



Before replacing actuator, damper must be inspected and determined to be fully functional. NFPA 80 and NFPA 105 contain a list of recommended checks. See NFPA below for a checklist.

Pneumatic Fire &/or Smoke Damper Actuator Replacement with Belimo FSxx Series

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Installer must be trained and experienced with repair of fire and smoke dampers and actuators. Contact Belimo for training classes if necessary.

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.

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.

The Authority Having Jurisdiction (local Fire Marshal and/or Building Official) must be consulted 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.



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. Damper blades shall be in plane of wall. Duct 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 and made available to AHJ.

For the Air Movement and Control Association damper maintainance manual go to:<u>http://www.amca.org/publications/damper_maintenance.aspx</u>



Pneumatic to Electric Conversions – Local Code Approval



Conversion of old dampers from pneumatic to electric may require approval from the local AHJ. Most older dampers are different from modern dampers and cannot be recertified since no UL555S procedure for listing exists.

Typically, installing a new actuator and electrical thermal sensor bring part of the damper up to current standards as the new parts are UL Listed and have been tested to the present UL 555 and UL 555S whereas the old damper's parts are not tested to the present standard.

Contact Belimo to discuss options.

The conversion of a damper from pneumatic to electric operation entails a number of steps not required in normal replacement of electric actuators.

Power must be brought to the dampers. Depending on the jurisdiction, life safety devices must usually be powered from a circuit with a secondary, back-up power source. This may not apply to containment dampers installed per Chapter 7 of the IBC, but does apply to actuators on dampers in an engineered smoke control system per Chapter 9 with wiring to the fire fighters' smoke control panel. Contact AHJ for local variations requiring back-up power.

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

- **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. in Fire Marshal Notification Form.





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 function.

Cross Reference

No specific pneumatic to electric cross reference is possible. Rather use of the UL 555S listings for the damper sizes is applied.

For greater detail see <u>www.belimo.us/firesmoke</u> RETROFIT or download from <u>https://www.belimo.us/mam/americas/technical_documents/pdf-</u> web/fire_and_smoke_doc/fire_smoke_competitive_replacement_data_reference.pdf

Based on UL 555S at 2000 fpm the following chart covers sizing. Call Belimo if a specific damper manufacturer's listings are needed.

Nominal sq.ft. per			
UL555S testing.	Temp	Actuator	
1.5 or less	250°F	FSTF	
4 or less	350°F	FSLF	
12 or less	350°F	FSNF	
16 or less	250°F	FSNF	
16 or less	350°F	FSAF*A	

Various sizes and configurations of Multisection dampers have been UL tested also. Call for information.

Note that in new installations meeting UL 555S that larger damper sections have passed with some manufacturers. The recommendations here are for clean older installations where corrosion may add load. The sizing is conservative.



Installation examples and Belimo mounting





Where axle shafts are used for the pneumatic actuators, direct coupling is possible.

Proposed Belimo Solution





Belimo linkage kits can be seen at https://www.belimo.com/pim/mam/ americas/technical_documents/dat a_sheets/man-airacc/Mechanical_Accessories.pdf





Left. Belimo actuators may be mounted using linkage kits where necessary.

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



Any number of variations exist for multiple actuators and mounting methods.





Remove tubing and actuator.

Disconnect and remove linkage.

Belimo FSNF required for the two sections. Direct couple and wire.

A clue that it is a Smoke damper is that it has no high temperature sensor.



Remove tubing and actuator. Disconnect and remove linkage. Retain the outboard bracket as it contains the shaft bearing.

Belimo FSLF required for the small damper. Direct couple and wire.

A clue that it is a Smoke damper is that it is mounted outside the plane of the wall.



Remove tubing and actuator. Disconnect and remove linkage. **Do not remove bearing bracket.**

Belimo FSLF required for the small smoke damper. Direct couple and wire.

Access may be tight in which case an FSNF with linkage may be used. Mounting Methods Guide: <u>https://www.belimo.us/mam/a</u> <u>mericas/technical_document</u> <u>s/pdf-</u> web/guides/mounting_metho ds.pdf





Above. An FSLF actuator can be direct coupled. The FSNF or FSAF can be direct coupled or linkage connected if space constraints dictate.

Contact Belimo with photographs and the control and wiring specifics of the application, We can provide custom installation instructions.







Remove tubing and actuator. Disconnect and remove linkage. Retain the outboard bracket as it contains the shaft bearing.

Belimo FSLF required for the small damper. Direct couple and wire.



FSLF mounted in place of pneumatic actuator.



Standard FSNF mounting.







Brackets are available from damper manufacturers although they are rarely required.



Actuator anti-rotation strap may not be screwed to the duct. It must attach to either the sleeve or to the mounting bracket. The duct must be able to fall away from the damper in case of ceiling collapse in a fire.





Anti- rotation strap





Anti-rotation strap can be attached to bracket, 4 x 4 plate, or sheet metal bracket.



FSNF mounted on the damper shaft. Two screws hold the antirotation strap. Two nuts secure cold-weld clamp onto shaft.

FSAF mounts the same.





Standard mounting. FSLF mounted on the damper shaft. Two sheet metal screws hold the anti-rotation strap. Two nuts secure cold-weld clamp onto shaft.



For short shaft mounting, the clamp can be installed between the actuator and sheet metal duct or sleeve.



Note that actuator floats freely. 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.

Clamp



Direct coupling is the modern method to connect actuators to dampers.





Miscellaneous parts

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



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.



The above examples show some of the linkage possibilities.



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



Fusible link fire damper function

In some cases a fusible link and shaft spring on the inside of the damper perform the closing function in case of fire. In that case, the external actuator is controlled by the smoke detector or a relay only.

Investigation of what method is being used is always necessary. Then the replacement method becomes clear.



Below: two details of a shaft spring and fusible link on damper arms.



EP Relays and shaft switches



Remove air line and EP relay, tagging 24V or 120V wires. Remove old actuator and linkage parts.



Below: there is a switch package attached to the damper shaft. It may be reused or a –S model of the Belimo may be installed.





Pneumatic control



One typical method was that the pneumatic actuator failed closed – no air pressure – and closed the damper. The EP shown above was operated from a fire alarm or smoke control panel.

Another typical method is shown below. A local fusible link air valve(s) will open upon sensing high temperature (>165°F typically). That will dump the air out of the actuators and close the dampers.

Pneumatic actuated dampers





Sensors

There are a number of variations possible and precise drawings requires that the damper make and primary sensor method be identified. These are typical.



The drawing above shows a typical smoke – not fire – damper control arrangement. The actuators are powered to drive the dampers open. A relay contact in the hot wire going to the actuators cuts power to spring them closed.



Proportional 2-10VDC Actuators in Parallel

Sequence of operation:

If temperature at either damper rises to 165°F then the thermal disk opens and removes power from both actuators which then spring closed. Actuators modulate to maintain position from a 2-10VDC signal.



SMOKE DAMPER ACTUATOR WIRING





Combination Fire & Smoke Damper

Sequence of Operation







Photo above is of the sensor of a typical modern 165°F thermal switch – primary heat sensitive device in UL's terminology.



Thermal sensor replacement – BAE165 US

Original equipment is recommended although not strictly required by code. UL does not regulate replacement or repair. See NFPA 80 or NFPA 105.



Belimo BAE165 US

Where existing sensor is defective or one must be added, the 165°F primary sensor may be used.



Various field modifications may have occurred over time. If any question about proper wiring exists, contact Belimo.

The Belimo BAE 165 is UL Listed for electrical use and has been tested for fire and smoke damper applications. It is not UL555S listed as a specific replacement part for old dampers. If manufacturer devices are not available, it will operate in the application as an equal or better component. AHJ approval should be obtained.





Junction box

If a j-box is needed with Belimo actuators, a chase nipple and 2 x 4 or 4 x 4 box can be attached to the conduit connector as shown below.



Wiring

The wiring on the right is the standard for 80% of applications in containment damper applications. The alarm connections are only present with smoke detectors.

TYPICAL FIRE - SMOKE COMBINATION DAMPER WIRING

Electric thermal disc





Alternate alarm connections. Several variations are possible. If an area smoke detection system exists, alarm wiring from smoke relay is not used.

Actuator auxiliary switches serve same function as damper blade switches to signal to FSCS.

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.



Wiring for TS and FSLF24 UL555S Damper



Other wiring options exist that are not detailed here. NFPA allows in an exception for dampers to be open when air handling units are off. This may not be allowed by local codes which override all other standards and guidelines. Wiring to fan systems, power, and back up power are not shown here.

In engineered smoke control systems, some dampers are normally open and some are normally closed, e.g., atria exhaust systems. Check sequence of operation.

Belimo will provide custom test forms if needed.







- 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.



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

If any structural modifications are made a permit and inspection are required. This includes removal and replacement of drywall.

In the wiring variation above, the damper does not have a thermal sensor. Either the UL555 fire function is performed by the fusible link and a shaft spring or the damper is smoke only and no thermal sensor is required.

The RELAY contacts open in event of smoke detection by automation system, smoke control system, or fire alarm system.



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 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 and UL 555S. Belimo actuators are UL, CSFM, and MEA listed.

Test Checklist

(Smoke dampers do not have sensors. Only steps a. & b. of Single sensor test 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.
 □ Open thermodisc using heat gun. Damper springs closed.
- d.
 Press thermodisc manual reset. Damper drives open.

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

2. Reopenable Two Sensor Fire-Smoke Combination Damper

(Since this system involves the Firefighters Smoke Control System,

the fire department should be informed.)

With FSCS switch in Auto position:

- a. Disconnect power from smoke detector or relay contacts. Actuator springs damper closed.
- b.
 □ Reconnect power. Actuator drives damper open.
- c.
 □ Trip thermal sensor. Actuator springs damper fully closed.
- d.
 □ Press manual reset. Actuator drives damper open.

Test FSCS switch functions

- 1. □ Move FSCS switch to Off position. Actuator springs damper fully closed.
- 2. D Move FSCS switch to Hand position. Actuator drives damper 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 FSCS 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 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.....