

# MS40-7043, MS41-7073/7153 Series

## SmartX Spring Return Proportional Actuators

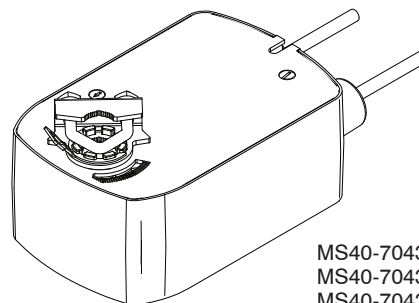
### Application

SmartX Actuators (Direct Coupled) are designed to be used in both damper and valve control applications. The following general instructions are for damper applications. Refer to the Applicable Literature table for valve literature.

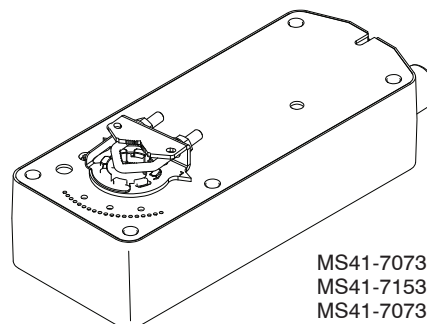
The MS4X-7XX3 series spring return actuators provide proportional modulation control of dampers and valves in HVAC systems.

### Features

- Proportional models controlled by 6...9 Vdc, 2...10 Vdc, or 4...20 mA with the addition of a 500 ohm resistor
- 133 lb-in (15 N-m), 60 lb-in (7 N-m) or 35 lb-in (4 N-m) of torque
- Rugged die-case housings rated for NEMA 2 / IP54
- Optional built-in auxiliary switch to provide for interfacing or signaling
- Provides 95° of rotation
- Visual position indicator provided
- Provides true mechanical clockwise or counterclockwise spring return operation for reliable fail safe application and positive close-off in air tight damper applications
- MS40-7043-MPX models controlled by 6...9 Vdc with auxiliary 20 Vdc power supply provides power to controllers, replacing MP-5XXX/MPR-5XXX electrohydraulic actuators
- Direct mount to round or square damper shafts
- Switch provided for selection of direct or reverse acting control mode
- Rotation limiting available
- MS41-7153 SmartX Actuators can be double-mounted (gang mounting) to accommodate high torque application requirements
- Five year warranty
- MS41-7073 and MS41-7153 SmartX Actuators are equipped with manual override



MS40-7043  
MS40-7043-501  
MS40-7043-MP  
MS40-7043-MP5



MS41-7073  
MS41-7153  
MS41-7073-502  
MS41-7153-502

Life Is On

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## Applicable Literature

| F-Number | Description                                                                                                            | Audience                                                                                                                                                                                | Purpose                                                                                                                                                              |
|----------|------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| F-26750  | MA4X-XXXX-2XX, MF4X-XXXX-2XX, MS4X-XXXX-2XX Series Actuator/Linkage Assemblies General Instructions                    | <ul style="list-style-type: none"> <li>– Sales Personnel</li> <li>– Application Engineers</li> <li>– Installers</li> <li>– Service Personnel</li> <li>– Start-up Technicians</li> </ul> | Describes the globe valve actuator/linkage assembly's features, specifications, and possible applications. Provides step-by-step mounting instructions.              |
| F-26751  | VX-2000 Series Ball Valve Assembly Installations Instructions                                                          | <ul style="list-style-type: none"> <li>– Sales Personnel</li> <li>– Application Engineers</li> <li>– Installers</li> <li>– Service Personnel</li> <li>– Start-up Technicians</li> </ul> | Describes the actuator/linkage/ball valve assembly's features, specifications, and possible applications. Provides step-by-step mounting instructions.               |
| F-26646  | MX4X-7XXX, MX40-6XXX SmartX Actuator Selection Guide                                                                   | <ul style="list-style-type: none"> <li>– Sales Personnel</li> <li>– Application Engineers</li> <li>– Installers</li> <li>– Service Personnel</li> <li>– Start-up Technicians</li> </ul> | Provides actuator specifications and part number cross referencing of phased out actuators with the new direct-coupled actuators.                                    |
| F-26752  | VX-2000, VX-7000, MX4X-7XXX, MX40-6XXX Linked Globe Valve Assemblies Actuator/Linkage Assemblies with SmartX Actuators | <ul style="list-style-type: none"> <li>– Sales Personnel</li> <li>– Application Engineers</li> <li>– Installers</li> <li>– Service Personnel</li> <li>– Start-up Technicians</li> </ul> | Provides part number cross referencing of phased out globe and ball valve assemblies with the new direct-coupled actuators.                                          |
| F-26080  | EN-205 Water System Guidelines                                                                                         | <ul style="list-style-type: none"> <li>– Application Engineers</li> <li>– Installers</li> <li>– Service Personnel</li> <li>– Start-up Technicians</li> </ul>                            | Describes Schneider Electric approved water treatment practices.                                                                                                     |
| F-13755  | CA-28 Control Valve Sizing                                                                                             | <ul style="list-style-type: none"> <li>– Application Engineers</li> <li>– Installers</li> <li>– Service Personnel</li> <li>– Start-up Technicians</li> </ul>                            | Provides charts, equations, and diagrams to assist in the configuration of valve system applications. TOOL-150, valve sizing slide rule may be purchased separately. |
| F-11080  | Valve Selection Chart Water                                                                                            |                                                                                                                                                                                         |                                                                                                                                                                      |
| F-11366  | Valve Selection Chart Steam (two-way valves only)                                                                      |                                                                                                                                                                                         |                                                                                                                                                                      |

## SPECIFICATIONS

### Actuator Inputs

**Control Signal:** See Table-1.

**Power Input:** See Table-1. All 24 Vac circuits are Class 2.

**Connections:** 3 ft. (91 cm) plenum rated cable for MS40-7043-XXX and 3 ft. (91 cm) appliance cables for MS41-7153-XXX and MS4X-7073-XXX, 1/2" (13 mm) conduit connectors. For M20 Metric conduit, use AM-756 adaptor.

### Actuator Outputs

#### Electrical:

##### Position Feedback Voltage "AO":

**MS40-7043, MS41-7153 and MS41-7073** 2...10 Vdc (max. 0.5 mA) output signal for position feedback or to operate up to four additional slave actuators.

##### Auxiliary Switches:

**MS40-7043-MP5 and MS40-7043-501** One SPDT 6A (1.5A) @ 24 Vac, adjustable 15...95° (MIN to 1 scale).

**MS41-7153-502 and MS41-7073-502** Two SPDT 7A (2.5A) @ 250 Vac, one fixed @ 5° and one adjustable 25...85°.

#### Auxiliary Power Supply:

**MS40-7043-MP and MS40-7043-MP5** +20 Vdc @ 25 mA (max).

#### Mechanical:

**Stroke:** Angle of rotation 95° ±5°. Adjustable 30°...95° with AM-689 installed on MS41-7153-XXX or MS41-7073-XXX. MS40-7043-XXX models are adjustable 40°...95° by adjusting the stop block position on the actuator.

##### Damper Shaft Clamp:

**MS40-7043-XXX** The factory installed universal clamp is used for shafts up to 5/8" (15 mm) diameter or up to 1/2" (13 mm) square. AM-710 accessory clamp is required when mounting actuators to shafts up to 3/4" (19 mm) diameter or up to 1/2" (13 mm) square.

**MS41-7153-XXX or MS41-7073-XXX** The factory installed universal clamp is used for shafts up to 3/4" (19 mm) diameter or up to 1/2" (13 mm) square. AM-687 accessory clamp is required when mounting actuators to shafts up to 1.05" (27 mm) diameter or up to 5/8" (15 mm) square.

**Position Indicator:** Visual indicator.

**MS41-7153 and MS41-7073** -5...90° (-5° is spring return position).

**MS40-7043** 0 to 1 (0 is spring return position).

**Nominal Damper Area:** Actuator sizing should be done in accordance with damper manufacturer's specifications.

**Direction of Rotation:** Clockwise or counterclockwise rotation determined by actuator mounting.

**Manual Override:** MS41-7073 and MS41-7153 are equipped with a manual rotation adjustment from -5°...85°.

**Right/Left Switch** Permits reverse acting/direct acting rotation.

### Environment

#### Ambient Temperature Limits:

**Shipping & Storage** -40...160°F (-40...71°C).

**Operating** -22...140°F (-30...60°C).

**Humidity:** 15...95% RH, non-condensing.

#### Location:

**MS41-7153-XXX and MS41-7073-XXX** NEMA 1 (IEC IP30). NEMA 2 (IEC IP54) with conduit connector in the down position.

**MS40-7043-XXX** NEMA 2 (IEC IP54) no restrictions.

### Agency Listings

**UL 873:** Underwriters Laboratories (File #E9429 Category Temperature-Indicating and Regulating Equipment).

**CUL:** UL Listed for use in Canada by Underwriters Laboratories. Canadian Standards C22.2 No. 24-93.

**European Community:** EMC Directive (89/336/EEC). Low Voltage Directive (72/23/EEC)

**Australia:** This product meets requirements to bear the RCM Mark according to the terms specified by the Communications Authority under the Radiocommunications Act 1992.

**Table-1 Specifications.**

| Part Number   | SmartX Actuator Power Input     |         |     |       |     |            |              | Approximate<br>Timing in Seconds<br>@ 70°F (21°C) <sup>a</sup> |                  | Auxiliary<br>Switch | Output Torque<br>Rating<br>lb.-in. (N-m) |               | Auxiliary<br>Power<br>Supply | Input                                                                  |
|---------------|---------------------------------|---------|-----|-------|-----|------------|--------------|----------------------------------------------------------------|------------------|---------------------|------------------------------------------|---------------|------------------------------|------------------------------------------------------------------------|
|               | Voltage                         | Running |     |       |     |            | Hold-<br>ing | Powered                                                        | Spring<br>Return |                     | Min. <sup>b</sup>                        | Max.<br>Stall |                              |                                                                        |
|               |                                 | 50 Hz   |     | 60 Hz |     | DC<br>Amps | 50/60<br>Hz  |                                                                |                  |                     |                                          |               |                              |                                                                        |
|               |                                 | VA      | W   | VA    | W   |            | W            |                                                                |                  |                     |                                          |               |                              |                                                                        |
| MS40-7043     | 24 Vac<br>± 20%<br>22-30<br>Vdc | 5.6     | 4.2 | 5.6   | 4.2 | 0.15       | 2.4          | <130                                                           | <25              | No                  | 35<br>(4)                                | 150<br>(17)   | None                         | 2...10 <sup>c</sup><br>Vdc or<br>4...20 <sup>d</sup><br>mA w/<br>500 Ω |
| MS40-7043-501 |                                 |         |     |       |     |            |              |                                                                |                  | One <sup>e</sup>    |                                          |               |                              |                                                                        |
| MS41-7073     |                                 | 5.8     | 4.6 | 5.8   | 4.6 | 0.17       | 2.3          | <195                                                           | <30              | No                  | 60<br>(7)                                | 250<br>(28)   |                              |                                                                        |
| MS41-7073-502 |                                 |         |     |       |     |            |              |                                                                |                  | Two <sup>f</sup>    |                                          |               |                              |                                                                        |
| MS41-7153     |                                 | 9.8     | 7.4 | 9.7   | 7.4 | 0.28       | 2.9          | <190                                                           | <30              | No                  | 133<br>(15)                              | 350<br>(40)   |                              |                                                                        |
| MS41-7153-502 |                                 |         |     |       |     |            |              |                                                                |                  | Two <sup>f</sup>    |                                          |               |                              |                                                                        |
| MS40-7043-MP  | 24 Vac<br>± 20%<br>22-30<br>Vdc | 6.6     | 5.0 | 6.6   | 5.0 | 0.17       | 3.2          | <130                                                           | <25              | No                  | 35<br>(4)                                | 150<br>(17)   | +20 Vdc<br>25 mA<br>Max.     | 6...9 <sup>c</sup><br>Vdc                                              |
| MS40-7043-MP5 |                                 |         |     |       |     |            |              |                                                                |                  | One                 |                                          |               |                              |                                                                        |

a Timing was measured with no load applied to the actuator.

b De-rating is required at low temperatures.

c 2-10 Vdc or 6-9 Vdc input impedance 80 k ohms.

d 4-20 mA with 500 ohm input impedance 500 ohms.

e One adjustable from 0° to 95° rotation (0 to 1 scale).

f One adjustable from 25° to 85° rotation and one set to operate @ 5° fixed.

## ACCESSORIES

|        |                                                                                 |
|--------|---------------------------------------------------------------------------------|
| AM-671 | Universal Mounting Bracket, AM-693 is required                                  |
| AM-672 | Universal Mounting Bracket, AM-693 is required                                  |
| AM-673 | Multiple Actuator Mounting Bracket (MA40-7153 series)                           |
| AM-674 | Weather Shield                                                                  |
| AM-675 | Base Mounting Plate for AM-674                                                  |
| AM-676 | Universal Shaft Extension, AM-710 required                                      |
| AM-703 | Input Rescaling Module, adjusts signals to 2...10 Vdc, zero and span adjustment |
| AM-704 | Interface, pulse width modulation                                               |
| AM-705 | Positioner (NEMA 4 housing)                                                     |
| AM-706 | Min and/or Manual Positioner for flush panel mount                              |
| AM-708 | 500Ω resistor for 0...20 mA control signal                                      |
| AM-714 | Weather Shield (polycarbonate)                                                  |
| AM-756 | Metric Conduit Adapter M20 x 1.5...1/2" NPT                                     |
| AM-761 | 7-inch replacement anti-rotation bracket                                        |
| AM-762 | 9-inch replacement anti-rotation bracket                                        |

### MS41-7153-XXX and MS41-7073-XXX

|        |                                                                                                                               |
|--------|-------------------------------------------------------------------------------------------------------------------------------|
| AM-686 | Damper Position Indicator                                                                                                     |
| AM-687 | Universal Clamp for up to 1.05" (27 mm) diameter shafts                                                                       |
| AM-688 | Replacement Universal Clamp                                                                                                   |
| AM-689 | Rotation Limiter                                                                                                              |
| AM-690 | Crank Arm for round shafts up to 3/4" (19 mm)                                                                                 |
| AM-691 | Crank Arm for jackshafts up to 1.05" (27 mm)                                                                                  |
| AM-692 | V-bolt Kit for AM-690 and AM-691 Crank Arms                                                                                   |
| AM-693 | Damper Linkage Kit                                                                                                            |
| AM-758 | Short "U" mounting bracket for replacing Honeywell Mod III type actuators and new installations, AM-690 or AM-691 is required |
| AM-759 | Tall "U" mounting bracket for replacing Honeywell Mod IV type actuators and new installations, AM-690 or AM-691 is required   |
| AM-760 | Slotted "L" mounting bracket, AM-690 or AM-691 is required                                                                    |
| AM-763 | Crank for manual override                                                                                                     |

**MS40-7043-XXX**

|        |                                                                                       |
|--------|---------------------------------------------------------------------------------------|
| AM-709 | Damper Position Indicator                                                             |
| AM-710 | Universal Clamp for up to 3/4" diameter shafts                                        |
| AM-711 | Crankarm for up to 1/2" round shaft                                                   |
| AM-712 | Crankarm Adaptor Kit                                                                  |
| AM-713 | Mounting Bracket for Honeywell Mod IV, M6415 type actuators, and new installations    |
| AM-715 | Crankarm Adaptor Kit for Honeywell Mod IV M6415 type actuators, and new installations |
| AM-717 | Replacement Universal Clamp                                                           |

**Table-2 Auxiliary Power Supply.**

| Model #                       | Rating                  |          |
|-------------------------------|-------------------------|----------|
| MS40-7043-MP or MS40-7043-MP5 | + 20 Vdc, 25 mA Maximum |          |
| Control Wires                 | Blue (+)                | Grey (-) |

**TYPICAL APPLICATIONS**  
(wiring diagrams)



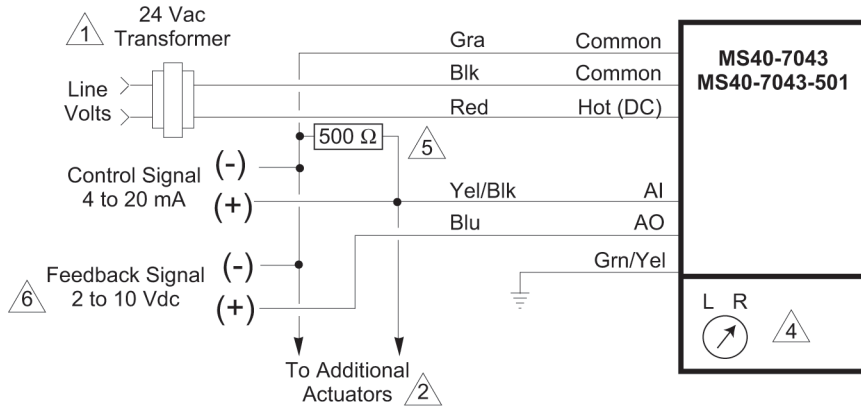
Figure-1 and Figure-2 illustrate typical wiring diagrams for spring return proportional actuators. See Table-1 for model selection and control signal specifications.

**Caution:** This product contains a half-wave rectifier power supply and must not be powered off transformers used to power other devices utilizing non-isolated full-wave rectifier power supplies. Refer to EN-206, Guidelines for Powering Multiple Devices from a Common Transformer, F-26363 for detailed information.

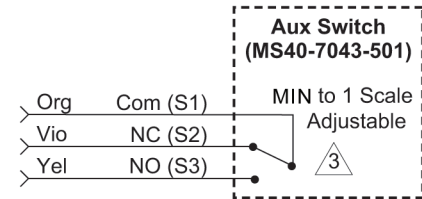
**Note:** DC operation is applicable to models manufactured after date code 0212.



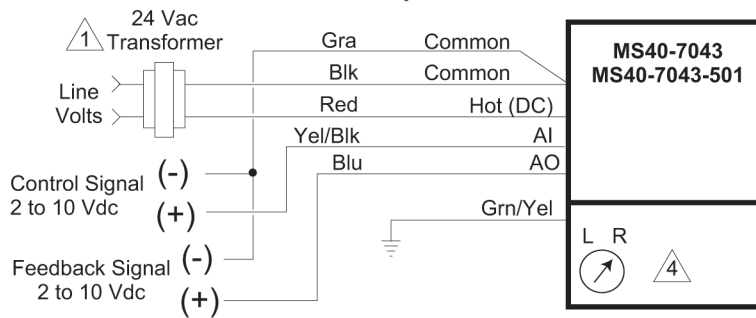
### 4 to 20 mAdc Proportional Control



### Optional Auxiliary Switch



### 2 to 10 Vdc Proportional Control



1 Provide overload protection and disconnect as required.

2 For parallel operation in 4 to 20 mA applications, actuators may be wired in series and mounted on separate shafts. Also, up to four actuators, mounted on separate shafts, may be wired in parallel. With four actuators wired to one 500 ohm resistor, a +2% shift of the control signal may be required. Power consumption and input impedance limits must be observed. Actuator input impedance is 80 kohm.

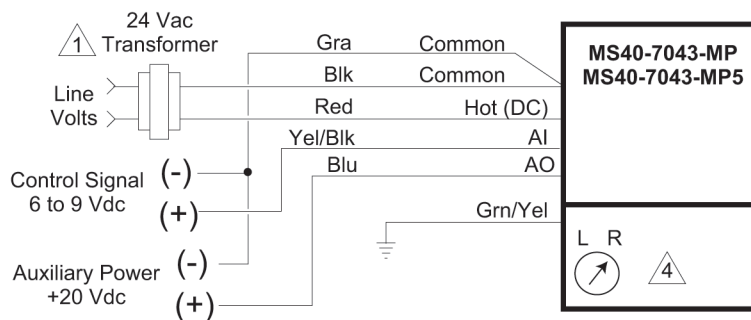
3 For end position indication, interlock control, fan startup, etc., MS40-7043-501 model incorporates one built-in auxiliary switch.

4 To reverse actuator rotation, use the reversing switch.

5 A field-supplied 500 ohm resistor (AM-708) is required between the gray and yellow/black leads to convert the 4 to 20 mAdc control signal to 2 to 10 Vdc.

6 Only connect common to negative (-) leg of control circuits.

### 6 to 9 Vdc Proportional Control with 20 Vdc Power Output



### TAC System 8000 6 to 9 Vdc Room Temperature Control

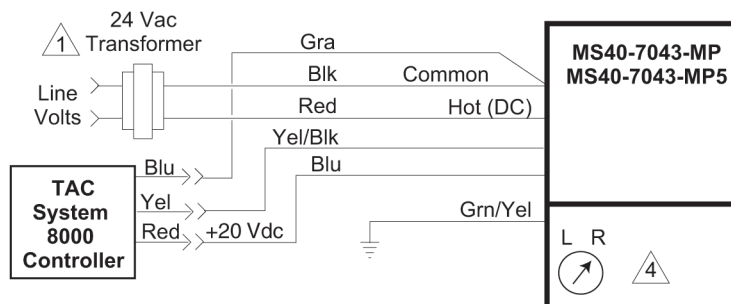


Figure-1 Proportional Control of System 8000 Room Temperature Controller  
Application of MS40-7043-XXX SmartX Actuator.

## MS41-7073-XXX and MS41-7153-XXX

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**Caution:** This product contains a half-wave rectifier power supply. It must not be powered with transformers that are used to power other devices utilizing non-isolated full-wave rectifier power supplies. Refer to EN-206, Guidelines for Powering Multiple Devices from a Common Transformer, F-26363 for detailed information.

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MS41-707X-502 and MS41-715X-502 units manufactured prior to the date code 0141 (October 6, 2001) used different color coding for the auxiliary switches.

### Auxiliary Switch 1

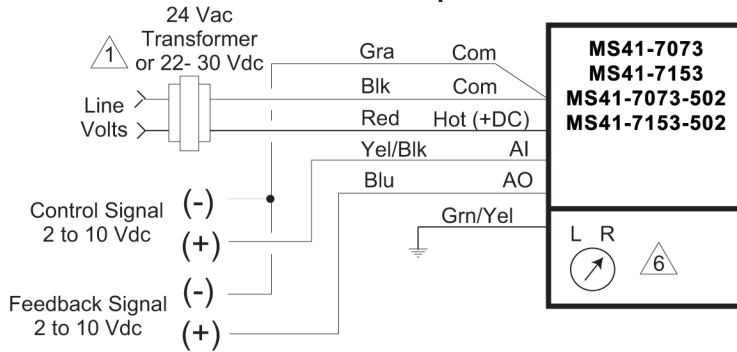
|         |                                             |
|---------|---------------------------------------------|
| Orange: | Fixed auxiliary switch common (com)         |
| Yellow: | Fixed auxiliary switch normally closed (NC) |
| Violet: | Fixed auxiliary switch normally open (NO)   |

### Auxiliary Switch 2

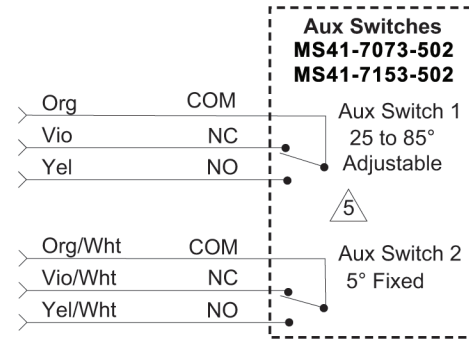
|               |                                                  |
|---------------|--------------------------------------------------|
| Orange/white: | Adjustable auxiliary switch common (com)         |
| Violet/white: | Adjustable auxiliary switch normally closed (NC) |
| Yellow/white: | Adjustable auxiliary switch normally open (NO)   |

The label information on these units is incorrect. If replacing these units, the auxiliary switch operation of the replacement actuator will be per the product label and Figure-2.

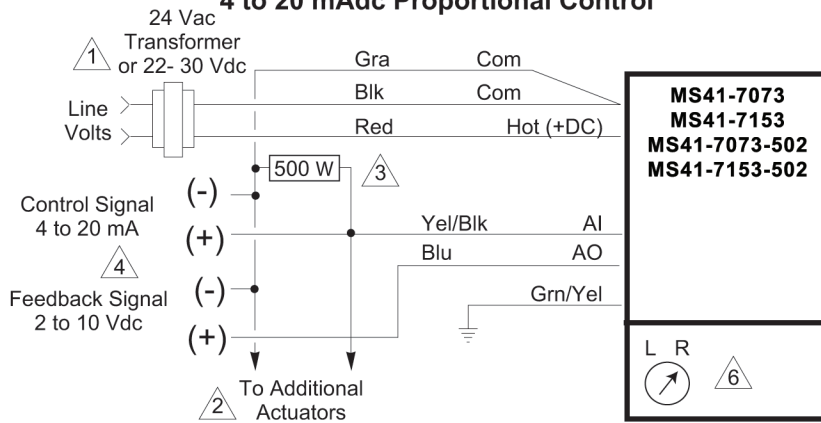
## 2 to 10 Vdc Proportional Control



## Optional Auxiliary Switches



## 4 to 20 mAdc Proportional Control



- 1 Provide overload protection and disconnect as required.
- 2 With four actuators wired to one 500 ohm resistor, a +2% shift of the control signal may be required. (Actuator input impedance is 80 k ohm.)
- 3 A field-supplied 500 ohm resistor (AM-708) is required between the gray and yellow/black leads to convert the 4 to 20 mAdc control signal to 2 to 10 Vdc.
- 4 Only connect common to negative (-) leg of control circuits.
- 5 For end position indication, interlock control, fan startup, etc., MS4X-7XX3-502 models incorporate two built-in auxiliary switches.
- 6 To reverse actuator rotation, use the reversing switch.
- 7 Both actuators must be set to operate in the same direction.

## Two Actuators on the Same Damper Shaft

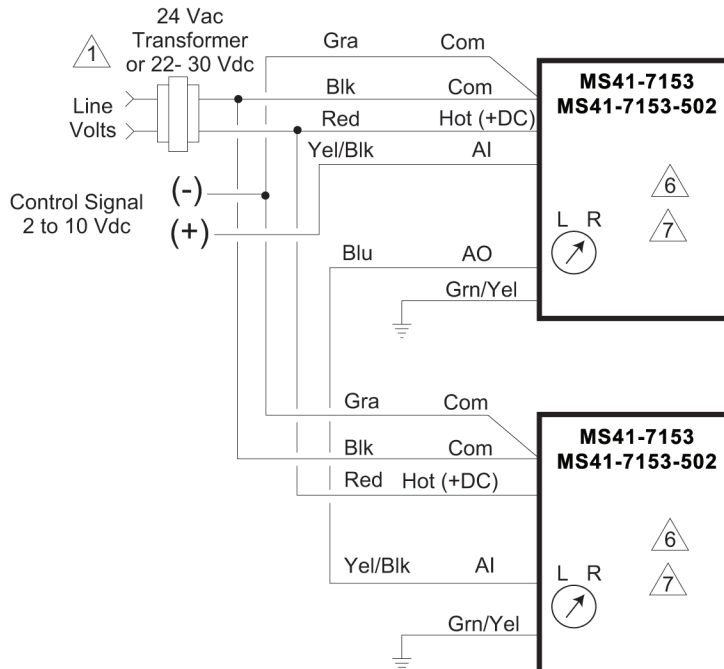


Figure-2 Typical Wiring Diagrams for Proportional Control 24 Vac Basic and Double Auxiliary Switch Models.

## INSTALLATION

### Inspection

#### INSTALLATION

Inspect the package for damage. If damaged, notify the appropriate carrier immediately. If undamaged, open the package and inspect the device for obvious damage. Return damaged products.

### Requirements

- Job wiring diagrams
- Tools (not provided):
  - #8 sheet metal screws (Universal Bracket)
  - 10mm open end wrench or socket wrench (Universal V-clamp)
  - 1/8 inch, allen wrench (Aux. Switch)
  - Appropriate screwdriver(s)
  - Drill and appropriate bits
- Appropriate accessories
- Training: Installer must be a qualified, experienced technician

### Precautions



#### General

##### Warning:

- Electrical shock hazard! Disconnect the power supply (line power) before installation to prevent electric shock and equipment damage.
- Make all connections in accordance with the job wiring diagram and in accordance with national and local electrical codes. Use copper conductors only.

##### Caution:

- Avoid electrical noise interference. Do not install near large contactors, electrical machinery, or welding equipment.
- MS41-707X and MS41-715X Manual override to be used only when power is not applied to unit.
- When operating manual override, back off 5° from full open mechanical stop to ensure proper release.
- MS41-707X and MS41-715X Do not attempt to use the manual override with actuators mounted in tandem. Damage to the gear train may occur.
- Do not drill holes in actuator body. Six pre-drilled holes are located on each side, under the label, to accept #10-24 thread forming screws for mounting accessories.

## Federal Communications Commission (FCC)

**Note:** This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in residential installations. This equipment generates, uses, and can radiate radio frequency energy and may cause harmful interference if not installed and used in accordance with the instructions. Even when instructions are followed, there is no guarantee that interference will not occur in a particular setting—Which can be determined by turning the equipment off and on—the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment to an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/television technician for help.

## Canadian Department of Communications (DOC)

**Note:** This Class B digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe B respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.



## European Standard EN 55022

**Warning:** This is a Class B digital (European Classification) product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

### Location

**Caution:** Avoid locations where excessive moisture, corrosive fumes, vibration, or explosive vapors are present.

### Mounting

**Caution:** To remain in NEMA 2/IP54 compliance, the MS41-715X and MS41-707X series actuators should be mounted with conduit end down.

Mount the SmartX Actuator directly on the damper shaft in locations that clear the maximum dimensions of the actuator case and allow the actuator to be mounted flush to the surface of the terminal box and perpendicular to the damper shaft.

MS41-707X and MS41-715X If the universal clamp is not set to 0° on the position indicator, manually wind the actuator in the direction indicated with hex wrench from -5°...0° and lock with a screwdriver.

**Note:** Some terminal boxes have sheet metal screw heads or other protrusions near the damper shaft. In these cases, a spacer or shim may be added under the anti-rotation bracket of the actuator to make the actuator perpendicular to the shaft.

### Damper Actuator Sizing

Correct sizing of the actuator is necessary for proper control of dampers. The area of damper that can be controlled by a given actuator is dependent upon the type of damper, the quality of the damper, the pressure drop across the damper in the closed position, and the velocity of the air flow through the damper. To obtain actual damper torque requirements, contact the damper manufacturer.

### Damper Shaft Sizing

Use the "Long Damper Shaft" mounting instructions if the damper shaft is at least 3-1/2" (90 mm) long.

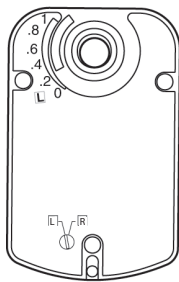
Use the "Short Damper Shaft" mounting instructions if the damper shaft is shorter than 3-1/2" (90 mm) or the area around the damper shaft is too narrow to allow standard mounting, as described in the "Short Damper Shaft" mounting section.

### Changing Direction of Rotation

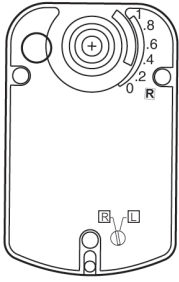
The MS40-7043, MS41-7074, and MS41-7153 actuators are equipped with a switch to control the direction of rotation. The switch can be set to "L" (left) or "R" (right) rotation. An actuator set to "L" will have a clockwise rotation when viewed from the left side. When viewed from the right side the rotation will be counterclockwise. Refer to Figure-3.

**Caution:** These are spring return actuators. It is possible to switch to a direction that moves the actuator against the -5° positive stop. Example: Viewing the actuator from the left side with the switch set to "R" and an increasing signal. The actuator will attempt to rotate beyond the -5° stop and will stall.

**MS40-704X**

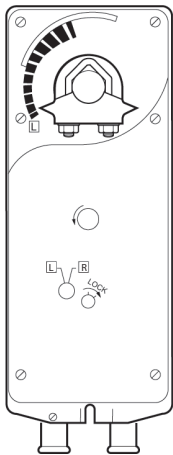


Viewed from L side:  
Switch on **L** – Counter-Clockwise rotation  
on increasing signal  
  
Switch on **R** – Clockwise rotation  
on increasing signal

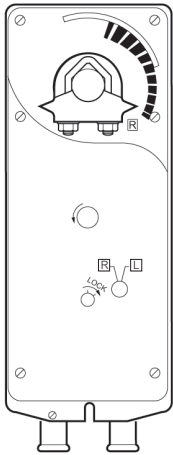


Viewed from R side:  
Switch on **R** – Counter-Clockwise rotation  
on increasing signal  
  
Switch on **L** – Clockwise rotation  
on increasing signal

**MS41-707X, MS41-715X-XXX**



Viewed from L side:  
Switch on **L** – Counter-Clockwise rotation  
on increasing signal  
  
Switch on **R** – Clockwise rotation  
on increasing signal

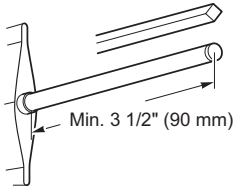
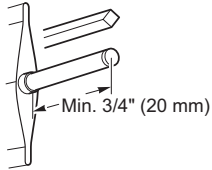
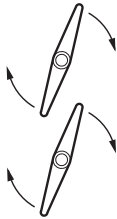
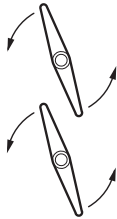


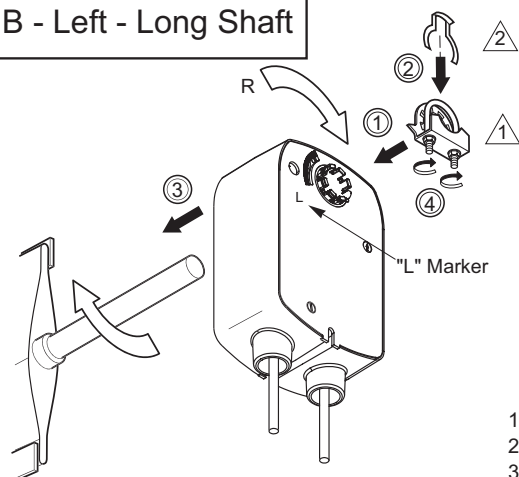
Viewed from R side:  
Switch on **R** – Counter-Clockwise rotation  
on increasing signal  
  
Switch on **L** – Clockwise rotation  
on increasing signal

Figure-3 Rotation Switch Settings.

# MS40-704X SmartX Actuator Installation

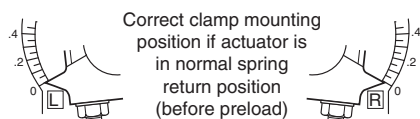
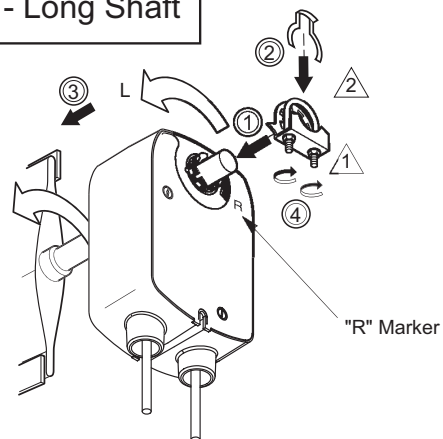
**Note:** The MS40-704X SmartX Actuator comes equipped with standard universal mounting clamp. For damper shafts larger than 5/8" (16 mm) in diameter, the AM-710 universal mounting clamp is required (order separately). The AM-710 clamp accommodates shafts sizes up to 3/4" (19 mm) diameter shafts.

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <div data-bbox="178 449 376 506"><b>Long Shaft</b></div> <div data-bbox="462 485 695 674"><p>Min. 3 1/2" (90 mm)</p></div>                                                                                                                                                                                                                                                     | <div data-bbox="857 449 1050 506"><b>Short Shaft</b></div> <div data-bbox="1154 478 1364 646"><p>Min. 3/4" (20 mm)</p></div> <div data-bbox="716 630 1049 674"><p>3/8" to 3/4" Diameter (10 mm to 20 mm)<br/>3/8" to 1/2" Square (10 mm to 13 mm)</p></div>                                                                                       |
| <p>Move the damper to its normal position. Verify the controller action is set to match the damper application.</p> <p>Normally closed damper: when damper is closed, actuator position indicator should be at 0°. When damper is open, actuator position indicator should be at 90°.</p> <p>Normally opened damper: when damper is open, actuator position indicator should be at 0°. When damper is closed, actuator position indicator should be at 90°.</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <div data-bbox="178 955 341 1014"><b>A - Left</b></div> <div data-bbox="449 1001 565 1218"></div> <div data-bbox="596 980 735 1052"><p><b>Shaft Rotates<br/>Clockwise<br/>To Open</b></p></div>                                                                                                                                                                              | <div data-bbox="857 955 1019 1014"><b>A - Right</b></div> <div data-bbox="1117 1001 1232 1218"></div> <div data-bbox="1263 980 1446 1052"><p><b>Shaft Rotates<br/>Counterclockwise<br/>To Open</b></p></div> <div data-bbox="742 1127 1027 1199"><p>This step determines<br/>shaft rotation. Linkage<br/>may change damper direction.</p></div> |

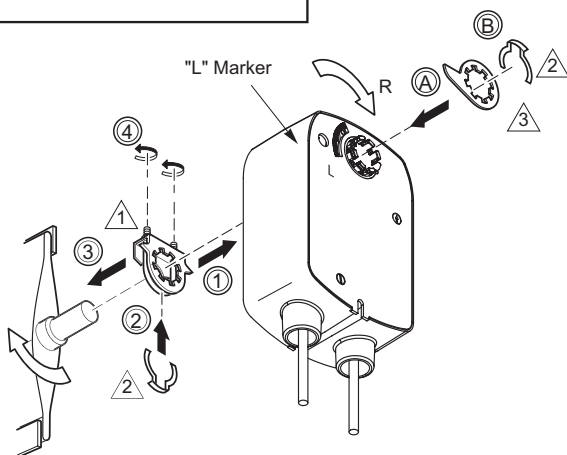
**B - Left - Long Shaft**

- 1 Universal mounting clamp.  
2 Retaining clip.

1. Assemble mounting clamp.
2. Assemble retaining clip.
3. Place actuator over shaft.
4. Hand tighten clamp nuts.

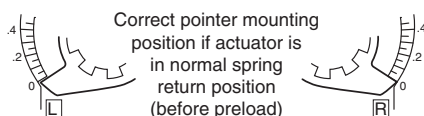
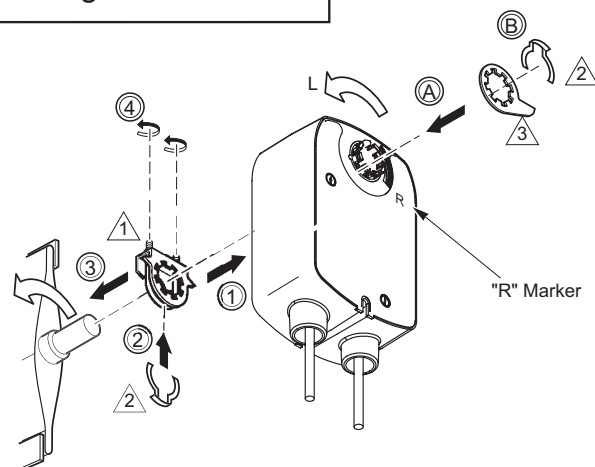
**B - Right - Long Shaft**

- 1 Universal mounting clamp.  
2 Retaining clip.

**B - Left - Short Shaft**

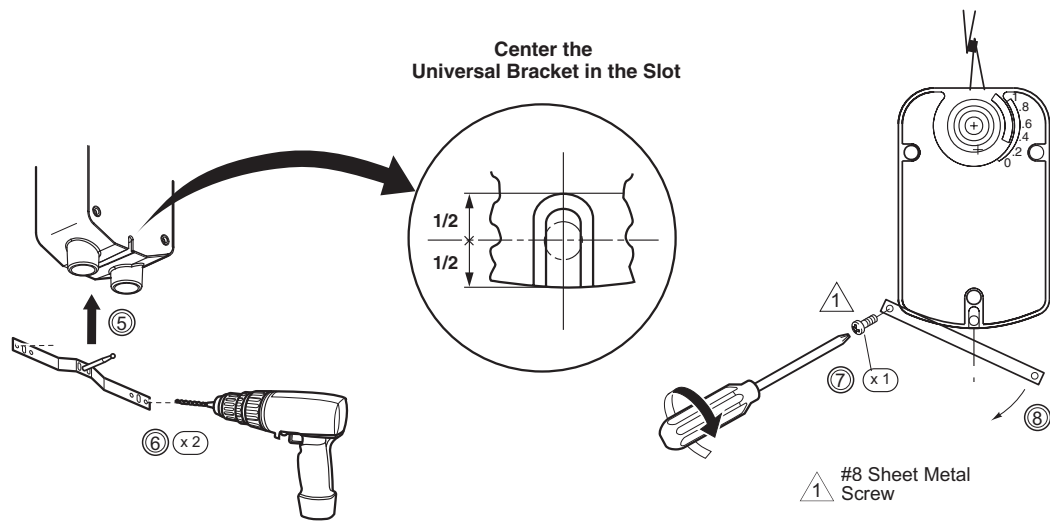
- 1 Universal clamp.  
2 Retaining clip.  
3 Damper position indicator.

- A. Assemble damper position indicator.  
B. Assemble retaining clip.
1. Position mounting clamp.
  2. Assemble retaining clip.
  3. Slide actuator over shaft.
  4. Hand tighten clamp nuts.

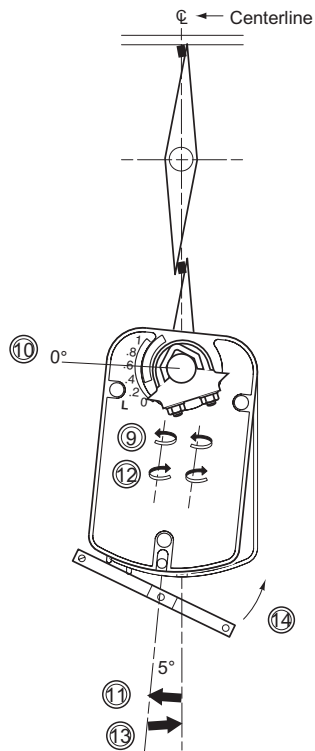
**B - Right - Short Shaft**

- 1 Universal clamp.  
2 Retaining clip.  
3 Damper position indicator.

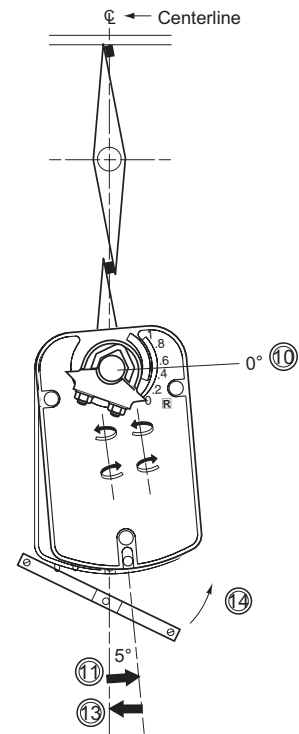
## C - Left and Right



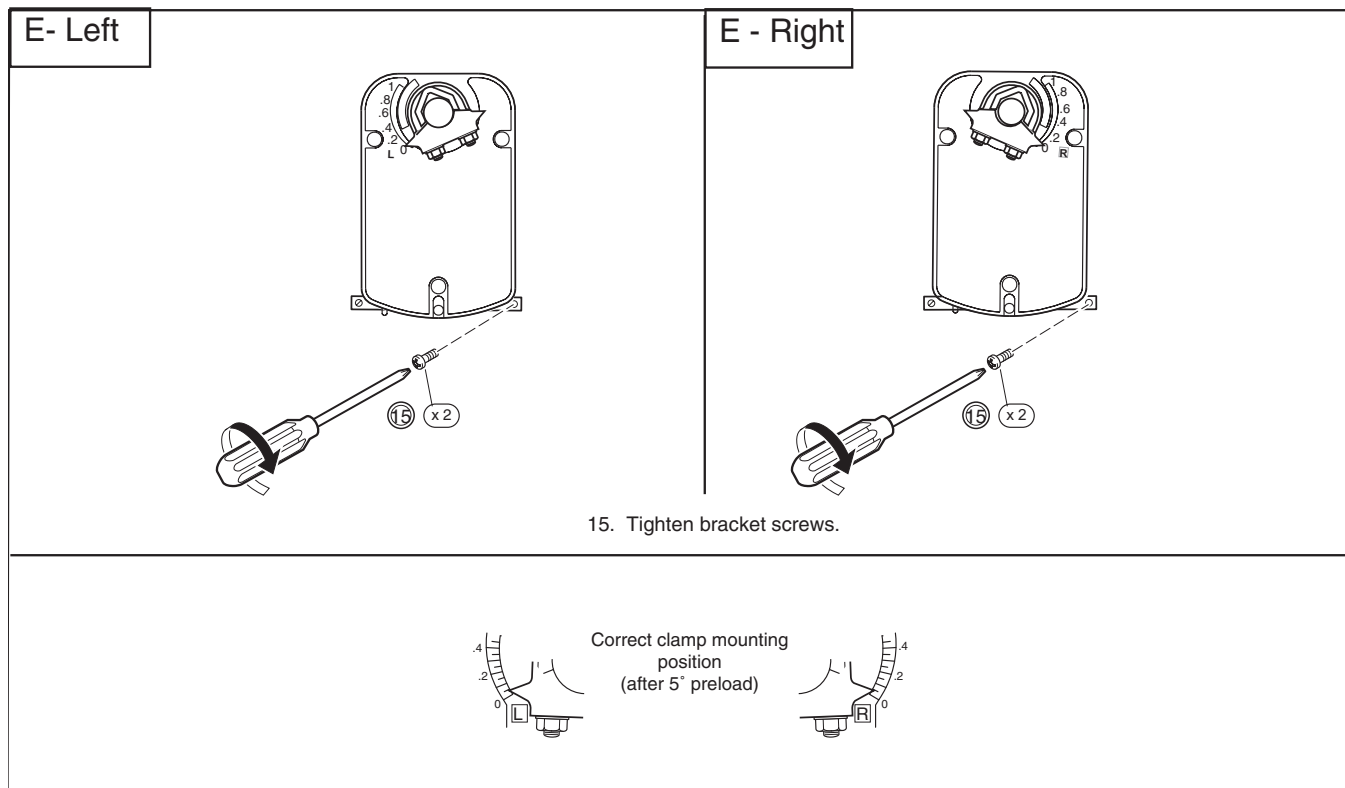
## D- Left



## D- Right



9. Loosen clamp nuts.
10. Check that the shaft is in full zero position.
11. Swing actuator 5° in the direction of travel. Do not move shaft.
12. Tighten clamp nuts to 4 to 6 lb-ft (5.4 to 8.2 N-m) of torque.
13. Move bottom of actuator back into position.
14. Pivot bracket back into position.



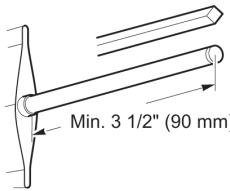
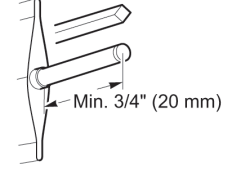
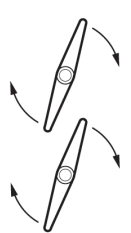
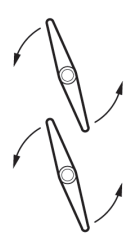
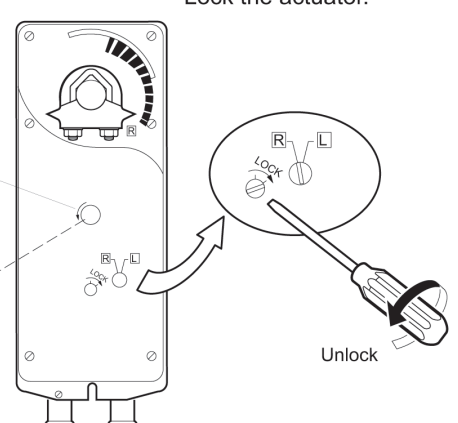
## MS4X-707X and MS4X-715X Series Installation

**Caution:** Do not drill additional holes in the actuator body. Six pre-drilled holes are located on each side, under the label, to accept #10-24 thread-forming screws for mounting accessories.

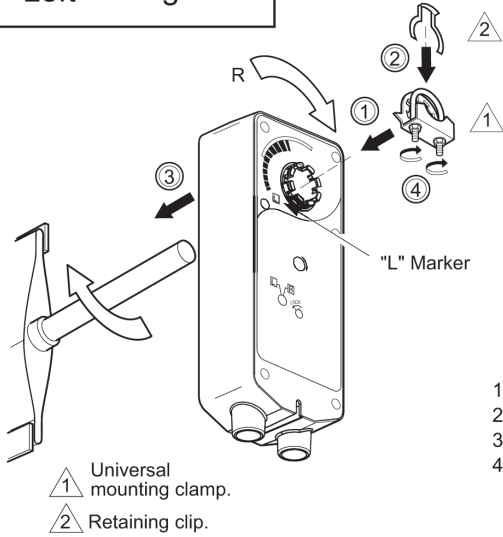
**Note:** The MS4X-707X and MS4X-715X series actuators come equipped with standard universal mounting clamp installed. For damper shafts larger than 3/4" (19 mm) in diameter, the AM-687 universal mounting clamp is required (order separately). The AM-687 clamp accommodates round shaft sizes up to 1.05" (27 mm) in diameter or 5/8" (16 mm) square shafts.

**Caution:** The MS41-707X and MS41-715X actuators are equipped with a manual override.

- The manual override to be used only when power is not applied to the unit.
- If the universal clamp is not set to 0° on the position indicator, manually wind the actuator in the direction indicated with hex wrench from -5°...0° and lock with a screwdriver.
- When operating manual override, back off 5° from full open mechanical stop to ensure proper release.
- Do not attempt to use the manual override with actuators mounted in tandem. Damage to the gear train could occur.
- Using power tools to adjust the manual override will cause damage to the gears.
- To unlock manual override without power, crank the manual override in the direction indicated a minimum of 5°.

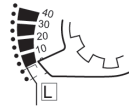
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                    |                                                                                                                                                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Long Shaft</b>                                                                                                                                                                                                                                                                                                                                                                                                                                              |  <p>Min. 3 1/2" (90 mm)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>Short Shaft</b> |  <p>Min. 3/4" (20 mm)</p>                                     |
| <p>3/8" to 3/4" Diameter (10 mm to 20 mm)<br/>3/8" to 1/2" Square (10 mm to 13 mm)</p>                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                    |                                                                                                                                                  |
| <p>Move the damper to its normal position. Verify the controller action is set to match the damper application.</p> <p>Normally closed damper: when damper is closed, actuator position indicator should be at 0°. When damper is open, actuator position indicator should be at 90°.</p> <p>Normally opened damper: when damper is open, actuator position indicator should be at 0°. When damper is closed actuator position indicator should be at 90°.</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                    |                                                                                                                                                  |
| <b>A - Left</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                |  <p><b>Shaft Rotates<br/>Clockwise<br/>To Open</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>A - Right</b>   |  <p><b>Shaft Rotates<br/>Counterclockwise<br/>To Open</b></p> |
| <p>This step determines shaft rotation. Linkage may change damper direction.</p>                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                    |                                                                                                                                                  |
| <b>B</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <p>For MS41-707X and MS41-715X only (manual override).</p> <p>If position indicator does not point to zero: Unlock the actuator.<br/>Insert hex wrench into manual override.<br/>Crank the actuator so the indicator points to 0°.<br/>Lock the actuator.</p> <div style="display: flex; align-items: center; justify-content: center;"> <div style="margin-right: 20px;"> <p>Manual Override</p>  </div> <div style="text-align: center;">  <p>Unlock</p> </div> </div> <p>Fully engage hex wrench into manual override before winding.</p> <p><b>Caution:</b> Do not crank the manual override if power is applied to the actuator.</p> |                    |                                                                                                                                                  |

### C - Left - Long Shaft

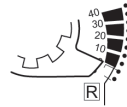


1. Assemble mounting clamp.
2. Assemble retaining clip.
3. Place actuator over shaft.
4. Hand tighten clamp nuts.

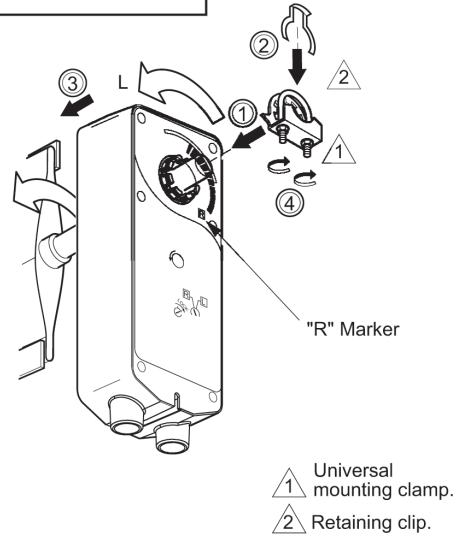
For MS41-707X and MS41-715X actuators:



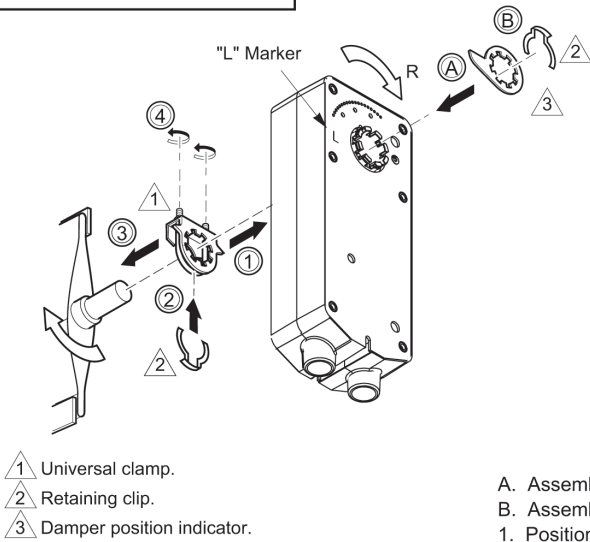
Correct pointer mounting position if actuator is locked at 5° preload.



### C - Right - Long Shaft

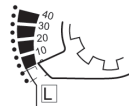


### C - Left - Short Shaft

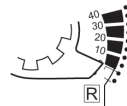


- A. Assemble damper position indicator.
- B. Assemble retaining clip.
1. Position mounting clamp.
2. Assemble retaining clip.
3. Slide actuator over shaft.
4. Hand tighten clamp nuts.

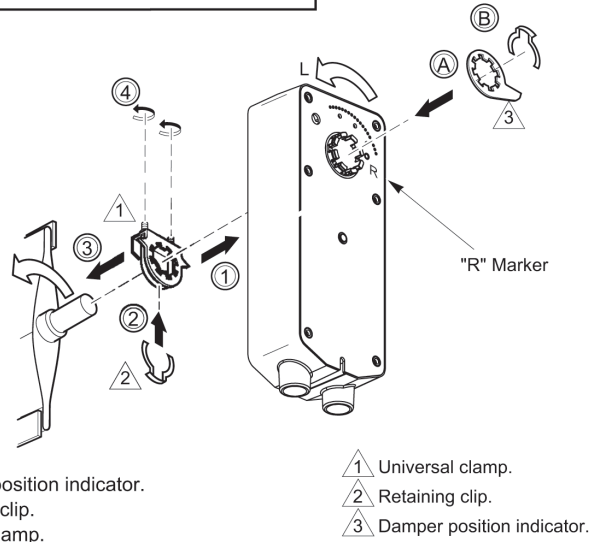
For MS41-707X and MS41-715X actuators:



Correct pointer mounting position if actuator is locked at 5° preload.

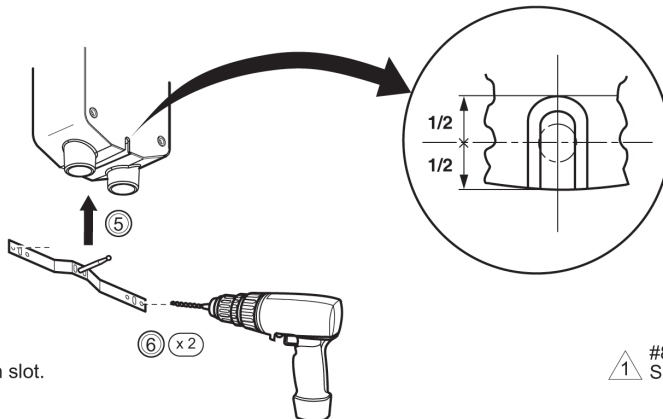


### C - Right - Short Shaft

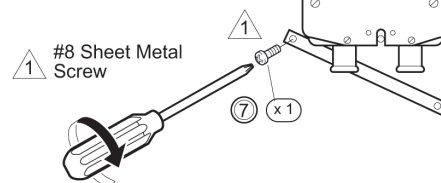


- 1 Universal clamp.
- 2 Retaining clip.
- 3 Damper position indicator.

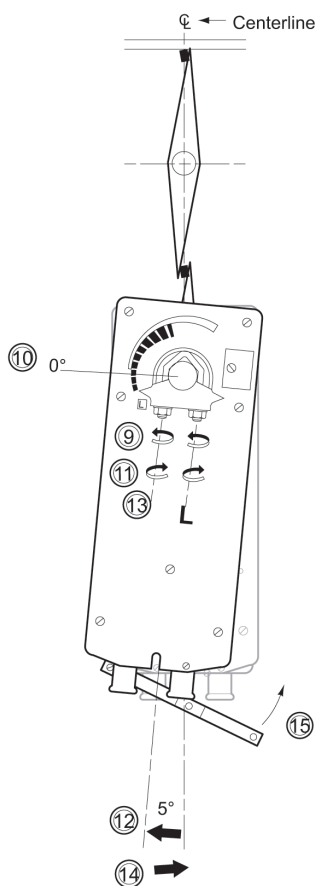
## D - Left and Right

Center the  
Universal Bracket in the Slot

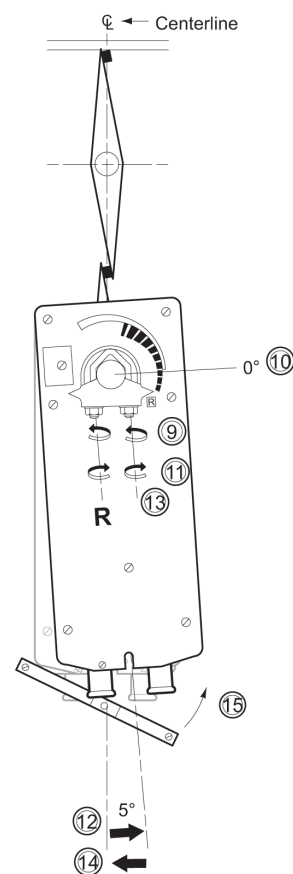
5. Center bracket in slot.
  6. Drill two holes.
  7. Start one screw.
- For MS41-707X and MS41-715X actuators, insert and tighten both screws.



## E- Left



## E- Right



8. Loosen clamp nuts.
9. Check that the shaft is in full zero position.

**For MS41-707X and MS41-715X only:**

10. Tighten clamp nuts to 8 - 10 ft-lb (11 - 14 Nm). This completes the installation for MA41-704X and MA41-715X.

## Jackshaft Installation

### (MS40-7043 Series)

The MS40-7043 actuator is designed for use with jackshafts up to 3/4" (19 mm) in diameter. In most applications, the MS40-7043 actuator may be mounted in the same manner as a standard damper shaft application. If the jackshaft diameter is larger than 5/8" (16 mm) in diameter, the optional AM-710 universal clamp must be used.

### (MS41-7153 and MS41-7073 Series)

The MS41-7153 and MS41-7073 actuators are designed for use with jackshafts up to 1.05" (27 mm) in diameter. In most applications, the actuator may be mounted in the same manner as a standard damper shaft application. If the jackshaft diameter is larger than 3/4" (19 mm) in diameter, the optional AM-687 universal clamp must be used.

### Multiple Actuator Mounting (MS41-7153 only)

If more torque is required than one actuator can provide, a second actuator may be mounted to the jackshaft or standard damper shaft, using the AM-673 multiple mounting bracket. See Figure-4.

---

**Caution:** MS41-707X, 715X - Do not attempt to use the manual override with actuators mounted in tandem. Damage to the gear train may occur.

---

Multiple actuators may be powered from one transformer provided the following rules are followed:

- The total current draw of the actuators (VA rating) is less than, or equal to, the rating of the transformer.
- Polarity on the secondary of the transformer is strictly followed.
  - All Black wires from all actuators are connected to the common lead on the transformer.
  - All Red wires from all actuators are connected to the hot lead.

---

**Caution:** Mixing the Black and Red wires on one lead of the transformer may result in erratic operation or failure of the actuator and/or controls.

---

Multiple actuators positioned by the same control signal may be powered from multiple transformers provided the following rules are followed:

- The transformers are properly sized.
- All Black wires from all actuators are tied together and tied to the negative lead of the control signal.

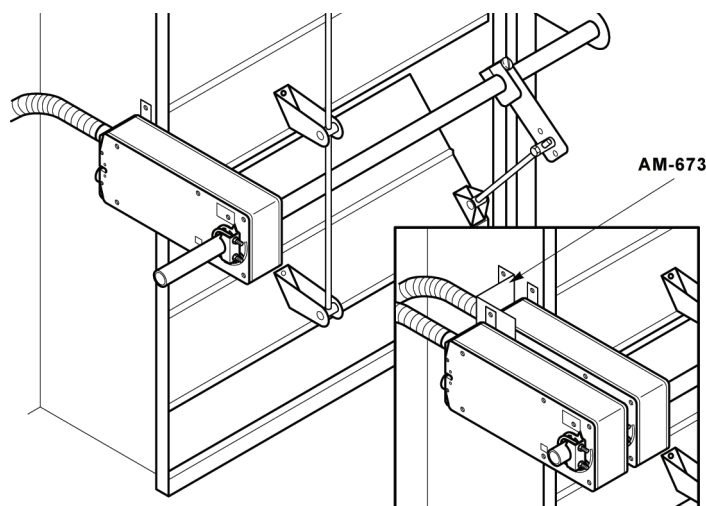


Figure-4 Mounting Multiple Actuators.

## Wiring Requirements

### Control Leads

See Table-3 for power wiring data. Refer to Figure-1 and Figure-2 for typical wiring.

**Table-3 Power Wiring.**

| Actuator Voltage    | Part Number         | Maximum Wire Run in ft. (m) |              |              |             |             |             |
|---------------------|---------------------|-----------------------------|--------------|--------------|-------------|-------------|-------------|
|                     |                     | 12 AWG                      | 14 AWG       | 16 AWG       | 18 AWG      | 20 AWG      | 22 AWG      |
| 24 Vac<br>22-30 Vdc | MS40-7043 (-MP)     | 1100<br>(335)               | 700<br>(213) | 430<br>(131) | 270<br>(82) | 170<br>(52) | 110<br>(34) |
|                     | MS40-7043-501 (MP5) |                             |              |              |             |             |             |
|                     | MS41-7073           | 1000<br>(305)               | 640<br>(195) | 400<br>(122) | 250<br>(76) | 160<br>(49) | 100<br>(30) |
|                     | MS41-7073-502       |                             |              |              |             |             |             |
|                     | MS41-7153           | 600<br>(183)                | 380<br>(116) | 240<br>(73)  | 150<br>(46) | 90<br>(27)  | 60<br>(18)  |
|                     | MS41-7153-502       |                             |              |              |             |             |             |

### Auxiliary Switch

MS40-7043-501(-MP5) SmartX Actuators include one built-in SPDT auxiliary switch which can be used for interfacing or signaling (e.g., for fan start-up). The switch is adjustable between 15° and 95° of rotation (MIN to 1 scale).

The MS41-7153-502 and MS41-7073-502 SmartX Actuators include two built-in SPDT auxiliary switches which can be used for interfacing or signaling (e.g., for fan start-up). The switch position near the normal (spring return) position is fixed at 5°. The other is adjustable between 25° and 85° of rotation.

#### Adjusting the Switching Point

Refer to Table-4 for auxiliary switch rating.

#### Adjusting the switching point for MS40-7043-501 (-MP5)

1. The actuator must be in its normal (spring return) position.
2. Use a flat screw driver to rotate the switch pointer until it is at the desired switch position on the MIN to 1 scale.

#### Adjusting the switching point for MS41-7153-502 or MS41-7073-502

1. The actuator must be in its normal (spring return) position.
2. Insert a 1/8" allen wrench into the hex hole located in the center of the adjustable switch pointer.
3. Rotate the wrench until the switch pointer is at the desired switch position in degrees, from 25...85°.

**Table-4 Auxiliary Switch Rating.**

| Part Number         | Voltage | Resistive Load | Inductive Load |
|---------------------|---------|----------------|----------------|
| MS40-7043-501 (MP5) | 24 Vac  | 6A             | 1.5A           |
| MS41-7073-502       | 250 Vac | 7A             | 2.5A           |
| MS41-7153-502       |         |                |                |

## Rotation Limitation

### Rotation Limitation for MS40-7043 Series SmartX Actuators

The Stop Block is used in conjunction with the tab on the universal clamp or the AM-709 position indicator. In order to function properly, the clamp or indicator must be mounted correctly.

The Stop Block controls the rotational output of the MS40-7043 and MS41-7043-501 actuators. It is used in applications where a damper has a designed rotation that is less than 90°, for example with a 45° or 60° rotating damper. It can also be used to provide a minimum damper position which is easily set, or changed, without removing the actuator from the damper.

1. Determine the amount of damper rotation required. The actuator stop block provides limited rotation from 40° ... 95°.
2. Loosen the screw securing the stop block to the actuator.

---

**Note:** The actuator is shipped with the Stop Block mounted to the “L” side. If the damper application requires the “R” side face the installer, simply remove the Stop Block and screw and move it to the new location.

---

3. Slide the stop block into position, so that its edge lines up with the degree graduation on the actuator face which corresponds with the required rotation. See Figure-5.
4. Secure the stop block in place.
5. Test the damper rotation by applying power and the required control signal. Re-adjust if necessary.

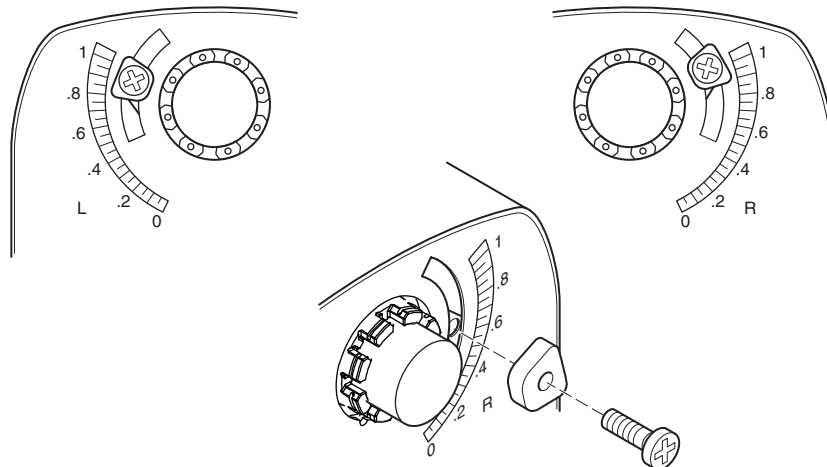


Figure-5 Adjusting Stop Block for Limited Rotation.

### Rotation Limitation for MS41-7153 and MS41-7073 SmartX Actuators

The AM-689 rotation limiter is used in conjunction with the tab on the universal clamp or the AM-686 position indicator which comes with the AM-689. In order to function properly, the clamp or indicator must be mounted correctly.

The AM-689 rotation limiter controls the rotational output of the MS41-7153, MS41-7153-502, MS41-7073, and MS41-7073-502 actuators. It is used in applications where a damper has a designed rotation that is less than 90°, for example with a 45° or 60° rotating damper. It can also be used to provide a minimum damper position which is easily set, or changed, without removing the actuator from the damper.

1. Determine the amount of damper rotation required.
2. Locate the AM-689 rotation limiter on the actuator so that its edge lines up with the degree graduation on the actuator face which corresponds with the required rotation. See Figure-6.
3. Find the appropriate cross-hair location through the slot of the rotation limiter. This is the mounting location for the retaining screw.
4. Pierce through the label material to allow easy fastening of the retaining screw.
5. Position the rotation limiter back to the desired position, making sure the locating “teeth” on the rotation limiter are engaged into the locating holes on the actuator.
6. Fasten the rotation limiter to the actuator using the self-tapping screw provided.
7. Test the damper rotation by applying power and the required control signal. Re-adjust if necessary.

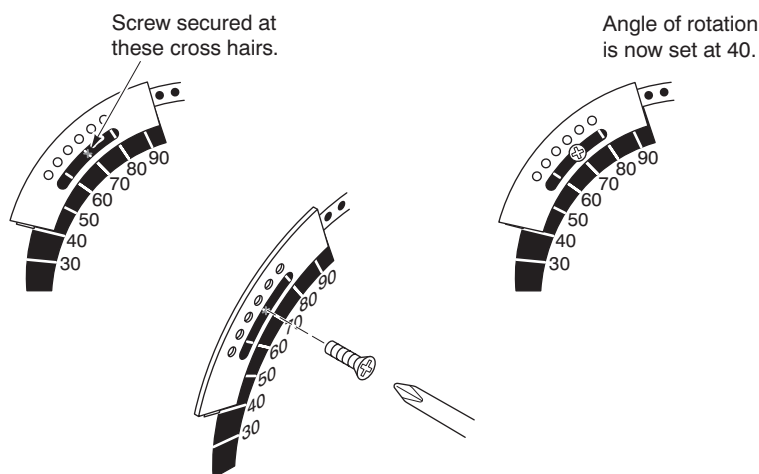


Figure-6 Securing the AM-689 Rotation Limiter.

## Minimum Damper Positioning

**Note:** When using the AM-689 rotation limiter with an MS41-7073 or MS41-7153 actuator to provide a minimum damper position, the short shaft mounting procedure must be used to mount the actuator.

### Caution:

- The AM-689 rotation limiter should not be used with an MS41-7073 or MS41-7153 actuator to provide a minimum damper position in outdoor air damper applications. The rotation limiter prevents the damper from reaching the full-closed position. This may cause coils to freeze or may cause other system problems to occur.

1. Position the damper to its minimum position by providing the appropriate control signal to the MS41-7073 or MS41-7153.
2. Place the position indicator onto the actuator spline in the approximate position shown in Figure-7. Fasten it with the retaining clip.
3. Place the AM-689 rotation limiter on the actuator so that it either makes contact with, or is as close as possible to, the edge of the indicator. See Figure-8.
4. Make sure that the locating teeth are engaged into the locating holes on the actuator. If all of the mounting teeth do not align with the holes, the mounting location of the indicator to the spline may have to be moved. The rotation limiter would then be remounted to get the best position match of both parts.
5. Find the cross-hair location through the slot of the rotation limiter. This is the mounting location for the retaining screw.
6. Pierce through the label material to allow easy fastening of the retaining screw.
7. Fasten the rotation limiter to the actuator using the self tapping screw provided.
8. Test the damper operation by applying power and the required control signal. Re-adjust if necessary.

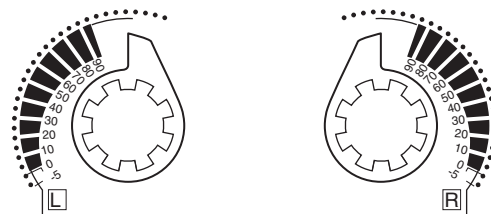


Figure-7 Installing the Position Indicator.

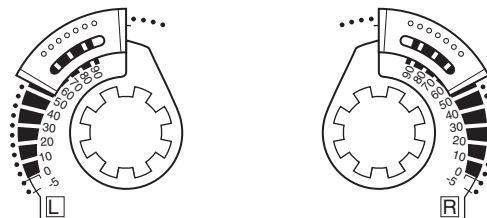


Figure-8 Positioning the Rotation Limiter.

## CHECKOUT

After the entire system has been installed and the actuator has been powered up, the following check can be made for proper system operation. Check for correct operation of the damper while actuator is being stroked.

1. Apply power to the actuator. Actuator and damper should be driven to their powered position as determined by the control signal.
2. On the MS4X-7XXX-50X models, check for correct auxiliary switch operation.
3. Break power to the actuator. Actuator and damper should return to the spring return position.

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**Note:** Check that the transformer(s) are sized properly.

- If a common transformer is used with multiple actuators, make sure that polarity is observed on the secondary. This means connecting all Black wires to one leg of the transformer and all Red wires to the other leg of the transformer.
  - If multiple transformers are used with one control signal, make sure all Black wires are tied together and tied to control signal negative (-).
  - Controllers and actuators must have separate 24 Vac power sources.
- 

## Go, No Go Test

1. Turn 24 Vac power to actuator off.
2. Disconnect and temporarily insulate the yellow/black input wire.
3. With "L" side of the actuator facing the installer, set the L/R switch to "R."
4. Turn actuator power back on.
5. Switch the L/R switch to the "L" position.
6. The actuator should drive to the full counterclockwise position.

## THEORY OF OPERATION

The actuators are mounted directly onto a damper shaft using a universal V-clamp. When the actuator is powered and a Vdc or mAdc control signal is applied to the actuator by the controller, the actuator rotates to a position determined by the control signal. At the same time the spring return mechanism is tensed. When power is removed from the actuator, the spring returns the actuator to its normal position. The actuators provide true mechanical spring return operation for reliable, positive close-off on air tight dampers.

The MS40-704X-501 models are provided with one built-in auxiliary switch. The SPDT switch is provided for interfacing or signaling, for example, fan startup. The switching function is adjustable between 15° and 95° rotation (MIN to 1 scale).

All MX4X-7XX3-XXX series actuators use a brushless DC motor which is controlled by a microprocessor. The microprocessor supplies intelligence to provide a constant rotation rate and to know the actuator's exact normal position. The microprocessor monitors and controls the brushless DC motor's rotation and provides a digital sensing function to prevent damage to the actuator in a stall condition. The actuator may be stalled anywhere in its normal rotation without the need for mechanical end switches.

The MS41-707X-502 and MS41-715X-502 models are provided with two built-in auxiliary switches. The SPDT switches are provided for interfacing or signaling, for example, fan startup. The switching function is adjustable on one switch between 25° and 95° rotation, and the other switch is fixed to operation at 5° rotation.

All MS41-7XX3 and MS41-7XX3-5XX actuators provide a 2 to 10 Vdc feedback signal corresponding to the actuator position as determined by the control signal. MS40-7043-MP and MS40-7043-MP5 models provide a 20 Vdc, 25 mA power supply used to power TAC System 8000 controllers in lieu of position feedback.

The MS41-707X-XXX and MS41-715X-XXX actuators are equipped with a manual override mechanism. This allows the actuator to be manually positioned at any point between -5° and 85° rotation. This mechanism is accessible on both sides of the actuator and can be used to ensure tight close-offs for valves and dampers. The manual override should not be used while a unit is powered or on units that are mounted in tandem.

MAINTENANCE

Regular maintenance of the total system is recommended to assure sustained optimum performance. The MS4X series actuators are maintenance free.

FIELD REPAIR

None. Replace with a functional actuator.

DIMENSIONAL DATA

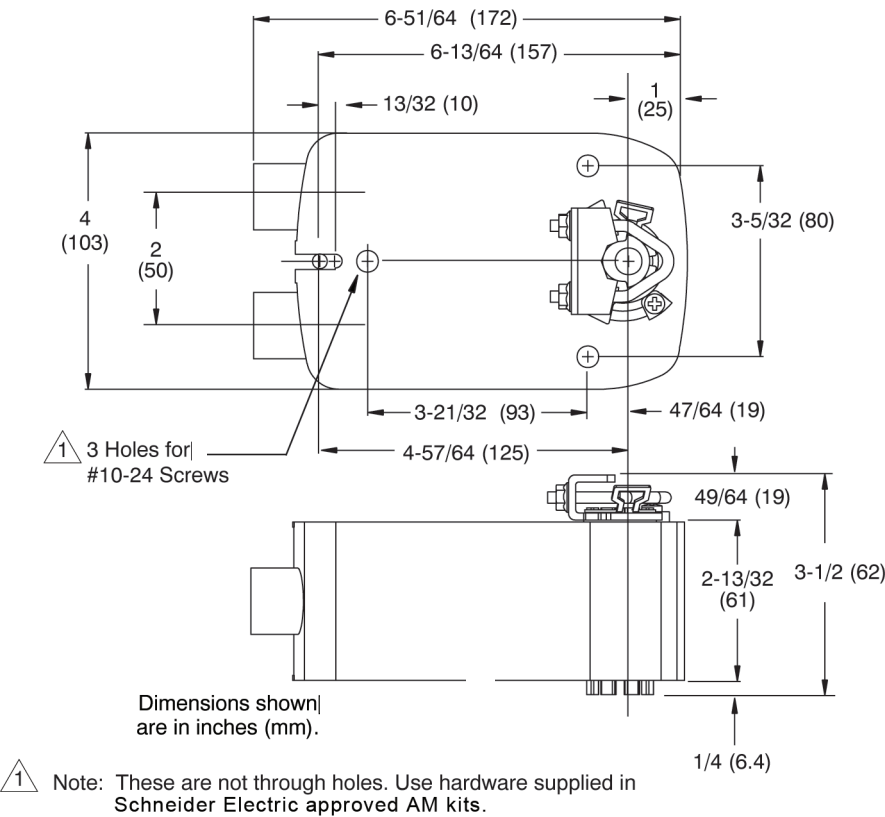


Figure-9 MS40-7043 Spring Return Damper Actuator Dimensions.

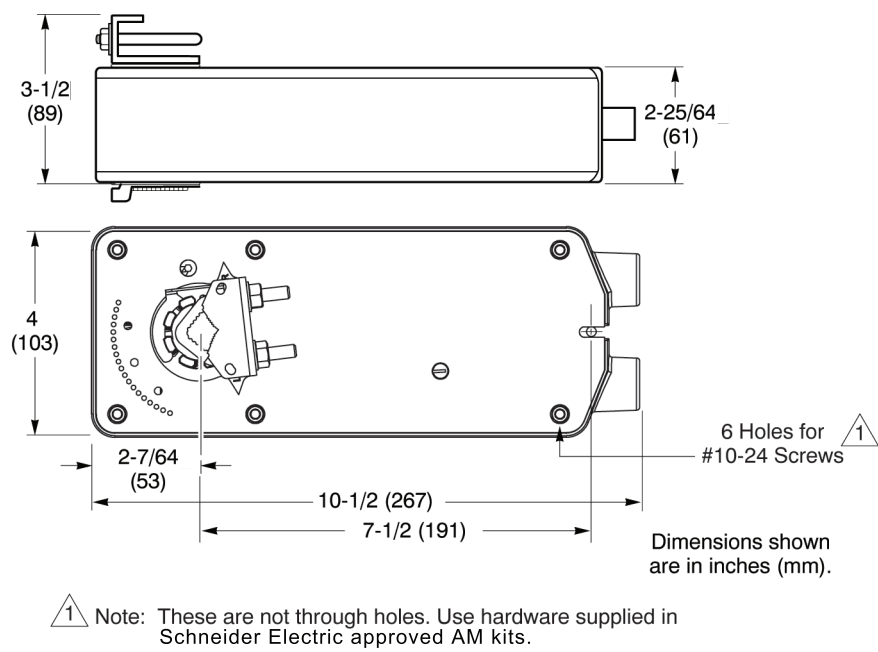


Figure-10 MS41-7073 and MS41-7153 Spring Return Damper Actuator Dimensions.