Fisher™ 657C Diaphragm Actuator Sizes 40i, 46i, and 60i

Contents

Figure 1. Fisher 657C Actuator

Introduction

Scope of Manual

This instruction manual provides information on installation, adjustment, maintenance, and parts ordering for the Fisher 657C actuator in sizes 40i, 46i, and 60i. Refer to separate instruction manuals for information about the desuperheater positioner and other accessories used with these actuators.

Do not install, operate, or maintain a 657C actuator without being fully trained and qualified in Yarway™ desuperheater, actuator, and accessory installation, operation, and maintenance. **To avoid personal injury or property damage, it is important to carefully read, understand, and follow all the contents of this manual, including all safety cautions and warnings.** If you have any questions about these instructions, contact your Emerson sales office before proceeding.

Table 1. Specifications

SPECIFICATION		ACTUATOR SIZE		
		40i	**46i**	**60i**
Nominal Effective Area	cm^2	445	1006	1006
	$Inch^2$	69	156	156
Acceptable Desuperheater Stem Diameters		12 mm or 1/2 inch	12 mm or 1/2 inch	16 mm
Yoke Boss Diameters	mm	71	71	91
	Inches	2-13/16	2-13/16	3-9/16
Maximum Allowable Output Thrust(1)	N	12010	30246	30246
	Lb	2700	6800	6800
Maximum Travel(3)	mm	89	105	105
	Inches	3-1/2	4-1/8	4-1/8
Maximum Casing Pressure for Actuator Sizing(1)	Bar	4.5	2.8	2.8
	Psig	65	40	40
Maximum Diaphragm Casing Pressure(1)(2)	Bar	5.2	3.4	3.4
	Psig	75	50	50
Operating Temperature Range		Nitrile Elastomers: -40 to 82°C (-40 to 180°F), Silicone Elastomers: -54 to 149°C (-65 to 300°F)		
Pressure Connections (internal)	1/4 NPT	X	X	X
	1/2 NPT (optional)	X	X	X
Approximate Weights	kg	34	66	72
	Lb	75	146	160

1. Normal operating diaphragm pressure must not exceed maximum diaphragm casing pressure and must not produce a force on the actuator stem greater than the maximum allowable output thrust or the maximum allowable stem load. Contact your Emerson sales office for more information concerning maximum allowable stem load.
2. 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.
3. Actuator travel may be less than the value listed after connecting the actuator to the valve.

Description

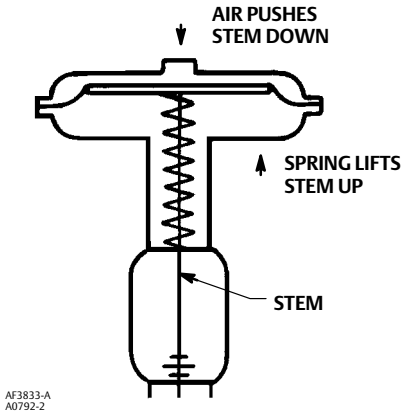
The Fisher 657C actuators (figure 1) are long stroke, spring opposed, direct-acting diaphragm actuators. They are designed for Yarway desuperheater line of products (AT-38/48, AT-37/47, AT-18/28, and 4300 Templow™). They are suitable for push-down-to-open (PDTO) applications and are available in sizes 40i, 46i and 60i to provide 89 mm (3.5 inch), or 105 mm (4.125 inch) maximum actuator travel.

A 657C actuator can be equipped with a top-mounted handwheel assembly. Adjustable casing-mounted down travel stop is also available for this actuator.

Specifications

Refer to table 1 for Specifications of the 657C actuator. See the actuator nameplate for specific information about your actuator.

Figure 2. Schematic of Fisher 657C Actuator



Educational Services

For information on available courses for Fisher 657C diaphragm actuators, as well as a variety of other products, contact:

Emerson Automation Solutions
Educational Services - Registration
Phone: 1-641-754-3771 or 1-800-338-8158
E-mail: education@emerson.com
emerson.com/fishervalvetraining

Installation

Key number locations are shown in figure 7 unless otherwise indicated. Also, refer to figure 3 for location of parts.

⚠ WARNING

Always wear protective gloves, clothing, and eyewear when performing any installation operations to avoid personal injury.

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

If installing into an existing application, also refer to the WARNING at the beginning of the Maintenance section in this instruction manual.

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 desuperheater stem load. (Contact your Emerson sales office with questions concerning maximum allowable desuperheater stem load.)

- Desuperheater/Actuator Assembly: If the actuator and desuperheater are shipped together as an assembly, it has been adjusted at the factory, and may be installed in the pipeline. After installing the desuperheater 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 desuperheater, the actuator should be mounted to the desuperheater before placing the desuperheater in the pipeline when practical. Refer to the actuator mounting procedures before placing the desuperheater in service. You may perform the Bench Set Spring Adjustment procedures in this section to confirm the adjustment has not changed since it was shipped from the factory. Support actuator when in any other position than vertical.

- 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.

Mounting the Actuator on the Desuperheater

The 657C actuator spring loading pushes the actuator stem up towards the actuator diaphragm (see figure 2). This spring action moves the stem away from the desuperheater while installing the actuator.

CAUTION

If the valve stem is allowed to remain in the up position (towards the actuator) during mounting, it can interfere with the actuator mounting, possibly 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.

Provide a temporary method of applying diaphragm loading pressure to the diaphragm to extend the actuator stem during bench set spring adjustments. Provide a regulator to adjust the actuator stem during bench set spring adjustments and a shut-off valve to isolate and prevent unwanted movement.

1. Provide a vise or some other method of supporting the desuperheater and the weight of the actuator during assembly. Push the desuperheater stem down away from the actuator while mounting the actuator.
2. Screw the stem locknuts all the way onto the desuperheater stem. With the concave side of the travel indicator disk (key 14, figure 7) facing the desuperheater, install the travel indicator disk on the desuperheater stem.
3. Lift or hoist the actuator onto the desuperheater yoke mounting boss:

   a. Screw the yoke locknut onto the desuperheater yoke mounting boss and tighten the locknut. (Note: On small size actuators, it may be necessary to remove the indicator disk and re-install it while lowering the actuator on to the desuperheater because the disk will not go through the actuator yoke opening.)

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

Figure 3. Actuator Components for Size 40i, 46i, and 60i Actuators

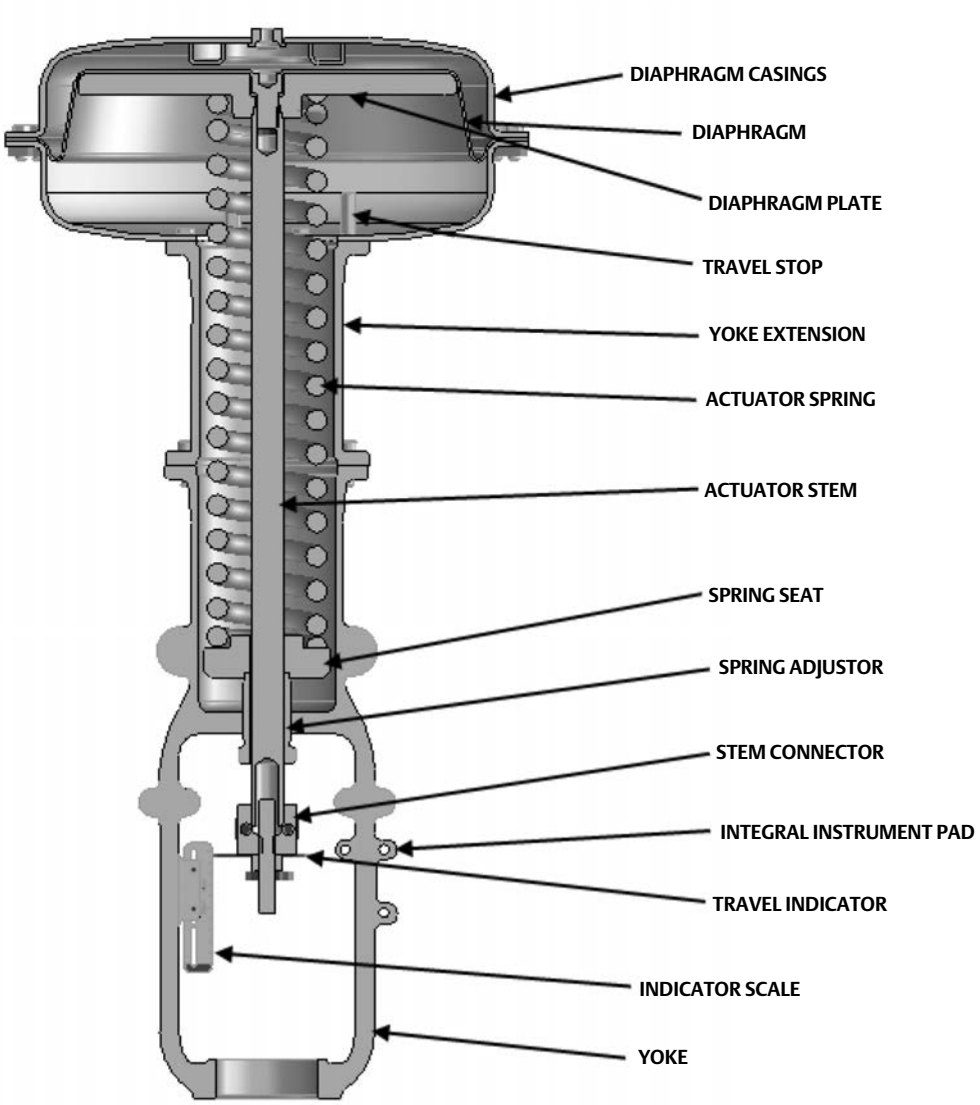
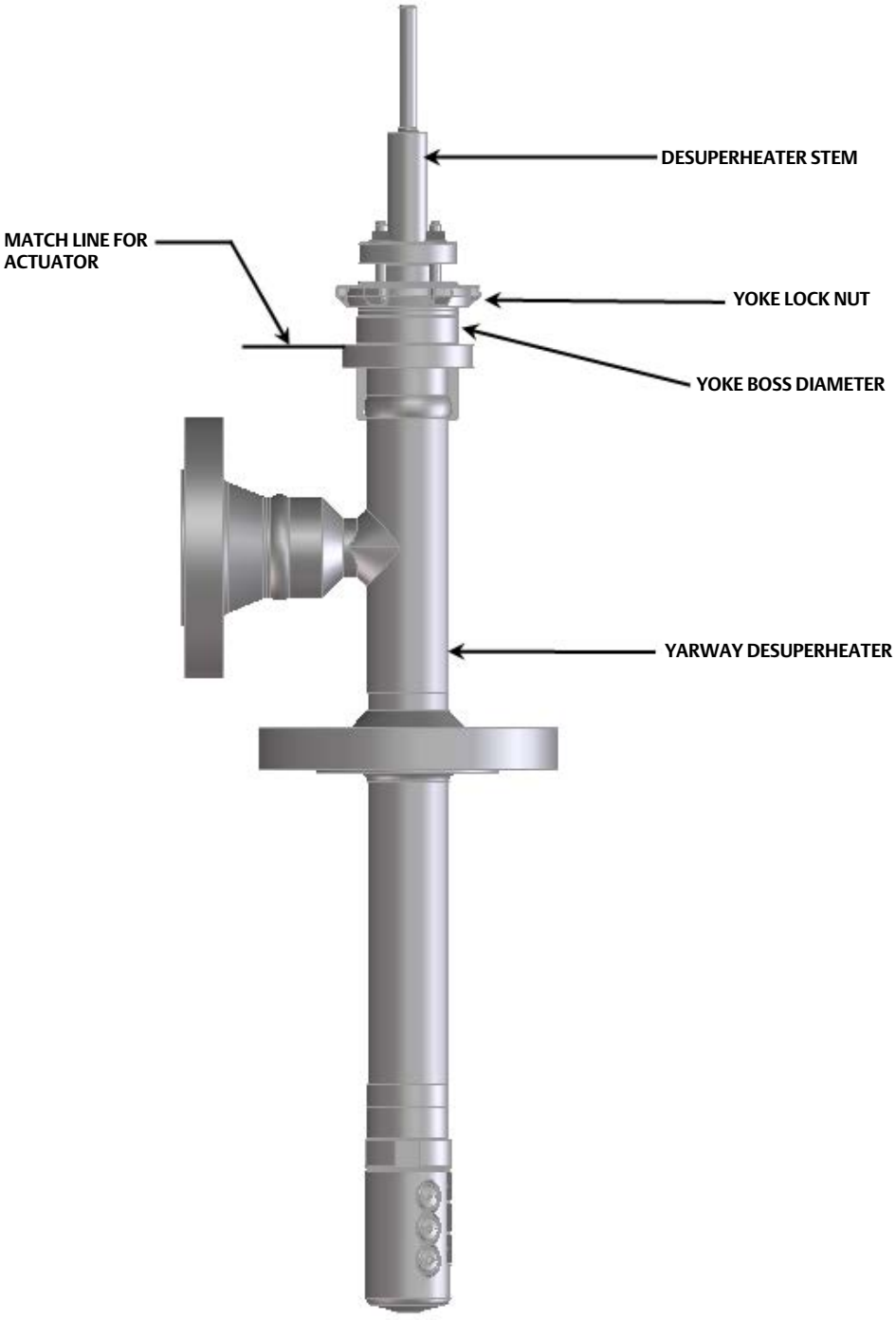


Figure 4. Construction of Yarway Desuperheater



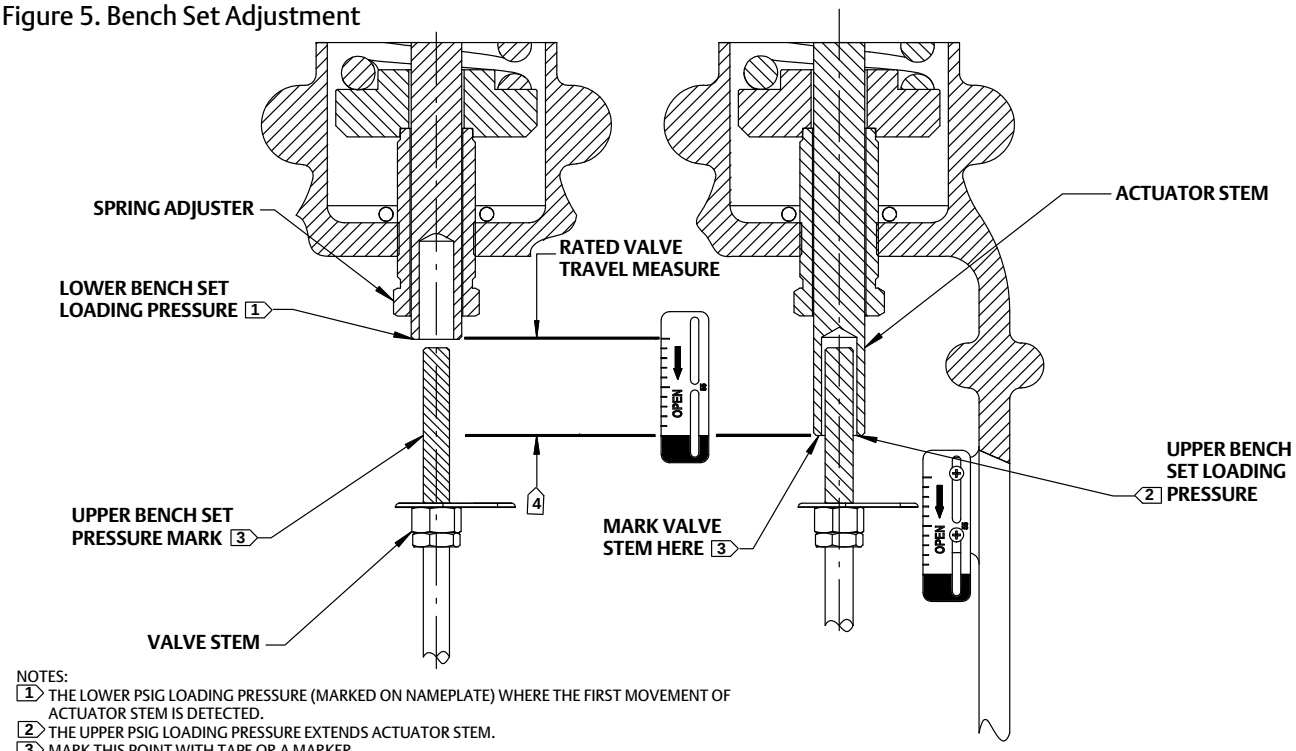
Discussion of Bench Set

The bench set pressure values are used to adjust the initial compression of the actuator spring with the desuperheater-actuator assembly "on the bench." The correct initial compression is important for the proper functioning of the desuperheater-actuator assembly when it is put into service and the proper actuator diaphragm operating pressure is applied.

The bench set values are 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 desuperheater (see the Spring Verification procedure).

Figure 5. Bench Set Adjustment



NOTES:
1 THE LOWER PSIG LOADING PRESSURE (MARKED ON NAMEPLATE) WHERE THE FIRST MOVEMENT OF ACTUATOR STEM IS DETECTED.
2 THE UPPER PSIG LOADING PRESSURE EXTENDS ACTUATOR STEM.
3 MARK THIS POINT WITH TAPE OR A MARKER.
4 MEASURE DISTANCE OF TRAVEL. IT SHOULD EQUAL THE TRAVEL SPAN SHOWN ON THE NAMEPLATE.

Spring Verification

Ensure that the actuator stem is at the top of its travel as shown in figure 5 and not connected to the desuperheater.

Note

Some spring compression is required to move the diaphragm to the top of its travel.

The steps provided are for push-down-to-open desuperheaters.

⚠ WARNING

When moving the actuator stem with diaphragm loading pressure, use caution to keep hands and tools out of the actuator stem travel path. Personal injury and/or property damage is possible if something is caught between the actuator stem and other desuperheater assembly parts.

Also, provide a certified pressure gauge suitable to accurately read the diaphragm pressure from 0 through 0.3 bar (5 psig) above the upper operating range pressure marked on the nameplate. Apply loading pressure to the diaphragm.

CAUTION

Stroke the actuator a few times to ensure that the pressure gauge is working correctly, and that the actuator is functioning properly. To prevent actuator damage, it is important to ensure that the actuator stem is stroking smoothly and not exhibiting binding or excessive friction. Binding or excessive friction could be an indicator of incorrect assembly or damaged parts.

1. If not already accomplished, provide a regulator to apply an adjustable loading pressure to the actuator during bench set adjustments and a shut-off valve to isolate and prevent the unwanted movement.
2. Set the diaphragm loading pressure at 0 bar (0 psig). Then, slowly raise the pressure towards the lower bench set pressure, as indicated on the nameplate, while checking for the first linear movement of the actuator stem. The actuator stem should show movement at the lower bench set pressure. If movement occurs before or after the lower pressure is reached, adjust the spring adjuster (see figure 5) into or out of the yoke until the actuator stem's movement is first detected at the lower bench set pressure.
3. Be sure the spring adjuster is adjusted to meet the requirements of step 2 above.
4. Apply the upper bench set pressure, as indicated on the nameplate. This pressure extends the actuator stem down toward the desuperheater. At the end of the actuator stem, use a marker or a piece of tape to mark the desuperheater stem (see figure 5).

Note

The actuator stem may slide over the desuperheater stem as shown in figure 5. If the actuator stem does not pass over the desuperheater stem, provide a method to mark this point of stem travel.

5. Slowly decrease the diaphragm loading pressure to the lower bench set pressure, as indicated on the nameplate.
6. Measure the distance between the marker or tape on the desuperheater stem to the end of the actuator stem. The distance should match the rated travel indicated on the nameplate.
7. If the measured travel matches the nameplate travel, bench set is complete. Proceed to the Installing the Stem Connector Assembly subsection.
8. If the measured travel is not exact, consider the spring free-length and spring rate tolerances may produce a slightly different bench set than specified. Contact your Emerson sales office for assistance.

Installing the Stem Connector Assembly

When installing the stem connector assembly (key 26), the actuator and desuperheater stem threads should engage the threads of the stem connector by the distance equal to the diameter of the stem.

⚠ WARNING

Install the stem connector securely before a positioner is mounted to the actuator and pressurized, using only a regulator-controlled air supply, not the positioner, to move the actuator stem.

To avoid personal injury or property damage, keep hands and tools out of the actuator stem travel path while applying loading pressure to move the actuator stem in the following steps.

CAUTION

To avoid damaging the seating surfaces, do not rotate the desuperheater plug while it is seated. Exercise care while installing the stem connector assembly to avoid damage to the desuperheater plug stem and desuperheater stem threads.

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, if present, before clamping the actuator and desuperheater stems together. Use only a mated pair of stem connector halves.

1. Pull the desuperheater stem up so that it is touching the seat ring.

   If necessary, screw the desuperheater stem locknuts down, away from the connector location. For all actuators, ensure that the travel indicator disk (key 14) is located on top of the locknuts.
2. Actuator should be at lower bench set.
3. Place the stem connector half with the threaded holes, approximately half way between the actuator and desuperheater stems, and align with the stem connector. A slight change to loading pressure may be necessary to align the threads. Refer to figure 7 to help locate the connector position.

CAUTION

Incomplete engagement of either the desuperheater stem or actuator stem in the stem connector can result in stripped threads or improper operation. Be sure that the length of each stem clamped in the stem connector is equal to or greater than one diameter of that stem. Damage to threads on either stem or in the stem connector can cause the parts to be replaced prematurely. Do not loosen the cap screws when the stem connector has spring or loading pressure force applied.

4. Install the other half of the stem connector and insert the lubricated cap screws and tighten them while ensuring even spacing between the stem connector halves on all sides. If installing a positioner, also attach the feedback bracket at the same time.

CAUTION

Over-tightening the desuperheater stem locknuts can make disassembly difficult.

5. Screw the desuperheater stem locknuts up until the indicator disk contacts the bottom of the stem connector. Do not overtighten the locknuts.
6. Slowly stroke the desuperheater from fully closed to fully open and verify full rated travel is achieved.

Be sure the desuperheater is in the closed position. Loosen the screws (key 17) on the travel indicator scale (key 18), and align it with the travel indicator disk (key 14). Stroke the desuperheater full travel to ensure that the travel matches the rated travel on the nameplate. If desuperheater travel is not correct, repeat the stem connector procedure.

Friction Discussion

If you are attempting to adjust the bench set after the actuator is connected to the desuperheater and the packing tightened, you must take friction into account. Make the spring adjustment so full actuator travel occurs at the bench set values

a. Add the friction force divided by the effective diaphragm area with increasing diaphragm pressure, or,

b. Subtract the friction force divided by the effective diaphragm area with decreasing diaphragm pressure.

If the stem connector assembly has been installed, the desuperheater friction may be determined by the following procedure:

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 a travel position in the rated travel of the desuperheater that does not contact a travel stop. Make a reference mark on the travel indicator scale using tape or some other method at this point.
3. Increase the actuator diaphragm pressure until the actuator is at a travel position greater than the position referenced in step 2 using the reference point to identify first movement.
4. Decrease the actuator diaphragm pressure and read the diaphragm pressure as the actuator returns to the position referenced in step 2.

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:

$$\text{Friction Force, = pounds} \quad 0.5 \left(\text{Difference in pressure readings, psig} \right) \times \left(\text{Effective diaphragm area, inches}^2 \right)$$

Refer to table 1 for the effective diaphragm area.

It is difficult to rotate the spring adjustor (key 12, figure 7) 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.

Note
The actuator down stop is the limit for downward movement, and the desuperheater seat is the limit for upward (away from the desuperheater) movement.

Deadband Measurement

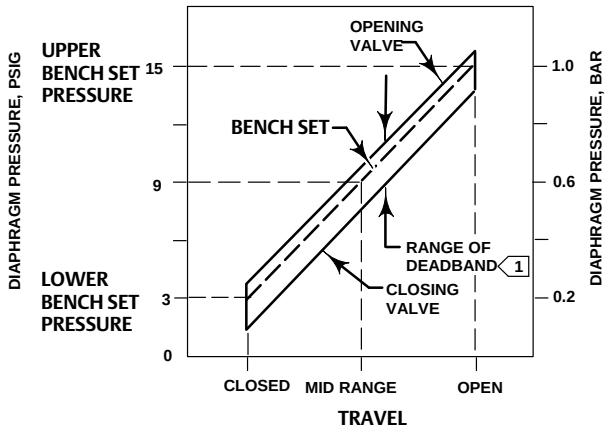
Deadband is caused by packing friction, unbalanced forces, and other factors in the desuperheater assembly. Deadband is the range a measured signal can vary without initiating a response from the actuator (see figure 6). Each actuator spring has a fixed spring rate (force divided by compression). You have verified that the right spring was installed in the actuator by completing the Spring Verification steps.

Deadband is one factor that affects the desuperheater 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 desuperheater is approximately at mid-travel. Note this pressure reading.
2. Slowly decrease pressure until movement of the desuperheater 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:

$$\text{Deadband} = \frac{\text{Deadband, psi}}{\text{Bench Set Span, psi}} = \text{nn\%}$$

Figure 6. Typical Desuperheater Response to Deadband



NOTE:
1 DEADBAND IS CAUSED BY FRICTION.

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Loading Connection

The loading pressure connections are made at the factory if the desuperheater, 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, desuperheater 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 internal connection in the top of the diaphragm casing.
2. If necessary, remove the 1/4 NPT bushing if a 1/2 NPT internal 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 desuperheater stem travel is correct when the correct pressure ranges are applied to the diaphragm.

⚠ WARNING

To avoid personal injury or product damage, do not place the desuperheater into service if it is not reacting correctly to diaphragm loading pressure changes. If desuperheater stem travel appears to be incorrect, refer to the Bench Set Spring Adjustment procedures at the beginning of this section.

Maintenance

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

⚠ WARNING

Avoid personal injury or property damage from sudden release of process pressure or bursting of parts. Before performing any maintenance operations:

- **Do not remove the actuator from the desuperheater while the desuperheater is still pressurized.**
- **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 desuperheater.**
- **Use bypass valves or completely shut off the process to isolate the desuperheater 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 precompression.**
- **Use lock-out procedures to be sure that the above measures stay in effect while you work on the equipment.**
- **The desuperheater packing box may contain process fluids that are pressurized, even when the desuperheater 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 Maintenance

This procedure describes how the actuator can be completely disassembled and assembled. When inspection or repairs are required, disassemble only those parts necessary to accomplish the job; then, start the assembly at the appropriate step.

Key numbers refer to figure 7 unless otherwise indicated.

Actuator Disassembly

1. Bypass the desuperheater. Reduce the loading pressure to atmospheric, and remove the tubing or piping from the upper diaphragm casing (key 1).

⚠ WARNING

To avoid personal injury from the precompressed spring force thrusting the upper diaphragm casing (key 1) away from the actuator, relieve spring compression (step 2), and carefully remove casing cap screws (key 22, step 4).

2. Thread the spring adjuster (key 12) out of the yoke (key 9) until all spring compression is relieved.
3. If required, remove the actuator from the desuperheater body by separating the stem connector (key 26) and removing the yoke locknut. Separate the stem connector by loosening the stem nuts (keys 15 and 16) and unscrewing the two cap screws.
4. Remove the diaphragm casing cap screws and nuts (keys 22 and 23), then lift off the upper diaphragm casing (key 1).
5. Remove the actuator diaphragm (key 2).
6. Remove the diaphragm plate, actuator stem, and cap screw (keys 4, 10, and 3) as an assembly. This assembly can be broken down further, if required, by removing the cap screw (key 3).
7. Remove the actuator spring (key 6) and the spring seat (key 11).
8. If required, remove the lower diaphragm casing (key 5) from the yoke extension (key 27) by loosening the cap screws (key 8) that hold it in place.
9. If required, remove the spring adjuster (key 12) by unscrewing it from the yoke (key 9).
10. Remove yoke extension (key 27).

Table 2. Actuator Assembly Recommended Torque Values

DESCRIPTION, KEY NUMBER	ACTUATOR SIZE	THREAD SIZE, INCH	TORQUE	
			N • m	Lbf • ft
Diaphragm plate to stem, key 3	40i	1/2-20	54	40
	46i and 60i	3/4-16	149	110
Diaphragm casing, key 22 and 23(1)	40i to 60i	3/8-24	27	20
Casing to yoke, key 8	46i and 60i	3/8-16	39	29
Top-mounted handwheel and travel stop mounting, key 141	40i to 60i	3/8-16	39	29
Stem connector, key 26(2)	40i	5/16-18	23	17
	46i and 60i	3/8-16	39	29
Yoke extension to yoke, key 28	40i to 60i	3/8-16	39	29

1. Observe tightening pattern and procedure described in the appropriate Actuator Assembly section.
2. Torque values when lithium grease is used on the threads.

Actuator Assembly

Refer to table 2 as appropriate.

1. Coat the threads and the spring seat bearing surface of the spring adjuster (key 12) with lithium grease (key 241), and thread the spring adjuster into the yoke (key 9). Place the spring seat (key 11) in the yoke on the spring adjuster and turn the spring adjuster to ensure that threads are properly engaged.
2. Position the yoke extension (key 27) on the yoke (key 9), and fasten the parts together by installing and evenly tightening the cap screws (key 28).
3. Position the lower diaphragm casing (key 5) on the yoke extension (key 27), and fasten the parts together by installing and evenly tightening the cap screws (key 8).
4. Set the actuator spring (key 6) squarely onto the spring seat (key 11).
5. If the diaphragm plate and actuator stem (keys 4 and 10) are separate, fasten them together using the cap screw and washer (keys 3 and 25). Coat the cap screw threads with lithium grease (key 241). Tighten the cap screw (key

3), 54 N•m (40 lbf•ft) torque for size 40i actuator, or 149 N•m (110 lbf•ft) torque for size 46i and 60i actuators. Slide the actuator stem and diaphragm plate (keys 10 and 4) into the yoke (key 9) and yoke extension (key 27) so the actuator spring (key 6) fits squarely between the diaphragm plate and the spring seat (key 11). Then slide the diaphragm rod through the spring adjuster (key 12).

Note

Key 25 is not part of size 40i constructions.

6. Place the diaphragm (key 2) pattern-side up on the diaphragm plate (key 4). Align the holes in the diaphragm and the lower diaphragm casing (key 5).
7. Position the upper diaphragm casing (key 1) on the diaphragm (key 2) and align the holes.

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.

CAUTION

Over-tightening the diaphragm casing cap screws and nuts (keys 22 and 23) 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.

8. Insert the cap screws (key 22), and tighten the hex nuts (key 23) in the following manner. The first four hex nuts tightened should be diametrically opposed and 90 degrees apart. Tighten these four hex nuts to 13 N•m (10 lbf•ft).
9. Tighten the remaining hex nuts in a clockwise, criss-cross pattern to 13 N•m (10 lbf•ft).
10. Repeat this procedure by tightening four hex nuts, diametrically opposed and 90 degrees apart, to a torque of 27 N•m (20 lbf•ft).
11. Tighten the remaining hex nuts in a clockwise, criss-cross pattern to 27 N•m (20 lbf•ft).
12. After the last hex nut is tightened to 27 N•m (20 lbf•ft), all of the hex nuts should be tightened again to 27 N•m (20 lbf•ft) in a circular pattern around the bolt circle.
13. Once completed, no more tightening is recommended.
14. Mount the actuator on the desuperheater by following the procedures in the Installation section.

Top-Mounted Handwheel Assembly

Turning the handwheel clockwise moves the the handwheel stem (key 133, figure 7) down, compressing the spring.

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

Key numbers refer to figure 7 unless otherwise indicated.

Disassembly for Top-Mounted Handwheel

1. Turn the handwheel (key 51) counter-clockwise so that the handwheel assembly is not causing any spring compression.
2. Bypass the desuperheater, reduce loading pressure to atmospheric, and remove the tubing or piping from the upper handjack body (key 142).

⚠ WARNING

To avoid personal injury from the precompressed spring force thrusting the upper diaphragm casing (key 1) away from the actuator, thread the spring adjuster (key 12) out of the yoke until all spring compression is relieved, then carefully remove casing cap screws (key 22, step 4).

3. Thread the spring adjuster (key 12) out of the yoke (key 9) until all spring compression is relieved.
4. Remove the diaphragm casing cap screws and nuts (keys 22 and 23, figure 7), and lift off the upper diaphragm casing and handwheel assembly.
5. If necessary, the handwheel assembly can be separated from the diaphragm casing by removing the cap screws (key 141). This may be necessary to replace the O-ring (key 139), or for ease of handling.
6. Loosen the travel stop locknut (key 137), and turn the handwheel (key 51) counter-clockwise. Remove the cotter pin and stop nut (keys 247 and 54), then lift off the handwheel.
7. Unscrew the travel stop locknut (key 137) from the handwheel stem (key 133), and turn the stem out of the bottom of the body (key 142). A screwdriver slot is provided on the top of the stem for this purpose.
8. Replace the O-ring (key 138) in the body (key 142).
9. For a handwheel assembly used on actuators, complete the disassembly by driving out the groove pin (key 140, figure 7) and sliding the pusher plate (key 135, figure 7) off the stem.

Assembly for Top-Mounted Handwheel

1. For a handwheel assembly used on actuators, coat the end of the handwheel stem (key 133, figure 7) with anti-seize lubricant (key 244). Slide the pusher plate (key 135, figure 7), onto the stem, and drive in the groove pin (key 140, figure 7) to lock the pieces together.
2. Coat the O-ring (key 138) with lithium grease (key 241), and insert the O-ring in the body (key 142).
3. Coat the threads of the handwheel stem (key 133) with anti-seize lubricant (key 244). Screw the stem into the body (key 142).
4. Thread the travel stop locknut (key 137) onto the handwheel stem (key 133).
5. Place the handwheel (key 51), and the stop nut (key 54) on the handwheel stem (key 133). Tighten the hex nut to fasten the parts together. Secure the nut with the cotter pin (key 247).
6. If the body (key 142) was separated from the upper diaphragm casing (key 1, figure 7), lubricate the O-ring (key 139) with lithium grease (key 241), and place the O-ring in the body. Align the holes in the diaphragm casing and the body, insert the cap screws (key 141), and tighten them evenly following a crisscross pattern to ensure a proper seal.
7. Position the upper diaphragm casing (key 1, figure 7) on the diaphragm (key 2, figure 7) and align the holes.

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.

CAUTION

Over-tightening the diaphragm casing cap screws and nuts (keys 22 and 23, figure 7) 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.

8. Insert the cap screws (key 22), and tighten the hex nuts (key 23) in the following manner. The first four hex nuts tightened should be diametrically opposed and 90 degrees apart. Tighten these four hex nuts to 13 N•m (10 lbf•ft).
9. Tighten the remaining hex nuts in a clockwise, criss-cross pattern to 13 N•m (10 lbf•ft).
10. Repeat this procedure by tightening four hex nuts, diametrically opposed and 90 degrees apart, to a torque of 27 N•m (20 lbf•ft).
11. Tighten the remaining hex nuts in a clockwise, criss-cross pattern to 27 N•m (20 lbf•ft).
12. After the last hex nut is tightened to 27 N•m (20 lbf•ft), all of the hex nuts should be tightened again to 27 N•m (20 lbf•ft) in a circular pattern around the bolt circle.
13. Once completed, no more tightening is recommended.
14. Mount the actuator on the desuperheater following the procedures in the Installation section.

Casing-Mounted Adjustable Down Travel Stops

The adjustable down travel stop (figure 8) limits the actuator stroke in the downward direction. To adjust, first relieve actuator loading pressure before removing the travel stop cap (key 187). Then loosen the jam nut and adjust the stop nut (keys 189 and 54) either down on the stem to limit travel, or up on the stem to allow more travel. Lock the jam nut against the stop nut, then replace the closing cap.

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 figure 8.

Disassembly for Casing-Mounted Travel Stop

Bypass the desuperheater. Reduce the loading pressure to atmospheric and remove the tubing, or piping, from the connection in the body (key 142).

Casing-Mounted Adjustable Down Travel Stops

⚠ WARNING

To avoid personal injury from the precompressed spring force thrusting the upper diaphragm casing (key 1) away from the actuator, relieve spring compression (step 1 and 2), and carefully remove casing cap screws (key 22, step 3).

1. Thread the spring adjuster (key 12) out of the yoke (key 9) until all spring compression is relieved.
2. Remove the travel stop cap (key 187). Unscrew the jam nut and stop nut (keys 189 and 54) until the travel stop assembly is no longer compressing the spring. Remove the jam nut and stop nut.

3. Remove the upper diaphragm casing (key 1, figure 7) as outlined in the Maintenance section.
4. Remove the cap screws (keys 141) and separate the travel stop assembly from the upper casing.
5. Remove and inspect the O-rings (key 139); replace if necessary.
6. For all actuator sizes: Loosen the stop nut (key 54), then unscrew the travel stop stem (key 133) out of the actuator stem. The lower diaphragm plate can now be removed.

Assembly for Casing-Mounted Travel Stop

1. Reassemble the up or down travel stop in the reverse order of the disassembly steps, being sure to apply lithium grease as shown by the lubrication boxes (key 241) in figures 7 or 9 as appropriate.
2. Readjust the travel stop to obtain the appropriate restriction by following the adjustment procedures presented in the introductory portion of the Casing-Mounted Adjustable Travel Stops section. Return the unit to operation.

Parts Ordering

Each actuator has a serial number stamped on the nameplate. Always mention this number when corresponding with your Emerson sales office regarding technical information or replacement parts.

⚠ WARNING

Use only genuine Fisher replacement parts. Components that are not supplied by Emerson Automation Solutions should not, under any circumstances, be used in any Fisher actuator, because they may void your warranty, might adversely affect the performance of the actuator, and could cause personal injury and property damage.

Parts Kits

Kits for Top-Mounted Handwheels

Retrofit kit includes parts to add a top-mounted handwheel. Kit 1 includes the handwheel assembly only. Kit 2 includes Kit 1 and a new diaphragm case that is required to mount the handwheel assembly.

Kit 1 Description	Thread Size	Part Number
Size 40i	1/4 NPT	38A1209X032
	1/2 NPT	CF
Sizes 46i and 60i	1/4 NPT	32B0262X012
	1/2 NPT	CF
Kit 2 Description	**Thread Size**	**Part Number**
Size 40i	1/4 NPT	38A1209X042
	1/2 NPT	CF
Sizes 46i and 60i	1/4 NPT	32B0262X022
	1/2 NPT	CF

Kits for Adjustable Down Travel Stops

Retrofit kit includes parts to add an adjustable down travel stop. Kit 1includes the adjustable down travel stop assembly only. Kit 2 includes Kit1 and a new diaphragm case that is required to mount the adjustable down travel stop assembly.

Kit 1 Description	Thread Size	Part Number
Size 40i	1/4 NPT	BV8054X0042
	1/2 NPT	BV8054X0052
Sizes 46i and 60i	1/4 NPT	BV8054X0062
	1/2 NPT	CF
Kit 2 Description	**Thread Size**	**Part Number**
Size 40i	1/4 NPT	BV8054X0012
	1/2 NPT	BV8054X0022
Sizes 46i and 60i	1/4 NPT	BV8054X0032
	1/2 NPT	CF

Parts List

Note
Contact your Emerson sales office for part numbers.

Actuator Assembly (figure 7)

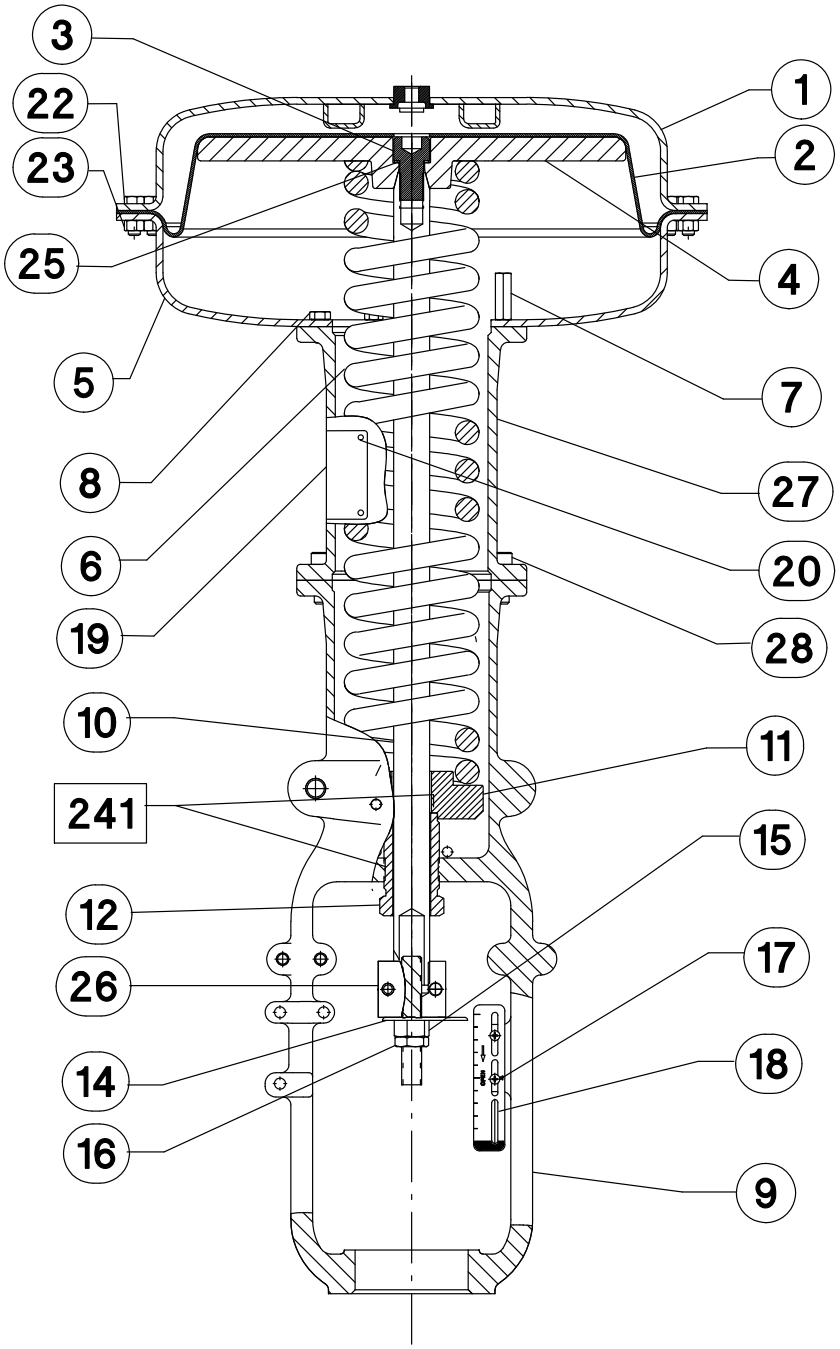
Key	Description
1	Upper Diaphragm Casing
2*	Diaphragm
3	Cap Screw
4	Diaphragm Plate
5	Lower Diaphragm Casing
6	Actuator Spring
7	Travel Stop Cap Screw
8	Cap Screw
9	Yoke
10	Actuator Stem
11	Spring Seat
12	Spring Adjuster
13	Lower Diaphragm Plate
14	Travel Indicator Disk
15	Stem Nut
16	Stem Jam Nut
17	Self-Tapping Screw
18	Travel Indicator Scale
19	Nameplate
20	Drive Screw
22	Cap Screw
23	Hex Nut
24	Twin Speed Nut
25(1)	Washer
26	Stem Connector Assy
28	Screw
27	Yoke Extension
30	Indicator Adaptor
31	Machine Screw
32	Washer
33	Pipe Bushing
241	Lubricant, Lithium Grease (not furnished with the actuator)
249	Warning Nameplate

Top Mounted Handwheel (figure 7)

Key	Description
51	Handwheel
54	Stop Nut
133	Handwheel Stem
135	Pusher Plate
137	Casing-Mounted Travel Stop Locknut
138*	O-Ring
139*	O-Ring
140	Groove Pin
141	Cap Screw
142	Body
164	Body Extension
171(2)	Thrust Bearing
241	Lubricant, Lithium Grease (not furnished with actuator)
244	Lubricant, Anti-Seize (not furnished with handwheel)
246(2)	Spacer
247	Cotter Pin

*Recommended spare parts
1. Key 25 not part of size 40i constructions
2. Key 171 and 246 not part of size 40i constructions.

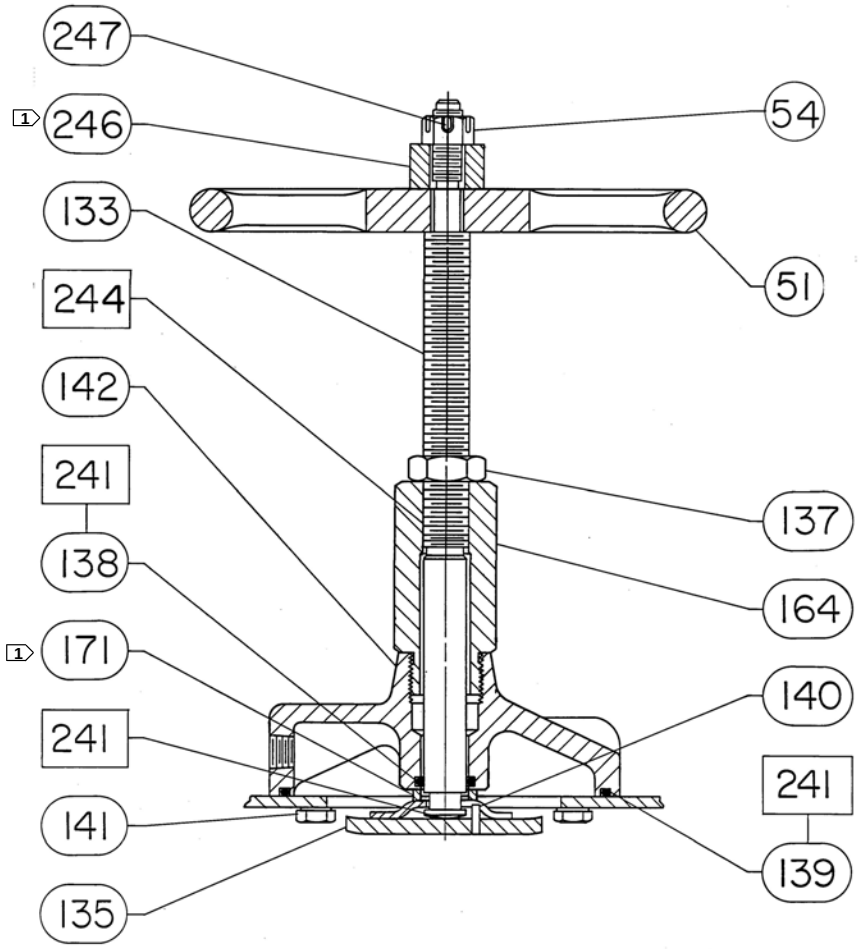
Figure 7. Fisher 657C Actuator Sizes 40i through 60i



☐ **APPLY LUB**
PARTS NOT SHOWN: KEY 7, 24, AND 249

NOTE:
1 KEY 25 IS NOT PART OF SIZE 40i CONSTRUCTIONS.

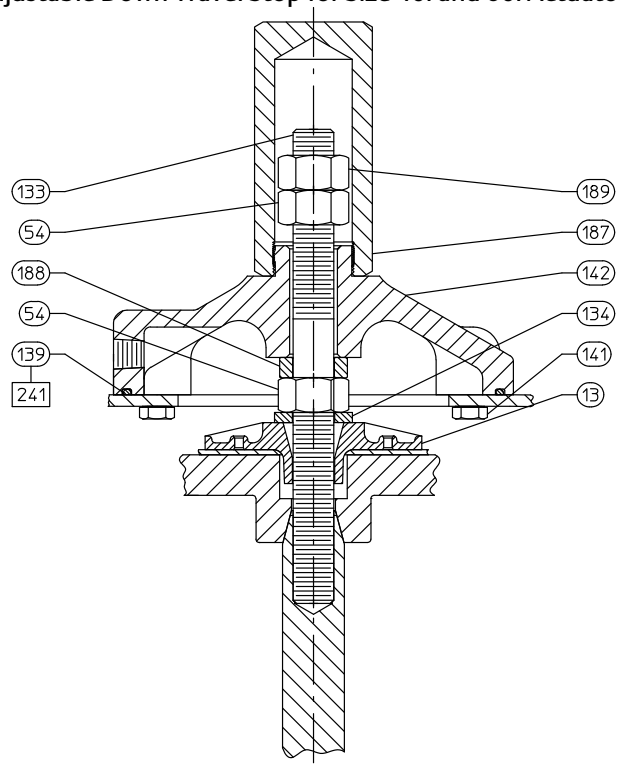
Figure 8. Top-Mounted Handwheel Assembly for Size 40i through 60i Actuators



☐ **APPLY LUB**

NOTE:
1 KEY 171 AND 246 ARE NOT PART OF SIZE 40I CONSTRUCTIONS.

Figure 9. Casing-Mounted Adjustable Down Travel Stop for Size 40i and 60i Actuators



☐ **APPLY LUB**

Casing-Mounted Adjustable Down Travel Stop (figure 8)

Key	Description
54	Stop Nut
133	Travel Stop Stem
134	Washer
139*	O-RIng
141	Cap Screw
142	Body
187	Travel Stop Cap
189	Jam Nut
241	Lubricant, Lithium Grease (not furnished with actuator)

*Recommended spare parts

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