BELIMO FIRE & SMOKE FACT SHEET

Contents

Fire Dampers 1
Smoke Kills 1
Smoke Dampers 2
Ceiling and Corridor Dampers 2
Combination Fire and Smoke Dampers 3
UL Classes 4
Code Authority 6
NFPA National Fire Protection Association 7
AMCA – Air Movement Control Association 7
Codes 7
Fire and Smoke Protection 8

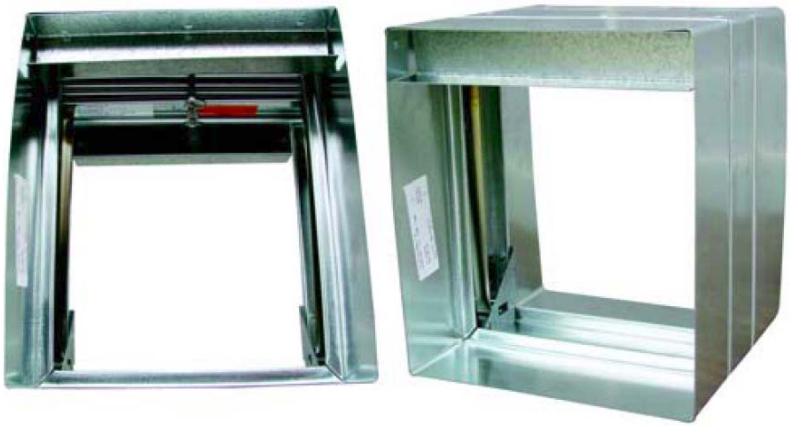
Fire Dampers

The fire damper is usually a non-actuated, spring loaded curtain damper. A fusible element melts at 165F or higher temperature and releases a catch which allows closure of the damper. Some of the bigger ones (3' x 3' or larger) are multiblade types with springs to close the damper. In the larger sizes, this gains the needed extra strength of the blade to hold against air pressure.

Typically, the damper is placed in a duct passing through a wall of specified thicknesses of drywall or concrete block. The wall and damper have a minimum time rating – 1 hr, 1-1/2 hr, or 3 hr – through which it takes a fire to burn. The compartmentalization restrains the spread of a fire.

The fire damper is heat actuated.

Roughly 2 x 10^6 fire dampers are sold in the US each year. About 270,000 combination fire and smoke or smoke only are sold; these are the actuated dampers.



Curtain Fire Dampers (Courtesy PCI – Pottorff)

Smoke Kills

It is typically easy to get away from a fire unless an explosion has occurred, however the smoke follows everywhere.

Smoke dampers are placed in ducts and walls that need to stop the passage of smoke. The typical application is to allow a means of egress in case of a fire.

Some smoke dampers are employed in a managed smoke system.

Smoke management systems contain the smoke in a smoke compartment or evacuate it to the outside to allow people to get out of the building before they are asphyxiated or poisoned by the large amounts of toxins released by the fire. In addition the fire fighters can remove the smoke and get some control over the areas in which they must work.

Smoke dampers are used in two different ways: 1) Containment to preserve compartmentation; 2) Engineered smoke control systems to pressurize spaces to prevent smoke movement or to exhaust smoke.

In the Americas, roughly 90% of fire and smoke dampers are applied for containment. The other 10% are found in engineered smoke control applications.

Balanced Fire Protection

The concept of balanced fire protection is dominant in the US today. Multiple levels of protection are best for those situations where one tactic fails. A strong structure that can withstand blast (for example from a boiler explosion) or earthquake protects occupants. Fire stopping keeps flames and smoke from traveling – fire dampers are a part of the fire stopping system.

Sprinklers can contain and sometimes put fires out in the local area where the fire starts. However, water sometimes fails due to a fire that overcomes the water available, due to errors shutting the water off, earthquakes that cut the water supply and may open gas lines leading to very large fires, or other unforeseen event. Redundant systems are best.

Smoke dampers close to prevent smoke spread. In managed smoke control, override switches are present at the FSCS (Fire Fighters' Smoke Control System) Panel, sometimes called the FFCP (Fire Fighters Control Panel). The damper overrides allow the emergency responder to select options: a) leave dampers and fans in automatic control of smoke detectors or alarm panel, b) close to prevent spread of smoke or feeding oxygen to a fire, or c) to open to allow evacuation of smoke or pressurization of a space.

Smoke Dampers

Except for the small single blade dampers, smoke dampers are multibladed. They are actuated since they must respond to smoke detection electrically and in some cases must be re-openable. The signal to close and re-open comes from a smoke detector, smoke alarm panel, or a hand-off-auto switch on a fire fighters control panel.

Smoke only comprise about 10% of the actuated dampers. Most are combination fire and smoke. Most smoke barrier walls are fire walls also.

Ceiling and Corridor Dampers

Ceiling and Corridor Wall dampers are special version dampers meant for installation in ceilings and walls. They protect passages meant to allow escape from a building that is on fire.

A common term for smoke damper is "rated damper." The damper is smoke rated. A lot of specialized vocabulary is used in the smoke market. For example, in the UL555 Standards, "heat responsive device" is the term used for "fuseable link" since it also encompasses the electrical thermal sensor also. The thermal sensor is typically a bimetal contact with a manual reset button.

The smoke damper is an actuated damper. It can be single or multibladed and either opposed or parallel blade. It has seals tight enough to keep most smoke from passing thru.

They are actuated by smoke alarm systems, smoke detectors, or at the firefighters control panel. The purpose is to keep smoke from traveling thru ducts or across barriers so that people can escape toxic smoke.

Combination Fire and Smoke Dampers

90% of the actuated dampers in the US are combination fire and smoke; only 10% are smoke only. They are tested to meet both fire stop and smoke restriction requirements of UL555 (fire) and UL555S (smoke).

The combination damper has a fusible link or a thermal bimetal and sometimes a secondary high temperature sensor. 80% of them close at 165F and are not re-openable. Re-openable dampers are used in managed smoke control systems and if the fire department panel switch is changed they can reopen above the 165F. If the temperature continues to rise to 212F, 250F, 350F or whatever the local code or application requires, then the damper re-closes and cannot be opened again until manually reset.

The fusible link method was standard in the past, but is mostly replaced by the electrical method today.

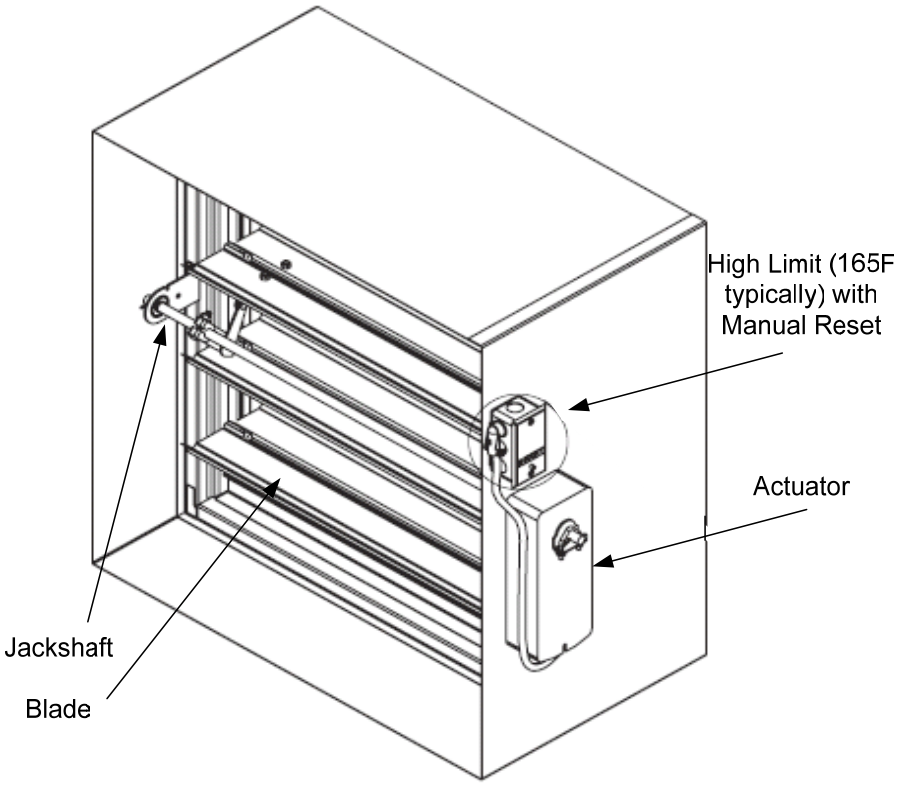
Several methods of release were used. See Belimo retrofit information for photographs, more complete descriptions, and details of the variations.

Pottorff is one example of a single spring method. When the fusible link melted, it released by disconnecting the jackshaft from the actuator linkage. Replacing the actuator only is not an accepted practice. A thermal sensor must be added. Since the old spring had to be driven by the actuator each time the damper opened, it is an extra load on the actuator. An FSLF would have to work against its own spring and that of the shaft spring. It would either fail to drive open or fail early because of the extra load. In addition, this is not a UL Listed method of operation.

Most manufacturers used two springs. One was released by the fusible link. It was not a load on the actuator as it was pre-tensioned manually. The other spring drove the damper back if the actuator power was disconnected. Most of these can be disassembled by removing the old actuator and actuator external springs. Then a modern Belimo can be installed. The fusible link has its own spring.

Some dampers used a single actuator spring and a modern thermal sensor. Functionally, it made no difference.

The early models of actuators did not have internal springs. All modern actuators have the internal spring which makes electrical disconnection simpler and safer.



Courtesy PCI - Pottorff

Modern combination F&S damper, thermal high limit, and Belimo actuator.

UL Classes

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

85% in the market are rated for 250F and 15% for 350F. Most actuators are rated for 350F. 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 250F and 350F for testing. In addition it had a high leakage rating, class 4, which is no longer allowed.

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

Summary of UL555 and UL555S tests

The fire codes in any city or state require various procedures. Among them is always the requirement that any fire, smoke, or combination fire and smoke damper be UL555 (fire) or UL555S (smoke) or both (combination) listed.

The testing must be done with the damper and actuator as an assembly since both must work together.

It is not absolutely necessary to understand the details of the tests. The simple fact that Belimo has passed with a certain damper is the essential issue. The standards are rather detailed. A summary of just part of them is given below.

UL tests the damper for leakage, high temperature integrity, and operation of the temperature sensors. Dampers are also tested for dust loading, salt spray exposure corrosion resistance, and spring closing force.

Other UL Standards may apply, e.g., UL33. for fusible links.

The damper and actuator must survive and operate correctly after 15 minutes at 2400 fpm air flow at 250F or 350F. The temperature degradation test and the heated air flow test are the essential actuator testing.

The UL555S test requires that the actuator open and close within 75 seconds.

The Uniform Building Code, UBC, required that dampers open and close in 15 seconds. This is a code, not a testing standard like UL555. Since UBC used to be the dominant code in all states west of the Mississippi, most fire and smoke actuators have 15 second response time.

The only test that measures the 15 seconds is at ambient temperature on job sites by the local inspector.

With the International Building Code now almost country wide, the UL 75 second time is typical. It is expected that all the US will be back to using the UL times by 2009. This is consistent with the testing standards and ensures quality.

The UL Standards have changed in the last few years. Various requirements have been added to try to correct problems. Those affecting actuators are more stringent testing and requirement and that actuators be factory mounted.

Replacement of failed actuators

One area, which UL does not address, is replacing actuators on old dampers. Local codes prevail on this subject and none address it specifically. The Authority Having Jurisdiction (the AHJ, typically the local inspector or fire marshal) determines what is allowable. Since some actuators are no longer made and some dampers no longer available, the replacement with alternates is necessary.

UL has stated that replacement of the actuator according to the damper manufacturers' field servicing procedures is required.

Most codes state that appliances should be repaired and that life safety devices must be repaired.

NFPA 80 (fire) and NFPA 105 (smoke) require repair as soon as possible and testing at 1 year and every 4 years (6 for hospitals).

History of Belimo in Fire and Smoke Market

Belimo first produced actuators for the Fire and Smoke market in 1978 for the European market only. This was the FM12FS-R, a direct coupled, external spring return actuator. The design was similar to the older US actuators. In 1982 the FS24-S actuator with internal springs was released.

During the years that followed a large number of FS variations were released with great success. In 1995 the new generation BF actuators with brushless DC motor and testing and monitoring options came out.

In 1999 the latest BLF, BFG and new monitoring option versions were released.

New models of smoke extraction damper actuators (1000F), LON and communicating actuators have been released in the last few years.

Today Belimo has over 80% market share of the Fire & Smoke actuators in the European market and as of this writing, 33% market share in the US. We are not the cheapest, but our quality has been the highest.

Most countries have variations on codes that make it difficult to provide the same actuator for every market. The Belimo SM24-S was originally a Korean F&S actuator. Specialized versions are made for other countries also. Very few of them are applicable in the US although code officials have granted exceptions when requested.

The NF24 and/or NF120 actuators were UL555 listed with Ruskin, Greenheck, Nailor, NCA, and PCI. If replacement needed, the FSLF (4 sq.ft. maximum) or FSNF (8 sq.ft. Ruskin, 12 sq.ft. all others) should be used for replacement. See cross reference for more detail.

Code Authority

Model codes are written by a number of associations and then adopted by state, county, and city jurisdictions. IBC and NFPA both have model codes.

In the U.S. there are a number of groups primarily responsible for standardizing codes.

BOCA International, International Conference of Building Officials (ICBO, the UBC), and the Southern Building Code Congress International (SBCCI) were the three main groups. They have joined to form the International Code Council who publish the International Building Code (IBC). Members include local and state government code officials, design professionals, trade associations and manufacturers.

The IBC is a minimal code and various states and cities add or modify to the needs of the geographical area. Changes are sometimes minor, and in some cases major rewriting has been performed.

The NFPA (National Fire Protection Association) has written a building code also. While NFPA is well accepted in the fire and electrical codes, the NFPA 5000 code has not been well accepted.

Federal buildings have a separate set of codes and standards which do not need to meet local codes.

Many universities have separate standards and codes as do some cities and states.

Protection of people is the first goal of the codes; this is not always clearly stated. Belimo will always consider life safety first in any consideration of our product applications. A secondary consideration is the protection of property. However, property protection also protects the occupants, so the two go hand-in-hand in many situations.

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 officials, manufacturers, consultants, and ASHRAE.

The most pertinent standards/codes are:
NFPA 70 – NEC – the National Electrical Code
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, Attria, and Large Spaces
NFPA 101 Life Safety Code
NFPA 80 Fire Doors and Other Opening Protectives
NFPA 105 Smoke Doors and Other Opening Protectives
NFPA 204 Smoke and Heat Venting

AMCA – Air Movement Control Association

AMCA is an organization of air moving equipment manufacturers. All the damper manufacturers are members. They issue various documents concerning quality testing, certification of products, and adherence to standards. Many consultants will specify meeting their standards at the prompting of reps of the manufacturers' who are members. Many of their documents are well worth studying.

AMCA standards do not have the force of an NFPA or UL.

The one standard that Belimo tests to is AMCA 520. This requires stalling the actuators open for 6 months to prove they still spring return. We have performed both 6 month and 1 year tests.

Codes

The local code process starts with the IBC in most areas and references NFPA, in particular the National Fire Code, National Electrical Code and Mechanical and Plumbing Codes.

Unless the codes are quite clear in smaller projects, the architect or mechanical engineer will hire a Code Consultant to put together the requirements for large buildings.

Code Consultants are usually Fire Protection Engineers, distinct from mechanical engineers. They have a different education and there are relatively few of them. Most metros have one; large metros have several. Rolf Jensen and Shermer have offices in many cities. Large ME companies have their own fire protection engineer on staff. Code Consultants do not write specifications; they would review some. They are more influencers of the architect and tell the ME what must be accomplished. In many cases, they remove various balanced fire protection elements and depend on sprinklers to an excessive degree.

UL, working with NFPA, ASHRAE, and interested parties sets testing standards to prove the quality and applicability of fire alarm systems, components like dampers, smoke detectors, and

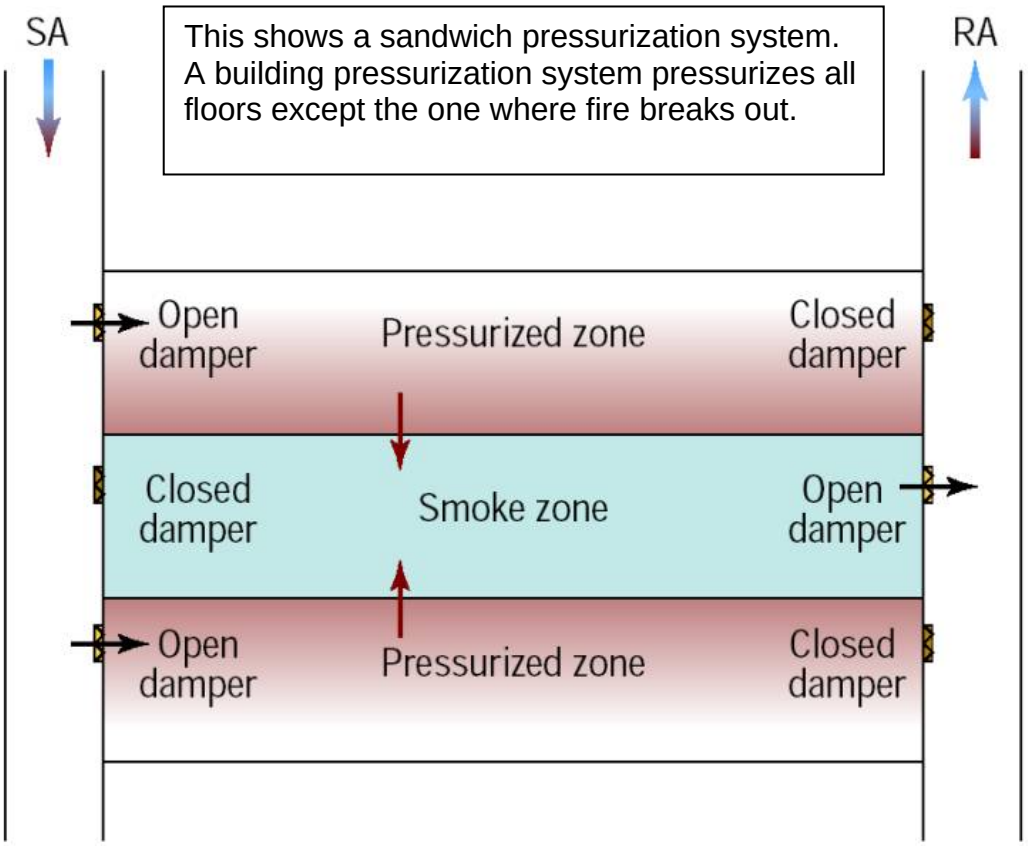
control panels. Actuators have not been extensively examined in the past, but in the future there will likely be standards of test that they must meet that go beyond simple electrical and fire safety.

Fire and Smoke Protection

Fire control in buildings typically consists of the one or more of the following:

1. Smoke detectors in spaces and all ducts to give early warning about fire. Codes vary by the state and city. A detector may be required between any 2 dampers. They are required in the return airs and sometimes the supply airs. The CFM of the unit often determines the exact requirements. Smoke detectors are sometimes supplied with the damper.
2. Dampers are placed in all ducts that pass thru smoke and fire protected walls. The walls are meant to stop fire and the spread of smoke. These are fire and smoke dampers. Some walls are firewalls, some are smoke barriers, some both.
3. Fire stats may be installed in the ducts to stop the fans, close dampers, send alarms, or whatever is determined by the codes to be required.
4. A central alarm system receives signals from any fire or smoke detector or any "pull station" (we all remember these from high school when we pulled them to get out of a social studies test) and will dial the fire department, set off alarms, release door locks, and perform mechanical functions as necessary. Emergency lighting may be turned on.
5. Mechanical functions may be any combination:
    a. Shut down fan(s) of AHU's serving the affected area. OA and EX dampers close to keep fans from delivering fresh oxygen to the zone which would fan the fire.
    b. Set up a "sandwich" where the floor or zone with a fire alarm is vented while the floors or zones adjacent are pressurized – fans blow in, no exhaust. That way smoke does not enter these areas.
    c. Turn on exhaust fans to remove smoke while closing all outside ventilation to keep oxygen from entering.
    d. Close all fire and smoke dampers to prevent spread of fire while ventilating the "means of egress" passages and stairwells to allow people to escape. A safety area "fire shelter" may exist which allows for ventilation to protect from fire when egress is restricted.
    e. Sprinkler systems. BOCA is high on sprinkling buildings but not on smoke control systems. UBC is high on the smoke control and sprinklers. A "sheltered fire" (wires inside a chase or above the ceiling) cannot be reached by the water.
    f. Sprinklers can be set off by the melting of the fuse in the overhead ceiling mounted head or by a central alarm system signal. Dry systems are put in garages or areas where the water could freeze. Wet systems have water in the pipes at all times.
    g. Ansul dry extinguishing chemical systems are placed above cooking equipment in restaurants. No dampers are ever in cooking exhausts for fear of clogging or failing and preventing hot gasses from escaping.
    h. Exhausting using either the HVAC fans or dedicated fans to remove smoke.
    i. Release fire and smoke doors to close.
    j. Start stairwell pressurization systems.

This is the sandwich pressurization system to avoid smoke movement into non fire zones.



TERMINOLOGY and GENERAL INFORMATION

Courtesy HPAC Engineering

More information, including a glossary can be found in the Frequently Asked Questions and other files on the BELIMO Fire and Smoke DASHBOARD.