What Engineers Need to Know About Fire & Smoke Dampers:

A Collection of Technical Articles and the AMCA Guide for Commissioning and Periodic Performance Testing

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Contents

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Fire Dampers and Smoke Dampers: The Difference is Important

The most effective fire protection plans include detection, suppression and containment requiring both active and passive fire protection. Active fire protection includes all systems designed to suppress or extinguish fire once it has started, as well as aid in the evacuation of occupants. These include smoke detectors, building pressurization, fire alarms, sprinklers, exit signs, and evacuation plans. However, active fire protection systems do not prevent the spread of smoke and toxic gases, the leading cause of death from fire. Passive fire protection is designed to prevent smoke, toxic gases, and fire from spreading; and by compartmentalizing fire, passive fire protection systems:

- Strengthen the effectiveness of active systems
- Facilitate occupant evacuation
- Protect property
- Minimize property damage

Compartmentalizing the building with fire-rated separations like fire walls, fire barriers, fire partitions, smoke barriers, and smoke partitions is a critical feature of the system. When penetrating these walls or partitions by the ductwork of the heating, ventilation, or air conditioning (HVAC) system, the integrity of their ratings are sustained by the use of fire dampers, smoke dampers, or combination fire/smoke dampers. These three damper types perform different functions and are installed and maintained differently as well. Knowledge of these differences is imperative to the proper application of the dampers and their performance in the life/safety system.

A fire damper closes once the duct temperature reaches a high enough level to melt a fusible link. A smoke damper closes upon the detection of smoke. The codes have recognized, and most engineers agree, that the best method of compartmentalization is through the use of the combination fire/smoke damper. It closes not only upon high duct temperature but also upon the detection of smoke. The combination fire/smoke damper can ship with override controls to pressurize individual spaces. It is UL leakage-rated to stop smoke in its tracks, which is a main difference from fire dampers. Only combination fire/smoke dampers or stand-alone smoke dampers are leakage-rated devices (Table 1).

Table 1: Underwriters Laboratories Standard UL555S Leakage Classifications

Leakage Classification	Leakage, cfm/sq-ft at Standard Air Conditions		
	4.5 in. wg.	8.5 in. wg.	12.5 in. wg.
I	8	11	14
II	20	28	35
III	80	112	140

Fire Dampers

A fire damper can be defined as "a device installed in ducts and air transfer opening of an air distribution or smoke control system designed to close automatically upon detection of heat. It also serves to interrupt migratory airflow, resist the passage of flame, and maintain the integrity of the fire rated separation."[1] Its primary function is to prevent the passage of flame from one side of a fire-rated separation to the other.

Fire dampers (Figure 1) are operated by a fusible device, typically a melting link. They are designed and tested under UL Standard 555: *Standard for Safety for Fire Dampers,* to maintain the integrity of the fire-rated separation. Fire dampers are equipped with a fusible link (rated for 165°F up to 286°F), which holds the blades open until it the link melts. Upon reaching the melting point, the blades then close and stop the flame from moving into an adjoining compartment.

Location: Fire dampers are installed in or near the wall or floor, at the point of duct penetration, to retain the integrity and fire rating of a wall or floor whether it is a ducted or open-plenum return application. Should the ductwork fall away, the damper needs to stay in the wall or floor to maintain the integrity of the wall or floor. One should actually think of the fire damper as part of the wall system itself.

Sleeves and Attachment: Fire dampers are required to be installed in sleeves. Lighter gauge sleeves (18–20 ga.) require a breakaway connection from the sleeve to the ductwork. Heavier, smaller dampers (16 ga.) can be installed with a hard duct connection. The manufacturer's installation instructions will include the approved method for attachment and spacing of the attachment (Figure 2).

Sealing: The spaces between the damper frame and the duct typically are not sealed due to thermal expansion. Breakaway connections as well as other seams can be sealed if the manufacturer's listing includes a UL-approved sealant.

There are two types of applications for fire dampers: static and dynamic. Static fire dampers can only be applied in HVAC systems that are designed to shut down in the event of a fire. Dynamic fire dampers have been tested for closure under airflow and carry both an airflow velocity (fpm) and pressure differential rating. The minimum rating for all dynamic fire dampers is 2,000 fpm and 4.0 in. wg. The minimum ratings are based upon closure at a minimum airflow of 2,400 fpm and 4.5 in. wg.

Figure 1: Example of a curtain-blade fire damper with fusible link and factory integral sleeve. Photo courtesy of Ruskin.

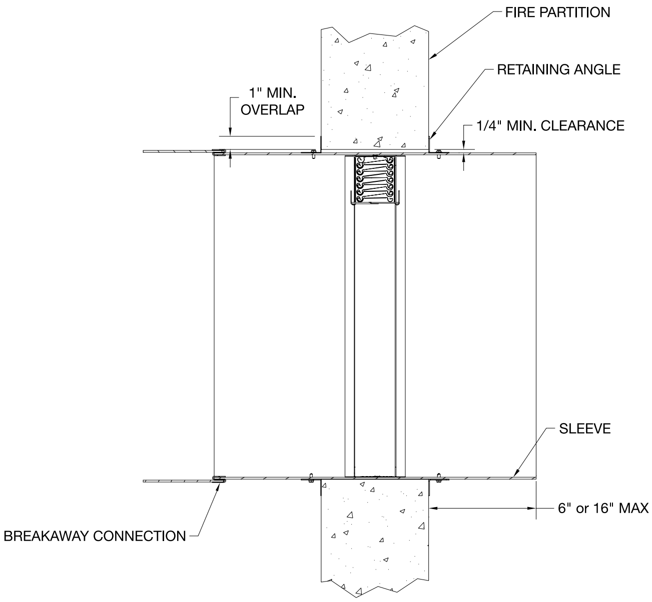

Figure 2: Typical fire damper installation, based on AMCA 503, Fire, Ceiling (Radiation), Smoke and Fire/Smoke Dampers Application Manual. Image courtesy of Ruskin.

Figure 3: Example of a typical smoke damper. Photo courtesy of Ruskin.

In addition to the two applications, fire dampers are also available in two basic designs: curtain-type and multiple-blade-type. Curtain-type dampers are the most common and consist of a "curtain" held up by a fusible link. Multiple-blade dampers are similar to control dampers with "blades" located in the airstream. Multiple-blade fire dampers generally offer greater restriction to airflow than a curtain-type fire damper for the same size duct. However, multiple-blade fire dampers can be applied in situations when the system air velocities exceed the curtain-type fire damper closure ratings. Multiple-blade fire dampers have been UL tested and are "dynamic" rated for closure at 4,000 fpm and 8.0 in. w.g.

Smoke Dampers

Smoke dampers (Figure 3) are defined as "a device installed in ducts and air transfer opening of an air distribution or smoke control system designed resist the passage of air and smoke. The device operates automatically and is controlled by a smoke detection system. They can be opened or closed from a remote fire command station if required."[1] Their primary function is to prevent the passage of smoke through the heating, ventilation, and air conditioning system, or from one side of a fire-rated separation to the other.

Smoke dampers are operated by either a factory-installed electric or a pneumatic actuator. They are controlled by smoke detectors and/or fire alarms. Smoke dampers are qualified under UL Standard 555S, *UL Standard for Safety for Smoke Dampers,* and have two general applications:

1. As part of a "passive smoke control system" in which they close upon detection of smoke and prevent the circulation of air and smoke through a duct, transfer, or ventilation opening.

2. As part of an "engineered smoke control system" designed to control smoke migration using walls and floors as barriers to create pressure differences. Pressurizing the areas surrounding the fire prevents the spread of smoke into other areas.

Smoke dampers have the following installation requirements:

Location: Smoke dampers are for use in or adjacent to smoke barriers. They must be installed no more than 24 in. from the smoke barrier. Of course, smoke dampers that are used to isolate air handlers are not limited to this distance requirement. NFPA 90A states that smoke dampers are to be used to isolate air handling units over 15,000 cfm.

Figure 4: Example of a combination fire/smoke damper with electric heat release device. Photo courtesy of Ruskin.

Figure 5a: Example of an "out of the wall/partition" combination fire/smoke damper. Photo courtesy of Pottorff.

Sleeves and Attachment: Smoke dampers do not necessarily have to be installed in sleeves. They can be installed directly in the duct. The manufacturer's installation instructions will include the approved method for attachment and spacing of the attachment.

Sealing: The joints between the damper frame and the duct must be sealed to prevent unwanted air leakage. Smoke damper leakage ratings are based on leakage through the blades and inside damper frame and not on additional leakage between the damper frame and duct or sleeve.

Combination Fire/Smoke Dampers

Combination Fire/Smoke dampers (Figure 4) meet the requirements of both the UL Standards for Safety, UL 555 Fire Dampers and UL 555S Smoke Dampers, and applications requirements as described above. They are used in HVAC penetrations where a wall, floor, or ceiling is required to have both a fire damper and smoke damper. They close upon the detection of heat (via duct temperature) or smoke (via a smoke detector) and "seal" the opening. Unlike regular fire dampers,

Figure 5b: An "out of the wall/ partition" fire damper installed on a 2-hour-rated steel/gypsum firewall. Photo courtesy of United Enertech.

Standards With Post-Installation Guidance

When designing damper systems for fire and smoke protection, engineers need to consider how they will be tested and maintained over the years they will be in place. Two standards published by the National Fire Protection Association (NFPA) provide operation, maintenance, and testing requirements: Chapter 6 of NFPA 105-2010, Standard for Smoke Door Assemblies and Other Opening Protectives, and Chapter 19 of NFPA 80-2010, Standard for Fire Doors and Other Opening Protectives. Together, these standards cover operational testing and inspection immediately after installation; periodic inspection and testing; and maintenance of smoke dampers, fire dampers, and combination fire/smoke dampers. They also include requirements for documentation of the inspection, tests, and maintenance.

however, fire/smoke dampers are available with electric heat release devices instead of fusible links. The electric release devices are resettable and allow the damper to close in a controlled manner rather than slamming closed and causing pressure problems in the HVAC system.

System designers should insist upon these electric fuse links when selecting a combination fire/smoke damper. Models designed with airfoil blades perform better (less pressure drop) than others. Less pressure drop in a system means energy savings. System designers should select products that certify their performance through a third party, such as the Air Movement and Control Association International (AMCA). Locations, sleeve attachments, and sealing of combination fire/smoke dampers follow the same criteria as fire dampers.

Important Note on Installation

The installation of life/safety dampers should always be accomplished in accordance with the manufacturer's instructions as tested by UL or another code-compliant approval agency. Installation instructions provided by a manufacturer should never be used to install the dampers of a different manufacturer as the dampers may not have been tested to and passed the specific installation. Recently, many damper designs, particularly combination fire/smoke dampers, have increased their application and installation flexibility, including "out of the wall/partition" installations (Figure 5a and 5b). The number of UL tests performed on FSDs has increased dramatically to accommodate the new designs and installation methods. These designs have made it easier to select and install the right damper without creating undue burden on the engineer, contractor, and the local authority having jurisdiction (AHJ). Mechanical inspectors and plan review teams are being educated on these changes and are becoming increasingly aware of the new installation methods. Again, it is important that the damper manufacturer's approved installation sheets be available for the AHJ during installation review.

As with any building system, inspection and maintenance of components is essential to proper operation. This is especially true of a fire/safety system! The National Fire Protection Association NFPA 105: *Standard for Smoke Door Assemblies and Other Opening Protectives* states each damper shall be tested and inspected one year after installation. The test and inspection frequency shall then be every 4 years, except in hospitals, where the frequency shall be every 6 years. The code also states that the damper shall be actuated and cycled. The inspections must be documented indicating the location of the damper, date of inspection, name of inspector, and deficiencies discovered.

Similarly, NFPA 80: *Standard for Fire Doors and Other Opening Protectives,* states that fire and combination fire/smoke dampers shall require inspection and testing one year after installation. In addition, the testing and inspection frequency shall then be every 4 years, except in hospitals, where the frequency shall be every 6 years. NFPA 80 also requires documentation of the inspections.

The use, proper installation, and maintenance of fire, smoke, and combination fire/smoke dampers in sprinkled or nonsprinkled buildings is a vital part of a properly designed life safety system. When fire emergencies happen, the fire, smoke and combination fire/smoke dampers will help contain the fire and resulting smoke to the compartment of origin and thus minimize life and property loss while helping the firefighters extinguish the blaze.

References

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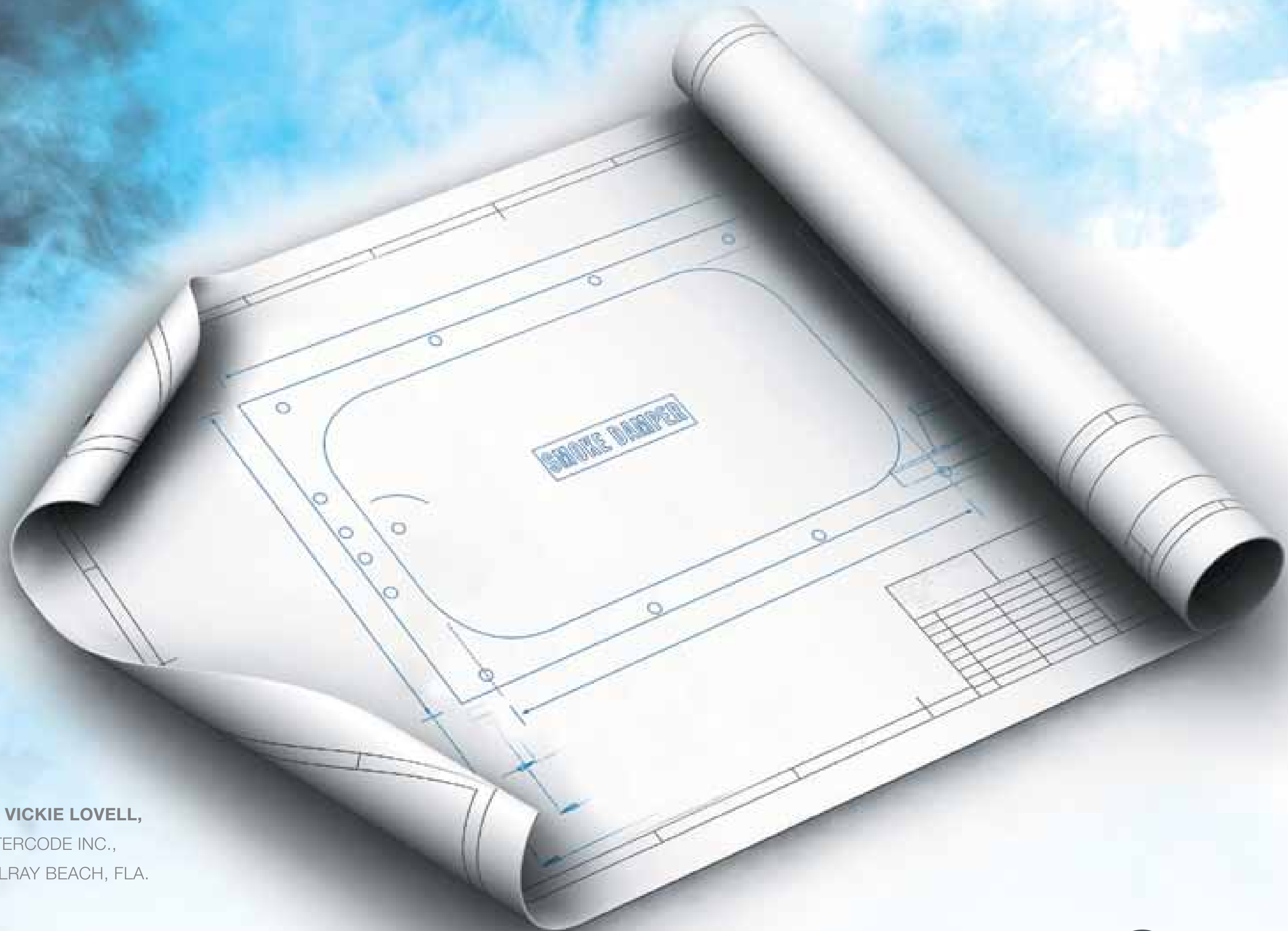

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DAMPERS:
An essential component of fire protection design

Automatic fire and/or smoke dampers and automatic fan shutdown in HVAC systems are effective in preventing the migration of smoke, flame, and heat during a fire.

Based on an examination of NFPA data in the 1930s, in 1939 the National Board of Fire Underwriters recommended that dampers be installed in HVAC systems to interrupt the passage of smoke, flame, and heat during a fire. Since that time, numerous experts in the field of the fire sciences have substantiated the effectiveness of automatic closing fire and/or smoke dampers and automatic fan shutdown in HVAC systems in preventing the migration of smoke, flame, and heat to areas of a building remote from the area of origin. Throughout the world, fire protection engineers and mechanical engineers continue to incorporate fire and/or smoke dampers into the fire protection design of many types of modern buildings.

CODE REQUIREMENTS

A fire damper is a device, installed an HVAC system, that closes automatically upon the detection of heat in accordance with UL standard 555. A smoke damper is a device installed in an HVAC system to control the movement of smoke in accordance with UL 555S. Combination fire/smoke dampers fulfill the function of both fire and smoke dampers, and must meet the testing requirements of both.

In the United States, the legacy model codes contained provisions for requiring construction capable of resisting smoke spread. Some of those requirements included the installation of smoke dampers. The 2000 Edition of the International Building Code (IBC) retained the requirement for smoke dampers in corridor walls when the corridor has a fire resistance rating in language similar to the legacy codes.

"The International Code Council (ICC) voting membership has consistently rejected proposals to entirely remove smoke dampers from duct penetrations from shafts."

But the 2000 IBC added a new requirement that requires smoke dampers at the penetration of shaft enclosures in lieu of requiring engineered smoke control systems, which had also been mandatory under certain conditions in two of three of the legacy codes. This code change was accepted in the new IBC on the basis that many of the previously required fire-rated and smoke-resistant floor and wall requirements in the legacy codes were permitted to be weakened or eliminated when automatic sprinklers were installed.

Because smoke dampers installed in duct penetrations of shaft enclosures is a relatively new building code requirement, and despite the concern about smoke spread throughout buildings (including sprinklered buildings), the requirement for smoke dampers in duct penetrations of shafts has been under attack in every IBC change cycle since 2000. The opponents of smoke dampers have previously cited the installed cost and maintenance cost of smoke dampers as an "unreasonable expense" to building owners, without increasing the safety of the building occupants. The debate will occur again during the hearings for the public comment on FS 113 May 18 to 19 in Dallas at the ICC Final Action hearings for the 2012 IBC.

The reliability and effectiveness of sprinklers is often cited as a justification for removing the requirement for smoke dampers in shafts. The International Code Council (ICC) voting membership has consistently rejected proposals to entirely remove smoke dampers from duct penetrations from shafts. Although the ICC has voted to support some revisions since the proposal was approved, it still applies to many buildings. However, the valid question remains as to the cost benefit of smoke dampers in shafts in sprinklered buildings.

AMCA RESEARCH

In 2008, the Air Movement and Control Assn. International (AMCA) contracted with Koffel Assocs. Inc. to conduct a literature search to identify credible work on this subject, and to use the research findings (if any) as the basis for additional computer modeling. The literature search resulted in two interesting findings:

First, no documents were found that would support the removal of smoke dampers in shaft penetrations. On the contrary, the literature search provided a sampling of fires from the past 25 years where smoke spread was an issue for occupant life safety. Many of the fires occurred in occupancies in which at least some of the legacy building code requirements would not specifically have required smoke dampers but would have required construction capable of preventing smoke spread, which could have included dampers. The data collection methods from the time period studied would not have specified when smoke dampers would have been required, or even if they had been provided as an above-code provision.

Second, the literature search identified a relatively recent modeling effort and some full-scale fire tests on the vertical spread of smoke in buildings via shafts. The additional modeling research, which has been contracted to be completed by Koffel Assocs., expands on these two studies in an attempt to better quantify the benefit of smoke dampers at duct penetrations of shafts in sprinklered buildings. (The report on the research and modeling conducted by Koffel Assocs. was nearing completion at the time of this article's printing, and will be available in the near future through AMCA's website at www.amca.org.)

THE SPRINKLER RELIABILITY DEBATE

At the heart of every debate in the decision to eliminate a fire or smoke protection feature in order to offset the expense of automatic sprinklers are two issues: reliability of automatic sprinkler systems and their relative cost/benefit. The fact that sprinkler systems fail to perform satisfactorily from time to time is not debated. However, the frequency and the causes of such failures stir controversy. When such malfunctions occur, a fire that would have been a nuisance can quickly become a potential catastrophe.

Sprinkler reliability figures are tossed about casually to promote their installation without much consideration given to the consequences of sprinkler failures in buildings where many other features have been eliminated. In 2009, NFPA's John Hall authored the report, "U.S. experience with Sprinklers and Other Automatic Fire Extinguishing Equipment." The fire data used to support the study was gathered from 2003 through 2006. In the study, Hall states that "automatic sprinklers are highly effective elements of total system designed for fire protection in buildings with sprinklers cover the area of origin, they do they operate in 95% of all reported structure

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fires large enough to activate sprinklers. When they operate, they are effective 96% of the time, resulting in a combined performance of operating effectively in 91% of reported fires were sprinklers was present in the fire area and the fire was large enough to activate."

In 1997, an NFPA study examined fire data from 1986 to 1995 to evaluate the extent of flame and smoke spread in sprinklered and nonsprinklered buildings. For high-rise buildings (seven stories or taller), the study showed that 11.4% of fires in sprinklered buildings resulted in smoke damage beyond the fire floor, while 15.4% of fires in nonsprinklered buildings resulted in smoke damage beyond the fire floor. For mid-rise buildings (three and six stories), 15.7% of fires in sprinklered buildings resulted in smoke damage beyond the fire floor while 34.4% of fires in nonsprinklered buildings resulted in similar damage.

While the study was unable to define the severity of the smoke damage or toxicity, it is significant that so many fires in sprinklered buildings had smoke damage beyond the fire floor. If smoke dampers were to be eliminated in sprinklered buildings, and the automatic sprinkler systems failed for whatever reason, the spread of smoke during fires would almost certainly increase.

It is important to note that neither NFPA report supports the position that sprinkler systems eliminate smoke, or that fires that are controlled by sprinklers do not continue to smoke production. G. W. Mullholland's paper entitled "Smoke Production and Properties," recorded in the 1995 SFPE Handbook of Fire Protection Engineering, estimated that if the airborne soot particulates produced by burning an upholstered armchair filled with 9 lbs of polyurethane foam were uniformly distributed throughout 1,800-sq-ft room, a person would not be able to see his or her own hand held at arm's length in front of his or her face. Even when sprinklers successfully suppress a fire, the fire can be expected to continue to burn and produce soot particulates and toxic gases.

Numerous studies have been conducted on fires where the sprinklers' water spray was shielded by some obstruction and never reached the item that was burning. Such fires effectively became nonsprinklered fires.

Experts confirm that automatic sprinkler systems are very effective, although not infallible or a panacea. The sprinkler industry, the fire service, and the fire protection community are continually striving to improve sprinkler reliability when the causes of sprinkler failure become known. John Klote, in an article entitled "Compartmentation and Dampers are Essential," stated, "in our ever-changing organizational functions, materials, construction methods, and architectural designs, it is reasonable to expect that new failure situations will arise. For that reason, sprinklered buildings need other fire (and smoke) protection features to ensure an adequate level of protection in the event of sprinkler failure."

Additionally, damper manufacturers, contractors, installers, and the fire service are cooperating to ensure that the dampers are both installed correctly and periodically inspected to ensure functionality.

Building codes can control the construction materials used in a building, which is taken into consideration when sprinkler systems are designed. However, neither building codes nor designers can control the materials that occupants bring into the building. If the wrong types of materials are brought into a building a sprinkler system that would otherwise control a fire can be easily overwhelmed. Therefore, sprinkler systems are best supported by designs, systems, and devices such as smoke dampers that help to manage smoke migration, even during successful sprinkler activation.

CONCLUSION

There is little debate as to whether an HVAC system can transport smoke to areas remote from the fire area's origin. However, there is still some debate as to how best to manage the smoke in both sprinklered and nonsprinklered fires. For many years, system shutdown was the standard approach to achieving some control over smoke migration.

Since 2000, however, the operation of the HVAC system in smoke control mode is not required in most buildings constructed to the IBC. Without an engineered smoke control system, or complete system shutdown and functional smoke dampers at shaft penetrations, the HVAC system can transport smoke to every building area the system serves. Even shutting down the HVAC system without dampers will not prevent it from supplying oxygen to the fire and will not entirely prevent smoke movement throughout the HVAC system.

The installation of smoke dampers at the shaft penetration by the duct can help inhibit smoke movement through the HVAC system.

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Increasing Use of Remote Testing for Fire/Smoke Dampers for Health Care

This article will address the application of available technologies using best practices to help hospitals save costs, protect lives and meet code-required fire life safety damper inspections. To lessen the risk of hospital-acquired infections and to reduce staff costs, health care facilities are urged to place fire/smoke dampers in locations that allow for easy staff access and to opt for equipment facilitating the remote testing of dampers.

INFECTION CONTROL

One cost-saving benefit of today's combination fire/smoke damper design, which uses an electric actuator and an optional position-indicating device, is the ability to monitor and test the damper remotely. This eliminates the need to physically gain access to the damper after the original inspection. Remote testing and monitoring contributes to the hospital's triple bottom line: saving labor, reducing the likelihood of infection and ensuring that critical life safety devices work when required.

Controlling infection is extremely important for hospitals. The Centers for Medicare & Medicaid Services make value-based incentive payments (VBP) to acute-care hospitals based on how well they perform or improve on certain quality measures, and payments are adjusted accordingly[1]. The number of healthcare-associated infections (HAI) is monitored as one of these quality measurements. While hand-washing is the single most important act in controlling the spread of infection, keeping facility staff out of the plenum space except when absolutely necessary also plays a vital part in basic infection control.

Conducting damper inspections in a health care facility is no small task, and facilities take much effort to minimize nosocomial (hospital-acquired) infections in patients. They will usually conduct an inspection by forming a multidisciplinary team within the hospital. This team, headed by an infection control officer, works together, removing patients from rooms being serviced. The team then may need to cordon off their work area with plastic sheeting to control the spread of particles, and they may deploy high-efficiency particulate air (HEPA) filters to catch any particulates set into motion in the process of gaining access to the damper above the ceiling. In areas dealing with airborne infections, the team may also have to schedule the shutdown of air handlers so as not to affect pressure differentials between spaces.

FIRE/LIFE SAFETY

In the case of fire, sprinkler systems alone are not sufficient to minimize the risk to people and property. Preventing the spread of steam and deadly gasses requires the installation of fire/smoke dampers as well. Fire produces toxic gases and volatile organic compounds (VOCs) as a byproduct of combustion. VOCs and toxic gasses can attach themselves to steam and smoke, and they can even travel through the air invisibly.

Much about the power of these elements was discovered during the MGM Grand Hotel fire of 1980. More people perished due to smoke inhalation and exposure to VOCs than from the fire itself. In fact, some people perished far from the fire zone, in areas completely devoid of smoke. It is now a commonly known fact that exposure to smoke, toxic gasses and VOCs is far more deadly than fire itself and is the leading cause of death associated with building fires. Harmful exposure conditions usually occur after flames have been extinguished. Light smoke or steam may or may not be present[2]. Because of the additional threat toxic gasses and VOCs pose, best practice today dictates that fire/smoke dampers be used in concert with sprinklers to protect life and property.

A more stringent testing schedule, code mandated or not, would benefit from easier damper access or remote damper testing technology. All critical lifesaving systems should be maintained and tested routinely. Dampers must be installed per International Building Code (IBC) and National Fire Protection Association (NFPA) Standard 105[3]. Code requires that all combination fire/smoke dampers be inspected and tested prior to occupancy and then tested again, one year later. The testing intervals are every four years thereafter unless the facility is an occupied hospital, in which case the interval is every six years. These testing intervals are mandated by NFPA 80[4], NFPA 105 and the International Fire Code (IFC). Dedicated smoke control systems and the dampers that are a part of those systems must be tested semiannually per the requirements of

NFPA 92[5]. A non-dedicated system, one that is also part of the HVAC system, must be tested at least annually. Dampers with the appropriate technology do not require access to the damper for testing after the initial inspection.

COST-SAVING MEASURES

While the previously outlined testing frequency is code minimum, many facilities professionals and building owners recognize that doing the minimum is not sufficient to maintain the equipment. AMCA Standard 520 recommends an actuator be cycled every six months to ensure both the actuator and the damper assembly are in working order and ready if needed[6]. A testing frequency of every four years for most buildings and once every six years for a hospital means that any product that fails during its third test is likely no longer under warranty, and 100% of the cost of any failed equipment and repair falls on the building owner. It is therefore financially pragmatic to test lifesaving systems more often that what is required at minimum.

Energy conservation is one of the most important factors in designing lifesaving systems but is seldom considered. The increased pressure drop associated with redundant dampers in the system requires more fan energy. In small duct applications, the additional pressure drop is compounded. Often, the reduction in fan energy consumption alone over the lifetime of the building can more than justify the cost differential between a curtain fire damper and combination fire/smoke damper with greater free area in the same size opening.

The smart application of technology and equipment can help building owners limit loss while saving money. Technology can simplify the inspection process by taking advantage of combination fire/smoke damper design and adding the ability to regularly maintain the fire and life safety system at the same time. The addition of damper-mounted test switches and mechanical position-indicating devices can reduce the time and labor involved in conducting a test.

Figure 1. Accessing dampers for code-required damper inspections and tests increases the risk of hospital-acquired infections.

Image courtesy of Nailor Industries Inc.

Figure 2. Placing dampers where staff has clear access saves time and dollars, and it increases the likelihood that all dampers will be found and tested.

Image courtesy of Ruskin

It is easier to perform periodic testing of a fire/smoke damper with an actuator than it is to replace the fusible links (as required per NFPA 80) when testing curtain-type fire dampers. Access doors are required because they facilitate repair and initial inspections. However, it is not necessary to physically look inside the access door unless dealing with a manual-curtain-type fire damper and the replacement of fuse links. Replacing fuse links can be very difficult when dampers are located in hard-to-reach areas, thus compounding time and costs.

Dampers with remote damper test switches and position-indicating devices lend themselves to more frequent testing due to the ease of access. An optional remote-mounted damper test switch, while functionally no different than the damper-mounted test switch, solves the problem of having to gain access above the ceiling to perform the damper test. Damper-open and damper-closed switches can be wired to remote indicating lights, LEDs or the building automation system, confirming the damper position and facilitating the test from the remote location. Most combination fire/smoke damper designs do not release the damper linkage from the operator, so optional end-of-travel switches internal to the actuator or blade-mounted switches provide equally reliable signals that the combination fire/smoke damper is in the position indicated. Remotely monitoring and testing a damper will, in the end, provide reliable results while saving a facility labor costs.

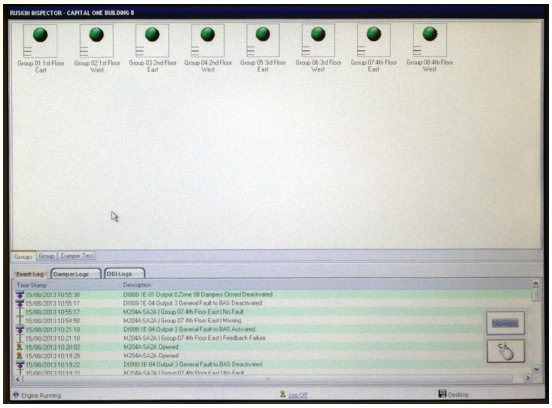

Figure 3. The screenshot shows the damper in the system, and the green dot indicates normal status. Three parallel lines indicate the damper is in the open position. There is an event log on bottom. *Image courtesy of Ruskin*

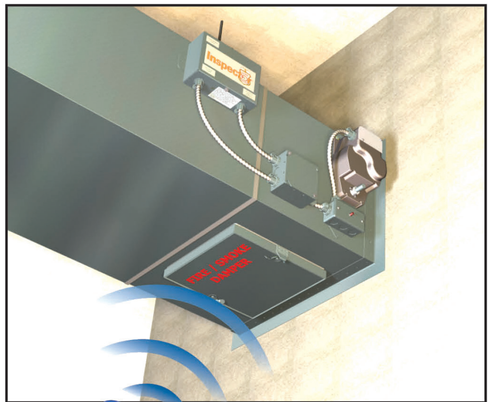

Figure 4. Wireless remote damper testing device with pass/fail status indicator.
Image courtesy of Ruskin

REMOTE MONITORING & TESTING APPROACHES

Many facilities have a fireman's control panel positioned in the entryway to the building. A UL-listed smoke control system will include a UL864-UUKL-listed firefighter's smoke control override panel. When remote testing and monitoring is to be accomplished using this panel, all of the fire/smoke dampers must be individually wired to this panel.

Existing building automation technology can easily be applied to accomplish required testing and monitoring while adding additional environmental control using three to six automation input/output (I/O) points per damper. Three I/O points provide the remote monitoring and testing function, the damper-open/damper-closed indicator and actuator on-off relay. Six I/O points might be necessary for remote indications near the damper, showing position and actuator status.

In a building automation system, a graphic user interface can facilitate the identification and location of the dampers in the system and their current status, as seen in Figure 3. Control programs allow a touch screen or mouse to remotely control the operation of the damper. The building automation system (BAS) program can facilitate damper monitoring, alarm generation, periodic testing sequence and fault logging. Automatic report generation is built in to document that the damper meets testing requirements for the authority having jurisdiction. This helps the building owner document that the fire life safety system has been tested.

A smoke control system or a system specifically for the purpose of fire-smoke damper monitoring and periodic testing can be completely separate from the building automation system. Off-the-shelf monitoring systems or custom smoke control systems have been available for over a decade and are installed in college campuses, science buildings, medical centers, jails, hospitals and high-rise office buildings around the world. When considering a system that has manually-operated remote damper test switches and panel-mounted indicator lights, also consider a fully automated system. Testing and monitoring is easily accomplished, given the capabilities of any building automation system. These systems can often be installed for nearly the same labor and hardware costs as manual test switches with remote-wired lights and switches, but a fully automated system provides continuous monitoring, environmental controls and the ability to regularly test all the dampers in the system remotely.

On smaller buildings, a system that provides continuous monitoring is not always necessary, but remote testing may be desirable. Wired or wireless technology can be applied to accomplish remote testing, and the logging of test results, manually or automatically, meets code requirements.

CONCLUSION

Sustainability should overshadow first cost in exchange for a solution that addresses the requirements to reduce infections and control costs while protecting the building occupants' overall safety. A well-planned, best-practice approach should include the proper mix of combination fire/smoke dampers and sprinkler solutions to protect the building and its occupants. Best practice is to replace two dampers with one lower pressure drop damper, which reduces installation labor and corresponding long-term energy costs. Combination fire/smoke dampers can be remotely tested, and that makes regular testing easily accomplished, adding value for the owner by automating maintenance and reducing or eliminating recurring inspection costs.

Preventing loss of any kind is paramount when considering the proper life safety products. When the proper product is chosen, it is then necessary to determine how to test the fire life safety equipment in a cost-effective way that compromises no patient's health. Acting on the knowledge imparted here will ensure the equipment functions in the event of a fire life safety event, which will protect lives and can reduce property damage.

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4 NFPA 80*: Standard for Fire Doors and Other Opening Protectives*. Quincy, MA: National Fire Protection Association, 2013.

5 NFPA 92*: Standard for Smoke Control Systems*. Quincy, MA: National Fire Protection Association, 2012.

6 AMCA 520, *Laboratory Methods for Testing Actuators*. Arlington Heights, IL: Air Movement Control Association International, 2009.

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Smoke Damper Testing and Maintenance for Service Life and Performance Assurance

Consultants in the field of fire engineering have long recognized the danger to life and damage to property that can be caused by smoke spread throughout buildings, even when the fire is confined to a small area.

A dramatic illustration of this concept is the 1980 MGM Grand fire in Las Vegas, which caused 85 deaths. Although the fire in this instance was located on the first floor of the hotel, most of the deaths occurred on the upper floors (floors 14–24) due to the migration of smoke. Smoke dampers are an integral part of any system designed to make a building safer by controlling and stopping smoke.

One globally applied concept is compartmentation of buildings using fire restrictive construction, required by all of the major building codes in the United States. Paragraph 8.2.2.1 of NFPA Standard 101 *Life Safety Code* describes this concept by stating, “Where required by other chapters of this code, every building shall be divided into compartments to limit the spread of fire and to restrict the movement of smoke.” NFPA 101 goes on to describe that *smoke barriers* subdivide building spaces for the purpose of restricting the movement of smoke, while *smoke partitions* are provided to limit the transfer of smoke.

Factors such as prevailing winds, stack effect, and the buoyancy of smoke contribute to the movement of smoke throughout a building. The heating, ventilating, and air conditioning (HVAC) ductwork and air-transfer openings in buildings can provide a pathway for the smoke to migrate through the building unless properly protected by smoke dampers. Every building code requires approved smoke dampers designed and tested in accordance with the requirements of UL Standard 555S, *Standard for Safety for Smoke Dampers,* to protect these types of openings in smoke barriers and smoke partitions (the codes do allow certain exceptions). If the barrier or partition also has a fire resistance rating, then a combination fire/smoke damper is required to protect the opening.

Smoke Dampers vs. Fire Dampers

Although this article addresses smoke dampers, it is important to note that fire dampers are also used in compartmentation and it is important to highlight the difference between these two types of dampers.

A fire damper can be defined as “a device installed in ducts and air transfer openings of an air distribution or smoke control system designed to close automatically upon detection of heat. It also serves to interrupt migratory airflow, resist the passage of flame, and maintain the integrity of the fire rated separation.” Its primary function is to prevent the passage of flame from one side of a fire-rated separation to the other. Fire dampers are generally operated by a fusible device, typically a melting link. They are designed and tested under UL Standard 555: *Standard for Safety for Fire Dampers*, to maintain the integrity of the fire-rated separation.

Smoke dampers are defined as “a device installed in ducts and air transfer openings of an air distribution or smoke control system designed to resist the passage of air and smoke. The device operates automatically and is controlled by a smoke detection system. They can be opened or closed from a remote fire command station if required.” Their primary function is to prevent the passage of smoke through the heating, ventilation, and air conditioning system, or from one side of a smoke-rated separation to the other. Smoke dampers are operated by either a factory-installed electric or a pneumatic actuator. They are controlled by smoke detectors and/or fire alarms. Smoke dampers are qualified under UL Standard 555S, *Standard for Safety for Smoke Dampers*. Combination fire/smoke dampers meet the requirements of both UL Standards 555 and 555S.

For more information about the characteristics of smoke, fire, and combination fire/smoke dampers, refer to the article, “Fire Dampers and Smoke Dampers: The Difference is Important,” by John Knapp, in the 2011 issue of *AMCA inmotion*, which is available at www.amca.org/publications/magazine.aspx.

UL Safety Testing

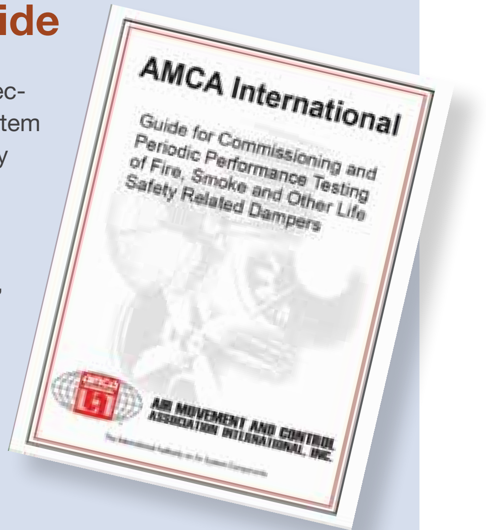
The 2011 article briefly mentioned that smoke dampers must undergo extensive testing to obtain a label from Underwriters Laboratory (UL) under Standard UL555S. To classify their smoke dampers, manufacturers must send several different sizes of dampers to UL for tests that include, but are not limited to, cycling, temperature degradation, leakage and operation, as follows:

Cycling Test: A damper must function as intended after being mechanically operated for 20,000 full strokes (closed and reopened). If the damper is to be operated as a smoke damper and a volume control damper, employing position devices that enable the damper to remain in positions other than fully open or fully closed, then it must go through 100,000 full strokes. As an alternative to the 100,000 full strokes, the damper may be cycled 20,000 full strokes and then 100,000 “repositioning” cycles of a minimum of 5 degrees.

Temperature Degradation Test: The dampers used for this test are to be those previously subjected to the cycling test and prior to subjecting them to the leakage test. The elevated temperatures are to be in increments of 100 °F (56 °C), and the minimum temperature to be UL qualified is 250 °F (121 °C). The damper is exposed to the elevated temperature for 30 minutes in the completely closed position. After the 30-minute period and while at the elevated temperature, the damper shall function as intended while operated through three complete operation cycles. The damper is cycled by using the actuator that has also been subjected to the test temperature. All building codes in the USA require smoke dampers to have a minimum elevated temperature rating of 250 °F (140 °C).

Leakage Test: The amount of leakage measured during this test shall determine the leakage class of the damper. For smoke dampers the leakage test is a continuation of the operation test.

AMCA Commissioning and Testing Guide



A building’s fire protection or life-safety system is comprised of many types of products, including, but not limited to, fire dampers, smoke dampers, combination fire-smoke dampers, and ceiling radiation dampers. All of these products must function properly as part of a comprehensive system during a fire or life-safety emergency. Proper installation, commissioning, and periodic performance testing are required to ensure these dampers function as intended in a fire emergency.

AMCA International recently released a Guide for Commissioning and Periodic Performance Testing of Fire, Smoke, and Other Life Safety Related Dampers. The new Guide provides recommendations for the proper commissioning of fire and life-safety dampers and describes the appropriate intervals and methods for performing periodic performance testing of life safety dampers.

A free copy of this guide is available in the Publications section of the AMCA website at www.amca.org/publications/damper_maintenance.aspx.

Figure 1: Blocking access doors to smoke dampers, in this case with wall framing members, can make testing and maintenance disruptive and expensive. Photo courtesy of David Sellers, PE, Facility Dynamics Engineering.

At the conclusion of the operation test, while the damper is in the closed position, the pressure and test temperature are to be maintained against the closed damper. The resultant leakage through the damper is then determined.

Table 1 below is taken from UL555S and describes the three different leakage classifications that can be derived from the leakage tests. The leakage classification is determined from the highest leakage value obtained from the specimens tested. All building codes in the USA require smoke dampers to meet a minimum of Class II leakage rating as defined in Table 1.

Operation Test: The minimum air velocity and closed damper pressure rating for dampers is 2000 fpm (10.2 m/s) and 4 in. of water (1.0 kPa). Air velocity and pressure ratings higher than the minimum are established in increments of 1,000 fpm (5.1 m/s) and in increments of 2 in. of water (0.5 kPa). Actual tests are performed at these pressures and velocities and include an additional safety factor. Under conditions of maximum specified air velocity, smoke dampers (including any actuators) must function without damage to the dampers or their components and shall completely close and open under the conditions. Dampers are to be tested with airflow in each direction.

Leakage Classification	Leakage, cfm/ft^2 at Standard Air Conditions		
	4.5 in-wg	8.5 in-wg	12.5 in-wg
I	8	11	14
II	20	28	35
III	80	112	140

Table 1: Underwriters Laboratories Standard UL555S Leakage Classifications.

Additional Product Tests

The evolution of the smoke damper and the testing requirements through the years has resulted in a product that is both high performing and reliable in its intended operation. The following are recently added tests that affirm the evolutionary improvement of product safety standards and testing:

Because installed smoke control or HVAC system smoke dampers may go for long periods of time without cycling, UL555S has recently added the requirement for a Long Term Holding Test. This test is intended to measure the ability of an actuator to return to its resting (non-powered) position after being held in a normal (powered) position for six months. Each actuator in the sample set is powered, without interruption, for a minimum period of 4320 hours (6 months). Upon removing power from the actuators, all actuators must return to the resting position within their rated time.

UL555S also recognizes that dampers can be built in multi-section arrangements and the standard requires additional testing to ensure the reliability of such arrangements. As mentioned previously, combination fire/smoke dampers must also meet all of the testing requirements of UL555.

Installation Considerations

NFPA 90A *Standard for the Installation of Air-Conditioning and Ventilating Systems* covers construction, installation, operation and maintenance of systems for air conditioning and ventilating, including dampers, to protect life and property from fire and smoke. Proper application of smoke and combination fire/smoke dampers in different types of barriers, partitions and/or occupancy types can be confusing and does require careful study of the appropriate building code. Engineers and contractors are encouraged to examine Figure A.5.3 in Annex A of NFPA90A, which resolves much of this confusion. The diagram is a building cutaway with many examples of the application of protection requirements of different penetrations.

While codes require fire, smoke, and combination fire/smoke dampers to be installed at required barriers and partitions, they also allow some smoke dampers to be removed or operated separately when installed within an engineered smoke control system.

The design and operation of the system requires careful planning, placement and control of the dampers to:

a) Provide for proper smoke control as well as required pressure differences across horizontal exits and smoke barriers when occupants are moved horizontally rather than evacuated, such as in an I-2 occupancy. Note: An I-2 facility is one that accommodates

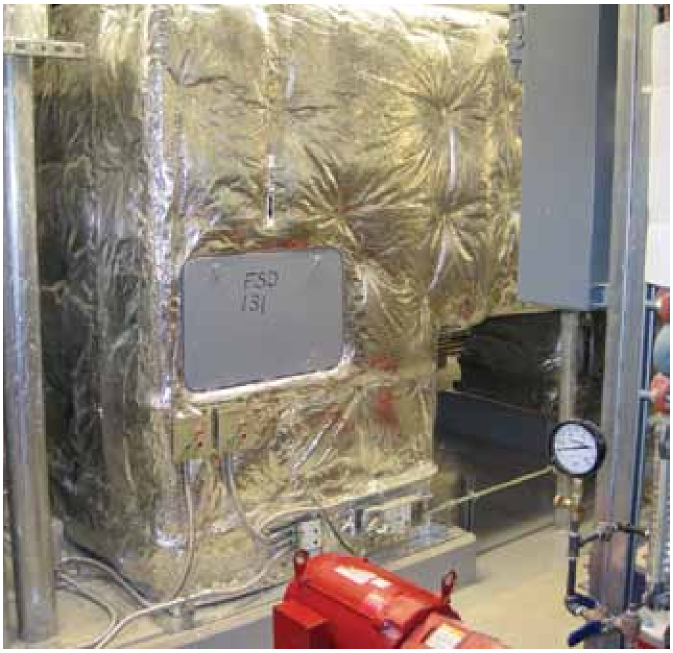


Figure 2: Proper installation of a combination fire-smoke damper in a duct that penetrates a penthouse floor. The installation has the controller, access panel with an identification number, and indicating lights all in full view and accessible. Photo courtesy of Pat Banse, PE, Smith Seckman Reid.

more than five persons "who are not capable of self-preservation."

b) Provide access for periodic testing. As shown in Figure 1, access doors to smoke and other life-safety dampers can be blocked by construction. Figure 2 shows a proper installation in a duct that penetrates a penthouse floor.

Field Testing and Maintenance

Smoke and combination fire/smoke dampers require very little maintenance but codes do require periodic testing after initial installation and commissioning. Information on periodic testing of smoke dampers can be found in NFPA105 *Standard for Smoke Door Assemblies and Other Opening Protectives* and of fire dampers in NFPA80 *Standard for Fire Doors and Other Opening Protectives*. These standards both require periodic testing one year after installation and then every 4 years, except in hospitals, where the frequency is every 6 years. NFPA92 covers testing of engineered smoke control systems, including dampers. The standard states that dedicated systems shall be tested at least semiannually and non-dedicated systems shall be tested at least annually.

Summary

Stopping smoke from migrating through HVAC systems during a fire helps save lives and minimize property damage. As stated earlier, all of the major building codes in the USA require the use of approved smoke dampers with a minimum elevated temperature rating of 250 °F (140 °C) and a minimum of Class II leakage rating. Whether the smoke control system is a passive "fans off" design or a dynamic "fans on" system, smoke dampers are up to the challenge of the heat and pressure. The evolution of the smoke damper and the test requirements of UL555S ensure a cost-effective, high performing and reliable product designed for this demanding application.

Guide for Commissioning and Periodic Performance Testing of Fire, Smoke and Other Life Safety Related Dampers

Purpose

Fire Dampers, Smoke Dampers, Combination Fire Smoke Dampers, Ceiling Radiation Dampers, and other types of Dampers that perform as part of a building's Fire Protection or Life-Safety System must function properly during a fire or life-safety emergency. Proper installation and periodic performance testing are required to ensure these dampers function as intended in a fire emergency.

The purpose of this document is to provide recommendations for the proper commissioning of Fire and Life Safety Related Dampers and to describe the appropriate intervals and methods for performing periodic performance testing of these dampers.

Background

Life Safety Dampers are designed to perform a number of functions in a building's HVAC, Fire and/or Smoke Control System and are an integral part of the overall life-safety system within the building. Generally, Fire Dampers are designed to close and prevent the spread of fire through an opening in a fire resistive barrier. Ceiling Radiation Dampers are designed to close and reduce the transfer of heat through an opening in the ceiling membrane of floor-ceiling or roof-ceiling assembly. Refer to the specified ceiling design for details regarding penetrations. Smoke Dampers operate to prevent the spread of smoke by closing to stop airflow or by opening to exhaust smoke. They can also be opened or closed to create pressure differences (as in an engineered smoke control system) to reduce the spread of smoke. Combination Fire Smoke Dampers perform the dual role of both Fire Dampers and Smoke Dampers.

Underwriters Laboratories (UL) has developed and maintains standards for the testing, qualification, and appropriate labeling of Fire Dampers (UL 555), Smoke Dampers (UL 555S), Combination Fire Smoke Dampers (UL 555 and UL 555S) and Ceiling Radiation Dampers (UL 555C & UL 263). Manufacturers of these dampers, who have complied with these UL requirements, provide classified and labeled dampers for installation where required in HVAC and Engineered Smoke Control Systems.

Building Codes and several NFPA and ASHRAE Standards identify where Fire, Smoke and Ceiling Radiation Dampers are required to be installed in a building's HVAC and/or Smoke Control System. Architects and Design Engineers incorporate Code required dampers in their building designs but also may incorporate additional requirements depending on a building's specific purpose and intended function.

Commissioning or Acceptance Testing

The term Commissioning is used to define an inspection process to determine if all components of a building are operating as intended by the building's design. Ensuring that a building's mechanical system, its HVAC System, and any Smoke Control or other Life-Safety related systems operate properly (including all Fire and Life-Safety Related Dampers), and documenting their proper operation is the result of the Commissioning process. This process is also known as Acceptance Testing.

Below are the AMCA recommended checklists for the commissioning of Fire and Life-Safety Related Dampers. For specific installation requirements of the brand and model damper being commissioned, the damper manufacturer's installation instructions shall be referenced.

Fire Dampers and Combination Fire Smoke Dampers

1. **Positioning of the Damper in the Opening** – Unless specifically allowed by the damper manufacturer's installation instructions, the centerline of the fire damper's frame shall be located in the plane of the fire rated assembly.

2. **Damper Sleeve** – Unless the damper frame is wide enough to provide for direct attachment of retaining angles, all fire dampers shall be mounted in a sleeve fabricated per the damper manufacturer's installation instructions. The sleeve shall not extend more than 6 inches beyond the wall or floor opening unless there is an actuator or factory mounted access door on the damper. When an actuator or factory mounted access door is installed, the sleeve shall not extend more than 16 inches beyond the wall or floor opening. The sleeve is still limited to extending 6 inches beyond the wall or floor opening on the side opposite the actuator or factory mounted access door.

3. **Clearance between Damper and Wall/Floor Opening** – Most dampers are tested with defined clearances between the damper's sleeve and the wall or floor opening. Unless otherwise indicated in the installation instructions, the annular space between the sleeve of the damper and the wall/floor opening should not be filled with firestop materials such as fill, void or cavity materials. Reference the damper manufacturer's installation instructions for the specific clearance requirements.

4. **Securing Damper and Sleeve to the Wall/Floor Openings** – Most approved damper installation methods require the use of retaining angles to secure the damper in the wall or floor opening. Reference the damper manufacturer's installation instructions for the required material gauge of the retaining angles, the required overlap between the retaining angles and the wall or floor, and the spacing and type of fasteners to be used.

5. **Duct to Sleeve Connections** – Dampers are tested and approved to use specific methods for connecting the damper sleeve to adjoining ductwork. Reference the damper manufacturer's installation instructions for the allowable duct to sleeve connections.

6. **Damper Access** – Access to the dampers shall be provided. Access shall be large enough to allow inspection and maintenance of the damper and its operating parts. The access points shall be permanently identified on the exterior by a label having letters not less than ½ inch in height reading: FIRE/SMOKE DAMPER or FIRE DAMPER.

7. **Damper Flow and Pressure Ratings** – For dynamic fire dampers and combination fire smoke dampers, it shall be verified that the system airflow and pressure are within the damper's ratings.

8. **Operation of the Damper** – After the damper is installed it shall be cycled to ensure proper operation. The operation test performed as part of the commissioning process shall follow the same procedure described in the Periodic Performance Testing section below.

Smoke Dampers

1. **Positioning of the Damper Relative to the Opening** – The centerline of the damper shall be mounted within 24 inches of the opening it is protecting. In addition, no ductwork shall branch-off between the damper and the wall or floor opening it is protecting.

2. **Sealing the Damper Frame to the Ductwork** – Many damper installations require that the damper frame be sealed to the ductwork it is being installed in. Reference the damper manufacturer’s installation instructions to determine if this requirement applies and to determine the allowable sealants.

3. **Damper Access** – Access to the dampers shall be provided. Access shall be large enough to allow inspection and maintenance of the damper and its operating parts. The access points shall be permanently identified on the exterior by a label having letters not less than ½ inch in height reading: SMOKE DAMPER.

4. **Damper Flow and Pressure Ratings** – It shall be verified that the system airflow and pressure are within the dampers ratings.

5. **Operation of the Damper** – After the damper is installed it shall be cycled to ensure proper operation. The operation test performed as part of the commissioning process shall follow the same procedure described in the periodic performance testing section below.

Ceiling Radiation Dampers

1. **Hourly Rating** – Ceiling dampers carry a maximum hourly rating for the assembly in which they are installed. Check that the maximum hourly rating of the damper installed is approved for the same hourly rating as the ceiling assembly.

2. **Positioning of the Damper in or Over the Penetration** – The damper can be installed on top of a steel diffuser, sitting directly on the rated ceiling grid, in a steel duct drop, or supported such that the frame rest at the penetration. Refer to the manufacturer’s installation instructions for the maximum allowed distance that the closed blades are allowed from the bottom of the rated ceiling. In the case of drywall installation, consult instructions for maximum allowed clearance between penetration and damper frame.

3. **Thermal Blanket** – When a damper is not located directly in the penetration and the damper frame is more than 1 inch smaller than the penetration, then a thermal blanket is normally required to reduce heat transfer across the grille back pan. Refer to the manufacturers installation instructions for the recommended material and size of the thermal blanket.

4. **Clearance between Damper, Grille, Duct, and Wall/Floor Opening** – Most dampers are tested with defined clearances as specified in their instructions. If not specified, a rule of thumb is to keep tolerances minimal (less than 1/8 inch) between connecting components. If possible, have the largest component extend over the smaller one below it. Reference the damper manufacturer’s installation instructions for the specific clearance requirements.

5. **Securing Damper to the Sleeve, Grille, Ductwork** – Most of the time, dampers are to be installed so that they are supported by the structural members above them or the ceiling grid. Ceiling dampers are not normally supported by the drywall, gypsum, or ceiling tiles alone. They are normally supported via steel wires, hangers, or duct drops with direct fasteners such as screws, rivets, and bolts. Reference the damper manufacturer's installation instructions for the required material and fasteners.

6. **Grille to Damper to Duct Connections** – Unless otherwise stated in the manufacturer's installation instructions, the damper will either lie on the ceiling grid or cover the neck of the diffuser. If connected to duct, the damper should be installed inside the duct connection.

7. **Operation of the Damper** – After the damper is installed, the fuse link shall be removed and the damper blades allowed to close upon its own mechanics. Cycling the damper ensures proper operation. The operation test performed as part of the commissioning process shall follow the same procedure described in periodic performance testing section below.

Periodic Performance Testing

Fire Life-Safety related dampers that are properly applied and installed and that have proven the ability to function as intended through a building commissioning process should require no specific on-going maintenance beyond the periodic testing described below to confirm operability.

Although the required frequency of this periodic operation testing varies by local jurisdiction, most local requirements reference one of two national standards, either NFPA 80 or NFPA 105. NFPA 80 covers the requirements for fire dampers and NFPA 105 covers the requirements for smoke dampers. Both documents contain the following frequency requirements for periodic operation testing:

Each damper shall be tested and inspected one year after installation. The test and inspection frequency shall then be every 4 years, except in hospitals, where the frequency shall be every 6 years.

The method used to perform the periodic operation testing depends on the type of damper. More specifically, it depends on how the damper operates. From an operability standpoint, fire life-safety related dampers fall into one of the two following categories:

1. **Dampers Requiring a Fusible Link to Operate** – Most Fire Dampers and Ceiling Radiation Dampers, and some Combination Fire Smoke Dampers are held in an open position by a fusible link. The fusible link is designed to melt at a specified temperature allowing gravity or a spring to close the damper. After the fusible link has melted these dampers remain closed until reopened manually and a new fusible link is installed.

2. **Dampers That Do Not Require a Fusible Link to Operate** – Smoke Dampers, some Fire Dampers and most Combination Fire Smoke Dampers do not use fusible links to operate. These dampers use an electric or pneumatic actuator to operate the damper. Fire Dampers and Combination Fire Smoke Dampers that do not use fusible links use a bi-metallic disc type thermostat to interrupt electrical power or air pressure to the actuator at a specified temperature. Once the electrical power or air pressure is interrupted the spring return feature of the actuator closes the damper.

Periodic Performance Testing for Fusible Link Operated Dampers

The recommended procedure for performing the periodic operation testing on fusible link operated dampers is described below. As always, the damper manufacturer's installation and operation instructions should be followed:

1. For safety considerations, ensure that the fan is off.

2. With the damper in the full-open position, remove the fusible link. Care should be taken to ensure that there are no obstructions, including hands, in the path of the damper blades before the fusible link is removed.

3. Once the fusible link is removed, ensure that the damper closes completely without assistance. If the damper is designed with a latch to hold the damper in the full-closed position confirm that the damper latches properly.

4. Return the damper to the full-open position and replace the fusible link. If the link appears damaged, replace with a functionally equivalent link.

Periodic Performance Testing for Dampers That Do Not Use a Fusible Link to Operate

The recommended procedure for performing periodic operation testing on dampers that do not require a fusible link to operate is described below. Two procedures are described. The first describes the procedure for dampers designed with position indication switches to verify that the damper has reached the full-open and full-closed position These switches can be wired to local or remote control panels or building automation systems (BAS) to indicate if the damper is in the full-open position, the full-closed position, or neither. The second procedure describes the procedure for testing dampers without position indication switches. As always, the damper manufacturer's installation and operation instructions should be followed.

Dampers with Position Indication Wired to Indication Lights, Control Panels or BAS

1. Use the signal from the damper's position indication device to confirm that the damper is in the full-open position.

2. Remove electrical power or air pressure from the actuator to allow the actuator's spring return feature to close the damper.

3. Use the signal from the damper's position indication device to confirm that the damper reaches its full-closed position.

4. Reapply electrical power or air pressure to reopen the damper.

5. Use the signal from the damper's position indication device to confirm that the damper reaches its full-open position.

Dampers without Position Indication

1. Visually confirm that the damper is in the full-open position.

2. Ensure that all obstructions, including hands, are out of the path of the damper blades and then remove electrical power or air pressure from the actuator to allow the actuator’s spring return feature to close the damper.

3. Visually confirm that the damper closes completely

4. Reapply electrical power or air pressure to reopen the damper.

5. Visually confirm that the damper is in the full-open position.

In addition to these requirements, NFPA 72 and NFPA 92 describe the periodic testing requirements for smoke control systems. Dampers that are part of smoke control systems shall be cycled as part of this testing.

List of Publications Referenced in this Document

UL 555 *Standard for Fire Dampers*
UL 555S *Standard for Smoke Dampers*
UL 555C *Standard for Ceiling Dampers*
UL 263 *Standard for Fire Tests of Building and Construction Materials*
NFPA 80 *Standard for Fire Doors and Other Opening Protectives*
NFPA 105 *Standard for the installation of Smoke Door Assemblies and Other Opening Protectives*
NFPA 72 *National Fire Alarm and Signaling Code*
NFPA 92 *Standard for Smoke Control Systems*