

# Linkage Experiments

## Purpose

The purpose of the linkage demonstrator is to provide hands-on experience with field issues that come up with linkage systems, including the nonlinear relationship between actuator stroke and damper rotation, actuator force and force available to produce torque, and hysteresis.

While the two demonstrators that are available generally allow the same experiments to be performed, there are some slight differences and if possible you should spend time with both demonstrators.

- The linkage demonstrator with the actual damper assembly also allows you to observe the details of damper construction and to contrast a conventional damper blade with an airfoil damper blade and observe different blade seal arrangements, including jamb seals.
- The linkage demonstrator with multiple actuators allows you to contrast an actuator assembly where the actuator pivots as it moves through its stroke with an actuator that remains fixed by provides a swivel joint in the shaft to accommodate relative motion.

Note that the work of the previous group may have left the linkage system in a less than optimal arrangement as a starting point for your experiment.

## Experiment 1 – Converting Linear Motion to Rotary Motion

1. Gradually increase and then decrease the air pressure to the actuator while watching it move. What happens to the actuator as its shaft extends and rotates the damper blade??  
  
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\_\_\_\_\_
2. If you are working with the demonstrator that has two actuators, repeat the preceding with the 2<sup>nd</sup> actuator. How does the motion of this actuator and its related linkage differ from what you observed for the upper actuator?  
  
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3. Do you think this would make a difference in how dampers connected to these different actuator mounting and linkage arrangements would perform, and if so, what do you think the differences would be?  
  
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December 1, 2010

## Experiment 2 – Assessing the Force Available to Rotate the Damper Blades as an Actuator Goes through Full Stroke

The force produced by the piston actuator acts in a line parallel with the piston actuator shaft. Only the component of this force that is applied perpendicular to the damper shaft crank arm is available to produce torque and/or blade rotation. The other component will act to bend the damper shaft.

1. Use an inclinometer to measure damper blade rotation. Starting with 2 psig, increase the signal to the system. Do the damper blades rotate the same amount for each psi pressure change?  

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2. Based on the angle between the actuator shaft and the crank arm, is the torque available at the damper blade the same for the different positions generated by the pressure changes?  

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3. Decrease the pressure in 1 psig increments and observe the response of the actuators and linkage systems. Does the response in the reverse direction mirror the response in the forward direction? If not, what are the differences?  

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4. Do you think this relationship would change if the geometry between the damper shaft and the crank arm at the beginning of the stroke were changed?  

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5. Based on your observations, what do you think happens to the amount of torque available to rotate the damper blades and/or compress the blade seals at the end of the stroke as the actuator moves through its full stroke?  

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6. How do you think the performance of the system served by these dampers would be impacted by the effects you have observed?  

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7. If a centerline drive actuator were used instead of a piston actuator, how many of the issues you have observed would be eliminated and how many would still need to be considered?  

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December 1, 2010

### Experiment 3 – Assessing Different Crank Arm to Damper Blade Angles

1. As time permits, experiment with different angles between the crank arm and the damper blade at the start of the stroke as well as the angle between the crank arms on the two interconnected dampers. Document your observations below.

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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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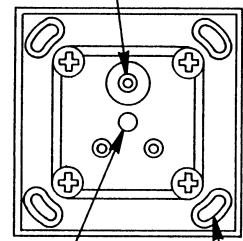
**NOTE:** Scale plates are sold in packs of ten.

## Details

All dimensions in inches (mm).

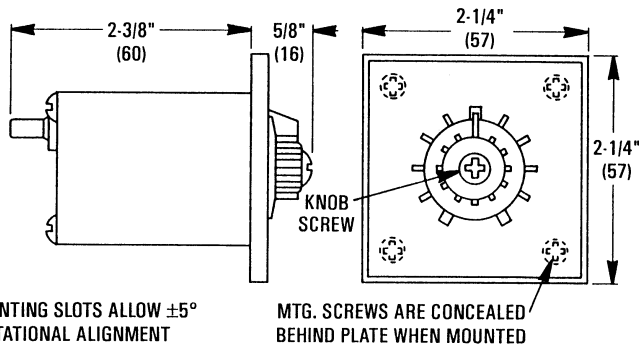
### YMC-1001 Model

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



EXHAUST HOLE-  
DO NOT PLUG

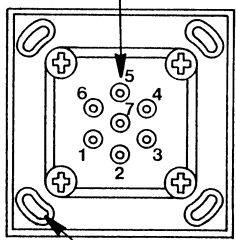
4 MOUNTING SLOTS ALLOW  $\pm 5^\circ$   
ROTATIONAL ALIGNMENT



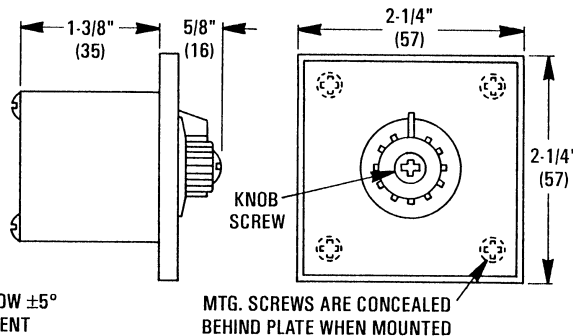
MTG. SCREWS ARE CONCEALED  
BEHIND PLATE WHEN MOUNTED

### 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.

### KMC Controls, Inc.

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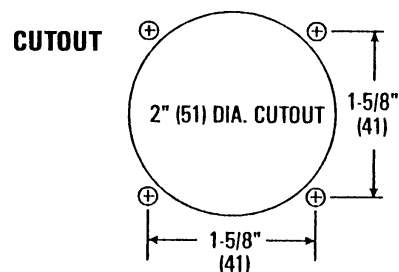
## Installation Guide

### Mounting

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

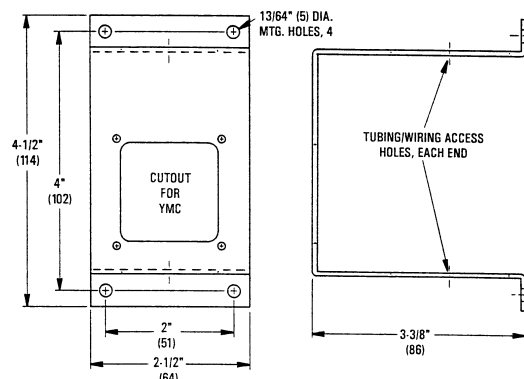
#### Hollow Walls:

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.



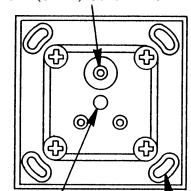
#### Flat Walls:

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.



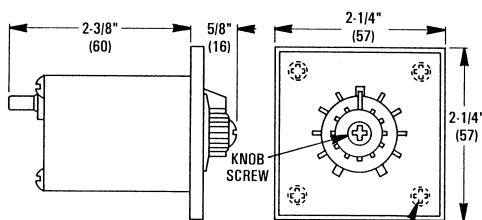
#### YMC-1001 Model

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



EXHAUST HOLE-  
DO NOT PLUG

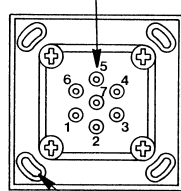
4 MOUNTING SLOTS ALLOW  $\pm 5^\circ$   
ROTATIONAL ALIGNMENT



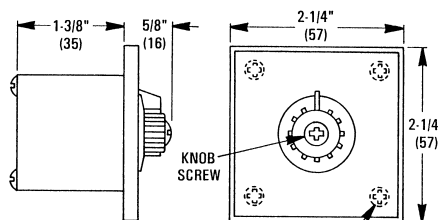
MTG. SCREWS ARE CONCEALED  
BEHIND PLATE WHEN MOUNTED

#### 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



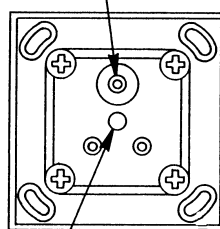
MTG. SCREWS ARE CONCEALED  
BEHIND PLATE WHEN MOUNTED

## 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.

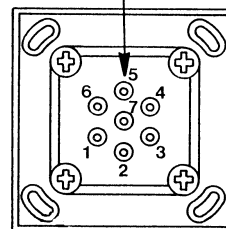
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YMC-6001	1	7-1
	2	7-2
	3	7-3
	4	7-4
	5	7-5
	6	7-6

**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.

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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

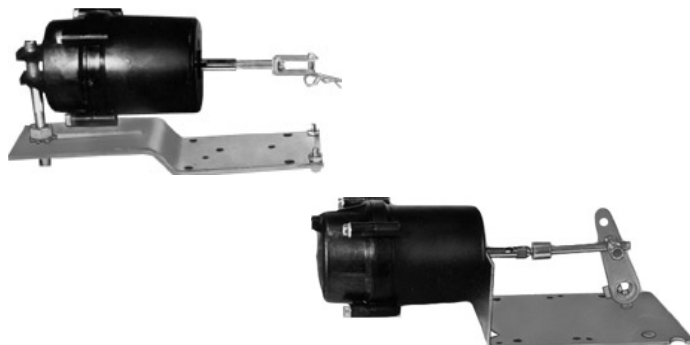
- 0: Bracket mount
- 1: Post mount

#### "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

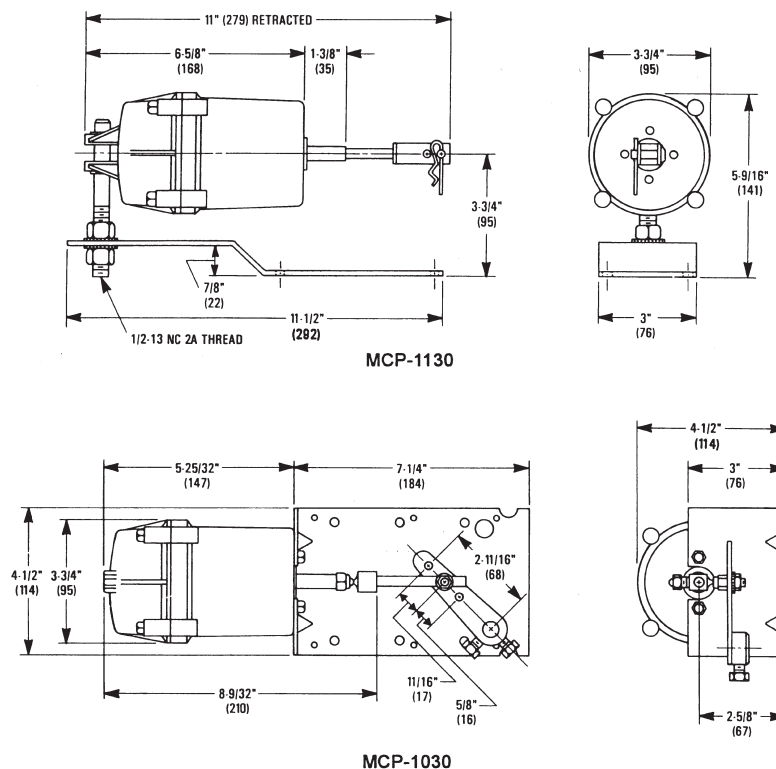
### Accessories/Replacement Parts

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

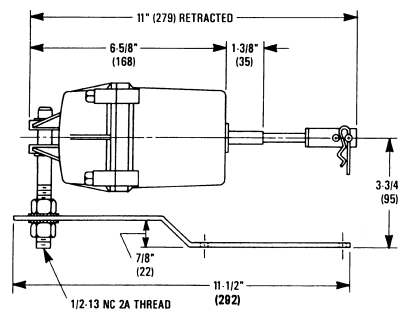
### Mounting

#### Post Mounted - Typically used for internal duct mounting.

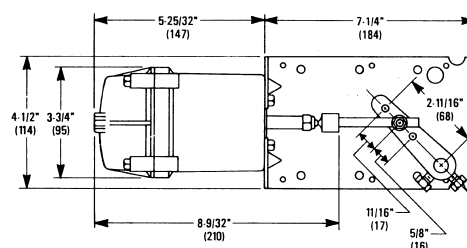
1. Connect the damper's blade clip or drive arm with the clevis pin and cotter pin.
2. Position the damper for its "normal" position.
3. Mount the offset bracket to either the damper frame or the duct.
4. Check that the linkage will not bind as the shaft extends and retracts.

#### 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

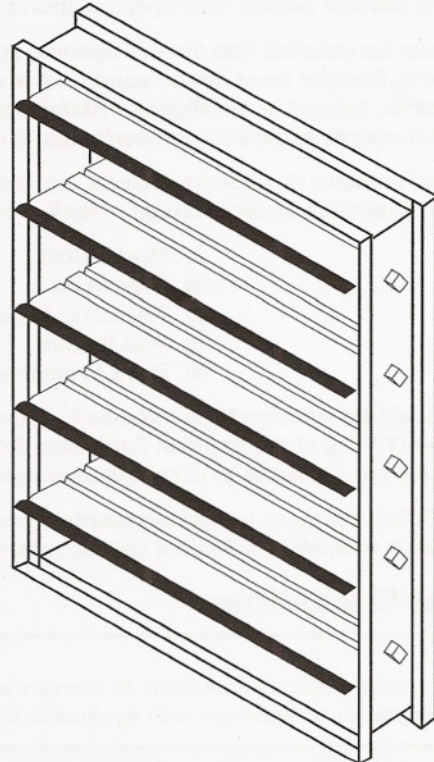
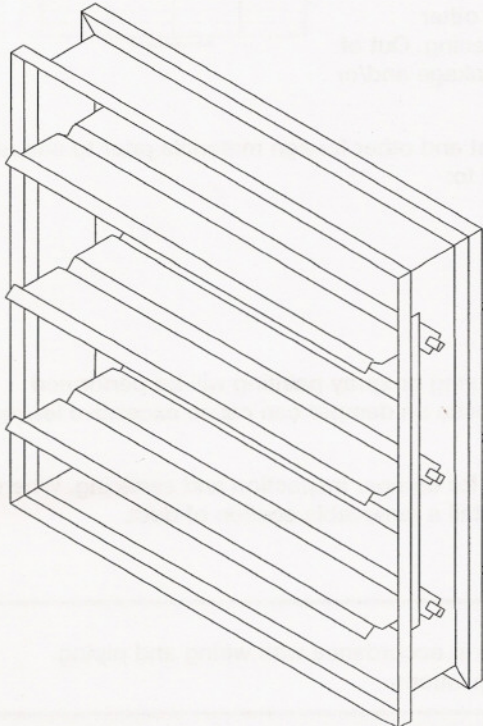
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## Installation, Operation, and Maintenance Instructions

This manual is the property of the owner, and is required for future maintenance. Please leave it with the owner when the job is complete.



### RECEIVING AND HANDLING

Upon receiving dampers, check for both obvious and hidden damage. If damage is found, record all necessary information on the bill of lading and file a claim with the final carrier. Check to be sure that all parts of the shipment, including accessories, are accounted for.

Dampers must be kept dry and clean. Indoor storage and protection from dirt, dust and the weather is highly recommended. Do not store at temperatures in excess of 100°F(37°C).

### SAFETY WARNING:

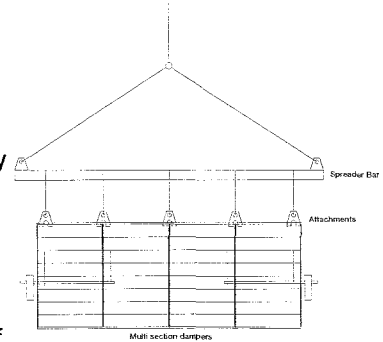
**Improper installation, adjustment, alteration, service or maintenance can cause property damage, injury or death. Read the installation, operating, and maintenance instructions thoroughly before installing or servicing this equipment.**



## Pre-Installation Guidelines

The basic intent of a proper installation is to secure the volume control damper into the opening in such a manner as to prevent distortion and disruption of damper operation. The following items will aid in completing the damper installation in a timely and effective manner.

- 1) Check the schedules for proper damper locations within the building. Visually inspect the damper for damage.
- 2) Lift or handle damper using sleeve or frame. Do not lift damper using blades, linkage, actuators, or jackshifting. When handling multiple sections assemblies, use sufficient support to evenly lift at each section mullion (see drawing). Do not drag, step on, apply excessive bending, twisting, or racking.
- 3) Do not install screws in damper frame that will interfere with unexposed blade linkage and prevent damper blades from opening and/or closing.
- 4) Damper must be installed into duct or opening square and free of twist or other misalignment. Damper must not be squeezed or stretched into duct or opening. Out of square, racked, twisted or misaligned installations can cause excessive leakage and/or torque requirements to exceed damper/actuator design.
- 5) Damper and actuator must be kept clean, dry and protected from dirt, dust and other foreign materials prior to and after installation. Examples of such foreign materials include but are not limited to:
  - a) Mortar dust
  - b) Drywall dust
  - c) Firesafing materials
  - d) Wall texture
  - e) Paint overspray
- 6) Damper should be sufficiently covered as to prevent overspray if wall texturing or spray painting will be performed within 5 feet (1.50m) of the damper. Excessive dirt or foreign material deposits on damper can cause excessive leakage and/or torque requirements to exceed damper/actuator design.
- 7) ACCESS: Suitable access (actuators maintenance, etc.) must be provided for damper inspection and servicing. Where it is not possible to achieve sufficient size access, it will be necessary to install a removable section of duct.



## Electrical Guidelines

Electrical and/or pneumatic connections to damper actuators should be made in accordance with wiring and piping diagrams developed in compliance with applicable codes, ordinances and regulations.

### SAFETY CAUTION !

Verify power requirements before wiring actuator. Greenheck is not responsible for any damage to, or failure of the unit caused by incorrect field wiring.

### SAFETY DANGER !

Electrical input may be needed for this equipment. This work should be performed by a qualified electrician.

## Installation - Failure to follow instructions will void all warranties

### 1. INSTALLING MULTIPLE DAMPER SECTION ASSEMBLIES

A damper assembly is not restricted to a maximum number of sections, but must not exceed the section sizes and overall sizes shown below.

Damper Model	Maximum Section Sizes for Single section Dampers	Max Overall Size for Multi-Section Dampers
VCD-15, VCD-18	48 in. x 60 in. (1219mm x 1524mm)	84 in. x 60 in. (2133mm x 1524mm)
VCD-20, VCD-23	48 in. x 74 in. (1219mm x 1879mm)	Unlimited
VCD-33, VCD-34	60 in. x 74 in. (1524mm x 1879mm)	Unlimited
VCD-40, VCD-42, VCD-43	60 in. x 74 in. (1524mm x 1879mm)	Unlimited

The damper sections must be attached together with #10 x 3/4 in. (19mm) max. sheet metal screws, 1/4 in. (6mm) diameter nuts and bolts, tack or spot welds, or 3/16 in. (4mm) diameter steel pop rivets. Attachments must be spaced a maximum of 6 in. (152mm) on centers and a maximum of 2 in. (50mm) from corners. Attachments must be made on front face and back face (air entering and air exiting side) of damper sections.

Two section high dampers require reinforcement using a 14 gauge (2mm), 5 in. (127mm) wide mullion as shown in Figure 6, or two individually sleeved units stacked vertically, shown in Figure 7. When using two individually sleeved units, the sleeve acts as the mullion, therefore no mullion is required (Mullions are not provided by Greenheck).

## Installation (continued)

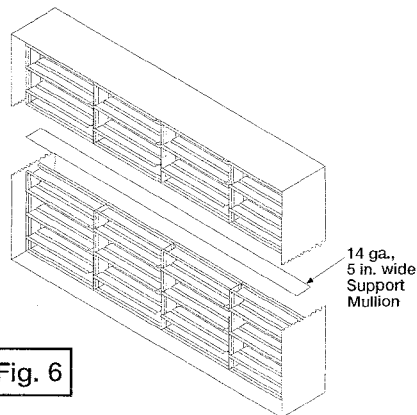


Fig. 6

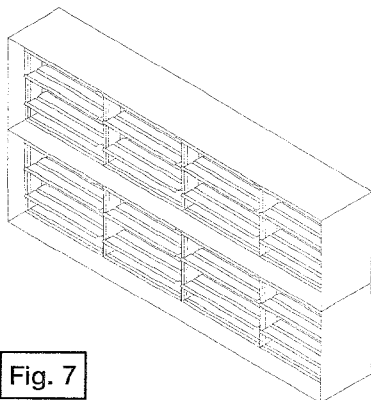


Fig. 7

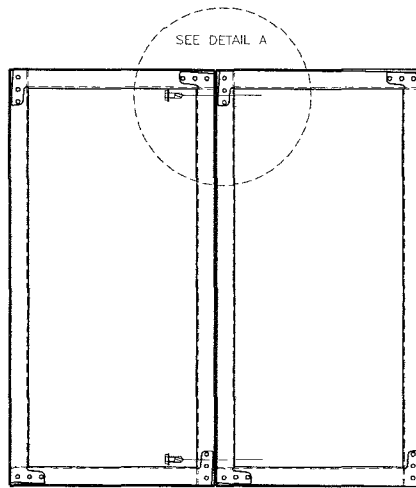
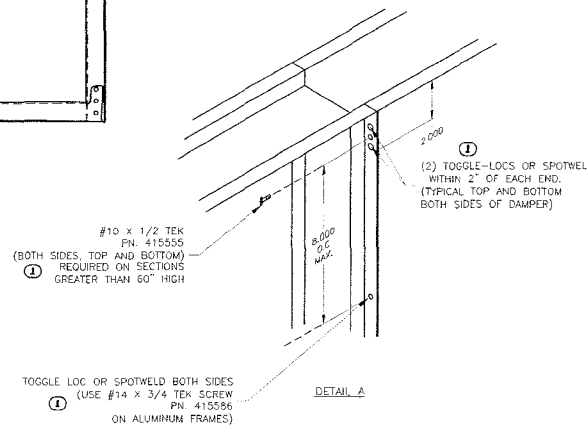


Fig. 8

Multiple section damper frames can be spotwelded or tek screwed together (see figure 8 & 9).



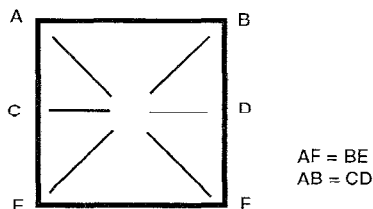
NOTE:

\* USE THIS FASTENING METHOD FOR ALL  
VCD AND MBD-15 DAMPERS.

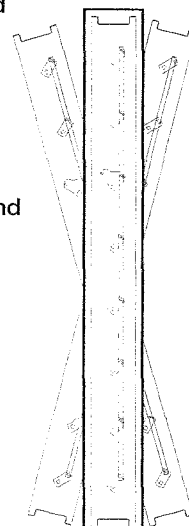
\* USE THIS FASTENING METHOD IF WIDTH  
OR HEIGHT IS GREATER THAN 60".

Fig. 9

- If more than two sections wide, unit ships as a multiple section assembly and a single section together. The single section is joined to the side of the multiple section where the jackshaft extends past the frame 4 inches.
- Duct opening or opening square should measure 1/4 inch (6mm) larger than damper dimension and should be straight and level.
- If no holes are present in frame, drill 1/4 inch (6mm) diameter holes at 6 inch (52mm) centers and fasten frames together with 1/4 inch (6mm) #20 (.03mm) bolts and nuts.
- Use shims between damper frame and duct opening or opening space to prevent distortion of frame by fasteners holding it in place. Brace at every horizontal mullion and vertically brace at every 8 feet (2.4m) of damper width for strength. Dampers in high velocity (2000 fpm [610m per second]) may require more bracing. Note: Greenheck dampers are specifically designed and engineered for structural integrity based on model and conditions. Attachment, framing, mating flanges, and anchoring of damper assemblies into openings, ductwork, or walls is the responsibility of the installer. Design calculations for these retaining and supporting members should be determined by field engineers for that particular installation.
- If damper actuator is to be mounted out of the airstream, the extension pin should extend approximately 6 inches (152mm) beyond the frame. On jackshafted units, the jackshaft should extend through the jackshaft bearing assembly and approximately, 6 inches (152mm) beyond the frame.
- Individual damper sections, as well as entire multiple section assemblies must be completely square and free from racking, twisting, or bending. Measure diagonally from upper corners to opposite lower corners of each section.



Do not twist  
or bow. Mount  
damper plumb  
in the opening.





## Installation (continued)

8. Damper blades, axles, and linkage must operate without binding. Before system operation, cycle dampers after installation to assure proper operation. On multiple section assemblies, all sections should open and close simultaneously.

## Damper Maintenance

Greenheck's dampers are designed to be trouble free and hassle free under normal operation. Dampers are to be installed square and straight so as to prevent binding during operation. The following annual damper maintenance suggestions will help to insure proper damper operation and increase the life expectancy of the damper.

<b>Foreign Matter</b>	Over the course of time, dirt and grime may collect on damper surfaces. The damper surfaces should be cleaned to prevent hindrance to airflow.
<b>Moving Parts</b>	<p>Make sure that parts such as linkage, bearings, blades, etc. that are intended to move freely, can do so. Lubricating these components can prevent possible rusting and unnecessary friction increase. Use only a moli-spray oil or similar graphite based oil as regular lubricating oil will attract dirt.</p> <p><i>Bearings.</i> Synthetic, oil impregnated, and ball bearings (without grease fittings) do not require lubrication. Ball bearings with grease fittings require only minimal grease.</p>
<b>Closure</b>	Remove foreign materials that may be interfering with blade closure or effective sealing of the blades with each other or with the frame.
<b>Operation</b>	While operating the damper through its full cycle, check to see that the blades open and close properly. If there is a problem, check for loose linkage, especially at the actuator. Tighten the linkage where required.

## Damper Trouble Shooting

The following is a cause and correction list for common concerns with the dampers.		
Symptom	Possible Cause	Corrective Action
Damper does not fully open and/or fully close	Frame is 'racked' causing blades to bind on jamb seals	Adjust frame such that it is square and plumb
	Actuator linkage loose	Close damper, disconnect power, adjust and tighten linkage
	Defective motor	Replace
	Screws in damper linkage	Locate screws and remove
	Actuator linkage hitting wall or floor	Damper installed too far into wall. Move out to line designated on damper label
	Contaminants on damper	Clean with a non oil-based solvent (see Damper Maintenance)
Actuator runs hot or makes a humming noise	Actuator type is MP-3754 or MP-3756 (stall type actuator)	None required since this normal for stall type actuators
	Actuator prohibited from reaching end of stroke	Disconnect linkage from jackshaft, open damper, power actuator to end of spring, tighten linkage. Verify amp draw.

## WARRANTY

Greenheck warrants this equipment to be free from defects in material and workmanship for a period of one year from the purchase date. Any units or parts which prove to be defective during the warranty period will be repaired or replaced at our option. Greenheck shall not be liable for damages resulting from misapplication or misuse of its products. Greenheck will not be responsible for any installation or removal costs. Greenheck will not be responsible for any service work or backcharges without prior written authorization.

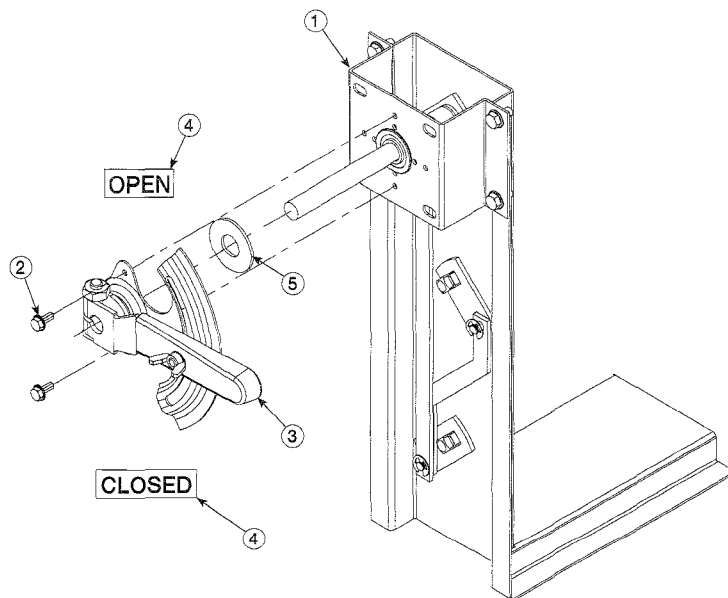


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#463384 VCD IOM Rev. 5 July 2006

Part Number 815607 1/2 in. Extension Pin Kit with Manual Quadrant			
No.	Qty	Description	Part Number
1	1	Extension Pin Kit	809735
2	2	#10 x 1/2 in. Self Drilling SMS	415555
3	1	1/2 in. dia. Manual Quadrant	455648
4	1	OPEN & CLOSED Labels	452690
5	1	Washer (included with No. 3)	

Part Number 811518 1/2 in. Manual Quadrant Kit			
No.	Qty	Description	Part Number
1	1	Extension Pin Kit	not included
2	2	#10 x 1/2 in. Self Drilling SMS	415555
3	1	1/2 in. dia. Manual Quadrant	455648
4	1	OPEN & CLOSED Labels	452690
5	1	Washer (included with No. 3)	



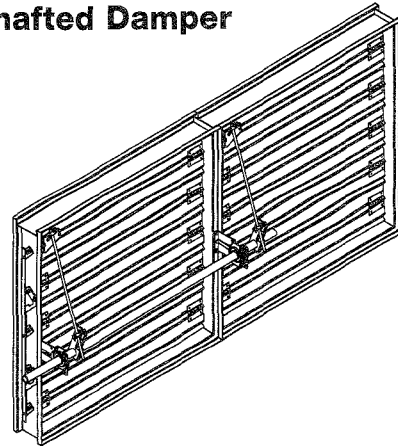
### Non-Jackshafted Dampers

Control damper should be mounted in the duct and the shaft extension mounted onto the correct blade of the damper before continuing with these instructions.

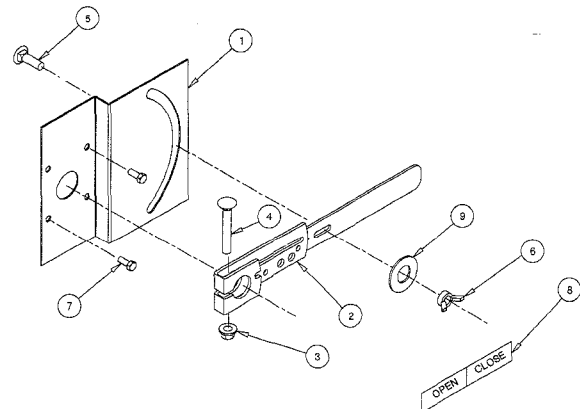
#### After Extended Shaft is Installed

1. Assemble Manual Quadrant to extension bracket assembly (screws provided).
2. With damper either fully open or closed, lock manual quadrant to extended control shaft so manual quadrant can move damper between open and closed. Note: Tighten down bolt on manual quadrant to 250 in. lb. of torque. Apply "OPEN" and "CLOSED" labels if damper movement is opposite to that engraved in the manual quadrant.
3. Set damper to desired position and tighten wing nut on manual quadrant to hold damper in place.

### Jackshafted Damper



Part Number 813938 1 in. Manual Quadrant Kit			
No.	Qty	Description	Part Number
1	1	1 in. Quadrant Bracket	649366
2	1	Quadrant Lever Arm Assembly	814406
3	1	3/8 -16 Spinlock Nut ZP	415457
4	1	3/8 -16 x 2.5 in. Carriage Bolt	415485
5	1	3/8 -16 x 1 in. Short shank Carriage Bolt	415820
6	1	3/8 - 16 Wing Nut	415821
7	4	1/4 -20 1/2 in. Self Threading Screw	415264
8	1	Label - Open/Close	452690
9	1	5/8 in. Flat Washer	415381



### Jackshafted Dampers

1. The jackshaft is, either, 1/2 in. diameter or 1 in. diameter depending upon the size of the damper. The manual quadrant kit for the 1/2 in. diameter jackshaft is Part #811518 and the manual quadrant kit for a 1 in. diameter jackshaft is Part #813938.
2. With damper either fully open or closed, lock manual quadrant to jackshaft so manual quadrant can move damper between open and closed. Note: Tighten down bolt on manual quadrant to 250 in. lb. of torque. Apply "OPEN" and "CLOSED" labels if damper movement is opposite to that engraved in the manual quadrant.
3. Set damper to desired position and tighten wing nut on manual quadrant to hold damper in place.



# Part Number 455049

## Field Installation Instructions for Extension Pin, Extension Pin Kit & Manual Quadrant Operators on Control Dampers

### NOTE: FOR DAMPERS INSTALLED IN DUCTS

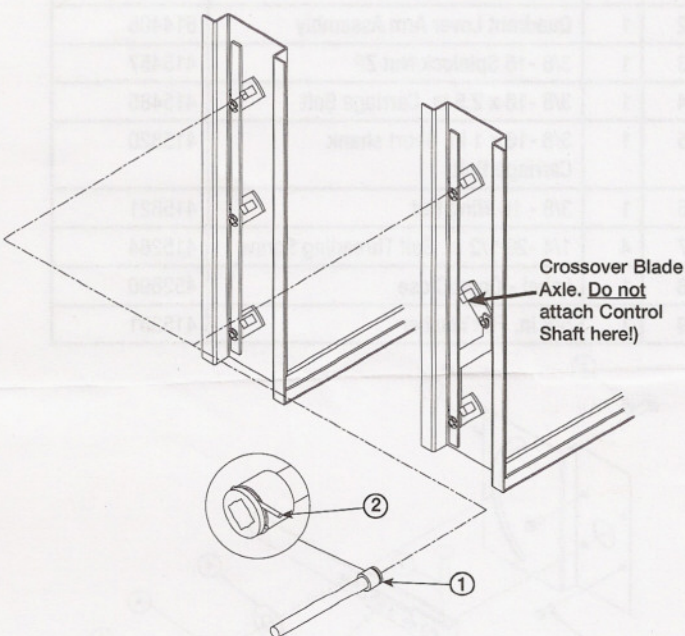
Extended Control Shaft is installed from outside of duct after damper is installed. Install as shown below.

#### TOOLS REQUIRED:

- 5/16 in. Hex Nut Driver
- 3/8 in. Electric Drill
- 1/2 in. Open End Wrench

#### Part Number 846031 Extension Pin with Clip

No.	Qty	Description	Part Number
1	1	Extended Control Shaft	452509
2	1	Retaining Clip	451738



#### Before Installing Damper in the Duct

- If damper has more than one blade, determine which blade axle will be driven by the extended control shaft. Always attach extended control shaft to a blade axle which is directly connected to the main linkage tiebar. DO NOT attach extended control shaft to a crossover blade axle.
- Cut hole approximately 1 in. (25mm) diameter in duct where damper drive blade axle will be located. Hole must provide clearance for enlarged portion of extended control shaft.

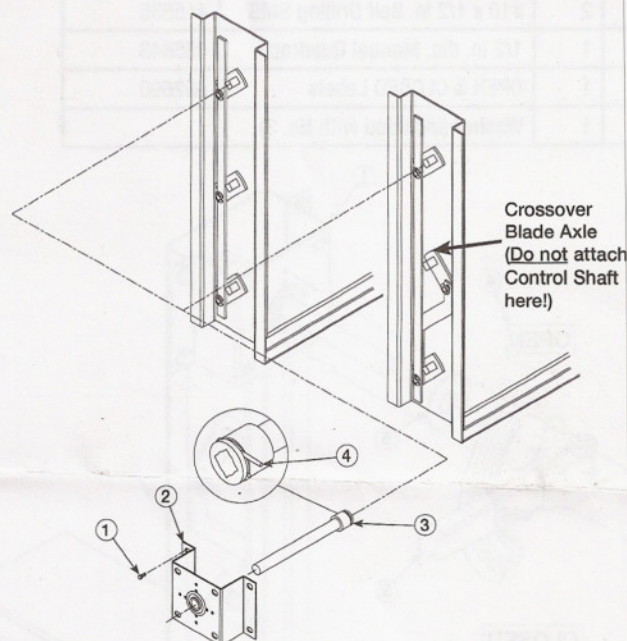
#### After Damper Is Installed in Duct

- Push extended control shaft through hole in duct and onto drive blade axle. Retainer clip should "click" into groove on drive blade axle and hold shaft into place.

Standard Control Shaft location is the third blade from the bottom on dampers with three or more blades. Control Shaft location is the first blade from the bottom on dampers with one or two blades.

#### Part Number 809735 1/2 in. Extension Pin Kit

No.	Qty	Description	Part Number
1	4	Screws	by others
2	1	Stand off bracket with ball bearing	815027
3	1	Extended Control Shaft	452509
4	1	Retaining Clip	451738



#### Before Installing Damper in the Duct

- If damper has more than one blade, determine which blade axle will be driven by the extended control shaft. Always attach extended control shaft to a blade axle which is directly connected to the main linkage tiebar. DO NOT attach extended control shaft to a crossover blade axle.
- Cut hole approximately 1 in. (25mm) diameter in duct where damper drive blade axle will be located. Hole must provide clearance for enlarged portion of extended control shaft.

#### After Damper Is Installed in Duct

- Push extended control shaft through hole in duct and onto drive blade axle. Retainer clip should "click" into groove on drive blade axle and hold shaft into place. Standard Control Shaft location is the third blade from the bottom on dampers with three or more blades. Control Shaft location is the first blade from the bottom on dampers with one or two blades.
- Install the stand off bracket with bearing over the extended control shaft and screw bracket to duct. Make sure screws (provided by others) do not interfere with damper linkage or blade movement.

**Caution:** Stand off bracket with bearing is needed to support the extended control shaft. If not installed as directed, the extended control shaft may not operate the damper correctly.





# GREENHECK

## Blade Seal Replacement Instructions for HCD, VCD, SMD, FSD, series

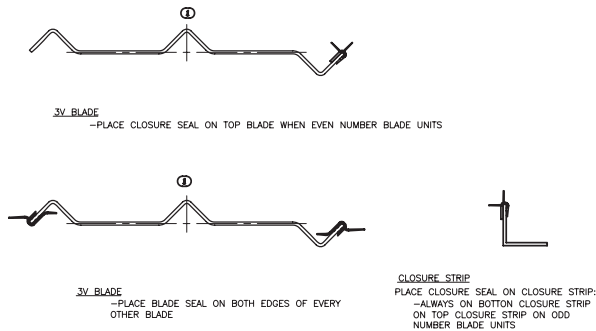
Greenheck offers three different blade styles and uses four different attachment methods for control damper blade seals. These instructions address either replacement or initial installation.

### 3-V Blade Style

Applicable to Models: VCD-18, VCD-23, SEVCD-23, SMD-201, SMD-202, FSD-211, FSD-212, FSD-231, CFSD-211, CFSD-212, OFSD-211, OFSD-212, SSFSD-211, SEFSD-211, HCD-120, HCD-220

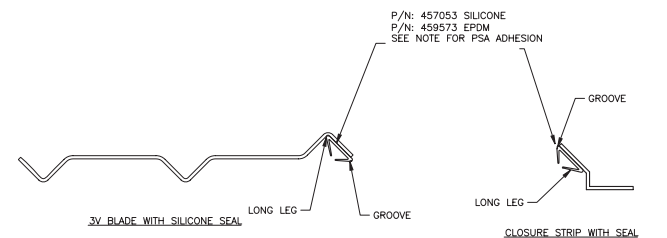
### Clip-On

The vinyl seal, also known as dual-durometer, pushes onto the blade edge and is held by the friction between the blade material and directional projections inside the rigid plastic clip. Seal material is cut-to-length before installing. Seal is normally installed to the drive blade and to every blade tip on the same side of damper.



### Stainless Steel/Silicone Composite

Silicone rubber seal has a stainless steel clip to mechanically fasten seal to the blade edge. Installation is the same as the vinyl seal.



Note:  
- Blade and closure strip must be cleaned with Isopropyl Alcohol to remove oil prior to application of seal to ensure complete adhesion.  
- Apply seal to blade and closure with moderate pressure with a roller.

### Silicone or EPDM Seal with Pressure Sensitive Adhesive (PSA)

- Open blades. Use scraper to remove any existing seal or adhesive.
- Surface must be free from dust, dirt, oil and moisture. Clean blade edge with alcohol or similar solvents. Do not use mineral spirits or other petroleum based solvents that leave a residue.

- Install when blade surface is above 70°F or above.
- Cut seal material slightly longer than blade with release paper still on seal material.
- Start at one end of blade. Peel off 1-2 feet of release paper at a time and place seal firmly onto blade surface. Do NOT touch the adhesive. Use finger or roller to press seal to blade. Do NOT stretch seal as it will pop off in time.
- Trim seal material at blade end as required. Excess seal is prone to pulling from blade surface and will force jamb seal away, increasing leakage.

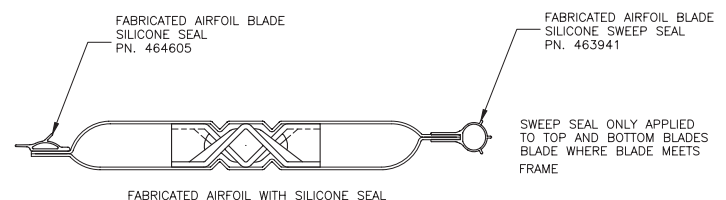
### Silicone Seal with Silicone Adhesive

Tremco Spectrem 1 adhesive is used to adhere silicone seal to painted surfaces, as PSA adhesives will not bond to most powder painted surfaces.

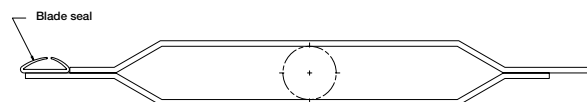
- Open blades. Use scraper to remove any existing seal or adhesive.
- Cut seal to approximate length with release material still on seal.
- Clean blade in the same manner as above. Temperature limits also apply.
- Apply thin 1/8 in. bead of Tremco Spectrem 1 to blade surface. Spread adhesive using a putty knife or scraper to approximately 1/2 in. (13 mm) wide.
- Install seal to blade edge, starting at one end and removing release paper as one moves down blade. Do NOT stretch seal.
- Press seal firmly into place. If seal was stretched, length will shrink.
- Allow adhesive material to cure 15 minutes. Trim seal to length.

### Fabricated Airfoil Blades

Applicable to models: VCD-33, VCD-34, SEVCD-33, SMD-301, SMD-302, FSD-311, FSD-312, FSD-311V, CFSD-311, CFSD-312, HCD-130, HCD-135, HCD-230, HCD-330, HCD-430, HCD-530



Note: Wipe down blade with Isopropyl Alcohol before seals are applied to blades.



HCD Fabricated Airfoil with Silicone Seal

### Silicone or EPDM Seal with Pressure Sensitive Adhesive (PSA)

- Open blades. Use scraper to remove any existing seal or adhesive.
- Surface must be free from dust, dirt, oil and moisture. Clean blade edge with alcohol or similar solvents. Do not use mineral spirits or other petroleum based solvents that leave a residue.
- Install when blade surface is above 70°F or above.
- Cut seal material slightly longer than blade with release paper still on seal material.
- Start at one end of blade. Peel off 1-2 feet of release paper at a time and place seal firmly onto blade surface. Do NOT touch the adhesive. Use finger or roller to press seal to blade. Do NOT stretch seal as it will pop off in time.
- Trim seal material at blade end as required. Excess seal is prone to pulling from blade surface and will force jamb seal away, increasing leakage.

### Silicone Seal with Silicone Adhesive

Tremco Spectrem 1 adhesive is used to adhere silicone seal to painted surfaces, as PSA adhesives will not bond to most powder painted surfaces.

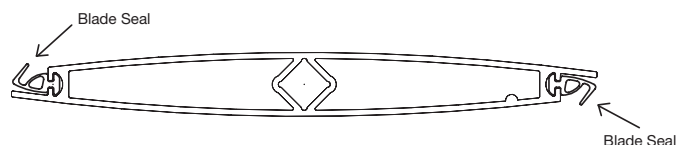
- Open blades. Use scraper to remove any existing seal or adhesive.
- Cut seal to approximate length with release material still on seal.
- Clean blade in the same manner as above. Temperature limits also apply.
- Apply thin 1/8 in. bead of Tremco Spectrem 1 to blade surface. Spread adhesive using a putty knife or scraper to approximately ½ in. (13 mm) wide.
- Install seal to blade edge, starting at one end and removing release paper as one moves down blade. Do NOT stretch seal.

- Press seal firmly into place. If seal was stretched, length will shrink.
- Allow adhesive material to cure 15 minutes. Trim seal to length.

### SS/Silicone Composite

Silicone rubber seal has a stainless steel clip to mechanically fasten seal to the blade edge. Seal material is cut-to-length before installing. Seal is normally installed to the drive blade and to every blade tip on the same side of damper.

### Aluminum Airfoil Blades



Applicable to models: VCD-40, VCD-42, VCD-43, SMD-401, ICD-45, HCD-140, HCD-240, HSD-401  
Extruded aluminum blades have a groove at both blade edges to hold seal. Blade ends are crimped to prevent seal from sliding out.

- Open blades. Remove existing seal. It is usually easiest to pull seal from blade end rather than pulling it out of groove along blade edge.
- Cut seal slightly longer than blade length. Do NOT stretch, as seal will creep back to original length.
- Start at one blade end. The non-attached seal lip is installed away from the blade surface. Seal can usually be stretched sufficiently to pass under existing blade end crimp. Needle nose pliers works well in grasping seal end.
- Use a center punch to re-crimp blade end if necessary.
- Trim seal to length.

Blade Type	Elastomer Material	Blade Attachment	Blade Thickness		Greenheck Part number	Temperature °F (°C)	
			Minimum	Maximum		Minimum	Maximum
3-V	Vinyl	Clip-on	16 ga.	14 ga.	455501	-20	180
	Silicone	PSA	All	All	464605	-60	350
	Silicone	Adhesive	All	All	457053	-60	400
	EPDM	PSA	All	All	468644	-20	250
	SS/Silicone	Clip-on	16 ga.	12 ga.	220108	-60	400
Fabricated Airfoil	Silicone	PSA	All	All	464605	-60	350
	Silicone	Adhesive	All	All	457053	-60	400
	EPDM	PSA	All	All	468644	-20	250
	SS/Silicone	Clip-on	16 ga.	12 ga.	220108	-60	400
Aluminum Airfoil	Silicone	Groove	n/a	n/a	461254	-60	400
	EPDM	Groove	n/a	n/a	460115	-20	250



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Blade Seal Replacement Instructions  
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