

## Glossary & Frequently Asked Questions

**See Page 11 for Specific  
Belimo Actuator Questions**



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## **General Fire and Smoke Questions**

### **Access door**

These are required for maintenance of fire and smoke dampers and duct smoke detectors.

### **Actuator**

Electric (c. 90%) or pneumatic (c.10%) motor. Fire & Smoke actuators are essentially the same as regular control actuators except they tolerate 250°F or 350°F for a half hour and must operate in under 75 seconds to open or to close per UL555S.

The main parts are clamp to grab onto the axle or jackshaft, anti-rotation strap to hold bottom end to duct, and the motor housing itself. Conduit connectors are provided on all US products since all life safety wiring must be in conduit or metal flex.

### **AHJ**

Authority Having Jurisdiction – typically the Building Official or Fire Marshal – the inspector.

### **Alarm Signaling**

With respect to the damper, the smoke detector has two sets of contacts. Upon detection of smoke, one set opens to cut power to the actuator and spring the damper closed. The other set closes and tells the fire alarm panel that a damper has closed. Manual reset is required. Where area detection is used, the alarm panel handles both sets of operations.

Actuator auxiliary switches are most often used to test the damper, but can be supervised and monitored by the alarm system in an engineered smoke control system.

### **AMCA – Air Movement Control Association**

AMCA is an organization of air moving equipment manufacturers. They write standards and promote quality testing, certification of products, and adherence to standards. While AMCA standards do not have the force of an NFPA or UL with respect to codes, they uphold quality in product construction and applications.

### **Area Separation**

A fire rated wall (expressed in hours) which divides the floor area of a building into acceptable areas for fire containment.

## **Balanced Fire Protection**

A mixture of compartmentation using fire and smoke barriers, sprinklers, means of egress, structural strength, passive fire and smoke protection sealing all holes, and smoke control fans and dampers to allow escape from buildings experiencing a fire or other disaster.

Sprinklers are known to fail about 15% of the time in fires. This can be due to water being shut off or a fire or explosion overpowering the sprinklers. When water is available, sprinklers are very effective. Seismic events can break water mains and gas lines leading to very hazardous situations. Passive methods prevent fire spread from the compartment where it originates. Structural strength prevents collapse.

The purpose of the balance is to ensure people can escape from the building to safety. Only secondarily are the protection methods for the property itself, although protecting the building serves to protect people. While the codes do not make any special efforts to protect fire fighters, all these protective measures protect them as well.

## **Breakaway Connection**

A joint connecting a smoke or fire damper sleeve and attached duct work which allows collapse of the duct during a fire without the damper being pulled out of the wall. See fire damper.

## **Ceiling Damper**

A ceiling damper is used to protect HVAC openings in a fire rated horizontal ceiling assembly. It closes automatically to restrict the passage of flame & heat. It is spring loaded and actuators are generally not used.

## **CODES**

**The code varies by jurisdiction although almost all are based on the International Building Code (IBC). New construction and replacement are different subjects. Since the codes focus on new construction they do not discuss replacement. Different inspectors see the subject differently.**

Defective actuators should be replaced.

UL clearly states that replacement is a matter for the local jurisdictions.

An equal or better actuator that meets the UL555S requirements should be used.

Permits not normally required for service work – “ordinary repairs” - including actuator replacement.

If a large number is being replaced, check with AHJ.

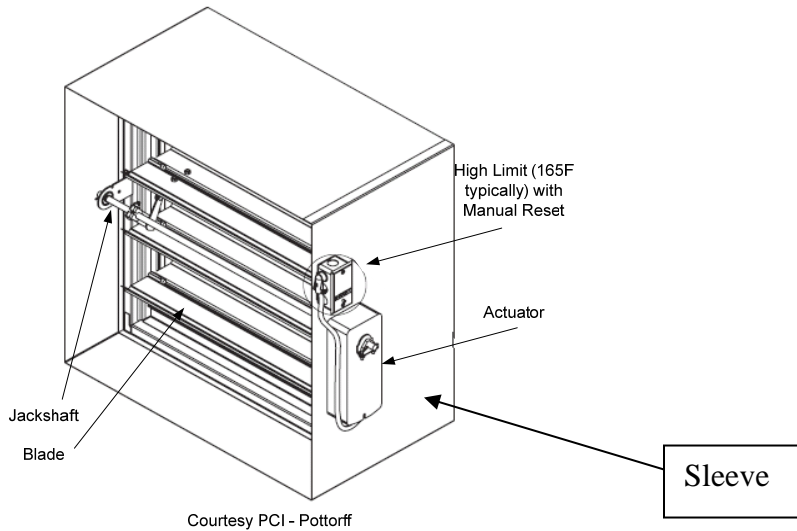
If any fire alarm wiring or connections are touched, a retest of the alarm system is typically required. The fire alarm company should then be consulted also.

See **What are most important technical issues for replacement?** below.

## **Combination Fire and Smoke Damper**

A fire and smoke damper. A combination avoids 2 dampers where a wall is both a fire stop and a smoke barrier. The combination must meet the rules of both UL555, fire, and UL555S, smoke. For that reason, it will be jackshafted or linkaged internally since the blades must be in the wall for the fire function and the actuator must be accessible for wiring and repair.

A new actuator, the FSAF24-BAL allows balancing the airflow as well as fire and smoke functions. This saves a damper and installation costs as well as saving space in typically constrained areas.



### Compartmentalization

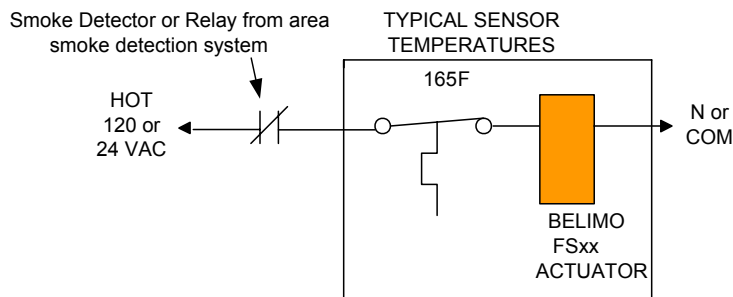
Sub-dividing each floor of a building with fire walls and smoke barrier partitions to restrict spread of smoke, flames, & heat in a fire. Where HVAC ducts penetrate the partitions, dampers are installed to stop fire and smoke. Where any other pipes penetrate the walls, fire stopping seals the holes.

### Conformance Testing

For a damper, the following is a sample:

- a. Open smoke detector or relay contacts. Actuator springs damper closed.
- b. Reclose contacts. Actuator drives damper open.
- c. Trip thermal sensor. Actuator springs damper closed. (A hair dryer type heat gun can be used. Matches or lighter not recommended.)
- d. After cooling, press manual reset on thermal sensor. Actuator drives damper open.

### TYPICAL FIRE - SMOKE COMBINATION DAMPER WIRING



**While not required by every code, Belimo provides a Fire Marshal form alone or attached to each replacement instruction. It is to be left on site with the building manager or owner to inform the AHJ that a damper was repaired. See New York City MEA below.**

### Corridor Damper

A fire/smoke damper used where ducts terminate in wall openings in an interior corridor. When the corridor is also an exit, the walls are fire and smoke barriers. These are actuated.

Applications vary; often the ducts are exhausts or supplies for fresh air. In some cases the supply air is reversed to become an exhaust if smoke is present.

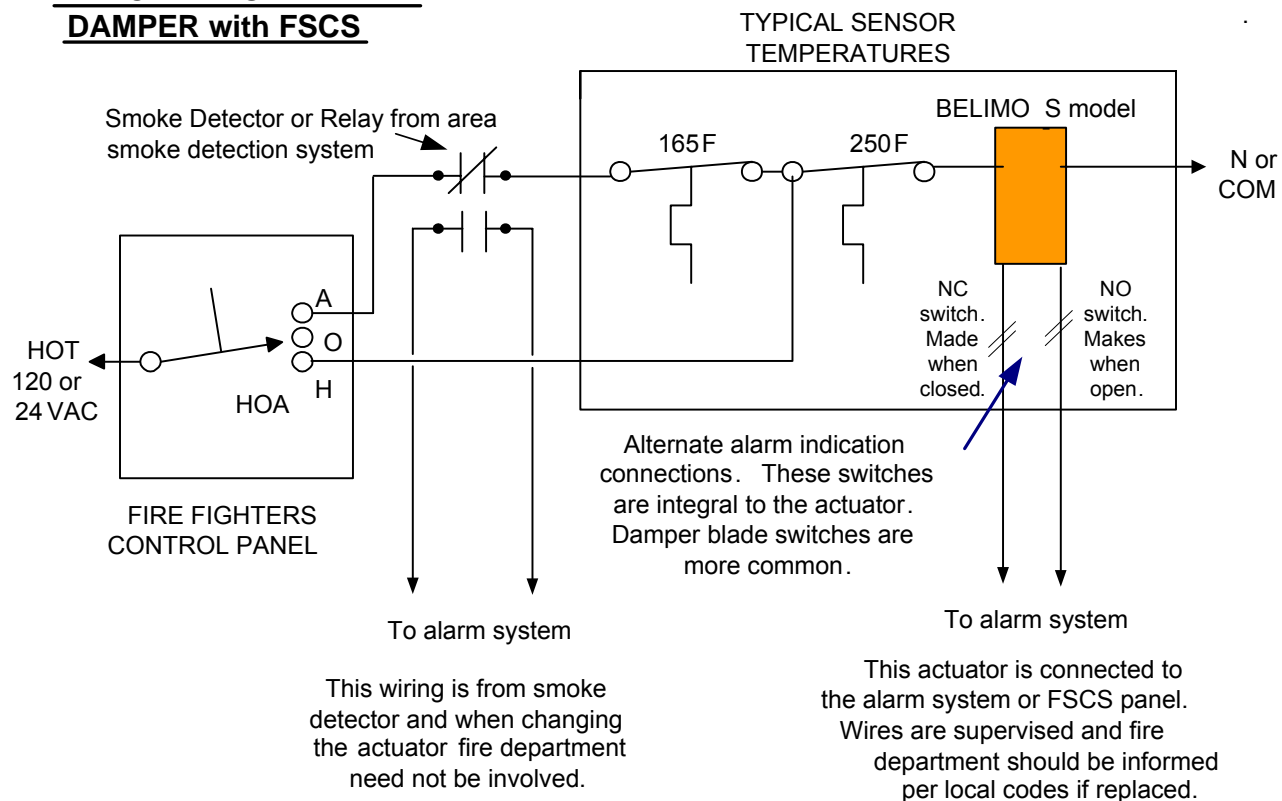
**Dynamic Fire Damper**

Fire damper designed to close against air flow in a system where the fans are kept running in event of a fire. They are approved for both dynamic and static closure. See Static Damper.

**Engineered Smoke Control System**

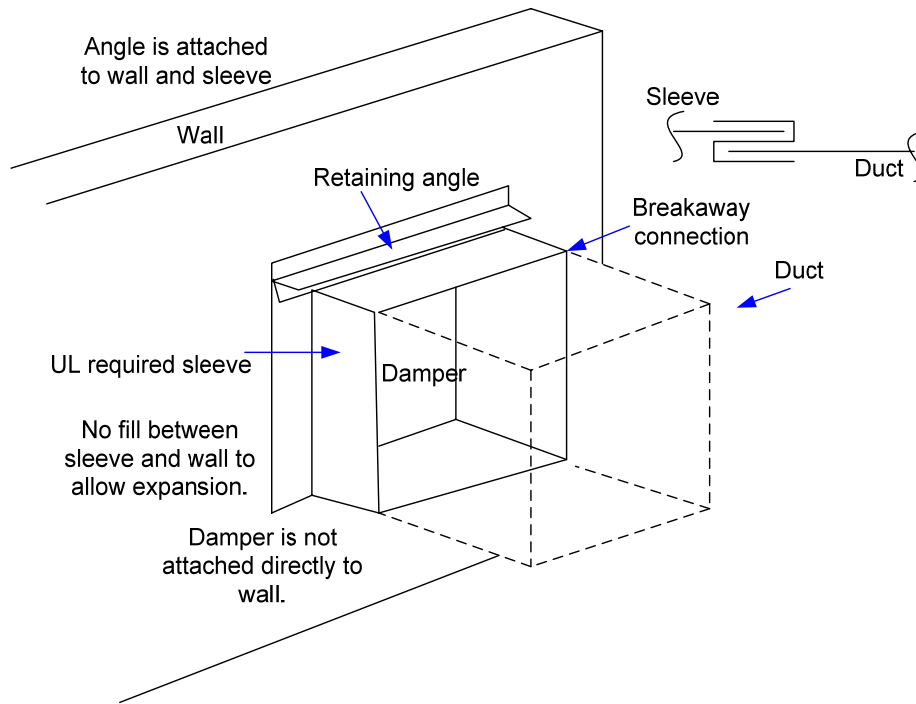
This is a large subject involving every tactic that can be used to protect occupants in case of fire. With respect to the damper actuators, they are supervised by the alarm system and connected to the Fire Fighters’ Smoke Control System Panel. See drawing below.

**TYPICAL REOPENABLE DAMPER with FSCS**



**Fire Damper**

A normally open damper installed in an air handling system within a fire wall. Note that the blades must be within the plane of the wall. It closes automatically upon the detection of heat to stop the passage of fire. It is tested in accordance with UL555. (A smoke damper is tested in accordance with UL555S.) The damper must remain in the wall if the duct collapses in a fire. See the breakaway connection in figure below.



### Fire Rated Ceiling

A ceiling tested for fire resistance as part of a floor-ceiling, roof-ceiling or floor-ceiling-wall assembly.

### Fire Rated Partition

A partition having an assembly of materials that will afford a given fire resistance rating (expressed in hours) to impede the spread of fire from one area to another.

### Fire Wall

A continuous (basement or floor to roof) wall having adequate fire resistance rating (expressed in hours) with an adequate structural stability under fire conditions to completely subdivide a building or completely separate adjoining buildings to restrict the spread of fire.

### Floor-Ceiling or Roof-Ceiling Assembly

An assembly comprised of floor-ceiling or roof-ceiling which, when fire tested as a unit, has been assigned a fire endurance rating expressed in hours. Commonly termed a floor-ceiling assembly.

### Fretting

Barber Colman-Siebe-Invensys MA2xx motor gears were sticking together keeping dampers open. This was referred to as gear fretting. AMCA 520 established a test procedure to ensure this would not occur with other motors. Belimo has passed the test with all the FS series. UL may add the AMCA test to its procedures in the future.

### Fusible Link

A device that holds a fire damper or fire door open until a designated ambient temperature is reached, then the fire damper or door is released to close. The device could be soldered, strut

type, glass bulb type or bi-metallic metal identified by a label, affidavit or listing acceptable as designated by UL Standard 33. Fusible links normally melt at 165°.

### **Heat Stop**

A method by which temperature rise is retarded for ceiling openings in a fire rated floor-ceiling or roof-ceiling assembly. Ceiling dampers are a commonly used method.

### **International Building Code, IBC**

This is the model code that states and jurisdictions in the US use.

<http://www.iccsafe.org/gr/Documents/stateadoptions.pdf>

For a map of the US and territories along with what I code is adopted go to:

<http://www.iccsafe.org/gr/Pages/adoptions.aspx>

Various other codes that are pertinent are the International Fire Code, Uniform Fire Code, International Mechanical Code, and Uniform Mechanical Code. In some jurisdictions, fire and smoke codes are contained in multiple documents. For example, in New York City, the Fire Code, the Building Code, and the Mechanical Code each has provisions regarding smoke control. For on-line free readable copies go to:

<http://www2.iccsafe.org/states/newyorkcity/>

Last accessed Mar 11, 2010.

### **Labeling**

Fire dampers are labeled to indicate for use in static or dynamic systems. A dynamic damper indicates air flow direction, max velocity, and pressure difference across the closed damper.

### **NFPA - National Fire Protection Association**

The NFPA is the originator of standards and many provisions of codes. It is composed of interested parties in all trades, fire departments, state and local building officials, manufacturers, consultants, and ASHRAE.

The most used standards/codes for fire protection are:

NFPA 70 National Electrical Code, NEC

NFPA 72 National Fire Alarm Code

NFPA 90A Standard for the Installation of Air-Conditioning and Ventilating Systems

NFPA 92A Smoke-Control Systems Utilizing Barriers and Pressure Differences

NFPA 92B Smoke Management Systems in Malls, Atria, and Large Spaces

NFPA 101 Life Safety Code

NFPA 80 Fire Doors and Dampers

NFPA 105 Smoke Doors and Dampers

NFPA 204 Smoke and Heat Venting

### **Occupancy Separation**

A wall, partition, floor-ceiling or roof-ceiling of fire-rated construction used to separate parts of a building.

## **Passive Fire Protection**

Sprinklers are considered active protection – they contain a fire. Passive protection involves compartmentalization (gypsum covered walls, fire doors), fire stopping all cracks, fire dampers and smoke dampers to prevent fire and smoke transport, large stairwells and egress passages, etc. Engineered smoke control systems with dampers and fans are not fire protection. They are active smoke control.

## **Primary sensor**

The lower or first temperature sensor in a fire damper or a combination fire and smoke damper. Smoke dampers do not have temperature limits. 165°F is used 80% of the time. 185°F is seen and 212°F is common where steam coils are present and would cause nuisance trips. See secondary sensor.

## **Proportional Fire & Smoke Damper (FSAF24-SR (-S) 2-10Vdc actuator)**

There are a number of potential uses, for example:

Stairwell pressurization. One must keep the stairwell pressure positive with respect to the space to prevent smoke from coming into the stairwell from a fire. The pressures specified by codes can vary, but typically the stairwell must be kept .1" higher in pressure than the space. The smoke must be restrained, but the doors must be able to open so too high a pressure cannot be allowed. Thus proportional control adjusts the airflow quantity to keep the pressures within an acceptable range.

Sometimes, the dampers for the stairwell pressurization are not rated dampers and UL555S dampers and actuators are not needed. A duct runs up the stairwell and every few floors the dampers' actuators are connected to differential pressure sensor-controllers. These dampers are not protecting from smoke passage.

In underfloor and any shaft to plenum that goes thru a firewall, a fire and smoke damper may be required. Where space constraints exist, it may be best to have a rated proportional actuated damper rather than two dampers.

Some applications use the Belimo FSAF24-BAL actuator. This is a three position actuator with a maximum opening potentiometer. For example, in a corridor exhaust fan operation, it may be desirable to have a minimum flow normally but a maximum flow if smoke is present. The BAL actuator can be automatically moved to provide the needed function. Normally it restricts the flow to that required for balancing. In case of smoke from a fire, it can open 100% to purge or close to stop passage of flame and smoke.

## **Radiation Damper**

A UL tested damper which is installed in the air distribution portion of a fire-rated floor-ceiling or roof-ceiling assembly. Not actuated. Also called ceiling damper.

## **Rating**

Fire dampers have ratings specified in hours, typically 1.5 hours and 3 hours. Smoke dampers ratings are in cfm of leakage per square foot of area at a rated pressure.

## **Sandwich Pressurization System**

An engineered smoke control system which exhausts the smoke zone and feeds fresh air into the adjacent zones to keep smoke from spreading into zones other than that of the fire origin.

Variations exist. A sandwich typically involves just 3 floors although sometimes the 2 floors above and below the fire-smoke floor are pressurized.

A building pressurization system exhausts the smoke floor and pressurizes all other floors.

Sometimes only the egress corridors are exhausted or pressurized.

### **Secondary sensor**

The higher or second temperature sensor in a combination fire-smoke damper. (Smoke dampers do not have temperature limits.) 250°F is the code recommended temperature. 350°F is used about 10% of the time. See primary sensor.

### **Sleeve**

The sheet metal duct section attached to a damper to allow mounting of controls and breakaway connections to ducts.

### **Smoke Barrier**

A continuous membrane, either vertical or horizontal, such as a wall, floor or ceiling assembly, that is designed and constructed to resist the movement of smoke. A smoke barrier may or may not have a fire resistance rating. Such barriers may have protected openings using dampers.

### **Smoke Control System**

There are two types:

1. **Passive Smoke Control Systems** use smoke dampers to close upon detection of smoke to prevent the movement of smoke through a duct opening. Typically a smoke detector in the duct is used, but area smoke detectors to a alarm or smoke panel could be used. This is also referred to as a containment system.
2. **Engineered Smoke Control Systems** use curtains, walls and floors as barriers to create pressure differences. By pressurizing the areas where fire is present the spread of smoke into other areas is prevented.

Separating dampers into two types avoids confusion. 85% are **containment**; they close upon sensing elevated temperature or smoke and do not reopen until manually reset. About 15% are **reopenable** as they are part of an engineered smoke control system.

### **Smoke Control Zone**

A space within a building enclosed by smoke barriers or fire barriers on all sides, including the top and bottom. Typically these are contiguous with a sprinkler zone.

### **Smoke Damper**

Controls smoke only; there is no duct fusible link, firestat, or sensor. It is controlled by a smoke detector or heat detector signal, fire alarm, or building fire/smoke management system. The damper is installed within 24" of the smoke barrier it protects.

### **Smoke Proof Enclosure**

As defined by the NFPA 101 Life Safety Code, a stair enclosure designed so that the movement of the smoke products of combustion produced by a fire occurring in any part of the building into the smoke proof enclosure shall be limited. The smoke proof enclosure must be a continuous stair enclosed from the highest point to the lowest point by two hour rated fire barriers. Stairwell pressurization systems keep smoke from any floor from entering the stairwell.

### **Stairwell Pressurization**

Stairwells will fill with smoke if a door to a fire floor is open. The stairwell is the means of egress and must be kept smoke-free to allow occupants to escape.

A typical stairwell pressurization system has a fan whose outlet goes to duct run up the stairwell. Dampers are placed every few floors and are controlled by pressure sensors.

When the fire alarm goes off, it energizes the stairwell pressurization system. The fan goes on and the dampers proportion to maintain about .05" to 0.1" higher pressure in the stairwell than on the floors. This prevents smoke from entering the stairwell.



Smaller systems may use a sidewall prop fan to pressurize the stairwell. In some cases multiple fans are employed.

### Static Damper

Fire damper designed to close only with fans off. See Dynamic Damper.

### Torque requirement

The torque required for fire and smoke dampers varies with manufacturer, model, temperature tested, and leakage class. The linkage between the jackshaft and the drive blade is a significant factor. Some manufacturers use a geometry that doubles torque delivered to the blade during the first 30 degrees of rotation and drops off to half during the last 30 degrees. For new installation, whatever the damper manufacturer has tested and supplies is required. The same actuator can do 16 sq.ft. at 250F with one manufacturer and 8 sq.ft. at 350F with another. It depends on what was tested more than actual capability.

### Torque Retrofit rules of thumb:

At 350°F	FSLF	4 sq.ft.	FSNF	8 sq.ft.	FSAF	Not allowed
At 250°F	FSLF	4 sq.ft.	FSNF	12 sq.ft.	FSAF	14 sq.ft.

Actual UL555S testing gives higher sq.ft. per actuator, but corrosion, dirt, and age will increase the torque requirement. Since the actuators are typically closed at 165°F, the 250°F rating provides another safety factor. Bigger is better when it comes to torque.

### UL

EMME is the file with damper manufacturer data. Click **View Listings** to get data.

[http://database.ul.com/cgi-bin/XYV/template/LISEXT/1FRAME/showpage.html?&name=EMME.GuidelInfo&ccnshorttitle=Dampers+for+Fire+Barrier+and+Smoke+Applications&objid=1074292361&cfgid=1073741824&version=versionless&parent\\_id=1073986213&sequence=1](http://database.ul.com/cgi-bin/XYV/template/LISEXT/1FRAME/showpage.html?&name=EMME.GuidelInfo&ccnshorttitle=Dampers+for+Fire+Barrier+and+Smoke+Applications&objid=1074292361&cfgid=1073741824&version=versionless&parent_id=1073986213&sequence=1)

### UL555, UL555S

UL safety standards for fire, smoke, and combination fire and smoke dampers contain a large amount of information. The precise details do not matter as much as the simple fact that the damper and actuator meet the standard. All building codes require that UL555 (S) dampers be used in fire and smoke barriers.

UL555S Test	Fifth Edition Before July 1, 2002	Sixth Edition After July 1, 2002
<i>Cycling</i>	<i>5000 cycles</i>	<i>20,000 cycles</i>
<i>Temperature Degradation</i>	<i>3 cycles after 30 min. at elevated temp.</i>	<i>Same</i>
<i>Hose spray, fire endurance</i>	<i>Damper only</i>	<i>Same</i>
<i>Operation-Heated Airflow</i>	<i>Ambient temperature 4 in. w.g. pressure</i>	<i>Elevated temperature, 2400 fpm and 4.5 in. w.g.</i>
<i>Leakage</i>	<i>Ambient</i>	<i>Elevated Temperature Class IV deleted</i>
<i>Actuators</i>	<i>May be field installed</i>	<i>Must be factory installed</i>

## UL Classes

Classes of dampers are I, II, and III depending on the amount of smoke leakage.

85% in the market are rated for 250°F and 15% for 350°F. The Belimo FSLF & FSNF actuators are rated for 350°F. The Belimo FSAF series is a 250°F. Class I & II are the lower leakage and are usually specified.

The leakage is primarily a damper function and the same actuator torque is applied.

The older UL555 standard had higher temperature ratings, but the current document only recognizes 250°F and 350°F for testing. In addition it had a high leakage rating, class 4, which is no longer allowed.

Tunnel dampers are tested for 492°F. Belimo is used on them only with an insulation case added by the damper manufacturer.

LEAKAGE  CLASS	MAXIMUM LEAKAGE CFM/sq.ft.	
	1" W.G.	4" W.G.
I	4	8
II	10	20
III	40	80

## Uniform Building Code, UBC

The former code for most of the states west of the Mississippi. A few cities still base their local codes on the UBC. See International Building Code.

## UUKL

UUKL is a file on UL's web site with the names of the companies and the specific products that have UL864 fire alarm listing. **Actuators are not part of an alarm system.** UL will not investigate or list actuators and dampers under the UL864 standard. Since the actuator is separated from the alarm system by a relay, no damage or failure of the actuator can harm the alarm network.

In the drawing below, the actuator and damper are not connected to the alarm system itself. Rather, a relay separates them.

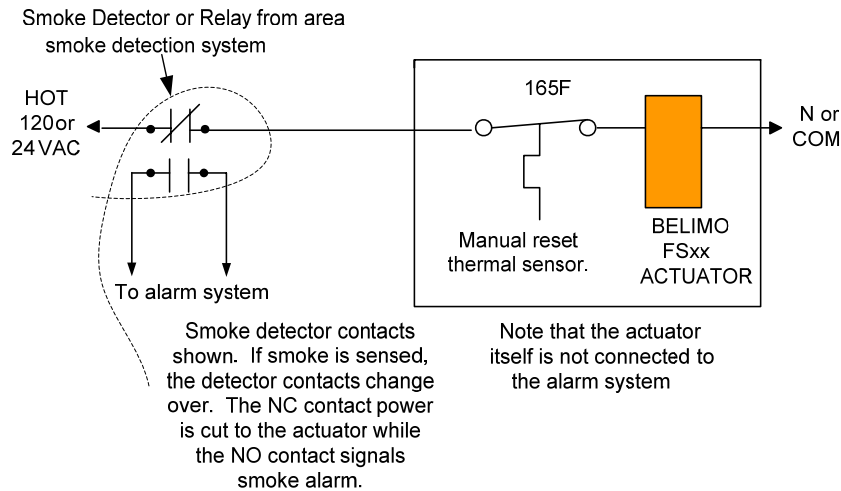
If area smoke detectors are used, then the NC contact below could be a contact on a fire alarm or smoke control panel or a relay contact. In that case, the NO contact does not exist here and the panel itself issues the alarm.

When the actuator auxiliary switches are connected to the fire alarm panel and/or FSCS, even indirectly through the fire alarm system, retesting of the alarm system must be performed. The extent of testing is determined by local codes or the AHJ. The minimum is testing of the damper actuator replaced. If it is a part of a zone, then the zone should be retested.

See Engineered Smoke Control System above for wiring connections.

(Incidentally, the wiring diagram below is the answer to the #1 question asked by engineers about fire and smoke damper actuators.)

## TYPICAL FIRE- SMOKE COMBINATION DAMPER WIRING



### Web Sites – Fire and Smoke and Damper Manufacturers

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

<http://www.ruskin.com>

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

<http://www.prefco-hvac.com/PRF-Main.html>  
<http://www.ncamfg.com/>  
<http://www.unitedenertech.com/news/>

Mestek:

American Warming and Ventilating – See airbalance.

<http://www.airbalance.com/abimain.asp>  
<http://www.arrowunited.com/firesmoke.asp>  
[http://www.cescoproducts.com/html/smoke\\_damper.html](http://www.cescoproducts.com/html/smoke_damper.html)  
<http://www.louvers-dampers.com/>

<http://www.firedamper.com/> (Lloyd)  
<http://www.leaderindustries.com/>  
<http://www.nailor.com/>,  
<http://www.safeair-dowco.com/>

### New York Rep-Licencees:

Accurate Specialty Metal (Pottorff)  
Air Louvers & Dampers (Ruskin)

Arlan (NCA)  
Imperial Damper (Safe-Air)

Complete Spiral (Prefco)

### Canada

## Europe

<http://www.belimo.ch/CH/EN/Product/FireSmoke/index.cfm>

### Specific Belimo Actuator Questions

#### Breaker Sizing

##### **How many Belimo FS actuators can be placed on a single transformer or breaker?**

It is unlikely that actuators would be the only load since smoke detectors and other life safety may be on the same breaker. It is wise to leave spare power available. Always use the run draw. See local codes for allowable loading.

The equation is  $VA = Volts \times Amps$ .

Wire runs must be large enough gauge or short enough that there is no voltage drop on way to actuators.

FSLF: From the data sheets the 24 VAC draws 5.0 VA. It is wise to load a transformer only 75% to ensure good voltage and a longer life. For a 40VA transformer,  $75\% = 30VA$ . Then  $30VA / 5VA = 6$  actuators. For a 100VA transformer,  $75VA$  load =  $75VA / 5VA = 15$  actuators.

The 120 VAC draws 18 VA according to data sheet.

Using  $VA = volts \times amps$ ,  $18 = 120 \times amps$ , or the FSLF120 draws  $18/120 = .15A$ .

Then given a 20A breaker and an allowable load of  $75\% = 15A$ ,  $15A / .15A = 100$ .

100 actuators could be placed on a 20A breaker.

FSNF: From the data sheet, both draw 27VA or the 120V amp draw is .23A. A 20A breaker loaded to 15A can carry  $15 / .23 = 65$  actuators.

FSAF: From the data sheet, the 24V is 10VA and the 120V draw is .1A. So 3 actuators can go onto a 40VA transformer and 150 actuators can go onto a 20A breaker.

##### **What? How can these numbers be true given the higher draws competitors show?**

Yes, the numbers above are true. At 120V on a 20A breaker:

FSLF is 100

FSNF is 65

FSAF is 150

##### **Why are there some differences between 24V and 120V and among the actuators above?**

The transformer losses vary and are optimized for different voltages. The FSAF is a slower actuator and thus draws a lot less due to gear ratio.

#### Continuous Duty

FS actuators are not designed for continuous duty at elevated temperatures.

The 2-position FS actuators are designed for fire and smoke UL555S applications. The UL testing is for 20,000 cycles. At elevated temperatures, they are tested for 3 cycles at a high torque load.

The FSAF24-BAL is UL tested for 100,000 10 degree movements and 20,000 full open-close cycles. The elevated temperature is for ½ hour and for 3 cycles. It is expected to move to its potentiometer position and sit for years and still spring return. It was tested for 6 months stalled.

FSAF24-SR proportional actuator can be proportioned using a 2-10V signal (or 4-20 mA with a 500Ω resistor. In this way, it functions the same as an AF24-SR or AF24-MFT except it is a 75 second actuator. It is tested for 100,000 movements by UL and is expected to last 500,000 by Belimo.

Typically the proportional works at ambient just like a 2-10Vdc signal actuator except it is a 75 second motor. Common application is in a shaft where a duct comes out to maintain pressure in an underfloor cooling application. Then, if there is a fire, the actuator can withstand 250F for a half hour if necessary. The exact sequence of operation depends on the control sequence.

So it is continuous proportioning at ambient. If the temperature is elevated above 122F, its life is shortened. If it sees 165F, it will live a long time. If it gets 250F, it will fail sometime after a little over a half hour.

Under normal conditions a fire and smoke damper is cycled once a day maximum – when the air handling system goes occupied and unoccupied. More often, the damper is driven open continuously and only

## **Linkages**

### **Can linkages be used with the FS series actuators?**

The data sheets for each actuator indicate that:

FSLF is direct coupled only. Several damper manufacturers make brackets for internal jackshaft mounting and direct coupling with special adaptors and hold-downs.

FSNF and FSAF can use the full range of linkages and housings.

## **Generators**

### **Can the Belimo FS actuators be used in Generator applications where the 15 second opening time is critical?**

Yes, however there are some cautions. The FS actuators are NEMA 1 instead of NEMA 2, like the regular actuators. The actuator must be shielded from rain and it must be mounted inside at rated ambient only.

### **What is then recommended for generators which must start in 10 seconds?**

Since a generator damper is spring open, the AF actuator with a 20 second full load spring time can be used. A parallel blade damper with a 50% authority will have 50% flow minimum at 10 seconds. This is enough to ensure the damper opens the rest of the way and the generator will not be starved for air.

### **What is recommended for actuation on the discharge of a generator where exhaust temperatures hit about 170F?**

All Belimo actuators have a storage temperature of 176F. Since the actuator is powered to keep the damper closed when the temperature is at ambient, there is no problem. When the generator is tested, the damper springs open. It is not powered. The 176F temperature limit is in effect. If the ambient then exceeds the actuator limits for a few

minutes, life span may be shortened, but not seriously. If the temperature is expected to exceed 176F for over a half hour, the actuator should be mounted outside the discharge.

Typically, planning ahead allows the actuator to be remote mounted removing the problems.

## **Mechanical and electrical paralleling**

### **Can the FS actuators be mechanically paralleled?**

FSLF. Not recommended. No linkages are manufactured by Belimo. (Ruskin makes one for a special application.) Use of one FSNF instead of two FSLF would be preferred in any event.

FSNF. Limited recommendation. With the ZG-102 and double the torque load, it was found that there is a chance of failure before 20,000 full cycles due to excessive gear stress. If the damper is going to be cycled frequently, failure is more likely.

It is recommended that one actuator be placed at each end of a jackshaft or one actuator per section be employed – split the jackshaft at each section. All standard linkages can be used including the ZG-102, but life span must be considered when applying.

FSAF. Yes. All standard linkages can be used.

### **Can the FS actuators be electrically paralleled?**

Yes, all can be wired to operate in unison.

## **Noise Level**

### **What is the noise level of the Belimo FS actuators?**

The holding level is inaudible. It does not register on a meter, so we have not rated it. The spring is audible, but that runs just once a day to once a year. Of maybe more importance is that there is no vibration of which noise is a symptom.

## **Quality**

### **What are the primary Belimo quality features compared to competition?**

- 5 year warranty
- Microprocessor control – motor runs cool for a very long life. Not the cheapest way to control, but the highest quality.
- Current draw for the size and torque of damper is lowest.
- Low noise level. Inaudible holding.
- Size is smallest making space constraints less of a problem
- Actuators do not have “creep closed” problem by not driving back open when short power interruptions occur.
- Swiss gear boxes. The failure of any gear or gear box component in Belimo actuators is 1 in 10,000 over the warranty period. Absolutely top quality.
- Cold-weld clamp. The teeth in the Belimo clamp grab shafts and will not slip.

- ISO 9001 quality control – average failure rate is certified below .3% over warranty period. Fire and smoke actuators are near .2% over first 2 years.

### **Do I need to specify Belimo to get it from the damper manufacturer?**

Yes.

While some manufacturers provide Belimo as the standard offering or as default in certain applications, some manufacturers use competitors' actuators.

## **Replacement for Competitive Failures**

### **What are the code issues most important for replacement?**

- All codes require defective assemblies to be repaired. NFPA 80 (fire) and NFPA 105 (smoke) are the standards with respect to dampers. They both state repair as soon as possible.
- UL has specifically stated that they do not regulate replacements and that the AHJ (Authority Having Jurisdiction), typically the local Fire Marshal or Building Official, has the final authority. The codes themselves do not detail replacement rules, so the local inspectors interpret the codes and different inspectors think different things.

Belimo recommends these ruling guidelines:

- Use an actuator that is UL555S listed with the damper manufacturer.
  - Various Belimo F&S actuators are UL555S listed with different damper manufacturers.
  - All Belimo actuators are UL873 or UL60730 listed. Use in fire and smoke requires listing with the damper also.
  - In general, inspectors want an "equal or better actuator." Rules vary among the different jurisdictions. Permits and inspections are required in some.
- Check the Belimo cross reference and UL listings in the Retrofits and Replacements section of the Belimo F&S Dashboard.
- Use the appropriate specific damper or manufacturer installation instructions found in the Belimo RETROFIT section.
- A Fire Marshal form is included with each instruction. It should be filled out and left on the premises.

### **What are most important technical issues for replacement?**

**TTT-VAT** is a pneumonic device to use for memory: Temperature, time, torque, voltage, amperage, and test.

- "Equal or better" implies:**
  - Current draw** – must be equal or lower than the original. Belimo is lowest and can replace all competitors of the same torque without fear of overloading a breaker.
  - Voltage** must be the same. In the US 90% are 120V, 10% are 24V.
  - Timing** – UBC and the older California Building Code required 15 seconds at ambient. Most of the US in under IBC and 75 seconds at elevated temperature is the drive and spring time. The FSLF & FSNF are 15 second; the FSAF is <75 second drive, <20 second spring. (In general, replacements

- should be the same time as the original. Local inspectors may rule otherwise and allow the present UL standard – 75 second – to be used where a 15 second actuator. This must be confirmed in each local jurisdiction.)
- iv. **Temperature** – the FSLF and FSNF are rated at 350F. The FSAF is for 250F. 250F is the standard required in most applications.
- b. **Torque requirement.** This varies by damper manufacturer. For replacement in general:
- i. 4 sq.ft. or less = FSLF at 350F.
  - ii. Up to 12 sq. ft. per FSNF at 350F. (Ruskin 8 sq.ft. 16 sq.ft. Pottorff.)
  - iii. Up to 14 sq. ft per FSAF. 250F only.
  - iv. Greater area than shown above can be operated by each actuator. However some old dampers are corroded and dirt has gummed up parts. Some shifting of ducts may have occurred. The torque requirement may be higher than originally passed UL. While the actuator output is higher and the damper requirement lower at ambient than at elevated temperature, the operation at elevated is the important factor. Spare torque should be provided.
- c. The damper and actuator **MUST** be TESTED after replacement. Just like a gas valve replacement, the contractor takes responsibility. Drive open. Open the sensor or remove power to ensure that the actuator springs the damper closed. Then drive open again. Check sensor (use a heat gun) and controls operation as described in Conformance Testing above.

## **-S Model Questions**

### **Do the -S version of the F&S actuators meet code requirements for damper position monitoring?**

There are two applications here with different answers:

- A. Local indicator lights are used for inspection purposes.
- B. Connection to a Firefighters' Smoke Control System

Verify local codes. In general -

- A. Yes with two provisos:
  - 1) Any field mounting requires an exception from the AHJ. This is an indication only and not covered by fire alarm requirements in most cases. Non critical application.
  - 2) They cannot be used to signal alarms, just to indicate open-close monitoring. They are not UL864 listed.
- B. Yes with three provisos:
  - 1) They must be UL555S listed with the damper manufacturer. Any field mounting requires an exception from the AHJ.
  - 2) The wiring must be supervised per fire alarm codes – typically chapter 9 of IBC.
  - 3) They cannot be used to signal alarms, just to indicate open-close monitoring. They are not UL864 listed. The contacts of the –S model may need to be isolated by a relay from any UL864 components.



Some AHJ's do not accept the actuator switches as proof. Others do not like the blade switches and prefer the actuator switch. Most codes do not say "HOW" to monitor, just that it must be done so under certain circumstances. Proximity switches are another choice.

Given the cold-weld clamp of the Belimo and the robust connection between the jackshaft and the damper blade, the Belimo Aux Switches are technically equal to blade switches with the coat-hanger connection which is not as strong.

The smoke detector has two sets of contacts. Upon detection of smoke, one set opens to cut power to the actuator and spring the damper closed. The other set closes and tells the fire alarm panel that a damper has closed.

## **Specification**

### **How do I specify Belimo?**

The Belimo specification is on the Belimo website F&S Dashboard. Customer service can also send to a customer.

## **Temperature**

### **Can the Belimo FS actuators be used in higher than normal operating temperatures?**

No. The ambient rating for long life is the same as other actuators. The 250°F or 350°F test temperature is for ½ hour in the UL555S test.

### **Can the FSNF be used at temperatures below 32F?**

No. The data sheet states correct specifications and should be observed. The FSNF has been tested at low temperatures and loses some torque and speed when it is operated. It will work, but not at specified torque, speed, or number of cycles.

**For generator exhaust applications see Generators.**

## **Valves**

### **Can the FS actuators be mounted to valves?**

No.

We cannot stop customers from doing so themselves, but the thermal isolation and faster motor and different electronics have not been tested for the condensation or frequent opening and closing of valve service.