



**WARNING!**

**Before replacing actuator, damper must be inspected and determined to be fully functional. See NFPA checklists below.**

## INSTRUCTION SHEET

### Replacement of Pottorff dampers with EM24 or EM120 motors with Belimo FSxx Series

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**WARNING!**

**Installer must be trained and experienced with repair  
of fire and smoke dampers and actuators.**

[www.belimo.us/firesmoke](http://www.belimo.us/firesmoke)

In the “Marking & Application Guide, Dampers for Fire Barrier and Smoke Applications & Ceiling Dampers” April 2013 by Underwriters Laboratories Inc.®, page 6 they state:

#### DAMPER ACTUATORS

“... field mounting or substitution of actuators is not covered within the scope of the UL certification of the product. However, this does not necessarily preclude replacement of actuators in the field. Like any appliance, field servicing of these products is not covered under the scope of the UL certification and factory follow-up service program. As with any part of the damper, it is expected that replacement of actuators in the field be done in accordance with the damper manufacturer’s normal field servicing program.”

## Code and Standard Issues

In general, the administrative section of codes state that all mechanical and electrical systems must be kept in working order and an individual section may state that all life safety devices and systems must be operable. NFPA 80 (Fire) & NFPA 105 (Smoke) require periodic testing and repair of dampers as soon as possible after any deficiency is uncovered. Required testing is shown in the chart below.

Chapter 7 IBC & IFC "Containment" Dampers	
Commissioning	
End of first year	
Every 4 years except in hospitals every 6 years	
Chapter 9 IFC "Smoke Control System" Dampers	
Dedicated	Non-dedicated
Commissioning	Commissioning
Semi-annually	Annually
Chapter 9 IBC & IFC Fire detection & Smoke control systems	
Dedicated	Non-dedicated
Weekly self-test	Not required

Fire & smoke dampers are appliances and field replacement of components is required when failure of any component occurs. Conversion of pneumatic to Belimo electric actuation should be discussed with the Authority Having Jurisdiction (AHJ, local Fire Marshal and/or Building Official). In particular the AHJ must be informed if any blade or auxiliary switches are employed and are connected to the fire alarm system or to a Fire Fighters Smoke Control System (FSCS) panel. Retesting is required. A permit and inspection may be required since connections to an alarm system have been touched. A wiring diagram and new sequence of operation should be submitted or left on the premises per the AHJ’s instructions.

## **NFPA 80 (Fire) & NFPA 105 (Smoke)**

NFPA requires damper inspection and repair of dampers.  
See [www.nfpa.org](http://www.nfpa.org) for Standards.

**See NFPA 80 & NFPA 105 for details. The damper cleaning and examination check list here is based on them.**

Damper installation shall meet code requirements. Fire stopping and drywall integrity shall be confirmed. Ducts shall be fall away with no fasteners connected to damper sleeve.

- a. Dampers and ducts shall be cleaned of all foreign debris and dust build-up.
- b. All exposed moving parts of the damper shall be dry lubricated as required by the manufacturer. (Do not use oil as it draws dirt.)
- c. Damper shall be examined without defective old motor or new actuator to determine:
  - i. The damper shall fully close from the open position.
  - ii. Damper shall fully open from the closed position.
  - iii. There are no obstructions to the operation of the damper. The damper shall not be blocked from closure in any way due to rusted, bent, misaligned, or damaged frame or blades. The damper shall not have defective hinges, side &/or blade seals, or other moving parts. The damper frame shall not be penetrated by any foreign objects that would affect operation.
- d. If the damper is equipped with a fusible link, the link shall be removed for testing to ensure full closure and lock-in-place if so equipped. If the link is damaged or painted, it shall be replaced with a link of the same size, temperature, and load rating.
- e. The fusible link shall be reinstalled after testing is complete.

After installation and wiring of new actuator it shall be tested.

- a. The checklist may be customized using material here and in NFPA Standards. Multiple geometric configurations of springs, fusible link, thermal sensor(s), and actuation are possible. Confirm with AHJ if any additional requirements exist.
- b. Electric thermal sensors, if present, must be tested and replaced if defective.
- c. The test shall be conducted with normal HVAC airflow.
- d. When equipped with smoke detection activation, the smoke detector shall be activated and damper operation observed.

Test voltage input to actuators and repair as necessary if voltage is not correct.  
Old breakers often deliver below 115V and failed actuators may be  
due to power supply problems.

**A record of all repairs must be kept on site and made available to AHJ.**

For the Air Movement and Control Association damper maintenance manual go to:  
[http://www.amca.org/publications/damper\\_maintenance.aspx](http://www.amca.org/publications/damper_maintenance.aspx)

## Local Code Approval

While it is not detailed in codes, the following rules should be followed for selecting Belimo actuators for replacement:

Check the technical specifications to ensure an “equal or better” actuator is used.

- **Temperature** – the replacement actuator shall have been UL555S tested at the same or better temperature as the original actuator. 250°F or 350°F are standard. (Code is 250°F. However, in engineered smoke control systems the consulting engineer may have required 350°F. Tunnels and some other applications require higher temperatures.)
- **Time** – the replacement actuator shall drive open and spring closed at a speed equal or faster than presently required by codes. (<75 seconds is UL 555S and most codes. Las Vegas is 60 seconds. Consult the AHJ with any questions.)
- **Torque** – replacement actuator shall have equal or greater torque than the failed actuator.
- **Voltage** – replacement actuator shall have the same voltage rating as the original.
- **Amperage** – the replacement actuator(s) shall not draw more amperage than the original(s) and cause the total connected amp draw on a circuit breaker to be greater than allowed by electrical code. (This is not a problem as Belimo actuators draw very low current.)
- **Final Testing** – actuated damper and associated devices shall be tested for proper operation.
- See Acceptance testing details below.



**WARNING!**

**In all cases, installation must comply with any and all local electrical and life safety codes. Operation of the system after installation must be performed to verify proper damper cycling. Final checkout requires verifying correct functions.**




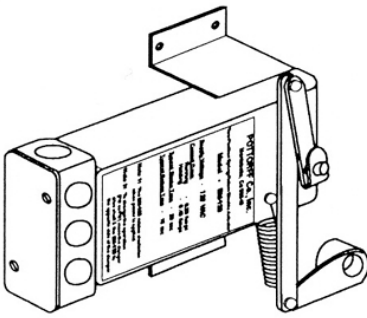
**WARNING!**

**Note that where any fire alarm wiring is touched, the fire department must be informed. A retest by the alarm company is usually required.**

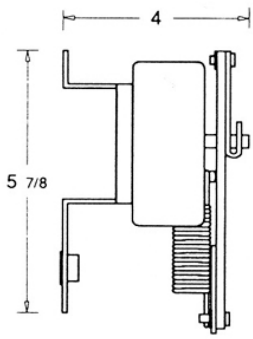
For the Air Movement and Control Association damper maintenance manual go to:  
[http://www.amca.org/publications/damper\\_maintenance.aspx](http://www.amca.org/publications/damper_maintenance.aspx)

## EMxx Motors

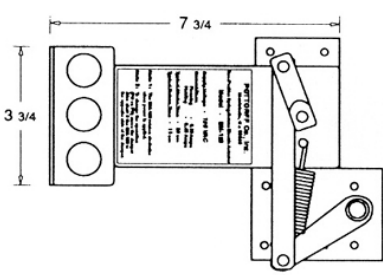
 <b>POTTORFF</b>	<b>SERIES EM</b> <b>model EM-24 &amp; EM-120</b> <b>damper actuator</b>
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**Model EM-120**  
(EM-24 is similar)



**Model EM-120 End View**



**Model EM-120 Side View**

**SPECIFICATIONS**

**Motor Type** - UL listed shaded pole, two position spring return.

**Electrical Req.** - EM-24 Voltage: 24 volts ac, 60 HZ.  
 Current: Running - 1.50 amps  
 Holding - 2.30 amps

EM-120 Voltage: 120 volts ac, 60 Hz.  
 Current: Running - .30 amps  
 Holding - .46 amps

**Rated Torque** - 75 in. lbs. (at the damper shaft).

**Shaft Rotation** - 1.8 rpm, clockwise

**Rotation Time** - Stroke Time - 20 sec  
 Return Time - 15 sec

**Temperature** - UL 555S rated to 350° F.

**Construction** - Die cast aluminum enclosure.  
 - Semi-oiless bearings, maintenance free.  
 - Precision, machine cut gears.

**Motor Bracket** - 16 Ga. Galvanized steel with mounting holes and damper shaft bushing

**OPTIONS**

- Motor voltage: EM-24 ☐  
    EM-120 ☐
- Damper action when power is applied to motor:
  - PO (power open) ☐
  - PC (power closed) ☐
- Factory mounted. ☐

8-26-93

POTTORFF COMPANY INC. 700 SOUTH VAIL AVENUE MONTEBELLO, CA 90640 (213) 728-0004

The drawings above show the EMxx motor and the external spring that is attached.





Typical linkage used with the EM24 or EM120 motor.

Note that the crank-arm partially visible on the right slid over the damper shaft.

When installing a Belimo, it is direct coupled over the damper shaft unless a space constraint exists.

Note that the spring that should be attached to the linkage is missing here.

Most applications follow the concept below. In some cases hybrids with electricla sensors were built. See Page 10 for electrical thermodisk applications.

### FSTF

Best solution for small dampers where any bracket has been hung out into the air is to use an FSTF actuator



The EMxx motors required an external spring to drive the damper closed and the actuator back to its start position. The Belimo has an internal spring

The actuator is used only for the smoke function closing and opening. The fire closing function is provided by the shaft spring and fusible link.

## ***Actuator replacement***

See Retrofit or Documentation Tabs in middle of page:

<https://www.belimo.us/solutions/actuators/product-documentation/damper-actuators-fire-and-smoke>

FSTF for dampers 1.5 sq.ft. and smaller

FSLF for dampers 4 sq.ft. and smaller.

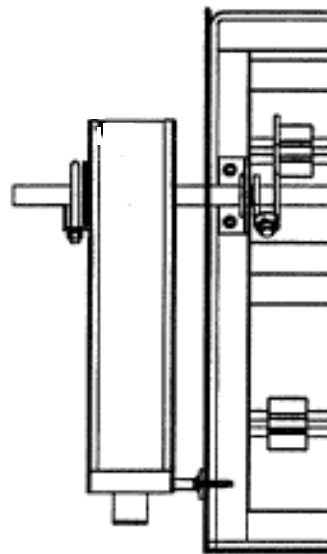
FSLF24 replaces the EM24, FSLF120 replaces the EM120.

FSNF for dampers from 4 to 12 sq.ft.

FSAF\*A for dampers up to 16 sq.ft.

Use dual actuators for larger dampers. Call for information on UL 555S listings.

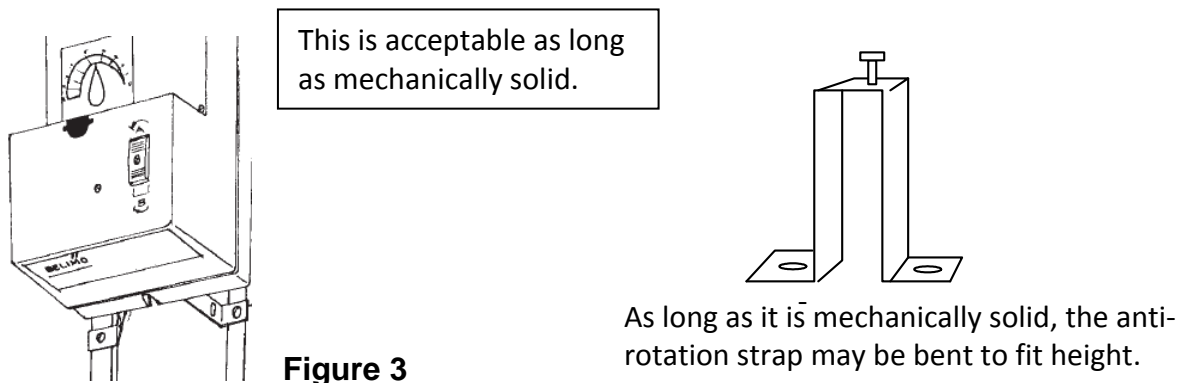
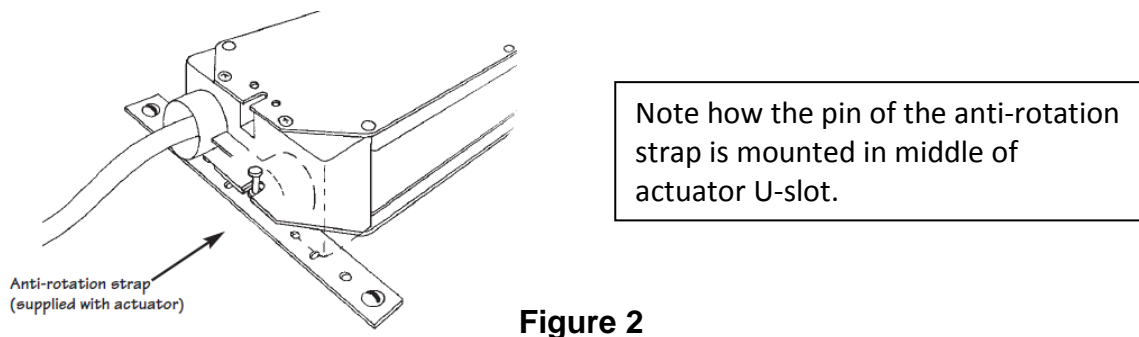
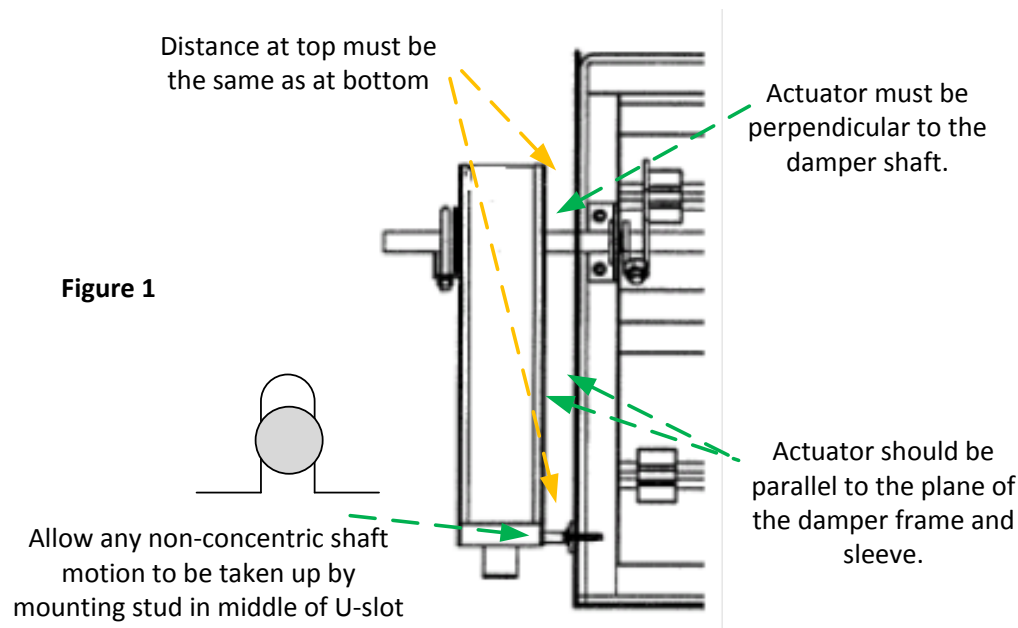
Normal  
mounting.



Actuator should be mounted straight and perpendicular to the damper shaft.

## Mounting

Note that actuator floats freely in direct coupling. Clamp cold welds when teeth dig into the damper shaft and the anti-rotation strap stud allows the actuator to move if shaft is not perfectly concentric. Rigid mounting by jamming the stud into the U-slot of actuator is NOT required.





## Short shaft mounting

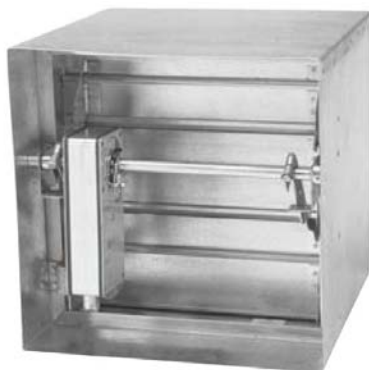


For short shaft mounting, the ZG-LMSA-1/2-5 can be used. Alternately, the clamp can be installed between the actuator and sheet metal.

Clamp



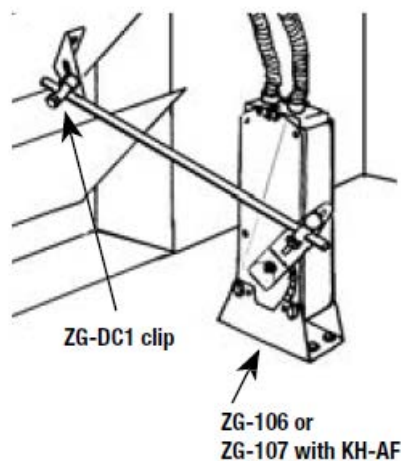
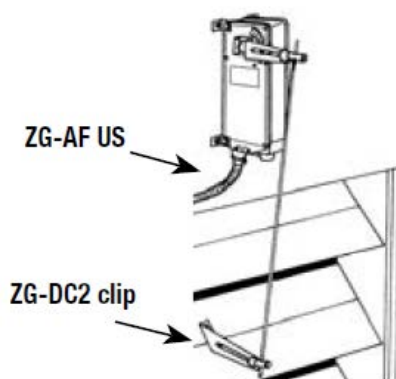
## Internal mounting



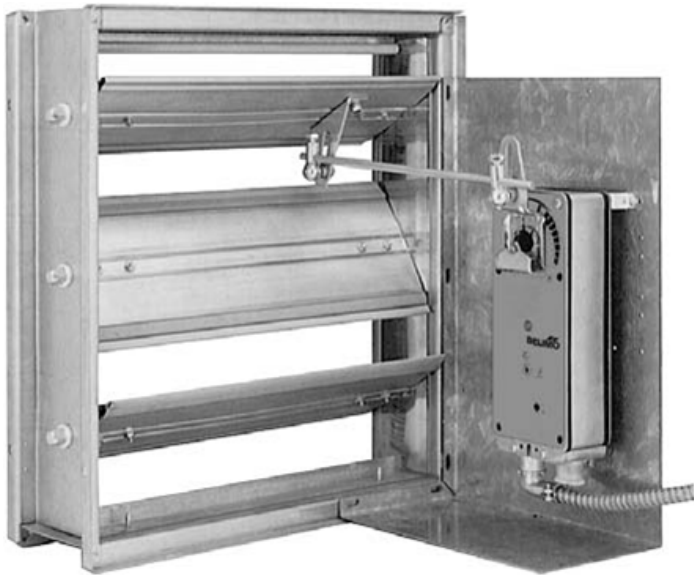
FSNF mounted on the damper shaft. Two sheet metal screws hold the anti-rotation strap. Two nuts secure cold-weld clamp onto shaft. A variety of brackets can be used to hold the conduit connector end of the actuator.

## Linkage mounting

Linkages are only needed where space constraints exist preventing the Belimo actuator from being direct coupled.



Possible alternate arrangements for damper clip.

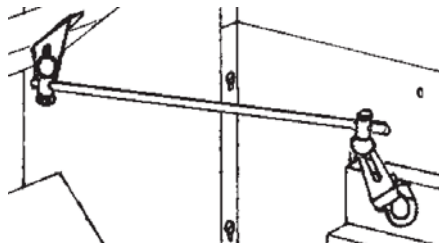
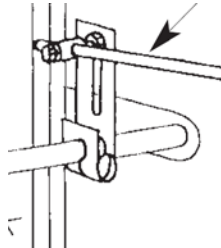
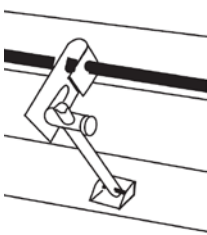


**Belimo linkage kits:**

[https://www.belimo.com/pim/mam/americas/technical\\_documents/datasheets/man-air-acc/Mechanical\\_Accessories.pdf](https://www.belimo.com/pim/mam/americas/technical_documents/datasheets/man-air-acc/Mechanical_Accessories.pdf)

**Mounting Methods Guide:**

[https://www.belimo.us/mam/americas/technical\\_documents/pdf-web/guides/mounting\\_methods.pdf](https://www.belimo.us/mam/americas/technical_documents/pdf-web/guides/mounting_methods.pdf)



### ***Miscellaneous parts***

Should they be needed, Belimo carries a range of parts. Ball joints and 5/16" rods are available from most distributors.



**KH12**

Where the crank arm on the jackshaft is broken or not of the type needed, the KH12 fits over the shaft without removing it. Zinc plated steel. Slot is for the KG10A ball joint. V-bolt fits  $\frac{3}{4}$ " to 1" (20 to 25mm) shafts.



**KH8**

KH-6. Zinc plated steel. For shafts 3/8" to 11/16"  
Uses KG6 ball joint. Slot width 1/4"

KH-8. Zinc plated steel. For shafts 3/8" to 11/16"  
Uses KG8 (90 degree) or KG10A ball joint. Slot width 21/64"



**KG8 3/8"**



**KG6, KG10A 1/4"**

**SH8** (not shown – see picture page 9). Push-rod for KG6 & KG8 ball joints. 5/16" 36" long  
Use SH10 3/8" rods for GMB and dual FSAF or FSNF linkages. 5/16" can bend under heavy loads.

**ZG-DC1**



**ZG-DC1** Damper blade clip and ball joints for blades typically 3.5" in width. Typically the actuator or rod to shaft is in front of blade.

**ZG-DC2**



**ZG-DC2** Damper blade clip and ball joints – typically used for 6" wide blade control dampers. Typically the actuator or rod to shaft is above or below the damper.

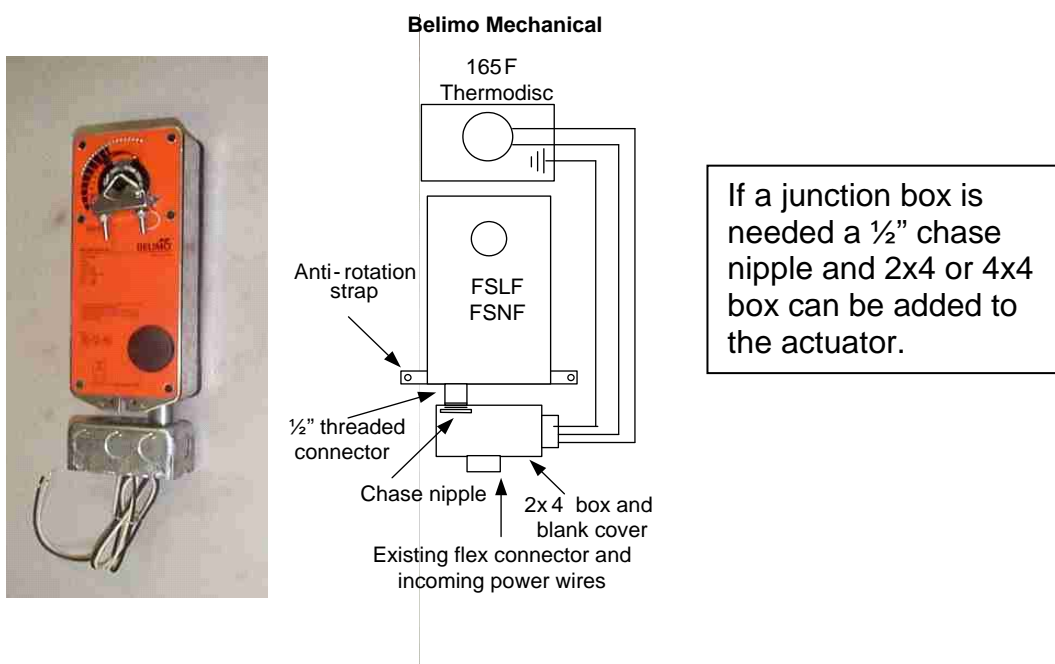


**WARNING!**

**USE CAUTION!**

**Springs may be under high tension and may cause serious injury!**  
**Exercise caution – wear face and hand protection.**

## Wiring



**WARNING!**

**Read Data Sheet provided in box with each actuator for specific wiring details.**



**WARNING!**

**Disconnect and lock out power before starting to disconnect old motor.**

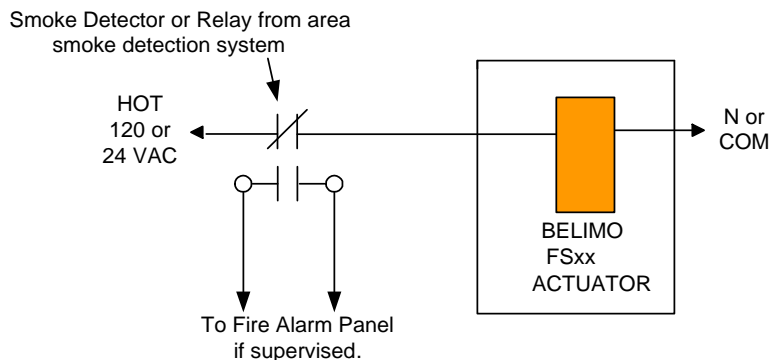


**WARNING!**

**Read Data Sheet provided in box with each actuator for specific wiring details.**

Where an electric sensor is not present, the wiring below is typical.

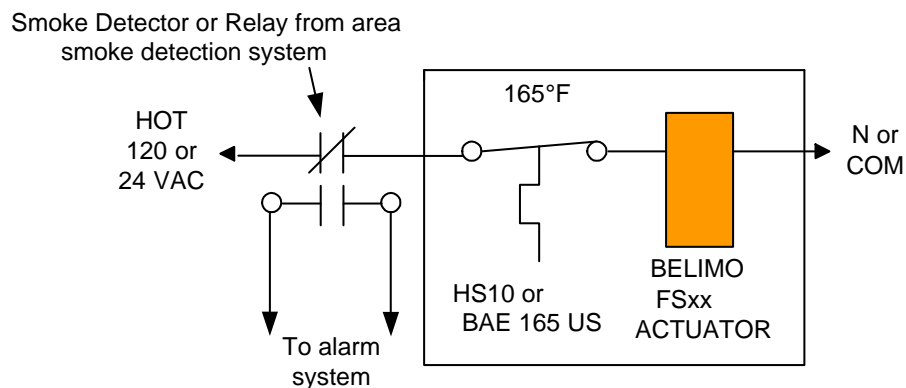
### Original wiring



The drawing below is the typical modern geometry and wiring method. Instead of a fusible link and two springs, the actuator is electrically powered through a electrical thermal switch that is manual reset. HS10 is Pottorff's part number and BAE 165 US is Belimo's part number. The thermal switches open at 165°F. Some EMxx motors could have been controlled using this method.

### TYPICAL FIRE - SMOKE COMBINATION DAMPER WIRING

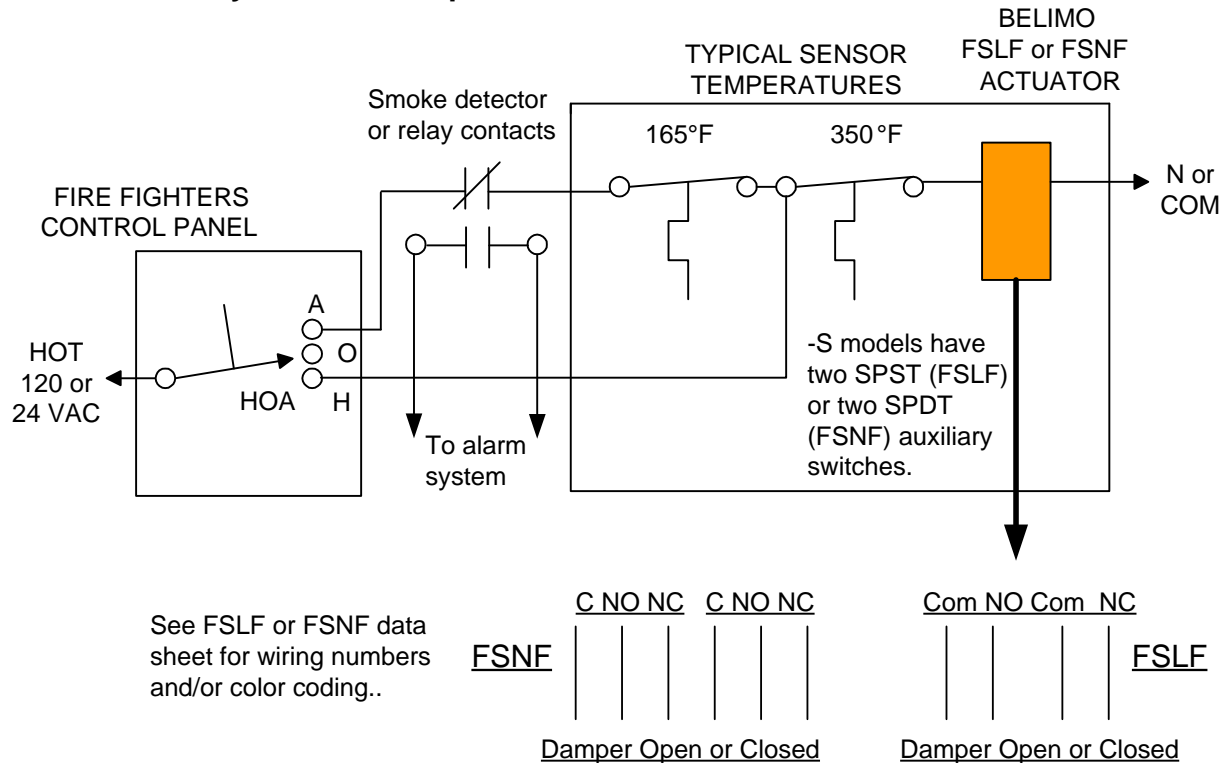
#### Electric thermal disc



Where the damper is used in a smoke control system, the functional wiring below is commonly connected to alarm or smoke control electronic modules in modern systems. The primary sensor is 165°F; the secondary sensor may be 250°F or 350°F.

## TYPICAL REOPENABLE DAMPER with FSCS

### Belimo Auxiliary Switches for position indication to FSCS



**The auxiliary switches are used to provide status indication to the fire fighters' smoke control panel. Typically there are two or three status lights or leds. This wiring is the responsibility of the fire alarm company. If it is touched, they must retest to verify proper operation. These switches are not alarm, but rather indicating.**



**WARNING!**

- Damper must be free to move from open to closed without undue stress.
- Damper and duct must be clean and free of all debris.
- Test damper and controls per Fire Marshal's checklist below.
- Fire alarm company may need to be present to verify proper status indication at FSCS panel.



## Auxiliary Switches

### Damper blade switch assembly



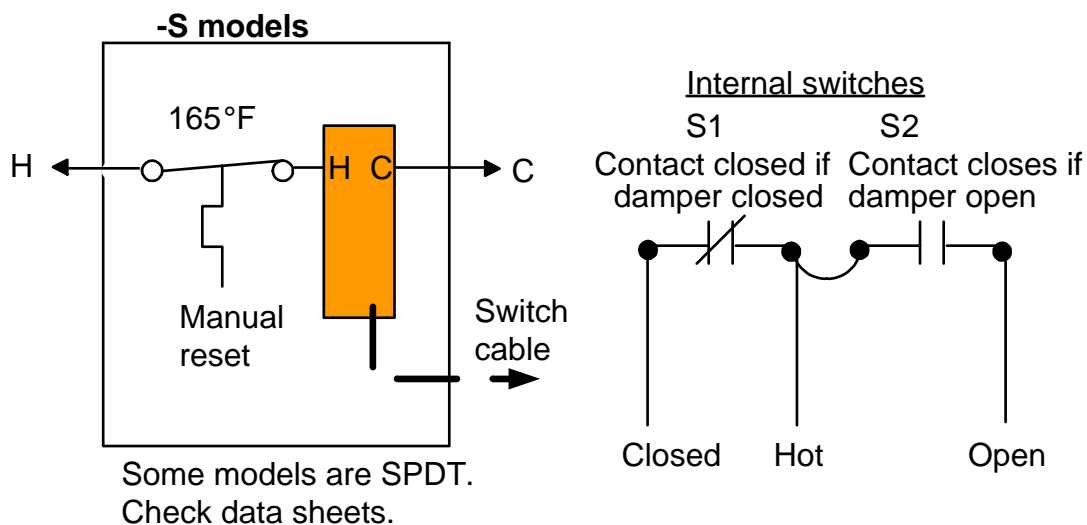
### Externally mounted auxiliary switches



Where the original switches for signaling position to a Fire Fighters' Smoke Control Panel or to local indicator lights must be replaced or are inoperative the Belimo -S model actuators may be used or a S2A-F may be installed.

#### Belimo S2A-F

FSLF (mid 2014ff), FSNF, and FSAF actuators can use the add on switch package.



## Building Official /Fire Marshal Form

Retain this portion of checklist at premises for inspection. See local AHJ for other information and requirements regarding conformance with NFPA 80 & NFPA 105.

These are tests to confirm actuator operation. These are NOT tests of the smoke control system operation. Some dampers are Normally Open. Reverse procedure regarding open & closed.

Repeat 3 times to ensure operation. This imitates UL555S test.

☐ Test Checklist (Smoke dampers do not have sensors. Only steps a & b apply.)

### 1. Fusible link Combination Fire & Smoke Damper

- a. ☐ Open smoke detector or relay wire or contact to cut power. *Damper springs closed.*
- b. ☐ Reconnect power. *Damper drives open.*
- c. ☐ Test fusible link and replace if required. Damper must close properly against air flow.

### 2. Electrical thermal sensor Combination Fire & Smoke Damper

- a. ☐ Open smoke detector or relay wire or contact to cut power. *Damper springs closed.*
- b. ☐ Reconnect power. *Damper drives open.*
- c. ☐ Using heat gun make HS10, BAE 165, or other open contacts. *Damper springs closed.*
- d. ☐ Allow sensor to cool and press reset button. *Damper drives open.*

### 3. Reopenable Two Sensor Fire & Smoke Combination Damper

(Since this system involves the Firefighters' Smoke Control System (FSCS), inform alarm company &/or fire department and request directions for retesting.)

☐ **When completed, ensure any sensors are reset and smoke detector is in normal state and FSCS switch is in Auto. Damper is normally Open; check sequence of operation.**

Damper Numbers or Location Identifying Numbers.....

Date.....-.....-.....

Contractor.....

Service Technician (Print).....

Service Technician (Signed).....

Phone Number (.....).....

Notes.....

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