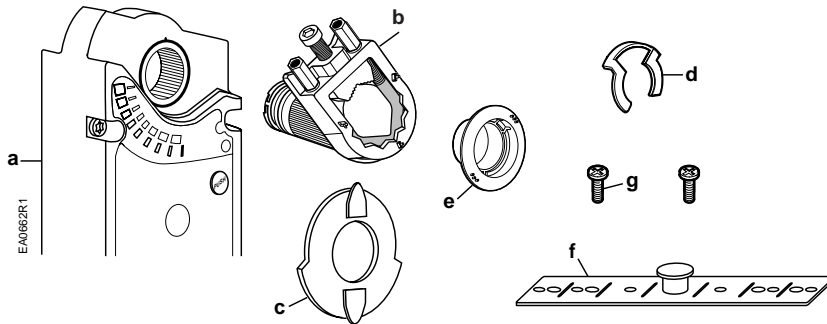




## EN221 and EN310 Non-Spring Return Electronic Actuators



- a. Actuator
- b. U-bolt shaft adapter
- c. Position indicator
- d. Shaft adapter locking clip
- e. Position indicator adapter
- f. Mounting bracket
- g. Mounting screws

Figure 1. Parts of the EN221 and EN310 Actuators.

### Product Description


This installation instruction describes the steps for direct-coupled mounting of the EN221 and EN310 series non-spring return (NSR) electronic actuators.


### Product Numbers

EN221x

EN310x

### Installation Conventions

**WARNING:**  Personal injury or loss of life may occur if you do not follow the procedures as specified.

**CAUTION:**  Equipment damage or loss of data may occur if you do not follow procedure as specified.

### Required Tools

- 10 mm (13/32-inch) open-end wrench
- Drill
  - 4 mm (5/32-inch) drill bit
- Phillips screwdriver
- Marker or pencil
- Adjustable pliers

### Expected Installation Time

30 minutes

### Prerequisite

The actuator is shipped from the factory with a 5° pre-load to ensure tight close-off of the damper. To release the pre-load, press the **PUSH** button before mounting the actuator.

### Installation



**WARNING:**  
Do not open the actuator.

**NOTE:** You must place the actuator on the damper shaft so that the front of the actuator is accessible. The label and the manual override button are on the front side.

1. Place the actuator on the damper shaft with the front of the actuator accessible. The label and the manual override button are on the front side.
2. **For the EN221B2x and EN310B2x only:** Determine the rotation of the damper shaft. Set the direction of rotation arrow to match the rotation.

EA0320R2



CLOCKWISE



COUNTER CLOCKWISE

Figure 2. Direction of Rotation Switch.

3. **For all models:** See Figure 3 and Figure 4 for clockwise-to-open (CW) installation. See Figure 5 and Figure 6 for counterclockwise-to-open (CCW) installation.



## EN221 and EN310 Non-Spring Return Electronic Actuators

### For Tandem Applications

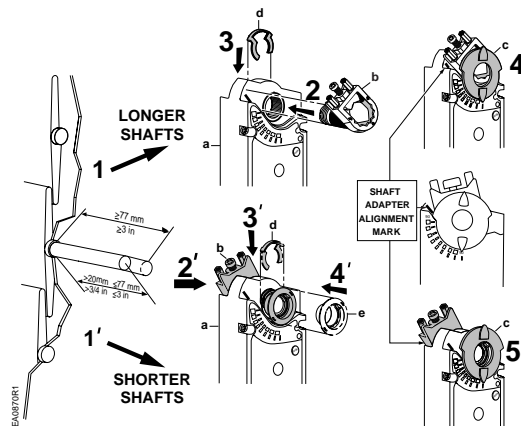
- The direction of rotation switches must be set identically on both actuators according to the clockwise or counterclockwise rotation of the damper shaft. The factory setting is clockwise.
- Minimum damper drive shaft length is four inches (100 mm).



### CAUTION:

No more than three actuators are to be used in tandem applications.

**NOTE:** EN310B2, containing offset and span features, cannot be used in a tandem application.



**Note:**  
Place the shaft adapter next to the alignment mark keeping the mark visible.

Figure 3. Shaft Adapter Placement for Clockwise Rotation on Short and Long Shafts.

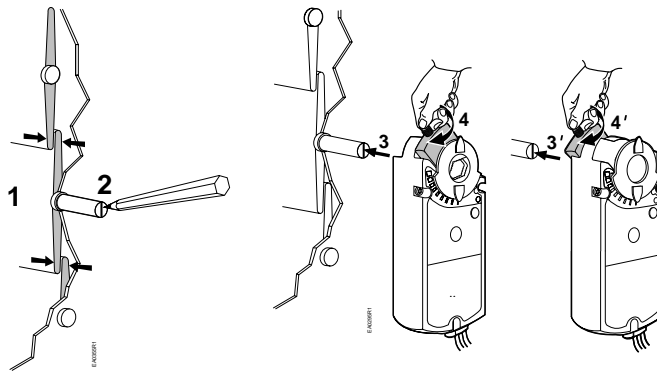


Figure 4. Mount the Actuator to the Damper Shaft. Go to Figure 7 to Complete the Mounting.



### EN221 and EN310 Non-Spring Return Electronic Actuators

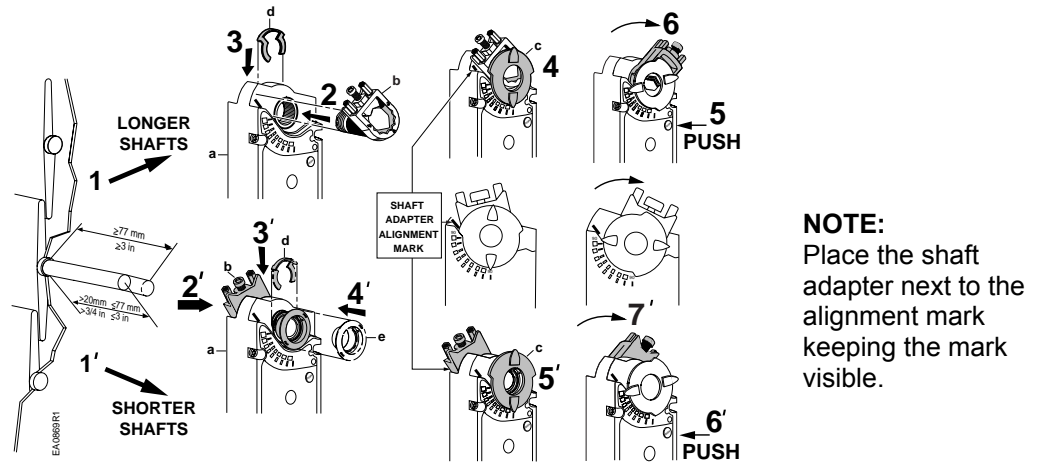


Figure 5. Shaft Adapter Placement for Counterclockwise Rotation on Short and Long Shafts.

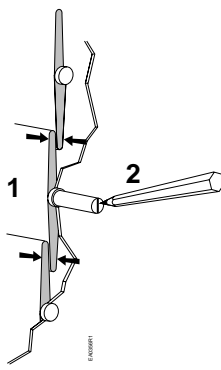


Figure 6. Mount the Actuator to the Damper Shaft.

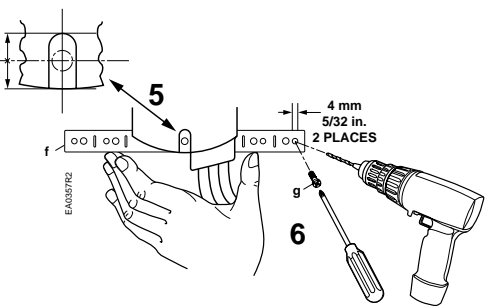
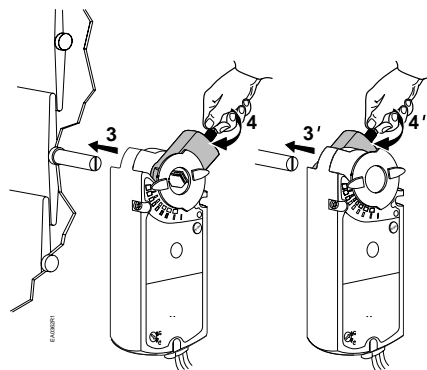


Figure 7. Attach the Mounting Bracket.

Place the actuator on the shaft with the damper blades in the desired 0 position.  
Tighten the middle screw so that the shaft is in the center of the shaft adapter opening.



## EN221 and EN310 Non-Spring Return Electronic Actuators

### Manual Override

To move the damper blades without power present, do the following:

1. Hold down the **PUSH** button.
2. Make adjustments to the damper position.
3. Release the **PUSH** button.

**NOTE:** If there is no load, the actuator will hold the new damper position. If load conditions exist, the actuator might not be able to hold.

Once power is restored, the actuator returns to automated control.

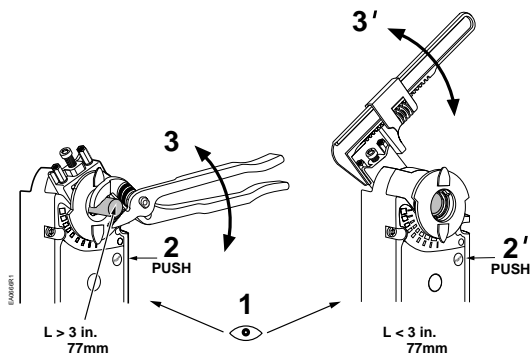


Figure 8. Manual Override for Long and Short Damper Shafts.

### Mechanical Range Adjustment

The angular rotation is adjustable between 0° and 90° at 5-degree intervals.

1. Loosen the shaft adapter from the damper shaft and remove the actuator from the damper shaft.
2. Remove the clip and shaft adapter from the actuator. See Figure 9.

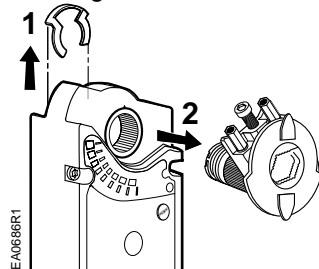


Figure 9.

3. Return the actuator gear train to the "0" position using the steps which follow for the clockwise or counterclockwise damper shaft rotation.

#### Clockwise-to-open:

- a. Insert the shaft adapter to the right as close as possible to the raised stop. Figure 10.

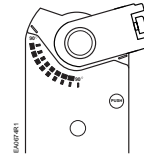


Figure 10.

- b. Hold down the **PUSH** button and rotate the shaft adapter to the left until it stops. Figure 11.

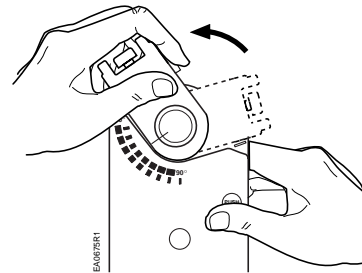


Figure 11.

- c. Release the **PUSH** button.
- d. If the shaft adapter is not resting against the left raised stop, remove the adapter and insert it against the left stop.
- e. Place the position indicator to the "0" position on the outside scale. Figure 12.

#### Counterclockwise-to-open:

- a. Insert the shaft adapter to the left as close as possible to the raised stop.
- b. Hold down the **PUSH** button and rotate the shaft adapter to the right until it stops.
- c. Release the **PUSH** button.
- d. If the shaft adapter is not resting against the right raised stop, remove the adapter and insert it against the right stop.
- e. Place the position indicator to "0" on the inside scale.



### EN221 and EN310 Non-Spring Return Electronic Actuators

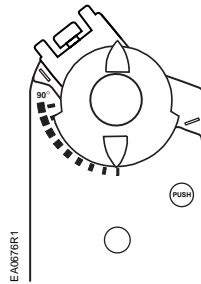


Figure 12.

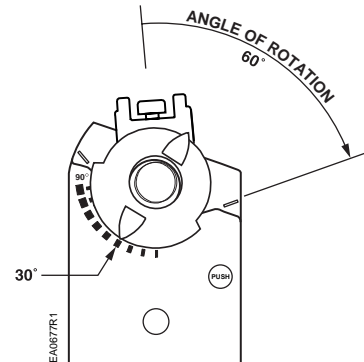


Figure 13.

4. Determine the angle of rotation for the damper blade shaft. Subtract that amount from 90°.
5. Remove the shaft adapter and insert it with the position indicator pointing to mark on the scale calculated in the previous step. Figure 13.
6. Attach the clip.
7. Rotate the damper blade shaft to its "0" position.
8. Return the actuator to the damper shaft and tighten the shaft adapter to the damper shaft.

### Mounting for NEMA 2 Rating

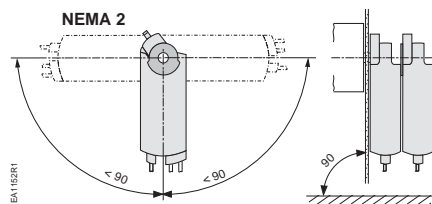


Figure 14. Acceptable NEMA 2 Mounting Position for Single and Tandem Applications.

### Dual Auxiliary Switch (-S option)

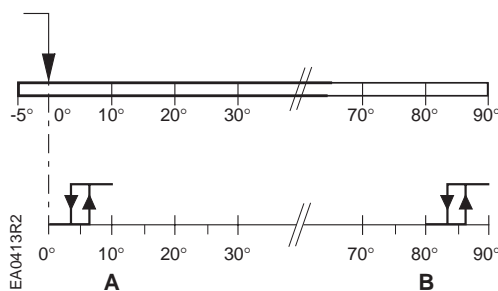


Figure 15.

Actuator rotary range with the shaft adapter mounted at position 0.

Setting range for Switches A and B: 0 - 90°

Setting interval: 5°

Switching hysteresis: 2°



## EN221 and EN310 Non-Spring Return Electronic Actuators

Factory setting:

- Switch A 5°
- Switch B 85°

To change the settings of A and B:

- Make sure the actuator is in the 0 position. The scale is valid only in the 0 position.
- Use a flat-blade screwdriver to turn the switch adjustment dials to the desired setting at which a signal is to be given.

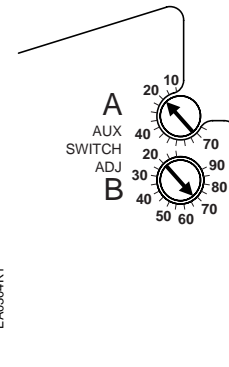
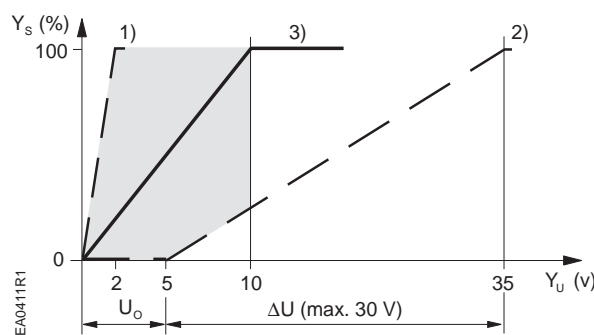


Figure 16. Dual Auxiliary Switch Dials.

## Zero Span Control Signal Adjustment (-ZS option)

The offset (start point) and span of the control signal can be adjusted. The offset,  $U_0$ , (start point) can be adjusted between 0 to 5 VDC. The span,  $\Delta U$ , can be adjusted between 2 to 30 VDC.



- $Y_s$  Mechanical positioning range (100% = angle of rotation 90°)
- $Y_u$  Control signal
- $U_0$  Offset (start point)
- $\Delta U$  Span

Examples above:

- Ex. 1.  $U_0 = 0V$ ,  $\Delta U = 2V$  The minimum working range for  $Y_s = 100\%$ .
- Ex. 2.  $U_0 = 5V$ ,  $\Delta U = 30V$  The maximum working range for  $Y_s = 100\%$
- Ex. 3.  $U_0 = 0V$ ,  $\Delta U = 10V$  Factory setting

Figure 17. The Minimum, Factory Setting, and Maximum Control Signal Adjustment.

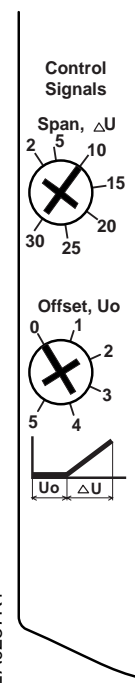


Figure 18. Setting for 10V Span, 0 Offset.

### Example:

Open the actuator from 0% to 50% (45°) using a control signal of  $U_{min} = 2V$  to  $U_{max} = 10V$ . Calculating the value of  $\Delta U$ :

$$\Delta U = \frac{100 [\%] (U_{max} - U_{min})}{\text{Working angle of rotation in } \%} = \frac{100 \times (10 - 2)}{50} = 16 \text{ V}$$



## EN221 and EN310 Non-Spring Return Electronic Actuators

### Settings:

Offset  $U_0 = 2$ , Span:  $\Delta U = 16V$

$U_{min}$  = minimum control signal

$U_{max}$  = maximum control signal

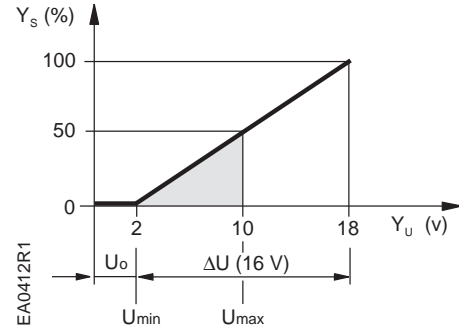


Figure 19. Example.

### Wiring

- All wiring must conform to NEC and local codes and regulations.
- Use earth ground isolating step-down Class 2 transformers. Do not use auto transformers.
- The maximum rating for a Class 2 step-down transformer is 100 VA. Determine the supply transformer rating by summing the total VA of all actuators and components used. It is recommended that no more than 10 actuators are powered by one transformer.



#### CAUTION:

Do not parallel wire EN221/EN310 actuators with any other type of actuator, including EN221/EN310 actuators with date codes earlier than 501.



#### WARNING:

Mixed switch operation is not permitted to the switching outputs of both auxiliary switches (A and B).

Either AC line voltage from the same phase must be applied to all six outputs of the dual auxiliary switches, or UL-Class 2 voltage must be applied to all six outputs.

**NOTE:** With plenum cables, only UL-Class 2 voltage is permitted.

#### Three-Position Control

If the damper blades turn counterclockwise (CCW) to open, reverse the 6 and 7 wires at the controller (see Table 1).

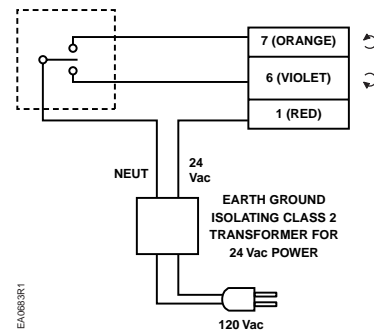


Figure 20. Three-Position Control.



EN221 and EN310 Non-Spring Return Electronic Actuators

Three-Position Control (24 VAC)

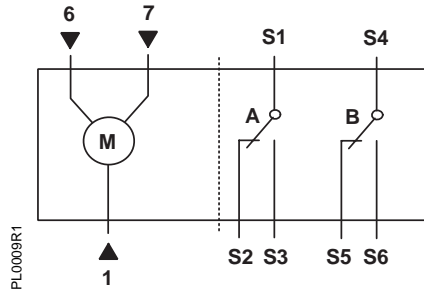


Figure 21.

Modulating Control (24 VAC)

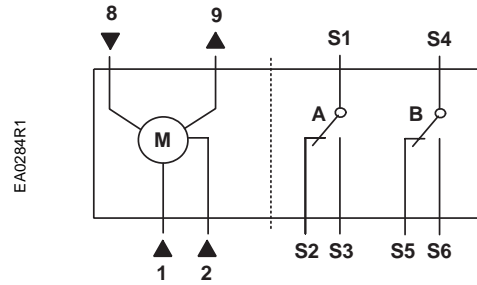


Figure 22.

Table 1. Three-Position Control 24 VAC.

Standard Symbol	Function	Color
		Plenum
1	(+)	Red
6	Control signal clockwise	Violet
7	Control signal counterclockwise	Orange
S1	Switch A Common	Gray/red
S2	Switch A NC	Gray/blue
S3	Switch A NO	Gray/pink
S4	Switch B Common	Black/red
S5	Switch B NC	Black/blue
S6	Switch B NO	Black/pink

Table 2. Modulating Control 24 VAC.

Standard Symbol	Function	Color
		Plenum
1	(+)	Red
2	Com	Black
8	0 to 10 VDC input signal	Gray
9	Output for 0 to 10 VDC position indication	Pink
S1	Switch A Common	Gray/red
S2	Switch A NC	Gray/blue
S3	Switch A NO	Gray/pink
S4	Switch B Common	Black/red
S5	Switch B NC	Black/blue
S6	Switch B NO	Black/pink





## EN221 and EN310 Non-Spring Return Electronic Actuators

### Start-Up/Commissioning

#### Three-Position Control, 24 VAC

1. Check that the wires are connected correctly.
2. Connect wires 1 (red) and 6 (violet) to a Digital Multimeter (DMM) with the dial set at VAC. Apply a control signal (24 VAC) to wire 6 to verify that the operating voltage is within range.
3. Connect wires 1 (red) and 7 (orange) to a DMM with the dial set at VAC. Apply a control signal (24 VAC) to wire 7 to verify that the operating voltage is within range.
4. Check operation:
  - a. Connect wire 1 (red) to the actuator.
  - b. Apply a control signal (24 VAC) to wire 6 (violet).
  - c. Allow the actuator shaft coupling to rotate from 0 to 90°.
  - d. Stop applying a control signal (24 VAC) to wire 7 (orange).
  - e. Apply a control signal (24 VAC) to wire 7 (orange).
  - f. Allow the actuator shaft coupling to rotate from 90 to 0°.
5. Check auxiliary switch A (-S option):
  - a. Set the DMM dial to OHMS (resistance) or continuity check.
  - b. Connect wires S1 and S3 to the DMM. The DMM should indicate an open circuit or no resistance.
  - c. Apply a 24 VAC signal to wire 6 (violet).  
The DMM should indicate contact closure as the actuator shaft coupling reaches the setting of switch A.
  - d. Stop applying a control signal to wire 6 (violet).
  - e. Connect wires S1 and S2 to the DMM. The DMM should indicate an open circuit or no resistance.
  - f. Apply a 24 VAC signal to wire 7 (orange).  
The DMM should indicate contact closure as the actuator shaft coupling reaches the setting of switch A.
6. Check auxiliary switch B (-S option):
  - a. Set the DMM dial to OHMS (resistance) or continuity check.
  - b. Connect wires S4 and S6 to the DMM. The DMM should indicate an open circuit or no resistance.
  - c. Apply a 24 VAC signal to wire 6 (violet).  
The DMM should indicate contact closure as the actuator shaft coupling reaches the setting of switch B.
  - d. Stop applying a control signal to wire 6 (violet).
  - e. Connect wires S4 and S5 to the DMM. The DMM should indicate an open circuit or no resistance.
  - f. Apply a 24 VAC signal to wire 7 (orange).  
The DMM should indicate contact closure as the actuator shaft coupling reaches the setting of switch B.

### Service



**WARNING:**

Do not open the actuator. If the actuator is inoperative, replace the unit.



## EN221 and EN310 Non-Spring Return Electronic Actuators

### Modulating Control, 24 VAC

1. Check that the wires are connected correctly.
2. Check that the offset (start point) and span are set correctly, if used.
3. Check that the direction of rotation switch matches the rotation of the damper shaft.
4. Connect wires 1 (red) and 2 (black) to a Digital Multimeter (DMM) with the dial set at VAC to verify that the operating voltage is within range.
5. Check operation:
  - a. Connect wires 1 (red) and 2 (black) to the actuator.
  - b. Set the DMM dial to VDC for the actuator input signal.
  - c. Connect wires 2 (black) and 8 (gray) to DMM.
  - d. Apply a full scale input signal (10 VDC) to wire 8 (gray).
  - e. Allow the actuator shaft coupling to rotate from 0 to 90°.
  - f. Disconnect wire 8 (gray) and the shaft coupling returns to the 0 position.
6. Check feedback:
  - a. Set the DMM dial to VDC.
  - b. Attach wires 2 (black) and 9 (pink) to the DMM.
  - c. Apply a full scale input signal to wire 8 (gray).  
The reading at the DMM should increase.
  - d. Remove the signal from wire 8 (gray) and the reading at the DMM should decrease and the actuator shaft coupling returns to the 0 position.
7. Check auxiliary switch A (-S option):
  - a. Set the DMM dial to OHMS (resistance) or continuity check.
  - b. Connect wires S1 and S3 to the DMM. The DMM should indicate an open circuit or no resistance.
  - c. Apply a full scale input signal to wire 8 (gray).  
The DMM should indicate contact closure as the actuator shaft coupling reaches the setting of switch A.
  - d. Connect wires S1 and S2 to the DMM. The DMM should indicate an open circuit or no resistance.
  - e. Stop the signal to wire 8 (gray).
  - f. The DMM should indicate contact closure as the actuator shaft coupling reaches the setting of switch A.
8. Check auxiliary switch B (-S option):
  - a. Set the DMM dial to OHMS (resistance) or continuity check.
  - b. Connect wires S4 and S6 to the DMM. The DMM should indicate an open circuit or no resistance.
  - c. Apply a full scale input signal to wire 8 (gray).  
The DMM should indicate contact closure as the actuator shaft coupling reaches the setting of switch B.
  - d. Connect wires S4 and S5 to the DMM. The DMM should indicate an open circuit or no resistance.
  - e. Stop the signal to wire 8 (gray).  
The DMM should indicate contact closure as the actuator shaft coupling reaches the setting of switch B.

### Service



**WARNING:**

Do not open the actuator. If the actuator is inoperative, replace the unit.



## EN221 and EN310 Non-Spring Return Electronic Actuators

### Dimensions

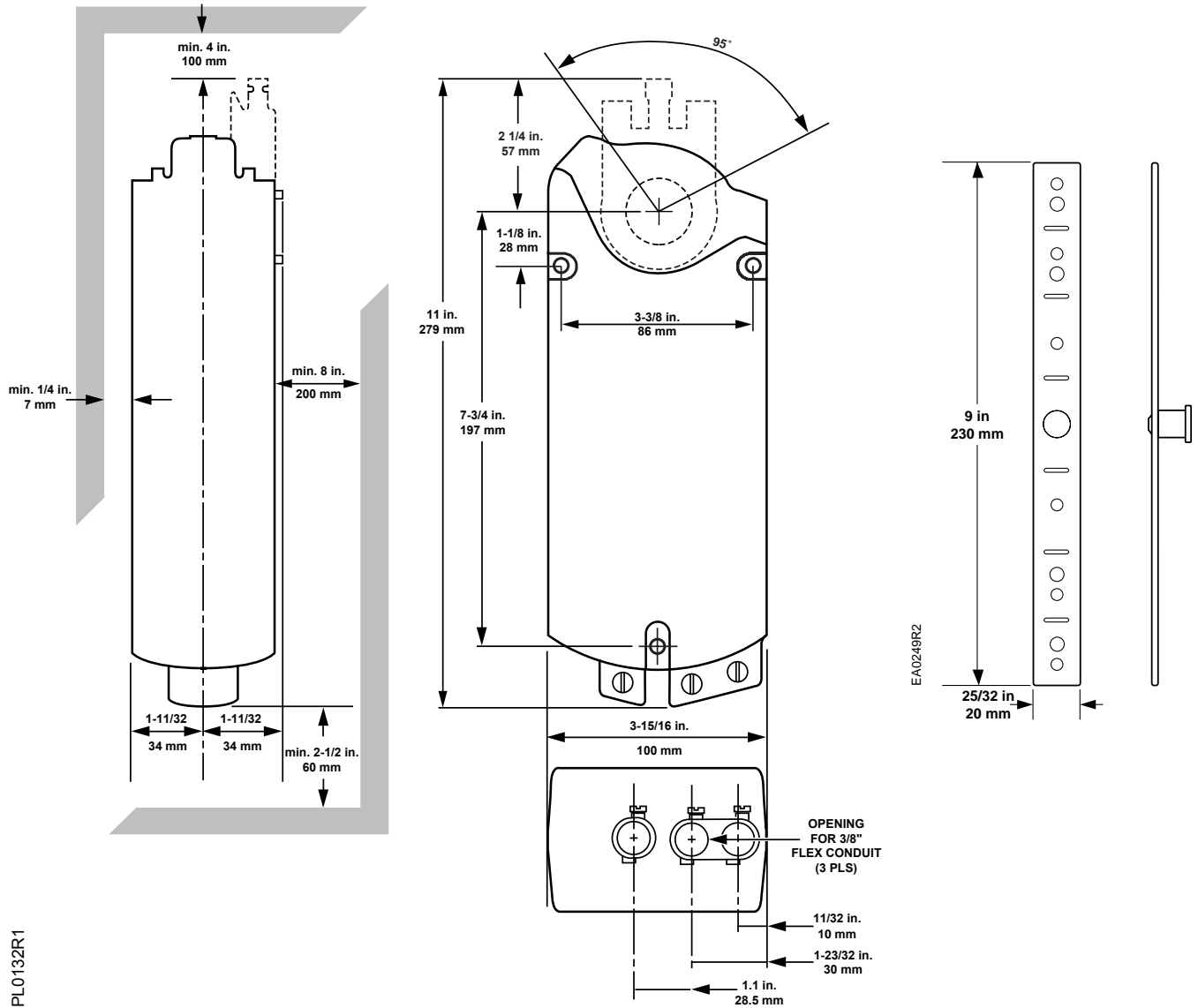


Figure 23. Dimensions of the EN221 and EN310 Actuator and Mounting Bracket.



### EN221 and EN310 Non-Spring Return Electronic Actuators

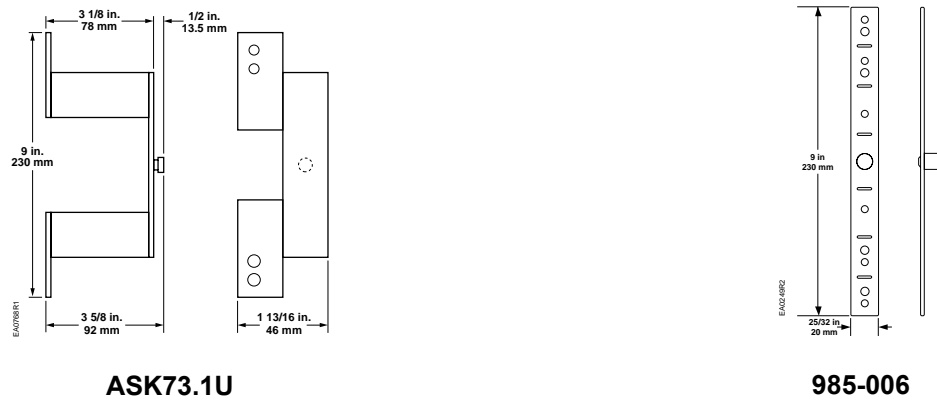


Figure 24. Dimensions of the Mounting Brackets used in Tandem Applications in Inches (Millimeters).

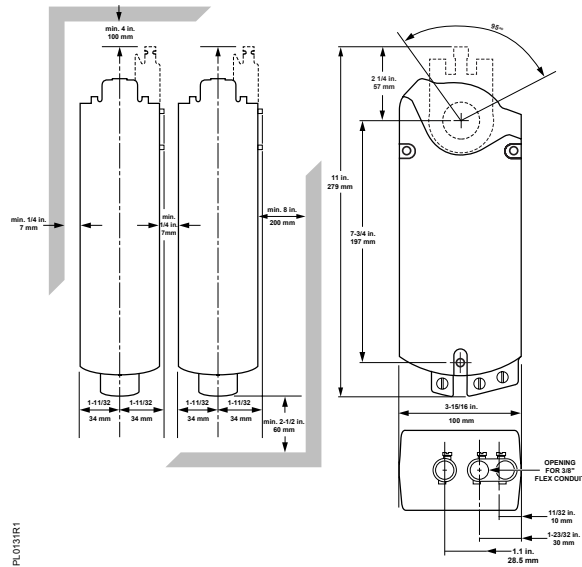


Figure 25. Dimensions and Service Envelope of the Actuators in Tandem Application in Inches (Millimeters).



## EN221 and EN310 Non-Spring Return Electronic Actuators

### Sizing Actuators for Damper Applications

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

- Obtain damper torque ratings (ft-lb/ft<sup>2</sup> or Nm/m<sup>2</sup>) from the damper manufacturer.
- Determine the area of the damper.
- Calculate the total torque required to move the damper:

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

- Select the total quantity of actuators, required:

$$\text{Number of Actuators} = \frac{\text{Total Damper Torque required}}{\text{SF} \times \text{Actuator Torque}}$$

(see note below) (refer to specifications)

**NOTE:** When calculating the number of actuators required, a safety factor (SF) 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).

- Mechanical coupling of the actuator is allowed if:
  - The same type of actuator is used.
  - The power trunk can handle added components.
  - The same control input goes to both actuators (parallel wiring).



## EN221 and EN310 Non-Spring Return Electronic Actuators

### ACCESSORIES

**NOTE:** The auxiliary switches and/or the control signal adjustment cannot be added in the field. Order the product number that includes the option(s), if required.

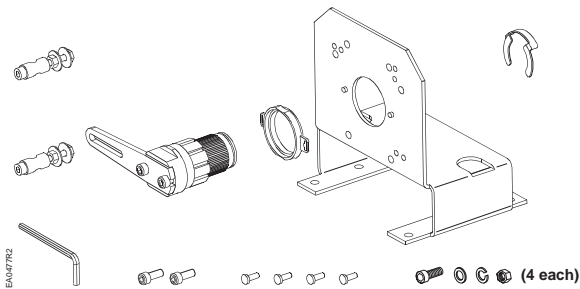


Figure 1. Floor Mount Kit.

**ASK71.1U** This kit allows foot mounting of the actuators. This kit should be used for in-the-airstream applications, and generally, anywhere a foot-mounted actuator can be mounted.

This kit contains a crank arm that changes the angular rotation into a linear stroke, a support bearing ring to minimize side loading on the actuator's output bearing, a mounting bracket, and required mounting fasteners.

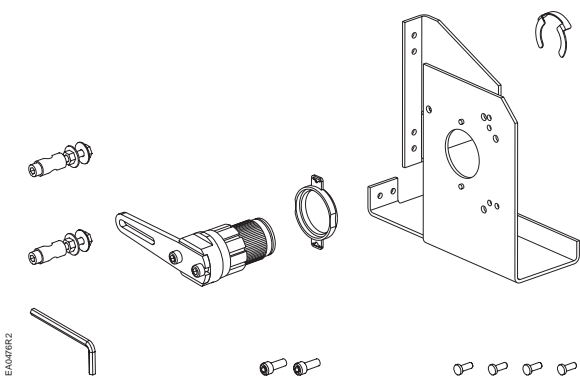


Figure 2. Frame Mount Kit.

**ASK71.2U** This kit allows mounting of the actuators directly to a damper frame. This kit should be used with louvers and vents and in applications where use of the floor mount kit is not possible.

This kit contains a crank arm that changes the angular rotation into a linear stroke, a support bearing ring to minimize side loading on the actuator's output bearing, a mounting bracket, and required mounting fasteners.

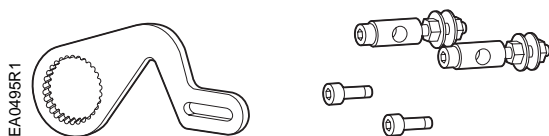


Figure 3. Crank Arm Kit.

**ASK71.3** This kit allows a direct coupled actuator to provide an auxiliary linear drive. This crank arm kit can be used to simultaneously drive a set of opposing or adjacent dampers with a single actuator.

This kit includes a crank arm that attaches to the splined hub of the shaft adapter, and other required mounting fasteners.

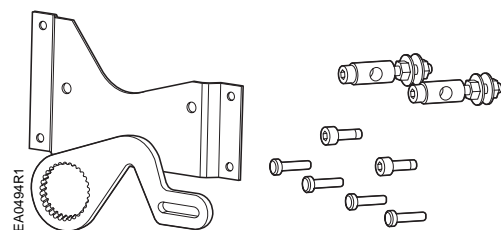


Figure 4. Crank Arm Kit with Mounting Bracket.

**ASK71.4** This kit allows economical mounting of an actuator to a variety of surfaces. This kit should be used in applications where the actuator can be rigidly surface mounted and a linear stroke output is required.

This kit includes a crank arm that attaches to the splined hub of the shaft adapter, a mounting bracket, and other required mounting fasteners.



## EN221 and EN310 Non-Spring Return Electronic Actuators

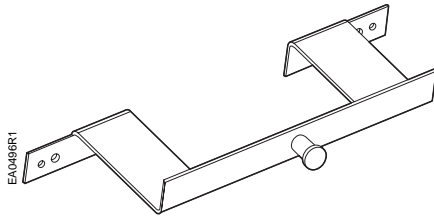


Figure 5. Tandem Mount Bracket.

**ASK73.1** This bracket provides an extended anti-rotation pin that allows two 3-position EN310 actuators to directly drive a single damper shaft.

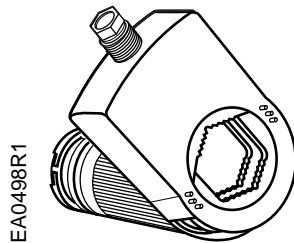
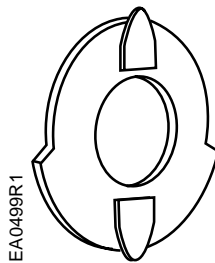


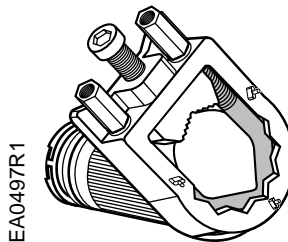
Figure 6. Self Centering Shaft Adapter.

**985-004** The self-centering shaft adapter will attach to a shaft up to 1.00 inch (25.4 mm) in diameter. (The special shaft adapter will attach to a 1.05-inch (26.6-mm) diameter shaft.) This shaft adapter is 13/16-inch (20 mm) taller than the height of the special shaft adapter.

## Service Parts



**985-003**  
Position indicators (package of 10).



**ASK74.1U**  
Special-Shaft Adapter.



**985-006**  
Anti-rotation (mounting) bracket.

Figure 7. Orderable Parts.



## EN221 and EN310 Non-Spring Return Electronic Actuator Installation Guide

General Installation .....	EAI/EN – 1
Mounting .....	EAI/EN – 1-3
Manual Override .....	EAI/EN – 4
Mechanical Range Adjustment.....	EAI/EN – 4-5
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