys 14 and 13, figures 6, 7, and 8) from the diaphragm casings. Lift off the upper diaphragm casing (key 1) and the mounting plate (key 158).
   - Turn the handwheel (key 58) to remove the handwheel screw (key 160) from the handwheel body (key 148). Remove the retaining ring (key 60) if the handwheel (key 58) must be separated from the handwheel screw.
   - If necessary, perform other actuator maintenance before returning to the following assembly steps.
6. For size 70 and 87 actuator handwheels (figure 12):
   - Remove the cap (key 247). Take out the cotter pin (key 167) and remove the castle nut, the bearing retainer, and thrust bearing (keys 166, 182, 181, and 180). It is not necessary to remove the extension rod (key 150) at this time.
   - Remove the hex nuts and cap screws (keys 14 and 13, figures 6, 7, and 8) from the diaphragm casings. Lift off the upper diaphragm casing (key 1), handwheel body (key 148) and attached parts.
   - If travel stops (key 152) are used, note and record their position relative to the cap screws (key 154) for use in assembly. Remove the travel stops and cap screws, and remove either the mounting plate (key 158, figure 12) or the handwheel body (key 148, figure 12) and attached parts.
   - Turn the handwheel (key 58) to remove the handwheel screw (key 160) from the handwheel body.
body (key 148). Remove the retaining ring (key 60) if the handwheel (key 58) must be separated from the handwheel screw.

- If necessary, perform other actuator maintenance before returning to the following assembly steps.

Assembly for Top-Mounted Handwheel

For size 30 through 60 and 76 actuator handwheels:

Refer to figures 9 and 11 for top-mounted handwheel assemblies.

1. If it was removed, slide the handwheel (key 58) onto the end of the handwheel screw (key 160), and snap the retaining ring (key 60) into place. Also, install the guide post (key 150) if it was removed.

2. Generously coat the threads of the handwheel screw (key 160) with lubricant (key 239 or equivalent). Turn the screw into the handwheel body (key 148).

3. Install the mounting plate (key 158) to the diaphragm casing (key 1, figures 6, 7, and 8) with the cap screws (key 154). Finger tighten the screws.

4. If travel stops were used, install the travel stops to their original positions as recorded in the proceeding Disassembly steps. Tighten the screws and travel stops.

5. Position the diaphragm casing (key 1, figures 6, 7, and 8), mounting plate (key 158), travel stops (key 152), if used, and cap screws (key 154) on the diaphragm. Install the cap screws and hex nuts (keys 13 and 14, figures 6, 7, and 8) and tighten in the following manner.

6. The first four bolts tightened should be diametrically opposed and 90 degrees apart. Tighten these four bolts to 13 N·m (10 lbf·ft).

7. Tighten the remaining bolts in a clockwise, criss-cross pattern to 13 N·m (10 lbf·ft).

8. Repeat this procedure by tightening four bolts, diametrically opposed and 90 degrees apart, to a torque of 27 N·m (20 lbf·ft).

9. Tighten the remaining bolts in a clockwise, criss-cross pattern to 27 N·m (20 lbf·ft).

10. After the last bolt is tightened to 27 N·m (20 lbf·ft), all of the bolts should be tightened again to 27 N·m (20 lbf·ft) in a circular pattern around the bolt circle.

11. Once completed, no more tightening is recommended.

12. If necessary, screw the extension rod (key 150 into the connector (key 27). Slide the guide plate (key 157) onto the extension rod (key 150). For size 45 through 76, place the spacer (key 253) on top of the guide plate (key 157). If necessary, replace the extension rod (key 150). Slide the handwheel body (key 148) over the extension rod, position the handwheel body on the spacer (key 253), align the holes, and insert and tighten the cap screws (key 161).

13. Lubricate and install the thrust bearings (keys 181 and 180), install the bearing retainer (key 182), install the castle nut (key 166) on the extension rod. Do not overtighten the castle nut on the bearing.

When you replace actuator diaphragms in the field, take care to ensure the diaphragm casing bolts are tightened to the proper load to prevent leakage, but not crush the material. Perform the following tightening sequence with a manual torque wrench for size 30-76 and 87 actuators.

Note

Over-tightening the diaphragm cap screws and nuts (keys 13 and 14) can damage the diaphragm. Do not exceed 27 N·m (20 lbf·ft) torque.

Note

Do not use lubricant on these bolts and nuts. Fasteners must be clean and dry.
Install the cotter pin (key 167). Replace the cap (key 247).

14. Refer to the Assembly portion of the Actuator maintenance section.

For size 70 and 87 actuators handwheels (figure 12):
Refer to figure 12 for top-mounted handwheel assemblies.

1. If removed, slide the handwheel (key 58) onto the end of the handwheel screw (key 160), and snap the retaining ring (key 60) into place.

2. Generously coat the threads of the handwheel screw (key 160) with lubricant (key 239 or equivalent). Turn the screw into the handwheel body (key 148).

3. If necessary, install the extension rod (key 150) into the connector (key 27) and tighten it. Position the handwheel body (key 148) on the diaphragm casing (key 1, figures 6, 7, and 8), and align the holes. Insert the cap screws (key 154). Finger tighten the screws.

4. If travel stops were used, return the travel stops to their original positions as recorded in the proceeding Disassembly steps. Tighten the screws and travel stops.

5. Slide the extension rod (key 150) into the handwheel screw (key 160), and position the diaphragm casing (key 1, figures 6, 7, and 8) with the attached parts on the diaphragm. Install the cap screws and hex nuts (keys 13 and 14, figures 6, 7, and 8) and tighten in the following manner.

6. The first four bolts tightened should be diametrically opposed and 90 degrees apart. Tighten these four bolts to 13 N\(\times\)m (10 lbf\(\times\)ft).

7. Tighten the remaining bolts in a clockwise, criss-cross pattern to 13 N\(\times\)m (10 lbf\(\times\)ft).

8. Repeat this procedure by tightening four bolts, diametrically opposed and 90 degrees apart, to a torque of 27 N\(\times\)m (20 lbf\(\times\)ft).

9. Tighten the remaining bolts in a clockwise, criss-cross pattern to 27 N\(\times\)m (20 lbf\(\times\)ft).

10. After the last bolt is tightened to 27 N\(\times\)m (20 lbf\(\times\)ft), all of the bolts should be tightened again to 27 N\(\times\)m (20 lbf\(\times\)ft) in a circular pattern around the bolt circle.

11. Once completed, no more tightening is recommended.

12. Lubricate and install the thrust bearings (keys 180 and 181), install the bearing retainer (key 182), install the castle nut (keys 166) on the extension rod. Do not overtighten the castle nut on the bearing. Install the cotter pin (key 167). Replace the cap (key 247).

13. Refer to the Assembly portion of the Actuator maintenance section.

Side-Mounted Handwheel Assembly for Size 34 through 60 Actuators
A side-mounted handwheel assembly (figures 13 and 14) is usually used as a manual actuator. This design is frequently used to drive the valve open or closed under loading conditions. Turning the handwheel clockwise past the neutral position always closes a push-down-to-close valve. A pair of levers (key 146, figure 13) on a handwheel assembly close the valve by moving the valve stem.

Instructions are given below for disassembly and assembly. Perform the disassembly only as far as necessary to accomplish the required maintenance; then begin the assembly at the appropriate step.

Disassembly for Side-Mounted Handwheel (34-60)
1. If desired, the handwheel assembly can be removed from the actuator yoke. To do this, remove...
the nuts (keys 147 and 170) from the U-bolts (keys 166 and 143) that hold the assembly to the yoke.
2. Remove the retaining ring (key 154), and drive out the lever pivot pin (key 153).
3. Two screws (key 156) hold the right- and left-hand levers (key 146) together. Remove the screw from the top of the levers so that the levers will drop down out of the assembly. Disassemble further, if necessary, by removing the other screw.
4. Remove the screw (key 161) and pointer mounting bolt (key 159, not shown) located behind the pointer (key 160).
5. Remove the nut (key 54), lockwasher (key 150), and washer (key 149), and take off the handwheel (key 51). Be careful not to lose the small ball (key 55) and spring (key 56).
6. Unscrew the bearing retainer (key 136) after loosening the locking set screw (key 168, not shown).
7. Pull the screw assembly (key 145) out of the handwheel body. The operating nut (key 132) will come out with the screw. Also, remove the bushing (key 151) on sizes 34 and 40.
8. If required, remove the bearings (key 152), one from the bearing retainer and the other from the handwheel body.

Assembly for Side-Mounted Handwheel (Sizes 34-60)
1. Pack the bearings (key 152) with lubricant (key 239 or equivalent). Insert one bearing and the bushing (key 151) in the handwheel body (key 142) as shown in figure 13 or 14. The bushing is not used in a handwheel assembly for size 45 through 60 actuators.
2. Coat the screw threads with lubricant (key 239) or equivalent, and thread the operating nut onto the screw. Slide the second bearing (key 152) onto the screw, and insert the end of the screw into either the bushing (key 151) as shown in figure 13 or 14 or into the bearing.
3. Thread the bearing retainer (key 136) into the body (key 142). Completely tighten the bearing retainer, and then loosen it one-quarter turn. Tighten the set screw (key 168, not shown) to hold the bearing retainer in place.
4. Coat the groove in the handwheel body (key 142) with lubricant (key 237 or equivalent). Insert the spring (key 56) and ball (key 55) into the handwheel (key 51). Holding the ball and spring in the handwheel, put the handwheel (key 51), the washer (key 149), the lockwasher (key 150), and the hex nut (key 54) on the end of the screw (key 145). Tighten the hex nut.
5. Position the pointer mounting bolt (key 159, not shown) and the pointer (key 160) as shown in figure 13 or 14. Insert and tighten the screw (key 161).
6. Assemble the two levers (key 146) with the cap screws (key 156) for handwheel assemblies for size 45, 50, and 60 actuators or with the machine bolts (key 156) for handwheel assemblies on size 34 and 40 actuators.
7. If the handwheel assembly was removed from the yoke, remount the handwheel assembly to the yoke using the dowel pins for alignment. Position the U-bolts (keys 166 and 143) on the yoke, and hand-tighten the hex nuts (keys 170 and 147) to hold the handwheel assembly in position. Cap screws (key 163) should be tight against the yoke legs to provide stability. Tighten nuts (key 144). Finish tightening the U-bolt nuts to 163 N•m [120 lbf•ft] (key 170) and 41 N•m [30 lbf•ft] (key 147). Be sure the handwheel assembly remains flat against the mounting pad and perpendicular to the yoke.
8. Position the levers (key 146) as shown in figure 13 or 14. Insert the lever pivot pin (key 153), and snap the retaining ring (key 154) onto the lever pivot pin.

Side-Mounted Handwheel Assembly for Size 70, 76, and 87 Actuators
A side-mounted handwheel assembly (figure 15) is usually used as a manual actuator. Turning the handwheel clockwise past the neutral position always closes the valve body. A sleeve (key 123, figure 15) on a handwheel assembly for a size 70, 76 or 87 actuator opens the valve body by moving the valve stem.

Instructions are given below for complete disassembly and assembly. Perform the disassembly only as far as necessary to accomplish the required maintenance; and then begin the assembly at the appropriate step.

Disassembly for Side-Mounted Handwheel (Sizes 70, 76, and 87)
1. Bypass the control valve. Reduce the loading pressure to atmospheric. Disconnect the loading pressure tubing or piping at the yoke.
2. Remove the cover band (key 87), and relieve spring compression by turning the spring adjuster (key 74) counterclockwise.
3. Remove the cap screws and nuts (keys 13 and 14) and lift off the upper diaphragm casing (key 1).
4. Remove the travel stop screw (key 12) and spacer (key 2), and take off the diaphragm plate (key 4), the diaphragm (key 3), and the lower diaphragm plate (key 71).

5. Unscrew the cap screws (key 90) and remove the following connected parts: the lower diaphragm casing (key 64), the O-ring (key 70), spring case adaptor (key 89), the seal bushing, O-rings, and snap ring (keys 7, 8, 9, and 72).

6. Remove the snap ring (key 72), and slide the seal bushing and O-rings (keys 7, 8, and 9) out of the spring case adaptor (key 89).

7. Take out the actuator spring (key 18).

8. Remove the stem connector (key 31) and stem connector cap screws.

9. Pull the actuator stem (key 144) up and out of the yoke. The spring seat (key 19), spring adjuster (key 74), thrust bearing (key 128), and the pinned adjusting screw (key 131) will come out with the actuator stem.

10. Turn the handwheel so that the lower sleeve (key 123) extends out of the bottom of the yoke. DO NOT move the neutral indicator scale (key 125).

11. Loosen two set screws (key 121), and unscrew the bearing retainer flange (key 45). Take out the worm gear and two thrust bearings (key 132), one on each side of the gear.

12. The worm shaft (key 51) and associated parts can be disassembled, if desired, by first removing the handwheel nut (key 127) and the handwheel (key 58). Do not lose the small ball (key 141) and spring (key 142).

13. Loosen the set screw (key 52) for each worm shaft retainer (keys 48 and 49). Unscrew the two worm retainers (keys 48 and 49). The ball bearings (key 50) will come out with the retainers.

Assembly for Side-Mounted Handwheel (Sizes 70, 76, and 87)

1. The front and back worm retainers (keys 48 and 49) each have a slot in their threads for a set screw (key 52). Pack the ball bearings (key 50) with lubricant (key 239 or equivalent), and insert one ball bearing in the back worm retainer (key 49) as shown in figure 15.

2. Thread the back bearing retainer and ball bearing (keys 49 and 50) into the yoke. Align the slot in the bearing retainer with the set screw hole in the yoke, insert the set screw (key 52), and tighten it.

3. Coat the worm shaft (key 51) threads with lubricant (key 239 or equivalent), and slide the shaft into the yoke so that the end of the shaft fits snugly into the back bearing retainer.

4. Insert the bearing in the front bearing retainer (key 49), and thread the retainer and ball bearing into the yoke. Align the slot in the retainer with the hole in the yoke, insert the set screw (key 52), and tighten it.

5. Put the spring and ball (keys 141 and 142) in the handwheel (key 58). Slide the handwheel onto the worm shaft (key 51). Thread the hex nut (key 127) onto the worm shaft.

6. Pack the two needle bearings (key 132) and coat the worm gear (key 44) threads with lubricant (key 239) or equivalent. Insert the key (key 122), the bearings, and the worm gear in the yoke (key 73) as shown in figure 15.

7. Slots are cut in the threads of the bearing retainer flange (key 45). Thread the flange into the yoke so that the slots and the holes for the set screws (key 121) align. Insert the screws, and tighten them.

8. The lower sleeve (key 123) has a milled groove in one end. Coat the sleeve threads with lubricant (key 239 or equivalent), slide the end of the lower sleeve with the groove into the bearing retainer flange, turn the handwheel, and feed the sleeve through the worm gear so that the slot in the lower sleeve engages the key (key 122) in the yoke. Continue turning the handwheel until the lower sleeve protrudes 81 mm (3.19 inches) below the surface of the yoke. The bottom of the lower sleeve should be even with the bottom of the extension on the neutral indicator.

9. Pack the thrust bearing (key 128) with lubricant (key 239) or equivalent. Slide the actuator stem (key 144) and the attached adjusting screw (key 131), pin (key 130), thrust bearing (key 128), spring seat (key 19), and spring adjuster (key 74) into the yoke. The lower end of the stem slides through the lower sleeve (key 123) and the lower sleeve slides into the adjusting screw (key 131), as shown in figure 15.

10. Position the actuator stem (key 144) against the valve stem. Clamp both stems between the two halves of the stem connector (key 31), and be sure the threads are engaged properly on both stems. The stem connector should not be closer than 3.2 mm (0.125 inches) to the lower sleeve when the actuator stem is in the retracted position. This adjustment will provide approximately 3.2 mm (0.125 inches) of free travel of the lower sleeve in either direction for manual operation. Fasten the halves together with the cap screws.
11. Put the actuator spring (key 18) in the yoke on the spring seat (key 19).

12. Coat the O-rings (keys 8 and 9) with lubricant (key 237) or equivalent, and insert them in the seal bushing (key 7). Slide the seal bushing and O-rings into the spring case adaptor (key 89).

13. Install the snap ring (key 72).

14. Slide the seal bushing and O-rings (keys 7, 8, and 9) over the actuator stem (key 144), and position the spring case adaptor (key 89), lower diaphragm casing (key 64), and O-ring (key 70) on the yoke.

15. Insert and tighten the cap screws (key 90).

16. Slide the lower diaphragm plate (key 71), the diaphragm (key 3) with the patterned side up, the diaphragm plate (key 4), the spacer (key 2), and the cap screw (key 12) on the actuator stem (key 144). Tighten the cap screw.

17. Put the diaphragm casing (key 1) on the diaphragm. Align the holes in the diaphragm (key 3) and the diaphragm casings (keys 1 and 64).

18. Install the cap screws and hex nuts (keys 13 and 14) and tighten in the following manner.

19. The first four bolts tightened should be diametrically opposed and 90 degrees apart. Tighten these four bolts to 13 N•m (10 lbf•ft).

20. Tighten the remaining bolts in a clockwise, criss-cross pattern to 13 N•m (10 lbf•ft).

21. Repeat this procedure by tightening four bolts, diametrically opposed and 90 degrees apart, to a torque of 27 N•m (20 lbf•ft).

22. Tighten the remaining bolts in a clockwise, criss-cross pattern to 27 N•m (20 lbf•ft).

23. After the last bolt is tightened to 27 N•m (20 lbf•ft), all of the bolts should be tightened again to 27 N•m (20 lbf•ft) in a circular pattern around the bolt circle.

24. Once completed, no more tightening is recommended.

25. Return the actuator to service after completing the Loading Connection procedure in the Installation section and the procedures in the Adjustments section.

**Casing-Mounted Travel Stops**

*Note*

If repeated or daily manual operation is expected, the actuator should be equipped with a side-mounted handwheel rather than a casing-mounted travel stop or top-mounted handwheel. The side-mounted handwheel is designed for more frequent use as manual operator.

Casing-mounted adjustable travel stops (shown in figures 16 through 20) are available to limit travel in the down direction (extending the actuator stem) or in the up direction (retracting the actuator stem). The travel stop in figure 16 is a down travel stop, the travel stop in figure 17 is an up and down travel stop, and the travel stops in figures 18, 19, and 20 are up travel stops.

Use the locknuts (key 151, figures 16 and 17), stem (key 150, figure 18), handwheel (key 58, figure 19) or cap screw (key 177, figure 20) to set the point at which the travel stop limits travel. Be sure to tighten the locknuts and replace the cap (key 149, figures 16 and 18; key 247, figure 17) after setting the travel stop.

Instructions are given below for disassembly and assembly. Perform the disassembly only as far as necessary to accomplish the required maintenance; then, begin the assembly at the appropriate step.
Key numbers are shown in figures 16 through 20.

1. Remove the cap (key 149 or 247) if the travel stop uses one. For down travel stops, loosen the locknuts (key 151, figures 16 and 17) so that the stop is not causing any spring compression.

2. Bypass the control valve, reduce loading pressure to atmospheric, and remove the tubing or piping from the connection on top of the yoke (key 73, figures 6, 7, and 8).

3. For down travel stops, turn the spring adjuster (key 74, figures 6, 7, and 8) out of the yoke toward the stem connector (key 31) to relieve all the compression in the spring (key 18).

4. For style 11 travel stops (figure 17), unscrew the cap screws (key 161), and make sure that the guide plate (key 157) can turn between the handwheel body (key 148) and the mounting plate (key 158).

5. Use a wrench on the nuts (key 151) to unscrew the extension rod (key 150). Remove the rod, the handwheel body (key 148), and the attached parts.

6. Unscrew the hex nuts and cap screws (keys 14 and 13, figures 6, 7, and 8) from the diaphragm casings. Lift off the upper diaphragm casing (key 1, figures 6, 7, and 8) and, for the style 11 travel stop, the mounting plate (key 158). For styles 10, 12 and 13, the travel stop assembly will be removed with the casing.

7. Note and record the position of travel stops (key 152) relative to the cap screws (key 154) for use in assembly. Unscrew the travel stops and cap screws, and remove either the mounting plate (key 158) or the handwheel body (key 148) and attached parts.

8. Separate the stem (key 150) and screw (key 160, figure 17) from the handwheel body.

9. Before reassembling, lubricate parts indicated by key 239 in figures 16 through 20. Use lubricant (key 239 or equivalent).

10. Reassemble parts in the reverse order of removal.

11. When replacing the cap screws (key 154) and, if used, the travel stops (key 152), be sure to return them to their original position as recorded in step 6.

**CAUTION**

Over-tightening the diaphragm cap screws and nuts (keys 13 and 14), figures 6, 7, and 8 can damage the diaphragm. Do not exceed 27 N•m (20 lbf•ft) torque.

12. Install the cap screws and nuts (keys 13 and 14, figures 6, 7, and 8) and finger tighten. Tighten the diaphragm cap screws and nuts to 27 N•m (20 lbf•ft) torque in a crisscross pattern.

13. Return the spring adjuster (key 74, figure 6, 7, and 8) to its original position. Re-adjust the travel stop.

**Parts Ordering**

Each actuator has a serial number stamped on the nameplate. Always mention this number when corresponding with your Fisher sales office regarding technical information or replacement parts. Also, reference the complete 11-character part number of each needed part as found in the following Parts Kits and Parts List sections.

**Note**

Use only genuine Fisher replacement parts. Components that are not supplied by Fisher should not, under any circumstances, be used in any Fisher valve, because they will void your warranty, might adversely affect the performance of the valve, and might jeopardize worker and workplace safety.

**Note**

Fisher does not assume responsibility for the selection, use, or maintenance of any product. Responsibility for proper selection, use, and maintenance of any Fisher product remains solely with the purchaser and end-user.
## Parts Kits

### Side-Mounted Handwheels Retrofit Kits

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<tr>
<th>Key</th>
<th>Description</th>
<th>Part Number</th>
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<td>Size 34 Push-Down-To-Close</td>
<td>30A8778X0E2</td>
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<td>Size 34 Push-Down-To-Open</td>
<td>30A8778X0F2</td>
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<td>Size 40 Push-Down-To-Open</td>
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<td>Size 45 &amp; 46 Push-Down-To-Close</td>
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<td>Size 50 &amp; 60 Push-Down-To-Close</td>
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<td></td>
<td>Size 50 &amp; 60 Push-Down-To-Open</td>
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### Top-Mounted Handwheels Retrofit Kits

Retrofit Kit includes parts to add a Top-Mounted Handwheel. Kit number 1 includes the handwheel assembly only. Kit number 2 includes Kit number 1 and a new diaphragm case that is required to mount the handwheel assembly.

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<td>Sizes 34</td>
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<td>Size 40</td>
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<td></td>
<td>Sizes 45 &amp; 50</td>
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<td></td>
<td>Sizes 46, 60, AND 76</td>
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<td></td>
<td>Sizes 70 &amp; 87</td>
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| Kit 2 | Size 30 | 30B3940X052 |
| | Sizes 34 | 30B3940X062 |
| | Size 40 | 30B3940X092 |
| | Sizes 45 & 50 | 33B9224X022 |
| | Sizes 46, 60, & 76 | 33B9224X032 |
| | Sizes 70 & 87 | CV0806X0022 |

### Actuator Repair Kits

Parts kit includes keys 8, 9, and 70. O-ring material is nitrite, and gasket material is composition.

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<td>R667X000402</td>
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### Parts List

#### Note

Part numbers are shown for recommended spares only. For part numbers not shown, contact your Fisher sales office.

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*Recommended spare parts*
Figure 6. Type 667 Actuator Sizes 30 through 60
Figure 7. Type 667 Size 70 and 76 Actuator

### Key Description

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### Key Description

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### Warning

*Recommended spare parts*
Figure 8. Type 667 Size 87 Actuator

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<th>Key</th>
<th>Description</th>
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<td>Thrust Bearing</td>
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<td>160</td>
<td>Handwheel Screw</td>
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<td>Cap Screw</td>
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<td>Bearing Retainer</td>
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<td>Castle Nut</td>
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<td>Pipe Nipple</td>
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<td>167</td>
<td>Cotter Pin</td>
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<td>Never-Seez or equivalent not furnished with handwheel</td>
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<tr>
<td>178</td>
<td>Machine Screw</td>
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<td>247</td>
<td>Handwheel Cap</td>
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<td>179</td>
<td>Lockwasher</td>
<td></td>
<td>253</td>
<td>Spacer, Handjack</td>
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</table>
Figure 9. Top-Mounted Handwheel Assembly for Size 30 through 40 Actuators

Apply lubricant.

Note:
The top mounted handwheel is not designed for use under heavy load or frequent use.

Side-Mounted Handwheel, Size 30-60 (figures 13 and 14)

<table>
<thead>
<tr>
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<tr>
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<td>Handwheel</td>
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<td>54</td>
<td>Hex Jam Nut</td>
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<td>55</td>
<td>Ball</td>
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<td>Spring</td>
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<td>Handwheel Body</td>
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<td>143</td>
<td>Mounting Bolts</td>
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<td>144</td>
<td>Hex Nut</td>
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</tr>
<tr>
<td>145</td>
<td>Handwheel Screw</td>
<td></td>
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<tr>
<td>146</td>
<td>Lever &amp; Pin Assembly</td>
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<tr>
<td>147</td>
<td>Hex Jam Nut</td>
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<td>148</td>
<td>Dowel Pin</td>
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<td>149</td>
<td>Washer</td>
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<td>150</td>
<td>Lockwasher</td>
<td></td>
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<tr>
<td>151</td>
<td>Bushing</td>
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<td>152</td>
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<td>153</td>
<td>Lever Pivot Pin</td>
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<td>Retaining Ring</td>
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<td>155</td>
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<td></td>
</tr>
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<td>156</td>
<td>Screw</td>
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</tbody>
</table>

241 Lubricant, Lubriplate MAG-1 or equivalent
   Not furnished with handwheel

244 Lubricant, Anti-Seize Lub-3 Never-Seez or equivalent
   Not furnished with handwheel

Side-Mounted Handwheel, Size 70, 76 and 87 (figure 15)

<table>
<thead>
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<th>Description</th>
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</tr>
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<td>38</td>
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Figure 10. Top-Mounted Handwheel Assembly, Style P2 for Size 45, 50, 60, and 76 Actuators

<table>
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<th>Part Number</th>
<th>Key</th>
<th>Description</th>
<th>Part Number</th>
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<td>Worm Gear</td>
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<td>Handwheel</td>
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<tr>
<td>45</td>
<td>Bearing Retainer Flange</td>
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<td>102</td>
<td>Plug, Pipe</td>
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<tr>
<td>48</td>
<td>Back Worm Retainer</td>
<td></td>
<td>127</td>
<td>Hex Nut</td>
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</tr>
<tr>
<td>49</td>
<td>Front Worm Retainer</td>
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<td>148</td>
<td>Travel Stop Body</td>
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<tr>
<td>50</td>
<td>Ball Bearing</td>
<td></td>
<td>149</td>
<td>Travel Stop Cap</td>
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<td>51</td>
<td>Worm Shaft</td>
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<td>Extension Rod</td>
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<td>Set Screw</td>
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<td>58</td>
<td>Handwheel</td>
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<td>153</td>
<td>Nut, Hex</td>
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<td>Cover Band Ass’y</td>
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<td>Screw, Cap, Hex Hd</td>
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<td>89</td>
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<td>Washer, Lock, Split</td>
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<td>Screw, Handwheel</td>
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<tr>
<td>127</td>
<td>Handwheel Cap</td>
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<td>161</td>
<td>Screw, Cap, Hex Hd</td>
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<tr>
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<td>Needle Bearing</td>
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<td>Washer</td>
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<td>Roll Pin</td>
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<td>Nipple, Pipe, NPT</td>
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<tr>
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<td>Lubricant, Anti-Seize lub-3 Never-Seez or equivalent</td>
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<tr>
<td>133</td>
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<td>247</td>
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<td>142</td>
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</tr>
</tbody>
</table>

Casing-Mounted Travel Stops (figures 16 through 20)

- Lubricant, Lubriplate MAG-1 or equivalent
- Lubricant, Anti-Seize Lub-3 Never-Seez or equivalent
- Not Furnished with Handwheel

Lubricant, Anti-Seize Lub-3 Never-Seez or equivalent is also not furnished with Handwheel.

237 Lubricant, Lubriplate MAG-1 or equivalent
239 Lubricant, Anti-Seize Lub-3 Never-Seez or equivalent
247 Travel Stop Cap
248 Mounting Plate
Figure 11. Top-Mounted Handwheel Assembly for Size 45-76 Actuators
Figure 12. Top-Mounted Handwheel Assembly for Size 70 and 87 Actuators
Figure 13. Side Mounted Handwheel Assembly for Size 34 and 40 Actuators

Figure 14. Side-Mounted Handwheel Assembly for Size 45 and 60 Actuators
Figure 15. Size 70, 76, and 87 Actuator with Side Mounted Handwheel Assembly
Figure 16. Style 10 Down Travel Stop (Casing Mounted)

Figure 17. Style 11 Up Or Down Travel Stop (Casing Mounted)
Figure 18. Style 12 Up Travel Stop (Casing Mounted)

Figure 19. Style 13 Up Travel Stop (Casing Mounted), size 30 shown

Figure 20. Style 14 Up Travel Stop (Casing Mounted)