

OpenAir™ GND Series Electronic Damper Actuator

UL Listed Fire/Smoke and Smoke Control Dampers

2-Position, 15-second Run Time,

15-second Spring Return Time



Description

The OpenAir™ direct coupled, fast-acting, two-position, spring return electronic actuators are available as 24 Vac/dc, 120 Vac, and 230 Vac models. They are intended for use on UL listed smoke control dampers and combination fire/smoke rated dampers.

Features

- Optional built-in auxiliary switches: Fixed switch points at 5° and 85 ° rotation.
- Optional built-in Electronic Fusible Link (EFL) capability with four temperature ratings: 165°F (74°C), 212°F (100°C), 250°F (121°C), 350°F (177°C).
- Reversible fail-safe spring return.
- All metal housing.
- Pre-cabled Teflon® insulated lead wires.
- Fifteen-second operation at rated torque, temperature and voltage.



Application

This actuator is used for the control of dampers requiring up to 53 lb-in (6Nm) driving torque. It is intended for control of UL listed smoke control dampers and combination fire/smoke HVAC dampers. This actuator is designed to meet the 2002 revisions to the UL 555/555S and the AMCA Standard 520 specifications.

Product Numbers

G	Direct-coupled Electronic Fire and Smoke Damper Actuator
N	Spring Return 53 lb-in (6 Nm)
D	15 second run time
1	24 Vac/dc
2	120 Vac
3	230 Vac
2	2-position
1	Standard version
6	Two auxiliary switches
.1	Fire and smoke shaft adapter
U	Assembled in USA
/B	Bulk pack 10
/F	Electronic Fusible Link (EFL) connection
/F/B	EFL connection and bulk pack 10

Warning/Caution Notations

WARNING		Personal injury/loss of life may occur if you do not perform a procedure as specified.
CAUTION:		Equipment damage may occur if you do not perform a procedure as specified.

Service



WARNING:

Do not open the actuator. Personal injury may occur if opened. Opening the actuator voids the warranty.

If the actuator is inoperative, replace the unit.

Specifications	Operating voltage	24 Vac \pm 20% 24 Vdc +20%, -10%
	Power supply	120 Vac \pm 10% 230 Vac \pm 10%
	Frequency	50/60 Hz
	Power consumption	24 Vac/dc
	running	20 VA/12W
	holding	8 VA/6W
	Power Consumption	120 Vac/230 Vac
	running	20 VA
	holding	9 VA
Function	Running torque	53 lb-in (6 Nm) (minimum)
	Stall torque (minimum)	160 lb-in (18 Nm)
	Torque reduction at elevated temperature	Less than 10%
	Runtime for 90° closing (on power loss) with spring return	15 seconds nominal 15 seconds maximum
	Nominal angle of rotation	95°
Life Expectancy		Minimum 35,000 full stroke cycles
Mounting	Damper shaft size	.5-inch (12,7 mm) round
	Damper shaft length, minimum	1.4-inch (36 mm)
Housing	Enclosure	NEMA 1
	Material	Die cast aluminum alloy
Ambient conditions	Operation	0°F to 140°F (-18°C to 60°C) one time 350°F (177°C)
	Storage and transport	-40°F to 158°F (-40°C to 70°C)
	Ambient humidity (non-condensing)	Maximum 95% rh non-condensing
	Teflon® cable	400°F (200°C)
Agency certification		UL873 cUL C22.2 No. 24-93 AS/NZS 2064 1/2:1997 Conforms to CE requirements for the EMC and low voltage directives Australian Electromagnetic Compatibility (EMC) per AS/NZS 4251.1/2:1999 (C-tick)
Miscellaneous	Pre-cabled connection	18 AWG, 3 feet (.9 meter) 3/8-in (.5mm) flexible conduit connector
	Dimensions	9-in. x 3.25-in. x 3-in. D (229 mm x 83 mm x 76 mm)
	Weight	≈4 lb (1.8 kg)

Accessories

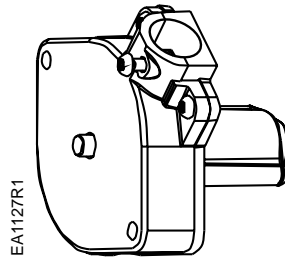


Figure 1.

Electronic Fusible Link (EFL)

ASK79.165 (165°F (74°C) operation)
ASK79.212 (212°F (100°C) operation)
ASK79.250 (250°F (121°C) operation)
ASK79.350 (350°F (177°C) operation)

NOTE: Determine and order appropriate actuator before selecting EFL.

Operation

When power is applied, the actuator coupling moves toward the open position, "90°". The actuator opens in 15 seconds nominal, 90° at 60 Hz. In the event of a power failure or when operating voltage is turned off, the actuator returns to the "0" position. The return time is 15 seconds nominal for 90°.

The National Fire Protection Association NFPA 92A Standard for Recommended Practice for Smoke-Control System and UL 864 Standard for Control Units and Accessories for Fire Alarm Systems, require weekly self-tests for **dedicated** smoke control equipment used in a smoke control system. The National Fire Protection Association NFPA 72 Standard for National Fire Alarm Codes states that all life-safety systems are to be functionally checked at least annually.

The GND actuator does not require any periodic cycling to function properly as an integral part of an active smoke control damper system. Check the smoke control damper/actuator every time you functionally check your smoke detectors, emergency lights, and/or power generators for operation.

Installation

Refer to the installation instructions for detailed guidelines. (See 129-402)



CAUTION:

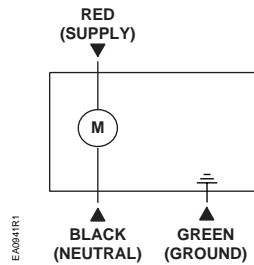
Read and carefully follow the Installation Instructions to avoid equipment damage.

Wiring

All wiring must conform to NEC and local codes and regulations.

Wire Designations

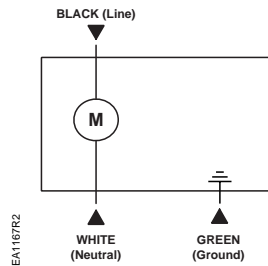
24 Vac/dc



Function	Color
Supply	Red
Neutral	Black
Ground	Green

Figure 2.

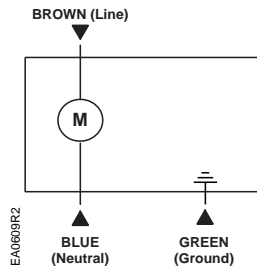
120 Vac



Function	Color
Line	Black
Neutral	White
Ground	Green

Figure 3.

230 Vac



Function	Color
Line	Brown
Neutral	Blue
Ground	Green

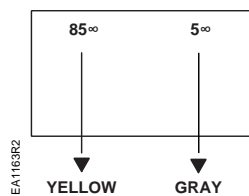


CAUTION:

The actuator must be wired with a 230 Vac line with respect to neutral and the ground lead must be connected for proper protection of the actuator. Any other connection, such as phase-to-phase, can damage the actuator.

Figure 4.

Auxiliary Switches



Switch	Wire Color	Switch Makes	Switch Breaks
5°	Gray	< 5°	> 5°
85°	Yellow	> 85°	< 85°

NOTE:

Both sets of contacts are open when actuator is between 5° and 85°.

Figure 5.

Wiring, Continued

NOTE:
When ordered, GND
Electronic Fusible Link
models come pre-wired
for coupling with EFL
sensor.

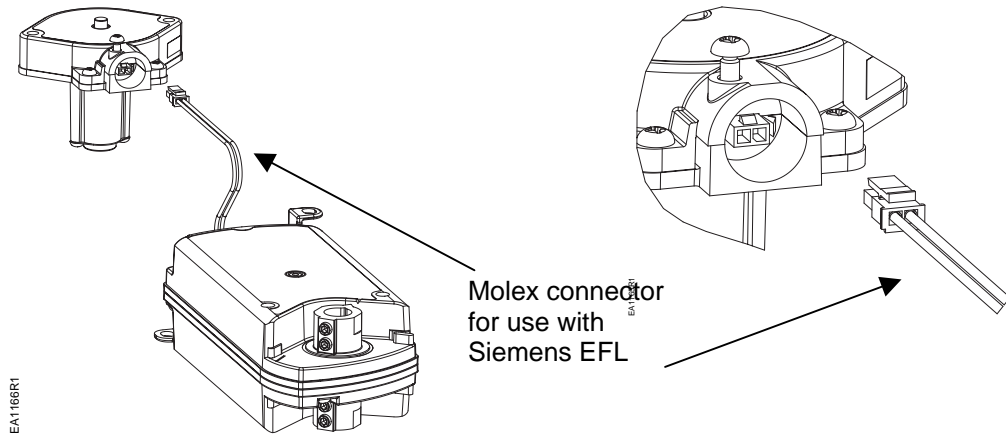


Figure 6.

Dimensions

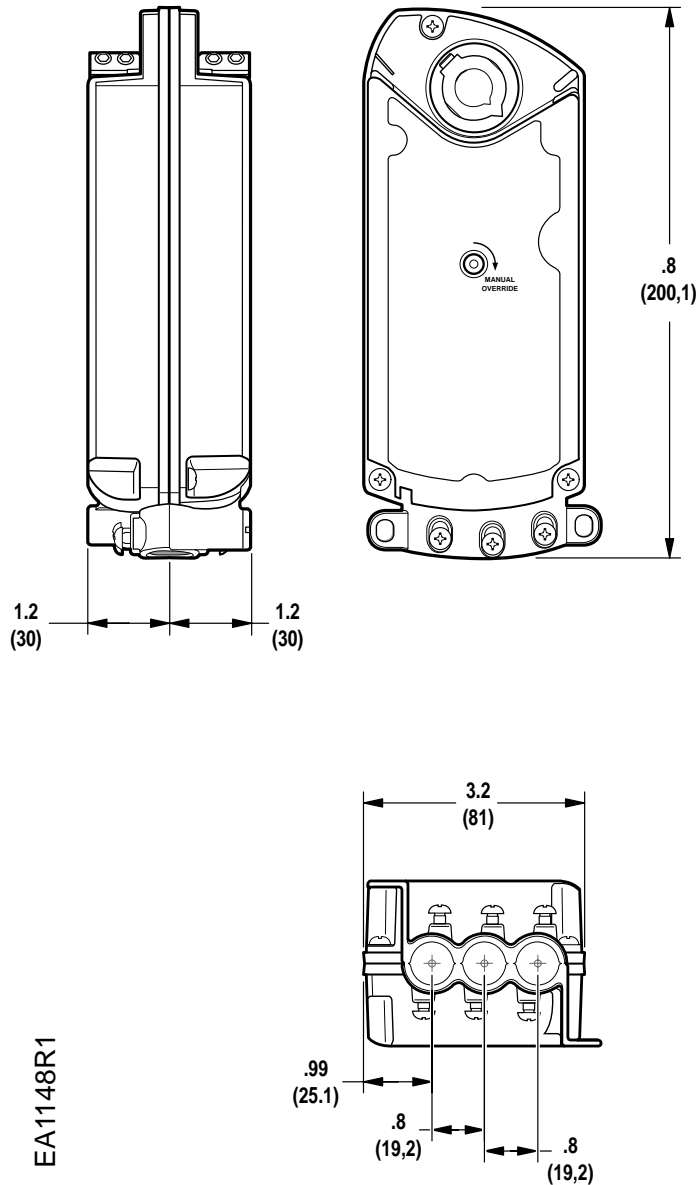


Figure 8. Dimensions in Inches (mm).

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OpenAir™ GGD Electronic Damper Actuator

Designed for UL Listed Fire/Smoke and Smoke Control Dampers

2-Position, 15-second Runtime 15-second Spring Return Time



Description

The OpenAir™ direct coupled, fast acting, two-position, spring return electronic actuators are available as 24 Vac, 115 Vac, and 230 Vac models. They are intended for use on UL listed smoke control dampers or combination fire/smoke rated dampers.

Features

- High temperature rated drive system.
- Reversible fail-safe spring return.
- All metal housing.
- Teflon® insulated lead wires.
- Mechanical range adjustment.
- Multiple shaft couplings available; will accommodate up to 1.05-inch shafts.
- Fifteen second nominal open time; 15-second nominal spring return time.

Application

This actuator is used for the control of dampers requiring up to 142 lb-in (16Nm) driving torque. It is intended for control of UL listed smoke control dampers or combination fire/smoke HVAC dampers. This actuator is designed to meet the 1999 revisions to the UL 555S and AMCA 500-D specifications. Minimum stall torque 350 lb-in.



Product Numbers

Table 1.

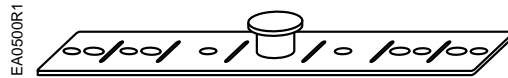
Type	Rotation	Shaft Adapter	24 Vac	115 Vac	230 Vac
Standard	95°	Self-centering	GGD121.1U	GGD221.1U	GGD321.1U
Eight pack of standard	95°	Self-centering	GGD121.1U/B	GGD221.1U/B	GGD321.1U/B
With oversize shaft adapter	95°	Oversized	GGD121.3U	GGD221.3U	GGD321.3U

Specifications	Operating voltage	24 Vac \pm 20%
	Power supply	115 Vac \pm 15%
		230 Vac \pm 10%
	Frequency	50/60 Hz
	Power consumption	
	running	150 VA
	holding	10 VA
Function	Running torque	142 lb-in (16 Nm)
	Spring return torque	108 lb-in (12 Nm)
	Minimum stall torque	350 lb-in (39 Nm)
	Torque reduction at elevated temperature	Less than 10%
	Runtime for 90°	
	operating with motor at 60 Hz	15 seconds nominal
	closing (on power loss) with spring return	15 seconds maximum
	Nominal angle of rotation	95°
Life Expectancy		Minimum 35,000 full stroke cycles.
Mounting	Damper shaft size	
	Standard	3/8 to 1 inch (8 to 25.6 mm)
	Oversize	1.05 inch maximum (26.6 mm)
	Minimum shaft length	3/4-inch (20 mm)
Housing	Enclosure	NEMA 1
	Material	Die cast aluminum alloy
Ambient conditions	Ambient temperature	
	operation	0 to 130°F (-18 to 55°C) One time 350°F (177 °C) for 1/2 hour (per UL555S)
	storage and transport	-25 to 158°F (-32 to 70°C)
	Ambient humidity (non-condensing)	Maximum 95% R.H.
Agency certification		UL listed to UL873 cUL certified to Canadian standard C22.2 No. 24-93 Australian EMC Framework (C-tick) with the limits per AS/NZS 2064 1/2:1997
Miscellaneous	Pre-cabled connection	18 AWG
	Dimensions	See <i>Figure 1</i> .
	Weight	\approx 7 lbs. (3.2 kg)
	Eight pack	\approx 56 lbs. (25.4 kg)

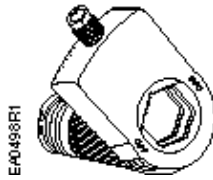
Warning/Caution Notations

WARNING		Personal injury/loss of life may occur if you do not perform a procedure as specified.
CAUTION:		Equipment damage may occur if you do not follow a procedure as specified.

Accessories



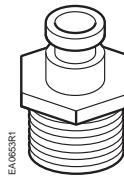
985-006 Anti-rotation (mounting) bracket.



985-004
 Self-centering shaft adapter.



ASK74.1 Oversized shaft adapter will accommodate up to a 1.05-inch (26.6 mm) diameter shaft. Use for coupling to 1-inch jackshafts that are slightly oversized.



985-035P25 Conduit adapter for accommodating a conduit box (pk of 25).



985-008P20 Conduit adapter for a 1/2-inch (12 mm) NPT connector (pk of 20).

Operation

When power is applied, the actuator coupling moves toward the open position, “90°”. The actuator opens in fifteen seconds nominal, 90° at 60 Hz. In the event of a power failure or when operating voltage is turned off, the actuator returns to the “0” position. The return time is fifteen seconds maximum for 90°.

The GGD actuator does not require any periodic cycling to function properly as an integral part of an active smoke control damper system.

NOTE: Siemens Building Technologies, Inc. however, strongly suggests that all life safety systems are functionally checked periodically. Check the smoke control damper/actuator every time you functionally check your smoke detectors, emergency lights, and/or power generators for operation.

Installation

Refer to the installation instructions for detailed guidelines.



CAUTION:

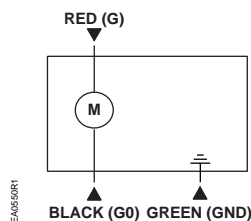
Read and carefully follow the *Installation Instructions* (129-255) to avoid equipment damage.

Wiring

All wiring must conform to NEC and local codes and regulations.

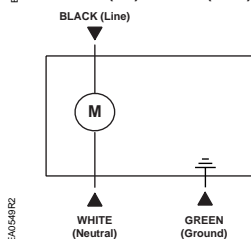
Wire Designations

24 Vac



Function	Color
Supply (SP)	Red
Neutral (SN)	Black
Ground	Green

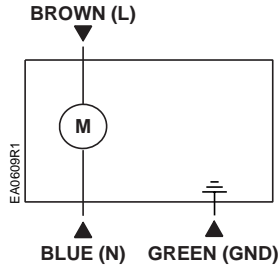
115 Vac



Function	Color
Line	Black
Neutral	White
Ground	Green

**Wire Designations,
 continued**

230 Vac



Function	Color
Line	Brown
Neutral	Blue
Ground	Green



CAUTION:

The actuator must be wired with a 230 Vac line with respect to neutral and the ground lead must be connected for proper protection of the actuator. Any other connection, such as phase to phase, can damage the actuator.

Service



WARNING:

Do not open the actuator. Personal injury may occur if opened. Opening the actuator voids the warranty.

If the actuator is inoperative, replace the unit.

Dimensions

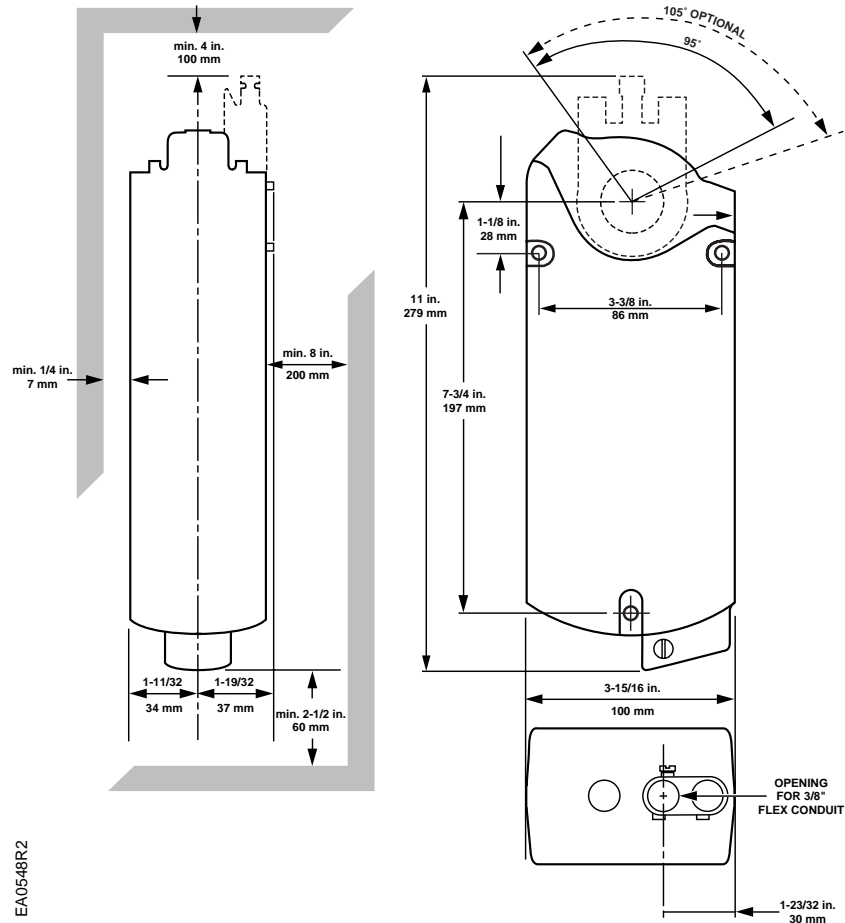
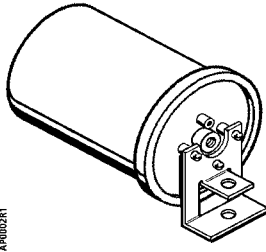


Figure 1. Dimensions of the Actuator.

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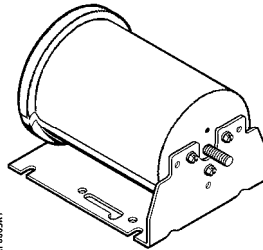
POWERS™ Controls

No. 3 Pneumatic Damper Actuator



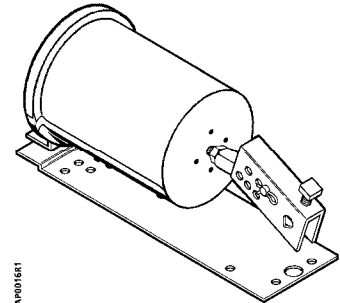
AP00281

331-4312 Pivot Mounting



AP00281

331-4313 Fixed Mounting



AP00281

331-4311 Extended Shaft Mounting

Description

The POWERS Controls No. 3 Pneumatic Damper Actuator is a compact, totally enclosed, rolling diaphragm-type actuator designed for modulating or two-position actuation of dampers or air valves.

Features

- All metal body construction
- Totally enclosed to protect internal parts
- Variety of spring ranges for sequencing
- Fixed or pivot mounting models
- Pivot mounting for extended shaft
- Positioning relay (optional)
- Variety of mounting/linkage kits for special applications
- Threaded shaft for easy mounting to accessory thread

Product Numbers

See Table 1.

Application

Typical applications are for control of mixing box dampers or air valves, and damper control for unit ventilators, unit conditioners and other HVAC applications.

These compact, totally enclosed actuators are easily installed either directly within the mixing box or unit enclosure, or externally, as required for each application.

Table 1. Product Numbers for No. 3 Pneumatic Damper Actuators.

Description	Mounting Style	Part No.		
		Nominal Spring Range		
		3-7 psi (21-48 kPa)	5-10 psi (35-69 kPa)	8-13 psi (55-90 kPa)
Actuator	Front	331-4310	331-4510	331-4810
Actuator, bracket	Fixed	331-4313	331-4513	331-4813
Actuator, bracket, clevis	Fixed	331-4314	331-4514	331-4814
Actuator, integral pivot	Pivot	331-4312	331-4512	331-4812
Actuator, integral pivot with pivot post *	Extended shaft	331-4311	331-4511	331-4811
Actuator, integral pivot with pivot post *	Extended shaft kit with positioning relay	—	—	332-4811
Actuator, bracket, ball joint connector	Fixed	331-4331	331-4531	331-4831
Actuator, bracket, ball joint connector and positioning relay	Fixed	—	—	332-4831
Extended shaft with 90° barb fitting (for fume hood controller applications)	Extended shaft	—	—	546-00020

* Mounted on plate for extended shaft with clevis and crank for 3/8-inch (10-mm), 7/16-inch (11-mm), or 1/2-inch (13-mm) diameter shaft.

NOTE: When the actuator is ordered with extended shaft mounting, the mounting plate, pivot post and hardware, clevis, damper crank, rocker arm, and all screws/nuts are included. Order other frame mounting accessories as required if not supplied by damper manufacturer.

Specifications		
Effective diaphragm area		8 inches ² (51.6 cm ²)
Stroke		2-3/8 inches (6 mm) *
Housing (totally enclosed)		Aluminum
Stem		Plated steel
Diaphragm		Ozone resistant rubber
Spring		Steel
Cup		Zytel
Maximum air pressure		30 psig (210 kPa)
Type of mounting		Fixed or pivot
Thrust and torque rating		See Table 3
Agency Approvals		Complies with UL555 and UL555S
	* For special applications, an actuator stroke of 2-3/4 inch is available in 3 to 7, 5 to 10, or 8 to 13 psi (21 to 58, 35 to 69, or 55 to 90 kPa) spring ranges. Some models are UL Recognized Components under UL's Damper Actuator category (EMKU2), which covers pneumatic damper actuators intended to be employed on fire dampers and leakage rated dampers. Contact Siemens Building Technologies, Inc. National OEM Sales and Marketing for information.	

**Specifications,
 Continued**

Operating

Nominal spring ranges	3 to 7 psi (21 to 50 kPa) 5 to 10 psi (35 to 69 kPa) 8 to 13 psi (55 to 90 kPa)
Operating temperature	-20°F to 160°F (-29°C to 71°C)
Air connection	Straight barb fitting for 1/4-inch OD plastic tubing installed in 1/8-inch NPT opening

Miscellaneous

Shipping Weight:	
Basic actuator	1.3 lb (0.58 kg)
Actuator with extended shaft mounting	3.1 lb (1.4 kg)
Actuator with fixed bracket	2.5 lb (1.1 kg)
Actuator with fixed bracket and clevis	2.7 lb (1.2 kg)
Actuator with extended shaft mounting and Positioning Relay	4.8 lb (2.2 kg)
Dimensions	See Figures 4 through 8

Accessories

Linkage kit, 4-inch link and crank	331-958
Linkage kit, 4-inch rod, ball joint and crank	331-947
Damper shaft crank, selectable radius, 45°, 60°, and 90°, angular rotation for 3/8 to 1/2-inch (10 to 13-mm) diameter damper shafts	331-941
Damper shaft crank, adjustable radius 3/4 to 2-7/8 inch (19 to 73 mm) for 1/2-inch (13-mm) diameter damper shafts	331-795
Damper shaft crank, adjustable radius 3/4 to 4-5/8 inch (19 to 177 mm) for 3/8-inch (9 mm) diameter damper shafts	331-805
Damper shaft extension, 1/2 x 9 inches long	333-042
Damper shaft extension, 1/2 inch shaft	331-631
Damper shaft extension Adapter, for 3/8 inch shaft	331-632
Pivot mounting kit (bracket and three mounting screws)	333-148
Pivot post	333-139
Fixed mounting bracket	331-916
Extended shaft mounting plate	331-033
Clevis, steel	333-207
Clevis, forged	331-292
Clevis pin	331-293
Clevis, frame mounting	331-653
Hitch pin	331-807
12-inch Damper actuator push rod	338-041
15-inch Damper actuator push rod	338-042
18-inch Damper actuator push rod	338-043
24-inch Damper actuator push rod	338-044
36-inch Damper actuator push rod	338-045
48-inch Damper actuator push rod	338-046
Damper blade rocker arm	333-034
Positioning relay	147-2000
Relay mounting kit	147-104

Table 3. Thrust Torque Ratings.

Nominal Spring Range	Maximum Thrust lb. (N)				Torque Rating* lb-in (Nm)			
	Full Stroke Forward			Spring Return (No Stroke) 0 psig (0 kPa)	Gradual Operation	2-Position Operation		
	15 psi (103 kPa)	18 psi (124 kPa)	25 psi (172 kPa)			15 psi (103 kPa)	18 psi (124 kPa)	25 psi (172 kPa)
3 to 7 psi (21 to 48 kPa)	64 (285)	88 (391)	144 (641)	24 (107)	10 (1.1)	20.2 (2.3)	20.2 (2.3)	20.2 (2.3)
5 to 10 psi (35 to 69 kPa)	40 (178)	64 (285)	120 (534)	40 (178)	10 (1.1)	33.6 (3.8)	33.6 (3.8)	33.6 (3.8)
8 to 13 psi (55 to 90 kPa)	16 (71)	40 (178)	96 (427)	64 (285)	10 (1.1)	53.8 (6.1)	53.8 (6.1)	53.8 (6.1)

* With maximum hysteresis of 2.5 psi (17.2 kPa) @ 90° rotation.

Sizing

The size and quantity of actuators required depends on several damper torque factors:

- Damper type (standard or low leakage)
- Quality of damper installation
- Number of damper sections
- Air velocity
- Static pressure
- Age of damper

To determine the correct actuator required for the installation:

- Obtain the damper torque ratings (lb-in/sq-ft) from the damper manufacturer.
- Determine the area of the damper.
- Calculate the total torque required to move the damper.
- Select the appropriate actuator(s).

Installation

For Actuators 331-4311, 331-4511, 331-4811, or 332-4811. These assemblies are designed for 90° damper rotation.

Extended Shaft Mounting, Pivot Mounting

NOTE: Clevis mounts in Crank Radius Hole No. 6 for 90° damper rotation.

1. Slip the 9/16-inch (14 mm) diameter hole in the mounting plate over the damper shaft (Figure 1).
2. Slip the crank over the 3/8 through 1/2-inch (10 through 13-mm) diameter damper shaft (Figure 2).
3. Position the mounting plate (Table 3).
4. Attach the mounting plate to the duct with four screws.

Installation, Continued

Table 3. Damper Blade Rotation.

Actuator Position in Relation to Damper Shaft	Crank Position in Relation to Damper Shaft	Rotation of Damper Blade on Increase of Pressure
Left	Above	Clockwise
	Below	Counterclockwise
Right	Above	Counterclockwise
	Below	Clockwise

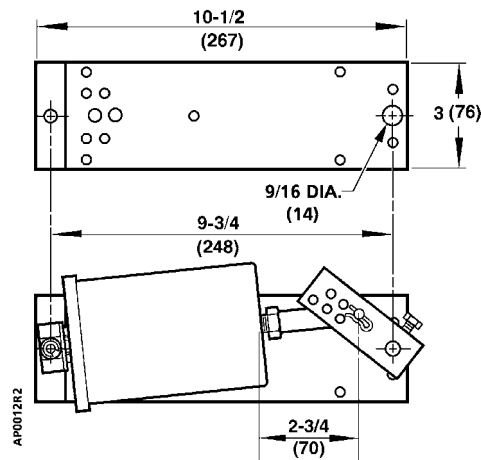
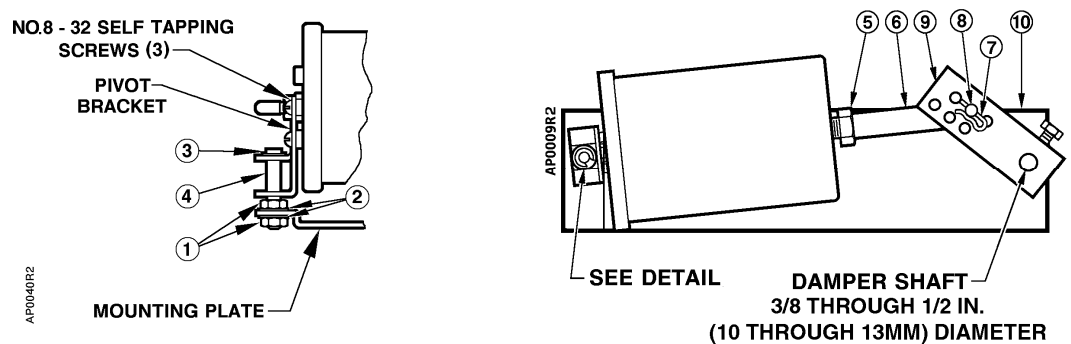


Figure 1. Mounting Plate and Extended Shaft Mounting.



Item	Description	Item	Description
1	Nut(s)	6	Clevis
2	Lock Washers (2)	7	Hitch Pin
3	E-ring	8	Clevis Pin
4	Pivot Post	9	Crank Assembly Kit No. 331-941
5	Nut	10	Actuator Mounting Plate

Figure 2. Extended Shaft Mounting with Pivot.

Installation, Continued

Extended Shaft Mounting, Fixed Actuator

For Actuators 331-4314, 331-4514, 331-4814 order Linkage Kit 331-958.

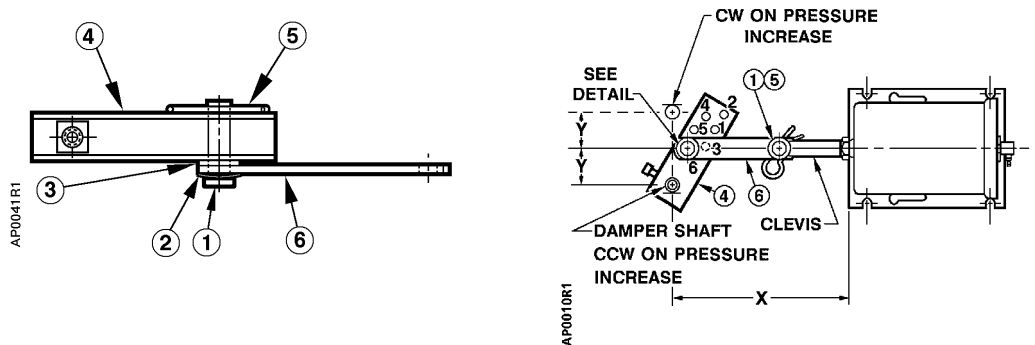
For Actuators 331-4313, 331-4513, 331-4813, order Clevis 333-207 and Linkage Kit 331-958.

1. Determine the direction of the damper shaft rotation (clockwise or counterclockwise) on an increase in pressure to the actuator.
2. Determine the angle of rotation required for the damper to move from closed to full open.

NOTE: Since the actuator stroke is 2-3/8 inch (6 cm) and the angle of rotation is known, the crank radius can be determined from the graph in *TB181 Maximum Thrust Ratings of Pneumatic Damper Actuators Technical Bulletin* (155-219P25) or use Table 4.

3. Attach the link to the crank at the radius value determined in Step 2.
4. Attach the clevis and other end of the linkage to the actuator shaft (Figure 3).
5. The normal position of the damper (open or closed) and its direction of rotation (CW or CCW) will determine the location of the actuator and linkage assembly (Table 3).
6. Attach an air line or Baumanometer (squeeze bulb) to the actuator and increase pressure until the actuator shaft moves one half of its stroke, 1-3/16 inch (3 cm). Select the correct location for the actuator assembly as determined in Step 5.
7. Slip the crank over the damper shaft and position the assembly so that the actuator shaft and link are straight and perpendicular to the crank.
8. Mark and attach the actuator bracket to the duct at this location. If this installation procedure is followed, there will be no problem with linkage scissoring or locking up.

The installation is complete.



Item	Description	Item	Description
1	Clevis Pin	4	Crank with Set Screw
2	Spring Washer	5	Hitch Pin
3	Washer, Nylon	6	Link, 4 inches (102 mm) long

Figure 3. Fixed Mounted Actuator Assembly with Linkage Kit 331-958.

Installation, Continued

Table 4. Crank Radius Connection.

Dimensions		Application	Crank Radius Connection	Crank Hole Number
X	Y			
7-7/8 inch (200 mm)	1-3/16 inch (30 mm)	2-3/8 inch (60 mm) stroke 90 ° Rotation	1-11/16 inch (43 mm)	6
7-7/8 inch (200 mm)	2-1/16 inch (52 mm)	2-3/8 inch (60 mm) stroke 60 ° Rotation	2-3/8 inch (60 mm)	5

NOTE: Crank Radius Holes No. 1 through 4 are used for No. 4 and No. 6 Pneumatic Damper Actuators only.

Dimensions

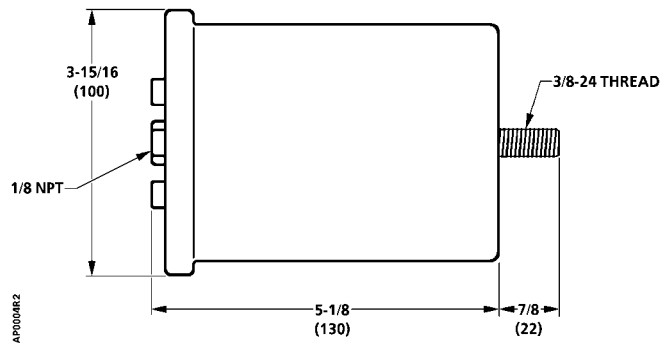


Figure 4. No. 3 Pneumatic Damper Actuator Dimensions. Dimensions are in Inches (Millimeters).

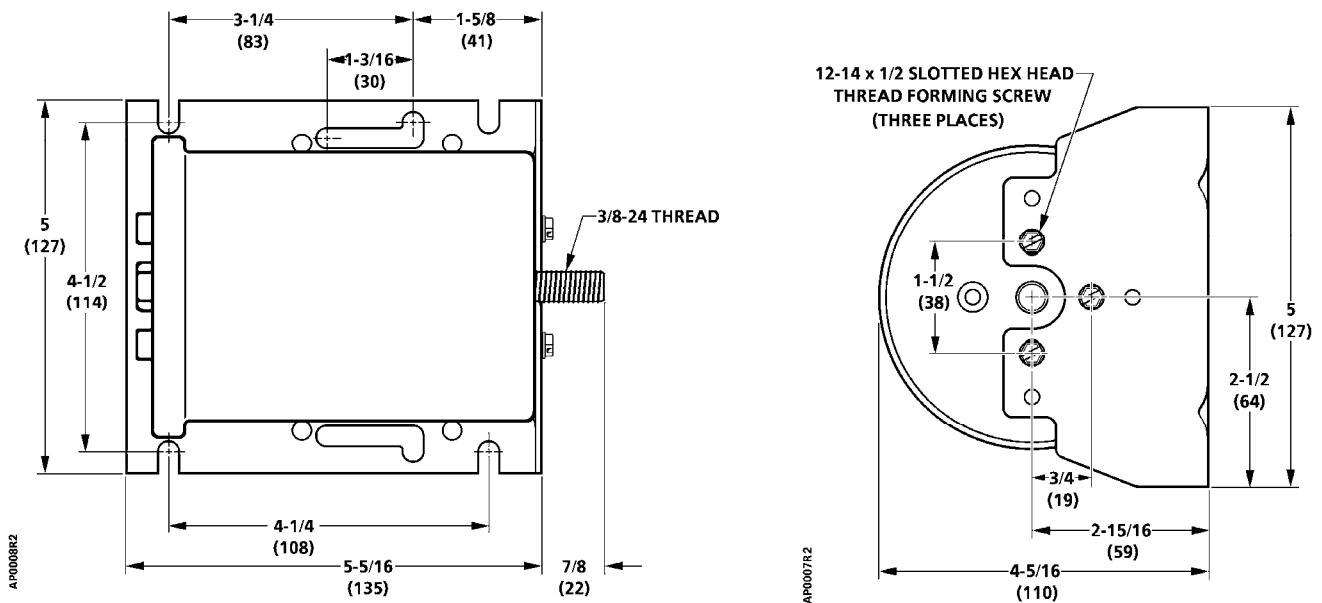


Figure 5. No. 3 Actuator with Fixed Mounting Bracket Dimensions. Dimensions are in Inches (Millimeters).

Dimensions, Continued

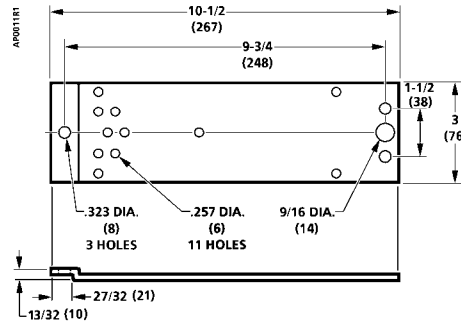


Figure 6. Extended Shaft Mounting Bracket Dimensions. Dimensions are in Inches (Millimeters).

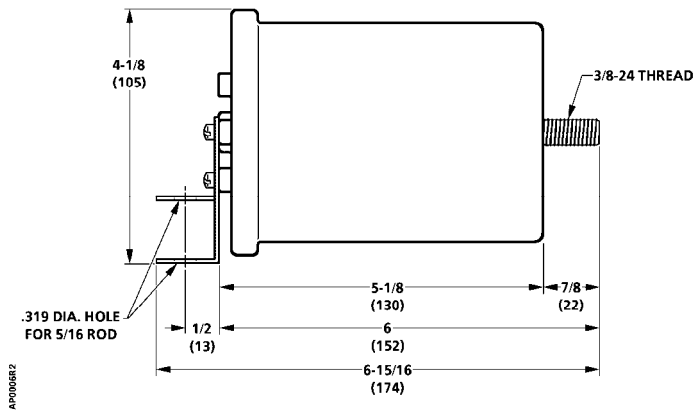
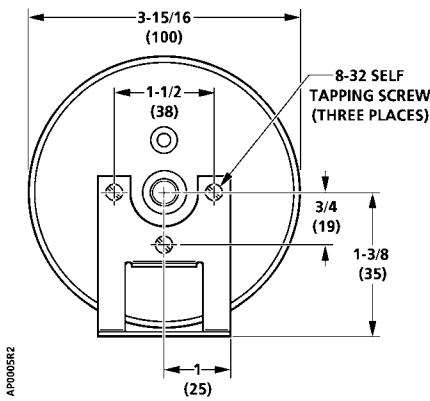


Figure 7. No. 3 Actuator with Pivot Mounting Bracket Dimensions. Dimensions are in Inches (Millimeters).

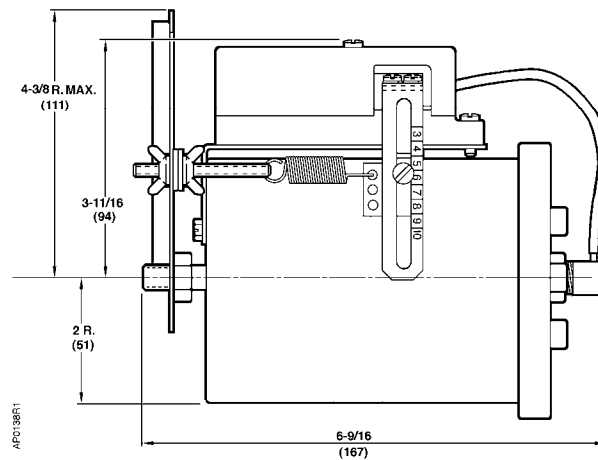
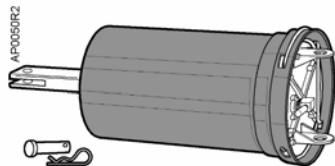


Figure 8. No. 3 Actuator with the RL 147 Positioning Relay Mounted Dimensions. Dimensions in Inches (Millimeters).

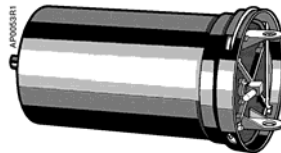
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POWERS™ Controls

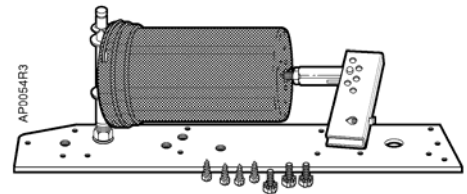
No. 4 Pneumatic Damper Actuator




**Actuator Assembly
331-2929 Typical**



**Actuator Assembly
331-2904 Typical**



**Actuator Assembly
331-3000 Typical**

Description	The Powers Controls No. 4 Pneumatic Damper Actuator is a totally enclosed pneumatic piston type actuator designed to operate dampers for ventilating systems, mixing box control, and other applications requiring a large effective diaphragm area and long stroke.
Features	<ul style="list-style-type: none"> • All metal body construction • Replaceable, ozone-resistant, EPDM rubber, rolling diaphragm • Pivot mounting for extended shaft or frame mounting • Fixed bracket mounting • Direct front mounting • Positioning relay (optional) • Forward travel stops (optional) • Adjustable hesitation point (hesitation actuator only)
Product Numbers	See Table 1.
Application	The No. 4 Pneumatic Damper Actuator is recommended for control of outdoor, return air, exhaust, face and bypass, fan discharge, and static pressure control dampers, as well as specialized dampers and air valves found in terminal units such as unit ventilators and mixing boxes.
	 <p>Certain actuators in Table 1 are UL Recognized Components for fire/smoke applications under category EMKU2. This category covers pneumatic damper actuators used on fire dampers and leakage rated dampers.</p>
	The No. 4 Pneumatic Damper Actuator hesitation model is frequently used to operate the outdoor air damper on unit ventilators. The hesitation feature enables the outdoor air damper to be synchronized with the unit valve to maintain a predetermined outdoor air requirement when the controlled zone is at the desired temperature.

Warning/Caution Notations



WARNING:		Personal injury, or loss of life may occur if you do not follow a procedure as specified.
CAUTION:		Equipment damage, or loss of data may occur if you do not follow a procedure as specified.

Table 1. Product Numbers for No. 4 Pneumatic Damper Actuator.

Description	Mounting Style	Product Numbers				
		Nominal Spring Range				
		3-7 psi (21-48 kPa)	3-13 psi (21-90 kPa)	5-10 psi (35-69 kPa)	8-13 psi (55-90 kPa)	2-3, 8-13 psi (14-21, 55-90 kPa) Hesitation Model
Actuator, mounting screws (non-pivot)	Front	331-2910	—	331-2917	331-2963	—
Actuator, bracket (non-pivot) 3-inch stroke for unit ventilator	Fixed	331-2911	—	331-2934	331-2966	331-2927
Actuator, bracket (non-pivot) 2-3/8 inch stroke for unit ventilator	Fixed	—	—	—	—	331-2974
Actuator, mounting plate, ball joint connector	Fixed	331-3015	331-3018	331-3016	331-3017	331-3019
Actuator, mounting plate, ball joint connector with positioning relay	Fixed	—	—	—	332-3017	—
Actuator, integral pivot	Pivot	331-2904 ¹	331-2905 ¹	331-2906 ¹	331-2961 ¹	331-2909 ¹
Actuator, integral pivot, clevis and clevis pin for use with frame mounting accessory	Pivot	331-2929	331-2930	331-2931	331-2968	—
Actuator, integral pivot with pivot post ²	Universal Kit	331-3000	331-3001	331-3002	331-2973 ¹	331-3004
Actuator, integral pivot with pivot post and positioning relay ²	Universal Kit with Positioning Relay	—	—	—	332-2973	—

¹ UL Recognized Components for Fire/Smoke Applications.

² Mounted on plate for extended shaft with clevis and crank for 3/8-inch (10-mm), 7/16-inch (11-mm), or 1/2-inch (13-mm) diameter shaft. Parts for frame mounting (blade drive) included with kit.

NOTE: When the actuator is ordered with universal mounting, the mounting plate, pivot post and hardware, clevis, damper crank, and all screws/nuts are included. Order other frame mounting accessories as required, if not supplied by damper manufacturer.

Specifications	Effective diaphragm area	11 inches ² (71 cm ²)
	Stroke	4 inches (102 mm)
	Stroke (Hesitation model)	3 inches (76 mm)
	Stem	Stainless steel
	Housing	Steel with cathodic epoxy electrocoat
	Diaphragm	Ozone-resistant, EPDM rubber
	Bearing	Oilite® sintered bronze bushing in aluminum die casting
	Maximum air pressure	30 psig (210 kPa)
	Nominal spring ranges	3 to 7 psi (21 to 50 kPa) 3 to 13 psi (21 to 90 kPa) 5 to 10 psi (35 to 70 kPa) 8 to 13 psi (55 to 90 kPa)
	Nominal spring range (Hesitation model)	2 to 3; 8 to 13 psi (14 to 21; 55 to 90 kPa)
	Ambient temperature range	
	Operating	-20°F to 200°F (-29°C to 93°C)
	Storage	-20°F to 200°F (-29°C to 93°C)
	Air connection elbow barb fitting for 1/4-inch OD plastic tubing	Installed in 1/8-inch NPT opening
Type of mounting	Front, bracket, pivot	
Thrust and torque rating	See Table 2	
Dimensions	See Figure 14	
Agency Approvals	Complies with UL555 and UL555S	

Table 2. Thrust and Torque Rating.

Nominal Spring Range	Maximum Thrust lb (N)				Torque Rating* lb-in (Nm)			
	Full Stroke Forward			Spring Return (No stroke) 0 psig (0 kPa)	Gradual Operation	2-position Operation or with Positioner		
	15 psi (103 kPa)	18 psi (124 kPa)	25 psi (172 kPa)			15 psi (103 kPa)	18 psi (124 kPa)	25 psi (172 kPa)
3-7 psi (21-50 kPa)	88 (391)	121 (538)	198 (881)	33 (147)	30 (3.4)	46 (5.2)	46 (5.2)	46 (5.2)
3-13 psi (21-90 kPa)	22 (98)	55 (245)	132 (587)	33 (147)	30 (3.4)	30 (3.4)	46 (5.2)	46 (5.2)
5-10 psi (35-70 kPa)	55 (245)	88 (391)	165 (734)	55 (245)	30 (3.4)	77 (8.7)	77 (8.7)	77 (8.7)
8-13 psi (55-90 kPa)	22 (98)	55 (245)	132 (587)	88 (391)	30 (3.4)	123 (14)	123 (14)	123 (14)
2-3, 8-13 psi (14-21, 55-90 kPa) Hesitation model	22 (98)	55 (245)	132 (587)	22 (98)	23 (2.6)	—	—	—

* With maximum hysteresis of 2.5 psi (17.2 kPa) @ 90° rotation.

Accessories

Linkage kits:	
Crank and link (Figure 9)	331-958
Rod, ball joint, and crank	331-947
Pivot post, ball joint, and crank	331-954
Cranks - damper shaft:	
5/8-inch (16 mm) diameter	333-182
3/4-inch (19 mm) diameter	333-183
1-inch (25 mm) diameter	333-181
Adjustable radius, 3/4 to 2-7/8 inch (20 to 73 mm) for 1/2-inch (13 mm) diameter damper shaft	331-795
Selectable radius (45°, 60°, or 90° rotation) for 3/8 to 1/2-inch (10 to 13 mm) diameter damper shaft	331-941
Clevis:	
Forged	331-653
Steel plated	333-207
Damper shaft extension kits:	
1/2-inch (13 mm) × 2-1/4 inch (54 mm) long (See <i>TB 128</i>)	331-631
1/2-inch (13 mm) × 9-inch (229 mm) long	333-184
Damper shaft extension kit adapter, 3/8-inch (9.5 mm)	331-632
Actuator shaft adapter, uses 1/2-inch NPT Pipe	333-030
Actuator shaft extensions:	
10-1/8-inches (257 mm) long	331-434A
Ball joint type, 12 inches (305 mm) long	331-674
Damper blade rocker arm	333-034
Damper push rods, 5/16 inch (8 mm) diameter:	
12 inches (30 cm) long	338-041
15 inches (38 cm) long	338-042
18 inches (46 cm) long	338-043
24 inches (61 cm) long	338-044
36 inches (91 cm) long	338-045
48 inches (122 cm) long	338-046
Spring clamp (secures 1/4-inch OD poly tubing to barb-fitting at higher control pressures or elevated temperatures)	531-833
Forward stroke stop kit	
Adjustable 2-3/8 to 4 inches (60 to 102 mm)	331-939
Positioning relay	147-2000
Positioning relay mounting kit	147-314
Universal mounting plate	
3/4-inch hole in plate for damper shaft	331-623
1-inch hole in plate for damper shaft (use with 333-194)	331-623A
Frame mounting lug	331-569
Offset mounting bracket	333-176

Service Kit

EPDM diaphragms (package of 5)

333-071

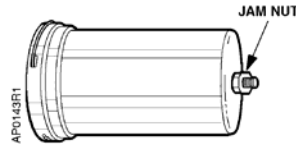


Figure 1. Actuator Jam Nut Location.



WARNING:

Do not remove the jam nut (Figure 1). Spring is under heavy load. Repair by trained personnel only.

Actuator Selection for Unit Ventilator

For specific unit ventilators, see Application Bulletins found in *Section 36* of the *POWERS™ Controls Installed Applications Manual (144-004)*.

Actuator Sizing

The quantity of actuators required depends on several torque factors. To determine the quantity of actuators required for the installation:

1. Obtain damper torque ratings (ft-lb/ft²) from the damper manufacturer.
2. Determine the area of the damper.
3. Calculate the total torque required to move the damper:

$$\text{Total Torque} = \text{Torque Rating} \times \text{Damper Area}$$

4. Calculate the total quantity of actuators required:

$$\text{Number of Actuators} = \frac{\text{Total Damper Torque Required}}{\text{SF}^1 \times \text{Actuator Torque (Table 2)}}$$

¹ Safety Factor: When calculating the number of actuators required, a safety factor should be included for unaccountable variables such as slight misalignments, aging of the damper, etc. A suggested safety factor is 0.80 (or 80% of the rated torque).

See *AB-300 Damper Actuator Sizing and Selection Application Bulletin* in the *HVAC Systems/Controls Reference Data (125-1853)* for additional sizing information. See *TB-181 POWERS™ Controls Maximum Thrust Ratings of Pneumatic Damper Actuators Technical Bulletin (155-219P25)* for additional torque requirements.

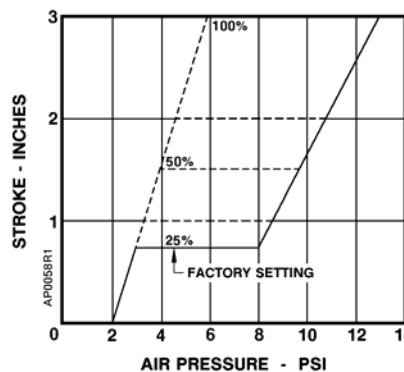


Figure 2. Hesitation Actuator Adjustment.

Operation

**Standard Actuator
 (Figure 3)**

The air tubing from a controlling instrument connects to the actuator's upper housing. With no control pressure to the actuator, the compression spring forces the diaphragm and actuator shaft toward the upper housing, but is limited by the jam nut on the actuator shaft. As the control pressure on the diaphragm increases, the spring compression is overcome and the actuator shaft gradually moves outward. Conversely, as control pressure decreases, the spring returns the shaft to the position at which the air pressure on the diaphragm balances the spring tension. For each value of control pressure there is a corresponding position of the shaft.

**Hesitation Actuator
 (Figure 4)**

The branch or return pressure from the controlling instrument connects to the upper housing of the actuator. With no branch pressure to the motor, the main spring forces the actuator shaft toward the upper housing, but is limited by the jam nut on the actuator shaft. As the branch pressure on the diaphragm increases from 0 to 2 psi (0 to 14 kPa), the compressive force in the main spring prevents the actuator shaft from moving. As the branch pressure increases from 2 to 3 psi (14 to 21 kPa), the force in the main spring is overcome and the actuator shaft moves to its hesitation point. At the hesitation point, the main spring seat is in contact with the retard spring seat. The compressive force in the retard spring prevents further actuator shaft travel between 3 and 8 psi (21 and 55 kPa). Above 8 psi (55 kPa), the resisting force in the retard spring is overcome and the actuator shaft moves to its maximum stroke between 8 and 13 psi (55 and 90 kPa).

Table 3. Construction Components (Figures 3 and 4).

Item	Part No.	Material	Description	Item	Part No.	Material	Description
1	333-099	Aluminum	Upper housing with pivot ears	7	331-915	Music wire	Retainer clip
2	333-071	EPDM	Diaphragm (Package of 5)	8	—	Stl. tubing	Spring guide
3	—	Steel	Lower housing	9	—	Music wire	Hesitation spring
4	—	Oil-tempered steel	Spring	10	—	Steel	Cycle adjusting rod
5	—	Zytel	Bearing plate	11	041-100	Brass	10-32 Hex nut
6	—	—	Piston cup/stem				

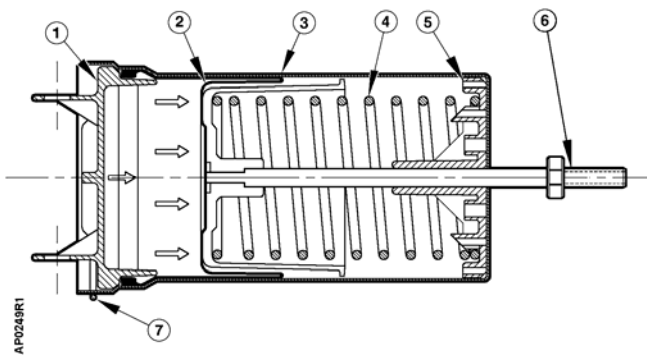


Figure 3. Standard Actuator.

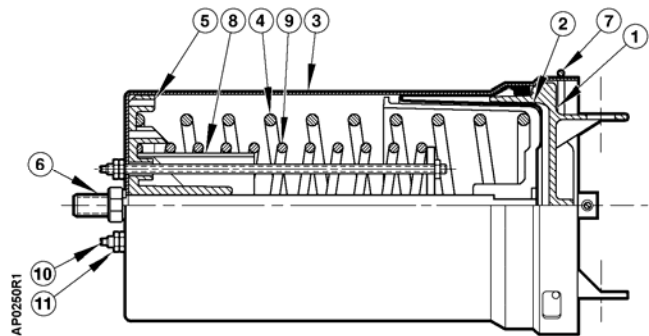


Figure 4. Hesitation Actuator.

Hesitation Actuator Adjustment

Example:

To obtain an initial hesitation point after one inch (25 mm) of shaft travel.

1. Add air pressure to the actuator until shaft travel is one inch (25 mm).
2. Turn locknuts on cycle adjustment rods until they contact lower housing, then lock together (Figure 4, Items 10 and 11). For initial hesitation point settings other than one inch (25 mm), follow this same procedure.



CAUTION:

Make certain cycle adjustment nuts are even to ensure smooth operation.

Extended Shaft Mounting - Pivot Actuator

1. Order one of the following for extended shaft mounting. These assemblies are designed for 90° damper rotation.

Actuator: 331-3000, 331-3001, 331-3002, 331-2973, or 331-3004

NOTE: Clevis mounts in Crank Radius Hole No. 1 for 90° damper rotation.

2. Slip the 3/4-inch (19 mm) diameter hole in the mounting plate over the damper shaft (Figure 5).

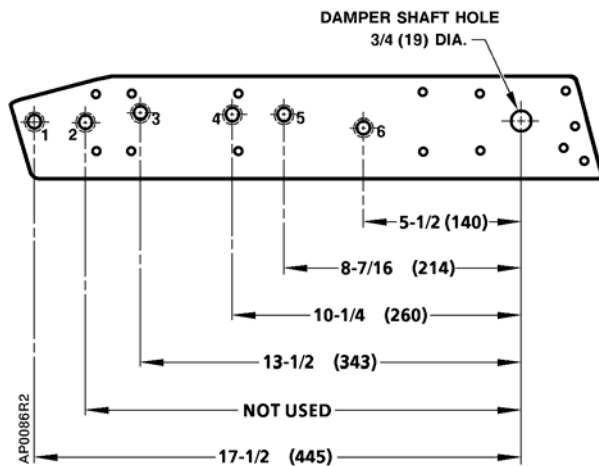


Figure 5. Actuator Mounting Plate 331-623. Dimensions in Inches (Millimeters).

Table 4. Mounting Plate Hole Identification.

Hole	Used For
1	No. 6 Actuator extended shaft mounting
2	Not used
3	No. 4 Actuator extended shaft
	No. 6 Actuator frame mounting NC
4	No. 6 Actuator frame mounting NO
5	No. 4 Actuator frame mounting NC
6	No. 4 Actuator frame mounting NO

**Extended Shaft
 Mounting - Pivot
 Actuator,
 Continued**

- Slip the crank over the 3/8 through 1/2-inch (10 through 13-mm) diameter damper shaft (Figure 6).

With the actuator assembly to the left of the damper shaft, an increase in actuator pressure rotates the damper blade clockwise (CW) when the crank is above the damper shaft (Figure 6), or counterclockwise (CCW) when the crank is below the damper shaft.

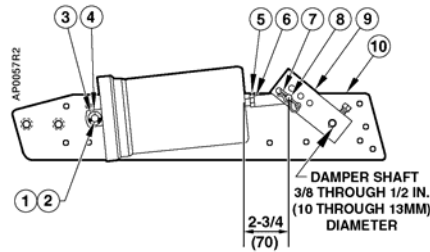


Figure 6. Actuator 331-3000 (Typical).

With the actuator assembly to the right of the damper shaft, an increase in actuator pressure rotates the damper blade CCW when the crank is above the damper shaft, or CW when the crank is below the damper shaft.

- Position the mounting plate and attach it to the duct with four screws.

Table 5. Actuator Accessories Shown in Figure 6.

Item	Part No.	Description	Qty.	Material
1	331-565	Pivot shaft	1	Steel
2	047-061J	E-ring	2	Steel
3	146-020K	Lock washer	1	Steel
4	041-162J	Nut	1	Steel
5	041-142	Nut	1	Steel
6	333-207	Clevis	1	Zinc plated steel
7	331-807	Hitch pin	1	Zinc plated steel
8	331-293	Clevis pin	1	Zinc plated steel
9	331-923	Crank assembly	1	Galvanized steel
10	331-623	Actuator mounting plate	1	Steel
—	034-283	Mounting screws	4	Steel
F	333-034	Rocker	—	Zinc plated steel
F	331-801	Clevis	1	Steel-reinforced plastic
F	034-123K	Mounting screws	3	Steel
F	041-230J	Nut	2	Steel
F	030-510J	Screws	2	Steel

"F" Parts for Frame Mounting.

**Extended Shaft
 Mounting - Fixed
 Actuator**

1. Order one of the following damper actuators, the clevis, and linkage kit (Figure 8):
 Actuator with mounting bracket: 331-2911, 331-2966, 331-2927, or 331-2974
 Clevis: 331-801
 Linkage Kit: 331-958
2. Determine the application, and select appropriate "X" and "Y" dimensions from Table 7. Select a rigid section of the duct, if possible, and then draw these lines on the duct.

NOTE: If the "X" dimension is 8-1/2 inches (216 mm), place the rear of the actuator against the damper shaft and draw a line along the front of the bracket for the "X" dimension. Measure the "Y" dimension.

3. If the actuator assembly mounts to the *right* of the damper shaft (Figure 8):
 - Draw the "Y" dimension line above the damper shaft if the damper blade is to rotate CCW as actuator pressure increases.
 - Draw the "Y" line below the damper shaft if the damper blade is to rotate CW as actuator pressure increases.

If the actuator assembly mounts to the *left* of the damper shaft:

- Draw the "Y" dimension line above the shaft if the damper blade is to rotate CW as actuator pressure increases.
- Draw the "Y" line below the damper shaft if the damper blade is to rotate CCW as actuator pressure increases.

CAUTION:



It is important to use the "X" and "Y" dimensions in Table 7 to position the actuator. They were selected to ensure that the crank is approximately perpendicular to the actuator shaft at half its stroke. This will prevent the linkage from scissoring or locking up (see Figure 7).

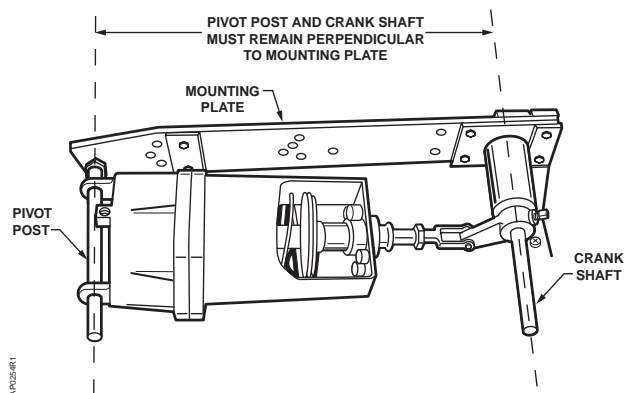
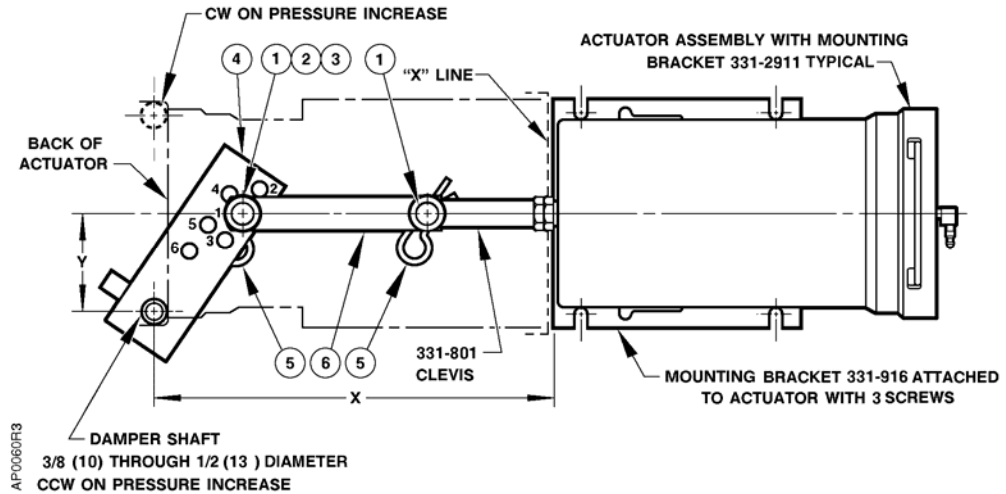


Figure 7. Perpendicular Mounting.

Extended Shaft Mounting - Fixed Actuator, Continued

4. Place the front of the actuator on the "X" dimension line so the actuator shaft faces the damper shaft. Place the centerline of the actuator over the "Y" dimension line (Figure 8).
5. Thread Clevis 331-801 onto the actuator shaft and tighten it against the lock nut. Assemble Linkage Kit 331-958 (Table 6, Items 1 through 6) to the actuator assembly per Figure 8. The linkage is assembled so the damper shaft will rotate CCW as actuator pressure increases. This is a typical normally closed damper installation.



**Figure 8. Fixed Mounted Actuator Assembly.
 Dimensions in Inches (Millimeters).**

**Table 6. Linkage Kit 331-958 Parts
 (Figure 8).**

Item	Part No.	Description	Qty.	Material
1	331-918	Clevis pin	2	Zinc plated steel
2	331-930	Spring washer	1	—
3	331-929	Washer	1	Nylon
4	331-941	Crank assembly	1	—
5	331-807	Hitch pin	2	Zinc plated steel
6	331-922	4-inch link	1	Steel

**Table 7. Linkage Kit 331-958 Crank Connections
 (Figure 8).**

Crank Hole Number	Dimensions Inches (Millimeters)		Application
	X	Y	
1	8-1/2 (216)	2 (51)	4-inch (102) stroke - 90° rotation
2	8-1/2 (216)	3 (76)	4-inch (102) stroke - 70° rotation
3	8 (203)	1-1/2 (38)	3-inch (76) stroke - 90° rotation
4	8 (203)	2-1/2 (64)	3-inch (76) stroke - 60° rotation

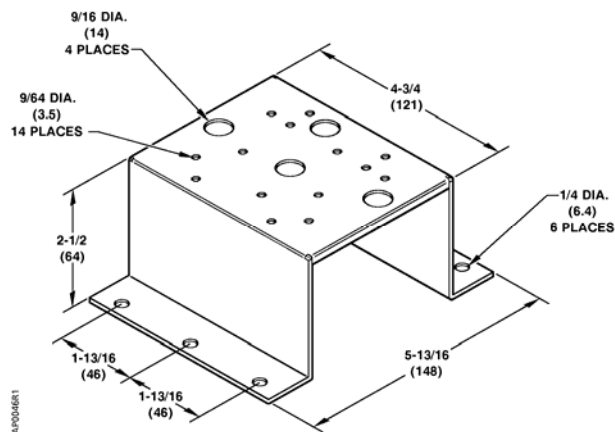
Frame Mounting

1. Order one each of the following:
 Actuator assembly: 331-3000, 331-3001, 331-3002, 331-2973, or 331-3004
 Mounting Lug: 331-569
2. Weld the mounting lug to the damper frame (Figure 10) so that it is parallel and 5/16-inch (8 mm) from the inside edge of the damper frame and perpendicular to it. Weld the mounting lug along both sides. The mounting lug should be as close as possible to the corner of the damper frame to minimize deflection. The damper manufacturer should weld the lug.
3. If the damper frame is aluminum, light gauge sheet metal, or an unusual shape, bolt a 3/16-inch (5-mm) thick, flat piece of steel to the frame. Then, weld the mounting lug to the piece of steel.
4. Attach the rocker to the blade in the proper position for a normally open or normally closed damper (Figure 10).
5. Attach the mounting plate to the mounting lug.
 - Normally open damper: Attach the plate to the lug (Figure 12). Place the pivot post in Hole 6.
 - Normally closed damper: Attach the plate to the lug (Figure 13). Place the pivot post in Hole 5.
6. Fasten the clevis to the rocker. Discard the crank and other parts not used.
7. The actuator mounting plate has a tendency to pivot at the point where the lug is welded to the damper frame when the actuator strokes. It is recommended that some means be devised in the field to prevent this from happening. A threaded rod attached to mounting plate and duct wall will normally work.

Offset Mounting Bracket

This bracket is designed to offset the Universal Mounting Plate 331-623 from ductwork and insulation.

NOTE: Depending on the application, two brackets may be required to support the actuator and universal mounting plate.



**Figure 9. Offset Mounting Bracket 333-176.
 Dimensions in Inches (Millimeters).**

Dimensions

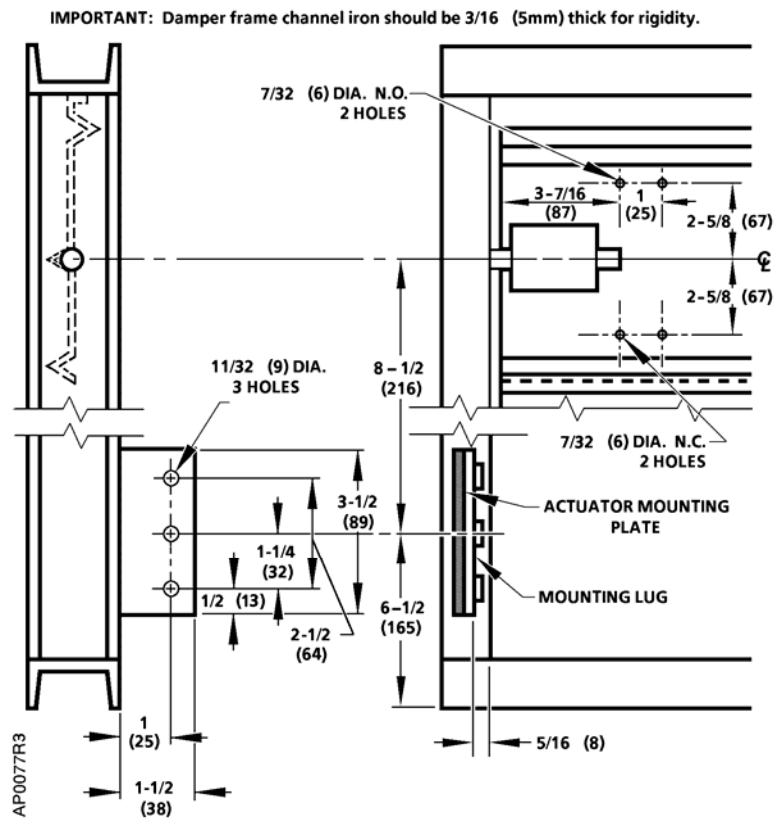


Figure 10. Frame Mounting Dimensions.
 Dimensions in Inches (Millimeters).

Dimensions, Continued

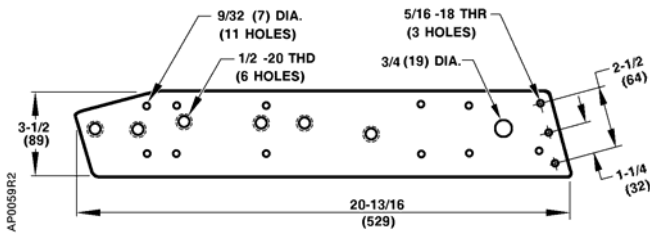


Figure 11. Actuator Mounting Plate 331-623, 1/4-Inch (6 mm) Thick. Dimensions in Inches (Millimeters).

Table 8. Mounting Plate Hole Designations (Figure 11).

Hole	Description
1	No. 6 actuator extended shaft mounting
2	Not used
3	No. 4 actuator extended shaft No. 6 actuator frame mounting NC
4	No. 6 actuator frame mounting NO
5	No. 4 actuator frame mounting NC
6	No. 4 actuator frame mounting NO

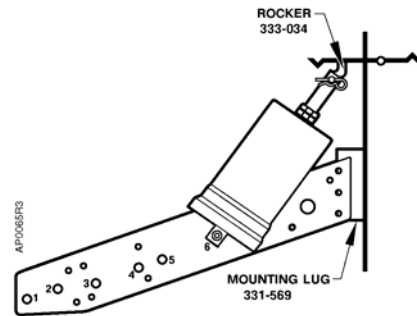


Figure 12. Frame Mounting Normally Open Damper.

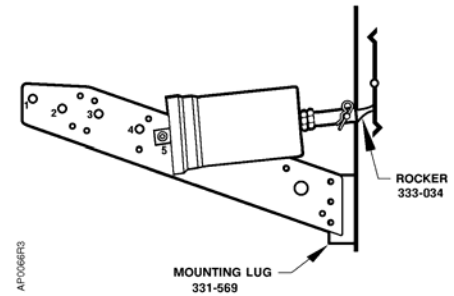


Figure 13. Frame Mounting Normally Closed Damper.

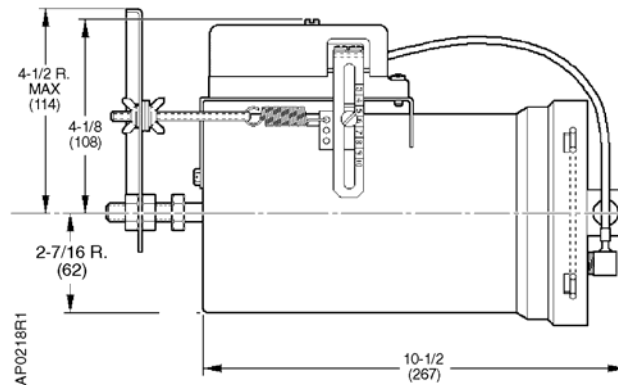


Figure 14. Dimensions with the RL 147 Positioning Relay Mounted. Dimensions in Inches (Millimeters).

Dimensions, Continued

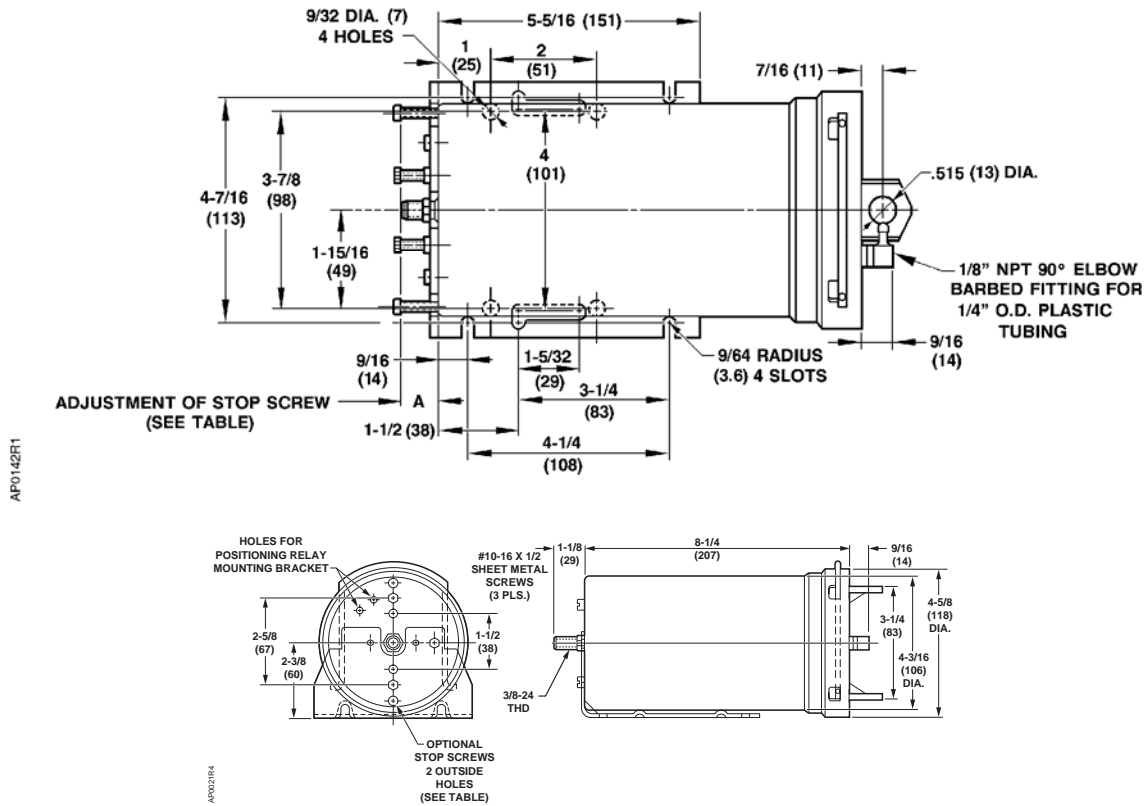


Figure 15. Bracket Mounted Actuator 331-2911 (Typical). Dimensions in Inches (Millimeters).

Table 9. Stop Screw Adjustment and Stroke Length (Figure 15).

Stop Screw Adjustment Dimension "A" Inches (Millimeters)	Stroke Length Inches (Millimeters)	
	Kit 331-938	Kit 331-939
IN 0	3.0 (76)	2-3/8 (60)
0.5 (13)	3.5 (89)	2-7/8 (73)
1.0 (25)	4.0 (102)	3-3/8 (85)
1.5 (38)	4.0 (102)	3-7/8 (98)
2.0 (51)		4.0 (102)
OUT 2-1/4 (57)		4.0 (102)

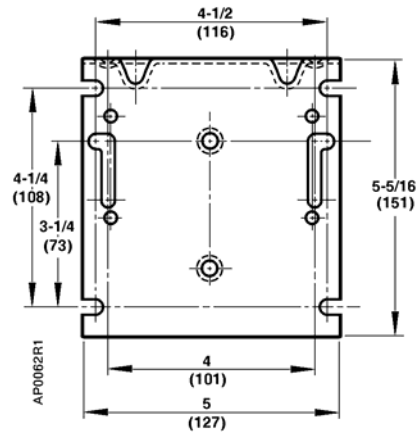


Figure 16. Mounting Bracket Dimensions. Dimensions in Inches (Millimeters).

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