



## ES142 Spring Return Electronic Actuators

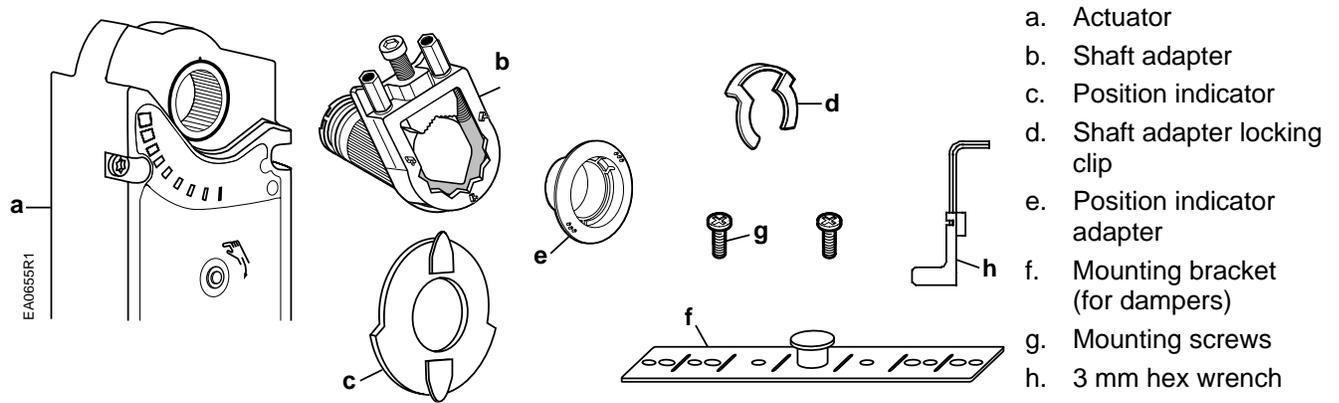


Figure 1. Parts of the ES142 Actuator.

### Product Description

This installation instruction describes the steps for direct-coupled mounting the ES142 series spring return electronic actuator.

### Product Numbers

ES142 (all versions)

### Required Tools

- 10 mm (13/32 in. open end wrench or ratchet
- Drill
- 4 mm (5/32 in.) drill bit
- 3 mm hex wrench (provided)
- Phillips screwdriver
- Marker or pencil

### Installation Conventions

#### Warning



Personal injury or loss of life may occur if you do not perform a procedure as specified.

#### Caution



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

### Expected Installation Time

30 minutes

### Prerequisites

**NOTE:** The actuator is shipped from the factory with a 5° preload on the spring. The position of the indicator points to the 0° position. When power is applied to the actuator, the preload is released.



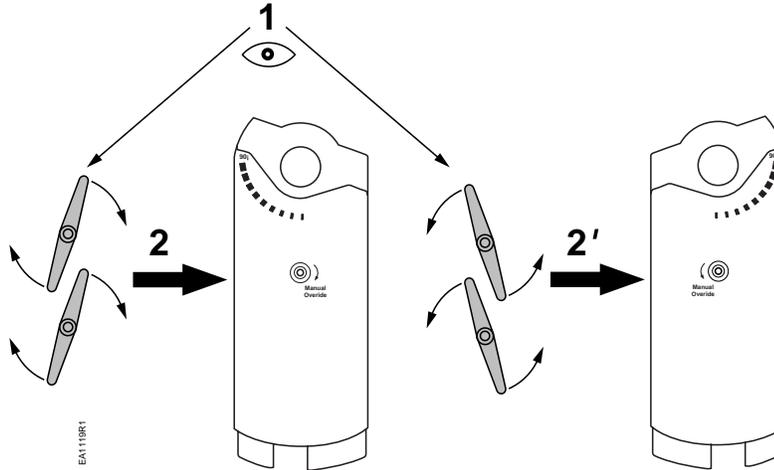
#### WARNING:

Do not open the actuator.



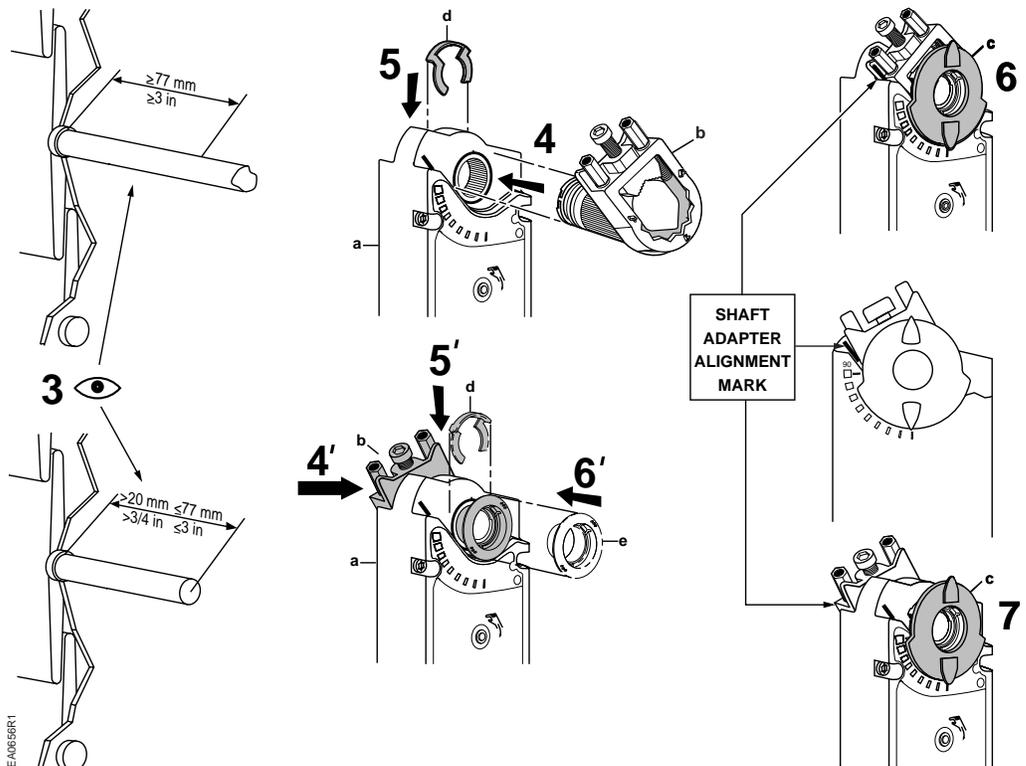
### ES142 Spring Return Electronic Actuators

## Installation



**NOTE:** The actuator can be mounted for clockwise or counterclockwise rotation of the damper shaft.

**Figure 2. Actuator Mounting Orientation.**

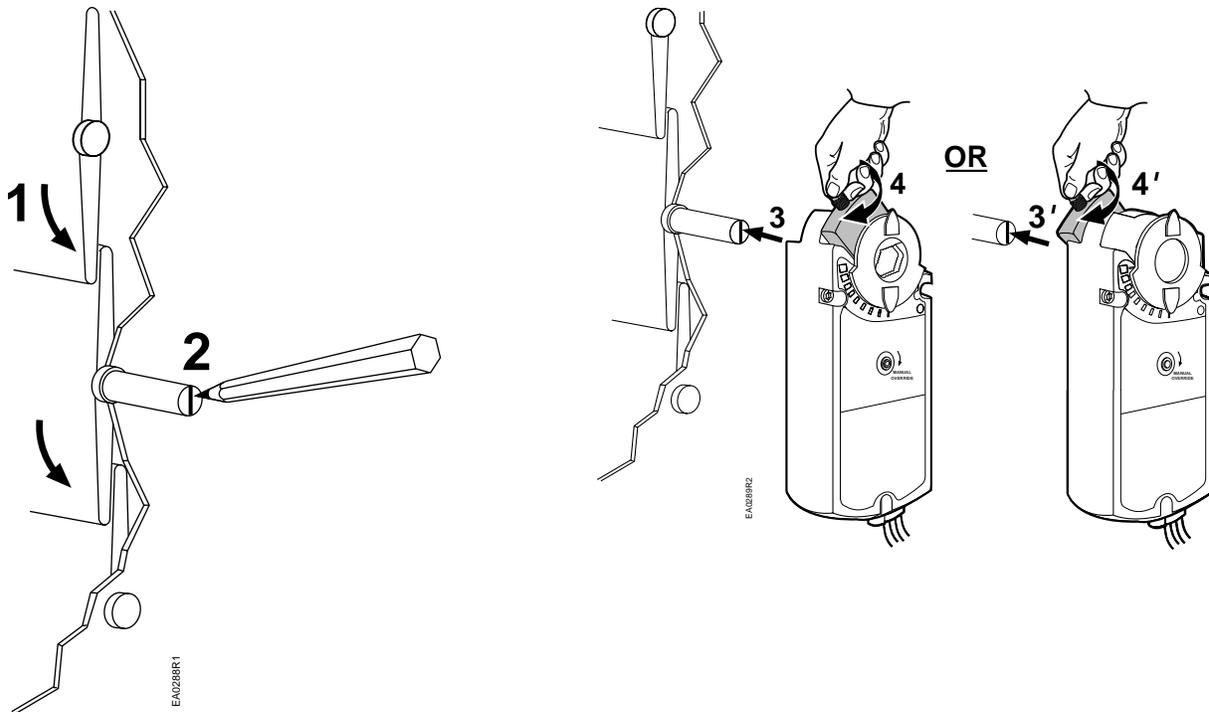


**NOTE:** The shaft coupling and position indicator can be mounted on either side of the actuator. Place the shaft adapter right next to the alignment mark keeping the mark visible.

**Figure 3. Shaft Length and Proper Shaft Adapter Location.**

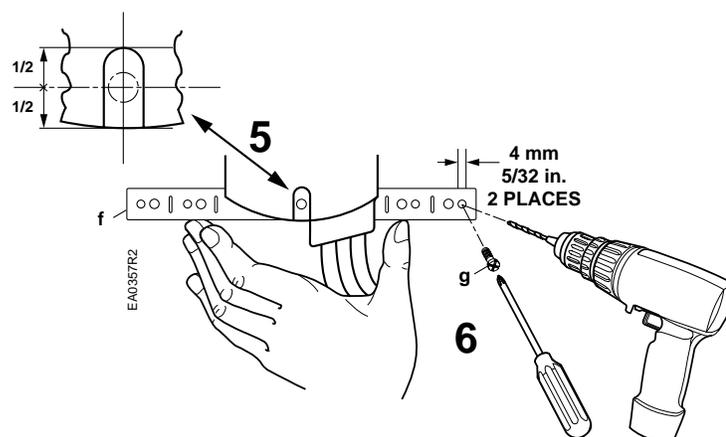


### ES142 Spring Return Electronic Actuators



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.

Figure 4. Actuator Mounting.

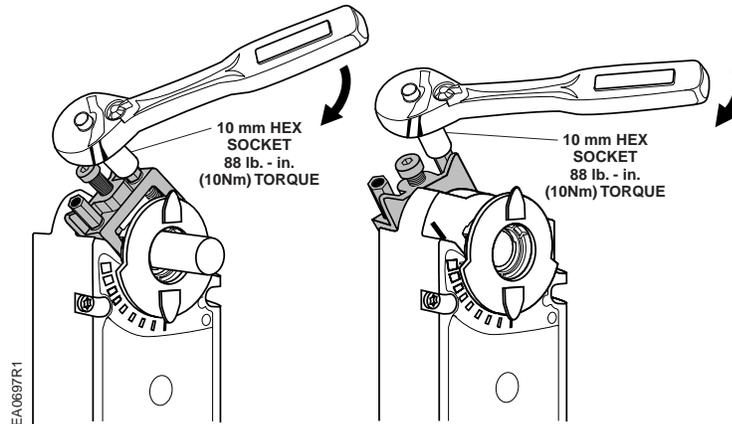


Anti-rotation tab should be approximately in the center of the actuator anti-rotation slot.

Figure 5. Fasten the Mounting Bracket.



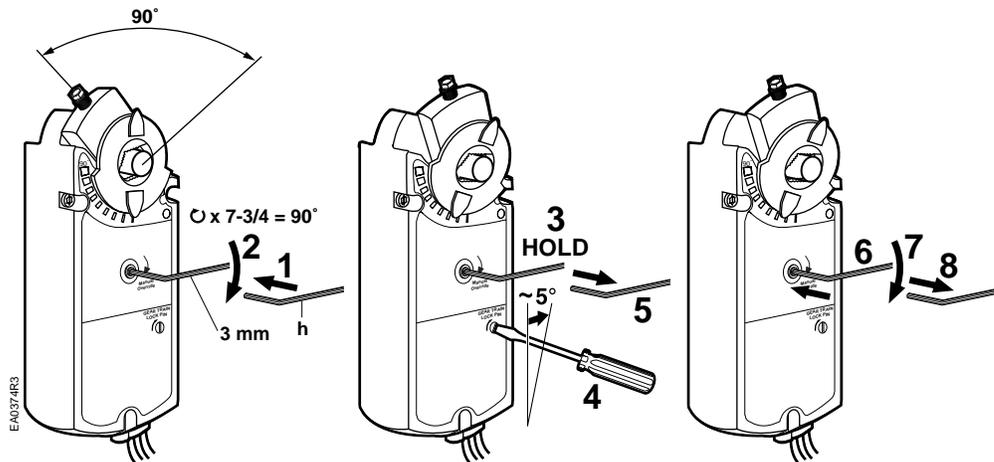
### ES142 Spring Return Electronic Actuators



**NOTE:** Keep the shaft in the center of the shaft adapter opening. Apply 7.5 lb-ft (10 Nm) torque maximum.

Figure 6. Fasten the Shaft Adapter to the Damper Shaft.

### Manual Override



**Rotating**

Turn the key in the direction of the arrow on the hand symbol.

**Locking in place**

Rotate the gear train lock pin.

**Releasing when power is absent**

Turn the key in the direction of the arrow.

Figure 7. Manual Override.



**CAUTION:**

When you lock the gear train lock pin, be careful to turn only about 5 degrees until you hear a light click or meet slight resistance. Turning too far will strip the head of the lock pin. Once power is restored, the actuator returns to automated control, without having to rotate the gear train lock pin.



## ES142 Spring Return Electronic Actuators

### Mechanical Range Adjustment – Limiting Rotation (0 through 90°)

Make sure the actuator is in the zero position when making this adjustment. If making the adjustment before the actuator is in service, take into account the 5° preload. To release the preload, insert the 3 mm hex key in the override opening and turn the key in the direction of the arrow.

To line up the actuator at the desired angle of rotation, begin by removing the clamp from actuator.

Rotate adapter and insert at desired angle of rotation. Return clamp to secure the adapter. Test rotation by applying signal.

If necessary, re-adjust adapter and restart.

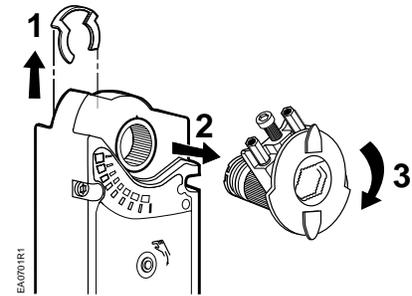


Figure 8.

The Angular Rotation is Adjustable between 0° and 90° at 5-degree Intervals.

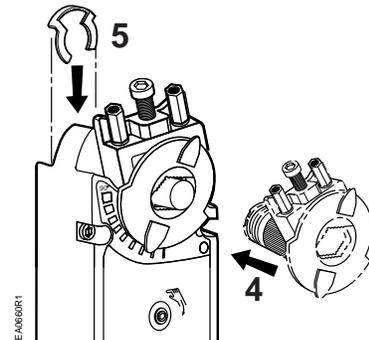


Figure 9.

### Mounting for NEMA 2

See Figure 10 for acceptable NEMA 2 mounting positions.

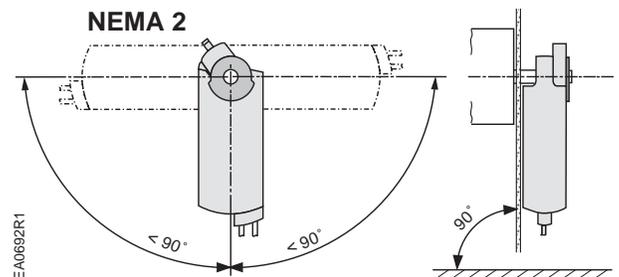


Figure 10. Acceptable NEMA 2 Mounting Positions.



## ES142 Spring Return Electronic Actuators

### DIP Switch Features

(ES142-M2 and ES142-M2-S Only)

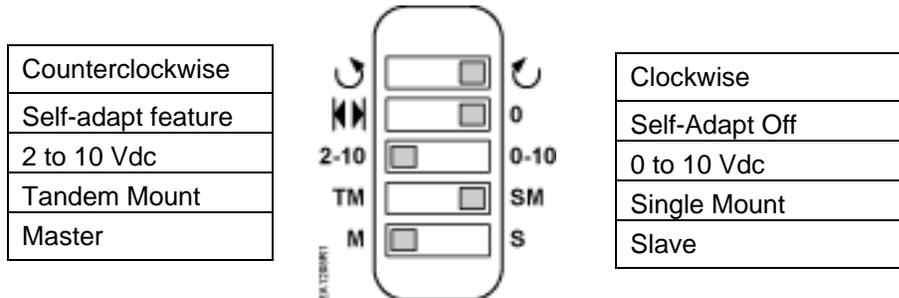


Figure 11. DIP Switch Settings.

- After setting the 4th DIP switch for TM (tandem mount) on all actuators used in the tandem application, one actuator must be identified as the Master by selecting the "M" on the 5th DIP switch.
- The rest of the actuators used in the application should have the "S" (slave) set on the 5th DIP switch.
- Connect all the 2 (black) Neutral wires and connect them to the power supply.
- Connect all the 1 (red) Supply wires and connect them to the power supply.
- The Output Signal 9 (pink) wire identified as the Master actuator, needs to be connected to all the Control Signal Wires 8 (gray) of the slave actuators used in the tandem application.

| Operating Voltage                 | Power Consumption |
|-----------------------------------|-------------------|
| Modulating Control                |                   |
| 24 Vac/dc                         | 9 VA/7W           |
| 2-Position and 3-Position Control |                   |
| 24 Vac/dc                         | 8 VA/6W           |
| 120 Vac                           | 9 VA              |



## ES142 Spring Return Electronic Actuators

### Dual Auxiliary Switch (-S option)

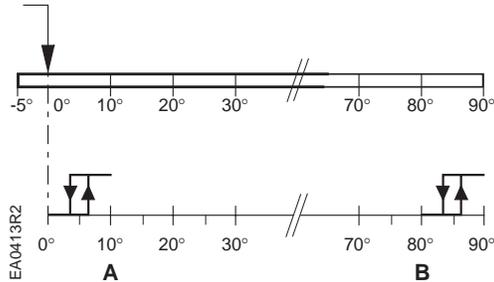


Figure 12.

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.

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°

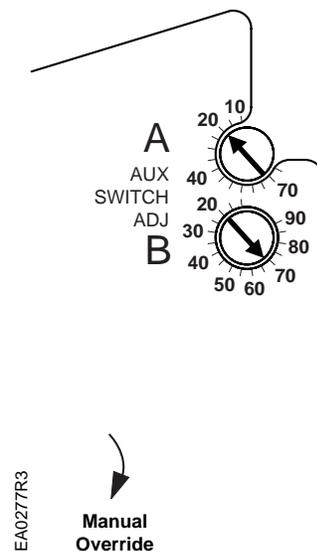


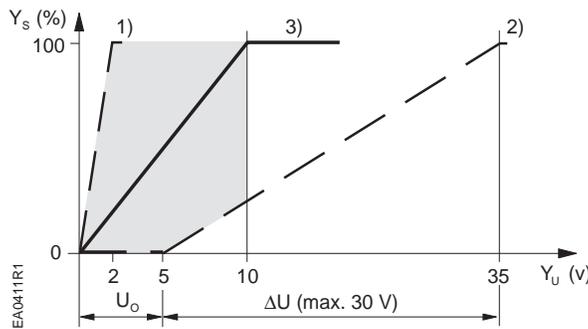
Figure 13. Dual Auxiliary Switch Dials.



### ES142 Spring Return Electronic Actuators

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

The offset (start point) and span of the control signal can be adjusted. The offset,  $U_0$ , 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 14. The Minimum and Maximum Control Signal Adjustment.

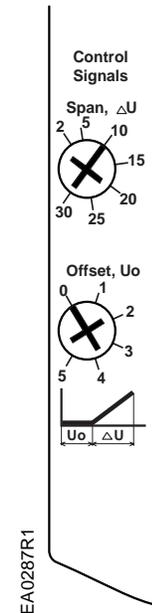


Figure 15. Setting for 10V Span, 0 Offset.

### 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  $\Delta U$ :

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

### Settings:

- Offset  $U_0 = 2$ , Span:  $\Delta U = 16V$
- $U_{min}$  = minimum control signal
- $U_{max}$  = maximum control signal

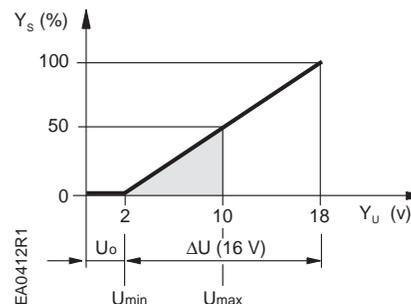


Figure 16. Example.



## ES142 Spring Return Electronic Actuators

### Wiring

#### 24 VAC or 120 VAC

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

#### 24 VAC

Use earth ground isolating step-down Class 2 transformers. Do not use auto transformers. Determine the supply transformer rating by summing the total VA of all actuators used. The maximum rating for a Class 2 step-down transformer is 100 VA. The ES142 (24 VAC) actuators require 8 to 9 VA; therefore it is recommended that up to 10 actuators (between 80 and 90% of transformer VA) can be powered by one transformer. Operating more than 10 actuators requires additional transformers or separate 100 VA power trunks.



#### WARNING:

Mixed switch operation is not permitted. To the switching outputs of both auxiliary switches (A and B), only apply:

- Standard cable (250 Vac/24 Vdc)
  - UL/cUL: line voltage, or
  - UL/cUL: Class 2 voltage.

**NOTE:** Either all six outputs of the dual auxiliary switches must be connected to line voltage or all six outputs must be connected to Class 2 voltage.

- Plenum cable (24V)
  - UL/cUL: Class 2 voltage.

### Wiring Diagrams

#### Three-Position Control (24 VAC/DC)

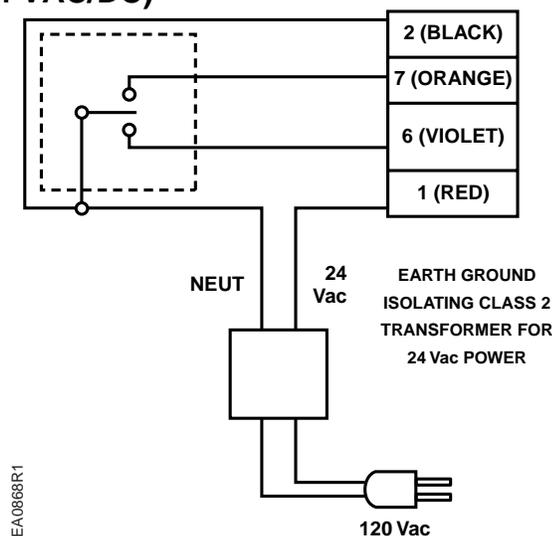


Figure 17. Three-Position Control.



**ES142 Spring Return Electronic Actuators**

**Two-Position Control (24 VAC/DC)**

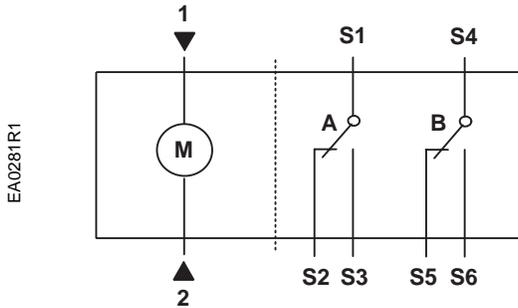


Figure. 18

**Two-Position Control (120 VAC)**

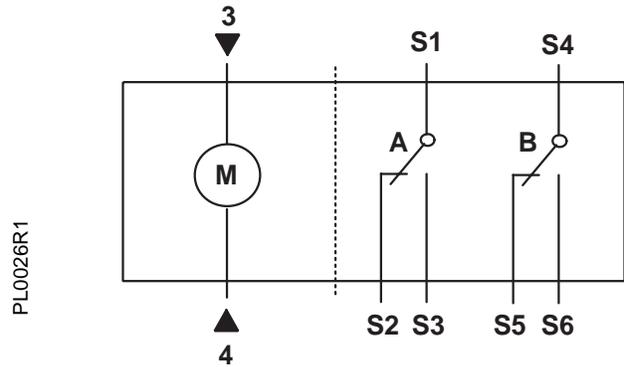


Figure 19.

Table 1. Two-position Control 24 VAC/DC.

| Standard Symbol | Function        | Color      |
|-----------------|-----------------|------------|
|                 |                 | Plenum     |
| 1               | (+)             | Red        |
| 2               | Com             | Black      |
| S1              | Switch A Common | Gray/red   |
| S2              | Switch A N.C.   | Gray/blue  |
| S3              | Switch A N.O.   | Gray/pink  |
| S4              | Switch B Common | Black/red  |
| S5              | Switch B N.C.   | Black/blue |
| S6              | Switch B N.O.   | Black/pink |

Table 2. Two-position Control 120 VAC.

| Standard Symbol | Function          | Color      |
|-----------------|-------------------|------------|
|                 |                   | Standard   |
| 3               | Line (120 VAC)    | Black      |
| 4               | Neutral (120 VAC) | White      |
| S1              | Switch A Common   | Gray/red   |
| S2              | Switch A N.C.     | Gray/blue  |
| S3              | Switch A N.O.     | Gray/pink  |
| S4              | Switch B Common   | Black/red  |
| S5              | Switch B N.C.     | Black/blue |
| S6              | Switch B N.O.     | Black/pink |



### ES142 Spring Return Electronic Actuators

#### Three-Position Control (24 VAC/DC)

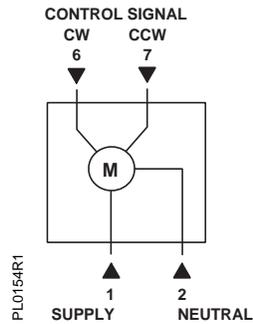


Figure 20.

#### Modulating Position Control (24 VAC/DC)

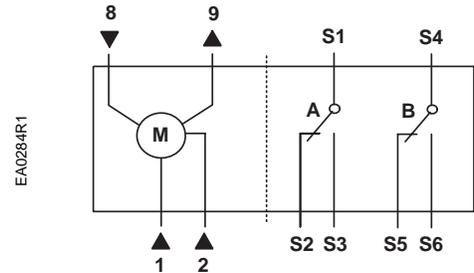


Figure 21.

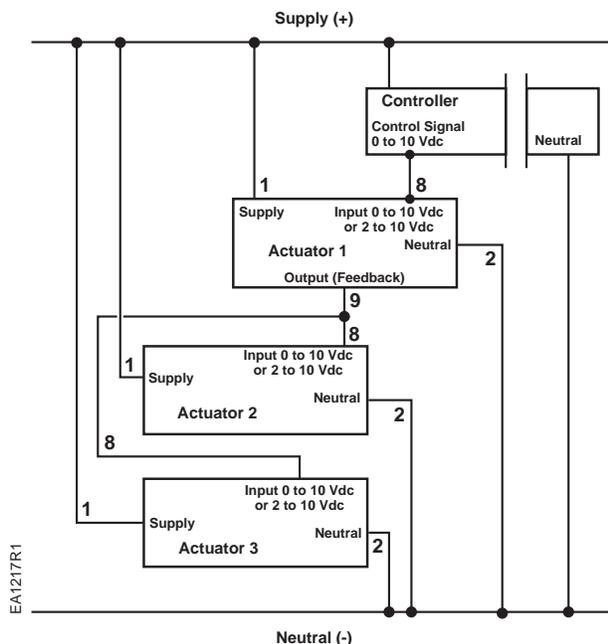
Table 3. Three-position Control 24 VAC/DC.

| Standard Symbol | Function                        | Color  |
|-----------------|---------------------------------|--------|
|                 |                                 | Plenum |
| 1               | (+)                             | Red    |
| 2               | Com                             | Black  |
| 6               | Control signal clockwise        | Violet |
| 7               | Control signal counterclockwise | Orange |

Table 4. Modulating Control 24 VAC/DC.

| Standard Symbol | Function                                      | Color      |
|-----------------|---|------------|
|                 |   | Plenum     |
| 1               | (+)   | Red        |
| 2               | Com   | Black      |
| 8               | 0 to 10 VDC/<br>2 to 10 Vdc input signal      | Gray       |
| 9               | Output for 0 to 10 VDC<br>position indication | Pink       |
| S1              | Switch A Common                               | Gray/red   |
| S2              | Switch A N.C.                                 | Gray/blue  |
| S3              | Switch A N.O.                                 | Gray/pink  |
| S4              | Switch B Common                               | Black/red  |
| S5              | Switch B N.C.                                 | Black/blue |
| S6              | Switch B N.O.                                 | Black/pink |

#### (0 to 10 Vdc or 2 to 10 Vdc) for Tandem Application (Master/Slave)





## ES142 Spring Return Electronic Actuators

### Start-Up/Commissioning

#### Two-Position Control, 24 VAC/DC

1. Check that the wires are connected correctly.
2. 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.
3. Check operation:
  - a. Connect wires 1 (red) and 2 (black) to 24 VAC/DC signal.
  - b. Allow the actuator shaft coupling to rotate from 0 to 90°.
  - c. Disconnect wire 1 (red) and the actuator shaft coupling returns to the 0 position.
4. Check spring return:
  - a. Connect wires 1 (red) and 2 (black) to the 24 VAC/DC signal.
  - b. Allow the actuator shaft coupling to rotate half-way.
  - c. Disconnect wire 1 (red).
  - d. The spring returns the actuator shaft coupling to the fail 0 position.
  - e. Connect wire 1 (red) and the actuator shaft coupling begins to move.
5. Check the 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 1 (red).
  - d. The DMM should indicate contact closure as the actuator shaft coupling reaches the setting of switch A.
  - e. Connect wires S1 and S2 to the DMM. The DMM should indicate an open circuit or no resistance.
  - f. Disconnect wire 1 (red).
  - g. The DMM should indicate contact closure as the actuator shaft coupling reaches the setting of switch A.
6. Check the 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 1 (red).
  - d. The DMM should indicate contact closure as the actuator shaft coupling reaches the setting of switch B.
  - e. Connect wires S4 and S5 to the DMM. The DMM should indicate an open circuit or no resistance.
  - f. Disconnect wire 1 (red).
  - g. 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.



## ES142 Spring Return Electronic Actuators

### Two-Position Control, 120 VAC

1. Check that the wires are connected correctly.
2. Connect wires to a Digital Multimeter (DMM) with the dial set at VAC to verify that the operating voltage is within range.
3. Check operation:
  - a. Connect wires 3 (black) and 4 (white) to 120 VAC signal.
  - b. Allow the actuator shaft coupling to rotate from 0 to 90°.
  - c. Disconnect wire 3 (black) and the actuator shaft coupling returns to the 0 position.
4. Check spring return:
  - a. Connect wires 3 (black) and 4 (white) to the 120 VAC signal.
  - b. Allow the actuator shaft coupling to rotate half-way.
  - c. Disconnect wire 3 (black).
  - d. The spring returns the actuator shaft coupling to the fail 0 position.
  - e. Connect wire 3 (black) and the actuator shaft coupling begins to move.
5. Check the 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 120 VAC across wires 3 (black) and 4 (white).
  - d. The DMM should indicate contact closure as the actuator shaft coupling reaches the setting of switch A.
  - e. Connect wires S1 and S2 to the DMM. The DMM should indicate an open circuit or no resistance.
  - f. Disconnect wire 3 (black).
  - g. The DMM should indicate contact closure as the actuator shaft coupling reaches the setting of switch A.
6. Check the 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 120 VAC across wires 3 (black) and 4 (white).
  - d. The DMM should indicate contact closure as the actuator shaft coupling reaches the setting of switch B.
  - e. Connect wires S4 and S5 to the DMM. The DMM should indicate an open circuit or no resistance.
  - f. Disconnect wire 3 (black).
  - g. 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.



## **ES142 Spring Return Electronic Actuators**

### **Three-Position Control, 24 VAC/DC**

1. Check that the wires are connected correctly.
2. 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.
3. Check operation:
  - a. Connect wires 1 (red) and 2 (black) to the actuator.
  - b. Apply a control signal (24 VAC/DC) to wire 6 (violet).
  - c. Allow the actuator shaft coupling to rotate from 0 to 90°.
  - d. Stop applying a control signal to wire 6 (violet).
  - e. Apply a control signal (24 VAC/DC) to wire 7 (orange).
  - f. Allow the actuator shaft coupling to rotate from 90 to 0°.
4. Check spring return:
  - a. Apply a control signal (24 VAC/DC) to wire 6 (violet).
  - b. Allow the actuator shaft coupling to rotate half-way.
  - c. Disconnect wire 1 (red).
  - d. The spring returns the actuator shaft coupling to the fail 0 position.

### **Service**



**WARNING:**

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



## ES142 Spring Return Electronic Actuators

### Modulating Control, 24 VAC/DC

1. Check that the wires are connected correctly.
2. Check that the offset (start point) and span are set correctly, if used.
3. 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.
4. 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 as required for voltage.
  - 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 1 (red) and the shaft coupling returns to the 0 position.
5. Check spring return:
  - a. Set the DMM dial to VDC.
  - b. Connect wires 2 (black) and 8 (gray) to DMM.
  - c. Apply an input signal (5 VDC) to wire 8 (gray).
  - d. Allow the actuator shaft coupling to rotate half-way.
  - e. Disconnect wire 1 (red). The spring returns the actuator shaft coupling to the fail 0 position.
  - f. Connect wire 1 (red) and the actuator moves.
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 fail 0 position.
7. Check the 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 the 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).
  - f. 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.



### ES142 Spring Return Electronic Actuators

#### Dimensions

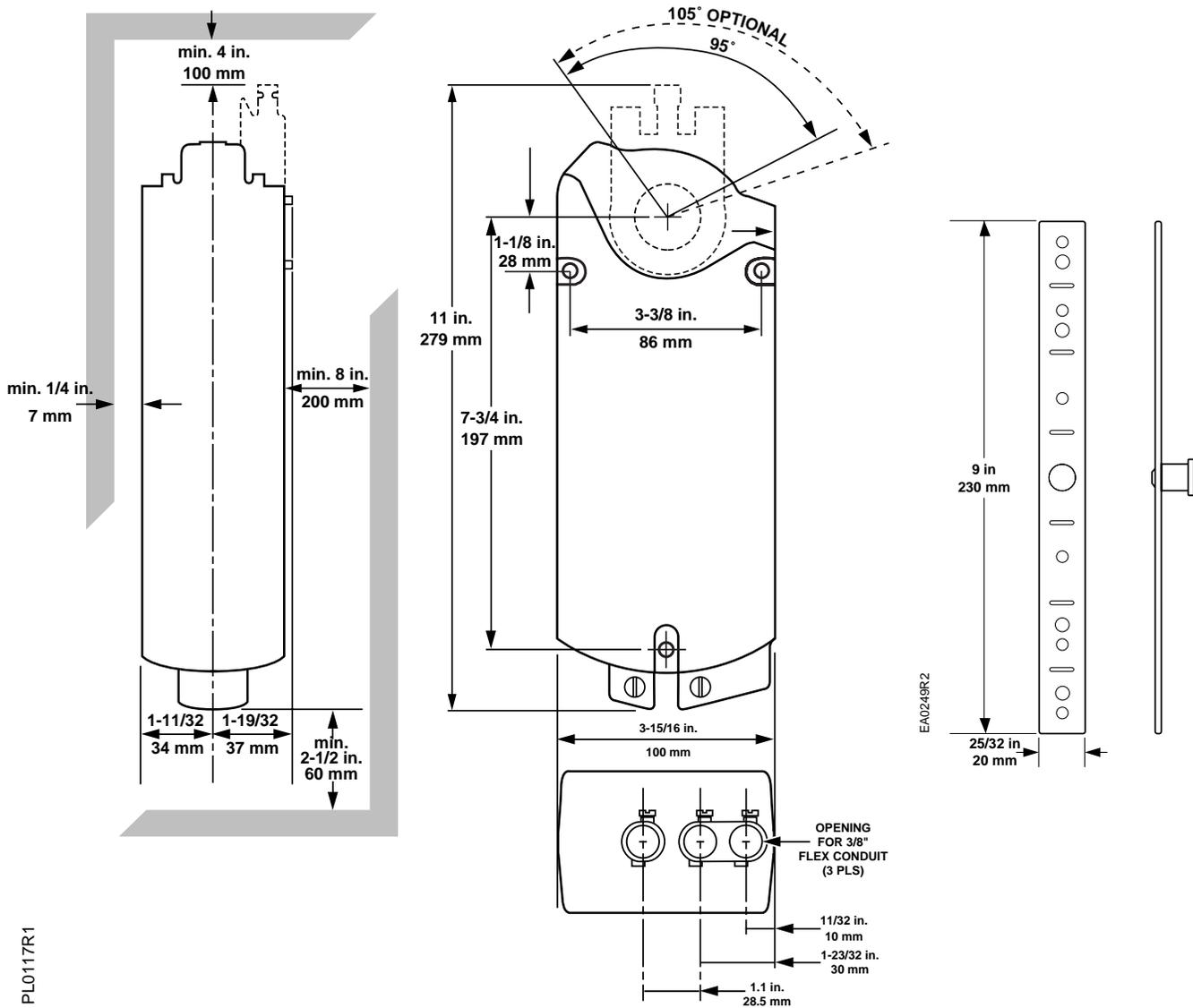


Figure 22. Dimensions of the ES142 Actuator and Mounting Bracket.



## ES142 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:

1. Obtain damper torque ratings (ft-lb/ft<sup>2</sup> or Nm/m<sup>2</sup>) 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. 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:

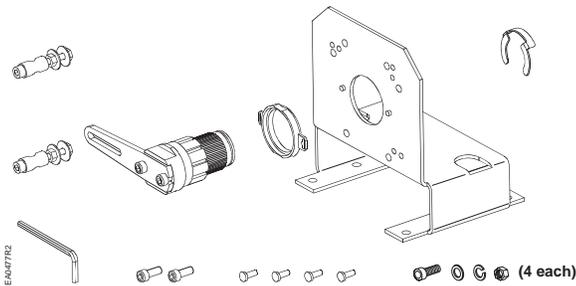
- The same type of actuator is used.
- The operating voltage is within the tolerance.



## ES142 Spring Return Electronic Actuators

### ACCESSORIES

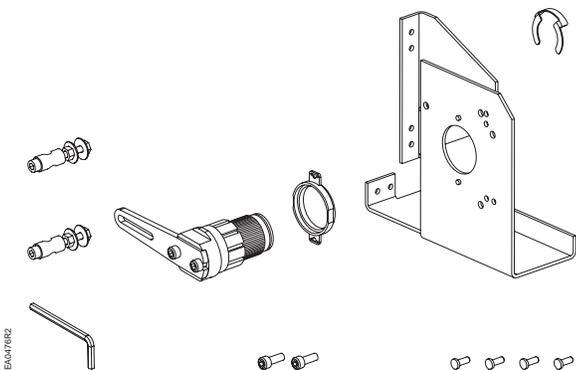
**NOTE:** The auxiliary switches and/or the control signal adjustment cannot be added in the field. Order the product number that includes the option(s), if required.



**Figure 1. Floor Mount Kit.**

**ASK71.1U** This kit allows foot mounting of the ES142 actuator. This kit should be used for in-the-airstream applications, and generally, anywhere a foot-mounted actuator can be mounted.

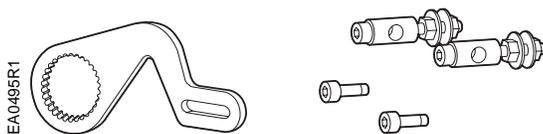
This kit contains a crank arm that changes the angular rotation into a linear stroke, a support bearing ring to minimize side loading on the actuator's output bearing, a mounting bracket, and required mounting fasteners.



**Figure 2. Frame Mount Kit.**

**ASK71.2U** This kit allows mounting of the ES142 actuator 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.

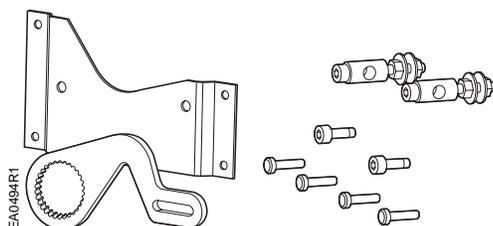
This kit contains a crank arm that changes the angular rotation into a linear stroke, a support bearing ring to minimize side loading on the actuator's output bearing, a mounting bracket, and required mounting fasteners.



**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.



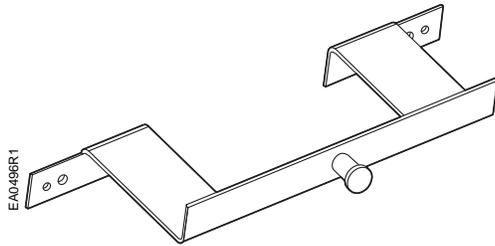
**Figure 4. Crank Arm Kit with Mounting Bracket.**

**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.

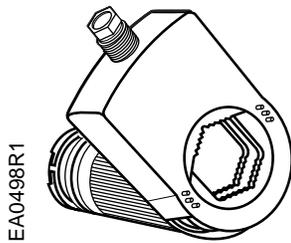


**ES142 Spring Return Electronic Actuators**



**Figure 5. Tandem Mount Bracket.**

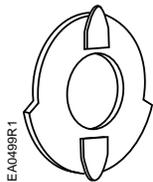
**ASK73.1** This bracket provides an extended anti-rotation pin that allows two ES142 actuators to directly drive a single damper shaft. For use with two and three-position actuators.



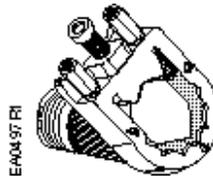
**Figure 7. Self-centering Shaft Adapter.**

**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-inches (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 8. Orderable Parts.**



## ES142 Spring Return Electronic Actuator Installation Guide

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