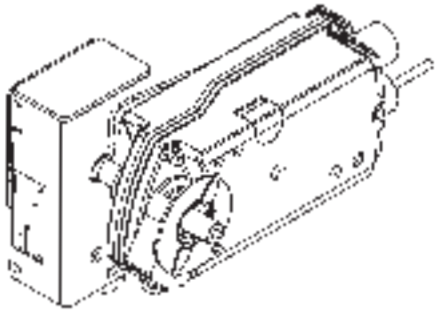
Invensys Building Systems
1354 Clifford Avenue (Zip 61111)
P.O. Box 2940
Loves Park, IL 61132-2940
United States of America

MX4X-6XXX-20X Series
MX4X-7XXX-20X Series

Actuator/Linkage Assemblies for Globe Valves General Instructions

Application

The actuator/linkage assemblies are mounted onto globe valves to control the flow of hot water, chilled water, and steam. These assemblies are used with 1/2" through 2" (15 mm to 50 mm) VB-7000 series two- and three-way globe valve bodies. These assemblies may also be used with obsolete 1/2" to 1-1/4" (15 mm to 32 mm) VB-9XXX.

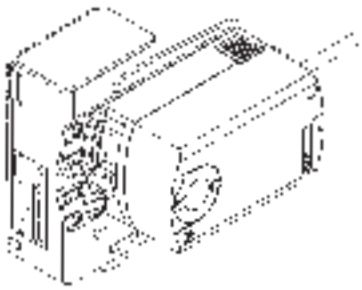


MX41-6152-20X

MX40-704X-20X

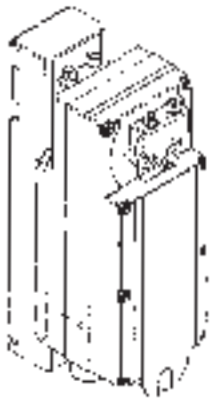
Features

- Used with 2-way and 3-way globe valves in modulating or two-position service
- Provides spring return and non-spring return actuator control
- Flexible actuator mounting orientation
- Maintenance-free construction
- Quick and simple installation
- Heavy-duty steel rack and pinion construction and sheet metal housing
- NEMA 1, Type 2 (IP 54) and NEMA Type 4 (IP 56) ratings available



MX41-6042-20X
MX41-6082-20X

MX4X-705X-20X
MX4X-715X-20X



MX40-717X-20X

Applicable Literature

F-Number	Description	Audience	Purpose
F-26642	MA40-704X, MA4X-707X, MA4X-715X DuraDrive Series Spring Return Two-Position Actuators General Instructions	– Sales Personnel – Application Engineers – Installers – Service Personnel – Start-up Technicians	Describes the actuator's features, specifications, and possible applications. Provides step-by-step mounting instructions.
F-26742	MA40-717X Dura Drive Series Actuators Spring Return Direct Coupled Actuator General Instructions		
F-26644	MF4X-7XX3 DuraDrive Series Spring Return Floating Actuator General Instructions		
F-26645	MS4X-7XX3 DuraDrive Series Spring Return Proportional Actuator General Instructions		
F-26748	MS40-717X DuraDrive Series Spring Return Direct Coupled Actuator General Instructions		
F-26749	MF40-7173 DuraDrive Series Spring Return Direct Coupled Actuator General Instructions		
F-27213	MF41-6043/MF41-6083 Series Non-Spring Return Rotary 24 Vac Three-Position Control Electronic Damper Actuators General Instructions		
F-27214	MS41-6043/MS41-6083 Series Non-Spring Return Rotary 24 Vac Modulating Control 0 to 10 Vdc Electronic Damper Actuators General Instructions		
F-27215	MF41-6153/MS41-6153 Series Non-spring return Rotary Electronic Damper Actuators General Instructions		
F-26646	MX4X-7XXX, MX40-6XXX Series DuraDrive Actuator Selection Guide	– Sales Personnel – Application Engineers – Installers – Service Personnel – Start-up Technicians	Provides actuator specifications and part number cross referencing of phased out actuators with the new Invensys Building Systems direct-coupled actuators.
F-27087	VX-2X13-5XX-9-XX and VB-2X13-500-9-XX Series DuraLynx Ball Valve Assemblies Ball Valve Body/Linkage Assemblies Installation Instructions	– Sales Personnel – Application Engineers – Installers – Service Personnel – Start-up Technicians	Describes the ball valve actuator/linkage assembly's features, specifications, and possible applications. Provides step-by-step mounting instructions.
F-26752	VX-7000 and VX-9000 Series MX4X-6XXX and MX4X-7XXX Series Linked Globe Valve Assemblies Actuator/Linkage Assemblies Selection Guide	– Sales Personnel – Application Engineers – Installers – Service Personnel – Start-up Technicians	Provides part number cross referencing of phased out globe and ball valve assemblies with the new Invensys Building Systems direct-coupled actuators.
F-26080	EN-205 Water System Guidelines	– Application Engineers – Installers – Service Personnel – Start-up Technicians	Provides treatment guidelines for water and steam systems.
F-13755	CA-28 Control Valve Sizing		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)		

F-Number	Description	Audience	Purpose
F-24380	VB-7211 Series 1/2" to 1-1/4" Union Straightway NPT Stem Up Open, Two-Way Valves General Instructions	– Sales Personnel – Application Engineers – Installers – Service Personnel – Start-up Technicians	Describes the valve's features, specifications, and possible applications. Provides step-by-step mounting, installation, and checkout instructions.
F-24384	VB-7221 Series 1/2" to 1-1/4" Union Straightway NPT Stem Up Closed, Two-Way Valves General Instructions		
F-26073	VB-7223 Series 1/2" to 2" Screwed NPT Stem Up Closed, Two-Way Valves General Instructions		
F-26074	VB-7313 Series 1/2" to 2" Screwed NPT Three-Way Mixing Valves General Instructions		
F-26075	VB-7213 Series 1/2" to 2" Screwed NPT Stem Up Open, Two-Way Valves General Instructions		
F-26076	VB-7323 Series 1/2" to 2" Screwed NPT Three-Way Diverting Valves General Instructions		
F-26077	VB-7215 Series 15 mm to 50 mm Screwed Rp Stem Up Open, Two-Way Valves General Instructions		
F-26078	VB-7315 Series 15 mm to 50 mm Screwed Rp Three-Way Mixing Valves General Instructions		
F-26079	VB-7225 Series 15 mm to 50 mm Screwed Rp Stem Up Closed, Two-Way Valves General Instructions		

SPECIFICATIONS

Table-1 Model Chart — Spring-Return Actuators.

Part Numbers	Power Input								SPDT Auxiliary Switches	Approximate Timing in Seconds @ 70 °F (21 °C) with No Load		Manual Override
	Voltage	Running				DC Amps	Holding					
		60 Hz		50 Hz			60 Hz	50 Hz				
		VA	Watts	VA	Watts		Watts	Watts		Powered	Spring Return	
Spring Return Actuators												
MA40-7043-200	24 Vac ± 20% 22-30 Vdc	4.4	2.9	4.4	2.9	0.11	0.8	0.8	No	<50	<26	No
MA40-7043-201									One[a]			No
MA40-7040-200	120 Vac ± 10%	4.3	3.4	6.4	3.8	—	1.2	1.6	No	<50	<26	No
MA40-7040-201									One[b]			No
MA40-7041-200	230 Vac ± 10%	4.6	3.9	5.8	4.1	—	1.2	1.5	No	<50	<26	No
MA40-7041-201									One[b]			No
MF40-7043-200	24 Vac ± 20% 22-30 Vdc	5.9	4.4	5.9	4.4	0.17	2.9	2.9	No[b]			No
MF40-7043-201									One[bc]			No
MS40-7043-200	24 Vac ± 20% 22-30 Vdc	5.6	4.2	5.6	4.2	0.15	2.4	2.4	No[c]	<130	<25	No
MS40-7043-201									One[bc]			No
MS40-7043-202	24 Vac ± 20% 22-30 Vdc	6.6	5.0	6.6	5.0		3.2	3.2	No[b]			No
MS40-7043-203									One[b]			No
MA41-7073-200[d]	24 Vac ± 20% 22-30 Vdc	4.8	3.2	4.8	3.2	0.13	0.8	0.8	No			Yes
MA41-7073-202[d]									Two[c]			Yes
MA41-7070-200[d]	120 Vac ± 10%	5.6	3.6	10.7	4.2	—	1.2	2.0	No	<80	<40	Yes
MA41-7070-202[d]									Two[c]			Yes
MA41-7071-200[d]	230 Vac ± 10%	8.0	4.0	17.0	5.1	—	1.4	2.7	No			Yes
MA41-7071-202[d]									Two[c]			Yes
MF41-7073-200[d]	24 Vac ± 20% 22-30 Vdc	6.2	4.8	6.2	4.8	0.18	2.8	2.8	No	<195	<30	Yes
MF41-7073-202[d]									Two[c]			Yes
MS41-7073-200[d]	24 Vac ± 20% 22-30 Vdc	5.8	4.6	5.8	4.6	0.17	2.3	2.3	No	<195	<30	Yes
MS41-7073-202[d]									Two[c]			Yes
MA41-7153-200[d]	24 Vac ± 20% 22-30 Vdc	9.7	7.5	9.8	7.5	0.29	2.8	2.8	No			Yes
MA41-7153-202[d]									Two[c]			Yes
MA41-7150-200[d]	120 Vac ± 10%	10.0	8.4	11.7	8.8	—	5.0	3.6	No			Yes
MA41-7150-202[d]									Two[c]			Yes
MA41-7151-200[d]	230 Vac ± 10%	10.6	8.5	15.5	9.5	—	3.3	4.6	No	<190	<30	Yes
MA41-7151-202[d]									Two[c]			Yes
MF41-7153-200[d]	24 Vac ± 20% 22-30 Vdc	9.7	7.7	9.8	7.7	0.30	3.3	3.3	No			Yes
MF41-7153-202[d]									Two[c]			Yes
MS41-7153-200[d]	24 Vac ± 20% 22-30 Vdc	9.7	7.4	9.8	7.4	0.28	2.9	2.9	No			Yes
MS41-7153-202[d]									Two[c]			Yes

Part Numbers	Power Input			SPDT Auxiliary Switches	Approximate Timing in Seconds @ 70 °F (21 °C) with No Load		Manual Override
	Voltage 50/60 Hz	Watts	VA				
			Running / Holding		Powered	Spring Return	
MA40-7173-200	24 Vac ± 20%	5.4	9.6 / 4.1	No	<145	<75	No
MA40-7170-200[e]	120 Vac ± 20%	7.2	11.4 / 9.4	No			No
MA40-7171-200	240 Vac ± 10%	7.4	11.8 / 9.5	No			No
MF40-7173-200	24 Vac ± 20%	5.5	10.0 / 4.3	No			No
MS40-7173-200	24 Vac ± 20%	7.1	9.4 / 5.4	No			No
MS40-7170-200[a]	120 Vac ± 20%	7.1	11.1 / 9.1	No			No
MS40-7171-200	240 Vac ± 10%	7.2	11.8 / 10.1	No			No

[a] Adjustable from 0 to 95° rotation (0 to 1 scale).
[b] With plenum cable.
[c] One adjustable from 25° to 85° rotation and one set to operate @ 5° fixed.
[d] For models without a manual override, subsititute 40 for 41 in the part number, For example, MA41-7073-200 becomes MA40-7073-200.
[e] The CE directive is not applicable to this model.

Table-2 Model Chart — Non-Spring Return Actuators.

Part Numbers	Power Input				SPDT Auxiliary Switches	Approximate Timing in Seconds @ 70 °F (21 °C) with No Load	Manual Override
	Voltage 50/60 Hz	Watts	VA				
			Running	Holding			
MF41-6043-200[a]	24 Vac +20%, -15%	2.0	2.3	—	No	90 sec. @ 60 Hz 108 sec. @ 50 Hz	Yes
MS41-6043-200[a]	24 Vac +20%, -15%	3.0	3.3	1.2	No		
MF41-6083-200[b]	24 Vac +20%, -15%	2.0	2.3	—	No	125 sec. @ 60 Hz 150 sec. @ 50 Hz	Yes
MS41-6083-200[b]	24 Vac +20%, -15%	3.0	3.3	1.2	No		
MF41-6153-200[c]	24 Vac +20%, -15%	3.0	3.0	—	No		
MS41-6153-200[d]	24 Vac +20%, -15%	4.0	5.0	1.2	No		

[a] With plenum cable.
[b] Minimum voltage at 90 to 130 °F (30 to 50 °C) 24 Vac +20%, -10%.
[c] Minimum voltage at 85 to 130 °F (29 to 50 °C) 24 Vac +20%, -5%.
[d] Minimum voltage at 85 to 130 °F (29 to 50 °C) 24 Vac +20%, -10%.

Table-3 Actuator/Linkage Compatibility Table

Actuator	Linkage (for VB-7XXX)	Actuator/Linkage Assembly
MX41-6043	AV-603	MX41-6043-200
MX41-6083		MX41-6083-200
MX41-6153	AV-605	MX41-6153-200
MX40-704X		MX40-704X-200
MX40-704X-502		MX40-704X-201
MX40-707X	AV-602	—
MX41-707X		MX41-707X-200
MX40-707X-502		—
MX41-707X-502		MX41-707X-202
MX40-715X-200		—
MX41-715X-200		MX41-715X-200
MX40-715X-202		—
MX41-715X-202		MX41-715X-202
MX40-717X-200		MX40-717X-200

Table-4 Assembly Compatibility Chart.

Actuator Models		Non-Spring Return Series			Spring Return Series			
Floating		MF41-6043	MF41-6083	MF41-6153	MF40-704X[a]	MF4X-707X	MF4X-715X	MF40-717X
Proportional		MS41-6043	MS41-6083	MS41-6153	MS40-704X[a]	MS4X-707X	MS4X-715X	MS40-717X
Two-Position		–	MA41-6083	MA41-6153	MA40-704X[a]	MA4X-707X	MA4X-715X	MA40-717X
Actuator Torque Rating (Min.)		35 in-lb (4 N-m)	70 in-lb (8 N-m)	133 in-lb (15 N-m)	35 in-lb (4 N-m)	60 in-lb (7 N-m)	133 in-lb (15 N-m)	150 in-lb (17 N-m)
2-Way	Size	Close-off Pressure (psi) [b c d]						
VX-7211 VX-7213 VX-7215[e] VX-7221 VX-7223 VX-7225[e]	1/2"	225	—	—	250	—	—	—
	3/4"	225			250			
	1"	100	130		125	180		
	1-1/4"	60	100	—	75	120	200	
	1-1/2"	40	70	140	50	100	140	160
	2"	20	40	80	25	40	80	120
3-Way Mixing	Size							
VX-7313 VX-7315[e]	1/2"	225	—	—	250	—	—	—
	3/4"	225			250			
	1"	100	180		125	180		
	1-1/4"	60	100		75	120		
	1-1/2"	40	80	140	50	80	140	160
	2"	20	40	80	25	40	80	120
3-Way Diverting	Size							
VX-7323	1/2"	250	—	—	250	—	—	—
	3/4"	250			250			
	1"	250			250			
	1-1/4"	250			250			
	1-1/2"	250			250			
	2"	250			250			

[a] Only the 35 lb-in actuators are applicable for retrofit on VB-9000 and older valves 1/2" through 1-1/4" (32 mm). Actuators are compatible with any valve which can accept an AV-400 or AV-600 linkage.

[b] Close-off ANSI IV (.01%) for soft seats and ANSI III for metal-to-metal seats with pressure at inlet (port A). For seat leakage ratings see “Applicable Literature” section for the list of literature on specific valve bodies.

[c] Close-off pressure ratings describe only the differential pressure which the actuator can close-off with adequate seating force. Consult valve body specifications for other limitations.

[d] On 2-way valves the rating value is the pressure difference between the inlet and outlet ports. On 3-way valves the rating applies to the pressure difference between the inlet ports.

[e] Metric thread 15 mm to 50 mm (Rp 1/2 to Rp 2).

Table-5 Final Assembly Configuration Chart.

Valve Assemblies	Valve Body Action	Assembly Start Position		Action
		Valve Stem	Flow	
VX-721X	2-Way Stem Up Open	Up	Open	A to AB Flow decreases as actuator rotates CW
VX-722X	2-Way Stem Up Closed	Up	Closed	A to AB Flow increases as actuator rotates CW
VX-731X	3-Way Mixing	Up	Flow B to AB	A to AB Flow increases as actuator rotates CW B to AB Flow decreases as actuator rotates CW
VX-732X	3-Way Diverting	Up	Flow B to AB	B to A Flow increases as actuator rotates CW B to AB Flow decreases as actuator rotates CW

Note: Actuator/Linkage assemblies are shipped from the factory, set for clockwise rotation with the rack in the up position at 0 Vdc.

ACCESSORIES

DYRF-588	"K" locknut for anti-rotation stud.
AM-756	Metric conduit adaptor M20 x 1.5 to 1/2" NPT (two per package).
NYBA-140	Open/Closed label.
YBA-519-1	Jam nut.
NYBA-206	Anti-rotation stud for MX41-6153 actuators.
NYBA-161	Anti-rotation stud for MX4X-704X, 707X, 715X actuators
NYBA-173	Anti-rotation stud for MX40-6043 Series actuators
NYBA-181	Anti-rotation stud for MX40-717X actuators.

INSTALLATION

Inspection

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 any damaged products.

Required

- Tools (not provided):
  - Appropriate wrenches for stem extensions, packing nuts, and bracket nuts
  - 3 mm hex wrench (for setscrew on MX41-6043, MX41-6083)
  - 10 mm socket wrench (for shaft clamp nuts on MX41-6153, MX4X-707X, MX4X-715X, MX40-717X)
  - Torque wrench, range to include 55 to 216 lb-in. (see Figure-11 through Figure-16 for actual torque requirements of fasteners for individual actuator models)
  - Pipe wrenches, two
  - TOOL-37, 1-5/8 inch open-end wrench for valve mounting nut
  - 5/16" open-end wrench (or TOOL-20-1) for jam nuts
  - Vise grip or pliers
  - Appropriate power supply (see Table-1 on page 4 or Table-2 on page 5 for actuator power requirements)
- Installer must be a qualified, experienced technician

Warning:

- Disconnect power (line power) at the breaker or fuse before installation to prevent electrical 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 locations where excessive moisture, corrosive fumes, or vibration is present.
- Install all two-way valves so that they close against the flow. An arrow on the valve body or a tag indicates the proper flow direction.
- Always install three-way mixing valves with two inlets and one outlet.
- Install three-way diverting valves with one inlet and two outlets. When piped for mixing, C_Vs may differ slightly.
- Install valves with the valve stem 5° or more above the horizontal. For steam applications, mount the actuator above the valve body at 45° from vertical. See Figure-18 on page 21.

TYPICAL APPLICATION (wiring diagrams)

Figure-1 through Figure-9 illustrate typical wiring diagrams for actuators. See Table-1 and Table-2 for model selection. Consult the actuator's General Instructions for detailed, actuator-specific wiring diagrams. See "Applicable Literature" on page 2.

Note:

MX40-707X-502 and MX40-715X-502 Prior to Date Code 0141 (2001, 41st Week)

Auxiliary Switch Color Codes

Different color coding was used for the auxiliary switches in these actuators, as follows:

Auxiliary Switch 1 (Prior to 0141)

Orange: Fixed auxiliary switch common (com)

Yellow: Fixed auxiliary switch normally closed (N.C.)

Violet: Fixed auxiliary switch normally open (N.O.)

Auxiliary Switch 2 (Prior to 0141)

Orange/white: Adjustable auxiliary switch common (com)

Violet/white: Adjustable auxiliary switch normally closed (N.C.)

Yellow/white: Adjustable auxiliary switch normally open (N.O.)

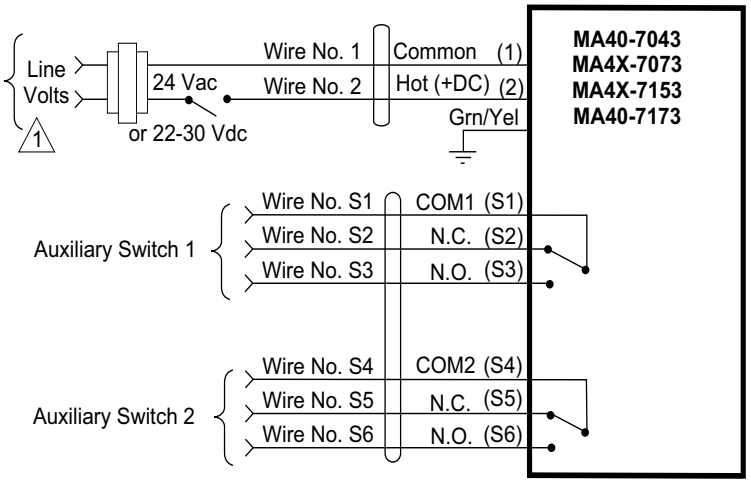
Label Information

These actuators have label information that is incorrect. When replacing these units, the auxiliary switch operation of the replacement actuator will be per the new unit's product label, and as shown in Figure-1 and Figure-2.

Note:

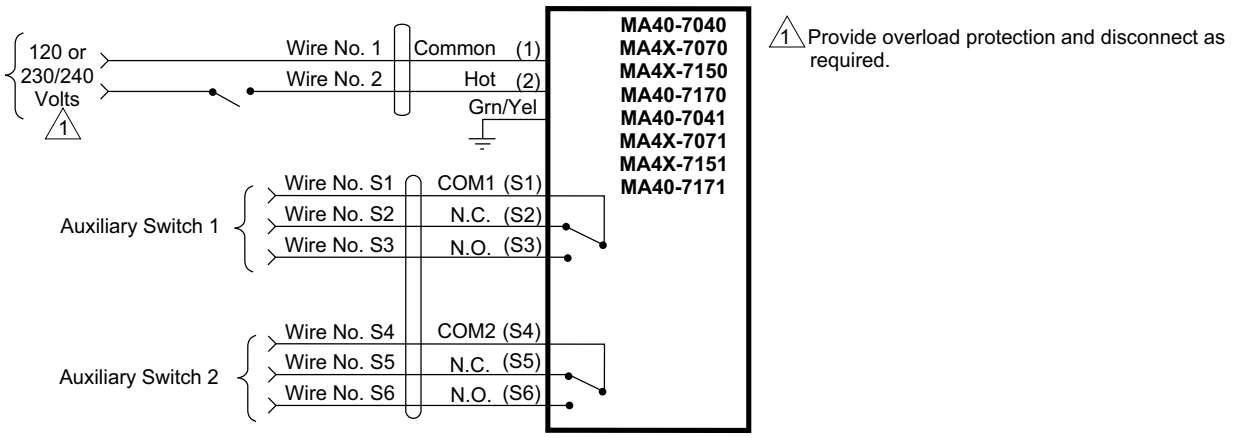
MX40-7043, MX4X-7073, and MX4X-7153 After Date Code 0212 (2002, 12th Week)

DC operation is applicable to these actuators. See the product label.



Model	Wire 1	Wire 2	S1	S2	S3	S4	S5	S6
MA40-7043	-	-	Org	Vio	Yel	-	-	-
MA41-7073 MA41-7153	L2 Black	L1 Red	COM1 Org	NC1 Vio	NO1 Yel	COM2 Org/Wht	NC2 Vio/Wht	NO2 Yel/Wht
MA40-7173	24G Blk/Blu	24H Black	None					

Figure-1 Typical Wiring Diagram for 24 Vac MA4X-7XX3 Two-Position Actuators.



Model	Wire 1	Wire 2	S1	S2	S3	S4	S5	S6
MA40-7040	-	-	Org	Vio	Yel	-	-	-
MA41-7070 MA41-7150	L2 White	L1 Black	COM1 Org	NC1 Vio	NO1 Yel	COM2 Org/Wht	NC2 Vio/Wht	NO2 Yel/Wht
MA40-7170	L2 White	L1 Black	None					

Model	Wire 1	Wire 2	S1	S2	S3	S4	S5	S6
MA40-7041 MA41-7071 MA41-7151	L2 Blue	L1 Brown	COM1 Org	NC1 Vio	NO1 Yel	COM2 Org/Wht	NC1 Vio/Wht	NO1 Yel/Wht
MA40-7171	L2 Blue	L1 Brown	None					

Figure-2 Typical Wiring Diagram for 120 Vac MA4X-7XXX, and 230/240 Vac MA4X-7XXX Two Position Actuators.

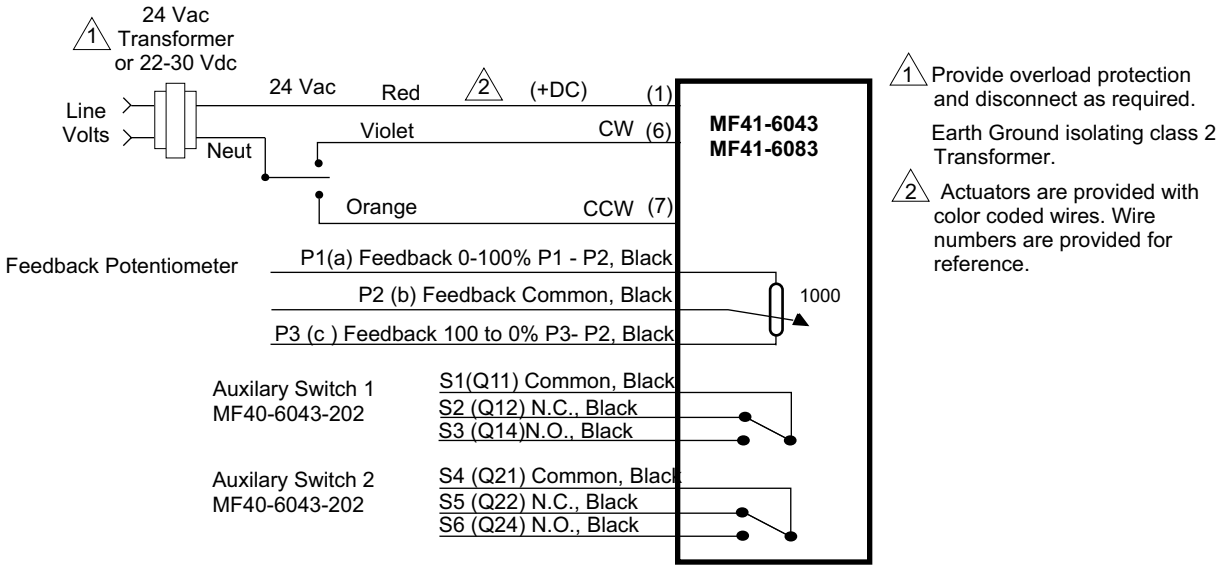


Figure-3 Typical Wiring Diagram for MF41-6043 and MF41-6083 Floating Actuators.

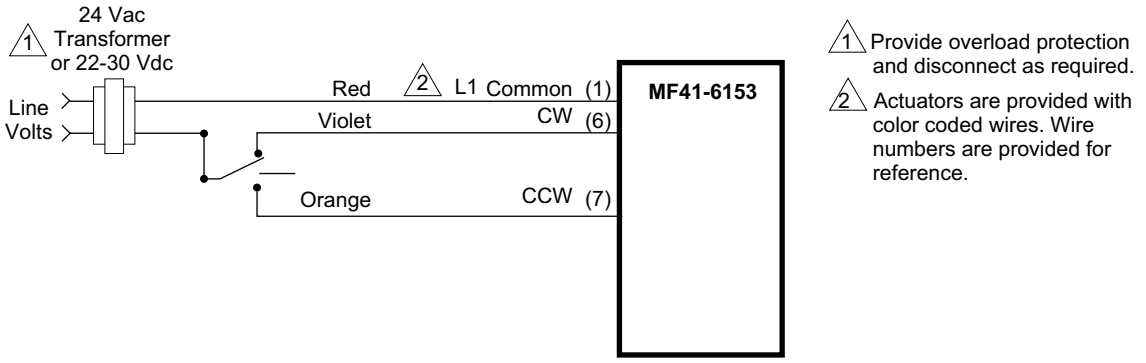


Figure-4 Typical Wiring Diagram for MF41-6153 Floating Actuators.

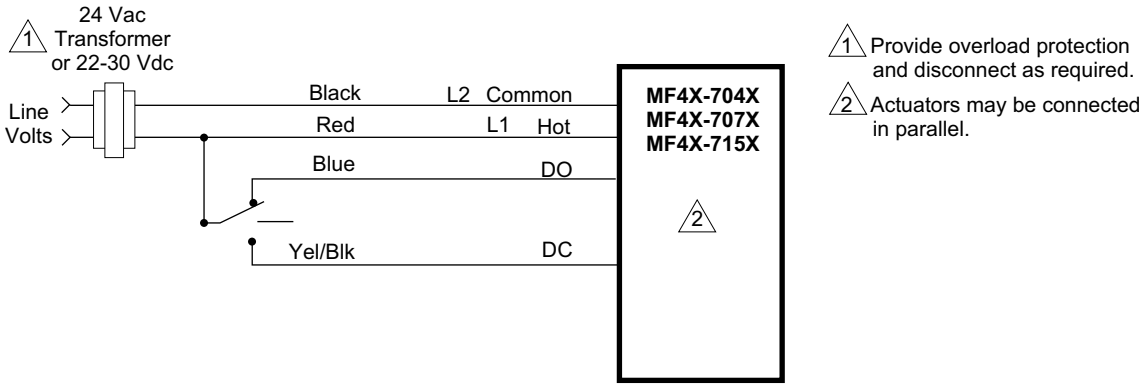


Figure-5 Typical Wiring Diagram for MF4X-704X, MF4X-707X, and MF4X-715X Floating Actuators.

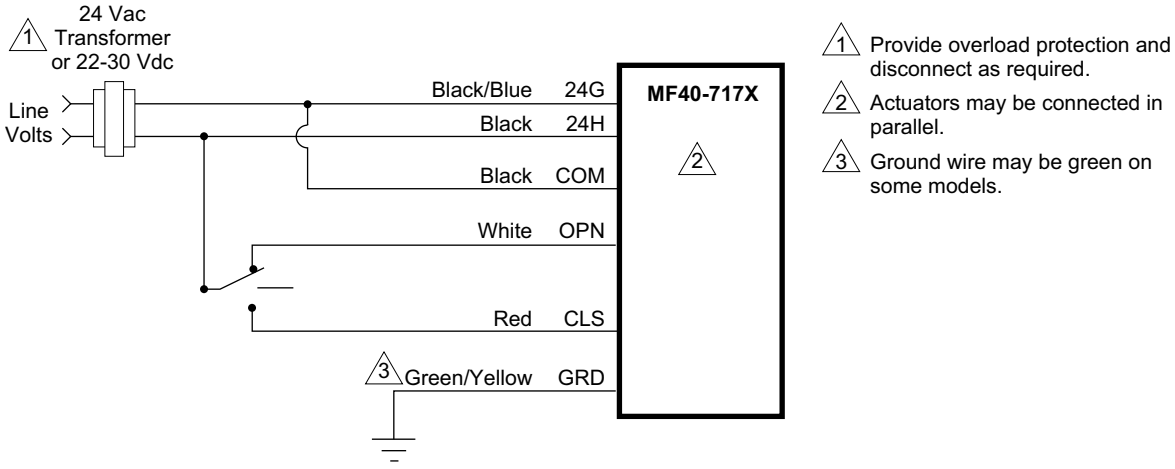


Figure-6 Typical Wiring Diagram for MF40-717X Floating Actuators.

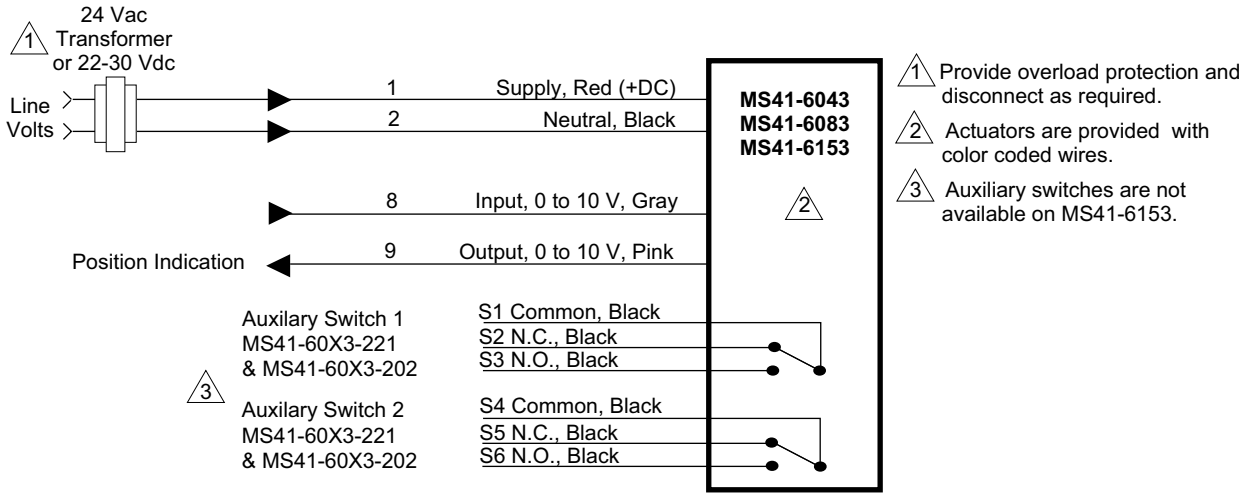


Figure-7 Typical Wiring Diagram for MS41-6043, MS41-6083, and MS41-6153 Proportional Actuators.

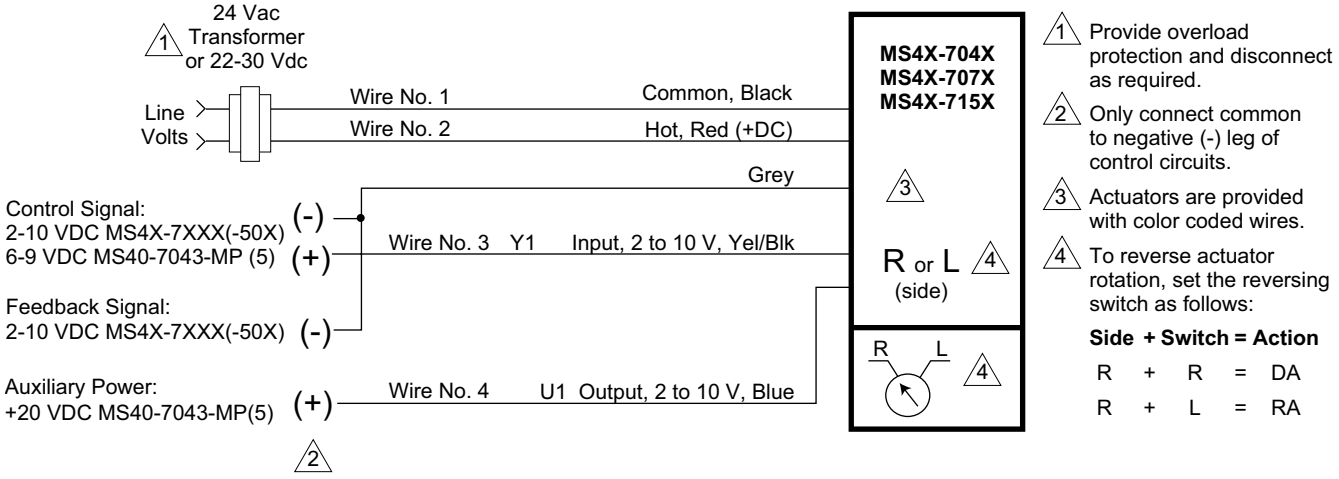
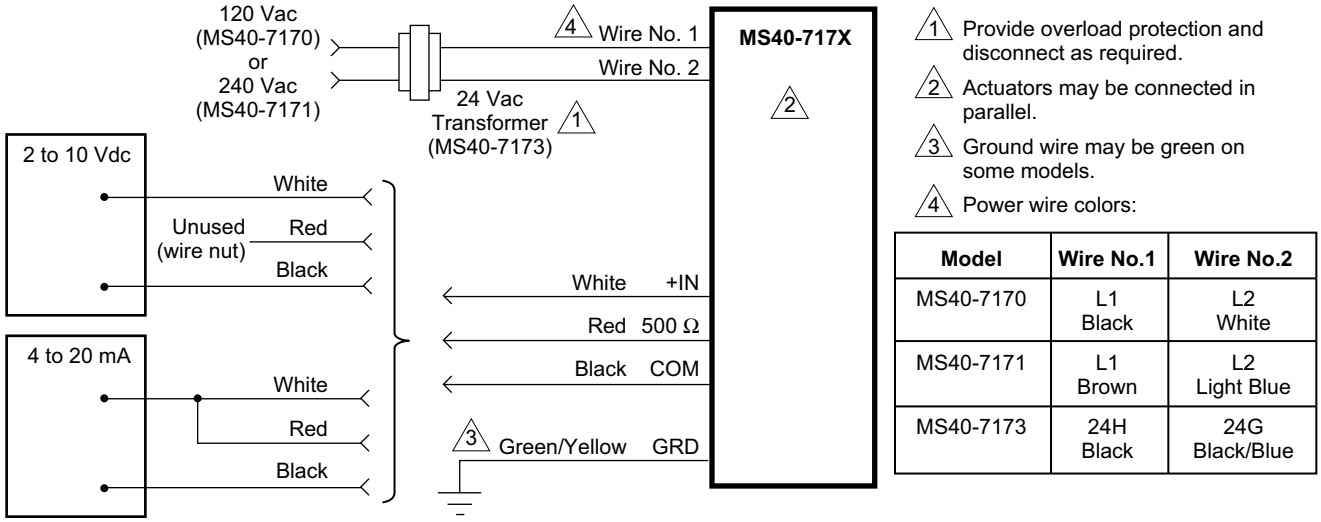


Figure-8 Typical Wiring Diagram for MS4X-704X, MS4X-707X, and MS4X-715X, Proportional Actuators.



Model	Wire No.1	Wire No.2
MS40-7170	L1 Black	L2 White
MS40-7171	L1 Brown	L2 Light Blue
MS40-7173	24H Black	24G Black/Blue

Figure-9 Typical Wiring Diagram for MS40-717X Proportional Actuators.

Mounting

Allow at least 5" (127 mm) above the actuator/linkage assembly for removal and reattachment of the actuator to the installed valve.

Assembling Actuator and Linkage to Valve Body

Process Overview

This assembly procedure consists of two sections:

- **Section A. Assembling Linkage to Valve — All Valve Types and Actuator Models**

  For all actuator models and valve types (2-way and 3-way), follow the instructions in this section to assemble the linkage to the valve.
- **Section B. Actuator Mounting and Setup**

  In this section, choose the subsection that is appropriate for the specific actuator type and valve type, to mount the actuator and adjust the linkage:
  - **B1. Actuators with Manual Override — 2-Way Valves (Stem Up Closed and Stem Up Open) and 3-Way Valves**

    These instructions apply to actuators with manual override, to be mounted onto 2-way valves (stem up closed and stem up open) and 3-way valves.
  - **B2. Spring-Return Actuators without Manual Override — 2-Way Valves (Stem Up Closed and Stem Up Open)**

    These instructions apply to spring-return actuators, to be mounted onto 2-way valves (stem up closed and stem up open).
  - **B3. Spring-Return Actuators without Manual Override — 3-Way Valves**

    These instructions apply to spring-return actuators, to be mounted onto 3-way valves.

Refer to Table-6, below, to determine the assembly path for the specific actuator and valve.

Table-6 Assembly Process for Mounting Actuator and Linkage to Valve Body.

Actuator Type	Valve Type	Actuators	Section A	Section B		
				Subsec B1	Subsec B2	Subsec B3
Actuators with Manual Override	2-Way Stem-Up Open	MX41-6043, MX41-6083, MX41-6153, MX41-707X, MX41-715X	X	X		
	2-Way Stem-Up Closed		X	X		
	3-Way		X	X		
Spring-Return Actuators without Manual Override	2-Way Stem-Up Open	MX40-704X, MX40-707X, MX40-715X, MX40-717X	X		X	
	2-Way Stem-Up Closed [a]		X		X	
	3-Way [a]		X			X

[a] Power is required to position the actuator during assembly.

Section A. Assembling Linkage to Valve — All Valve Types and Actuator Models

1. Assemble the linkage to the valve, according to Figure-10.

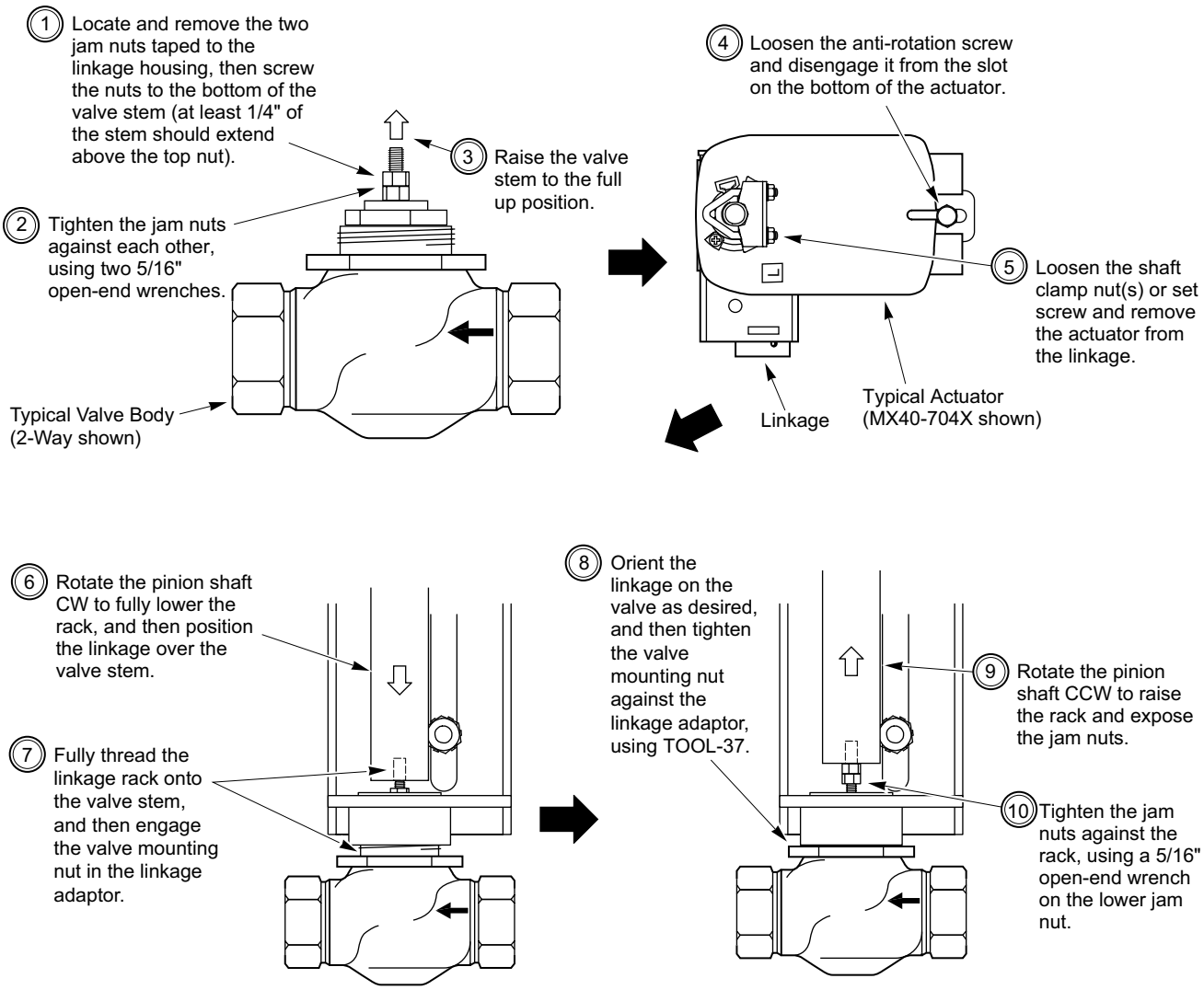


Figure-10 Assembling Linkage to Valve.

2. Continue the assembly process according to the following section, “Section B. Actuator Mounting and Setup.”

Section B. Actuator Mounting and Setup

To mount the actuator and set up the assembly, refer to the subsection that applies to the specific actuator type and valve type.

B1. Actuators with Manual Override — 2-Way Valves (Stem Up Closed and Stem Up Open) and 3-Way Valves

MX41-6043, MX-41-6083

a. Install the actuator onto the linkage and valve, and set up the assembly, according to Figure-11.

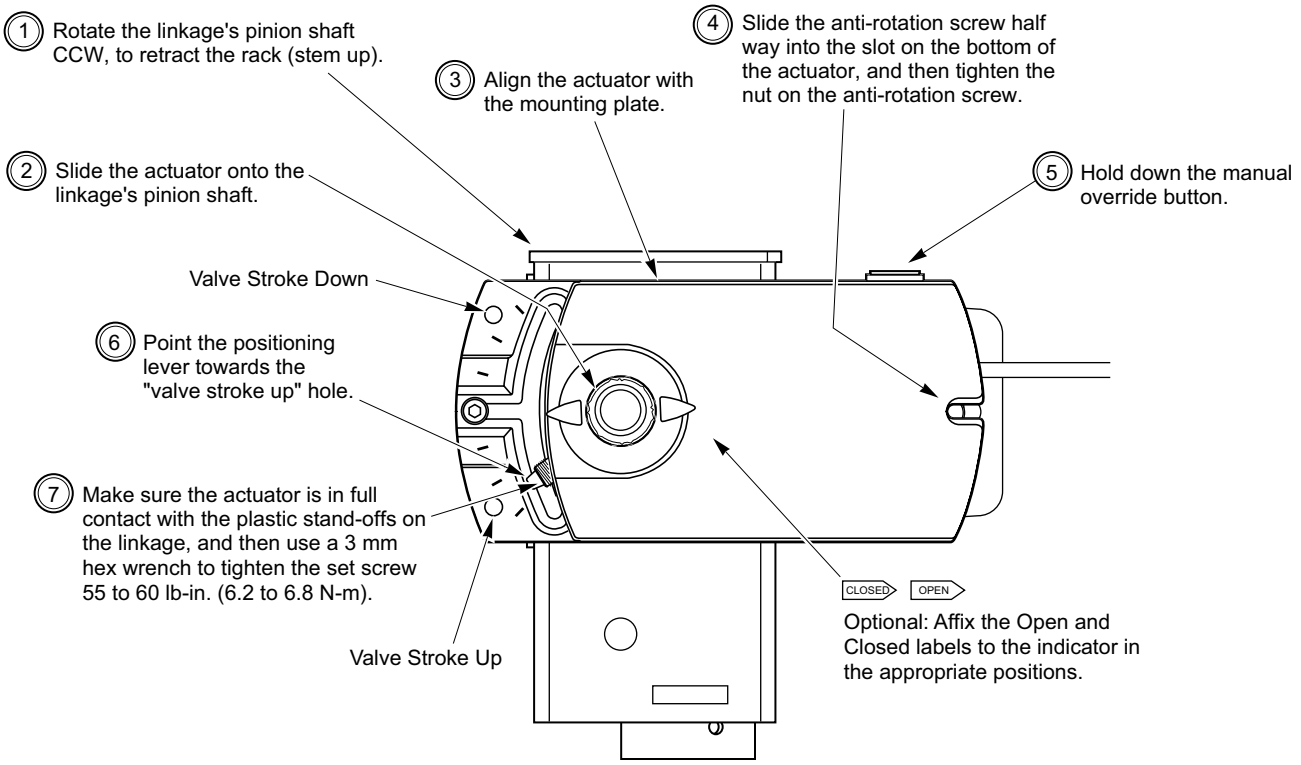


Figure-11 Mounting MX41-6043 and MX-41-6083 Actuators and Setting up Actuator/Linkage/Valve Assemblies.

b. Apply power to the actuator and check the system's operation for heating or cooling output, in response to the control signal.

c. Proceed to ""Valve Mounting" on page 20 for instructions on installing a new valve. If the assembled actuator/linkage is mounted onto an established valve, refer to the wiring information in "TYPICAL APPLICATION (wiring diagrams)" on page 8. To locate detailed instructions for a specific actuator, refer to the actuator's General Instructions sheet, listed in "Applicable Literature" on page 2.

a. Install the actuator onto the linkage and valve, and set up the assembly, according to Figure-12.

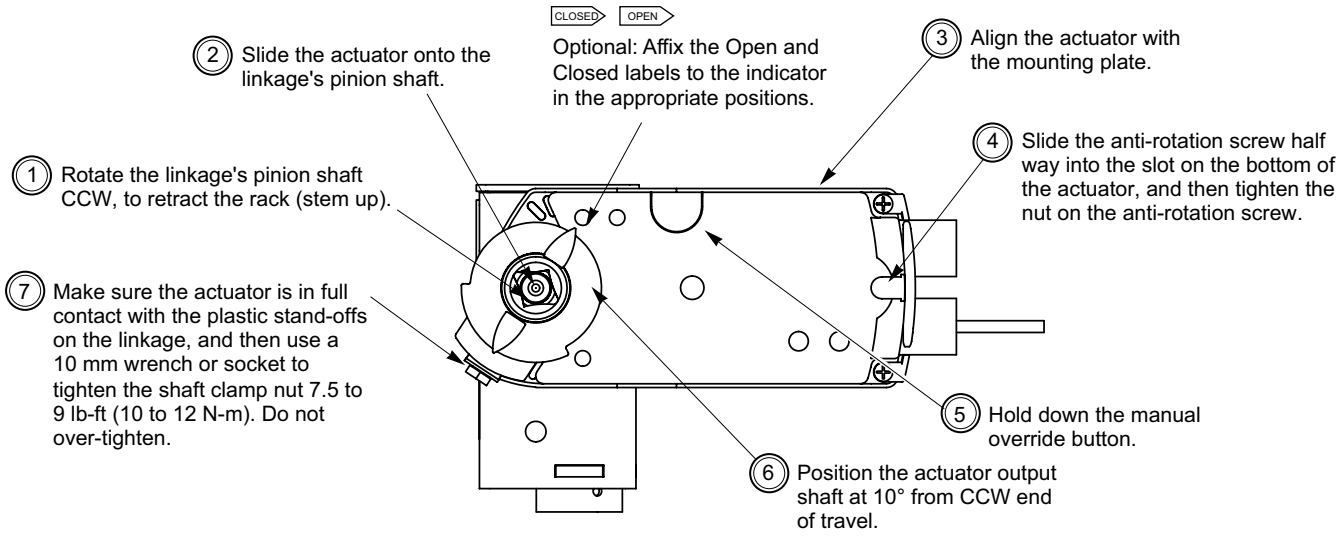


Figure-12 Mounting MX41-6153 and Setting up Actuator/Linkage/Valve Assembly.

b. Apply power to the actuator and check the system's operation for heating or cooling output, in response to the control signal.

c. Proceed to ""Valve Mounting" on page 20 for instructions on installing a new valve. If the assembled actuator/linkage is mounted onto an established valve, refer to the wiring information in "TYPICAL APPLICATION (wiring diagrams)" on page 8. To locate detailed instructions for a specific actuator, refer to the actuator's General Instructions sheet, listed in "Applicable Literature" on page 2.

MX41-707X, MX41-715X

a. Install the actuator onto the linkage and valve, and set up the assembly, according to Figure-13.

Note: The MX41-707X and MX41-715X actuators feature a manual override mechanism that may be used to reposition the actuator's output shaft. See Figure-20 on page 23. These actuators are shipped at +5° for valve close-off preload. If this preload must be reset, refer to note (triangle) 2 in Figure-20.

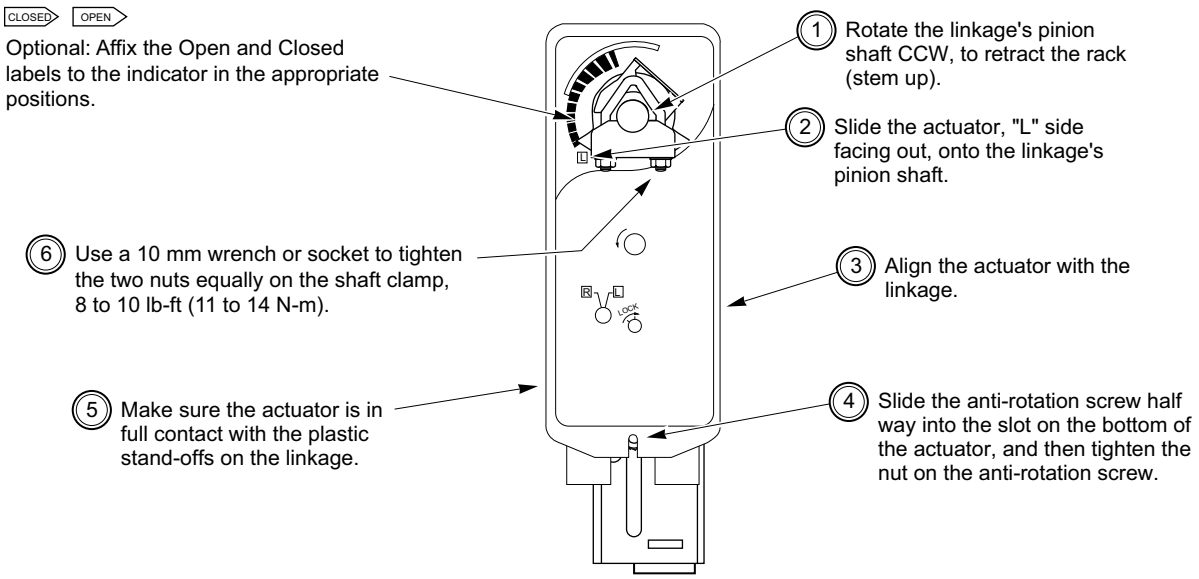


Figure-13 Mounting MX41-707X or MX41-715X and Setting up Actuator/Linkage/Valve Assembly.

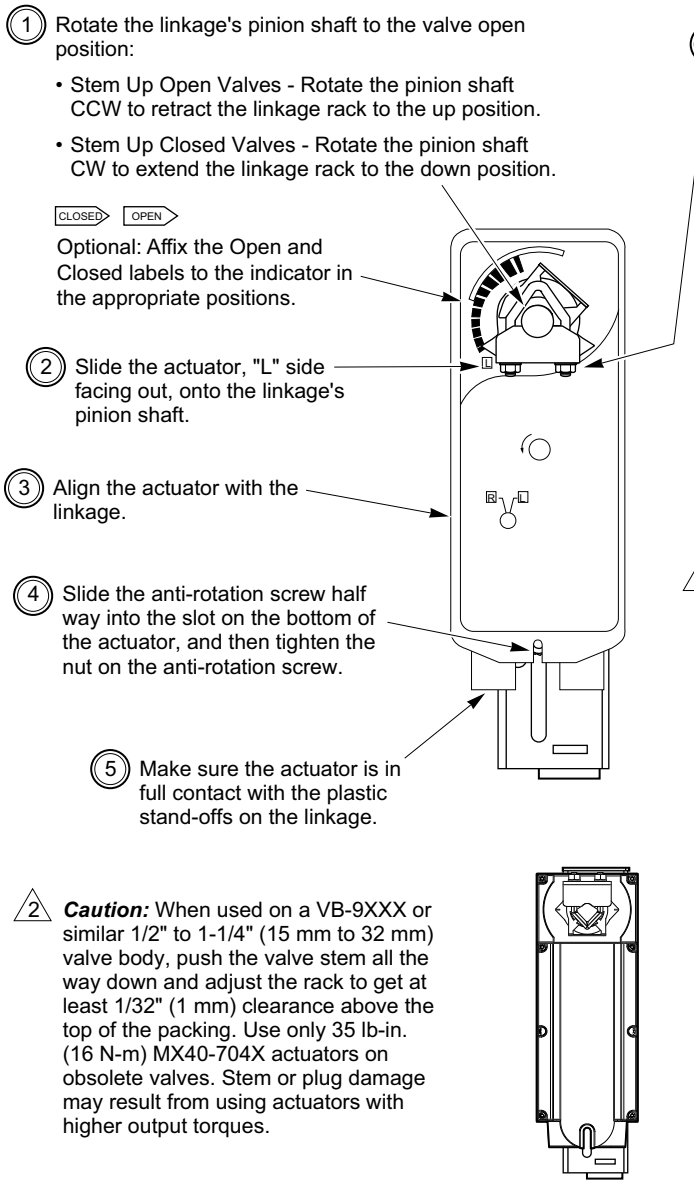
b. Apply power to the actuator and check the system's operation for heating or cooling output, in response to the control signal.

c. Proceed to ""Valve Mounting" on page 20 for instructions on installing a new valve. If the assembled actuator/linkage is mounted onto an established valve, refer to the wiring information in "TYPICAL APPLICATION (wiring diagrams)" on page 8. To locate detailed instructions for a specific actuator, refer to the actuator's General Instructions sheet, listed in "Applicable Literature" on page 2.

B2. Spring-Return Actuators without Manual Override — 2-Way Valves (Stem Up Closed and Stem Up Open)

MX40-704X, MX40-707X, MX40-715X, MX40-717X

a. Install the actuator onto the linkage and 2-way valve, and set up the assembly, according to Figure-14.



6 Lightly finger-tighten the two nuts on the shaft clamp(s), and then set up the actuator and tighten the shaft clamp(s) as follows:

For N.O. Operation, Stem Up Open Valves

a. Verify that the linkage rack is still in the full up position.

b. Use a 10 mm wrench or socket to torque the nuts equally on the shaft clamp(s), 8 to 10 lb-ft (11 to 14 N-m). The actuator is now in the open position, without power.

For N.C. Operation, Stem Up Closed Valves

a. Power the actuator to the end of stroke (see the section, "TYPICAL APPLICATION (wiring diagrams)". 1 2

b. Verify that the linkage rack is still in the full down position.

c. Use a 10 mm wrench or socket to torque the nuts equally on the shaft clamp(s), 8 to 10 lb-ft (11 to 14 N-m). The actuator is now in the open position, at the end of stroke.

2 ***Caution:*** When used on a VB-9XXX or similar 1/2" to 1-1/4" (15 mm to 32 mm) valve body, push the valve stem all the way down and adjust the rack to get at least 1/32" (1 mm) clearance above the top of the packing. Use only 35 lb-in. (16 N-m) MX40-704X actuators on obsolete valves. Stem or plug damage may result from using actuators with higher output torques.

Procedures Apply to MX40-717X Also

1 ***Tip:***

- MA40-7XXX Two-Position - When power is applied (L1, L2), the actuator will travel to the end of stroke.
- MF40-704X, MF40-707X, MF40-715X Floating Control - Connect the blue lead to the red lead, and then apply power (L1, L2) to drive the actuator to the end of stroke.
- MF40-717X Floating Control - Connect the white (+) lead to the black (-) lead, and then apply power (L1, L2) to drive the actuator to the end of stroke.
- MS40-704X, MS40-707X, MS40-715X Proportional Control - Change the reversing switch setting from direct acting (L) to reverse acting (R), and then apply power to drive the actuator to the end of stroke. When finished, return the switch setting to direct acting (L).
- MS40-717X Proportional Control - Apply 10 Vdc (signal) to the white (+) and black (-) leads, and then apply power (L1, L2) to drive the actuator to the end of stroke.

Figure-14 Mounting Spring-Return Actuator on 2-Way Valve and Setting up Actuator/Linkage/Valve Assembly.

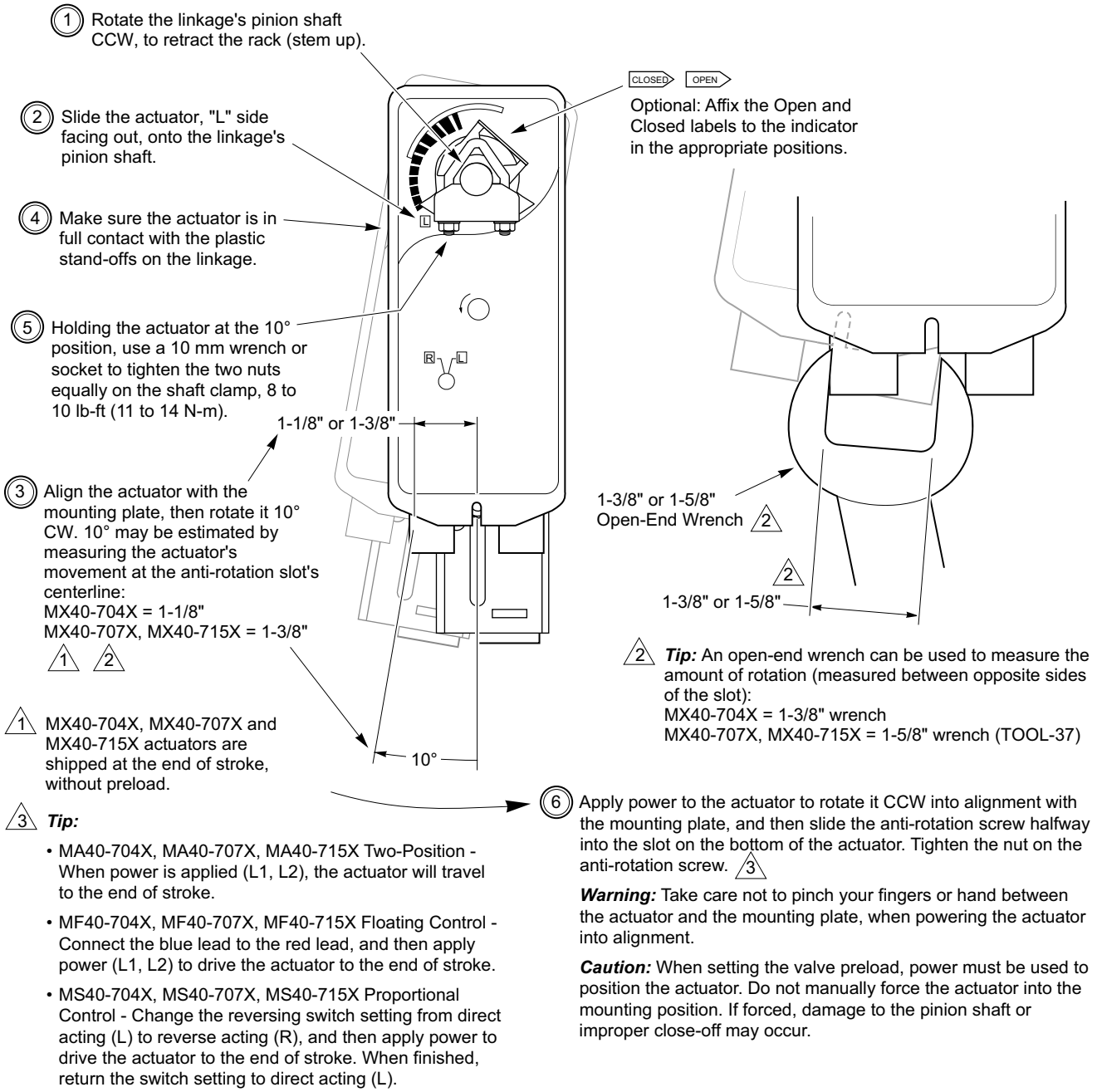
b. Apply power to the actuator and check the system's operation for heating or cooling output, in response to the control signal.

c. Proceed to ""Valve Mounting" on page 20 for instructions on installing a new valve. If the assembled actuator/linkage is mounted onto an established valve, refer to the wiring information in "TYPICAL APPLICATION (wiring diagrams)" on page 8. To locate detailed instructions for a specific actuator, refer to the actuator's General Instructions sheet, listed in "Applicable Literature" on page 2.

B3. Spring-Return Actuators without Manual Override — 3-Way Valves

MX40-704X, MX40-707X, MX40-715X

a. Install the actuator onto the linkage and 3-way valve, and set up the assembly, according to Figure-15.



1 MX40-704X, MX40-707X and MX40-715X actuators are shipped at the end of stroke, without preload.

2 ***Tip:*** An open-end wrench can be used to measure the amount of rotation (measured between opposite sides of the slot):
MX40-704X = 1-3/8" wrench
MX40-707X, MX40-715X = 1-5/8" wrench (TOOL-37)

3 ***Tip:***

- MA40-704X, MA40-707X, MA40-715X Two-Position - When power is applied (L1, L2), the actuator will travel to the end of stroke.
- MF40-704X, MF40-707X, MF40-715X Floating Control - Connect the blue lead to the red lead, and then apply power (L1, L2) to drive the actuator to the end of stroke.
- MS40-704X, MS40-707X, MS40-715X Proportional Control - Change the reversing switch setting from direct acting (L) to reverse acting (R), and then apply power to drive the actuator to the end of stroke. When finished, return the switch setting to direct acting (L).

6 Apply power to the actuator to rotate it CCW into alignment with the mounting plate, and then slide the anti-rotation screw halfway into the slot on the bottom of the actuator. Tighten the nut on the anti-rotation screw. 3

Warning: Take care not to pinch your fingers or hand between the actuator and the mounting plate, when powering the actuator into alignment.

Caution: When setting the valve preload, power must be used to position the actuator. Do not manually force the actuator into the mounting position. If forced, damage to the pinion shaft or improper close-off may occur.

Figure-15 Mounting MX40-704X, MX40-707X, MX40-715X and Setting up Actuator/Linkage/Valve Assembly.

b. Apply power to the actuator and check the system's operation for heating or cooling output, in response to the control signal.

c. Proceed to ""Valve Mounting" on page 20 for instructions on installing a new valve. If the assembled actuator/linkage is mounted onto an established valve, refer to the wiring information in "TYPICAL APPLICATION (wiring diagrams)" on page 8. To locate detailed instructions for a specific actuator, refer to the actuator's General Instructions sheet, listed in "Applicable Literature" on page 2.

MX40-717X

a. Install the actuator onto the linkage and 3-way valve, and set up the assembly, according to Figure-16.

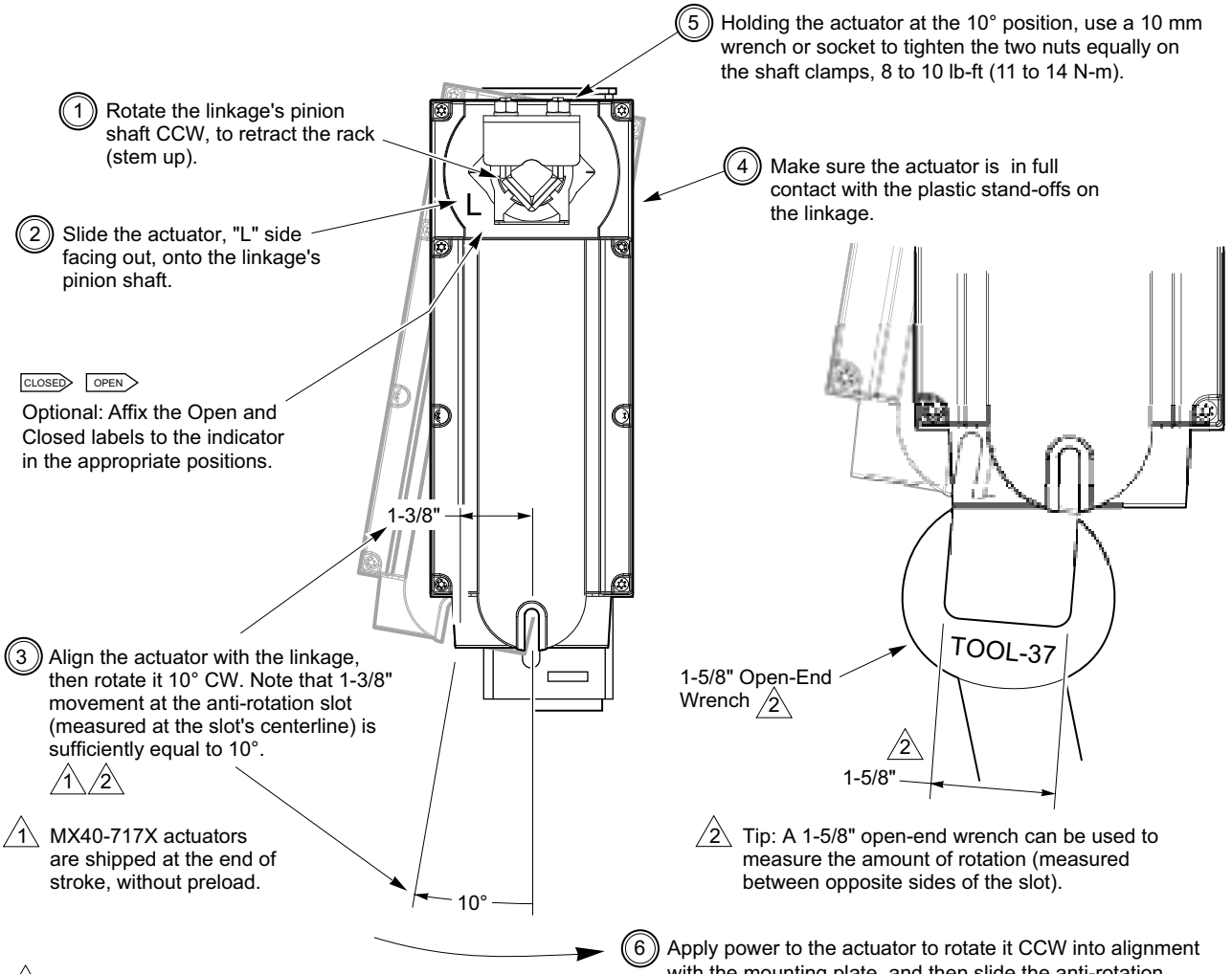


Figure-16 Mounting MX40-717X and Setting up Actuator/Linkage/Valve Assembly.

b. Apply power to the actuator and check the system's operation for heating or cooling output, in response to the control signal.

c. Proceed to ""Valve Mounting" on page 20 for instructions on installing a new valve. If the assembled actuator/linkage is mounted onto an established valve, refer to the wiring information in "TYPICAL APPLICATION (wiring diagrams)" on page 8. To locate detailed instructions for a specific actuator, refer to the actuator's General Instructions sheet, listed in "Applicable Literature" on page 2.

Valve Mounting

The valve should be mounted in a weather-protected area, in a location that is within the ambient temperature limits of the actuator. The installation of the actuator assembly should provide clearance on all sides to allow for any maintenance that may be needed.

1. Following general piping practices is recommended.
2. Apply pipe sealant sparingly to all but the last two threads of a properly threaded, reamed, and cleaned pipe. Make sure the pipe chips, scale, etc. do not get into the pipe since this material may lodge in the valve seat and prevent proper closing and opening of the valve. The valve must be piped with an inlet and an outlet.
3. Start the joint hand-threading the pipe into the valve. If the thread alignment feels normal, continue to turn the pipe by hand as far as it will go.
4. Use a pipe wrench to fully tighten the pipe to the valve.

Caution: Do not over-tighten the pipe, which may cause stripped threads. Avoid twisting or crushing the valve while tightening the pipe.

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5. Insulate only the valve body.
6. In chilled or cold water systems where the environment is humid, use a drip pan under the valve to catch condensate.

Caution:

- Do not insulate the actuator/linkage. Doing so will result in excess heat buildup within the actuator.
- The globe valve assembly must be mounted so that the actuator is at least 5° above the horizontal (Figure-17) to ensure that any condensate that forms will not travel into the linkage or actuator.
- On steam applications, the globe valve assembly must be mounted at 45° from vertical (Figure-18).

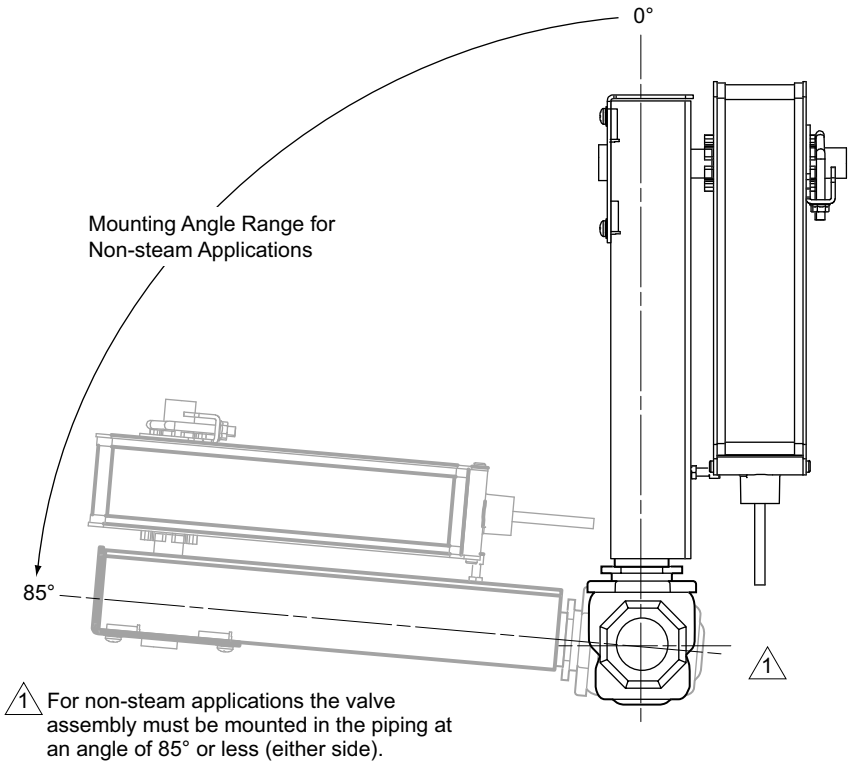
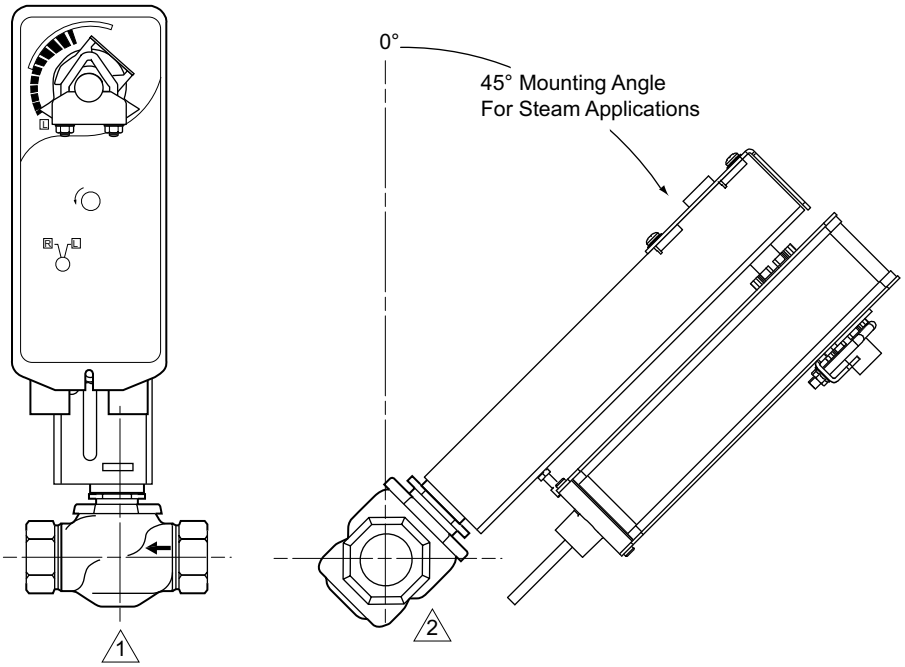


Figure-17 Typical Mounting Position.



1 The actuator must be mounted in the orientation shown above.

2 For steam applications the valve assembly must be mounted in the piping at a 45° angle (either side).

Figure-18 Steam Application Mounting Position.

Manual Override for MX41-6043, MX41-6083 and MX41-6153 Non-Spring Return Actuators

When necessary, the MX41-6XX3 actuator's output shaft can be manually repositioned for emergency positioning or for resetting to an alternative degree of rotation. This is done by pressing the manual override button, which disengages the actuator's gears so that the output shaft is free to rotate (Figure-19).

Caution:

- Only use manual override when the actuator drive motor is not powered.
- Engaging the manual override when the actuator is powered will cause damage to the gears.
- Using power tools to adjust the override will cause damage to the gears.
- Avoid manually repositioning the actuator beyond its adjustable travel limit setting.

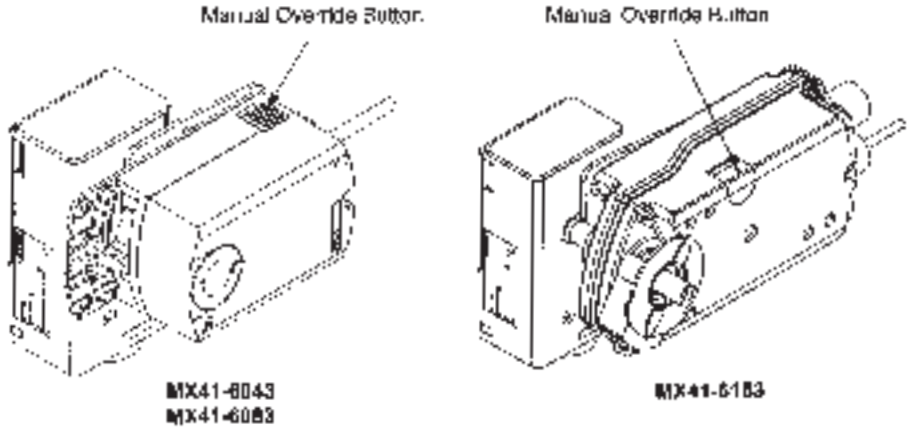


Figure-19 Manual Override Button on MX41-6XX3 Actuators.

Manual Emergency Positioning

Reposition the actuator for emergency positioning as follows:

1. Disconnect power from the actuator.
2. Reposition the actuator's output shaft:
   a. Press the manual release button on the actuator housing, to disengage the gears.
   b. Turn the shaft clamp assembly clockwise or counterclockwise by hand until the pointer is set at zero or at some other required position.
   c. Release the manual override button to allow the gears to re-engage.
3. When the emergency situation has been corrected, set up the actuator and linkage as needed, according to "Section A. Assembling Linkage to Valve — All Valve Types and Actuator Models" and "B1. Actuators with Manual Override – 2-Way Valves (Stem Up Closed and Stem Up Open) and 3-Way Valves."
4. Reconnect power to the actuator.

Alternate Degree of Rotation

Reposition the actuator to an alternate degree of rotation as follows:

1. Disconnect power to actuator.
2. Loosen the shaft clamp nut or setscrew.
3. Reposition the actuator's output shaft:
   a. Press the manual release button on the actuator housing, to disengage the gears.
   b. Turn the shaft clamp assembly clockwise or counterclockwise by hand until the pointer is set at zero or at some other alternate degree of rotation.
   c. Release the manual override button to allow the gears to re-engage.
4. Secure the actuator's output shaft on the linkage's pinion shaft by tightening the shaft clamp nut 7.5 to 9 lb-ft (10 to 12 N-m) or shaft clamp setscrew 55 to 60 lb-in (6.5 to 7 N-m).
5. Reconnect power to the actuator.

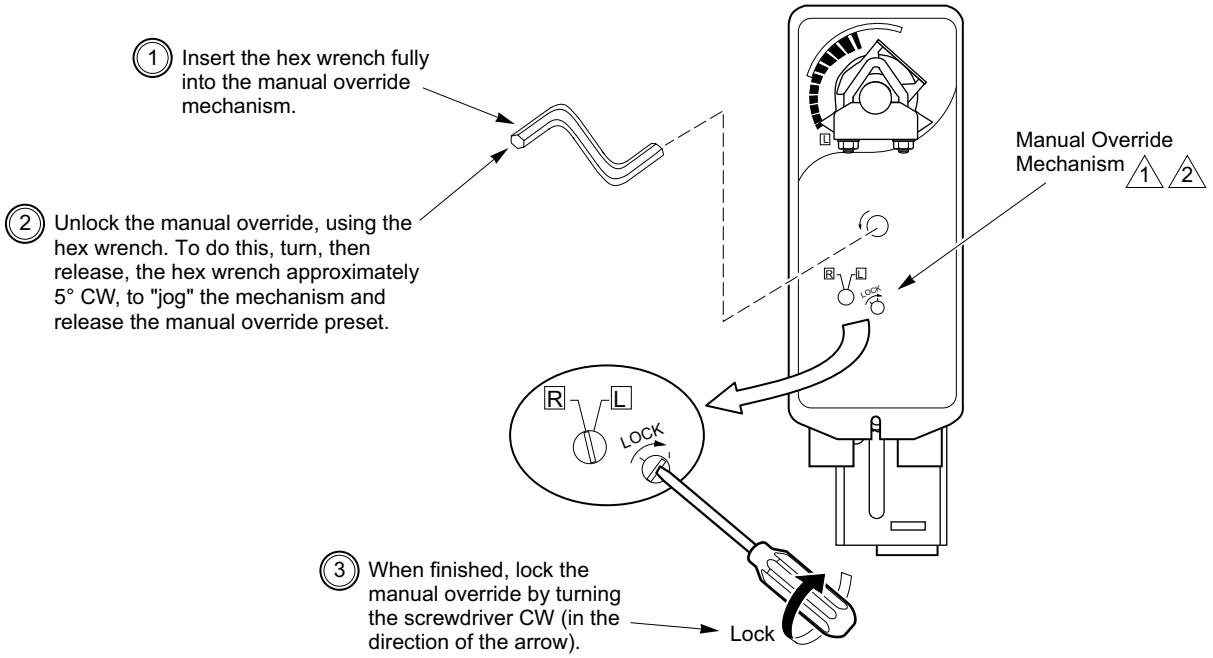
Manual Override for MX41-704X and MX41-715X Spring Return Actuators

When necessary, the MX41-704X or MX41-715X actuator's output shaft can be repositioned, using the manual override mechanism as follows:

1. Disconnect power from the actuator.
2. Crank the manual override mechanism and lock it into the override position, as shown in Figure-20.
3. The actuator will return to normal operation (the manual override lock will release) the next time power is applied.

Caution:

- Only use manual override when the actuator drive motor is not powered.
- Engaging the manual override when the actuator is powered will cause damage to the gears.
- Using power tools to adjust the override will cause damage to the gears.
- Avoid manually repositioning the actuator beyond its adjustable travel limit setting.



1 MX41-707X and MX41-715X actuators are shipped at +5° to provide proper valve preload. When necessary, the manual override mechanism may be used to reposition the actuator at any point between -5° and 85°. This mechanism is accessible on both sides of the actuator and can be used to ensure tight close-offs for valves.

2 If the rotation indicator is not pointing to +5°, the proper actuator preload is not set. Unlock the actuator according to steps 1 and 2, and then rotate the hex wrench one full turn (approximately 10°) so that the actuator indicator is at +5°. When finished cranking, lock the manual override according to step 3. The lock will release the next time the actuator is powered.

When using the manual override mechanism:

- Fully engage the hex wrench in the manual override before cranking.
- When operating the manual override, ensure proper release by backing off 5° from the full open mechanical stop.

Caution: Do not use the manual override while a unit is powered, or when units are mounted in tandem.

Figure-20 Manual Override on MX41-704X or MX41-715X Spring Return Actuators

CHECKOUT

1. Checkout the operation of the valve/actuator/linkage assembly:
   a. Power the actuator and run the valve to the stem down position. The valve stem should operate smoothly. At the stem down position, the valve should shut off tightly or fully open, depending on the valve body style. See Table-5 on page 6.
   b. For spring-return actuators, allow the actuator to spring-return to the stem up position. For non-spring return actuators, power the actuator to the stem up position. The valve stem should operate smoothly. At the stem up position, the valve should be in its full open or closed position, depending on the valve body style.
2. Ensure that the valve seats before the actuator reaches the end of its stroke.

Note: 3-way valves must seat before the actuator reaches either end of stroke. If this does not occur, proper close-off may not be achieved. Return to the "Mounting" section and repeat the appropriate procedure.

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3. If the valve stem does not operate smoothly, the valve may have been twisted or crushed during installation, or the stem may have been bent from rough handling. These conditions may require that the valve be replaced.
4. With the piping under pressure, check the valve body and the connections for leaks.

THEORY OF OPERATION

The actuator/linkage assembly offers a rack and pinion design that converts the rotary motion output of the actuator into linear motion, in order to operate 1/2" to 2" (15 mm to 50 mm) VB-7000, obsolete 1/2" to 1-1/4" (15 mm to 32 mm) VB-9000, and older globe style valves.

The unit is designed to furnish the specified actuator torque in both actuator drive directions, to fully close off the valve against the flow. The rack and pinion design also provides uniform force and timing over the entire valve stroke.

MAINTENANCE

The actuator/linkage requires no maintenance. Regular maintenance of the total system is recommended to assure sustained optimum performance.

Water and Steam System Maintenance

All heating and cooling systems are susceptible to valve and system problems caused by improper water treatment and system storage procedures. The information in this section is provided to help avoid valve and water system problems resulting from improperly treated water or incorrect storage procedures, and to obtain maximum life from Invensys valves.

The durability of valve stems and valve packing depends on the maintenance of nondamaging water conditions. Inadequate water treatment or filtration that is not in accordance with chemical supplier/ASHRAE handbook recommendations, can result in the formation of corrosion, scale, and abrasive particles. Scale and particulates can cause scratches in valve stems and packing, and can adversely affect the life of the valve packing and other parts of the hydronic system.

To maintain safe conditions, clean the system prior to start-up, using a nitrite or molybdate based treatment program. Use filtration equipment where needed. Properly store off-line systems and monitor water treatment results, using corrosion test coupons.

Follow the advice of a water treatment professional. For further details, consult *EN-205 Water and Steam System Guidelines, Engineering Information,* F-26080.

FIELD REPAIR

None. Replace an inoperative actuator/linkage assembly with a functional unit.