

Sequencing Experiments

Purpose

The purpose of this demonstrator is to demonstrate how actuators can be sequence via the appropriate selection of spring ranges, how process loads can shift the spring ranges from those stated in the actuators specifications, and how a positioning relay can be used to re-establish proper sequencing under process load conditions.

The experiment assumes that the actuator on the left represents an actuator associated with a normally open preheat coil valve while the actuator on the right represents an actuator associated with an economizer cycle (i.e. a cooling process). The spring ranges were selected so that an increasing pressure will modulate the preheat valve closed and then modulate the economizer maximum outdoor air damper open and the return air damper closed to use outdoor air for cooling

Experiment 1 – Observing the “Out-of-the-box” Response

1. Prior to proceeding verify that the positioning relay is disconnected from the arm on the actuator shaft and that the control signal is connected directly to the actuator. Using the knob, start at 2 psi and increase the signal to the actuators in 1 psi increments. At what pressure does the preheat coil actuator start to move? _____
2. At what pressure does the preheat actuator reach full stroke and what is the stroke of the actuator? _____
3. At what pressure does the economizer actuator start to move? _____
4. At what pressure does the economizer actuator reach full stroke and what is the stroke of the actuator? _____
5. Do the observations match the stated start points and spring ranges for the actuators? If not, why do you think there could be differences?

Experiment 2 – Observing the “Out-of-the-box” Response with a Process Load Applied to the Preheat Actuator

1. Place the bench weights into the bread pan supported by the preheat coil actuator. These weights represent the force that water flowing through the preheat valve might generate as it pushes on the valve plug (the part of the valve the shuts off and regulates flow). Using the knob, start at 2 psi and increase the signal to the actuators in 1 psi increments. At what pressure does the preheat coil actuator start to move? _____
2. At what pressure does the preheat actuator reach full stroke and what is the stroke of the actuator? _____
3. At what pressure does the economizer actuator start to move? _____

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4. At what pressure does the economizer actuator reach full stroke and what is the stroke of the actuator? _____
5. How does the response of the system with a load on the preheat actuator differ from the “out-of the box” response?

6. What are the implications of your observations if these actuators were serving an operating HVAC system?

Experiment 3 – Adding a Pilot Positioner (a.k.a. a Positive Positioning Relay) to the System to Restore Sequencing

The tan colored cylindrical device mounted on the preheat coil actuator is a pilot positioner. This device is connected to the actuator shaft so it knows if the actuator shaft moves. It also is connected to the control signal, so it knows if the control system wants the shaft to move. Finally, it is connected to a supply of air. This allows it to supply air to the actuator until it moves enough to satisfy the requirements of the control signal. The thin disc on the top of the positioner allows its start point to be adjusted. The tension of the spring connected between it and the arm on the actuator shaft controls its span; i.e. the pressure change that needs to occur to cause it to move the actuator through its full stroke. The spring's span needs to match the actuator's span.

1. Proceed with the experiment by lowering the control signal to minimum. Disconnect the actuator from the control signal and connect it to the output from the pilot positioner. Also select the thinner of the two available springs (the 5 psi span spring) and connect one end of the spring to the holes in the arm mounted on the actuator shaft. Connect the other end of the spring to the chain coming out of the pilot positioner so that the spring just starts to put tension on the chain with the actuator fully retracted. Increase the control signal to 3 psi and turn the start point disc on the top of the positioner so that the preheat valve actuator just starts to extend.
2. Repeat the steps you did previously (step the actuators through their stroke in 1 psig increments) and observe the response of the system with and with out the weights in the preheat coil actuator bread pan. How does the response differ from the response you observed before the pilot positioner was connected?

7. Install the heavier 10 psig spring in place of the 5 psig spring and repeat the experiment. How does the response of the system differ from what you observed in step 2?

Description

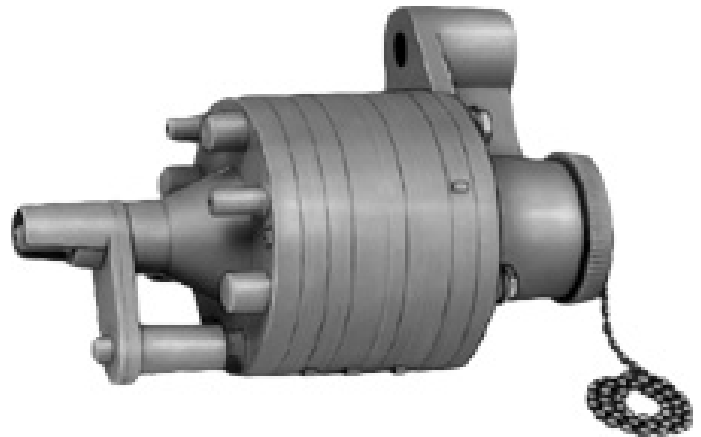
The KMC CMC-1001 non-metallic positive positioner, is designed to work with KMC pneumatic damper actuators. The CMC-1001s can be factory mounted or field installed on 3", 4", or 6" stroke actuators.

The CMC-1001's start-point is adjustable from 3 to 10 psi. The overall span is a direct function of the selected feedback spring. Springs are available in 5 psi and 10 psi spans and may be ordered separately.

CMC-1001 is designed to be used with actuators containing an 8 to 13 psi spring so that equal force can be obtained on both power and return strokes.

Features

- ◆ Factory mounted, or field installed on 3", 4", or 6" stroke actuators
- ◆ Adjustable start point
- ◆ Adjustable overall span

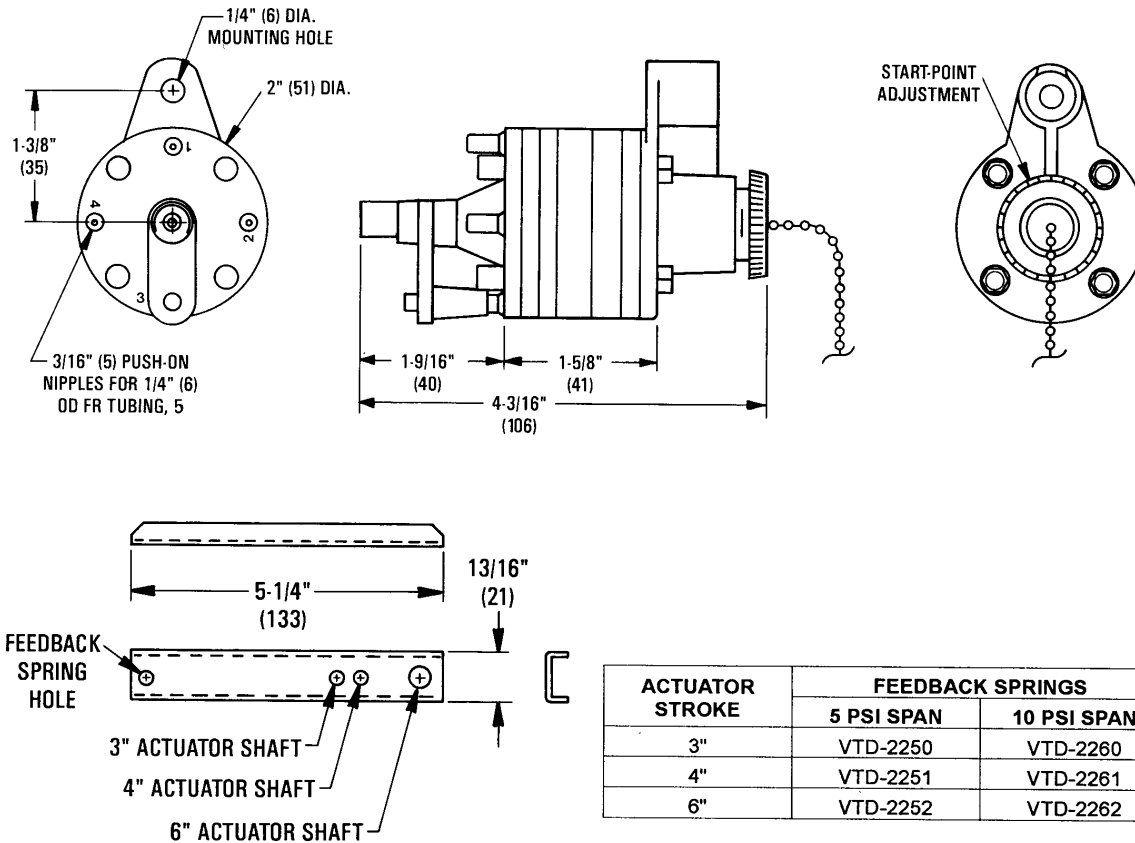


Accessories

VTD-1500	Feedback arm
VTD-2250	Spring; 3" stroke, 5 psi span
VTD-2251	Spring; 4" stroke, 5 psi span
VTD-2252	Spring; 6" stroke, 5 psi span
VTD-2260	Spring; 3" stroke, 10 psi span
VTD-2261	Spring; 4" stroke, 10 psi span
VTD-2262	Spring; 6" stroke, 10 psi span

Details

All dimensions in inches (mm).



Specifications

Supply Pressure 20 to 30 psig (138 to 207 kPa)

Air Consumption 14.4 scim @ 20 psig (3.93 mL/s @ 138 kPa)

Connections 3/16" (5 mm) nipples for 1/4" (6 mm) O.D. polyethylene tubing

Port Markings

Center Supply Pressure
 "1" Output to Actuator
 "2" Signal Input

Material

Body ABS, UL Flame Class 94 HB
 Diaphragms Neoprene

Output Capability 0 to supply pressure

Weight 4 oz. (113 grams)

Temperature Limits

Operating 40° to 120° F (4° to 49° C)
 Shipping -40° to 140° F (-40° to 60° C)

KMC Controls, Inc.

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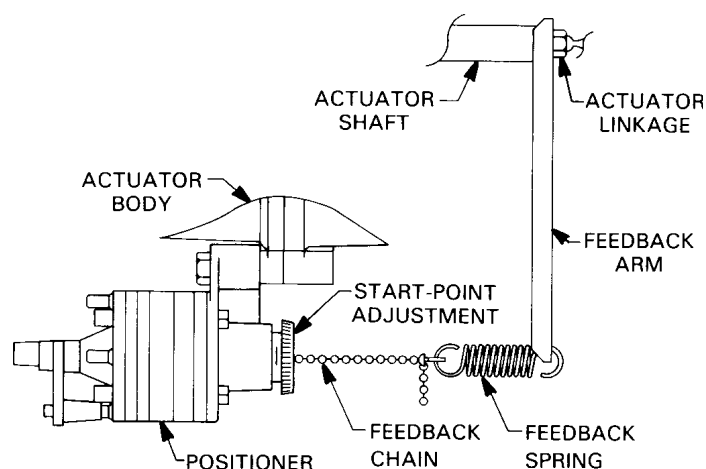
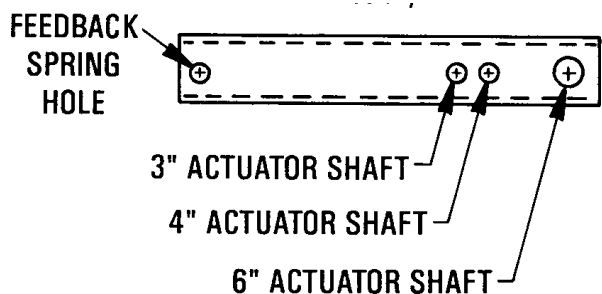
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Installation Guide

Mounting

The CMC-1001 is designed to mount directly on the MCP-1030 /1130 /1040 /1140 /5140 /1160 and /5160 series actuators.

1. Remove one of the screw/bolts that hold the actuator housing together. DO NOT remove more than one screw/bolt.
2. Slide the positioner over the mounting boss
3. Reinstall the screw/bolt. Be careful not to cross-thread the actuator housing.
4. Using the proper hole in the feedback arm, slide the arm over the actuator shaft. The arm is held between the shaft and the damper linkage.
5. Connect the 5 psi or 10 psi feedback spring to the hole at the base of the feedback arm
6. Connect the other end of the feedback spring to the feedback chain. There should be no slack between the positioner and the arm.



Connections

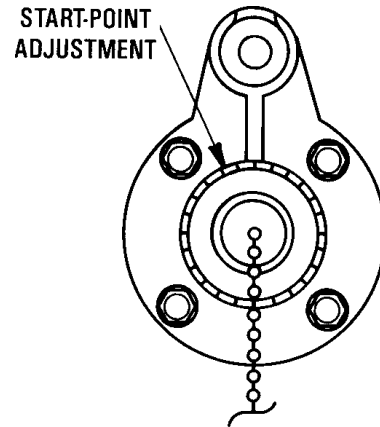
1. Using 1/4" (6 mm) O.D. FR tubing, connect the main air supply to the 3/16" (5 mm) port on the bottom of the unit.
2. Provide a supply of clean, dry, 20-30 psig (38-207 kPa) control air
3. Connect the input, start-point, pressure to "Port 2"
4. Connect Port #1 to the actuator
5. Insert the small beige in-line restrictor in the line between Port #1 and all 3" and 4" actuators. This part is not needed on 6" actuators.

Adjustments and Calibration

Once connections are complete and supply air is applied, turn the start-point adjustment dial until the actuator begins to move.

Example:

A start-point of 4 psi with a 5 psi span spring will yield an operating range of 4–9 psi.



Maintenance

No routine maintenance is required.

Each component is designed and manufactured for reliability and performance. Careful installation and use will ensure long term dependability.

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Description

The YMC Switch Series combine manually actuated gradual switches with selector switches.

The YMC-1001, gradual switch, is designed to deliver a variable, selected air pressure from the branch line to a remote device. The YMC-1001 is used in pneumatic control circuits to remotely position devices and adjust receiver-controller set-points.

The YMC-2001 and 2002 models have two selector switches, the YMC-3001 and 3002 have three switches and the YMC-6001 has six positions. Typical application for these switches include diverting and supply/exhaust of pneumatic signals to other devices.

A variety of scale plates are available. A mounting bracket for panel mounting is also available.



Model

YMC-1001	Gradual switch
YMC-2001	2-position switch, DPDT, non-vented
YMC-2002	2-position switch, DPDT, vented
YMC-3001	3-position switch, non-vented
YMC-3002	3-position switch, vented
YMC-6001	6-position, non-vented

Accessories

HMO-4506	Mounting bracket
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Scale Plates All Models

HDO-1101	Blank
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Scale Plate YMC-1001

HDO-1102	0 to 100%
HDO-1103	Increase CW arrow
HDO-1104	Increase CCW arrow

Scale Plate YMC-2001/2002:

HDO-1201	Occupied- Unoccupied
HDO-1202	Summer-Winter
HDO-1203	On-Off
HDO-1204	On-Auto

HDO-1205	Open-Close
HDO-1206	1-2
HDO-1207	Day-Night
HDO-1208	Heat-Cool
HDO-1209	Manual-Auto

Scale Plate YMC-3001/3002:

HDO-1301	1-2-3
HDO-1302	On-Auto-Off
HDO-1303	Day-Auto-Night
HDO-1304	Occ.-Auto-Unocc.
HDO-1305	Heat-Auto-Cool
HDO-1306	Summer-Auto-Winter
HDO-1307	Open-Auto-Close

Scale Plates YMC-6001:

HDO-1601	1-2-3-4-5-6
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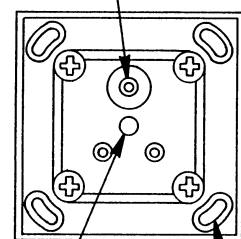
NOTE: Scale plates are sold in packs of ten.

Details

All dimensions in inches (mm).

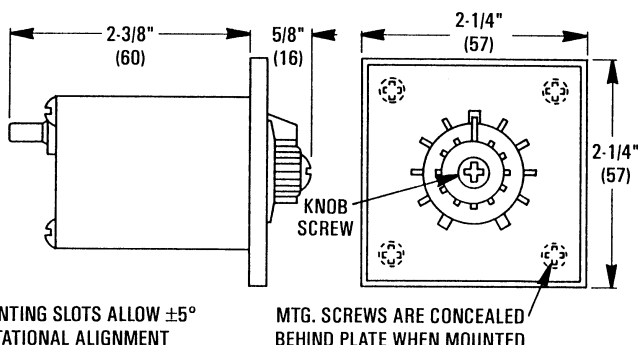
YMC-1001 Model

PUSH-ON CONNECTIONS FOR
3/16" (5) ID FR TUBING



EXHAUST HOLE-
DO NOT PLUG

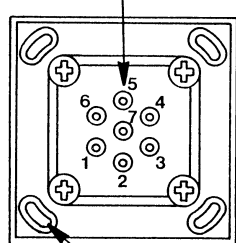
4 MOUNTING SLOTS ALLOW $\pm 5^\circ$
ROTATIONAL ALIGNMENT



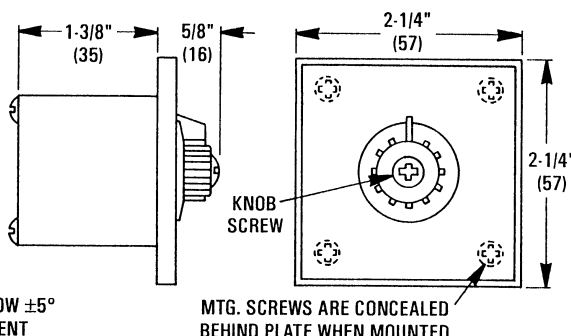
MTG. SCREWS ARE CONCEALED
BEHIND PLATE WHEN MOUNTED

YMC-2001, 2002, 3001, 3002, & 6001 Models

PUSH-ON CONNECTIONS FOR
3/16" (5) ID FR TUBING



4 MOUNTING SLOTS ALLOW $\pm 5^\circ$
ROTATIONAL ALIGNMENT



MTG. SCREWS ARE CONCEALED
BEHIND PLATE WHEN MOUNTED

SWITCH PATTERN

MODELS	POSITION	PORTS CONNECTED
YMC-2001, 2002	Left	2-1; 5-4
	Right	2-3; 5-6
YMC-3001, 3002	Left	7-1
	Center	7-2
	Right	7-3
YMC-6001	1	7-1
	2	7-2
	3	7-3
	4	7-4
	5	7-5
	6	7-6

Specifications

Supply Pressure 30 psig (207 kPa) max

Air Capacity

YMC-1001 28.8 (7.87 mL/s)

YMC-2000/3000/6001 576 scim (157.4 mL/s)

Air Consumption

YMC-1001 28.8 (7.87 mL/s)

YMC-2000/3000/6001 None

Output Range YMC-1001 2-18 psig (14-124 kPa) equals 0-100%

Branch Ports YMC-1001, B1 and B2 internally connected. Cap if unused.

Connections 3/16" (5 mm) nipples for 1/4" (6 mm) O.D. polyethylene tubing.

Temperature Limits

Operating 40° to 120° F (4° to 49° C)

Shipping -40° to 140° F (-40° to 60° C)

Material

Housing: Beige ABS, UL Flame Class 94 HB; Scale plates: aluminum

Weight:

YMC-1001 3 oz (85 grams)

YMC-2,3,6001 2 oz. (57 grams)

!CAUTION

Pneumatic devices MUST operate with CLEAN, DRY, control air. Any other medium will result in the device's eventual failure.

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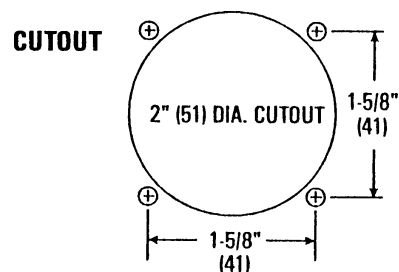
Installation Guide

Mounting

Units may be hollow-wall mounted or connected to a ring panel backplate using a HMO-4506 bracket.

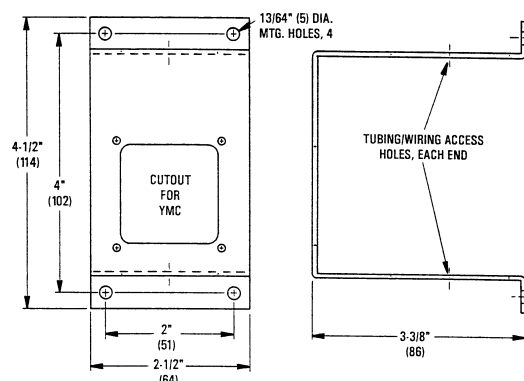
Hollow Walls:

1. Cut a 2" (51 mm) diameter hole.
2. Make connections to the back of the unit (see Connections).
3. Secure unit with the four 5 x 1/2" sheet metal screws (provided).
4. Loosen knob screw and remove the front knob.
5. Apply the scale plate of your choice.
6. Replace knob and lock with knob screw.



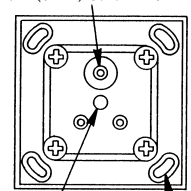
Flat Walls:

1. Install the HMO-4506 mounting bracket.
2. Make connections to the back of the unit (see Connections).
3. Secure unit with the four screws (provided), inserted in the 13/64" mounting holes.
4. Loosen knob screw and remove the front knob.
6. Apply the scale plate of your choice.
7. Replace knob and lock with knob screw.



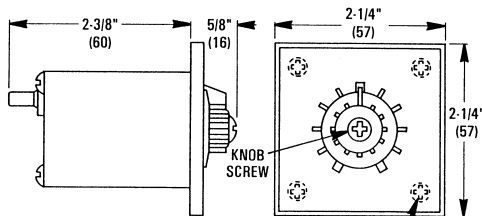
YMC-1001 Model

PUSH-ON CONNECTIONS FOR
1/4" (6 mm) O.D. FR TUBING



EXHAUST HOLE-
DO NOT PLUG

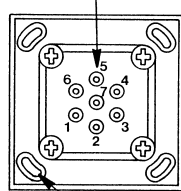
4 MOUNTING SLOTS ALLOW $\pm 5^\circ$
ROTATIONAL ALIGNMENT



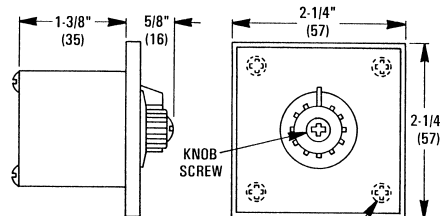
MTG. SCREWS ARE CONCEALED
BEHIND PLATE WHEN MOUNTED

YMC-2001, 2002, 3001, 3002, & 6001 Models

PUSH-ON CONNECTIONS FOR
1/4" (6 mm) O.D. FR TUBING



4 MOUNTING SLOTS ALLOW $\pm 5^\circ$
ROTATIONAL ALIGNMENT



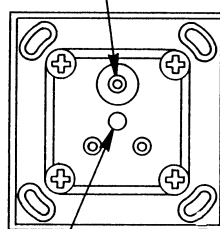
MTG. SCREWS ARE CONCEALED
BEHIND PLATE WHEN MOUNTED

Connections

- ◆ Use only clean, dry, control air. No attempt should be made to use any other medium.
- ◆ Use 1/4" (6) O.D. FR Tubing for all connections.
- ◆ Connect clean, dry, main air supply to upper center Port on YMC-1001.
- ◆ Refer to the table below when making all other connections.

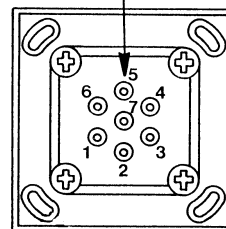
SWITCH PATTERN		
MODELS	POSITION	PORTS CONNECTED
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	Right	2-3; 5-6
YMC-3001, 3002	Left	7-1
	Center	7-2
	Right	7-3
YMC-6001	1	7-1
	2	7-2
	3	7-3
	4	7-4
	5	7-5
	6	7-6

YMC-1001 Model
Push-on Connections for
1/4" (6 mm) O.D. Tubing



EXHAUST HOLE-
DO NOT PLUG

All Other Models
Push-On Connections for
1/4" (6 mm) O.D. FR Tubing



Adjustments and Calibration

Upon receipt, no adjustment should be required.

Maintenance

No routine maintenance is required.

Care should be taken to keep the unit clean from dust during installation.

Each component is designed for dependable, long term reliability and performance.

KMC Controls
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Description

The KMC MCP-1030 and MCP-1130 Series 3" Pneumatic Damper Actuators are designed to position automatic air dampers in pneumatically controlled systems. The units may be used for gradual or two-position applications.

Models are available with either post or right angle bracket mounting. Right angle models are shipped with crank arms for either 1/2" or 3/8" damper shafts. Either style is available with a factory mounted positive positioner. Actuators with positive positioners include an 8 to 13 psi internal spring and a 5 psi span spring. A 10 psi spring may be ordered separately.

Models

Using the table below, choose the model appropriate for your application.

MCP-1 X 30- Y - ZZZ

"X" Mounting Bracket

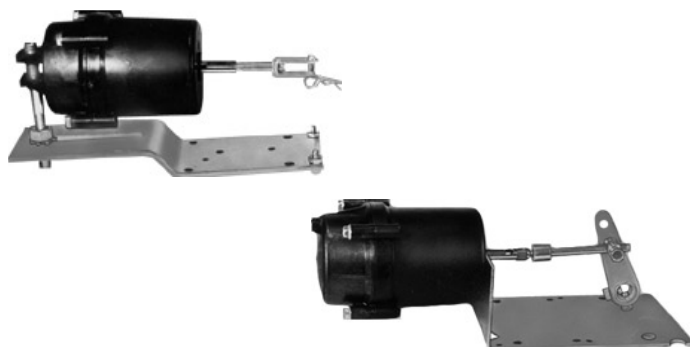
- 0: Bracket mount
- 1: Post mount

"Y" Spring Ranges and Retracted/Extended Torque (Based on 0 and 20 psi applied, at 90°)

- 1: Non-metal, positive positioner (CMC-1001)
- 2: 3 to 12 psi; 31/84 in. lbs. (12 to 83 kPa; 4/9 N•m)
- 3: 5 to 10 psi; 52/105 in. lbs. (34 to 69 kPa; 6/12 N•m)
- 5: 8 to 13 psi; 84/74 in. lbs. (55 to 90 kPa; 9/8 N•m)
- 6: 10 to 15 psi; 105/52 in. lbs. (69 to 103 kPa; 12/6 N•m)
- 8: 4 to 8 psi; 42/126 in. lbs. (28 to 55 kPa; 5/14 N•m)
- 9: Metal, positive positioner (CMC-1002)

"ZZZ" Bracket/Linkage

- 520: MCP-1130 with clevis
- 108: MCP-1030 with ball joint
- 111: MCP-1030 with 1/2" crank arm
- 112: MCP-1030 with 3/8" crank arm



Features

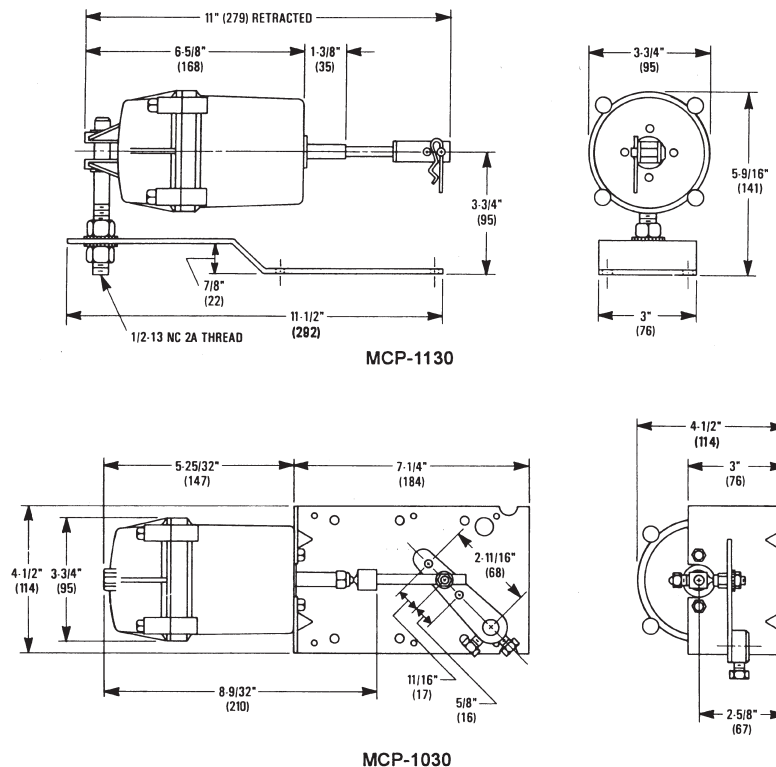
- ◆ Allows gradual or two position operation
- ◆ Variety of springs and bracket linkages provide flexibility
- ◆ Post or right-angle mounting options

Accessories/Replacement Parts

CMC-1001	Non-metallic positive positioner
CMC-1002	Metal positive positioner
VTD-0803	1/4-20 x 5/16" ball joint for actuator
VTD-0804	1/4-20 ball joint for crank arms
VTD-1100	1/4" clevis pin, post mount actuators
VTD-1205	Hairpin cotter, post mount actuators
VTD-1414	3-hole crank arm, 3/8" damper shafts
VTD-1415	3-hole crank arm, 1/2" damper shafts
VTD-1500	Positioner feedback arm
VTD-1634	5/16" push rod, right angle actuators
VTD-2250	5# feedback spring; CMC-1001
VTD-2254	5# feedback spring; CMC-1002
VTD-2260	10# feedback spring; CMC-1001
VTD-2264	10# feedback spring; CMC-1002
VTD-9423	Replacement actuator diaphragm
MCP-0302	3 to 12 psi act. for MCP-1030 series
MCP-0303	5 to 10 psi act. for MCP-1030 series
MCP-0305	8 to 13 psi act. for MCP-1030 series
MCP-0335	8 to 13 psi Phoenix actuator
MCP-0306	8 to 13 psi act. for MCP-1030 series
MCP-0308	8 to 13 psi act. for MCP-1030 series
MCP-0352	3 to 12 psi act. for MCP-1130 series
MCP-0353	5 to 10 psi act. for MCP-1130 series
MCP-0355	8 to 13 psi act. for MCP-1130 series
MCP-0356	8 to 13 psi act. for MCP-1130 series
MCP-0358	8 to 13 psi act. for MCP-1130 series

Details

All dimensions in inches (mm).



Damper Type	Up to 1000 FPM	1000 to 2500 FPM	2500 to 3000 FPM
Opposed blades without seals	3 in-lb / sq.-ft	4.5 in-lb / sq.-ft	6 in-lb / sq.-ft
Parallel blades without seals	4 in-lb / sq.-ft	6 in-lb / sq.-ft	8 in-lb / sq.-ft
Opposed blades with seals	5 in-lb / sq.-ft	7.5 in-lb / sq.-ft	10 in-lb / sq.-ft
Parallel blades with seals	7 in-lb / sq.-ft	10.5 in-lb / sq.-ft	14 in-lb / sq.-ft

Specifications

Material

Body	Glass-filled nylon, UL 94 HB (Nylatron GS63-13)
Diaphragm	Neoprene
Piston	Glass-filled nylon, UL 94 HB (Nylatron GS63-13)
Shaft	CRS with nickel plating
Bearings	Glass-filled nylon, UL 94 HB (Nylatron GS63-13)

Weight

3.5 lbs. (1.58 kg)

Effective Area

7 sq. inches (45 sq. cm)

Stroke

3 inches (76 mm)

Control Signal Connection

3/16" (5 mm) fitting for
1/4" (6 mm) O.D. polyethylene
tubing

Control Signal Pressure Input

0–20 psig (138 kPa) operating
30 psig (207 kPa) maximum

See note under Temperature Limits

Temperature Limits

Operating	–20° to 180° F (–29° to 82° C)
Shipping	–40° to 180° F (–40° to 82° C)

NOTE: If application requires operation near maximum temperature AND maximum pressure, install a tubing restraint at the actuator connection.

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Installation Guide

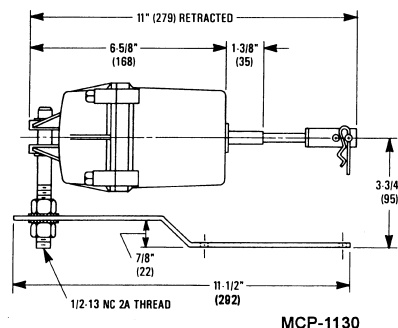
Mounting

Post Mounted - Typically used for internal duct mounting.

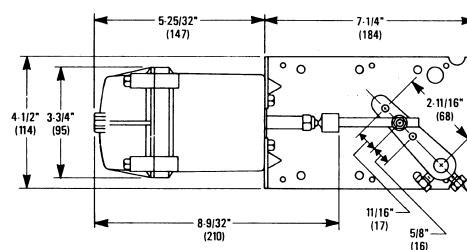
1. Connect the damper's blade clip or drive arm with the clevis pin and cotter pin.
2. Position the damper for its "normal" position.
3. Mount the offset bracket to either the damper frame or the duct.
4. Check that the linkage will not bind as the shaft extends and retracts.

Right Angle Mounted - Typically used for external duct mounting.

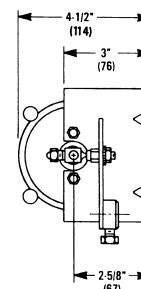
1. Slide the crankarm over the damper shaft.
2. Determine whether the damper shaft must rotate Clockwise (CW) or Counter Clockwise (CCW).
3. Locate the half-circle cutouts on the outside corners of the bracket.
4. Place the appropriate half circle cutout over (for clockwise rotation), or under (for counter clockwise rotation) the damper shaft.
5. Loosely mount the actuator externally on the duct or air handling unit.
6. Leave sufficient room for adjusting and servicing the unit.
7. Position the damper for its "normal" position.
8. Tighten the crankarm set screws.
9. Check that the linkage will not bind as the shaft extends and retracts.
10. Firmly anchor the bracket to the duct. The actuator assembly is positioned for 90° rotation.



MCP-1130



MCP-1030



Connections

- ◆ Use 1/4" (6 mm) O.D. polyethylene tubing.
- ◆ Use only clean, dry control air. No attempt should be made to use any other medium.

NOTE: If the application requires operation near the maximum temperature and maximum pressure, add a tubing restraint to the actuator connection.

1. Connect the signal (0 to 20 psig) to the 3/16" fitting on the base of the actuator.
2. Slowly apply supply pressure to fully stroke the actuator and linkage.
3. Check for any binding. Fine tuning can be accomplished by adjusting the balljoint on the pushrod.

Adjustments



DANGER

The MCP-1030 and MCP-1130 contain a large powerful spring. Exercise extreme caution if disassembly is required. The actuator shaft **MUST** be restrained to prevent the spring from expanding.

Actuators with positioners contain an 8-13 psi spring. A positioner allows the unit to operate over any 5 psi span with the start-point adjustable from 3-10 psi. Replace the 5 psi spring with a 10 psi spring to widen the span.

To change the positioner start-point:

1. Apply the desired signal pressure.
2. Rotate the start-point adjuster until the actuator starts to stroke.

Maintenance

No routine maintenance is required.

Each component is designed for dependable, long term reliability and performance.

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