

# Regarding Obsolete and Defective Fire & Smoke Damper Actuator Replacement

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## **History**

Smoke and combination fire & smoke dampers have been controlled using a number of different manufacturers' actuators in the last 20 years.

Change has obsoleted many combinations of products. Some dampers and some motor manufacturers are no longer in the business and some companies do not have current UL555S listing. Some damper models are no longer made and no existing actuator has been tested with it using the UL 555S Standard. Some actuators are no longer made and newer actuators have not been tested on the older damper models.

Exact replacement is not possible for those no longer manufactured. Where lower quality motors were used, exact replacement is not the best technical practice in any case.

Better quality and easier to install actuators (less field errors) are now available. The Belimo concept of direct coupling has been copied by most manufacturers.

As a result, local inspectors may have to decide what rules are to be applied for repair and replacement. The codes do not clearly spell out rules for any repair, for example gas valves which fail and for which there is no exact replacement.

### **UL**

In the "Marking & Application Guide, Dampers for Fire Barrier and Smoke Applications & Ceiling Dampers" April 2003 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 manufacture's normal field servicing program."

## ***Code and Standard Issues***

In general, the administrative section of any code states 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.

Fire & smoke dampers are considered to be appliances and field replacement is expected. Just as with gas valves, replacement permits are not required if nothing else is affected except the damper and actuator.

### **Local Code Approval**

While the manufacturing and assembly of new installation smoke and combination fire and smoke dampers and actuators are well regulated by local codes and UL Standards 555 and 555S, the replacement of obsolete and defective actuators is a matter for the local Authority Having Jurisdiction (AHJ).

The regulations vary in different jurisdictions and different inspectors may apply different criteria. In general, permits and inspections are not required. Consult local AHJ – typically the Fire Marshal or Building / Mechanical Inspection Department.

While the Fire Marshal may have overall jurisdiction requiring actuated dampers, the mechanical inspector is more familiar with technical details. If any doubt about a repair exists, the mechanical department should be consulted.

The AHJ has final say on all replacement issues. Some examples:

1. A letter from the damper manufacturer recommending the use of the Belimo actuator was required. No permit or inspection.
2. Use of field mounting instructions from the damper manufacturer was required.
3. The installing contractor takes responsibility for any repair and the methods used must meet current codes. (This requires that UL555S 75 second actuators be replaced with UBC required 15 second actuators in some geographic regions.)
4. Each replacement damper actuator must be tested to ensure it opens and closes properly.
5. Replacement actuator must be UL555S listed with the damper manufacturer.

While it is not mandated in codes, Belimo requests that the following rules be applied when using Belimo actuators for replacement:

- A. For a first time replacement in a jurisdiction, check with local code officials or fire marshal for general rules and any special requirements.

- B. If Belimo is UL555S Listed with the damper, replacement is permitted. Damper manufacturer instructions are available. See Belimo UL555S Damper Listings list below. (Where the existing damper or motor is no longer made, obtain approval from the AHJ.)
- C. Where damper manufacturer instructions exist, obtain either from them or Belimo and follow procedures.
- D. Check the technical specifications to ensure an “equal or better” actuator is used. See Technical Details below.
- E. Test the operation of the controls, damper, and actuator according to the requirements of local codes, damper manufacturer, and the Belimo list below under Recommended Acceptance Testing. For a large retrofit project, the AHJ may need to be present to observe and confirm.

**Belimo FS series actuators are UL555S listed with ten of the eleven US and Canadian damper manufacturers.**  
**This is the number one criteria for use in replacement.**

### ***Technical Details***

1. It is standard procedure for damper manufacturers to obtain UL555S listing with several actuators for the same damper. Where the actuator being installed is **UL555S listed** for the damper, no further requirements are necessary provided the torque, voltage, amperage, and speed are matched correctly – that is, the correct model is employed.
2. Where older dampers or actuators are involved and are no longer manufactured the following rules shall apply:
  - a. **Check damper** for proper operation. Without actuator mounted, the damper must open and close smoothly and without any binding. Inspect all components; repair of damper requires damper manufacturer instructions. Clean all components; insure that shifting of ducts or damage to side seals has not restricted closure or failure of mechanical parts has not occurred over time.
  - b. **Test** the electric thermal disc or fusible link. Older version of NFPA recommends changing the link every 4 years. Newer version requires check at one year old and then every 6 years. (In state of flux at this time of writing.)

- c. **Torque** – replacement actuator shall have equal or greater torque than the failed actuator.
- d. **Voltage** – replacement actuator shall have the same voltage rating as the original.
- e. **Amperage** – the replacement actuator(s) shall not draw more amperage than the original(s) and cause the total amperage to rise above that which the electrical circuit breaker is designed to carry.
- f. **Speed** – the replacement actuator shall drive open and spring closed at the speed presently required by codes. (15 seconds is the present UBC and California requirement. 75 seconds is the ICC, UL555S requirement. The AHJ may grant an exception and “grandfather” slower actuators where the original actuator was slower.)
- g. **Temperature** – the replacement actuator shall operate at the rating of the original actuator (250°F or 350°F are standard).
- h. **Final Testing** – actuated damper and associated devices shall be tested for proper operation. Release power to spring closed. Drive back open. Check fusible links and test thermal disk (heat or pressure depending on make).
- i. Where any **structural modification** to building is required, a permit is required.
- j. Where change from **pneumatic to electric** is performed, a permit is required. In addition, the damper manufacturer shall provide instructions, wiring diagrams, and other components (e.g., elevated 250°F thermal disks for electrical interruption).
- k. If the actuator auxiliary switches themselves are connected to the fire alarm panel or to the Fire Smoke Control System (fire fighters control panel switches), then the wiring is probably supervised and the AHJ must be advised to see if conformance testing is needed.

**This is uncommon, but could occur.** More commonly, damper blade switches are used, but both are technically possible.

### **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 operation of damper for UL555S functions including sensors or fusible link.

### **WARNING**

INSTALLER MUST BE A TRAINED AND EXPERIENCED SERVICE TECHNICIAN.

Typically, the original actuator was tested at the maximum area and temperature that would pass UL555S. As such, the torque requirement of an old damper may be higher due to corrosion, dirt, or movement of the ductwork. If any doubt exists, apply the next higher torque actuator for replacement.

For mounting concepts and wiring information see **Belimo Retrofit FS Tech Guide.doc** and individual Specification Data Sheets.



**Finished mounting and wiring.**



### ***Belimo UL555S Damper Listings***

Testing is ongoing. Call for new information. The use of a Belimo is not limited to the following. Check with local AHJ for variations.

**Air Balance** (Associated with American Warming, Cesco,

Louvers & Dampers, Reed Air, Mestek)

Single thickness blade, 3-Vee type fire/smoke and smoke dampers.

FSNF24,120 @ 250 degrees F = 48 W by 24 H or 36 by 36 Class 1

@ 350 degrees F = 36 by 36. Class 1

Galvanized airfoil blade, fire/smoke and smoke dampers.

FSLF24, 120 @ 250 degrees F = 16 W by 18 H

FSNF24, 120 @ 250 degrees F = 24 by 36 or 36 by 24.

The 122 fire/smoke damper has been replaced by the FS-style single-thickness blade damper.

The 124 fire/smoke damper has been replaced by the FA-style airfoil blade damper.

<http://www.american-warming.com/>

**E.H.Price, Canada**

See NCA. Same dampers.

**Greenheck**

FSNF

Belimo is on every model other than round.

12 sq. ft on 3V at 250F internal and external

9 sq. ft. for 350F dampers. 36w x 48h maximum

Airfoil is 32 x 50 at 250F

FSLF

4 sq.ft. at 350F all dampers

36" W x 24" H at 250F all dampers.

The Belimo FSNF120 is listed at 350F on all the Greenheck dampers.

This is the FSD200 series and the SMD 200 series. These are 3V blades.

Also on the FSD and SMD300 series which is an airfoil.

The SMD401 series is only 250F since it is aluminum. Not an actuator barrier.

Section sizes vary, but max for one actuator is 32" x 50." They can do up to 8 sections with 8 actuators for a max size of 128" x 120."

Today Greenheck uses electrical switches to release the damper by cutting power to the actuator. In the past, they used the actuator to do smoke only function with an external spring and a fusible link to release a jackshaft spring for the fire functions.

There are internal mount actuators that slid over the jackshaft. Replacement requires the jackshaft be disconnected, actuator slid off, new one slid on. All this while the spring mechanism is still attached to the jackshaft. Obtain instructions from Greenheck.

Small access doors make this difficult.

Replace damper is first choice for internal mount.

External mount is simple.

<http://www.greenheck.com/>

**Leader**

**Not listed. Testing in 2007. Do not use Belimo at present.**

**Lloyd**

FSNF UL555S listed..

**Nailor**

FSNF 36X36 @350F

36X48 damper 250deg internal mount actuator. 144" x 96" 8 sections

Models 1210 smoke and 1220 combination, 36" x 48" at 250F.

FSLF

[http://nailor.com/contact\\_nailor.htm](http://nailor.com/contact_nailor.htm)

**NCA (Arlan in New York, E.H.Price in Canada)**

FSNF 12 sq.ft

FSLF 4 sq.ft.

**Pottorff (Accurate Specialty Metal in New York City), PCI Industries**

FSLF

4 sq.ft. at 350F  
36" x 24" at 350F

FSNF

Maximum 16.5 sq.ft. at 250F  
12 sq.ft. at 350F

140=3V

FSD-150

150 = Air Foil

170 = Corridor

Minimum Internal: 9x10 or 10x11 w/ accessories FSD140,170,340

Minimum External: 6x6 or 6x8 w/ accessories

Max Section size: 36x48 at 350F or 72x33 at 250F (2 sections, one actuator)

Max Section size: 30x48 FSD150

16 sq. ft. max at 250F, 140 only

141,2,3 = Class 1, 2, or 3

141=1st digit = time, 1= 1.5 hr.

<http://www.pottorff-hvac.com/>

**Prefco division Perfect Air / Metalair (Hugh Richards in New York City)**

FSNF

Model 5010, 5020, 5020-1, 5050, & 5015 - Fire/Smoke

Model 1175-1, 2 & 3 - Control Dampers

Model 5150 & 5151- Smoke Dampers

Model 5050 - Fire/Smoke Damper

36" w x 48" h down to 6" x 6" at 350F Class 1 leakage

Some older Prefco dampers employed external pulleys, cables, and springs. No longer used. Belimo is not recommended for the old dampers unless a shaft is available.

FSLF

Testing in 2007.

<http://www.prefco-inc.com/index.html>



**Ruskin (ALD in New York City)**

FSNF 350F

FSD60 64W x 48H. 8 sq. ft max

FSD36 72W x 48H. 8 sq. ft. max

Where necessary, 2 sections wide with one actuator = 72W x 16H

Multisections and multiple actuators used as necessary.

No 250F tested separately. When done, damper sizes will increase.

Belimo is default on 4-8 sq. ft. 24V; option on others.

FSLF 350F

Same dampers. 4 sq ft. and 36" W x 24" H

Corridor dampers.

All rectangular combo and smoke.

Not ceiling and not round.

<http://www.ruskin.com/>

**Safe-Air Dowco (Imperial in New York City)**

4 sq. ft. 24" x 24" 350F Class I leakage

4 sq. ft. 24" x 24" 250F Internal

<http://www.safeair-dowco.com/>

**Replacement Information by Actuator (Not inclusive).**

Where any modification of damper or structure is required, permit should be obtained.

Contact Larry Felker at Belimo for more information:

775-857-4243 x 5205

Make & Model	Power	Torque-Stroke	Belimo Replacement	Notes
<b>Siebe-Barber Colman</b>				
MA318	24	60-180 stroke	FSNF24	-500 is aux switch.
MA418	120	60-180 stroke	FSNF120	Use -S Belimo
MA220	120	Remove external spring.	FSNF120	
MA230	120	Remove external spring.	FSNF120	
MA240	No direct replacement			
180 degree rotation. Linkage kit may be possible depending on mounting geometry.				

<b>Honeywell</b>				
ML4105A1000	120	CCW	50 FSLF120	FSNF120
ML4105B1009	120	CW	50 FSLF120	FSNF120
M4105C1008	230	CCW	50 FSLF230	FSNF230
ML4105D1007	230	CW	50 FSLF230	FSNF230
ML4115A1009	120	CCW	30 FSLF120	FSNF120 FSNF is best. For dampers under 4 sq. ft.,
ML4115B1008	120	CW	30 FSLF120	FSNF120
ML4115C	230	CCW	30 FSLF230	FSNF230 FSLF is sufficient.

**PRELIMINARY Fire & Smoke Damper Actuator Replacement**

**3/29/2007**

ML4115D	230	CW	30	FSLF230	FSNF230		
ML4202	120	CW	20	FSLF120			
ML4302	120	CCW	20	FSLF120			
ML4702	230	CW	20	FSLF230	FSNF230	Check HW data sheets for torque ratings.	
ML4802	230	CCW	20	FSLF230	FSNF230		
ML8202	24	CW	20	FSLF24	FSNF24	20 in-# to 50 in-#.	
ML8302	24	CCW	20	FSLF24	FSNF24		
32003532-002 Aux Switch Package						Use <b>-S</b> model.	
ML8105A1006	24	CCW	50	FSLF24	FSNF24		
ML8105B1005	24	CW	50	FSLF24	FSNF24		
ML8115A1005	24	CCW	30	FSLF24	FSNF24		
ML8115B1004	24	CW	30	FSLF24	FSNF24		
MS4209F	120	CW	80		FSNF120		
MS4309F	120	CCW	80		FSNF120		
MS4709F	230	CW	80		FSNF230		
MS4809F	230	CCW	80		FSNF230		
MS8209F	24	CW	80		FSNF24		
MS8309F	24	CCW	80		FSNF24		
MS4120F1006	120		No aux 2	FSAF within		May require 2 FSNF at 350F.	
MS4120F1204	120		SPST	UL555 listing parameters.			
MS4620F1005	230		No aux 2				
MS4620F1203	230		SPST	16 sq.ft. to			
MS8120F1002	24		No aux 2	20 sq.ft.			
MS8120F1200	24		SPST	175 in-#			
S2024-F	24		No aux	175 in-#		S = Halogen and silicone free wires.	
S20230-F	230		No aux 2			S = Double insulated actuators.	
S2024-F-SW2	24		SPDT 2			BF series is Halogen and silicone free.	
SO230-F-SW2	230		SPDT			Non UL	
<b>Ruskin Models</b>		Made by Honeywell					
H2000A	120	CCW	30		FSNF120		
H2000B	120	CW	30		FSNF120		
H2024A	24	CCW	30		FSNF24		
H2024B	24	CW	30		FSNF24		
H2230A	230	CCW	30		FSNF230		
H2230B	230	CW	30		FSNF230		
32003532-002 Aux Switch Package						Use <b>-S</b> model of proper voltage.	

<b>Siemens</b>						
GGD221	24	100	FSAF24	250F	FSNF24	350F
GGD221	120	100	FSAF120	250F	FSNF120	350F
GGD321	230	100	FSAF230	250F	FSNF230	350F

**Siebe.** MA220, etc. FSLF and FSNF can be used. DISCONTINUED.  
 MA418. 1 Amp draw. FSNF is .23A (120V).

**Multiproducts.**  
 Typically crank arm mounted. Some cannot be replaced. Call for information.

**ECM** - Out of business.

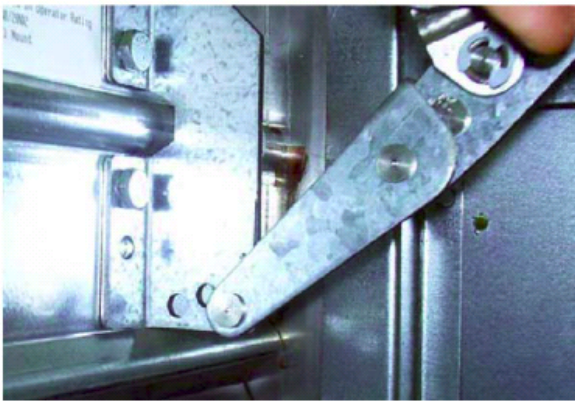
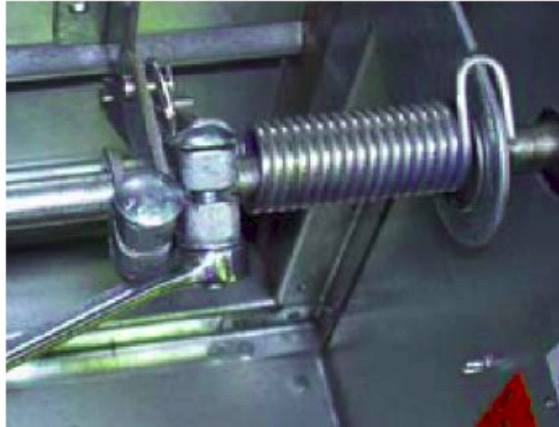
<b>Comparison of Belimo FS &amp; Competitive Actuators (Specs from 2005.)</b>							
	<b>BELIMO</b>	(at 250F)	<b>Honeywell</b>				<b>Siemens</b>
	FSLF120	FSNF120	ML4115	ML4105	ML4202	MS4209	GGD221.1U
Rated Torque (in-#)	30	70	30	30 or 50	20	80	142
Actual	45 run 35 spring	110 run 95 spring					110 Spring
Noise level							
Holding	10	10	<20dB		<20dB	20dB	
Running	55 dB	55 dB	65 at 1m		65dB	80 at 1m	
Controller	Micro	Micro	Analog				Analog
Current draw	24V 120V						
Drive	5VA 18VA	.23A	.18A	.2A	.18A (120V)	.25A	<b>1.25A</b>
Hold	3.5VA 6.5VA	0.1A	15VA	.11A	.11A (120V)	.1A	10VA
Temperature	350F	350F	250-350°F	250-350°F	250-350°F	350F	350F
Time drive open							17
Ambient	<15 sec	<15	15 sec		15 sec	14-25 sec	<15
Elevated 250F/350F	15-20	<15	18-25 sec		18-25 sec	75 sec max	<15
Time spring closed							
Ambient	<15	<15	15		15		6
350	<15	<15	>15			20 sec max	6
Clamp	Steel	Steel	Square with round adaptor.	Aluminum	Aluminum		Aluminum
Direction of rotation:	Flip over	Flip over	Separate models CW/CCW				Flip over
Housing material	Zinc coated steel	Zinc coated steel	Aluminum	Aluminum	Aluminum	Aluminum	Aluminum
Overload protection:	Electronic 0 to 95° rotation						

Note that individual dampers have some variations. Shaft springs were used by some manufacturers with the old motors that did not have internal springs. When using the modern Belimo with an internal spring, the old spring must be removed or disconnected.

**Shaft spring**

The older dampers employed a fusible link to release a shaft spring. The typical actuator used was non-spring and is no longer made. The current practice is to use a spring actuator and an electronic high temperature limit to cut power.

Damper manufacturer instructions are required to ensure proper procedures.



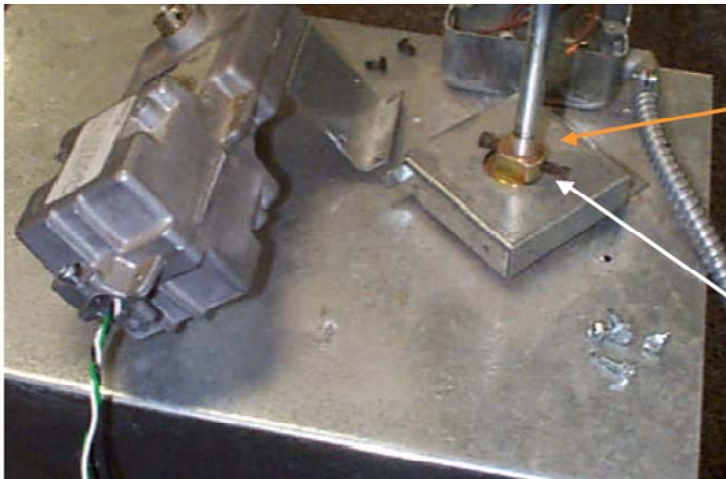
**Kneelock**

Manufacturers' instructions guide in the proper sequence for removing shaft mounted springs. In the picture to the left, the kneelock is released before the spring torsion can be eased for mounting external actuator and an electronic high temperature limit installed.

Photographs courtesy PCI - Pottorff

**Note: kneelock must be reconnected.**

External Shaft Spring Type - Ruskin



External spring mechanism and housing.

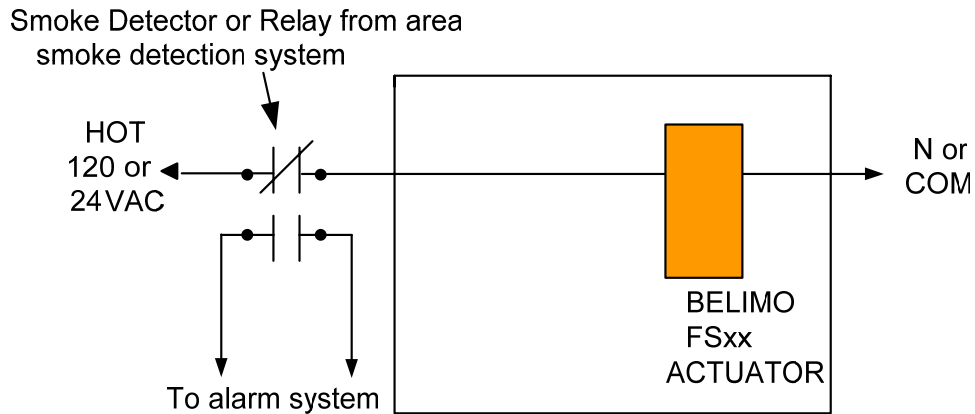
A. Loosen square head bolts to remove spring mechanism.

## Installation Notes & Recommended Acceptance Testing

### Fusible link type damper

1. Examine damper seals, fusible link or equivalent, and blades to ensure integrity.
2. Disconnect incoming power and wiring at junction box or actuator.
3. Tag all wires.
4. Remove old actuator and mounting bracket. (If shaft spring must be bypassed, see damper manufacturer specific instructions.)
5. Ensure damper opens and closes smoothly.
6. Attach shaft adaptor if required by damper manufacturer and tighten.
7. Mount Belimo FSNF or FSLF depending on torque or function required
8. Reconnect wiring per original drawing. Typical wiring shown below.
9. Restore incoming power.
10. Test all functions including:
  - a. Open smoke detector or relay contacts. Actuator springs damper fully closed.
  - b. Reset contacts. Actuator drives damper open.
  - c. Disconnect fusible link if present. Actuator is disconnected and the damper spring engages to fully close damper. (If a McCabe™ link is used, trip and reset it instead of the fusible link.)
  - d. Reconnect fusible link. Actuator holds damper open.

### Typical fusible link or McCabe™ link DAMPER ACTUATOR WIRING



Note that the actuator  
itself is not connected to  
the alarm system.

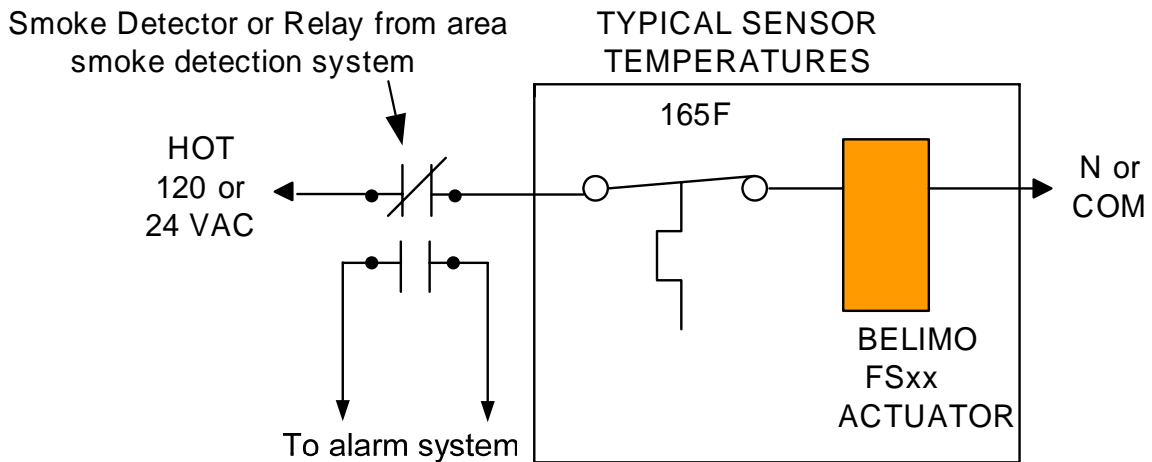
**In this application, the fusible link disengages the actuator and the fire spring closes the damper for fire. The actuator is used for the smoke function.**

## Electric thermal disc type damper

1. Disconnect incoming power and wiring to thermal sensor at actuator. Tag all wires.
2. Remove old actuator and mounting bracket
3. Mount Belimo FSNF or FSLF depending on torque or function required
4. Reconnect wiring per original drawing. Typical wiring shown below.
5. Restore incoming power.
6. Test all functions.
  - a. Open smoke detector or relay contacts. Actuator springs damper fully closed.
  - b. Re-close contacts. Actuator drives damper open.
  - c. Trip thermal sensor. Actuator springs damper fully closed.
  - d. Press manual reset. Actuator drives damper open.

## TYPICAL FIRE - SMOKE COMBINATION DAMPER WIRING

### Electric thermal disc



Note that the actuator itself is not connected to the alarm system.

### **WARNING**

**ANY STRUCTURAL CHANGE TO BUILDING OR DAMPER ITSELF WOULD REQUIRE A PERMIT AND INSPECTION.**

**IF THERE ARE ANY CONNECTIONS FROM ACTUATOR TO FIRE OR SMOKE ALARM SYSTEM, THEN MOST AHJ's WOULD REQUIRE A PERMIT AND INSPECTION.**

**Re-openable Two Sensor Fire-Smoke Combination Damper Wiring.**

With FFCP switch in Auto position:

1. Open smoke detector or relay contacts. Actuator springs damper fully closed.
2. Reclose contacts. Actuator drives damper open.
3. Trip thermal sensor. Actuator springs damper fully closed.
4. Press manual reset. Actuator drives damper open.

Move FFCP switch to Off position:

Actuator springs damper fully closed.

Move FFCP switch to Hand position:

Actuator drives damper back open.

1. Open smoke detector or relay contacts. Damper stays open.
2. Trip primary (lower temperature) thermal sensor. Damper stays open.
3. Trip secondary (higher temperature) thermal sensor. Actuator springs damper fully closed.
4. Press manual reset of secondary sensor. Actuator drives damper open.

Move FFCP switch back to Auto position:

Actuator springs damper closed if Primary sensor is still open.  
 Actuator stays open if Primary sensor has re-closed.

**When completed, ensure sensors are reset and smoke detector is in normal state and FFCP switch is in Auto.**

**TYPICAL REOPENABLE DAMPER with FFCP**

