WARNING!

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

Replacement of pneumatic actuators on Ruskin negator spring dampers with Belimo FSxx Series

Contents

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800 543-9038

WARNING!

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

www.belimo.us/firesmoke

UL®

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 Semi-annually	Commissioning 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**. 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 maintainance manual go to:
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.

(Mnemonic device: TTT-VAT)

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.

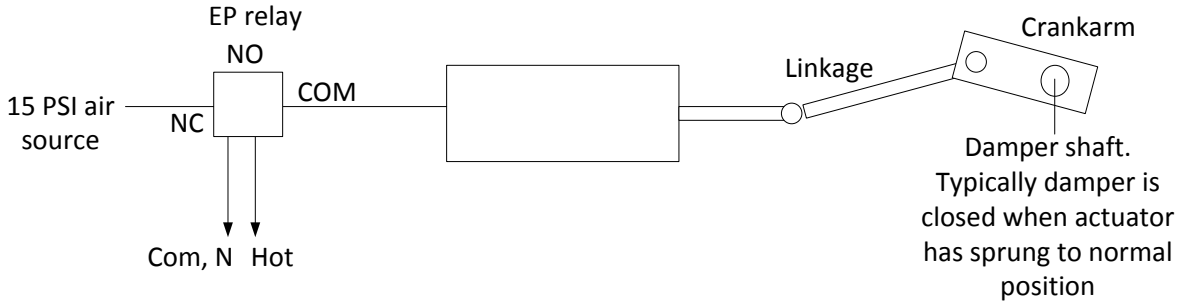
WARNING!

Note that where any fire alarm wiring is touched, the fire department must be informed.

Pneumatic Actuation

Mounting a Belimo actuator is straightforward when replacing most pneumatic actuation. Mount over the shaft when the old actuators were external. For internal mount contact Belimo or consulting our Mounting Methods Guide and Mechanical Accessories at www.belimo.us in the documentation section.

Most existing pneumatic smoke control systems used an EP relay to put air into the actuator to drive the damper open. They cut power to the EP relay (right) which dumps air out of the actuator. The old controls will have been wired similarly to the drawing below. In many cases one EP controlled multiple actuators. If that is the case, multiple relays from the smoke control system may be required. Contact Belimo should wiring assistance be required.



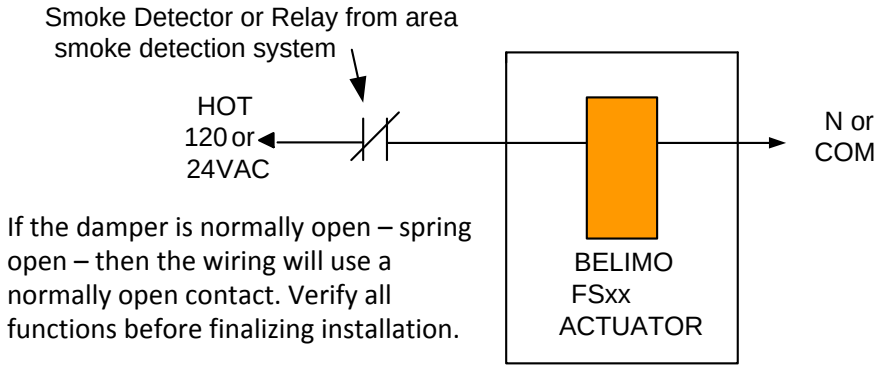
Typical pneumatic actuation. If smoke control system cuts power to EP relay then actuator has zero air pressure and springs damper closed.

WARNING!

Conversion of a pneumatic actuated fire and smoke damper is not a like-for-like replacement. Consult with AHJ for any submittal, permit, inspection, and re-testing requirements.

Fusible-rod DAMPER ACTUATOR WIRING

Where the fusible-rod and negator spring(s) are present and functional, this is the typical wiring. There is no electrical thermal disk as the fire closing function is performed by the rod and negator spring.



If the damper is normally open – spring open – then the wiring will use a normally open contact. Verify all functions before finalizing installation.

SEE ACTUATOR REPLACEMENT SECTION FOR DERATED DAMPER AREA RECOMMENDATIONS.

Actuator replacement begins with the damper, not the old motor

The negator damper design is unlike modern dampers. A negator spring attaches from a post on the damper frame to the blade. A fusible rod connects between the blade and the jackshaft. The rod melts at 165°F (74°C) disconnecting the crank arm and motor from the blade. The negator blade spring pulls the damper blades closed.

In normal operation if air pressure is cut from the actuator, both the negator spring and the actuator spring close the damper blades. The actuator no longer holds the damper blades open.

There is a fusible link on a bracket connected to the blade. The link melts at 165°F and allows the catch on the frame to hold the damper closed. It is not involved in the actuator replacement process. The fusible link should be replaced if broken.

See following pages for examples of the components discussed above.

FUNCTIONAL
Negator spring connecting post and damper blade.

BROKEN
Negator spring separated between post and damper blade.

Far Left. From top – Jackshaft, crank arm, fusible rod, blade, negator spring. At the very bottom left is the spring catch latch plate.

Right
The fusible link and spring catch are seen on the blade.

Broken fusible-rod or negator spring

Neither the fusible rods or negator springs are available.

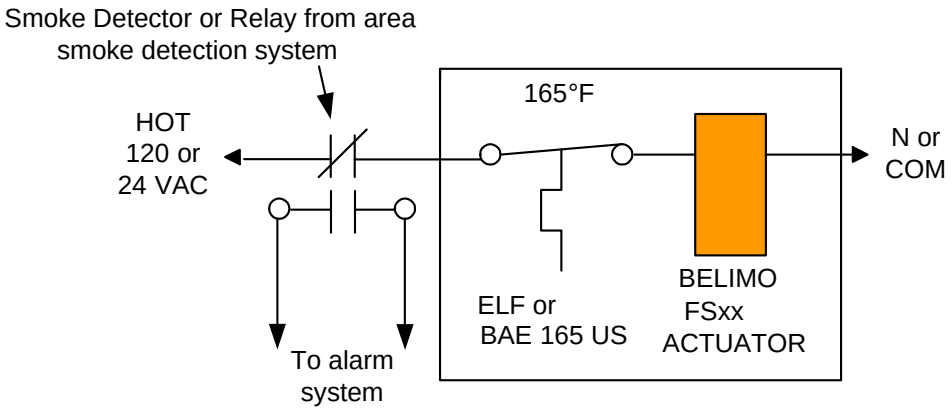
If the damper is otherwise intact with functioning negator springs, fusible link and spring catch, and fusible rods, then if replacing pneumatic actuators with Belimo actuators, it is recommended to bring the damper up to modern methods. However, the actuators only may be replaced along with updated control wiring. See below for component replacement methods.

Intact negator springs should be removed to prevent possible obstruction. With a Belimo actuator with an internal spring, the damper will perform the same as modern dampers.

Note that the smoke control system cuts power to one or more actuators in addition to the local EFL or BAE control. Confirm all wiring performs the same function as the original or as the AHJ instructs.

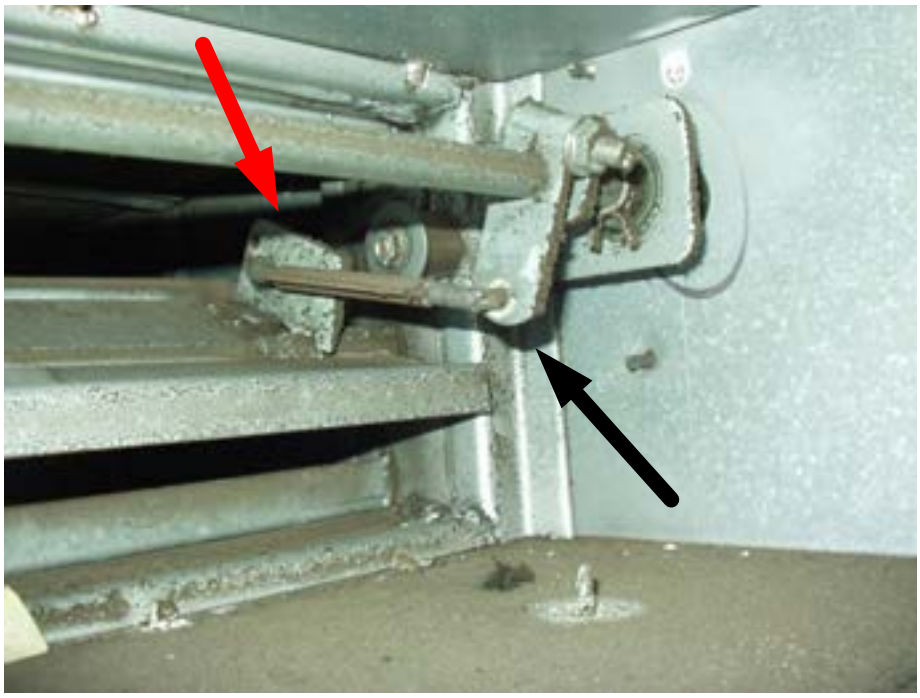
TYPICAL FIRE - SMOKE COMBINATION DAMPER WIRING

Electric thermal disc



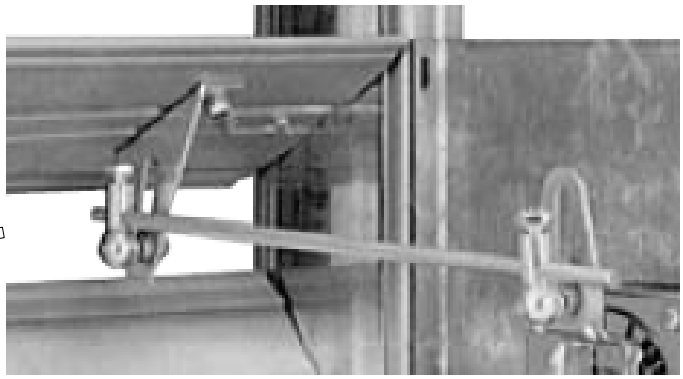
Replacing the fusible rod

The pieces of the fusible-rod must be removed and two5/16” ball joints and a short push-rod installed to connect the damper blade to the jackshaft crank arm.



The fusible rod connects in the same 5/16” holes on the damper blade bracket (red arrow) and crank arm (black arrow) as ball joints.

The fusible rod is replaced by two ball joints and a short piece of push rod as shown here. A thermal sensor takes its place.



WARNING!

The damper’s fire closing function will not operate unless the negator spring works or the damper is repaired per the instructions here or from Ruskin.

Actuator replacement

See https://www.belimo.us/solutions/actuators/product-documentation/damper-actuators-fire-and-smoke#tab2 for instructions for electric motor replacements.

Most pneumatic actuators were externally mounted to the damper shaft or jackshaft. Replacement is simple.

If the old damper's negator springs and fusible rod are intact, then use an FSLF 30 in-lb actuator for dampers with a single negator spring under 2 sq.ft. in total area. For dampers from 2 to 6 sq.ft. with 2 negator springs, use the FSNF 70 in-lb actuator.

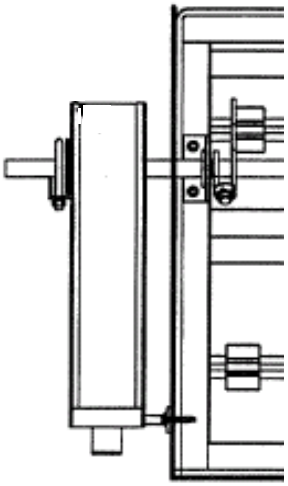
If the old damper's negator spring has been removed and the fusible rod replaced with ball joints and a short push rod, then:

FSLF for dampers 4 sq.ft. and smaller.
FSNF for dampers from 4 to 12 sq.ft.
FSAF for dampers up to 16 sq.ft.

Use dual actuators for larger dampers – such dampers should not exist, but unauthorized field modifications may have occurred.

Direct Coupling

Typical mounting.



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

Examples of actuators hung in the air. Adaptors can be fabricated in a sheet metal shop or use of electrical box covers or unistrut are approved. The Belimo anti-rotation strap is screwed or bolted to the adaptor.

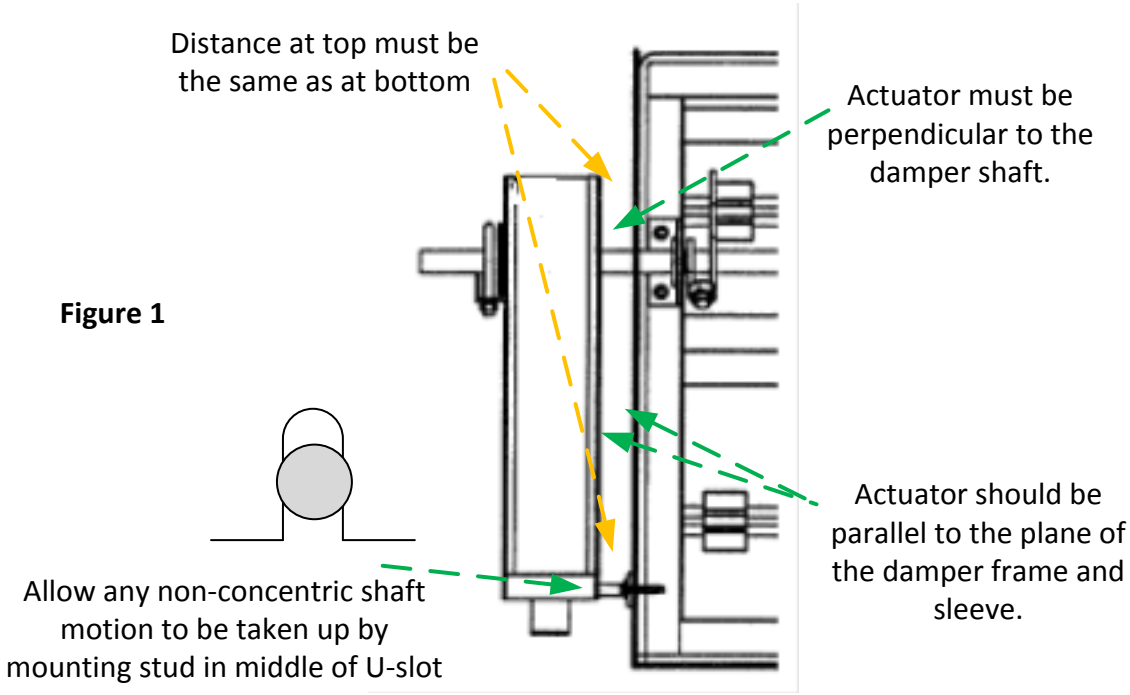
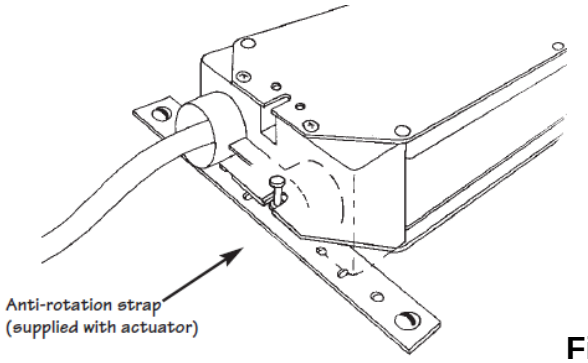
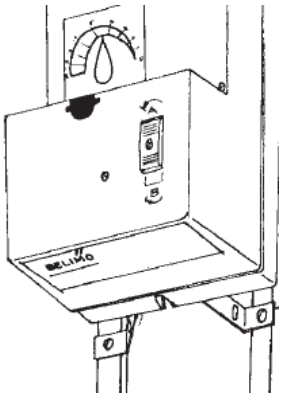


Figure 1



Note how the pin of the anti-rotation strap is mounted in middle of actuator U-slot.

Figure 2



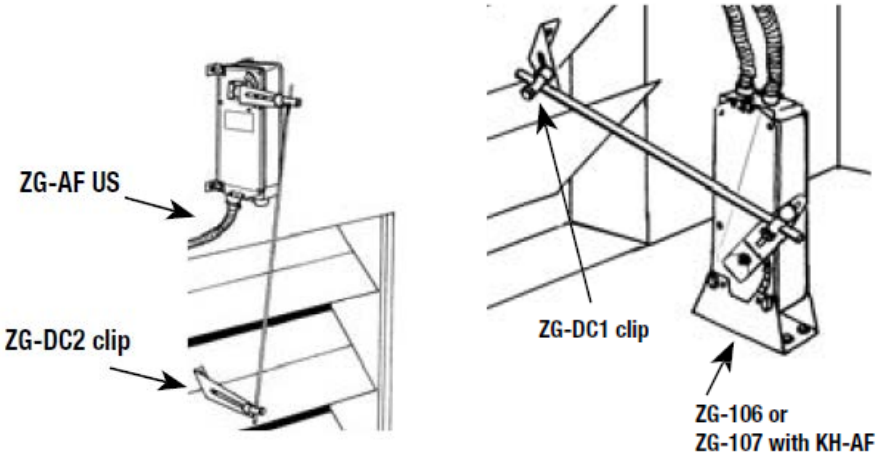
This is acceptable as long as mechanically solid.

Figure 3

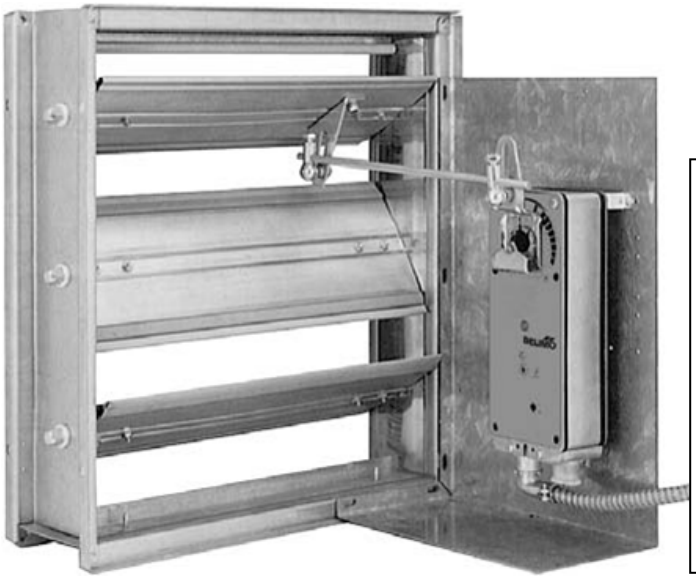
Linkage mounting

WARNING!

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



Possible alternate arrangements for damper clip. (FSNF, FSAF actuators shown.)



Belimo linkage kits:
https://www.belimo.com/pim/mam/americas/technical_documents/data_sheets/man-air-acc/Mechanical_Accessories.pdf

Mounting Methods Guide:
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.

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 ¾” 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”

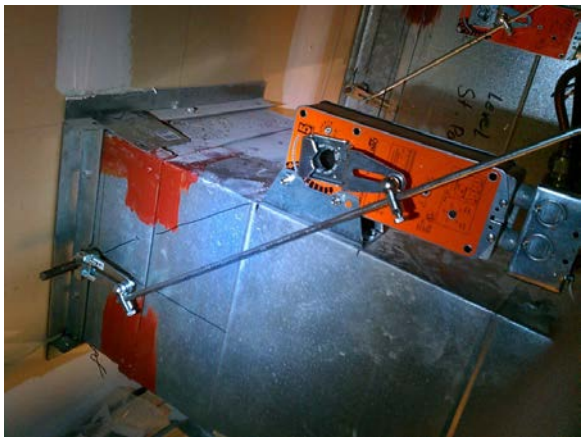
KG6, KG10A ¼”

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 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.

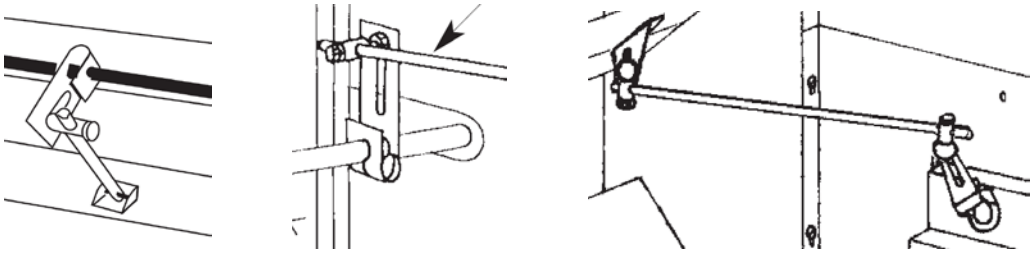
ZG-DC2 Damper blade clip and ball joints – typically used for 6” wide blade control dampers. Typically the ctuator or rod to shaft is above or below the damper.

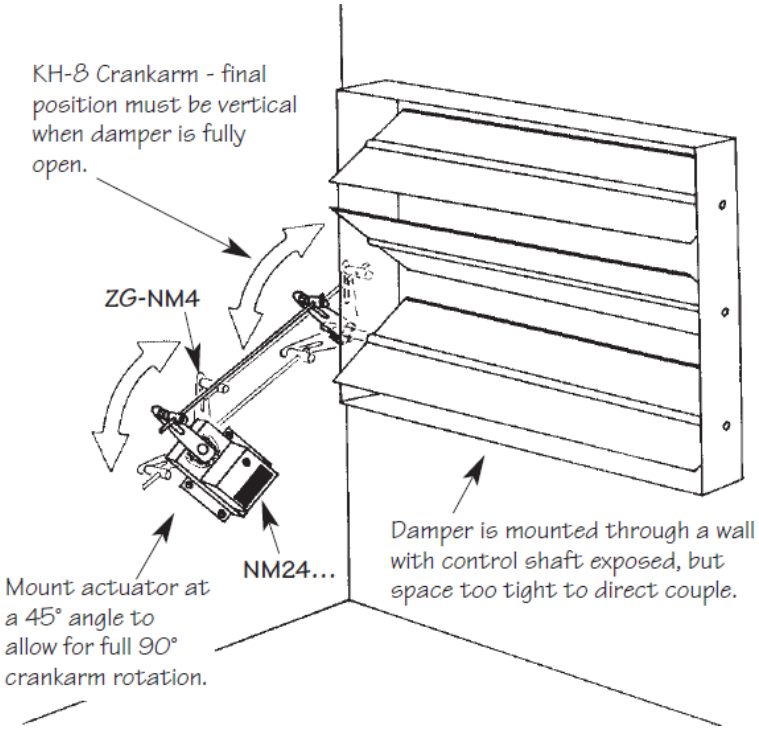
Useful mounting ideas



If the damper shaft is too close to the wall to direct couple, a crank arm may be used. Several duct mount kits are available . ZG108 is the most commonly used. A leg kit, the ZG-AF US is also common.

Where existing shaft is short, the clamp can be mounted between the actuator and the duct.



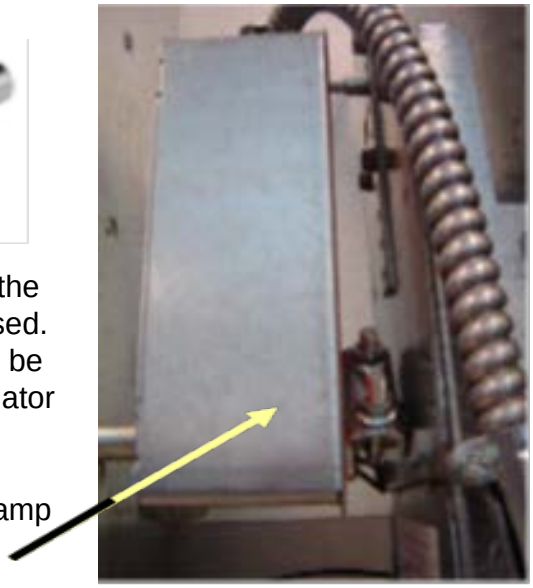


Note that actuator floats freely in direct coupling. Clamp cold welds when teeth dig into the damper shaft and the anti-rotation strap stud allows the actuator to move if shaft is not perfectly concentric. Rigid mounting by jamming the stud into the U-slot of actuator is NOT usually best.

Short shaft mounting

ZG-LMSA-1/2-5

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.



WARNING!

USE CAUTION!

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

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.

Thermal sensor replacements – BAE165 US

Belimo BAE165 US

Where existing sensor is defective or one must be added, the 165°F primary sensor may be used. Original equipment is recommended although not strictly required by code. UL does not regulate replacement or repair. See NFPA 80 or NFPA 105.

Auxiliary Switches

Damper blade switch assembly

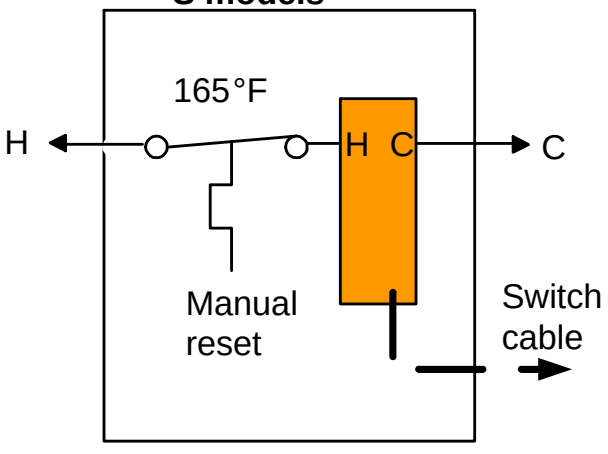
Externally mounted auxiliary switches

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.

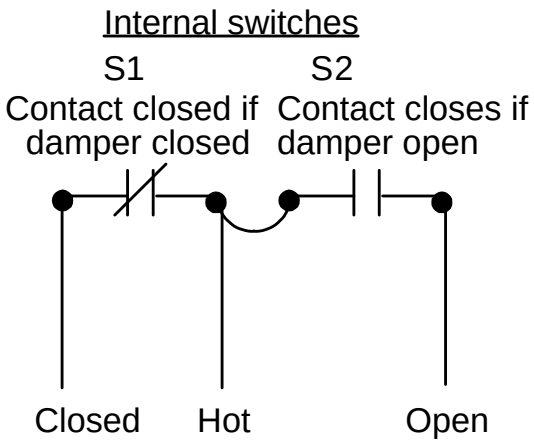
Belimo S2A-F .

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

-S models



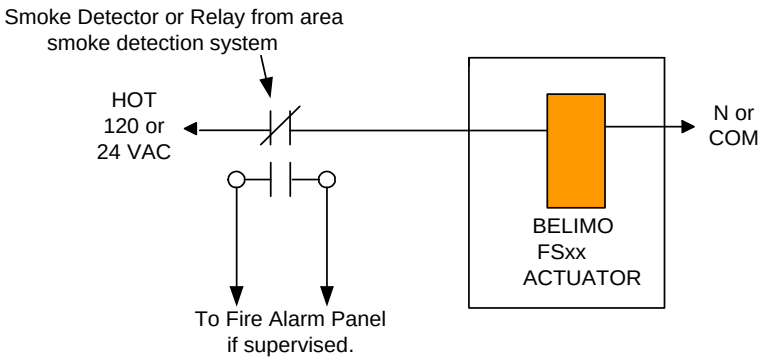
Some models are SPDT. Check data sheets.



Wiring

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

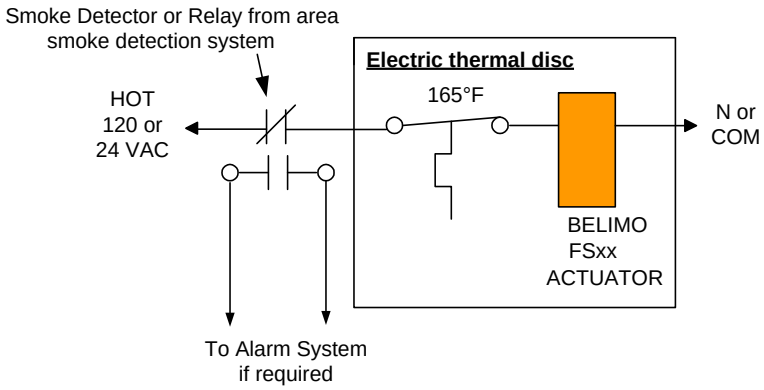
Original wiring



Since the negator spring and fusible rod perform the damper fire closing function, the only wiring is to the smoke detection system. In some cases a thermal disc may be present. Contact Ruskin or Belimo for correct procedures.

Typical wiring for modern dampers is shown below.

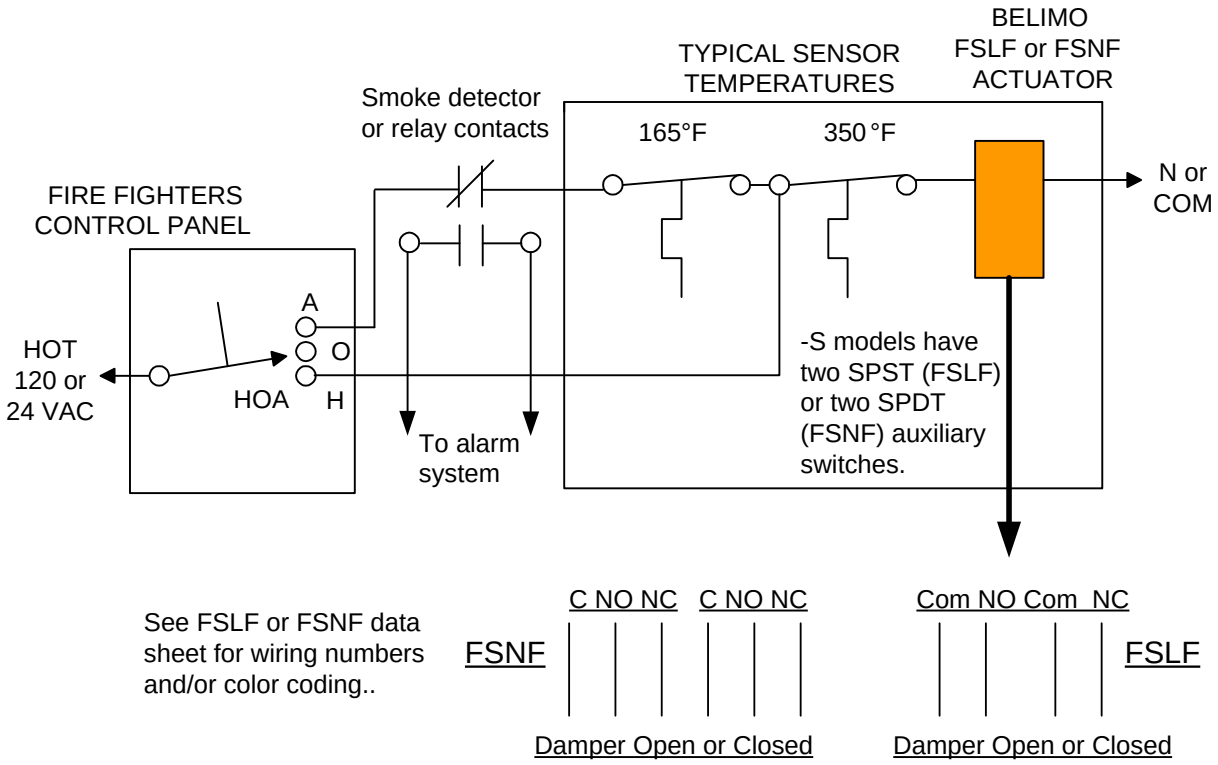
TYPICAL FIRE - SMOKE COMBINATION DAMPER WIRING



Note where actuator aux switch is used for alarm signaling or smoke control system, a retest of the alarm is typically required by local codes.

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.

Some dampers are Normally Open. Reverse procedure regarding open & closed.

Other variations

Other companies also used the negator spring and fusible rod method. Contact Belimo with make and model for instructions.

Fire Marshal Form for Replacement Fire & Smoke Actuators

Most jurisdictions require leaving a record of repairs of life safety devices on the building premises.

UL does not regulate replacement issues. Repair recommendations can be found in **NFPA 80** Standard for Fire Doors and Other Opening Protectives and **NFPA 105** Standard for the Installation of Smoke Door Assemblies and Other Opening Protectives.

Fire & smoke dampers are considered to be appliances and field replacement of defective parts is required.

Consult local Authority Having Jurisdiction (Building Dept or Fire Marshal) for other details.

Building Official / Fire Marshal Notification Form

Retain this portion of checklist at premises for Fire Marshal inspection. See local AHJ or Fire Marshal 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.

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

1. Single Sensor Combination 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 EFL or BAE open contacts. *Damper springs closed.*
d. □ Allow sensor to cool and press reset button. *Damper drives open.*

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

2. Negator Spring Damper

a. □ Open smoke detector or relay wire or contact to cut power. *Damper springs closed.*
b. □ Reconnect power. *Damper drives open.*
The fusible rod cannot be tested.

3. Reopenable Two Sensor Fire-Smoke Combination Damper

(Since this system involves the Firefighters' Smoke Control System, inform fire department and request directions for retesting.)

Negator spring dampers could have been applied to re-openable applications. Contact Ruskin or Belimo for instructions if any other sensors are mounted on damper.

☐ **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……

……

……

If any variations on possible applications are encountered, contact Belimo for assistance.