

Fisher™ 480 Series Yokeless Piston Actuators



General Application

Fisher 480 Series actuators 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 (Fisher 3570) or from on-off loading and unloading devices.

Features

- **Actuator Versatility**—Actuator with or without positioners and snubbers is available in an assortment of sizes, stroking speeds, thrusts and travels to handle most control requirements.
- **Compact Design**—Yokeless construction permits a low-profile assembly by allowing close coupling to the control device; either through a bracket or, with some versions, by direct mounting on a bonnet flange.
- **Wide Range Supply Pressure Capability**—The cylinder (and 3570 positioner if used) can operate with supply pressures as low as 2.4 bar / 35 psig or as high as 10.3 bar / 150 psig.
- **Long Stroke**—Actuators have maximum rated travels of up to 206 mm / 8.125 in.
- **Positioner Versatility**—Positioner/actuator action is easily reversed in the field with no additional parts. Positioner sensitivity, travel span and travel starting point are factory set and need to be reset only if operating conditions have changed or if the positioner has been reversed. See Figure 1.



W1867

FISHER 480-15 PISTON ACTUATOR

Actuator Frequency Response

Figure 3 shows how various size actuators respond when the input supply pressure is cycled at small amplitude (3 to 5%) and increasing frequency. Assume the cycling supply pressure and the movement of the actuator rod are represented by sine waves. As the actuator rod is forced to move faster, its motion begins to fall behind the input in both time (shown as phase lag) and amplitude (shown as normalized gain). Both of these parameters are affected by the inertia of the actuator and, consequently, changes are more pronounced in the larger constructions.

480 Series Actuator Specifications

Available Configurations	Operative Ambient Temperature ⁽²⁾	
See the Actuator Configurations section	With Nitrile O-rings: -46 to +80°C / -50 to +175°F With Fluorocarbon O-rings (Optional): ⁽³⁾ -18 to +149°C / 0 to 300°F	
Cylinder Pressure	Actuator Size and Piston Size	
Maximum Allowable: ⁽⁴⁾ 10.3 bar / 150 psig Required to Produce a Given Thrust: See Figure 2 Minimum Recommended: Valves with low torque requirements – (2.4 bar / 35 psig); all other valves – (3.4 bar / 50 psig)	See Table 1	
Maximum Supply Source Consumption	Pressure Connections	
With Positioner and Constant Input Signal: 0.54 normal m ³ /hr ⁽¹⁾ / 20 scfh ⁽¹⁾ of air at 6.9 bar / 100 psig Without Positioner: Depends on cylinder volume and supply pressure	Standard is 1/4 NPT. For larger sizes, contact your Emerson sales office .	
Travel Information	Actuator Construction Materials	
Maximum Rated Travels, All 480 Series actuators with Linear Output: See Table 1 Travel Stops Available for 480 Series actuators with 105 mm / 4.125 in.Maximum Rated Travels: See Table 1	Part	Material
	Cylinder and piston	Aluminum
	Piston rod extension	Chrome-plated Stainless Steel
	Cylinder seal bushings	Brass
	O-rings	Nitrile or Fluorocarbon
Thrust Information	Linkage Connections and Mounting Information	
See Figure 2	See Figures 7, 8, 9 and 10	
Torque Output	Options	
480, 480-15 and 480-16 (for butterfly valves): Contact your Emerson sales office .	■ 376 Series trip valve system to fail actuator ■ up, ■ down or ■ lock in last position ■ TopWorx™ DXP M21GNEB electrical valve stem position switch ■ Micro-Switch limit switches	
Stroking Speeds		
See Table 1		
1. Normal m ³ /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.		

3570 Actuator Specifications

Available Configurations	Frequency Response ^(1,2)																		
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 3570C: Similar to 3570 except that the positioner is equipped with automotive tire valves instead of pressure gauges. The valves can be used for clip-on test pressure gauges. The relay nozzles on these positioners are locked in place with locknuts to resist unwanted nozzle movement due to vibration.	See Figure 3																		
Input Signal	Pressure Connections																		
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	Vent: 3/8 NPT All Others: 1/4 NPT																		
Bellows Pressure Rating	Pressure Indications																		
Standard Bellows: 3.4 bar / 50 psig Optional Bellows: 6.2 bar / 90 psig	3570C: Tire valves accept standard pressure gauge chucks 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																
Supply Pressure	Static Air Consumption ⁽³⁾																		
Maximum: 10.3 bar / 150 psig Minimum: 2.4 bar / 35 psig	0.56 normal m³/hr / 20 scfh with 6.9 bar / 100 psig supply pressure																		
Output Signal	Operative Ambient Temperature ^(1,2)																		
Type: Pneumatic pressure as required by the actuator Action: Field reversible between direct and reverse (see Table 2)	With Nitrile O-rings: -34 to +79°C / -30 to +175°F With Fluorocarbon O-rings (Optional): ⁽³⁾ -18 to +149°C / 0 to 300°F																		
Hysteresis ^(1,2)	Actuator Construction Materials																		
0.15% of total stroke or instrument pressure span	<table><tr><th>Part</th><th>Material</th></tr><tr><td>Base, cover and beam</td><td>Aluminum, Die cast</td></tr><tr><td>Bellows</td><td>Brass</td></tr><tr><td>Bias and range spring</td><td>Steel, Plated</td></tr><tr><td>Relay body</td><td>Zinc, Die Cast</td></tr><tr><td>Relay nozzle(s)</td><td>Stainless steel</td></tr><tr><td>Diaphragm</td><td>Nitrile or Fluorocarbon</td></tr><tr><td>O-rings</td><td>Nitrile or Fluorocarbon</td></tr></table>			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)	Stainless steel	Diaphragm	Nitrile or Fluorocarbon	O-rings	Nitrile or Fluorocarbon
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)	Stainless steel																		
Diaphragm	Nitrile or Fluorocarbon																		
O-rings	Nitrile or Fluorocarbon																		
Resolution ^(1,2)																			
0.2% of instrument pressure span																			
Repeatability ^(1,2)	Options																		
0.3% of instrument pressure span	Fisher SS-52 clip-on chuck (with or without gauge) for 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 m³/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.																			

Table 1. Size, Piston, Stroking Speed and Travel Information

ACTUATOR SIZE	EFFECTIVE PISTON AREA		PISTON DIAMETER		STROKING SPEED ⁽¹⁾		SINGLE-FLANGE				TRAVEL STOPS AVAILABLE FOR ACTUATORS WITH 105 mm / 4.125 in. MAXIMUM RATED TRAVEL	
							—16 Versions		All Others Except Fisher 487, 487-1 ⁽²⁾			
	cm ²	in ²	mm	in.	mm/s	in./s	mm	in.	mm	in.	mm	in.
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						
80	88-1/2	571	10-3/4	273	0.8	20	8-1/8	206	4-1/8	105	3/4, 1-1/8, 1-1/2, 2, 3	19, 29, 38, 51, 76
100	130-1/2	842	13	330	0.59	15	8-1/8	206				
130	221-1/2	1492	17	432	0.33	8	---	---				

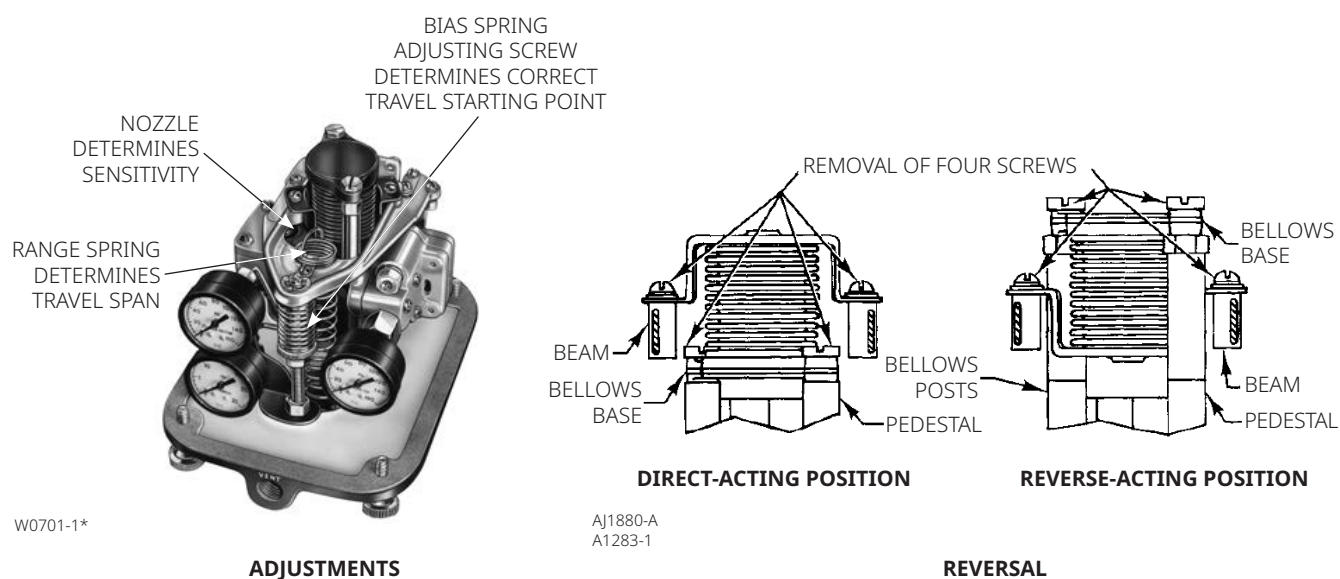
1. For actuators with positioners at 6.9 bar / 100 psig supply pressure and all prestroke conditions satisfied. Stroking speeds for actuators without positioners or with snubbers will depend on the particular construction involved.

2. See 480 Series Actuators Specifications for these travels.

Table 2. Action Under Normal Operating Conditions

ACTUATOR DESCRIPTION		DESIRED PISTON MOTION	
		Down	Up
With positioner	Direct-acting	Increasing input signal pressure to bellows ⁽¹⁾	Decreasing input signal pressure to bellows ⁽¹⁾
	Reverse-acting	Decreasing input signal pressure to bellows ⁽¹⁾	Increasing input signal pressure to bellows ⁽¹⁾
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.

Figure 1. Positioner Simplicity

Actuator Configurations

480: Yokeless piston actuator with positioner.

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

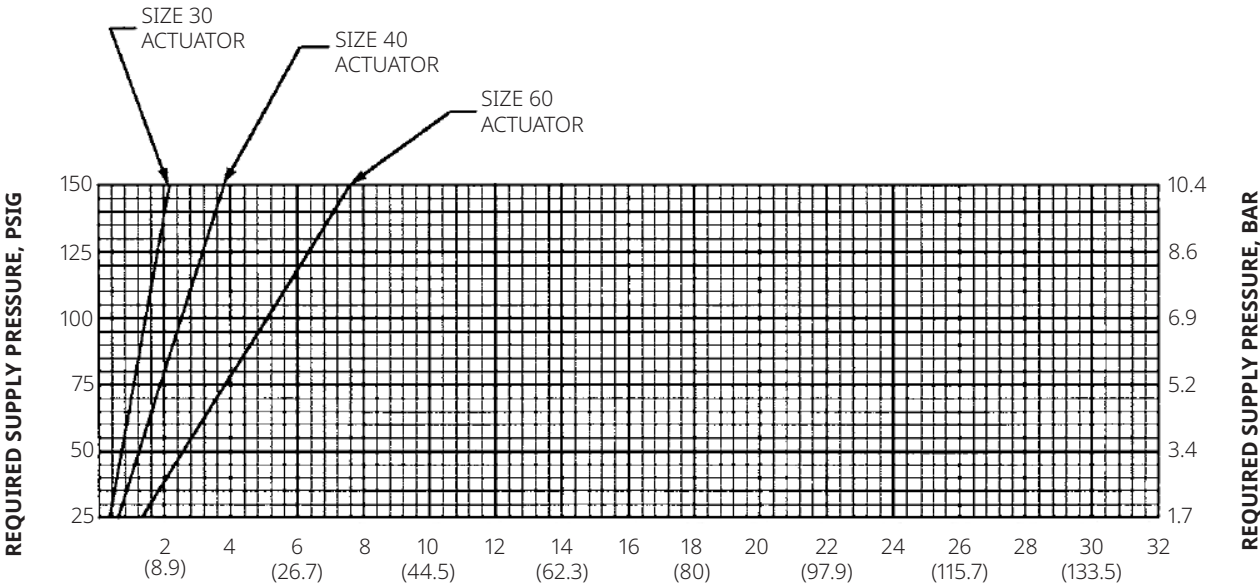
The above actuators come with standard mounting flange, 105 mm / 4.125 in. maximum rated travel and threaded piston rod connection with sizes 30 through 60 for mounting on ball valves, louvers and dampers with brackets.

These actuators 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 in. maximum travel and threaded piston rod connection and comes in sizes 30 through 60.

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

Figure 2. Supply Pressure and Thrusts

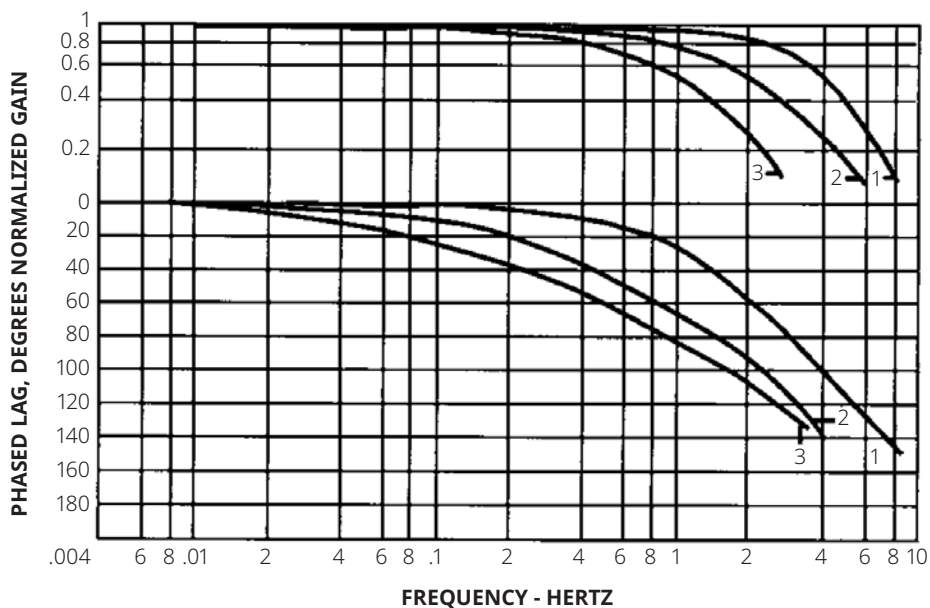


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THRUSTS IN THOUSANDS OF POUNDS (IN THOUSANDS OF NEWTONS) FOR ACTUATORS WITH POSITIONERS.⁽¹⁾

Note:

1. May be increased by 10% for actuators without positioners. Either this thrust or the maximum allowable loading for the control device is the limiting factor for usable actuator force.

Figure 3. Frequency Response

1. SIZE 30 - 19 MM / 0.75 IN. TRAVEL
2. SIZE 40 - 38 MM / 1.5 IN. TRAVEL
3. SIZE 60 - 38 MM / 1.5 IN. TRAVEL

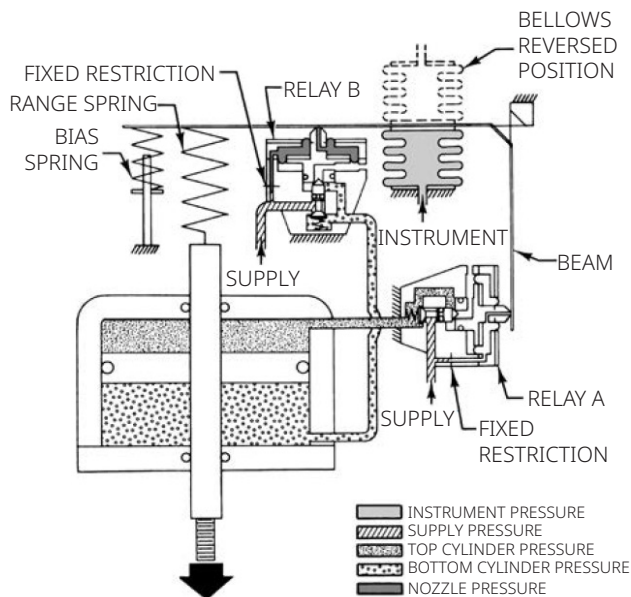
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Principle of Operation

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 actuators in the 480 Series, this device is a 3570 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 such 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.

Figure 4. Operation of Actuator with Positioner


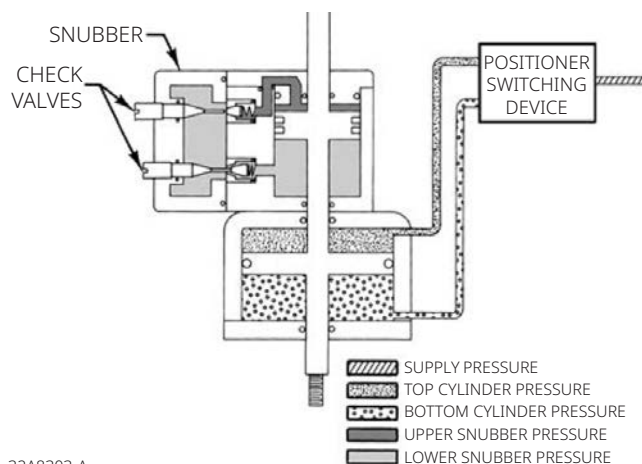
BJ8256-A
A1286

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.

Figure 5. Operation of Actuator with Snubber


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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 5). 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.

Installation

The actuator may be installed in any position, but normal installation is with the actuator vertical above the valve. Dimensions are given in Figures 6, 7, 8, 9 and 10.

Ordering Information

When ordering, specify:

1. Type number

a. For actuator, suffix dash numbers of desired constructions are appropriate.

b. For positioner (if used)
2. Supply pressure
3. Actuator size and connection size and style desired
4. Input signal range
5. Desired stroking time and direction, if applicable
6. Operative ambient temperature
7. Travel
8. Desired options
9. Application requirements
- a. Type, body size, port diameter, stem connection size and the action of the valve to be used with the actuator.
- b. Valve inlet pressure
- c. Valve shutoff pressure drop
- d. Valve flowing pressure drop
- e. Process fluid temperature

Table 3. Cylinder Diameter and Bolt Center Location, All Actuators

ACTUATOR SIZE	C		H, DEGREE OF ARC	
	mm	in.	Standard Flange	Universal Mounting Flange
30	171	6.75	0	45
40	206	8.12	45	45
60	267	10.50	22.5	45
80	311	12.25	0	45
100	381	15	11-1/4	45
130	489	19.25	9	45

Figure 6. Cylinder Diameter and Bolt Center Location, All Actuators (refer to Table 3)

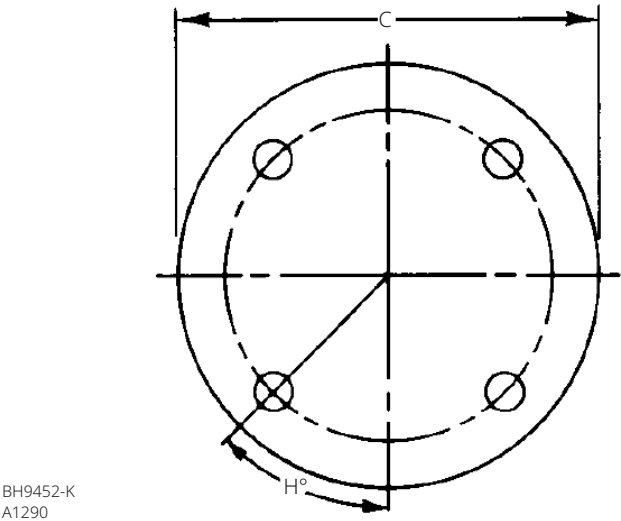
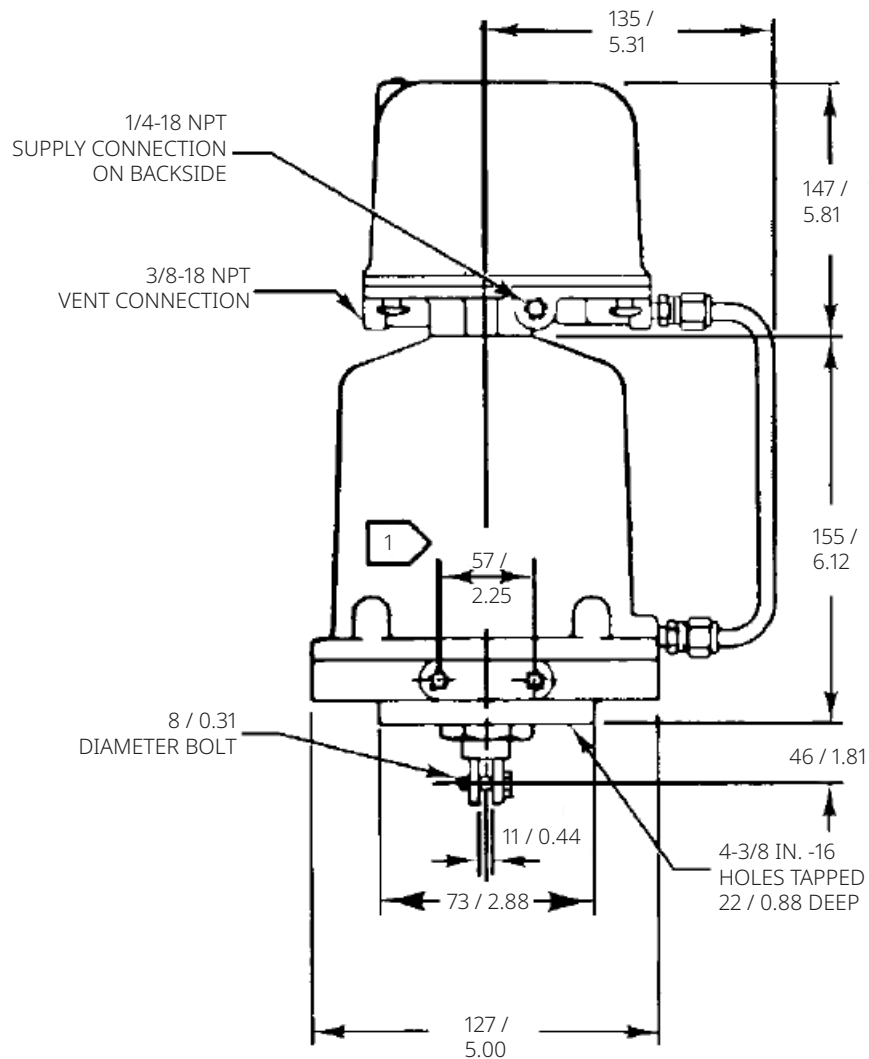


Figure 7. Dimensions for Actuators with Clevis Connection



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mm / in.

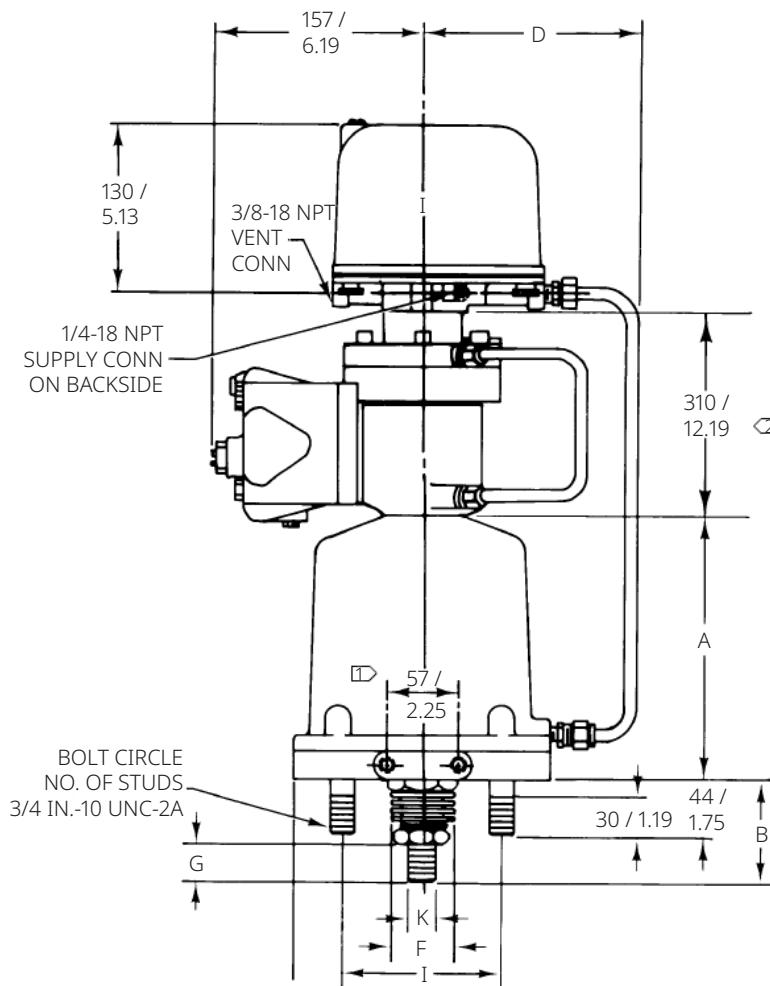
Note:

1. Duplicated on opposite side; each hole is 5/16 in.-18 UNC-2B and tapped 13 / 0.50 deep.

Table 4. Dimensions and Mounting Information for Actuators with Threaded Piston Rod and Standard Mounting Flange or Positioner or Snubber

ACTUATOR SIZE	A		B		D		F		G		I			K
											Number	Bolt Circle Diameter		Threaded Piston Rod Connection UNF-2A
	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.				
30	250	8.06	86	3.38	170	6.69	63	2.50	33	1.31	2	146	5.75	7/8 in.-14
40	208	8.19	83	3.25	173	6.81	63	2.50	33	1.31	4	181	7.12	
60	211	8.31	79	3.12	203	8.00	63	2.50	33	1.31	8	241	9.50	
80	267	10.50	121	4.75	232	9.12	82	3.25	48	1.88	10	298	11.75	1-1/4 in.-12
100	267	10.50	121	4.75	260	10.25	82	3.25	48	1.88	16	356	14.00	
130	368	14.50	103	4.06	260	10.25	82	3.25	48	1.88	20	457	18.00	

Figure 8. Dimensions and Mounting Information for Actuators with Threaded Piston Rod and Standard Mounting Flange or Positioner or Snubber (Refer to Table 4)



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A1291

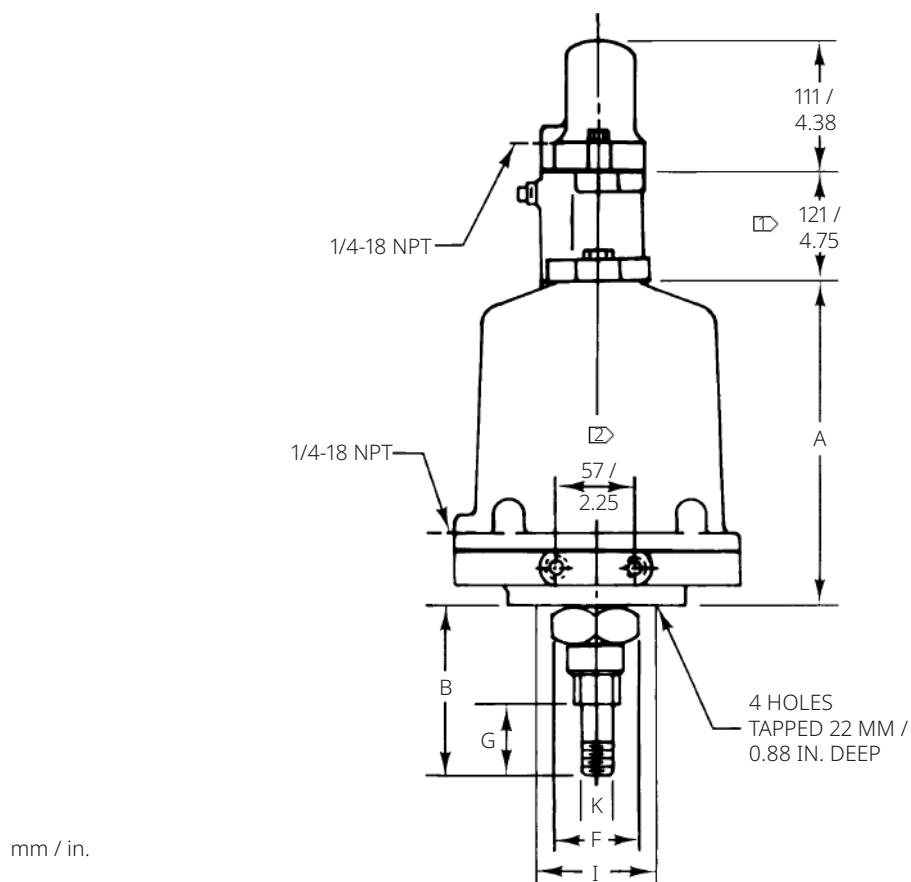
mm / in.

Notes:

1. Duplicated on opposite side; each hole is 5/16 in.-18 UNC-2B and tapped 13 / 0.50 deep.
2. This dimension does not exist if no snubber is used.

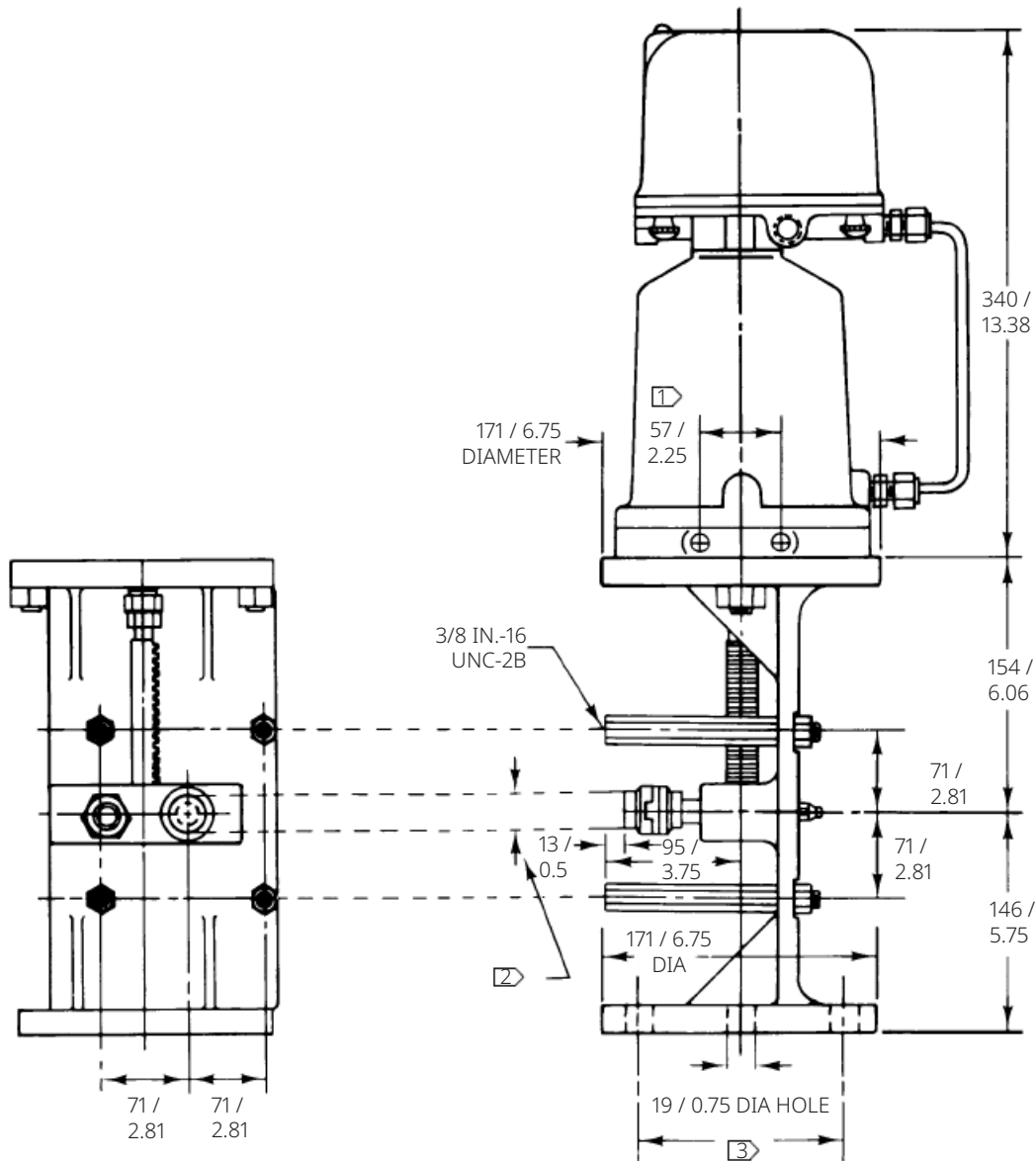
Table 5. Dimensions for Actuators without Positioner, with Long Stroke or with Threaded Piston Rod and Universal Mounting Flange

ACTUATOR SIZE	A				B				F				G				I				K
	—15 Versions		—16 Versions		—15 Versions		—16 Versions		—15 Versions		—16 Versions		—15 Versions		—16 Versions		Bolt Circle Diameter		Thread Diameter	Threaded Piston Rod Connection UNF-2A	
	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.			
30, 40, 60	222	8.75	---	---	90	3.56	---	---	64	2.5	---	---	33	1.31	---	---	99	3.88	1/2-13	7/8-in.-14	
	222	8.75	343	13.5	90	3.56	108	4.25	64	2.5	47	1.87	33	1.31	51	2.00	99	3.88	1/2-13	7/8-in.-14	
80, 100, 130	222	8.75	343	13.5	90	3.56	108	4.25	64	2.5	47	1.87	33	1.31	51	2.00	99	3.88	1/2-13	7/8-14	
	276	10.88	397	15.63	111	4.38	114	4.5	83	3.25	76	3.00	48	1.88	68	2.69	140	5.50	3/4-10	1-1/4-14	

Figure 9. Dimensions for Actuators without Positioner, with Long Stroke or with Threaded Piston Rod and Universal Mounting Flange (Refer to Table 5)**Notes:**

1. For -16 version only.
2. Duplicated on opposite side; each hole is 5/16 in.-18 UNC-2B and tapped 13 mm / 0.50 in. deep.

Figure 10. Dimensions for Actuators with Rotary Couplings



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B0662

mm / in.

Notes:

1. Duplicated on opposite side; each hole is 5/16 in.-18 UNC-2B and tapped 13 mm / 0.50 in. deep.
2. Socketed coupling with setscrew adjustment. 6 mm / 0.25 in., 10 mm / 0.38 in. and 13 mm / 0.50 in. inside diameters.
3. Four holes total on 140 mm / 5.5 in. bolt circle.

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