

# 480 Series Yokeless Piston Actuators

## Introduction

### Scope of Manual

This instruction manual provides installation, maintenance, and parts information for 480 Series yokeless piston actuators.

Do not install, operate, or maintain 480 Series actuators without first • being fully trained and qualified in valve, actuator, and accessory installation, operation, and maintenance, and • carefully reading and understanding the contents of this manual. If you have any questions about these instructions, contact your Emerson Process Management™ sales office before proceeding.

#### Note

**Neither Emerson, Emerson Process Management, nor any of their affiliated entities assumes responsibility for the selection, use and maintenance of any product. Responsibility for the selection, use, and maintenance of any product remains with the purchaser and end-user.**

### Description

480 Series actuators (figure 1) are yokeless piston actuators that are used in either throttling or on-off applications with ball valves, butterfly valves, louvers, dampers, and rheostats. They require pneumatic pressure loading from double-acting positioners (the 3570 Series) or from on-off loading and unloading devices.

### Specifications

Table 1 lists specifications for the 480 Series actuator and table 3 lists specifications for the 3570 Series actuator.



Figure 1. Type 480-15 Piston Actuator

### Actuator Configurations

**Type 480:** Yokeless piston actuator with positioner.

**Type 481:** Yokeless piston actuator without positioner. Other types may be obtained without positioner by adding -1 to the type number.

The above types come with standard mounting flange, 105 mm (4.125 inch) maximum rated travel, and threaded piston rod connection with sizes 30 through 60 for mounting on ball valves, louvers, and dampers with brackets.

These types may be obtained with the following alternate universal mounting flange constructions:

**-15 Added to Type Number:** Allows butterfly valve mounting for a standard actuator with 105 mm (4.125 inch) maximum travel and threaded piston rod connection, and comes in sizes 30 through 60.

**-16 Added to Type Number:** Provides 206 mm (8.125 inch) maximum travel and threaded piston rod connection, and comes in sizes 40 through 60.



# 480 Series Actuators

Table 1. 480 Series Actuator Specifications

| <p><b>Available Configurations</b><br/>See the Actuator Configurations section.</p> <p><b>Cylinder Pressure</b><br/><b>Maximum Allowable:</b><sup>(4)</sup> 10.3 bar (150 psig)<br/><b>Required to Produce a Given Thrust:</b> See figure 2.<br/><b>Minimum Recommended:</b> Valves with low torque requirements -- (2.4 bar [35 psig]); all other valves -- (3.4 bar [50 psig])</p> <p><b>Maximum Supply Source Consumption</b><br/><b>With Positioner and Constant Input Signal:</b> 0.54 normal m<sup>3</sup>/hr<sup>(1)</sup> (20 scfh<sup>(1)</sup>) of air at 6.9 bar (100 psig)<br/><b>Types Without Positioner:</b> Depends on cylinder volume and supply pressure.</p> <p><b>Travel Information</b><br/><b>Maximum Rated Travels, All Types with Linear Output:</b> See table 2.<br/><b>Travel Stops Available for Types with 105 mm (4.125 inch ) Maximum Rated Travels:</b> See table 2</p> <p><b>Thrust Information</b><br/>See figure 2</p> <p><b>Torque Output</b><br/><b>Types 480, 480-15, and 480-16 (for butterfly valves):</b> Contact your Emerson Process Management sales office</p> | <p><b>Stroking Speeds</b><br/>See table 2</p> <p><b>Operative Ambient Temperature<sup>(2)</sup></b><br/><b>With Nitrile O-Rings:</b> -34 to 79°C (-30 to 175°F)<br/><b>With Fluorocarbon O-Rings (Optional):<sup>(3)</sup></b> -18 to 149°C (0 to 300°F)</p> <p><b>Actuator Size and Piston Size</b><br/>See table 2</p> <p><b>Pressure Connections</b><br/>Standard is 1/4 NPT. For larger sizes, contact your Emerson Process Management sales office.</p> <p><b>Construction Materials</b><br/><b>Actuator:</b></p> <table border="1"> <thead> <tr> <th>Part</th> <th>Material</th> </tr> </thead> <tbody> <tr> <td>Cylinder and Piston</td> <td>Aluminum</td> </tr> <tr> <td>Piston Rod Extension</td> <td>SST, Chrome Plated</td> </tr> <tr> <td>Cylinder Seal Bushings</td> <td>Brass</td> </tr> <tr> <td>O-Rings</td> <td>Nitrile or Fluorocarbon</td> </tr> </tbody> </table> <p><b>Options</b></p> <ul style="list-style-type: none"> <li>■ 376 Series trip valve system to fail actuator</li> <li>■ up or ■ down or ■ lock in last position</li> <li>■ Type 304 electrical valve stem position switch</li> <li>■ Micro-Switch limit switches</li> </ul> | Part | Material | Cylinder and Piston | Aluminum | Piston Rod Extension | SST, Chrome Plated | Cylinder Seal Bushings | Brass | O-Rings | Nitrile or Fluorocarbon |
|--|---|------|----------|---------------------|----------|----------------------|--------------------|------------------------|-------|---------|-------------------------|
| Part   | Material  |      |          |                     |          |                      |                    |                        |       |         |                         |
| Cylinder and Piston  | Aluminum  |      |          |                     |          |                      |                    |                        |       |         |                         |
| Piston Rod Extension   | SST, Chrome Plated  |      |          |                     |          |                      |                    |                        |       |         |                         |
| Cylinder Seal Bushings   | Brass   |      |          |                     |          |                      |                    |                        |       |         |                         |
| O-Rings  | Nitrile or Fluorocarbon   |      |          |                     |          |                      |                    |                        |       |         |                         |

1. Normal m<sup>3</sup>/hr.— normal cubic meters per hour (0°C and 1.01325 bar, absolute); Scfh — standard cubic feet per hour (60°F and 14.7 psia).  
 2. These terms are defined in ANSI/ISA Standard S51.1  
 3. Without snubber. If this actuator has a snubber, the temperature specification is the same for the nitrile version.  
 4. The pressure limits in this bulletin and any applicable standard or code limitation for actuator should not be exceeded.

Table 2. Size, Piston, Stroking Speed, and Travel Information

| ACTUATOR SIZE | EFFECTIVE PISTON AREA |                   | PISTON DIAMETER |       | STROKING SPEED <sup>(1)</sup> |        | SINGLE-FLANGE |       |   |       | TRAVEL STOPS AVAILABLE FOR TYPES WITH 105 mm (4.125 INCHES) MAXIMUM RATED TRAVEL |      |
|---------------|-----------------------|-------------------|-----------------|-------|-------------------------------|--------|---------------|-------|---|-------|--|------|
|               | Cm <sup>2</sup>       | Inch <sup>2</sup> | mm              | Inch  | mm/s                          | Inch/s | —16 Versions  |       | All Others Except Types 487, 487-1 <sup>(2)</sup> |       | mm   | Inch |
|               |                       |                   |                 |       |                               |        | mm            | Inch  | mm  | Inch  |  |      |
| 30            | 107                   | 16.5              | 121             | 4.75  | 102                           | 4      | - - -         | - - - | 105   | 4.125 | 89   | 3.5  |
| 40            | 182                   | 28.25             | 156             | 6.125 | 52                            | 2.05   | 206           | 8.125 | 105   | 4.125 | 89   | 3.5  |
| 60            | 258                   | 55.5              | 216             | 8.5   | 33                            | 1.30   |               |       |   |       |  |      |

1. For actuators with positioners at 6.9 bar (100 psig) supply pressure and all prestroke conditions satisfied. Stroking speeds for actuators without positioners or with snubbers will depend on the particular construction involved.  
 2. See "480" series Actuators Specifications" for these travels.

Table 3. 3570 Series Actuator Specifications

**Available Configurations**

**Type 3570:** Valve positioner with two relays and three pressure gauges for monitoring input signal and output pressures to the top and underside of the actuator piston

**Type 3570C:** Similar to Type 3570 except that the positioner is equipped with automotive tire valves instead of pressure gauges. The valves can be used for clip-on test pressures gauges. The relay nozzles on these positioners are locked in place with locknuts to resist unwanted nozzle movement due to vibration

**Input Signal**

**Standard Ranges:** 0.2 to 1.0 bar (3 to 15 psig) or 0.4 to 2.0 bar (6 to 30 psig)

**Split Ranges:** Typically uses one half of standard range when two control valves are operated by one input signal from a single controller.

**Optional Ranges:** As required within the limits of the bellows

**Bellows Pressure Rating**

**Standard Bellows:** 3.4 bar (50 psig)

**Optional Bellows:** 6.2 bar (90 psig)

**Supply Pressure**

**Maximum:** 10.3 bar (150 psig)

**Minimum:** 2.4 bar (35 psig)

**Output Signal**

**Type:** Pneumatic pressure as required by the actuator

**Action:** Field reversible between direct and reverse (see table 4)

**Hysteresis<sup>(1,2)</sup>**

0.15% of total stroke or instrument pressure span

**Resolution<sup>(1,2)</sup>**

0.2% of instrument pressure span

**Repeatability<sup>(1,2)</sup>**

0.3% of instrument pressure span

**Frequency Response<sup>(1,2)</sup>**

See figure 3

**Pressure Connections**

**Vent:** 3/8 NPT

**All Others:** 1/4 NPT

**Pressure Indications**

**Type 3570C:** Tire valves accept standard pressure gauge chucks

**Type 3570:** See table below

| Type of Indication             | Number Used | Standard Gauge Range bar (psig)          |
|--------------------------------|-------------|--|
| Positioner input signal gauge  | 1           | 0 to 2.1 (0 to 30) or 0 to 4.1 (0 to 60) |
| Cylinder supply pressure gauge | 0           | 0 to 11.0 (0 to 160)                     |

**Static Air Consumption<sup>(3)</sup>**

0.56 normal m<sup>3</sup>/hr (20 scfh) with 6.9 bar (100 psig) supply pressure

**Operative Ambient Temperature<sup>(1,2)</sup>**

**With Nitrile O-Rings:** -34 to 79°C (-30 to 175°F)

**With Fluorocarbon O-Rings (Optional):<sup>(3)</sup>** -18 to 149°C (0 to 300°F)

**Construction Materials**

**Actuator:**

| Part                  | Material                |
|-----------------------|-------------------------|
| Base, Cover and Beam  | Aluminum, die cast      |
| Bellows               | Brass                   |
| Bias and Range Spring | Steel, Plated           |
| Relay Body            | Zinc, Die Cast          |
| Relay Nozzle(s)       | SST                     |
| Diaphragm             | Nitrile or Fluorocarbon |
| O-Rings               | Nitrile or Fluorocarbon |

**Options**

Type SS-52 clip-on chuck (with or without gauge) for Type 3570C positioners

1. These terms are defined in ANSI/ISA Standard S51.1

2. For actuator with positioner only. Does not apply to other constructions or actuator-valve combination.

3. Normal m<sup>3</sup>/hr.— normal cubic meters per hour (0°C and 1.01325 bar, absolute); Scfh — standard cubic feet per hour (60°F and 14.7 psia).

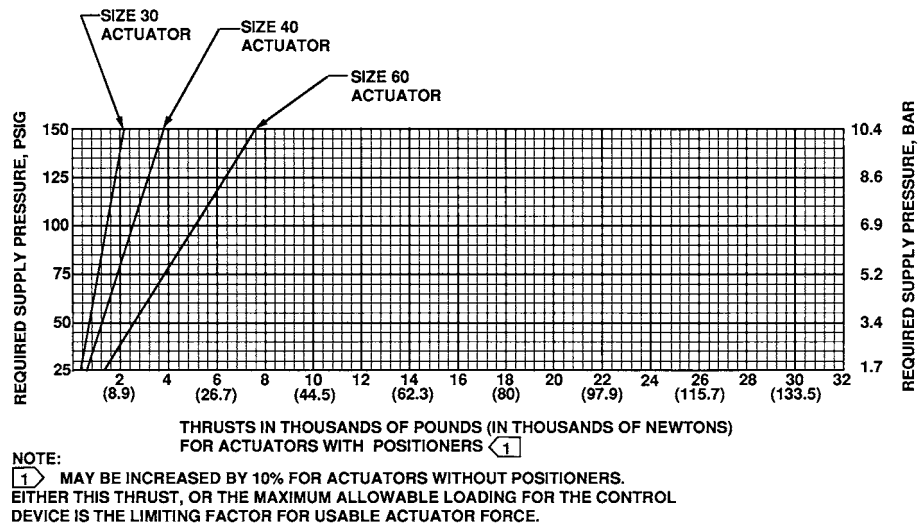


Figure 2. Supply Pressure and Thrusts

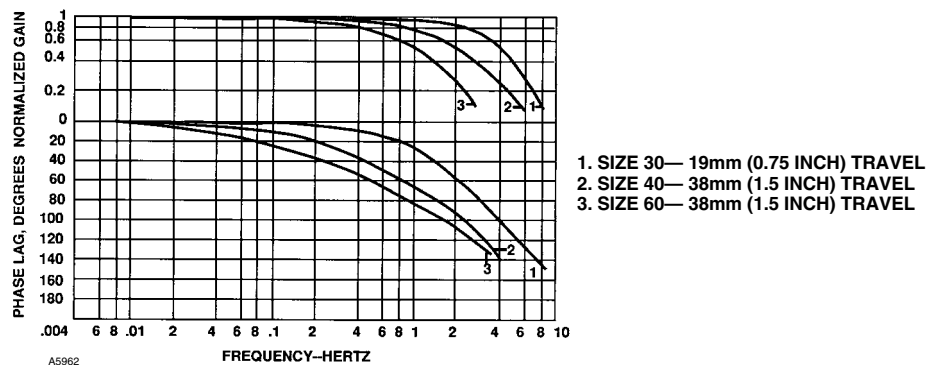


Figure 3. Frequency Response

Table 4. Action Under Normal Operating Conditions

| ACTUATOR DESCRIPTION |                | DESIRED PISTON MOTION  |  |
|----------------------|----------------|--|--|
|                      |                | Down   | Up   |
| With Positioner      | Direct-acting  | Increasing input signal pressure to bellows <sup>(1)</sup>     | Decreasing input signal pressure to bellows <sup>(1)</sup>     |
|                      | Reverse-acting | Decreasing input signal pressure to bellows <sup>(1)</sup>     | Increasing input signal pressure to bellows <sup>(1)</sup>     |
| Without positioner   |                | Supply pressure loaded on top of piston, exhausted from bottom | Supply pressure loaded on bottom of piston, exhausted from top |

1. Supply pressure is routed through relays to piston.

## Installation

### WARNING

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

Personal injury or equipment damage caused by sudden release of pressure may result if the valve assembly is installed where service conditions could exceed the limits given in table 1 or 3 or on the appropriate nameplates. To avoid such injury or damage, provide a relief valve for overpressure protection as required by accepted industry or local, state, and Federal codes and good engineering practices.

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.

Inspect this equipment on arrival to note any damage which may have occurred in transit. If the actuator is attached to a valve body when received, install the valve in the pipeline with flow in the direction of the arrow on the valve body. (Some valve types, notably various butterfly valves, can be installed with flow in either direction and are unmarked as to proper flow direction.)

A three-valve bypass around the main valve is recommended to permit continuous operation during periodic maintenance or inspection of the main valve.

When Series 480 actuators are supplied to operate dampers, louvers, or similar equipment, a suitable mounting plate should be provided, and the piston rod of the actuator connected to the operating arm of the damper, etc., with appropriate linkage.

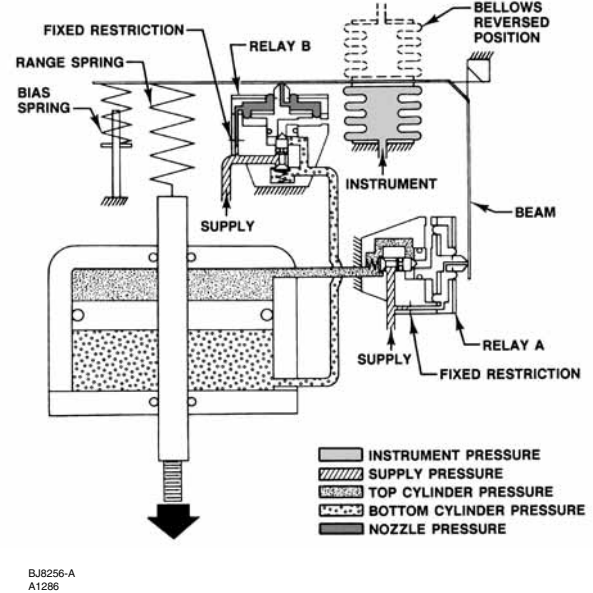


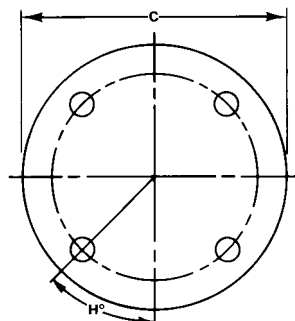
Figure 4. Operation of Actuator with Positioner

## Principle of Operation

### Actuator

These actuators react to a pressure unbalance that is created by loading supply pressure on one side of the piston and unloading the opposite side. Some type of switching device is required to shift the supply pressure from one side of the piston to the other. For most types in the 480 Series, this device is a 3570 Series positioner. However, a separate loading device must be provided for actuators without positioners.

For actuators with positioners (figure 4), the pneumatic output signal from a controller or instrument is piped to the positioner bellows. As long as the bellows receives a constant input signal pressure, the beam remains motionless and allows supply pressure to bleed through both relay nozzles so that a constant pressure is maintained between the nozzle and the fixed orifice. The relays are in equilibrium with their inlet and exhaust valves closed.

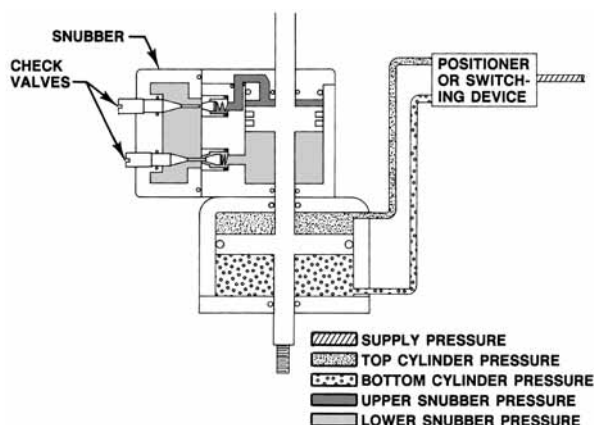


BH9452-K  
A1290

Figure 5. Cylinder Diameter and Bolt Center Location, All Types (refer to table 5)

Table 5. Cylinder Diameter and Bolt Center Location, All Types

| ACTUATOR SIZE | C   |       | H, DEGREE OF ARC |                           |
|---------------|-----|-------|------------------|---------------------------|
|               | mm  | Inch  | Standard Flange  | Universal Mounting Flange |
| 30            | 171 | 6.75  | 0                | 45                        |
| 40            | 206 | 8.12  | 45               | 45                        |
| 60            | 267 | 10.50 | 22.5             | 45                        |



32A8303-A  
A1287

Figure 6. Operation of Actuator with Snubber

Assume that a downward piston motion is required and the bellows receives a corresponding change in input signal pressure. This causes the beam to pivot so that it covers the nozzle on relay A. (Beam movement is accomplished either by increasing the input signal pressure on a direct-acting positioner to expand the bellows, or by decreasing the input signal pressure on a reverse-acting positioner to contract the bellows.)

The nozzle pressure in relay A increases due to the restriction created by the beam over the nozzle. Through relay action, the air pressure to the top of

the piston is increased. At the same time, relay B reacts to the change in beam position to decrease the pressure to the underside of the piston. Due to the resulting unbalanced forces acting on the piston, it moves down, changing the valve plug position.

Piston movement is fed back to the beam by means of a range spring which is connected to the beam and to the piston rod extension, applying a force to the beam opposite to that caused by the expanding or contracting bellows. This feedback arrangement prevents overcorrection and ensures a definite position of the piston and valve plug for a given instrument signal.

If upward piston motion is required, the beam pivots over the nozzle on relay B. The result is relay, piston, and feedback action opposite that for downward piston motion.

Reversal of positioner action is accomplished simply by removing four screws, inverting the bellows, and installing two bellows posts for support if the change is from direct to reverse action. Bellows posts are stored in the positioner case and are not used if the change is from reverse to direct.

### Actuator with Snubber

As the actuator piston strokes, the snubber piston moves inside an oil-filled cylinder, forcing oil from one side of the piston to the other through two check valves (see figure 6). The resistance to flow created by the settings of the check valves and the shock absorbing quality of the oil combine to damp out any

tendency of the valve plug to jump. The plug of each check valve is held off its seat by the positioning of the adjusting screws. Thus, with the adjusting screws backed off all the way, maximum damping will be obtained.

## Pressure Connections

### Type 480

The Type 3570 positioner, an integral part of Type 480 actuator units, is factory-assembled to the actuator. Two connections, "Supply" and "Instrument", remain to be made after valve installation. Both are 1/4 NPT holes in the positioner and are labelled. Minimum supply pressure is 2.4 bar (35 psig), but for optimum performance, supply pressure should be held as near as possible to the 10.3 bar (150 psig) maximum. Supply pressure air or gas should be clean and dry, as well as non-corrosive. Use of a Type 252 filter is recommended.

The positioner case should always be vented to prevent pressure buildup. If the valve is installed with the actuator below the pipeline, provide a new vent location in the lowest part of the case by removing the cadmium-plated pipe plug from the case and screwing it into the standard vent location. This also serves as a drain hole to prevent accumulation of condensate.

### Type 481

The Type 481 actuator also requires 1/4 NPT external supply pressure piping. The Type 481 has only a pressure tap cover on top of the cylinder. Supply air pressure must be connected to it, and also to the lower cylinder connection located near the cylinder/cylinder flange joint. An external four-way valve or other switching device must be provided between the main supply pressure line and these two actuator pressure connections.

## Adjustments

All three adjustments on the Type 480 actuator are on the Type 3570 positioner. For further information on the positioner, such as Adjustments,

Maintenance, Reversing, and Relay Operation, refer to the Type 3570 instruction manual, form 1837.

The Type 481 actuator requires no adjustments.

## Actuator Maintenance

### WARNING

**Avoid personal injury from sudden release of process pressure. Before performing any maintenance operations:**

- **Always wear protective gloves, clothing, and eyewear when performing any maintenance operations to avoid personal injury.**
- **Disconnect any operating lines providing air pressure 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 on both sides of the valve. Drain the process media from both sides of the valve.**
- **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.**

It is necessary for efficient and proper operation of the actuator that all parts be free from dirt, abrasives, and foreign material. Upon assembly at the factor, all synthetic rubber O-rings have been coated with water-resistant lithium grease. It is recommended that this lubricant be used on all O-rings, especially those on moving parts or in contact with moving parts, whenever the actuator is dismantled.

# 480 Series Actuators

## Disassembly

Refer to figures 7 and 8.

References to “positioner” can be ignored if a Type 481 actuator is involved.

1. Bypass the valve body or shut off the pressure in the pipeline.

### CAUTION

**The adjustable linkage between the actuator and the main valve should not be disconnected when the valve is open with fluid flowing. (Dampers or louvers should be in safe, stable positions prior to disconnection.)**

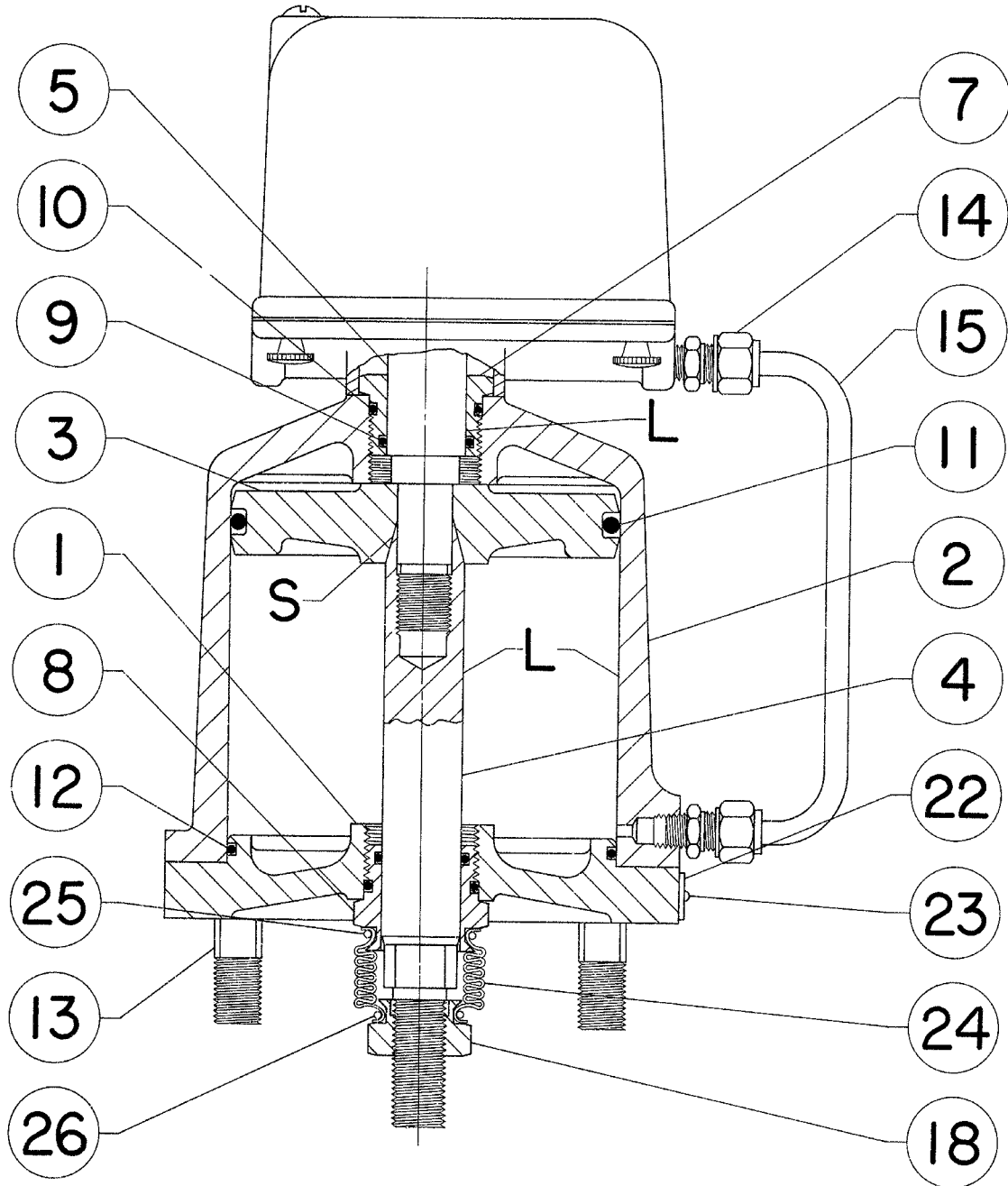
2. Shut off all pressure to the actuator. Remove all tubing lines (cylinder, instrument, and supply) from the actuator.
3. Remove the positioner cover after loosening the four cover screws on the underside of the positioner base.
4. Disengage the range spring by unscrewing the spring retainer from the piston rod extension.
5. Loosen the two cap screws that hold the positioner to the cylinder. When removing the positioner, do not lose the small O-ring that is used in the passage from the positioner to the top of the cylinder.
6. Next remove the clevis bolt from the adjustable linkage. Remove the bottom snap ring (key 26) and

unscrew the clevis and the boot locknut from the actuator piston rod.

7. Remove the nuts that hold the cylinder to the mounting flange and lift off the cylinder.
8. Remove the stud bolts (key 123) that hold the cylinder to the cylinder flange. Two slots, 180 degrees apart, are located at the lower edge of the cylinder. Insert a screwdriver in these slots and pry the cylinder loose. The piston and piston rod will come out with the cylinder. The piston can then be removed by pulling it out the open end of the cylinder.
9. Unscrew both seal bushings (keys 7 and 8).
10. Inspect all parts for excessive wear and defects. Replace all worn O-rings. Lubricate as mentioned above.
11. To reassemble, reverse the above procedure.

### Note

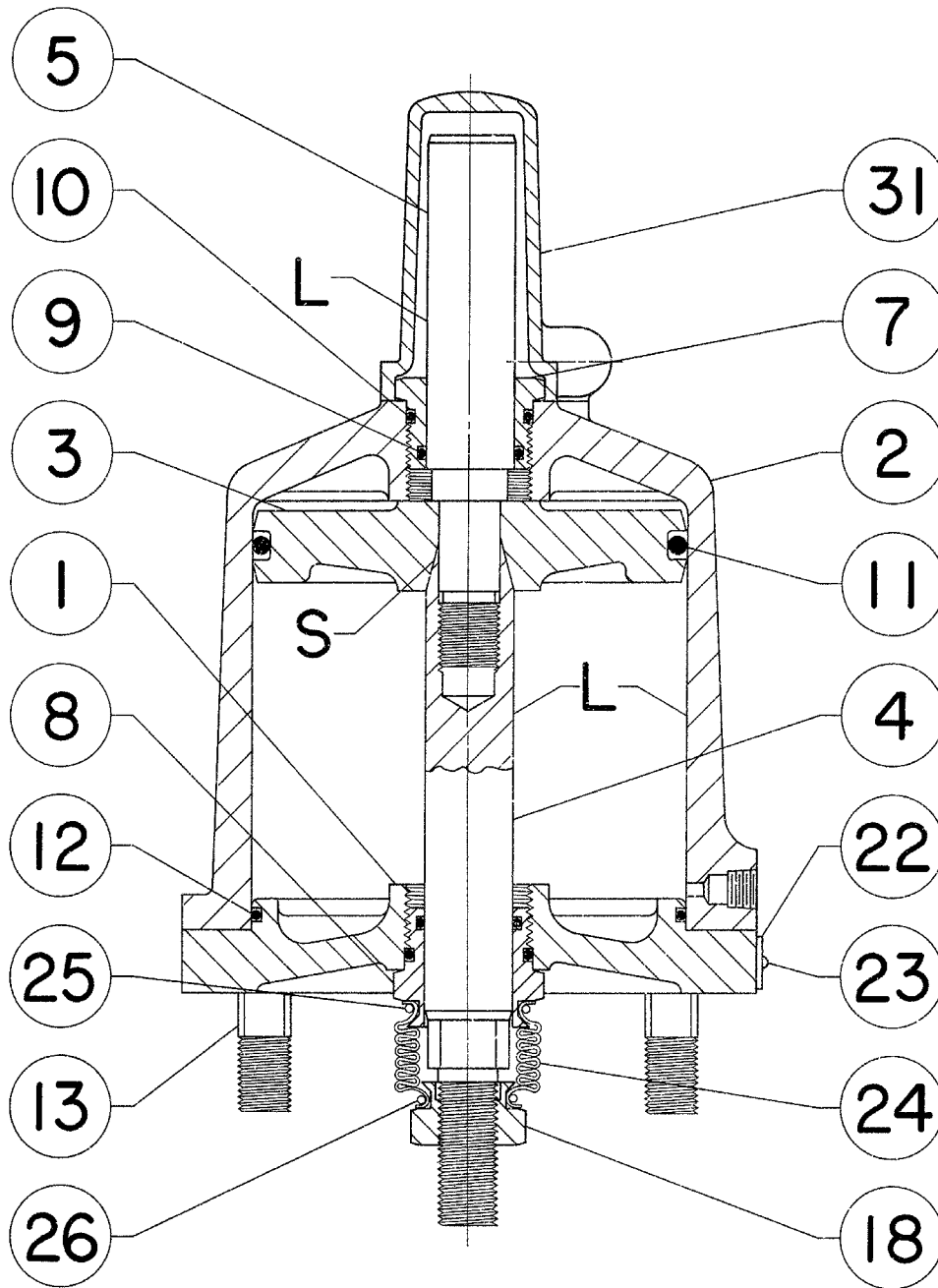
**When reassembling the actuator after the piston rod extension (key 5) has been removed from the piston rod (key 4), clean the threads of the piston rod thoroughly and apply a thread locking adhesive (medium strength) to the threads. Tighten the piston rod extension securely to a torque of 203 N•m (150 lbf•ft). This torque is approximately equal to the torque that would be developed by placing a force of 150 pounds on the end of a one-foot wrench, 75 pounds on the end of a two-foot wrench, etc.**



PARTS NOT SHOWN: 27 AND 112

40A9540-A

Figure 7. Type 480 Piston Actuator - Size 30- 60



PARTS NOT SHOWN: 27, 78, 79, AND 112

40A9538-A

Figure 8. Type 481 Piston Actuator - Size 30- 60

## Parts Ordering

When corresponding with your Emerson Process Management sales office about this equipment, refer to the serial number found on the actuator nameplate (key 22). Also, specify the complete 11-character part number from the following Parts List when ordering replacement parts.



### 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 will void your warranty, might adversely affect the performance of the valve, and could give rise to personal injury and property damage.**

#### Note

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## Parts List

#### Note

**Part numbers are shown for recommended spares only. For part numbers not shown, contact your Emerson Process Management sales office.**

| Key | Description                    | Part Number |
|-----|--------------------------------|-------------|
| 1   | Cylinder Flange                |             |
| 2   | Cylinder                       |             |
| 3   | Piston                         |             |
| 4   | Piston Rod                     |             |
| 5   | Piston Rod Extension           |             |
| 7   | Upper Seal Bushing             |             |
| 8   | Lower Seal Bushing             |             |
| 9*  | Stem Seal O-ring               |             |
|     | Sizes 30, 40, and 60 (2 req'd) | 1E73690699  |
| 10* | Bushing Seal O-ring            |             |
|     | Sizes 30, 40, and 60 (2 req'd) | 1D34830689  |
| 11* | Piston Seal O-ring             |             |
|     | Size 30                        | 1H86210699  |
|     | Size 40                        | 1H86220699  |
|     | Size 60                        | 1H86240699  |
| 12* | Cylinder Seal O-ring           |             |
|     | Size 30                        | 1H86200699  |
|     | Size 40                        | 1D44480699  |
|     | Size 60                        | 1H86230699  |
| 13  | Cylinder Stud                  |             |
| 14  | Compression Fitting            |             |
| 15  | Cylinder Tubing                |             |
| 18  | Boot Locknut                   |             |
| 22  | Nameplate                      |             |
| 23  | Drive Screw                    |             |
| 24* | Piston Rod Boot                |             |
|     | Sizes 30, 40, and 60           | 1H93790699  |
| 25  | Top Boot Snap Ring             |             |
| 26  | Bottom Boot Snap Ring          |             |
| 27  | Travel stop                    |             |
| 30  | Piston Nut                     |             |
| 31  | Positioner                     |             |
| 45  | Spring Retainer Spacer         |             |
| 78* | Cover Seal                     |             |
|     | Type 481 only                  | 1C85380699  |
| 79  | Cover Screw                    |             |
| 160 | Pipe Plug                      |             |

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