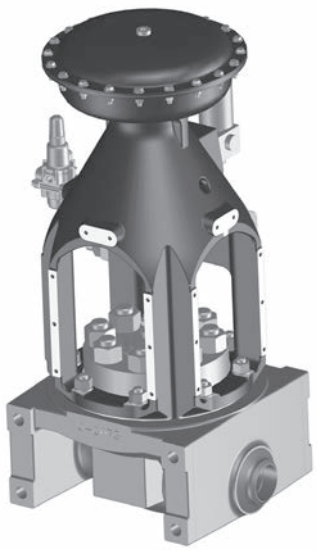
Fisher™ 657NS2 Diaphragm Actuators Size 45, 70, and 80

Contents

Figure 1. Fisher 657NS2 Actuator with HPNS Valve



Introduction

Scope of Manual

This manual provides installation, adjustment, maintenance, and parts list information for the Fisher 657NS2 actuator (figure 1). Refer to separate instruction manuals for information regarding the control valve and accessories.

Do not install, operate, or maintain 657NS2 actuators without being fully trained and qualified in valve, 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 Process Management sales office before proceeding.

Table 1. Fisher 657NS2 Specifications

SPECIFICATION		ACTUATOR SIZE		
		45	70	80
Nominal Effective Area	cm^2	677	1419	2065
	$Inch^2$	105	220	320
Yoke Boss		NS2		
		Sizes A, B, and C		
Acceptable Valve Stem Diameters	mm	12.7	19.1	25.4
	Inch	1/2	3/4	1
Maximum Allowable Output Thrust(1)	N	23,352	42,720	88,110
	Lb	5250	9600	19,800
Maximum Travel(5)	mm	51	76	76
	Inch	2	3	3
Maximum Casing Pressure for Actuator Sizing(3)	Bar	3.4	3.8	4.9
	Psig	50	55	70
Maximum Diaphragm Casing Pressure(2, 3)	Bar	4.1	4.5	5.5
	Psig	60	65	80
Material Temperature Capabilities(3, 4)	-40 to 82°C (-40 to 180°F) with EPDM diaphragm			

1. Do not exceed maximum allowable valve stem load when applying maximum allowable thrust.
2. Maximum allowable diaphragm casing pressure may be used only when maximum allowable stem forces are not exceeded.
3. The pressure and temperature limitations in this manual, and any applicable code limitation, should not be exceeded.
4. EPDM may be used up to 121°C (250°F), but with reduced life. Contact the factory for more information.
5. Actuator travel may be less than maximum when connected to a valve with a shorter travel. See the actuator nameplate for the actuator travel.

Table 2. Diaphragm Casing Volumes, cm^3 ($Inch^3$)

ACTUATOR SIZE	CLEARANCE VOLUME, cm^3 ($INCH^3$)	TRAVEL, mm (INCH)						
		11 (0.4375)	16 (0.625)	19 (0.75)	29 (1.125)	38 (1.5)	51 (2)	76 (3)
45	1556 (95)	---	2786 (170)	2999 (183)	3720 (227)	4424 (270)	5408 (330)	---
70	3490 (213)	5244 (320)	5948 (363)	6424 (392)	7833 (478)	9242 (564)	11110 (678)	14879 (908)
80	9833 (600)	---	---	---	15568 (950)	17698 (1080)	20320 (1240)	25236 (1540)

Table 3. Actuator Stem Assembly Bolt Torque Values

ACTUATOR SIZE	TORQUE	
	N•m	Lbf•Ft
45	271	200
70	271	200
80 (key 132A)	650	480
80 (key 132B)	407	300

Table 4. Actuator Mounting Bolt Torque Values

ACTUATOR SIZE	ACTUATOR MOUNTING STUD BOLT TORQUE	
	N•m	Lbf•Ft
45	292	215
70	292	215
80	292	215

Description

The 657NS2 actuator is a direct-acting, spring-opposed diaphragm actuator used for operation of automatic control valves. The 657NS2 actuator yoke construction and special yoke-to-body or yoke-to-bonnet bolting provides a high structural resonant frequency that exceeds most nuclear service seismic requirements.

Specifications

Tables 1 through 4 provide specifications for the various sizes of 657NS2 actuators discussed in this instruction manual. All torque values given are ± 5%, unless otherwise specified. Specific actuator information is found on the actuator yoke nameplate.

Maximum Pressure Limitations

The casing and diaphragm of 657NS2 actuators are pressure operated. This air pressure provides energy to compress the spring, to stroke the actuator, and push the diaphragm to close the valve. The following explanations describe the maximum pressure limits for an actuator. Refer to table 1 for maximum values.

⚠ WARNING

To avoid personal injury or parts damage, do not exceed the Maximum Pressures listed in table 1. Exceeding any of the maximum pressures can result in uncontrolled movement of parts, damage to actuator parts and the control valve, and loss of control of the process. Use pressure-limiting or pressure-relieving devices to prevent casing pressure from exceeding these limits.

- Maximum Diaphragm Pressure for Actuator Sizing: This is defined as the maximum pressure that can be applied to stroke the actuator, overcome unbalance forces, and provide seat load.
- Maximum Diaphragm Casing Pressure: If the maximum diaphragm casing pressure is exceeded, damage to the diaphragm, casing, or actuator may result. This pressure is not to be used for normal operating pressure.

⚠ WARNING

To avoid personal injury or parts damage, do not exceed the Maximum Diaphragm Casing Pressure listed in table 1. The Maximum Diaphragm Casing Pressure must not produce a force on the actuator stem greater than the maximum allowable actuator output thrust or the maximum allowable stem load.

Principle of Operation

The 657NS2 actuator positions the valve plug in response to varying pneumatic loading pressure on the actuator diaphragm. Figure 2 shows the operation of these actuators. The actuator stem moves down as the loading pressure is increased on the top of the diaphragm. As the loading pressure is decreased, the spring forces the actuator stem up.

The spring and diaphragm have been selected to meet the requirement of the application, and in service, the actuator should produce full travel of the valve with the diaphragm pressure as indicated on the nameplate.

Lifting Guidelines

CAUTION

Loads must be applied only in the plane of the eye. If the plane of the eyebolt is not aligned with the load, estimate the amount of unthreading necessary to properly align the eye. Remove the eyebolt and add shims to adjust the angle of the plane of the eye. The load should never be applied at more than a 45 degree angle from the bolt centerline. Refer to eyebolt manufacturer's instruction manual for further details.

The quantity of eyebolts for lifting purpose is the minimum recommendation. More eyebolts can be used per customer experience.

⚠ WARNING

Always read, understand, and follow instructions. Failure to do so can result in severe injury or death. Never stand, work or crawl under the load. The load could swing, pieces could drop, or the load could fall or slip. Allow for this possibility by establishing a safe distance between yourself and the load.

Lifting Valve/Actuator Assembly

To lift the valve/actuator assembly, eyebolts should be used. Insert four 3/8 inch shouldered pattern eyebolts positioned 90 degrees apart on the diaphragm casing flange for size 45 and 70. Use six 7/16 inch shouldered pattern eyebolts positioned 60 degrees apart on the diaphragm casing flange for size 80. Two nuts are required with one on each side of the diaphragm casing flange. A longer strap is recommended, so that the angle between the straps connecting each eyebolt can be smaller, which helps the eyebolts hold more weight. The eyebolt should be ASTM A489-K04800 or stronger material. Use protective pads between the strap and casing to help prevent damage to the painted surface. A single hoist lift point on the strap will balance and lift the valve/actuator assembly in a level manner. If necessary, use an additional sling around the valve inlet and outlet or around actuator legs for body stabilization.

Lifting Valve Only

To lift the valve, eyebolts should be used. Insert 3/4-10 shouldered pattern eyebolts into two threaded holes located on the top of the NPS 1-4, and NPS 6 valve bodies, positioned 180 degrees apart. For NPS 8 valve bodies, insert two 3/4-10 shouldered pattern eyebolts into two threaded holes located on the top of the bonnet, positioned 180 degrees apart. The eyebolt material should be ASTM A489-K04800 or stronger material. Be sure at least 90% of the threads are engaged in the receiving hole, with a minimum thread engagement of at least 1-1/2 times the thread diameter in steel. If necessary, place two nylon slings around the inlet and outlet of the valve body for stabilization. Use padding as needed to protect any painted surfaces. The valve can now be lifted using a hoist capable of leveling the lifting points.

Lifting Actuator Only

To lift the actuator and accessories, eyebolts should be used. Insert two 3/8 inch shouldered pattern eyebolts positioned 180 degrees apart on the diaphragm casing flange for size 45 and 70. Use four 7/16 inch shouldered pattern eyebolts positioned 90 degrees apart on the spring casing for size 80. Two nuts are required with one on each side of the diaphragm casing flange. The eyebolt material should be ASTM A489-K04800 or stronger material. Use protective pads between the strap and casing to help prevent damage to the painted surface. A single hoist lift point on the strap will balance and lift the actuator in a level manner.

Installation

The diaphragm actuator is normally shipped mounted on a valve body. Follow the valve body instructions when installing the control valve in the pipeline. For information on mounting valve accessories, refer to the appropriate valve accessories instruction manual.

⚠ 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.

⚠ WARNING

If the control valve and actuator are installed with the actuator in any position other than vertical, the actuator may not conform with safety-related qualifications. Nonvertical orientation should be part of existing qualification analysis on file at the plant site to ensure conformance with safety-related qualifications. Certain nonvertical orientations can cause water to collect in the yoke and actuator spring areas, eventually causing degradation in product performance.

Note

The 657NS2 actuator is intended to mount to Fisher HPNS valves. Actuators mount to the valve body on NPS 1 through NPS 6 valves. The actuator mounts to the bonnet on NPS 8 valves.

If the actuator and control valve body are separate, mount the 657NS2 actuator on the valve body by following the procedures in the Mounting the Actuator on the Valve section of this manual.

Mounting the Actuator on the Valve

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.

The 657NS2 actuator spring loading pushes the actuator stem up towards the actuator diaphragm. This spring action moves the stem away from the valve while installing the actuator.

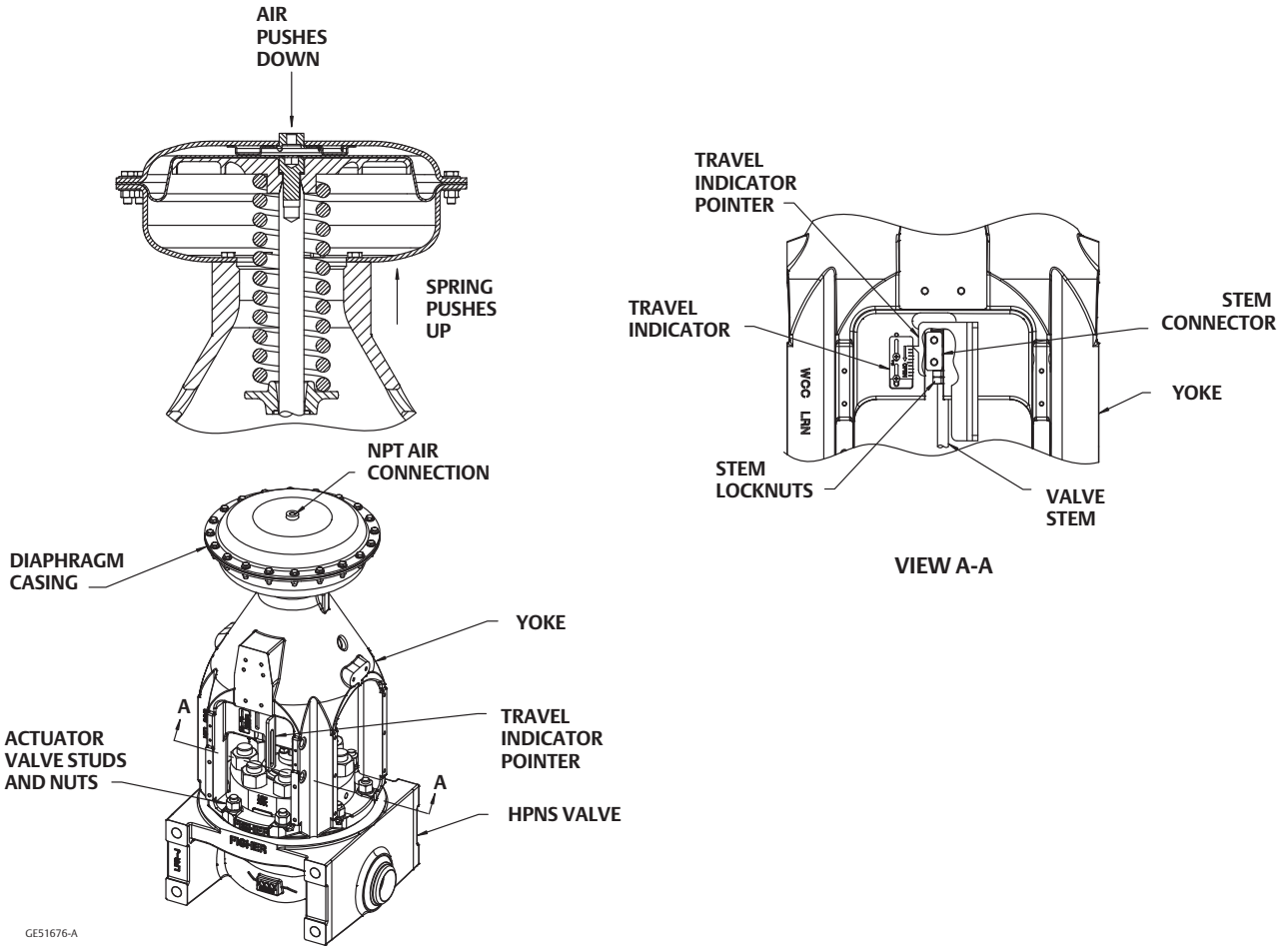
Refer to figures 2, 4, and 5.

1. Provide a vise or some other method of supporting the valve and the weight of the actuator during assembly. Push the valve stem down away from the actuator while mounting the actuator.
2. Thread the stem locknuts (key 115) all the way onto the valve stem (key 4).
3. Coat the threads of the actuator mounting studs (key 101) with Nuclear Grade Never-Seez® (key 27) up to the deformed thread. Thread the actuator mounting studs (key 101) into the valve body (key 1) until the deformed thread prevents further insertion.
4. Place the actuator on top of the valve with the Fisher logo on the same side as the Fisher logo on the bonnet. If the assembly has a Type III drawing, mount the actuator as shown on that drawing.
5. Coat the remaining threads of the actuator mounting studs (key 101) and the contact faces of the nuts (key 102) with Nuclear Grade Never-Seez (key 27). Place the washers (key 143) over the studs (key 101) and thread the nuts (key 102) onto the studs (key 101) and hand tighten. Torque the actuator mounting nuts (key 102) evenly in a criss-cross pattern to 292 N • m (215 lbf • ft).
6. 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 Adjustment procedures below, to verify that the actuator is still adjusted correctly.

Loading Connection

1. Connect the loading pressure piping to the NPT internal connection in the top of the upper diaphragm casing.
2. For size 70 actuators, remove the 1/4-inch bushing in the 1/2 NPT internal connection to increase connection size, if necessary.
3. 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 accessory instruction manual as necessary.
4. Cycle the actuator several times to check that the valve stem travel is correct and that the travel occurs when the correct pressure range is applied to the diaphragm.
5. If valve stem travel is incorrect, refer to the Travel Adjustment procedure in the Adjustments section.
6. If the pressure range is incorrect, refer to the Bench Set procedure in the Adjustments section.

Figure 2. Schematic and Stem Connection Details for Fisher 657NS2



Adjustments

Travel Adjustment

⚠ 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 control valve assembly parts.

Make travel adjustments when the motion observed during actuator travel is different from the travel stamped on the actuator nameplate. If the Mounting the Actuator on the Valve procedure was followed correctly, this adjustment should not be necessary.

1. Back the stem locknuts away from the stem connector, and slightly loosen the stem connector cap screws.

CAUTION

Do not use wrenches or other tools directly on the valve stem. Damage to the stem surface and subsequent damage to the valve packing might result.

2. Tighten the locknuts together using a wrench, then screw the valve stem either into the stem connector to lengthen travel or out of the stem connector to shorten travel.
3. Cycle the actuator to check the travel. If actual travel is not equal to the specified travel, adjust and check travel until correct. Tighten the stem connector cap screws when correct travel is obtained.
4. Thread the stem locknuts against the stem connector.

Bench Set

Discussion of Bench Set

The bench set pressure range is used to adjust the initial compression of the actuator spring with the actuator assembly "on the bench". The correct initial compression ensures that the valve-actuator assembly will function properly when it is put in 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 (see the Mounting the Actuator on the Valve procedure) by making the adjustment before the actuator is connected to the valve.

If you are adjusting to 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 such that 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, determine valve friction as described below:

1. Install a pressure gauge in the supply 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. Record 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. Record 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:

$$\begin{matrix}\textit{Friction}\\ \textit{Force,}\\ \textit{pounds}\end{matrix} = 1/2 \begin{pmatrix}\textit{Difference}\\ \textit{in pressure}\\ \textit{readings, psig}\end{pmatrix} \times \begin{pmatrix}\textit{Effective}\\ \textit{diaphragm area,}\\ \textit{inches}^2\end{pmatrix}$$

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 the zero or at the full travel position, ensure that the readings are taken when the travel just begins or just stops at the position selected.

The spring adjusting screw is difficult to rotate when the full actuator loading pressure is applied to the actuator. Release the loading pressure before adjusting, then re-apply loading pressure to check the adjustment.

Bench Set Adjustments

Ensure that the actuator stem is at the top of its travel and not connected to the valve.

Note

Some spring compression may be required to ensure that the actuator stem is at the top of its travel and not connected to the valve.

⚠ 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 control valve assembly parts.

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.

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 product damage, it is important to be sure that the actuator assembly is not binding or producing any loading friction on the actuator stem movement.

Key numbers are shown in figures 4 and 5.

1. If not already accomplished, push the valve stem down away from the actuator to the closed position.
2. Connect an unpressurized, regulated air hose to the port on the top of the upper diaphragm casing.
3. Slowly increase the pressure on the top of the diaphragm (key 105) from 0 bar (0 psig) towards the lower bench set pressure while checking for the first movement of the actuator stem (key 125). The actuator stem (key 125) should show movement at the lower bench set pressure.

Note

Before turning the spring adjusting screw, assemble the stem connector around the actuator stem and put the long piece of the stem connector into the anti-rotating slot 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 bench set pressure is reached, adjust the spring adjusting screw (key 127). Turn it clockwise to increase the preload in the spring (key 110) or turn it counterclockwise to decrease the preload in the spring until the first movement of the actuator stem (key 125) is first detected at the lower bench set pressure.

5. Slowly increase the pressure on the top of the diaphragm (key 105) until the upper bench set pressure is reached.
6. Mark a line on the actuator stem (key 125) and another on the leg of the actuator yoke or yoke/casing assembly (key 109), making sure the lines are level.
7. Slowly decrease the pressure on the top of the diaphragm (key 105) until the lower bench set pressure is reached.
8. Measure the distance between the two lines. This distance should be equal to the rated valve travel.
9. If the distance is correct, bench set is complete. Proceed to the Installing the Stem Connector Assembly subsection.
10. If this distance differs from the rated valve travel, verify that the correct spring and actuator stem are being used and verify that the upper bench set pressure is correct. Remember the free-length and load rate tolerances for the spring may produce a slightly different span than specified. Contact your Emerson Process Management sales office for assistance. After replacing the spring, repeat the steps above.
11. Bleed the pressure from the top of the diaphragm (key 105), and remove the air hose from the port in the upper diaphragm casing.

Installing the Stem Connector Assembly

When installing the stem connector assembly (key 103), the actuator and valve stem threads should engage the threads of the stem connector by a distance equal to the diameter of the stem.

1. If necessary, push the valve stem down so that the valve plug is touching the seat ring on direct-acting valves.

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.

2. If necessary, screw the valve stem locknuts down, away from the connector location.
3. Slowly increase the diaphragm pressure to the upper bench set pressure. 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 (key 103B) with the threaded holes, approximately halfway between the actuator and valve stems. Refer to figures 4 and 5 to help locate the connector position.

⚠ WARNING

Incomplete engagement of either the valve stem or actuator stem in the stem connector can result in stripped threads, loss of process control, and/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.

5. Attach the other stem connector half (key 103A) with the anti-rotator in the groove on the yoke and insert the hex cap screws (key 103C) and tighten them. If the actuator is to be used with a positioner, the positioner feedback bracket will be held in place on the stem connector bolt half (key 103A) by the hex cap screws (key 103C). Secure the stem connector assembly with the hex cap screws (key 103C). Torque the cap screws (key 103C) to the value in table 5.

Table 5. Stem Connector Torque Specifications

Actuator Size	Stem Connector Torque	
	N • m	lbf • ft
45	41	30
70	41	30
80	102	75

6. Release pressure from the actuator casing. Screw the valve stem locknuts (key 115) up until the upper one contacts the bottom of the stem connector assembly (key 103). Do not overtighten the locknuts.
7. Apply Loctite 242 (key 185) to hex cap screws (key 147). Attach the proximity switch target mounting bracket (key 148) to the stem connector half (key 103B) using the hex cap screws (key 147) and washers (key 146) (for size 80 only). Center the bracket vertically on the stem connector and tighten the hex cap screws, torque to 23 N • m (17 lbf • ft) for size 80, or torque to 91 N • m (67 lbf • ft) for size 45 and 70. Adjust the travel scale vertically to align the open mark on the scale with the pointer on the bracket and tighten the mounting screws.
8. Apply pressure to the actuator to ensure the valve strokes to full travel. If not, repeat the stem connector procedure.
9. Release pressure from the actuator. Be sure that the valve stem (key 4) fully retracts to the open position.

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.

⚠ WARNING

To avoid personal injury due to the sudden, uncontrolled movement of parts, do not loosen the cap screws when the stem connector has spring or loading pressure force applied to it.

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 3). Each actuator spring has a fixed spring rate (force). You have verified that the correct spring was installed in the actuator by completing the Bench Set 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:

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

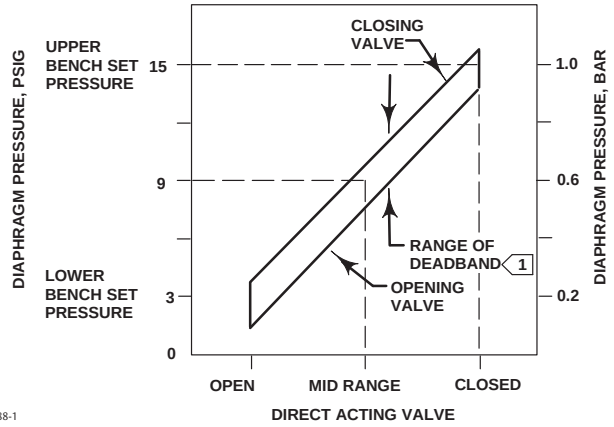
Deadband Adjustments

1. Monitor loading pressure carefully when making adjustments. Do not exceed the maximum pressure specifications of either the loading regulator or the actuator casings (refer to table 1 for Maximum Diaphragm Casing Pressure).
2. Each actuator spring has a fixed pressure span. Changing the spring compression shifts the span up or down to make valve travel coincide with the loading pressure range.

3. For sizes 45 and 70, turn the spring adjusting screw (key 127, figure 4) into the yoke to shift the span up or turn the spring adjustor out of the yoke to shift the span down. For size 80, remove the spring adjusting screw cover (key 138, figure 5) by removing the cap screws (key 139, figure 5) and washer (key 189, figure 5). Then rotate the spring adjusting screw (key 127, figure 5) to shift the span.

For successful operation, the actuator stem and valve plug stem must move freely in response to the loading pressure change on the diaphragm.

Figure 3. Typical Valve Response to Deadband



NOTE:
1 DEADBAND IS CAUSED BY FRICTION.

Operation

In a direct-acting diaphragm actuator, an increasing loading pressure causes the actuator stem to move downward, compressing the spring. When the diaphragm pressure is decreased, the spring moves the actuator stem upward. This is shown graphically in figure 2. In the event of failure of the loading pressure to the diaphragm of the actuator, the actuator stem moves to the extreme upward position. Thus, the control valve will open on failure of the loading pressure.

The nameplate attached to the yoke of the actuator provides information about the specific construction and operating range. The spring and diaphragm have been selected to meet the requirements of the application, and in service, the actuator should create full travel of the valve plug when the diaphragm pressure (operate) range indicated on the nameplate is applied.

The nameplate specifies a bench set pressure range in addition to a diaphragm pressure (operate) range. The bench set range is that pressure range required to stroke the valve fully without any pressure in the body and no packing friction, as would be the case if the valve were set on the work bench. However, in service, with the specified pressure drop applied across the valve, it should stroke over the diaphragm pressure (operate) range indicated on the nameplate.

When the control valve and actuator are installed, the actuator should be checked for correct travel, freedom from excessive friction, and correct action (air-to-close) to match the controlling instrument. For successful operation, the actuator stem and the valve plug stem must move freely in response to the loading pressure change on the diaphragm.

Maintenance

Normally, only the elastomeric parts and the spring of the 657NS2 actuator require inspection or replacement. The maintenance instructions are divided into three subsections: Replacement of the Elastomeric Parts, Disassembly, and Assembly. Perform only those steps applicable to the actuator size and required maintenance.

All maintenance operations can be performed with the valve in the line.

It is recommended that the diaphragm and all of the other elastomeric parts of the 657NS2 actuator be inspected every two outages. The absolute maximum replacement period for any of the elastomeric parts is six years.

⚠ 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 valve while the valve 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 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 precompression.**
- **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.**
- **Check with your process or safety engineer for any additional measures that must be taken to protect against process media.**

Replacement of the Elastomeric Parts

Size 45 and 70 Actuators

Perform the following if it is desired to replace only the elastomeric parts of the 657NS2 actuator, and no other maintenance is necessary. The diaphragm is the only elastomeric part in the size 45 and 70 actuators. Key number references are shown in figure 4 for size 45 and 70 actuators.

1. 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. Reduce the actuator loading pressure to atmospheric pressure, and remove the tubing or piping from the top of the upper diaphragm casing (key 104).
2. Remove the cap screw (key 194). Thread the adjusting screw (key 127) out of the yoke (key 109) until all spring compression is relieved. To aid in assembly, record the position of the adjusting screw (key 127) on the actuator stem (key 125).
3. Remove the diaphragm casing cap screws, nuts, and washers (keys 119, 120, and 145), and lift off the upper diaphragm casing.
4. Take out the diaphragm (key 105), and install a new one.

Note

When you replace actuator diaphragms in the field, take care to ensure the diaphragm casing cap screws 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 45 and 70 actuators.

CAUTION

Overtightening the diaphragm casing cap screws and nuts (keys 119 and 120) can damage the diaphragm. Do not exceed a torque of 27 N•m (20 lbf•ft) when performing this tightening procedure.

Note

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

5. Place the upper diaphragm casing (key 104) into position, and replace the diaphragm casing cap screws, washers, and nuts (keys 119, 145, and 120). Tighten the hex nuts (key 120) 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).
6. Tighten the remaining hex nuts in a clockwise, crisscross pattern to 13 N•m (10 lbf•ft).
7. Repeat this procedure by tightening four hex nuts, diametrically opposed and 90 degrees apart, to a torque of 27 N•m (20 lbf•ft).
8. Tighten the remaining hex nuts in a clockwise, crisscross pattern to 27 N•m (20 lbf•ft).
9. 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.
10. Once completed, no more tightening is recommended.
11. Apply NyoGel 718B (key 149) onto the slot of the actuator stem (key 125). Thread the spring adjusting screw (key 127) into the yoke (key 109) so that it matches the position recorded during disassembly. Apply Loctite 242 (key 185) to cap screws (key 194). Thread it into the hole on the hex head of the spring adjusting screw. If necessary, keep rotating the spring adjusting screw into the yoke for less than ½ turn, making sure the cap screw engages with the slot in the actuator stem. Torque the cap screw to 23 N•m (17 lbf•ft).
12. Replace the tubing or piping to the top of the upper diaphragm casing.

Size 80 Actuators

The elastomeric parts in a size 80 actuator include the diaphragm and O-rings. Since replacement of these parts necessitates complete disassembly, perform the steps outlined in Size 80 Actuators, disassembly and assembly procedures.

Disassembly

Size 45 and 70 Actuators

Key number references are shown in figure 4 for size 45 and 70 actuators.

1. 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. Reduce the actuator loading pressure to atmospheric pressure, and remove the tubing or piping from the top of the upper diaphragm casing (key 104).
2. To aid in assembly, record the position of the spring adjusting screw (key 127) relative to the actuator yoke (key 109). Remove the cap screw (key 194). Thread the spring adjusting screw out of the yoke until all spring compression is relieved.
3. If necessary, remove the actuator from the valve body by separating the stem connector (key 103) and removing the eight stud bolt nuts and washers (keys 102 and 143). Separate the stem connector by loosening the stem hex nuts (key 115) and unscrewing the two cap screws.
4. Remove the diaphragm casing cap screws, nuts, and washers (keys 119, 120, and 145), and lift off the upper diaphragm casing (key 104).
5. Take out the molded diaphragm (key 105).
6. The diaphragm plate and actuator stem (keys 108 and 125) can be taken out of the yoke as an assembly. This assembly can be further disassembled, if desired, by removing the diaphragm head hex screw (key 112) and washer (key 137).
7. Take out the actuator spring (key 110) and the spring seat (key 121).

8. The lower diaphragm casing (key 122) can be removed from the yoke, if required, by removing the cap screws (key 114) that hold the lower diaphragm casing in place.
9. Unscrew the spring adjusting screw (key 127) from the yoke to complete the disassembly.

Size 80 Actuators

Key number references are shown in figure 5.

1. Bypass the control valve. Reduce the actuator loading pressure to atmospheric pressure, and remove the piping or tubing from the upper diaphragm casing connection. Use lock-out procedures to ensure that the above measures stay in effect while you work on the equipment.
2. Remove the hex cap screws, washers, and adjusting screw cover (keys 139, 189, and 138).
3. Unbolt the cap screws and washers (keys 114 and 144), and remove the spring case assembly (key 131) with guide bushing (key 140). If desired, remove the snap ring (key 124) and slide the guide bushing (key 140) out of the spring casing assembly (key 131). Inspect the guide bushing for wear and replace if necessary.
4. Measure and record the distance from the top of the casing flange/upper casing assembly (key 141) and the top of the spring adjusting screw (key 127).
5. Remove the stem connector cap screws (key 103C) and stem connector halves (keys 103A and 103B). If necessary, the actuator may be removed from the valve body by removing the valve body/ bonnet stud hex nuts and washers (keys 102 and 143).
6. Remove the hex jam nut (key 135), spring adjusting screw (key 127), the stud (key 188), the spring seat (key 121), and the spring seat bearing and race (keys 130 and 129).
7. Remove the actuator spring (key 110).
8. Unbolt the diaphragm casing cap screws, hex nuts, and washers (keys 119, 120, and 145), and lift the casing flange/upper casing assembly with seal bushing (key 116) straight up until clear of the actuator stem (key 125).
9. Remove the snap ring (key 124) and slide the seal bushing (key 116) out of the casing flange/upper casing assembly (key 141). Inspect the seal bushing for wear, and replace if necessary. Remove the seal bushing O-rings (keys 117 and 118).
10. Slide or lift the actuator stem (key 125) with the attached diaphragm plates and diaphragm (keys 107, 108, and 105) out of the actuator.
11. To aid in unscrewing the hex nuts (key 132), attach the stem connector assembly (key 103) onto the actuator stem and grip the stem connector in a vise. This procedure will help secure the actuator stem and help prevent damage.
12. Unscrew the hex nuts (key 132), and slide them, the diaphragm plate (key 108), diaphragm (key 105), and upper diaphragm plate (key 107) off the actuator stem.

Assembly

Size 45 and 70 Actuators

Key number references are shown in figure 4 for size 45 and 70 actuators.

1. Apply Nuclear Grade Never-Seez (key 27) to the threads and spring seat bearing surface of the spring adjusting screw (key 127). Thread the spring adjusting screw (key 127) into the yoke (key 109).
2. Apply Loctite 242 (key 185) to cap screws (key 114). Use the cap screws (key 114) to attach the lower diaphragm casing (key 122) to the yoke. Tighten the cap screws to 41 N•m (30 lbf•ft) for size 45 and 102 N•m (75 lbf•ft) for the size 70.
3. Insert the spring seat (key 121) and spring (key 110) into the yoke. Be sure the spring seat fits squarely on the adjusting screw and that the spring is properly seated in the spring seat.

4. Apply Loctite 242 (key 185) to diaphragm head hex screw (key 112). Assemble the actuator stem (key 125) and the diaphragm plate (key 108) with the diaphragm head hex screw and washer (key 112 and 137). Tighten the cap screw in accordance with table 3.
5. Insert the stem and diaphragm plate as an assembly, making sure that the stem fits inside the adjusting screw and that the spring fits squarely on the diaphragm plate. Orient the slot side of the actuator stem so that it faces towards an open window of the yoke (recommendation is facing to the opening to the right of the word “FISHER” on the yoke).
6. Install a new diaphragm (key 105) if one is required. Otherwise, replace the molded diaphragm (key 105) onto the diaphragm plate so that the molded edge points outward toward the spring (see figure 4) and the word Fisher printed on the diaphragm is visible. Line up the holes in the diaphragm's edge with the diaphragm casing cap screw holes.

Note

When you replace actuator diaphragms in the field, take care to ensure the diaphragm casing cap screws 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 45 and 70 actuators.

CAUTION

Overtightening the diaphragm casing cap screws and nuts (keys 22 and 23) can damage the diaphragm. Do not exceed a torque of 27 N•m (20 lbf•ft) when performing this tightening procedure.

Note

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

7. Place the upper diaphragm casing (key 104) into position, and replace the diaphragm casing cap screws, washers, and nuts (keys 119, 145, and 120). Tighten the hex nuts (key 120) 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).
8. Tighten the remaining hex nuts in a clockwise, crisscross pattern to 13 N•m (10 lbf•ft).
9. Repeat this procedure by tightening four hex nuts, diametrically opposed and 90 degrees apart, to a torque of 27 N•m (20 lbf•ft).
10. Tighten the remaining hex nuts in a clockwise, crisscross pattern to 27 N•m (20 lbf•ft).
11. 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.
12. Once completed, no more tightening is recommended.
13. Apply NyoGel 718B (key 149) onto the slot of the actuator stem (key 125). Thread the spring adjusting screw (key 127) into the yoke so that it is in the same position recorded during disassembly. Continue to rotate the spring adjusting screw (key 127) until a threaded hole on the hex head aligns with the slot on the actuator stem (key 125).
14. Apply Loctite 242 (key 185) to the cap screw (key 194), insert the cap screw into the threaded hole of the spring adjusting screw (key 127) and the slot on the actuator stem (key 125). Tighten the cap screw to 23 N•m (17 lbf•ft).
15. Replace the tubing or piping to the top of the upper diaphragm casing. Mount the actuator, and make the stem connection by following the procedures in the Mounting the Actuator on the Valve section.

Size 80 Actuators

Key number references are shown in figure 5.

1. Carefully slide the upper diaphragm plate (key 107), the diaphragm (key 105), and the diaphragm plate (key 108) onto the actuator stem (key 125). Coat the threads and seat surfaces of the two hex nuts (key 132) with Nuclear

Grade Never Seez (key 27). Thread the two hex nuts (key 132) lightly against the diaphragm plate. To aid in tightening the hex nuts (key 132), attach the stem connector assembly (key 103) onto the actuator stem, and grip the stem connector in a vise. Tighten the first hex nut (key 132A) to approximately 651 N•m (480 lbf•ft) torque. Tighten the second hex nut (key 132B) to 407 N•m (300 lbf•ft) torque. Remove the actuator stem subassembly from the vise, and remove the stem connector assembly (key 103) from this subassembly.

2. Place the actuator stem and attached parts into the lower diaphragm casing. Prop the stem up so that the diaphragm plates are positioned as shown in figure 5.
3. Lubricate the O-rings (keys 117 and 118) and the inside diameter of the seal bushing (key 116) with NyoGel 718B (key 149), as appropriate for the installation. Place the seal bushing and O-rings in the casing flange/upper casing assembly (key 141), and secure the bushing with the snap ring (key 124).
4. Slide the casing flange/upper casing assembly (key 141) over the actuator stem (key 125) and onto the lower diaphragm casing so that all cap screw holes are aligned.

Note

When you replace actuator diaphragms in the field, take care to ensure the diaphragm casing cap screws 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 80 actuators.

CAUTION

Overtightening the diaphragm casing cap screws and nuts can damage the diaphragm. Do not exceed the following maximum torque values for the appropriate diaphragm material:EPDM/Meta-Aramid: 95 N•m (70 lbf•ft); Nitrile, Silicone, FKM (fluorocarbon) / Meta-Aramid: 68 N•m (50 lbf•ft).

Note

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

Table 6. Size 80 Casing Cap Screw Torque Values

DIAPHRAGM MATERIAL	INITIAL TORQUE	FINAL TORQUE
	N•m (lbf•ft)	N•m (lbf•ft)
EPDM / Meta-Aramid	41 (30)	82 ± 13 (60 ± 10)
Nitrile, Silicone, FKM/Meta-Aramid	34 (25)	68 (50)

5. Fasten the two diaphragm casings together with the cap screws, washers, and nuts (keys 119, 145, and 120) and tighten the hex nuts (key 120) in the following manner. The first four hex nuts tightened should be diametrically opposed and 90 degrees apart. Tighten these four hex nuts to the initial torque value found in table 6 for the diaphragm material being used.
6. Tighten the remaining hex nuts in a clockwise, crisscross pattern to the initial torque value found in table 6 for the diaphragm material being used.
7. Repeat this procedure by tightening four hex nuts, diametrically opposed and 90 degrees apart, to the final torque value that is specified in table 6 for the diaphragm material being used.
8. Tighten the remaining hex nuts in a clockwise, crisscross pattern to the final torque value that is specified in table 6 for the diaphragm material being used.
9. After the last hex nut is tightened, complete another tightening sequence. Tighten in a circular pattern around the bolt circle to the final torque value that is specified in table 6 for the diaphragm material being used.
10. Once completed, no more tightening is recommended.
11. Place the spring (key 110) on the casing flange/upper casing assembly (key 141).
12. Place the spring seat (key 121) onto the actuator spring (key 110).

13. Lubricate the spring seat race and bearings (keys 129 and 130) with NyoGel 718B (key 149). Place them on the spring seat. See figure 5.
14. Coat the top threads of the actuator stem (key 125) with Nuclear Grade Never-Seez (key 27). Thread the spring adjusting screw (key 127) and the stud (key 188) onto the actuator stem (key 125) until the distance between the top of the casing flange/upper casing assembly (key 141) and the top of the adjusting screw (key 127) is the same as in step 4 of the Disassembly procedure for size 80 actuators. Thread the hex jam nut (key 135) onto the stud (key 188). Torque to 91 N•m (67 lbf•ft).
15. Coat the inside diameter of the guide bushing (key 140) with NyoGel 718B (key 149). Install the guide bushing (key 140) into the spring case assembly (key 131), and secure the bushing with the snap ring (key 124).
16. Place the spring case assembly (key 131) on the upper diaphragm casing. Apply Loctite 242 (key 185) to the cap screws (key 114). Insert and tighten the cap screws and washers (keys 114 and 144) to 102 N•m (75 lbf•ft).
17. Install the spring adjusting screw cover (key 138) onto the spring casing assembly (key 131) using cap screws (key 139) and washers (key 189). Torque the cap screws to 23 N•m (17 lbf•ft).
18. Mount the actuator, and make the stem connection by following the procedure in the Mounting the Actuator on the Valve section.

Parts Ordering

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

⚠ WARNING

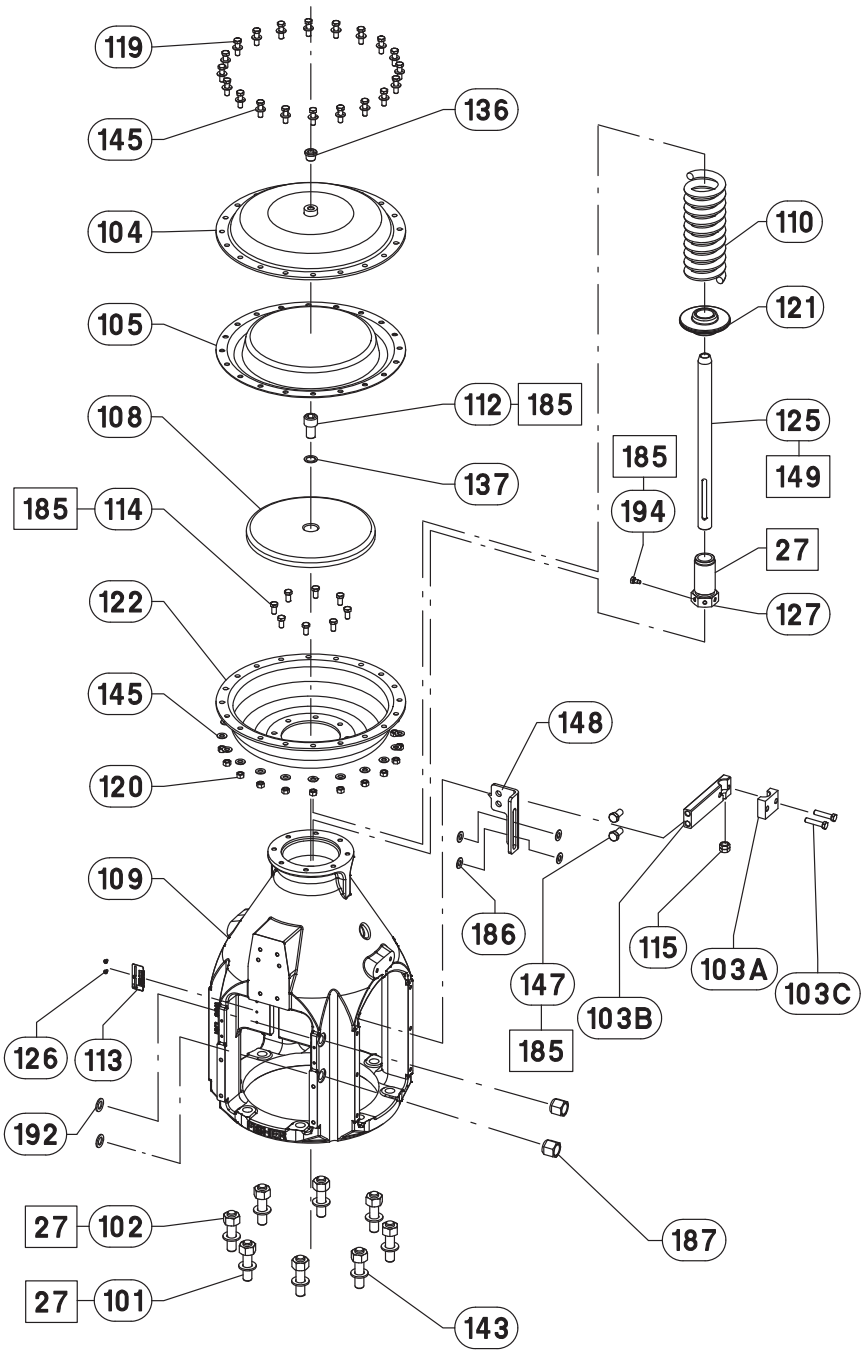
Use only genuine Fisher replacement parts. Components that are not supplied by Emerson Process Management should not, under any circumstances, be used in any Fisher valve, because they may void your warranty, might adversely affect the performance of the valve, and could cause personal injury and property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

Parts List

Key	Description	Part Number
27	Nuclear Grade Never-Seez (not furnished)	
101	Stud, Mounting	see following table
102	Nut, Mounting	see following table
103A	Stem Connector Bolt Half	see following table
103B	Stem Connector Nut Half	see following table
103C	Hex Cap Screw, Stem Connector	see following table
104	Upper Diaphragm Casing	see following table
105*	Diaphragm	see following table
106	Vent Assy., Small	see following table
107	Upper Diaphragm Head	see following table
108	Lower Diaphragm Head	see following table
109	Yoke or Yoke/Diaphragm Casing Assy	see following table
110	Spring	see following table
112	Diaphragm Head Hex Screw	see following table
113	Travel Scale	see following table
114	Hex Cap Screws, Casing	see following table
115	Jam Nut, Valve Stem	see following table
116*	Seal Bushing	see following table
117*	O-ring, Inside	see following table
118*	O-ring, Outside	see following table
119	Hex Cap Screw, Diaphragm Casing	see following table
120	Hex Nuts, Diaphragm Casing	see following table
121	Spring Seat	see following table
122	Lower Diaphragm Casing	see following table
124	Snap Ring	see following table
125	Actuator Stem	see following table
126	Machine Screw, Travel Scale	see following table
127	Spring Adjusting Screw	see following table
129*	Thrust Bearing Race	see following table
130*	Thrust Bearing	see following table
131	Spring Casing Assembly	see following table
132	Hex Jam Nut, Diaphragm Head	see following table
135	Jam Nut	1A3412X0052
136	Pipe Bushing	see following table
137	Washer, Diaphragm Head	see following table
138	Spring Adjusting Screw Cover	see following table
139	Hex Cap Screw, Adjusting Screw Cover	see following table
140*	Guide Bushing	see following table
141	Casing Flange/Upper Casing Assembly	see following table
143	Washer, Mounting Stud	see following table
144	Washer, Casing	see following table
145	Washer, Diaphragm Casing	see following table
146	Washer, Pointer	see following table
147	Hex Cap Screw, Pointer	see following table
148	Travel Pointer	see following table
149	NyoGel 718B (not furnished)	
185	Loctite 242 (not furnished)	
186	Washer, Plain	17B4654X012
187	Adaptor, Switch	GE56473X012
188	Stud	18A6447X022
189	Washer, Plain	1B8659X0042
190	Yoke Cover	see following table
191	Screw, Yoke Cover	see following table
192	Washer, Plain	GE54163X012
194	Screw, Cap, Hex HD	GG17032X012

*Recommended spare parts

Figure 4. Size 45 or 70 Fisher 657NS2 Actuator

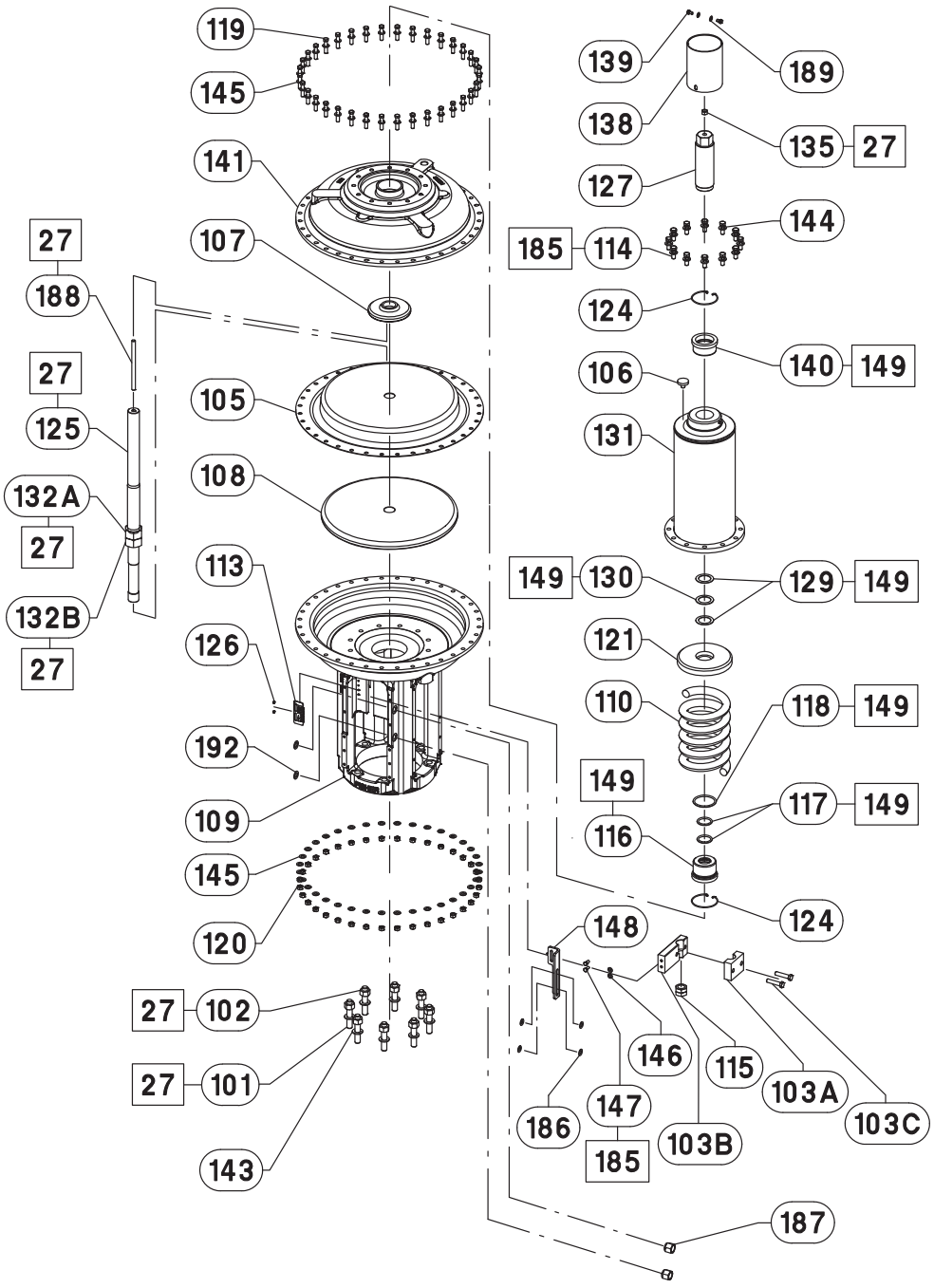


☐ APPLY LUB

NOTE: KEY 136 SIZE 70 ONLY
KEY 190 AND 191 NOT SHOWN

GE49521-E

Figure 5. Size 80 Fisher 657NS2 Actuator



☐ APPLY LUB

KEY 190 AND 191 NOT SHOWN

GE49549-E

657NS2 Troubleshooting

Table 7. 657NS2 Troubleshooting

Problem	Possible Solution
Actuator Stroke is less than full rated travel	Check for debris or damage that may be jamming actuator.
	Ensure the stem connector is assembled as specified.
	Verify bench set for proper actuator spring load. See Discussion of Bench Set in this instruction manual.
	Ensure all parts are intact and assembled as specified.
	Inspect valve, see valve instruction manual.
Air leakage	Verify diaphragm casing bolts are torqued as specified with the proper tightening procedure.
	Disassemble and inspect sealing surfaces and diaphragm on the actuator diaphragm case and yoke, especially the diaphragm for scratches or nicks. Replace damaged parts as needed.
Valve does not move	Ensure the stem connector is assembled as specified.
	Disassemble and inspect the diaphragm casing and check for debris or damage that may be jamming the actuator. Replaced damaged parts as needed.
	Inspect valve, see valve instruction manual.
	Verify bench set for proper actuator spring load. See Discussion of Bench Set in this instruction manual.
	Inspect all air connections for leakage.
Other	Contact Emerson Local Business Partner if more assistance is needed.

Table 8. Fisher 657NS2 Spare Parts*

Part Description / Key No.	Replacement Part Number	Qty	Classification	Spare Part Code(1)	Spare Part Requirement Rationale	Shelf Life	Shelf Life Rationale(2)
Diaphragm, Key 105	Refer to following table	1	Non-Safety Related	O/n	Recommendation to purchase this spare part is based on shelf life restrictions. The diaphragm is a key component within the actuator construction, required to ensure optimal performance over time. Degradation of the diaphragm could lead to inconsistencies with valve operation. Emerson Process Management recommends replacing this component every 6 years.	N/A	See FGS8A31 rev. P for information regarding elastomer shelf life.
O-ring, Key 117	Refer to following table	2(3)	Non-Safety Related	O/n	If the seal bushing must be removed, this O-ring should be replaced.	N/A	See FGS8A31 rev. P for information regarding elastomer shelf life.
O-ring, Key 118	Refer to following table	1(3)	Non-Safety Related	O/n	If the seal bushing must be removed, this O-ring should be replaced.	N/A	See FGS8A31 rev. P for information regarding elastomer shelf life.
Seal Bushing, Key 116	Refer to following table	1	Non-Safety Related	O/n	Cycled parts will exhibit wear over time. Based on experience and testing, Emerson Process Management recommends replacing this component every 12 years.	N/A	Does not exhibit a tendency to degrade over time.
Thrust Bearing Race, Key 129	Refer to following table	2	Non-Safety Related	O/n	Cycled parts will exhibit wear over time. Based on experience and testing, Emerson Process Management recommends replacing this component every 12 years.	N/A	Does not exhibit a tendency to degrade over time.
Thrust Bearing, Key 130	Refer to following table	1	Non-Safety Related	O/n	Cycled parts will exhibit wear over time. Based on experience and testing, Emerson Process Management recommends replacing this component every 12 years.	N/A	Does not exhibit a tendency to degrade over time.
Guide Bushing, Key 140	Refer to following table	1	Non-Safety Related	O/n	Cycled parts will exhibit wear over time. Based on experience and testing, Emerson Process Management recommends replacing this component every 12 years.	N/A	Does not exhibit a tendency to degrade over time.

1. ME/n = construction/installation spares. P/n = preoperational spares. S/n = start-up spares. O/n = operational spares.
2. Dependent on good storage practices and conditions.
3. Not required for all constructions.

*Recommended spare parts

Table 9. Keys 101 and 143 Yoke Mounting Studs and Washers

ACTUATOR SIZE	VALVE SIZE, NPS	DATA SHEET(1)	QUANTITY	STUD SIZE, INCH	KEY 101 MOUNTING STUD PART NUMBER	MATERIAL	KEY 143 WASHER PART NUMBER
45B	3	116	8	3/4-10 x 3.5	1B958831012	SA 193 B7	1A375738982
70C	6	121	8	3/4-10 x 3.75	1K552131012	SA 193 B7	1A375738982
80A	8	104	8	3/4-10 x 4.25	1P590231012	SA 193 B7	1A375738982

1. Data Sheet Number refers to PV14 Data Sheets for the AP1000 Power Plant Design

Table 10. Key 102 Yoke Mounting Nuts

ACTUATOR SIZE	VALVE SIZE, NPS	DATA SHEET(1)	QUANTITY	STUD SIZE, INCH	PART NUMBER	MATERIAL
45B	3	116	8	3/4-10	1A352024072	SA 194 2H
70C	6	121	8	3/4-10	1A352024072	SA 194 2H
80A	8	104	8	3/4-10	1A352024072	SA 194 2H

1. Data Sheet Number refers to PV14 Data Sheets for the AP1000 Power Plant Design

Table 11. Key 103 Stem Connector Assy

ACTUATOR SIZE	VALVE SIZE, NPS	DATA SHEET(1)	VALVE STEM SIZE, INCH	ASSY. PART NUMBER
45B	3	116	0.5	GG05859X012
70C	6	121	0.75	GG05594X012
80A	8	104	1	GG06723X012

1. Data Sheet Number refers to PV14 Data Sheets for the AP1000 Power Plant Design

Table 12. Keys 104 Upper Diaphragm Casing

ACTUATOR SIZE	VALVE SIZE, NPS	DATA SHEET(1)	KEY 104 UPPER DIAPHRAGM CASING PART NUMBER
45B	3	116	3E830928992
70C	6	121	2N126628992

1. Data Sheet Number refers to PV14 Data Sheets for the AP1000 Power Plant Design

Table 13. Key 105* Diaphragm

ACTUATOR SIZE	VALVE SIZE, NPS	DATA SHEET(1)	PART NUMBER
45B	3	116	2E8595X0032
70C	6	121	2N1269X0042
80A	8	104	GE45044X022

1. Data Sheet Number refers to PV14 Data Sheets for the AP1000 Power Plant Design

Table 14. Key 107 Upper Diaphragm Head

ACTUATOR SIZE	VALVE SIZE, NPS	DATA SHEET(1)	PART NUMBER
45B	3	116	N/A
70C	6	121	N/A
80A	8	104	16A0858X012

1. Data Sheet Number refers to PV14 Data Sheets for the AP1000 Power Plant Design

Table 15. Key 108 Lower Diaphragm Head

ACTUATOR SIZE	VALVE SIZE, NPS	DATA SHEET(1)	PART NUMBER
45B	3	116	2H511322012
70C	6	121	2N757522012
80A	8	104	GE44940X012

1. Data Sheet Number refers to PV14 Data Sheets for the AP1000 Power Plant Design

Table 16. Key 109 Yoke or Yoke/Diaphragm Casing Assembly

ACTUATOR SIZE	VALVE SIZE, NPS	DATA SHEET(1)	PART NUMBER
45B	3	116	GG05118X022
70C	6	121	GG05123X022
80A(2)	8	104	GE57013X012

1. Data Sheet Number refers to PV14 Data Sheets for the AP1000 Power Plant Design
2. The size 80A actuator has a casing/casing flange weldment.

*Recommended spare parts

Table 17. Key 110 Spring

ACTUATOR SIZE	VALVE SIZE, NPS	DATA SHEET(1)	PART NUMBER
45B	3	116	1E8266X0032
70C	6	121	1N1287X0022
80A	8	104	1H7475X0012
1. Data Sheet Number refers to PV14 Data Sheets for the AP1000 Power Plant Design			

Table 18. Key 112 and Key 137 Diaphragm Head Hex Screw and Washer

ACTUATOR SIZE	VALVE SIZE, NPS	DATA SHEET(1)	BOLT SIZE, INCH	KEY 112 SCREW PART NUMBER	MATERIAL	KEY 137 WASHER PART NUMBER
45B	3	116	3/4-16 x 1.25	1E775432982	ASTM A574	1E833628992
70C	6	121	3/4-16 x 1.25	1E775432982	ASTM A574	1E833628992
1. Data Sheet Number refers to PV14 Data Sheets for the AP1000 Power Plant Design						

Table 19. Key 114 and Key 144 Hex Cap Screws and Washers

ACTUATOR SIZE	VALVE SIZE, NPS	DATA SHEET(1)	SCREW SIZE, INCH	SCREW QTY. REQUIRED	KEY 114 SCREW PART NUMBER	WASHER QTY. REQUIRED	KEY 144 WASHER PART NUMBER
45B	3	116	3/8-16 x 0.75	8	1A3684X0082	N/A	N/A
70C	6	121	1/2-13 x 0.88	12	1N1293X0092	N/A	N/A
80A	8	104	1/2-13 x 1.50	12	1A4533X0162	12	1A5189X0042
1. Data Sheet Number refers to PV14 Data Sheets for the AP1000 Power Plant Design							

Table 20. Key 113 and 126 Travel Scale and Machine Screw

ACTUATOR SIZE	VALVE SIZE, NPS	DATA SHEET(1)	VALVE TRAVEL, INCH	KEY 113 TRAVEL SCALE PART NUMBER	KEY 126 MACHINE SCREW PART NUMBER
45B	3	116	1.5	1E808338992	59081160X12
70C	6	121	3.0	1H746138992	1A3431X0012
80A	8	104	2.50	1K511038992	
1. Data Sheet Number refers to PV14 Data Sheets for the AP1000 Power Plant Design					

Table 21. Key 115 Valve Stem Jam Nut

ACTUATOR SIZE	VALVE SIZE, NPS	DATA SHEET(1)	VALVE STEM SIZE, INCH	NUT SIZE, INCH	PART NUMBER
45B	3	116	0.5	1/2-20	1A353735252
70C	6	121	0.75	3/4-16	1A351135252
80A	8	104	1	1-14	1C6352X0042
1. Data Sheet Number refers to PV14 Data Sheets for the AP1000 Power Plant Design					

Table 22. Keys 116*, 117*, 118* and 124 Seal Bushing Components

ACTUATOR SIZE	VALVE SIZE, NPS	DATA SHEET(1)	KEY 116* SEAL BUSHING PART NUMBER	KEY 117* INSIDE O-RING PART NUMBER	KEY 118* OUTSIDE O-RING PART NUMBER	KEY 124 SNAP RING PART NUMBER
45B	3	116	N/A	N/A	N/A	N/A
70C	6	121	N/A	N/A	N/A	N/A
80A	8	104	26A0856X032	16A1178X072	1D4392X0112	1H744037022
1. Data Sheet Number refers to PV14 Data Sheets for the AP1000 Power Plant Design						

Table 23. Key 119, 120 and 145 Diaphragm Casing Connecting Hex Cap Screws, Nuts and Washers

ACTUATOR SIZE	VALVE SIZE, NPS	DATA SHEET(1)	SCREW SIZE, INCH	NUT AND SCREW QTY. REQUIRED	KEY 119 HEX CAP SCREW PART NUMBER	KEY 120 HEX NUT PART NUMBER	WASHER QTY. REQUIRED	KEY 145 WASHER PART NUMBER
45B	3	116	3/8-24 x 1.25	20	1A3683X0042	1A3465X0092	40	1H7231X0032
70C	6	121	3/8-24 x 1.50	28	1A3464X0032	1A3465X0092	56	1H7231X0032
80A	8	104	7/16-20 x 2.0	36	1A9155X0082	1A3403X0062	72	17B4654X032
1. Data Sheet Number refers to PV14 Data Sheets for the AP1000 Power Plant Design								

*Recommended spare parts

Table 24. Key 121 Spring Seat

ACTUATOR SIZE	VALVE SIZE, NPS	DATA SHEET(1)	PART NUMBER
45B	3	116	1R180023122
70C	6	121	1N757722012
80A	8	104	GG06476X012
1. Data Sheet Number refers to PV14 Data Sheets for the AP1000 Power Plant Design			

Table 25. Key 122 Lower Diaphragm Casing

ACTUATOR SIZE	VALVE SIZE, NPS	DATA SHEET(1)	PART NUMBER
45B	3	116	3E831625062
70C	6	121	2N127125062
1. Data Sheet Number refers to PV14 Data Sheets for the AP1000 Power Plant Design			

Table 26. Key 125 Actuator Stem

ACTUATOR SIZE	VALVE SIZE, NPS	DATA SHEET(1)	PART NUMBER
45B	3	116	GG17087X012
70C	6	121	GG17027X012
80A	8	104	GG06475X012
1. Data Sheet Number refers to PV14 Data Sheets for the AP1000 Power Plant Design			

Table 27. Key 127 Spring Adjusting Screw

ACTUATOR SIZE	VALVE SIZE, NPS	DATA SHEET(1)	KEY 127 SPRING ADJUSTING SCREW PART NUMBER	JAM NUT	STUD
45B	3	116	GG14378X012	16A1134X022	GG14378X012
70C	6	121	GG14377X012	GG14354X012	GG14377X012
80A	8	104	GG06478X012	1A3412X0052	18A6444X032
1. Data Sheet Number refers to PV14 Data Sheets for the AP1000 Power Plant Design					

Table 28. Key 106 Small Vent Assembly

ACTUATOR SIZE	VALVE SIZE, NPS	DATA SHEET(1)	PART NUMBER
80A	8	104	17A5515X012
1. Data Sheet Number refers to PV14 Data Sheets for the AP1000 Power Plant Design			

Table 29. Keys 124 and 140* Guide Bushing Components

ACTUATOR SIZE	VALVE SIZE, NPS	DATA SHEET(1)	KEY 124 SNAP RING PART NUMBER	KEY 140* GUIDE BUSHING PART NUMBER
80A	8	104	1H744037022	GG06477X022
1. Data Sheet Number refers to PV14 Data Sheets for the AP1000 Power Plant Design				

Table 30. Key 131 Spring Casing Assembly

ACTUATOR SIZE	VALVE SIZE, NPS	DATA SHEET(1)	PART NUMBER
80A	8	104	GG06616X012
1. Data Sheet Number refers to PV14 Data Sheets for the AP1000 Power Plant Design			

Table 31. Key 132 Diaphragm Head Jam Nuts

ACTUATOR SIZE	VALVE SIZE, NPS	DATA SHEET(1)	PART NUMBER
80A	8	104	1C1122X0042
1. Data Sheet Number refers to PV14 Data Sheets for the AP1000 Power Plant Design			

Table 32. Key 138 and 139 Spring Adjusting Screw Cover and Hex Screws / Washers

ACTUATOR SIZE	VALVE SIZE, NPS	DATA SHEET(1)	KEY 138 ADJUSTING SCREW COVER PART NUMBER	SCREW SIZE (INCH)	QTY. REQUIRED	KEY 139 HEX CAP SCREW PART NUMBER	WASHERS
80A	8	104	GG06480X012	5/16-18 x 0.50	2	1C2752X0072	1B8659X0042
1. Data Sheet Number refers to PV14 Data Sheets for the AP1000 Power Plant Design							

*Recommended spare parts

Table 33. Key 136 Pipe Bushing

ACTUATOR SIZE	VALVE SIZE, NPS	DATA SHEET(1)	PART NUMBER
70C	6	121	1C3790X0012
1. Data Sheet Number refers to PV14 Data Sheets for the AP1000 Power Plant Design			

Table 34. Key 141 Casing Flange/Upper Casing Assembly

ACTUATOR SIZE	VALVE SIZE, NPS	DATA SHEET(1)	PART NUMBER
80A	8	104	GE57014X012
1. Data Sheet Number refers to PV14 Data Sheets for the AP1000 Power Plant Design			

Table 35. Key 129* and 130* Thrust Bearing Race and Thrust Bearing

ACTUATOR SIZE	VALVE SIZE, NPS	DATA SHEET(1)	KEY 129* THRUST BEARING RACE PART NUMBER	KEY 130* THRUST BEARING PART NUMBER
80A	8	104	1K6254X0022	1K6253X0022
1. Data Sheet Number refers to PV14 Data Sheets for the AP1000 Power Plant Design				

Table 36. Key 146, 147, and 148 Pointer Washer, Pointer Hex Cap Screw, Travel Pointer

ACTUATOR SIZE	VALVE SIZE, NPS	DATA SHEET(1)	KEY 146 POINTER WASHER PART NUMBER	KEY 147 POINTER HEX CAP SCREW PART NUMBER	KEY 148 TRAVEL POINTER PART NUMBER
45B	3	116	N/A	1A5823X0032	GG05867X012
70C	6	121	N/A	1A5823X0032	GG05598X012
80A	8	104	1B8659X0042	GE56486X012	GG06950X012
1. Data Sheet Number refers to PV14 Data Sheets for the AP1000 Power Plant Design					

Table 37. Key 190 and 191 Yoke Cover and Screws

ACTUATOR SIZE	VALVE SIZE, NPS	DATA SHEET(1)	YOKE COVER QTY	KEY 190 COVER PART NUMBER	SCREW SIZE, INCH	SCREW QTY REQUIRED	KEY 191 SCREW PART NUMBER
45B	3	116	1	GG08470X012	5/16-18 X 0.50	4	1C2752X0042
70C	6	121		GG08473X012	10-24 X 0.50		1A3406X0012
80A	8	104		GG08471X012	5/16-18 X 0.50		1C2752X0042
1. Data Sheet Number refers to PV14 Data Sheets for the AP1000 Power Plant Design							

*Recommended spare parts

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