

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.

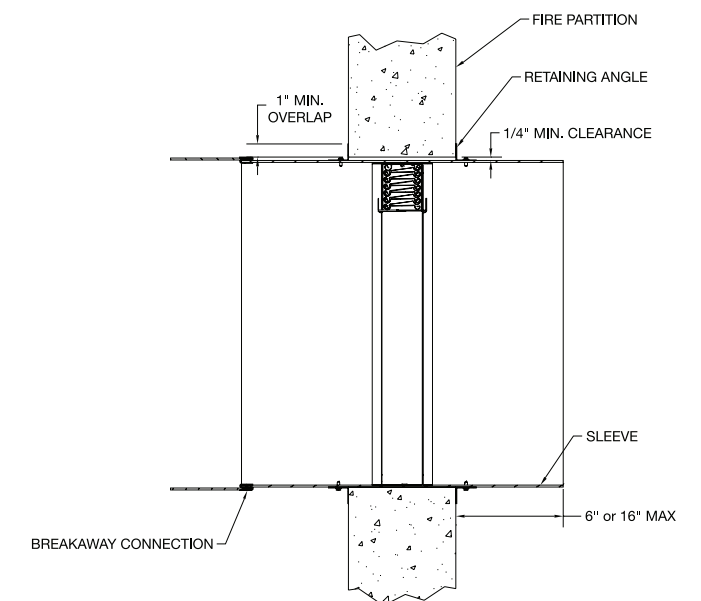


Figure 2: Typical fire damper installation, based on AMCA 503, Fire, Ceiling (Radiation), Smoke and Fire/Smoke Dampers Application Manual. Image courtesy of Ruskin.



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.

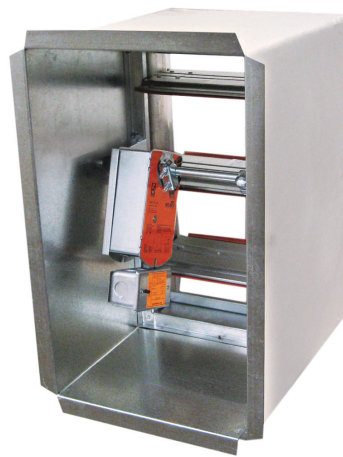


Figure 5a: Example of an “out of the wall/partition” combination fire/smoke damper. Photo courtesy of Pottorff.

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.

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.

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.

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

1. AMCA Publication 503-03, *Fire, Ceiling (Radiation), Smoke and Fire/Smoke Dampers Application Manual*, Air Movement and Control Association International, 2003.
2. UL 555S, *Standard for Safety—Smoke Dampers*, Underwriters Laboratories, June 1999. 🔗