

Life Safety Dampers Selection and Application Manual

- Ceiling Radiation Dampers • Fire Dampers
- Combination Fire Smoke Dampers • Smoke Dampers



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HOW TO USE THIS MANUAL

This manual can be utilized in a variety of ways. It can be studied from cover to cover as a textbook on fire, smoke, combination fire smoke dampers, and ceiling radiation dampers or it can be used as a reference on one or more of the following topics:

- **Fire, smoke, or combination fire smoke damper applications**
- **Selection of the correct damper and actuator**
- **Damper and actuator installation requirements**
- **Ceiling radiation dampers**
- **Codes and standards that regulate and qualify fire, smoke, or combination fire smoke dampers**

There are answers to a list of “Most Commonly Asked Questions” at the end of this manual and summaries of “Key Points to Remember” at the end of each section.

DAMPER APPLICATION

Fire Damper Application

Fire dampers are required by all building codes to maintain the required fire resistance ratings of walls, partitions, barriers and floors when they are penetrated by air ducts or other air transfer openings. One of the basic requirements of building fire protection is the compartmentation or dividing up of buildings using fire rated walls, floors, or other partitioning methods. This compartmentation concept is intended to contain any fire to the compartment of fire origin and thereby minimize damage to property and protect the lives of people living and/or working in the building. A duct or ventilation opening in any of the fire rated partitions would permit a fire to spread from the compartment of origin to adjoining compartments or spaces. Fire dampers are installed in these duct or ventilation openings. They close automatically upon detection of heat by a heat-responsive device (usually by the melting of a fusible link at 165°F [74°C]), blocking the opening and preventing the spread of fire into the adjoining compartment.

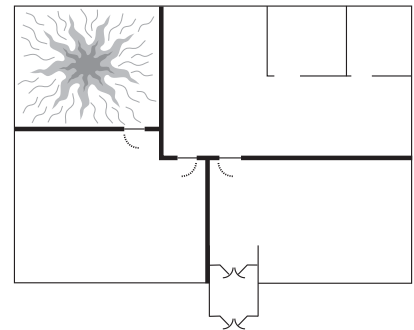
UL (Underwriters Laboratories) Classified fire dampers are tested to UL Standard 555 “Fire Dampers”. They are always supplied with an appropriate UL label. There are significant factors required that must be considered when specifying a fire damper for a certain application. These are:

Fire Resistance Ratings

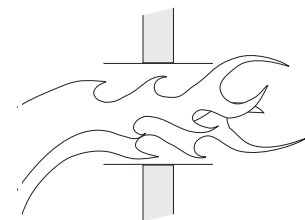
Two fire resistance ratings are available: 1½ hours and 3 hours. Walls, floors, or partitions with fire resistance ratings of 3 hours or more require fire dampers with a 3 hour rating. Fire resistance ratings less than 3 hours require 1½ hour rated fire dampers. (Reference 2015 International Building Code, section 717.3.2).

Airflow Closure Ratings

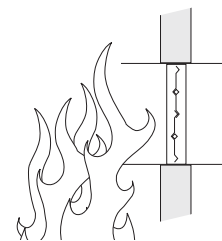
Fire dampers can be either STATIC or DYNAMIC rated. STATIC rated fire dampers have no airflow closure rating and can only be applied in HVAC systems that are designed to shut down automatically in the event of a fire. DYNAMIC rated fire dampers carry a UL 555 rating to close while the HVAC system is running. DYNAMIC rated fire dampers carry both an airflow velocity (ft/min) rating and a pressure differential rating (in. wg) and should be selected to operate against the conditions they will see in their application. DYNAMIC rated fire dampers are always an appropriate selection.



Fire rated partitions contain fire damage to the compartment of fire origin.



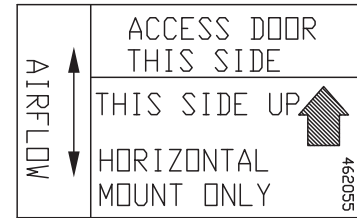
Unprotected partition



Partition protected by fire damper

Mounting Orientation

Fire dampers are required to pass a test for vertical mount and/or a test for horizontal mount. Dampers need to be installed in the correct orientation to ensure life safety and proper fire protection. Each vertical or horizontal mount damper carries its own label. These mounting orientations are not interchangeable.



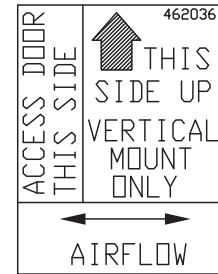
Horizontal Label

Smoke Damper Application

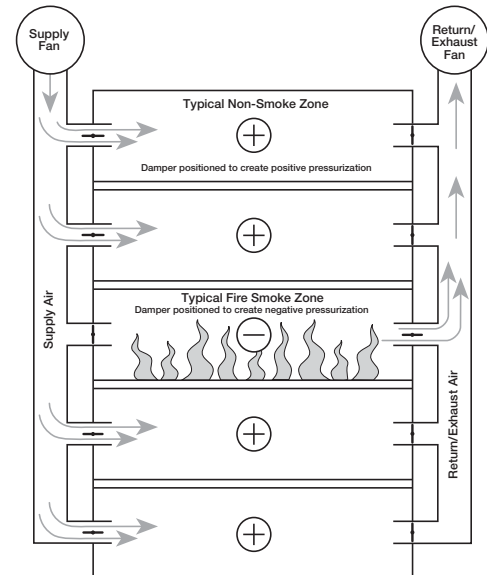
Smoke dampers have two general applications. They may be applied in a “Passive Smoke Control System” where they simply close and prevent the circulation of air and smoke through a duct or ventilation opening in a smoke barrier. They also may be applied as part of an “Engineered Smoke Control System” designed to control the spread of smoke using walls and floors as barriers and using the building’s HVAC system and/or dedicated fans to create pressure differences. Higher pressures surround the fire area and prevent the spread of smoke from the fire zone into other areas of the building. Smoke dampers are motorized with electric or pneumatic actuators and may be controlled by a smoke or heat detector signal, a fire alarm signal, or by the building control system to accomplish the intent of the design.

UL Classified smoke dampers are tested to UL Standard 555S “Smoke Dampers” and are always supplied with an appropriate UL label. It is necessary to determine which of the following ratings are required when applying a UL smoke damper:

- **Leakage:** Class I (lowest leakage), Class II, or Class III (highest leakage). The 2015 International Building Code (IBC), section 717.3.2 requires a minimum of Leakage Class II. Leakage Class I is recommended to provide the safest level of protection.
- **Elevated Temperature:** 250°F or 350°F (121°C or 177°C) is the temperature at which the actuator must be able to operate the damper and the temperature at which the leakage test is conducted. Most often 350°F (177°C) is selected for the highest level of safety.
- **Velocity and Pressure:** UL 555S requires each smoke damper with its installed actuator to be rated for operation to open against a specific pressure differential (in. wg) and to close against a specific velocity of airflow (ft/min). Dampers should be selected to operate at the pressures and velocities they will see in their application, with a minimum of 4 in. wg (1 kPa) and 2000 ft/min (10.2 m/s).



Vertical Label



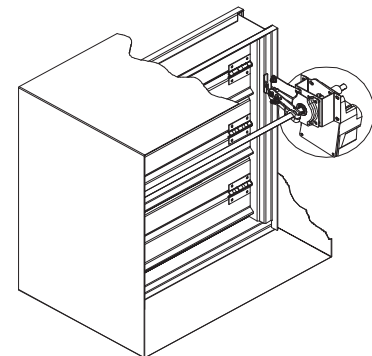
Typical Engineered Smoke Control System
Smoke is contained to the fire zone by higher pressures in adjacent zones

Combination Fire Smoke Damper Application

A combination fire smoke damper performs the function of both a fire damper and a smoke damper. Building layouts and designs often combine fire and smoke rated partitions and barriers requiring the installation of both a fire damper and smoke damper at the same location. Combination fire smoke dampers must be qualified under UL Standard 555 as a fire damper AND under UL Standard 555S as a smoke damper. The considerations listed above for both of these damper types apply to the selection and application of combination fire smoke dampers.

Corridor Ceiling Fire Smoke Damper Application

UL has established a separate classification to list dampers for this application. UL 555 and 555S qualification plus additional tests in actual corridor ceiling construction are required by UL to classify a combination fire smoke damper.



Typical Smoke Damper

DAMPER SELECTION

Selection Process

Five basic decisions are required to select a fire, smoke, or a combination fire smoke damper. The process involves defining requirements for:

- **Blade Style** - Curtain, 3V, airfoil, or round blade styles
- **Fire Resistance Rating** - 1½ or 3 hours based on code requirements and building design (2015 International Building Code, section 717.3.2)
- **Leakage Rating** - Class I, II, or III (2015 International Building Code, section 717.3.2, requires a minimum of Leakage Class II)
- **Elevated Temperature Rating** - 250°F or 350°F (121°C or 177°C) 2015 International Building Code, section 717.3.2, requires a minimum of 250°F (121°C)
- **Operational Ratings** - Velocities and pressure differentials the damper will see in its application

• Blade Style

Blade style decisions are based on application, velocity, and the pressure required for your system. The curtain blade style is appropriate for fire damper applications only and airflow velocities up to 4,000 ft/min (20.3 m/s). The 3V blade style is appropriate for use in airflow velocities up to 2,000 ft/min (10.2 m/s). Airfoil style blades are appropriate for use with airflow velocities up to 4,000 ft/min (20.3 m/s). A round style blade is appropriate for use in airflow velocities up to 3,000 ft/min (15.2 m/s) where you need to connect to round ductwork or where minimum pressure drop is desired. Pressure loss information is available at www.greenheck.com.

• Fire Resistance Rating

Fire and combination fire smoke dampers installed in walls, floors, or partitions are required by the applicable building code to have a fire resistance rating. Select a fire damper and combination fire smoke damper with a 1½ hour rating for use with a wall, floor, or partition with a less than 3 hour fire resistance rating. If the wall, floor, or partition has a fire resistance rating of 3 hours or more, the damper must have a rating of 3 hours.

Type of Penetration	Minimum Damper Rating (hours)
Less than 3 hour fire resistance rated assemblies	1½
3 hour or greater fire resistance rated assemblies	3

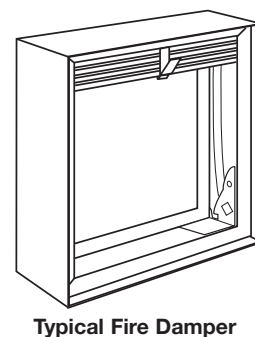
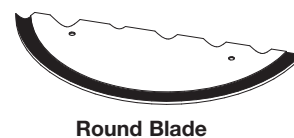
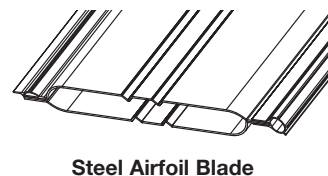
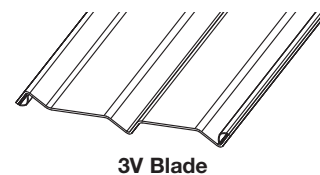
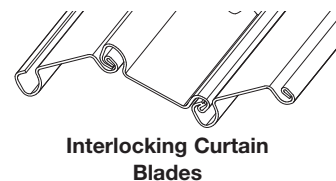
If the barrier is not required to have a fire resistance rating, then no fire rating is required and a smoke damper may be selected (see 2015 International Building Code, section 717.5.2). Smoke dampers may be required in corridor penetrations in accordance with 2015 International Building Code 717.5.4.1.

• Leakage Rating

UL Standard 555S identifies three leakage classes as follows:

Leakage Class	Maximum Leakage in			
	cfm/ft ² @ 4 in. wg	cfm/ft ² @ 8 in. wg	cmh/m ² @ 1 kPa	cmh/m ² @ 2 kPa
Class I	8	11	146	201
Class II	20	28	366	512
Class III	80	112	1463	2048

Designers are generally advised to select the lowest leakage class.



Even though the 2015 edition of the International Building Code requires a minimum of Leakage Class II, there are some applications where a higher leakage class can be used. Leakage Class I (the lowest leakage) rated dampers are available from most manufacturers ensuring appropriate competition if Class I is selected.

• Elevated Temperature Rating

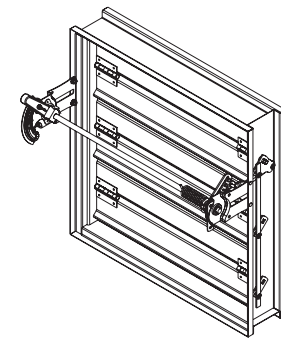
The purpose of a building Smoke Control System is to keep certain areas of a building free from smoke during the early phases of a fire so building occupants can safely evacuate and firefighters can more easily locate and attack the fire. The UL 555S Elevated Temperature Rating is a 30 minute emergency rating to ensure the damper (and its installed actuator) can resist a short exposure to elevated temperature and still operate as required. Although 250°F (121°C) is the minimum elevated temperature rating, 350°F (177°C) is available for all Greenheck fire smoke damper models at no additional cost. The 2015 International Building Code (IBC) requires the minimum 250°F (121°C) rating. Modulating actuators and extruded aluminum blade models are rated at 250°F (121°C). All Greenheck FSD (combination fire smoke) dampers and SMD (smoke) damper models are UL 555 and UL 555S rated to 350°F (177°C).

• Operational Rating

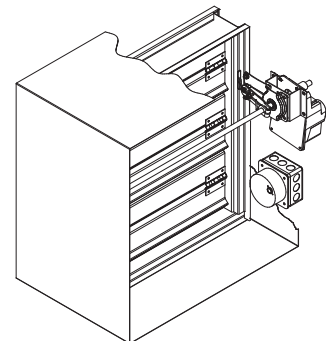
Operational ratings are dependent on the damper's size and installed actuator. Both UL 555 and UL 555S require a combination fire smoke damper and its installed actuator be rated for a maximum airflow rate (velocity in ft/min) through the open damper and a maximum pressure (in. wg) across the closed damper. The installed actuator must operate the damper open and close against these rated velocities and pressures. Greenheck combination fire smoke dampers with 3V blades are rated up to 2,000 ft/min (10.2 m/s) and pressure up to 6 in. wg (1.5 kPa). The airfoil blade models are rated up to 4000 ft/min (20.3 m/s) and pressure up to 8 in. wg (2 kPa).

Dynamic rated fire dampers are typically rated without actuators. Round, curtain style fire, and multi-blade fire dampers meet the requirement of UL 555 with airflow ratings up to 4,000 ft/min (20.3 m/s) and pressure up to 10 in. wg (2.5 kPa).

Considerations of blade style, fire resistance rating, and leakage rating lead directly to the selection of an appropriate Greenheck fire, combination fire smoke or smoke damper model. Once an appropriate damper model has been selected, its elevated temperature and operational ratings should be compared with the requirements for these ratings.

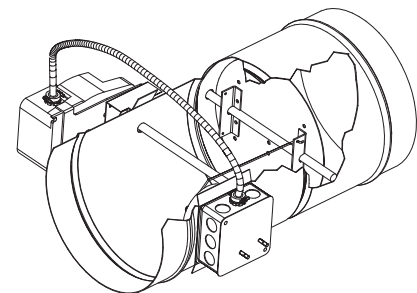


Typical Multi-Blade Fire Damper



Typical Combination Fire Smoke Damper

RRL and actuator act to close damper when temperatures exceed thermostat (165° - 350°F [74° - 177°C]) to protect the duct from fire and smoke penetration.



Typical Round Combination Fire Smoke Damper

KEY POINTS TO REMEMBER

- Codes require fire dampers in most applications where the barrier being penetrated to have a required fire resistance rating of 2 hours or more. Code requirements vary. Always follow the requirements of the applicable building code.
- Smoke dampers are required where a duct penetrates a smoke partition or barrier within a building, in a corridor penetration AND when any damper performs a function in an engineered smoke control system.
- 1½ hour fire dampers appropriately protect walls, partitions, and barriers with fire resistance ratings less than 3 hours. 3 hour fire dampers are required if a barrier's fire resistance rating is 3 hours or more.
- STATIC rated fire dampers can be applied only if the HVAC system is automatically shut down in the event of a fire emergency. DYNAMIC rated fire dampers can be applied in all HVAC systems.
- When selecting a fire or combination fire smoke damper there are five basic decisions which affect final model selection: blade style, fire resistance rating, leakage rating, elevated temperature, and operational ratings.

ACTUATOR SELECTION

A smoke damper's function is to OPEN or CLOSE to either seal off an opening, or to create a pressure difference to prevent the spread of smoke. The damper actuator drives the damper to OPEN or CLOSE. When a smoke damper or a combination fire smoke damper is selected, a very important part of the process is the selection of an appropriate damper actuator. Qualification of the damper under UL Standards 555 and 555S involves testing both the damper and its installed actuator. This means the actuator must be selected from the damper manufacturer's list of actuators that have been tested with and are UL Listed for the smoke or combination fire smoke damper model that will be furnished. Actuators must be furnished factory-installed by the damper manufacturer.

Selection Process

Actuators may be ELECTRIC or PNEUMATIC. Damper size limitations are based on the velocity of airflow through the open damper and the pressure differential across the closed damper.

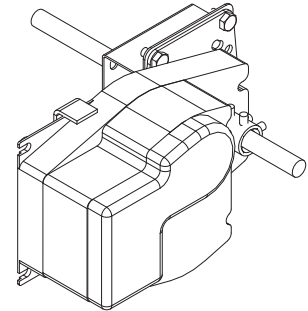
• Actuator Type

Select either ELECTRIC or PNEUMATIC actuators based on the type of control system that will operate the dampers and any other appropriate factors. Most electric actuators are available in 24VAC, 24VDC, 120VAC, or 230VAC. Pneumatic actuators require 25 - 30 psi (172 - 207 kPa) control air. Operation may be two position, three position, balancing or modulating control. Consult Greenheck for other voltage, frequency, or control requirements.

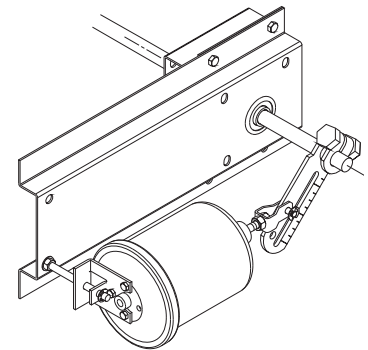
• Actuator Model

Each specific actuator model will have a series of maximum damper size ratings depending on the damper model, airflow velocity through the open damper, temperature rating required, and maximum pressure differential across the closed damper. As an example, damper size limitations for two of the more commonly used actuators installed to operate Greenheck's model FSD-311 (airfoil blade combination fire smoke damper) with a 4 in. wg (1 kPa) maximum pressure differential are as follows:

Damper Actuator	Mounting Location	Velocity ft/min (m/s)	Temperature °F (°C)	Maximum Size W x H in. (mm)
Siemens 331-4551 (pneumatic)	External or Internal	2000 (10.2)	350 (177)	24 x 24 (610 x 610)
	External	3000 (15.2)	350 (177)	18 x 18 (457 x 457)
Honeywell MS4104, 4604, 8104 (24V, 120V, 230V electric)	External or Internal	2000 (10.2)	350 (177)	24 x 24 (610 x 610)
	External	3000 (15.2)	350 (177)	18 x 18 (457 x 457)



Electric Actuator



Pneumatic Actuator

Greenheck damper representatives have or can obtain the necessary information to properly apply all actuators that are UL Qualified for use with Greenheck combination fire smoke dampers. Greenheck's Computer Aided Product Selection (CAPS) program contains the necessary data and greatly simplifies actuator selection.

Actuator Mounting Options

Actuators must be factory mounted. Factory mounting options include external (on a damper sleeve or sideplate) or internal. Internal actuator mounting (where the actuator is mounted inside a duct) should be avoided if possible, as it increases the difficulty of actuator inspecting, testing, and servicing.

• Factory Mounting - External on a Sleeve

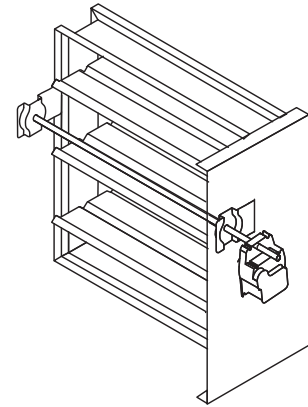
As all combination fire smoke dampers require a sleeve for proper installation, the most practical choice is for the damper to be furnished by the factory complete with a sleeve and the actuator installed on the outside of the sleeve. This is the standard and recommended actuator mounting option for combination fire smoke dampers.

• Factory Mounting - External on a Sideplate

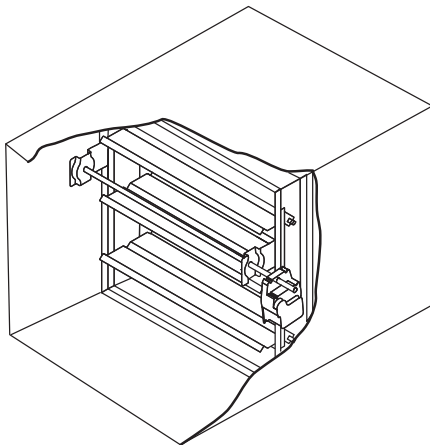
Smoke dampers do not always require sleeves for proper installation. External installation of the actuator can be provided using a sideplate (usually the full height of the damper as illustrated). These dampers are installed in a slotted duct section with the sideplate covering the slot in the side of the duct. Full height sideplates may not be practical on large smoke dampers (particularly multi-section assemblies).

• Factory Mounting - Internal

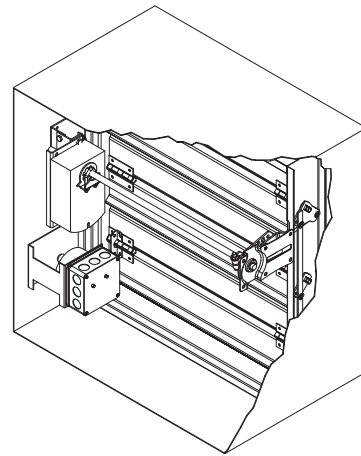
Most actuators can be mounted internally (in the airstream) to accommodate those installations where space constraints prevent the more desirable external installation. There are limitations on small sizes with options (such as the TOR, RRL/OCI, OCI or PRV), which occupy much of the available internal space.



Damper with sideplate actuator externally mounted.



Damper mounted in sleeve with actuator externally mounted.



Damper mounted in sleeve with actuator internally mounted.

KEY POINTS TO REMEMBER

- Actuators may be electric or pneumatic and may be two position, three position, balancing or modulating control.
- An actuator's damper size rating is dependent on the airflow velocity and pressure difference for each specific damper.
- The most practical way to supply combination fire smoke dampers is with a factory-furnished sleeve with the actuator mounted externally.
- Sideplate external actuator mounting is available on smoke and combination fire smoke dampers.

SLEEVE REQUIREMENTS

All UL fire and combination fire smoke damper listings require that the damper be mounted in a sleeve of the required gauge and length prior to installation. The sleeved damper is installed in the wall or floor opening and retained as part of the structure by angles attached to the sleeve. The sleeved damper becomes part of the wall (or floor) structure and ducts are attached to the sleeve. UL requires that connecting ducts terminate at each end of the damper sleeve.

• Sleeve Thickness

Sleeve gauge or thickness requirements depend on the size of the damper and on the type of duct-to-sleeve connections used. UL allows two types of duct-to-sleeve connections: RIGID and BREAKAWAY.

A RIGID connection is, by UL's definition, any connection that has not been qualified as a BREAKAWAY connection. A number of qualified BREAKAWAY connections, as well as procedures for qualifying additional BREAKAWAY connections, are defined in UL Standard 555. All qualified BREAKAWAY connections must be described in the damper manufacturer's fire and combination fire smoke damper installation instructions. Table 1 provides minimum fire and combination fire smoke damper sleeve thickness requirements as defined by UL 555.

• Sleeve Length

The required sleeve length depends on the thickness of the wall or floor being penetrated, and the space constraints imposed by the damper's actuator, accessories, and options. UL imposes the following maximum sleeve length restrictions for combination fire smoke and multi-blade fire dampers: Sleeves may not extend more than 6 in. (152 mm) beyond the wall or floor on the non-actuator side (B dimension, Figure 1). On the actuator side of the opening (A dimension, Figure 1), the sleeve may extend 16 in. (406 mm). On fire dampers, sleeves shall extend a maximum of 6 in. (152 mm) beyond the wall or floor opening on each side. If the sleeve is provided with an access door, it may extend 16 in. (406 mm) on the side equipped with the access door. Sleeves must extend far enough beyond each side of the wall or floor to accommodate the retaining angles required for installation (usually 1½ in. [38 mm]) plus whatever is required for the duct-to-sleeve connections (usually a minimum of 1½ in. [38 mm]). On the actuator side of the damper, the sleeve must be long enough to accommodate the actuator and accessories (A dimension, Figure 1).

Table 1: Minimum Sleeve Thicknesses for Fire/Combination Fire Smoke Dampers

Sleeve Gauge	Duct Dimension	Type of Duct to Sleeve Connection Permitted
14 ga. (0.075 in.) - 10 ga. (0.138 in.) [2mm - 3.5mm]	All duct sizes	Rigid or Breakaway
16 ga. (0.060 in.) [1.5mm]	36 in. (914mm) max. width 24 in. (610mm) max. height 24 in. (610mm) diameter	Rigid or Breakaway
16 ga. (0.060 in.) [1.5mm]	All duct sizes	Breakaway only
18 ga. (0.048 in.) [1.2mm]	85 in. (2159mm) wide and over	
20 ga. (0.036 in.) [0.9mm]	55 in. - 84 in. wide (1397mm - 2134mm)	
22 ga. (.030 in.) [0.76mm]	31 in. - 54 in. wide (787mm - 1372mm)	
24 ga. (0.024) [0.6mm]	13 in. - 30 in. wide (330mm - 762mm)	
26 ga. (0.018 in.) [0.46mm]	12 in. wide and under (305mm)	

Sleeve thickness must not be less than the gauge of the connecting duct. UL Standard 555 requires all ducts to terminate at fire damper sleeves.

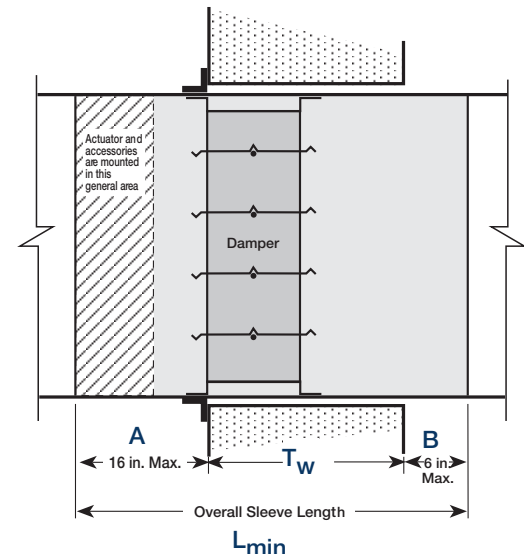


Figure 1: Sleeve Length Considerations

Figure 2 provides a means of estimating the minimum required sleeve length.

Figure 3 provides typical sleeve lengths for given wall thicknesses.

Figure 2: Minimum Sleeve Length Equation

L_{min}	=	$A + B + T_w$
L_{min}	=	minimum sleeve length
A	=	length of sleeve beyond wall (actuator side)
B	=	length of sleeve beyond wall (non-actuator side)
T_w	=	wall thickness

Figure 3: Typical Sleeve Length Requirements

Wall or Floor Thickness Inches (mm)	Sleeve Length Required Inches (mm)
4 - 6 (102 - 152)	16 - 21 (406 - 533)
7 - 10 (178 - 254)	21 - 24 (533 - 610)
11 - 13 (279 - 330)	24 - 28 (610 - 711)

Greenheck's standard and most economical sleeve lengths are 16, 21, and 24 inches (406, 533, and 610 mm).

KEY POINTS TO REMEMBER

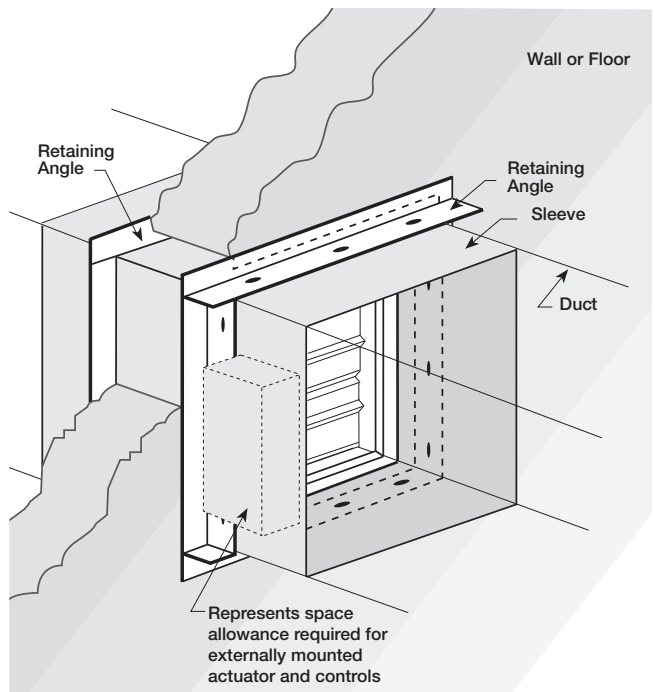
- All fire and combination fire smoke dampers require sleeves for installation.
- The damper and sleeve are part of the wall. The ductwork terminates at each end of the damper sleeve.
- Damper size and RIGID or BREAKAWAY duct-to-sleeve connections determine the required sleeve thickness. The sleeve thickness shall not be less than the thickness of the connecting duct.

SPACE REQUIREMENTS FOR PROPER INSTALLATION

When a combination fire smoke damper is being installed, it must fit in the space available with room for wiring or piping. After the damper is installed, it must work properly and perform its important function for the life of the building. The damper, its actuator, and any optional accessories must be accessible for inspection, testing, and service (per NFPA 80, 90A, 92A, 101 and 105). Actuators and other components may require replacement as part of a planned maintenance program. While space requirements are somewhat predictable, spending a little time making sure everything will fit can eliminate many problems and save money for all concerned.

The damper actuator and optional accessories are normally externally mounted on one side of the damper's sleeve. It is Greenheck's standard practice for these items to be on the right side of the sleeve. This is a "right hand mount". When specifically requested, they may be mounted on the left side of the sleeve, as shown, which we call a "left hand mount". As many combination fire smoke dampers have a "top" or "this side up" designation, and cannot be turned upside down, it is very desirable to clearly define the right or left hand actuator mounting requirements when the damper order is released for fabrication. A capability unique to Greenheck's combination fire smoke dampers allows dampers to be turned upside down (when installed vertically or horizontally) to overcome unforeseen clearance problems. Greenheck designed its UL Qualified combination fire smoke dampers not to have a "top" or "this side up" designation to provide flexibility for the installing contractor.

Greenheck's combination fire smoke damper product submittal and our Computer Aided Product Selection (CAPS) program includes dimensional information describing space requirements for damper actuators and optional accessories. If space above or below the damper sleeve is limited, special note should be taken as



some standard actuator mountings require clearance in this area. In most cases, clearance problems can be accommodated if they are defined before production of the dampers. Clearance problems discovered after the dampers are on the jobsite can be extremely costly.

Internal actuator mounting should be considered only as a last resort solution to clearance problems. Even with internal actuator mounting, external clearances may still be required. Access to the actuator for wiring, piping, inspection, and service must be provided. Internal mounting may not be available on smaller size dampers because there simply is not enough room to fit the actuator inside the sleeve.

KEY POINTS TO REMEMBER

- Actuators and optional accessories occupy space outside of the combination fire smoke damper sleeve or sideplate, and appropriate clearances are required.
- Actuators mounted externally will be right hand mounted as standard, but can be left hand mounted upon request.
- Internal actuator mounting is not a good solution to lack of clearance and should not be used unless there is no other solution.

DAMPER OPTIONS

Closure Device

Smoke and combination fire smoke dampers without options are fairly straight-forward devices. The damper is linked to its actuator, which moves the damper to its open or closed position in response to signals from the building control system, fire alarm system, smoke alarm system or the electric heat-responsive sensing device on the damper itself.

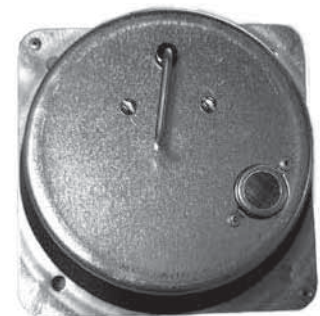
Fire dampers and round combination fire smoke dampers are equipped standard with a fusible link. Fusible links meet UL33 requirements.

Combination fire smoke dampers are equipped standard with a Reusable Resettable Link (RRL), an electric heat-responsive sensing device. The RRL has a fixed temperature setting (usually 165°F [74°C]) and performs the same function as a fusible link, which is to sense an abnormally high temperature (presumed to be caused by a fire) and allow the damper to close to prevent the spread of fire and smoke. The sensor interrupts power to the actuator, causing the actuator's spring return mechanism to close the damper. If the damper is equipped with a pneumatic actuator, a PRV (pneumatic relief valve) or an EP switch (electro-pneumatic solenoid valve) is used in conjunction with an RRL to control the pneumatic damper.

An advantage of the RRL is that it can be reset (by pushing a reset button at the sensor), eliminating the need to replace a fusible link each time on the damper. It is recommended that a careful inspection of the damper and the electric sensor be made before resetting as exposure to actual fire conditions may render these devices unusable. As UL requires that labeled fire dampers be set up at the damper factory to close automatically upon sensing an abnormally high temperature, the RRL can only be furnished when the damper actuator is factory installed and wired to the electric sensor before shipment. This feature is particularly desirable if periodic testing requirements involve application of elevated temperature to the thermostat (or heat sensing devices) to verify they will respond in the proper manner to actual fire conditions.



RRL



RRL/OCI

When a combination fire smoke damper is equipped with a pneumatic actuator, a Pneumatic Relief Valve (PRV) is used to exhaust air from a pneumatic actuator when the 165°F (74°C), 212°F (100°C), or 350°F (177°C) fusible link melts, allowing the damper blades to close. THE PRV OPTION DOES NOT REQUIRE ANY ELECTRICAL POWER.

Smoke dampers are not equipped with RRLs, PRVs, or fusible links, and operate only in response to alarm or control signals.

• Single-Point Wiring

In correlation with UL requirements, all actuators must be linked through one heat responsive device to ensure a single event closing on multi-section dampers. All actuators and accessories are wired to a single junction box for a convenient single point wiring installation. This is standard on all combination fire smoke dampers (FSD).

Blade Indication

• OCI Option (Open Closed Indication)

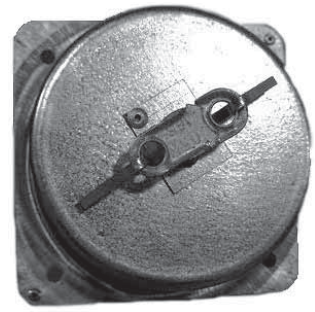
This option provides two switches, one set to close when the damper blades are at their open position, and the other set to close when the damper blades are at their closed position. These switches are physically linked to a damper blade and therefore give a true representation of the damper's position. Normally these OCI switches are wired to indicator lights (often located in the Firefighter's Smoke Control Station), however, they may be used for other purposes as required.

• Actuator End Switches

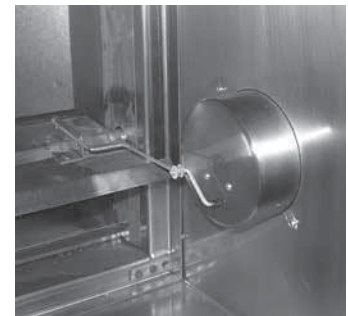
Actuator end switches are also commonly referred to as auxiliary switches. These switches are internal to the actuator and perform the same function as the OCI option. These switches are also normally wired to indicator lights (at the Firefighter's Smoke Control Station), or used for other purposes as required. The end switches are offered as an alternative to the OCI option based on preference of the design engineer.

Temperature Override

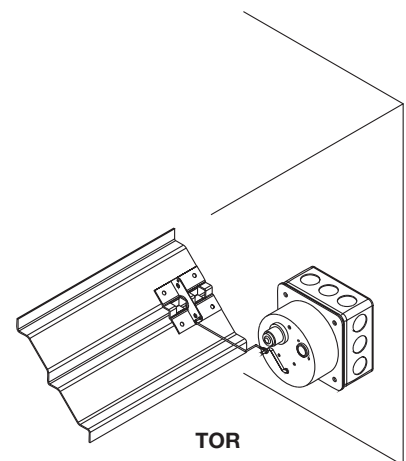
An Engineered Smoke Control System may require the combination fire smoke dampers to be open at a higher temperature than what is specified in the building code (often required to close at 165°F [74°C]) to perform its smoke control functions in a HVAC system. Most authorities agree that fire dampers can be open during emergency periods so the HVAC system can perform its smoke control functions as long as there is a higher temperature limit (usually 350°F [177°C]) at which these dampers will close and remain closed. All authorities do not agree that the code required fire damper closure temperature of 165°F (74°C) may be waived in favor of a higher temperature for smoke control applications. This dual requirement for the combination fire smoke dampers to close at 165°F (74°C) and yet to be open to allow smoke control system operation can be accomplished by using an OVERRIDE OPTION. These override options allow the 165°F (74°C) closure command to be overridden by a remote electrical signal (reopening the damper) but also provide for the damper to close automatically at a higher temperature usually 350°F (177°C) and remain closed thereafter. The latest NFPA 90A Standard and 2015 IBC permit the use of a single 350°F (177°C) closure control in combination fire smoke dampers, eliminating the requirement to close these dampers at 165°F (74°C) and to reopen them for smoke control purposes.



PRV



OCI



TOR

• TOR Option (Temperature Limited Override Option)

The TOR Option incorporates two temperature sensing devices (thermostats) with fixed settings (usually 165°F [74°C] and 350°F [177°C]) and eliminates the fusible link entirely (similar to the RRL option which has only one sensor). The primary sensor (usually 165°F [74°C]) can be bypassed by an external electrical signal allowing the damper to reopen and remain open until the temperature reaches the setting of the secondary sensor (usually 350°F [177°C]). When the temperature of the secondary sensor is exceeded, the damper closes and remains closed thereafter. Both sensors are of the manual reset type. After temperatures have cooled down below the sensor set points, they can be reset by pushing a reset button located at the sensor. Before resetting any sensor, a careful inspection of the damper and the sensors should be made as exposure to actual fire conditions may render these devices unusable. This option requires factory installation of the damper actuator and factory wiring of the electric sensor to meet UL requirements for fire dampers. If the damper is equipped with a pneumatic actuator, an EP switch (electro-pneumatic solenoid valve) is required in conjunction with the TOR option. Additionally, the TOR Option incorporates two damper blade position indicator switches which function as described under the OCI option heading.



TOR

Testing Device

• Momentary or Toggle Test Switch

The momentary or toggle test switch cuts the power to the damper actuator assembly and in turn closes the damper blades. It is used with a combination fire smoke or smoke damper to test and cycle the damper on location for both start-up testing and maintenance. This UL Qualified assembly ships factory mounted and wired.



Momentary Test Switch

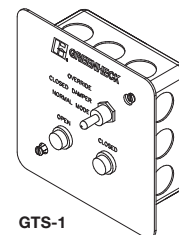
• GTS (Greenheck Test Switch)

Greenheck test switches are used in dynamic smoke management systems containing combination fire smoke dampers and smoke dampers. These switches provide an easy way to perform testing and maintenance of motorized life safety dampers. All Greenheck test switches come with a 5 x 5 in. (127 x 127 mm) stainless steel plate.

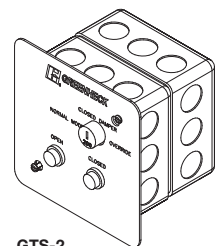
GTS-1 and **GTS-2** is a single control panel to be used on combination fire smoke dampers equipped with TOR (Temperature Override Control). **GTS-1** control panel has a toggle switch with red indicator light for closed damper, green for open damper. The **GTS-1** is available factory-mounted or shipped loose. **GTS-2** has a key switch with red indicator light for closed damper, green for open damper. The **GTS-2** is available shipped loose. The LED lights are replaceable.

GTS-3 is a control panel that can be used on combination fire smoke dampers with RRL/OCI, TOR, or smoke damper with an OCI. This test switch has red/green open and close indicator lights with momentary test switch. The **GTS-3** is available factory-mounted or ship loose.

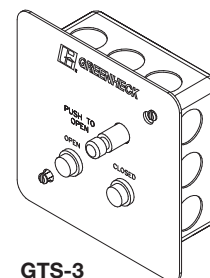
GTS-4 is a control panel that can be used with combination fire smoke dampers with RRL/OCI, TOR, or smoke damper with an OCI. This test switch has red/green open and close indicator lights only. The **GTS-4** is available factory-mounted or ship loose.



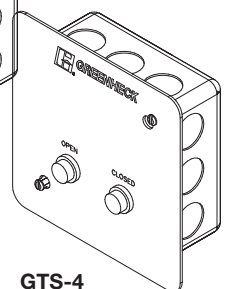
GTS-1



GTS-2



GTS-3



GTS-4

Smoke Detectors

A smoke detector's purpose is to sample air currents passing through a duct and upon alarm, provide management of fans, blowers, combination fire smoke dampers and smoke dampers.

• Photoelectric Smoke Detector

The photoelectric smoke detector samples air currents passing through a duct and provides dependable performance for management of smoke and combination fire smoke dampers. There are two smoke detectors available:

1. The DH-98-P is rated for air velocities from 300 - 4000 ft/min (1.5 - 20.3 m/s).
2. The D4120 is rated for air velocities from 100 - 4000 ft/min (0.5 - 20.3 m/s)

These smoke detectors can either be factory-mounted and wired or shipped loose.

• No Flow Smoke Detector

The no flow smoke detector is rated for systems without a minimum operating velocity. This smoke detector is rated for air velocities 0 to 3000 ft/min (0 to 15.2 m/s) and is mounted internally to the damper sleeve. It can be used on dampers with a maximum of two actuators. No flow smoke detectors have a built-in test switch.

Security Bars

When a specification requires security bars to be installed with the damper, they can be shipped factory assembled. Installation of security bars into dampers reduces security risks and reinforces the equipment. Security bars maintain the UL Classification for all products and are welded into the sleeve. Two types of security bars are available:

- Cross bar - round steel bars placed horizontal and vertical on center, based on customer selection or
- Punched mid bar - round steel bars placed vertical on center, based on customer selection, with flat mid-bars placed horizontal on dampers wider than 24 inches (610 mm).

Transition

When square or rectangular smoke and combination fire smoke dampers are required to be installed with round, square, rectangular, or oval ductwork, they must be supplied with the appropriate transition option. Square or rectangular dampers are constructed 0, 1, or 2 inches (0, 25, or 51 mm) larger than the duct dimensions (depending on the transition type) and provided with a factory sleeve. The sleeve is transitioned at each end to the appropriate round, square, rectangular or oval duct size. Square or rectangular dampers can also be transitioned in this manner to achieve a higher free area.

Square or rectangular fire dampers have six transitions available: B, B2, C, CO, CR, and R. Square or rectangular dampers are constructed 0, 1, or 2 inches (0, 25, 51 mm) larger than the duct dimensions (depending on the transition type). Transitions are constructed the same way except no sleeve is required.

True round fire, combination fire smoke, and smoke dampers are available when round ductwork is used in diameters up to 24 inches (610 mm).



D4120 Smoke Detector



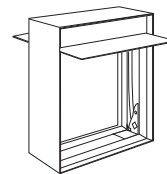
DH-98-P Smoke Detector



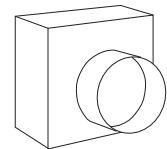
No Flow
Smoke Detector



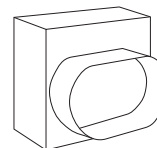
Security Bars



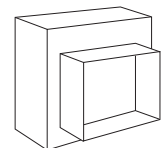
Type B/B2



Type CR
Type R



Type CO
Type O



Type C

Transitions

Quick Connect Breakaway Connection

Greenheck was the first manufacturer to successfully UL Qualify a universal breakaway duct connection that is compatible with TDC, TDF, Ductmate®, Nexus or Ward flange systems. The universal breakaway connection is available on fire, smoke, and combination fire smoke dampers. Dampers can be ordered with breakaway connection three different ways:

- Universal flange attached to one end of the sleeve
- Universal flange attached to both ends of the sleeve
- One end attached and one shipped loose

Factory Mounted Retaining Angle

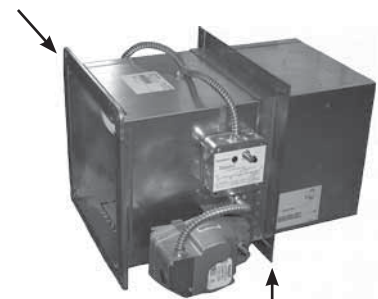
Retaining angles can be ordered factory mounted by Greenheck in four different ways:

- Single Fastened - one retaining angle mounted
- Single Wrapped - one retaining angle wrapped around the damper sleeve and wire tied
- Double Wrapped - the same feature as single wrapped, but with two sets of retaining angles
- Fastened & Wrapped - one retaining angle fastened and one angle wrapped around the damper

Factory Mounted Access Door

According to NFPA 80 (2007 edition) & NFPA 90A (2002 edition), an access door is required in air ducts adjacent to each fire, smoke, or combination fire smoke damper for maintenance and inspection. Greenheck can install the access door in the sleeve to save on labor costs in the field.

Quick connect breakaway connection



Factory mounted retaining angle



Access door factory mounted

KEY POINTS TO REMEMBER

- The OCI option provides two switches to indicate that a damper is open or closed. Auxiliary switches in the actuator may also be used to determine damper open/close.
- The TOR option allows overriding or bypassing of the primary fire damper closure signal allowing the combination fire smoke damper to reopen and the HVAC system to perform smoke control functions.
- If the damper is equipped with a pneumatic actuator, an EP switch is required with an appropriate electric power circuit, to allow the electric thermostat (RRL or TOR) to control the actuator. An optional PRV may be ordered in lieu of the standard RRL / EP switch closure system to eliminate the need for 120VAC or 24VAC power.
- Square or rectangular combination fire smoke or smoke dampers to be installed with round or oval ductwork require the appropriate transition options.

INSTALLATION REQUIREMENTS

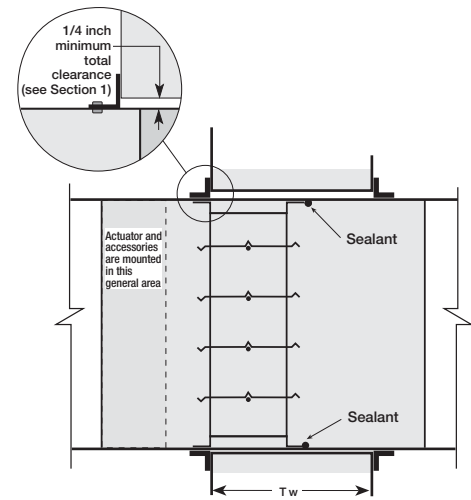
The 2015 IBC (International Building Code), section 717.2 states the following: “Fire dampers, smoke dampers, combination fire/smoke dampers and ceiling radiation dampers located within air distribution and smoke control systems shall be installed in accordance with the requirements of this section, the manufacturer’s installation instructions and the dampers’ listing.”

UL requires all fire and combination fire smoke damper manufacturers to publish specific damper installation instructions detailing the required installation methods and procedures to properly install each specific model of damper. These instructions must be followed to maintain the validity of the damper’s UL listing. A copy of the appropriate installation instruction(s) is included with each shipment of UL fire, smoke, or combination fire smoke dampers. Installation requirements may differ between damper manufacturers as a manufacturer may qualify alternate installation methods by conducting additional tests at UL. Dampers must be installed in accordance with instructions published by the company that actually manufactured the dampers.

Combination Fire Smoke Damper Installation

Combination fire smoke damper installation instructions encompass the following requirements:

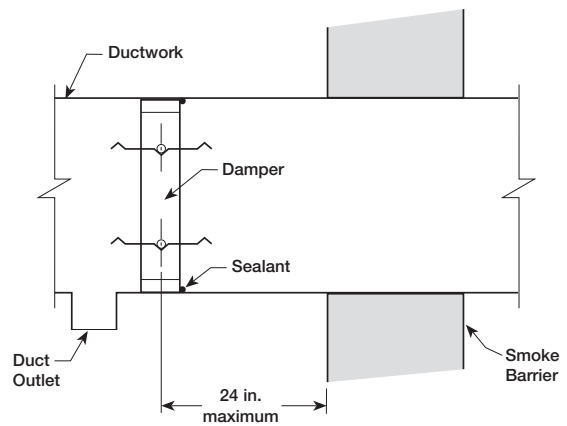
- **Clearances required between damper sleeves and wall or floor openings** - Clearances of 1/8 in. (3 mm) per foot of damper width or height are normally required for galvanized steel dampers, with a minimum of 1/4 in. (6 mm) and a maximum of 1 1/2 inches (38 mm). On true round dampers, the wall/floor opening must be a minimum of 7/8 in. (22 mm) larger than the outside diameter of the damper.
- **Sleeve requirements** - Sleeve thickness requirements depend on damper size and type of duct-to-sleeve connection used. Sleeve length restrictions also apply. See pages 9 and 10 for installation instructions for details.
- **Fastening the damper to the sleeve** - Instructions will show method of attachment and spacing of attachments.
- **Installing damper/sleeve assembly in wall and floor openings** - Installation options for securing the damper to wall or floor openings depend on the following factors: model, size, mounting orientation, and wall or floor construction. Single side or two side retaining angle options are available. Check with local authority having jurisdiction. See installation instructions for detail.
- **Sealing of the damper frame to the ductwork** - Smoke and combination fire smoke dampers must have the joint between the damper frame and duct sealed to prevent unwanted air leakage.
- **Duct-to-sleeve connections** - These can be rigid or breakaway type. Breakaway connections should be described in detail in the manufacturer's installation instructions (see page 9).



Smoke Damper Installation

Smoke damper installation instructions encompass the following requirements:

- **Location of the damper in the ductwork** - Damper centerline must be located no more than 24 in. (610 mm) from the protected smoke barrier.
- **How to attach damper to the ductwork** - Instructions will show method of attachment and spacing of attachments.
- **Sealing of the damper frame to the ductwork** - The joint between damper frame and duct must be sealed to prevent unwanted air leakage.



Actuator Installation

Factory installation of actuators on smoke and combination fire smoke dampers is required by UL 555S. Maintenance helps to ensure that a system can be trusted to perform its function in an emergency.

Wiring or Piping of Smoke and Combination Fire Smoke Damper Actuators

Electrical and/or pneumatic connections to smoke and combination fire smoke damper actuators should be made in accordance with control schematics and diagrams developed specifically for the job or project and that comply with the project specifications. Refer to the latest version of NFPA 70, National Electrical Code.

Damper and Actuator Maintenance

Smoke Control Systems maintenance schedules should include, as a minimum, periodic testing and cycling of system components. Dampers and their actuator(s) must be maintained, cycled and tested as a minimum in accordance to:

- The latest editions of NFPA 80, 90A, 92, 101, and 105
- Actuator manufacturer's recommendations
- Local codes
- Other applicable industry standards

KEY POINTS TO REMEMBER

- Fire and combination fire smoke dampers must be installed in accordance with their manufacturer's installation instructions for the specific damper model.
- Smoke dampers centerline may be installed in ductwork within 24 in. (610 mm) of the smoke barrier they are intended to protect. Combination fire smoke dampers must be installed within and as part of, the fire rated barrier using sleeves and retaining angles, unless they are specifically tested otherwise (OFSD models).
- Required sleeve gauge or thickness depends on the damper size and the type of "duct-to-sleeve connections" used. If connections are "rigid", the sleeve must be 16 ga. (1.5 mm) minimum (14 ga. [1.9 mm] for larger dampers). If connections are "breakaway", the sleeve can be the same as the gauge of the connecting ductwork (see pages 9 and 10 for specific requirements).
- Factory installed combination fire smoke and smoke damper actuators are required by UL 555S.
- Maintenance of engineered life safety systems should include periodic cycling and testing of dampers and actuators in that system. Refer to industry codes and standards (such as NFPA 80, 90A, 92A, 101, and 105), as well as component manufacturers for specific recommendations.

SPECIAL INSTALLATION CASES

Maximum Damper Size Limitations

The maximum size opening that can be protected by any manufacturer's fire, smoke, or combination fire smoke damper is specifically stated in the manufacturer's UL Listing. These listings, which can be found on UL's website (www.ul.com) under the category EMME, provide both the maximum single-section size and the maximum multiple-section size of a damper model. If no multiple-section size is listed, the damper is limited strictly to single-section applications.

The maximum damper sizes found in the UL Listings are based on tests conducted in accordance with UL Standard 555 (fire dampers) and UL Standard 555S (smoke dampers); combination fire smoke dampers are subject to both UL Standards 555 and 555S. Filling openings larger than the maximum tested damper size is not approved by UL unless the opening requires only a static rated fire damper. Oversized openings in dynamic systems cannot be divided into smaller sections using support mullions. As always, the authority having jurisdiction can decide whether or not to approve an installation.

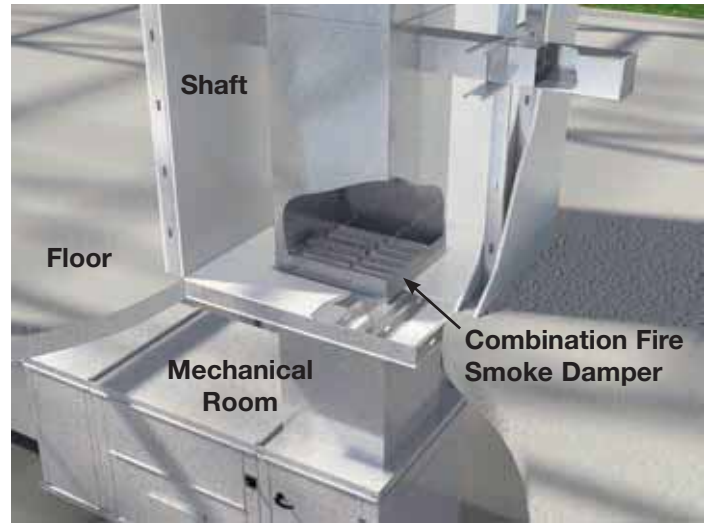
Horizontal Fire Smoke Damper in a Non-Concrete Barrier

Fire rated shafts enclose the space extending through one or more stories of a building, connecting vertical openings in successive floors, or floors and roof. One of the more difficult tasks facing designers, contractors, and inspectors when working with a shaft that is penetrated by a duct, is protecting the horizontal opening at the bottom of the rated shaft. There are three typical methods used to enclose the bottom of the shaft when it does not extend to the bottom of the building or structure.

The first method is to enclose the bottom of the shaft with a fire resistant rated construction that is equal to the rating of the lowest floor penetrated but not less than the rating required for the shaft enclosure. It is important to note that when a shaft is enclosed at the bottom with fire resistant rated construction, it is required that the assembly has passed the fire test in the horizontal position and any penetrations in the shaft be protected per applicable building codes. Duct penetrations can then be protected with vertically mounting fire smoke dampers.

The second method is to terminate the shaft in a room which has the same purpose of the shaft and separate that room from the remainder of the building with construction equal to the fire resistive rating of the shaft. Duct penetrations can then be protected with vertically mounting fire smoke dampers.

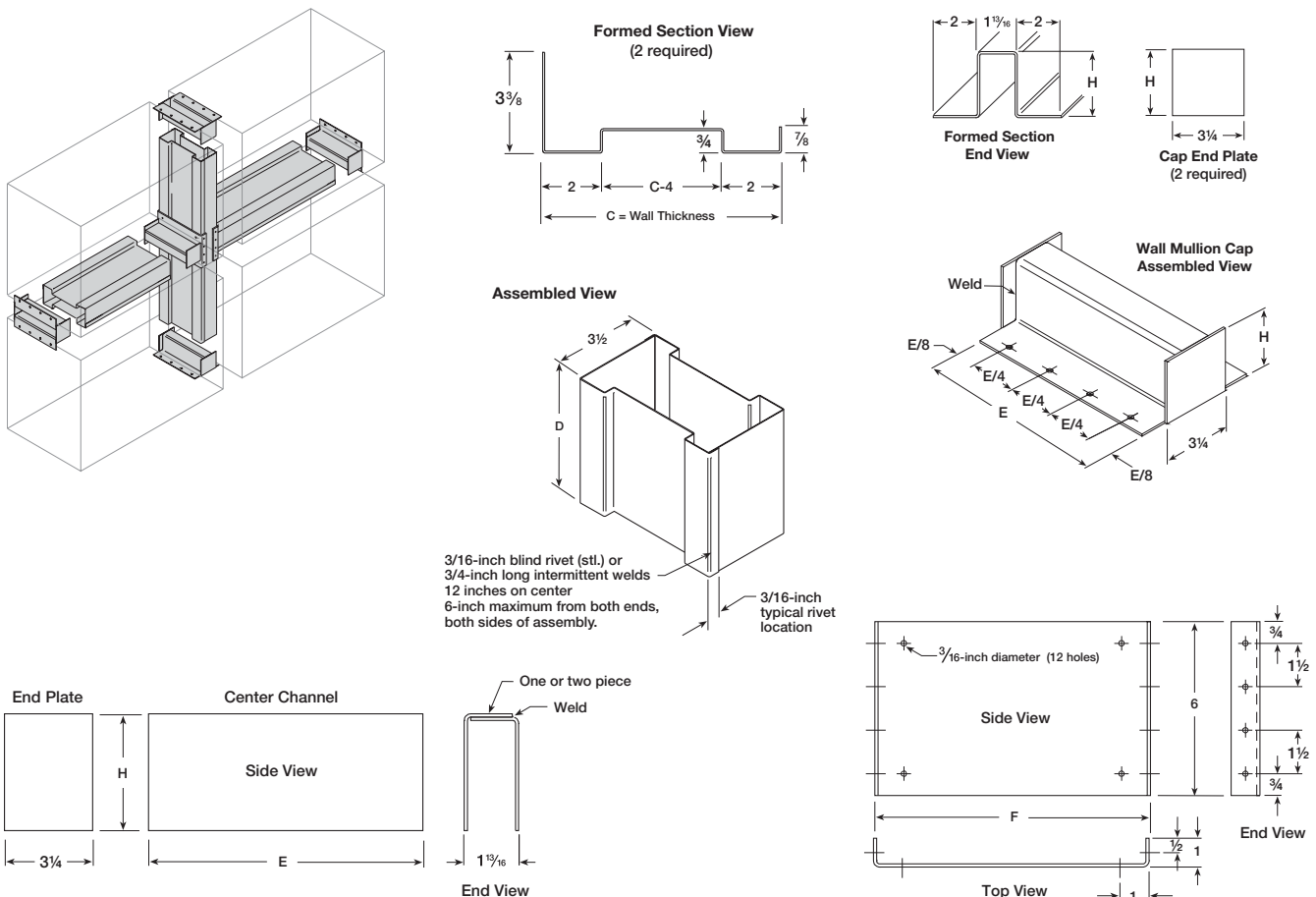
The third method is to protect the opening at the bottom of a shaft using Greenheck's 2 hour fire rated floor/ceiling design. UL Fire Resistance Design Number I503 is the first UL listed floor/ceiling design made from steel studs and gypsum board that is approved with damper penetrations. Greenheck series DFD, FD and FSD dampers are approved to be used in this innovative design. This installation method results in more usable space for the owner, more flexibility for the design professional, and reduces installation time for the contractor. See back cover for a video link.



AMCA Mullion System - For Static Fire Dampers Only

The Air Movement and Control Association (AMCA) International, Inc., the damper industry trade association, in cooperation with the Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), have developed a steel mullion system that allows the division of large wall openings so that multiple dampers may be installed within the overall wall opening. These steel mullions are designed to be fabricated by any commercial sheet metal shop. They are approved for use in masonry or concrete block walls from 7 to 12 in. (178 to 305 mm) thick. AMCA steel mullion systems can be used horizontally to divide a wall opening up to 120 in. (3048 mm) high or vertically to divide a wall opening of any size. Both vertical and horizontal mullions can be used in a single opening. A typical detail of an AMCA steel mullion system is shown in this section. Mullion construction, application, and limitations are shown in greater detail in Greenheck's Mullion Installation Instructions.

SPECIAL NOTE: AMCA steel mullion systems may only be used with static rated fire damper assemblies. They cannot be used to install combination fire smoke dampers in wall openings that exceed the maximum UL Approved size for the combination fire smoke damper model being installed.



What if a Damper Cannot be Installed per the Manufacturer's Installation Instructions?

The proper approach in these instances is to propose a solution that is based on sound engineering judgement and have the solution evaluated and approved by the appropriate authority having jurisdiction (usually the building code official responsible for administering the building code that applies).

There are a number of resources available to consult when looking for a sensible solution to a fire smoke damper installation problem. Here are a few suggestions:

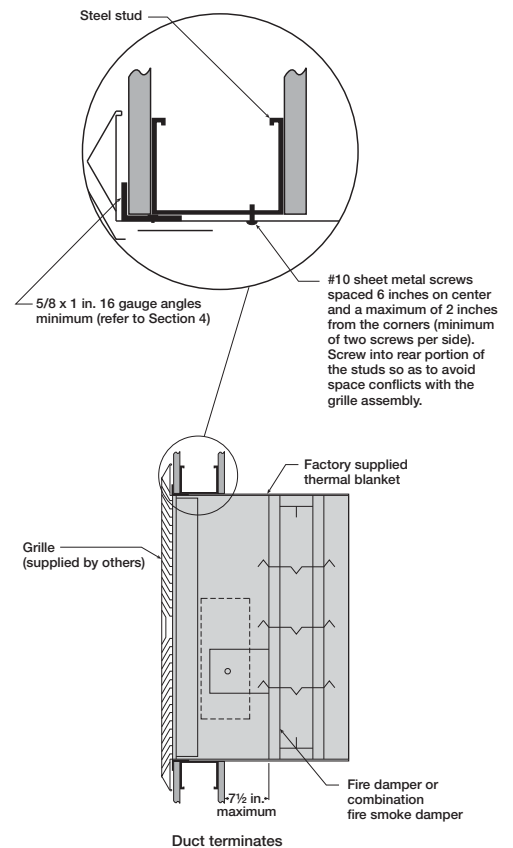
- Has this situation been encountered before and if so, how was it handled? Ask the building code inspector or official.
- Greenheck's damper representatives are well informed as to what alternate fire, smoke, combination fire smoke damper installation methods have been approved in their territory.
- Look in the SMACNA Fire, Smoke, and Radiation Damper Installation Guide for HVAC Systems. This publication illustrates many fire smoke damper installation situations and includes suggested alternate methods for consideration.
- Greenheck will often have knowledge of alternative installation methods that have been approved by other authorities having jurisdiction. Also, our experience in conducting UL fire tests allows us to make suggestions based on actual test experience. Greenheck's damper representatives should be contacted for this type of information.

What if a Damper Cannot be Installed in the Wall?

Greenheck has tested and qualified fire and combination fire smoke dampers for installation out of the plane of the wall (models OFD, ODFD, & OFSD). This damper series is designed to allow 'through the grille' access to actuator and controls. Model OFSD series dampers meet all requirements of UL 555 and UL 555S.

Steps to Take When an Unapproved Installation Must be Provided

1. Identify the problem and be ready to explain why an approved installation cannot be made.
2. Research the alternate installation methods that may be applicable and select a practical alternative that provides relative equivalency based on engineering principles.
3. Illustrate your proposed alternative and discuss it with the damper manufacturer (or representative), job design engineer, or both. Obtain an agreement that it is an acceptable alternative.
4. Submit your alternative damper installation to the authority having jurisdiction and obtain formal approval. Only the authority having jurisdiction can approve an alternative combination fire smoke damper installation. It is usually much easier to obtain approval before a damper has been installed. After an installation has been rejected by the inspector, it is often quite difficult to obtain approval.



CEILING RADIATION DAMPERS

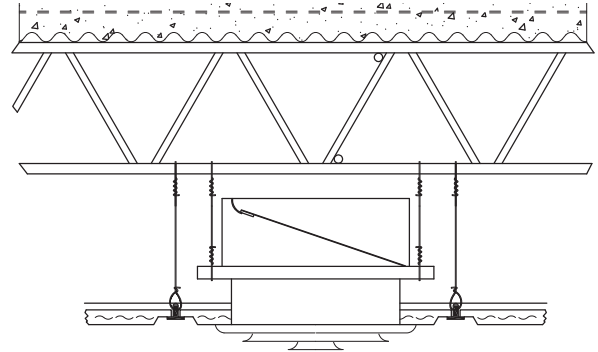
Ceiling Radiation Damper Application

Ceiling radiation dampers (also called ceiling dampers) are designed to protect openings in the ceiling membrane of rated floor/ceiling and roof/ceiling assemblies. Ceiling dampers close upon the activation of a temperature response device designed to release at a selected temperature (this is usually a 165°F (74°C) fusible link).

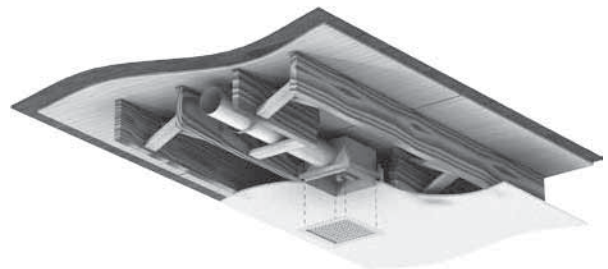
There are two general applications for UL Classified ceiling dampers:

1. The first is in rated floor/ceiling or roof/ceiling assemblies that were tested with and are now listed with generic hinged door type ceiling dampers. Most floor/ceiling and roof/ceiling designs listed with hinged door type dampers utilize acoustical ceiling tiles as their ceiling membrane and have non-combustible structural members (i.e. they do not use wood trusses or joists). Dampers designed to take the place of a hinged door type ceiling damper are evaluated per UL 555C. Any UL 555C Classified damper may be used in these applications. However, ceiling dampers may not be used in floor/ceiling or roof/ceiling designs that are not specifically listed with a generic hinged door type ceiling dampers as part of their design.
2. The second application is in rated floor/ceiling or roof/ceilings designs that were tested with and are now listed with a specific, proprietary, damper design. These floor/ceiling and roof/ceilings designs typically have gypsum board ceiling membranes and combustible structural members (i.e. wood trusses or wood joists). Dampers designed to be used in specific floor/ceiling or roof/ceilings designs are evaluated per UL 263. Although these floor/ceiling and roof/ceilings designs are listed with specific damper models, there are often designs with identical or nearly identical construction that are listed with different damper models.

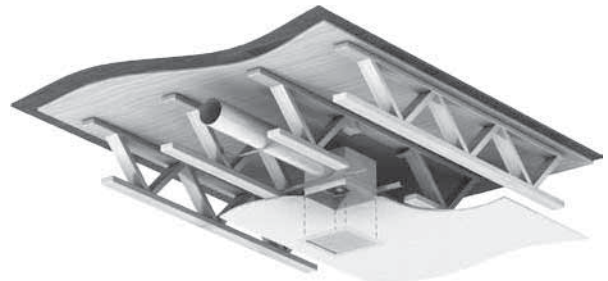
In summary, the first step in determining the appropriate ceiling damper for a given application should be to review its listed design in the UL Fire Resistance Directory (or equivalent directory). The floor/ceiling or roof/ceiling design will either be listed for use with a generic hinge door type damper (in which case any UL 555C Classified ceiling damper may be used), a proprietary damper model, or with no allowable damper penetrations.



Typical floor/ceiling assembly with a generic hinged door type damper



Typical floor/ceiling assembly with wood joist



Typical floor/ceiling assembly with wood truss

KEY POINTS TO REMEMBER

- Ceiling radiation dampers must be installed in accordance with their manufacturer's installation instructions for the specific damper model.
- Ceiling radiation dampers used in lieu of hinged door type dampers are tested to ANSI/UL 555C.
- Ceiling radiation dampers used in proprietary ceiling designs are tested to ANSI/UL 263.
- For field or design modifications, reference the Guide Information in The Fire Resistance Directory Volume 1.

CODE AND STANDARD MAKING ORGANIZATIONS INFLUENCING FIRE SMOKE DAMPER APPLICATION AND USE

Organization	Applicable Codes, Standards, Publications
<p>ICC International Code Council, Inc. 500 New Jersey Ave, NW, 6th Floor Washington, D.C. 20001 Phone: 1-888-422-7233 www.iccsafe.org</p>	<ul style="list-style-type: none"> • International Building Code (IBC) <ul style="list-style-type: none"> - Uniform Building Code - National Building Code - Standard Building Code • International Mechanical Code (IMC)
<p>ICBO International Conference of Building Officials 5360 Workman Mill Road Whittier, CA 90601-2298 Phone: (562) 699-0541</p>	<ul style="list-style-type: none"> • Uniform Mechanical Code (UMC)
<p>NFPA National Fire Protection Association 1 Batterymarch Park Quincy, MA 02269-9101 Phone: (617) 770-3000 www.nfpa.org</p>	<ul style="list-style-type: none"> • NFPA 80: Fire Doors & Other Opening Protectives • NFPA 90A: Installation of Air Conditioning & Ventilating Systems • NFPA 92A/92B: Smoke Control Management Systems in Malls, Atria, & Large Areas • NFPA 101: Life Safety Code • NFPA 105: Standard For The Installation of Smoke Door Assemblies
<p>UL Underwriters Laboratories, Inc. 333 Pfingsten Road Northbrook, IL 60062-2096 Phone: (847) 272-8000 www.ul.com</p>	<ul style="list-style-type: none"> • UL 555: Fire Rated Dampers • UL 555S: Smoke Dampers • UL 555C: Ceiling Radiation Dampers • UL Fire Resistance Directory
<p>ASHRAE American Society of Heating, Refrigerating, & Air Conditioning Engineers, Inc. 1791 Tullie Circle, N.E. Atlanta, GA 30329 Phone: (404) 636-8400 www.ashrae.org</p>	<ul style="list-style-type: none"> • ASHRAE Handbook • Design of Smoke Management Systems • Commissioning Smoke Management Systems
<p>SMACNA Sheet Metal and Air Conditioning Contractors' National Association, Inc. 4201 Lafayette Center Drive Chantilly, VA 22021-1209 Phone: (703) 803-2980 www.smacna.org</p>	<ul style="list-style-type: none"> • Fire, Smoke, & Radiation Damper Installation Guide For HVAC Systems • HVAC Duct Construction Standards
<p>AMCA Air Movement and Control Association International, Inc. 30 W. University Drive Arlington Heights, IL 60004-1893 Phone: (708) 394-0150 www.amca.org</p>	<ul style="list-style-type: none"> • Publication 503-03: Fire, Ceiling Radiation, Smoke, Fire/Smoke Dampers Application Manual • Standard 500D: Laboratory Methods of Testing Dampers For Rating • Publication 511: Certified Ratings Program for Air Control Devices

CODES AND STANDARDS

The terms “code” and “standard” are often used interchangeably but there is a fine point of difference. A code is a set of regulations and requirements written in appropriate language with the expectation that it will become law. A code is enacted into law when it is adopted by formal action of a governing body or other authority having jurisdiction.

A standard is not necessarily written with the expectation that it will be adopted by some authority having jurisdiction and become law. Rather, a standard is intended to establish a defined level of performance or requirements, and often includes a listing of the necessary tests and qualifications for compliance with the standard. Codes often reference standards making them a part of the referencing code. For example, the 2015 International Building Code references UL Standard 555 as the appropriate standard for qualifying fire dampers for use under the International Building Code.

Compliance with the Applicable Building Codes is Mandatory

If a state, city, or other authority having jurisdiction has adopted one or more codes governing construction within that jurisdiction, these codes are the law and must be followed. As there are many code documents in existence that have not been adopted by every authority with jurisdiction, it is important that both the designer and contractor know exactly what codes are applicable to the building in question.

In 1997, representatives of SCBBI, BOCA, and ICBO, by appointment of the International Code Council (ICC), began developing the latest significant body of code, the International Building Code. The intent of the International Building Code is to provide “a comprehensive set of regulations for building systems consistent with and inclusive of the scope of the existing model codes” (2015 International Building Code, International Code Council, 2015, p. iii). The existing model codes encompassed by the IBC are the Uniform Building Code, the National Building Code, and the Standard Building Code.

The subject of codes and standards cannot be treated in any depth in the space available in this manual. See installation instructions and installation supplements for specific information.

The National Fire Protection Association

The National Fire Protection Association merits special mention because of its significance as a standard writing and trendsetting organization in the fire and life safety arena. NFPA, a non-profit membership organization founded in 1896, brings together all interested parties to promote safety from fire, electricity, and related hazards through research, codes and standards, technical services, and public education. Many of NFPA's Codes and Standards provide the basis for model building code requirements or actually become a part of these codes. New concepts and other changes in various NFPA Standards are usually adopted by the several model building codes during the code review and revision process.



UL STANDARDS FOR TESTING AND RATING OF FIRE, SMOKE, COMBINATION FIRE SMOKE AND CEILING RADIATION DAMPERS

Two UL Standards provide the basis for testing, qualifying, and rating fire, smoke and combination fire smoke dampers. These two UL Standards are:

UL 555 Fire Dampers

UL 555S Smoke Dampers

Here is a summary of the major tests required to qualify dampers to these standards:

- **Fire Endurance Test and Hose Stream Test (UL 555)**

Dampers are exposed to a standard test fire for a period of either 1½ or 3 hours. This standard test fire is controlled to follow the time temperature curve illustrated. Immediately after conclusion of this fire test, the dampers are subjected to a high pressure hose stream test during which water, at a nozzle pressure of 30 psi (207 kPa) for 1½ hour dampers and 45 psi (310 kPa) for 3 hour dampers, is applied to the dampers from a distance of 20 feet (6 meters). The hose stream test provides an extreme shock that ensures the dampers are structurally strong enough to withstand the rigors of the most severe fire conditions.

- **Operational Reliability Cycle Test (UL 555S)**

Fire smoke dampers intended for operation by gravity or spring force (not driven by an actuator) must be cycled open and closed 250 times. Fire smoke dampers that are driven by an electric or pneumatic actuator must be cycled open and closed (by their actuator) 20,000 times. In addition to the 20,000 full stroke cycles, if the fire smoke damper is also intended for use as a volume control damper, it must be cycled open and closed (by its modulating actuator) 100,000 repositioning cycles. These operational cycling tests are accomplished prior to the temperature degradation and leakage tests (described below) and ensure that the damper will function reliably after repeated operations.

- **Salt Spray Exposure Test (UL 555 & UL 555S)**

A damper sample is exposed to salt spray in a test chamber for a period of 120 hours. After this exposure, the damper must close (and latch if a latch is provided). This test demonstrates a damper's ability to function after a more severe fouling than the damper is likely to experience during its intended application.

- **Operational Performance Test (UL 555 & UL 555S)**

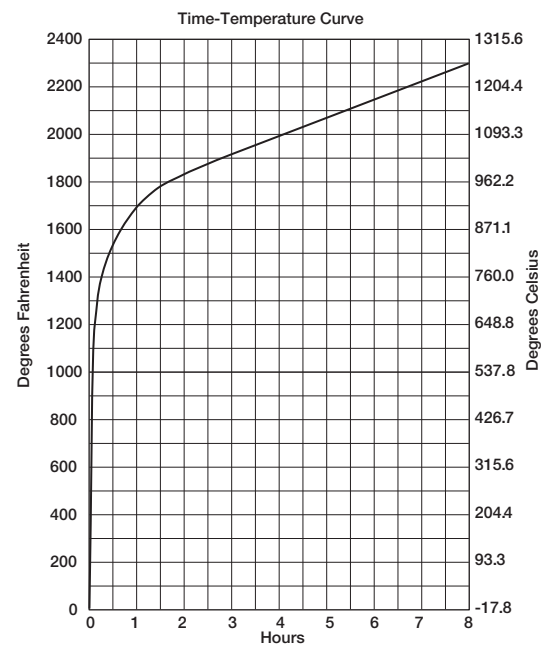
A damper is subjected to airflows and pressures, and must demonstrate its ability to operate in the manner expected by its configuration and intended application. Smoke and combination fire smoke damper actuators must operate the dampers open and closed three times and combination fire smoke dampers must also close as they would if their heat responsive device (RRL or fusible link) would operate. A damper model's airflow velocity and differential pressure ratings are based on the velocity and pressure conditions against which the damper demonstrates its ability to operate.

- **Temperature Degradation and Cycling Test (UL 555 & UL 555S)**

A damper with an actuator that has previously been subjected to the OPERATIONAL RELIABILITY CYCLE TEST (described above) is exposed to an elevated temperature of 250°F (121°C) minimum (or higher in multiples of 100°F [38°C]) for a period of 30 minutes. After 30 minutes exposure and while still at the elevated temperature, the damper actuator must operate the damper open and closed three times. Time of operation cannot exceed 75 seconds for any of the open or closed operations.

- **Leakage Test (UL 555S)**

At least three damper sizes of each model being tested (minimum width by maximum height, maximum width by minimum height, and maximum width by maximum height) that have previously been subjected to both the OPERATIONAL RELIABILITY CYCLE TEST and the TEMPERATURE DEGRADATION AND CYCLING TEST must be tested for leakage. The minimum airflow and pressure ratings of dampers shall be 2000 ft/min (10.2 m/s) and 4 in. wg. (1 kPa). Ratings shall be set in 1000 ft/min (5 m/s) increments from the minimum airflow and in 2 in. wg (0.5 kPa) increments from the minimum pressure. Leakage testing must be conducted at 400 ft/min (2 m/s) higher than the rated airflow and 0.5 in. wg (.1 kPa) higher than the rated pressure. A damper's leakage rating is based on the worst-case performance of the three damper sizes tested. See page 5 of this manual for an explanation of damper leakage ratings.



UL STANDARDS FOR TESTING AND RATING OF FIRE, SMOKE, COMBINATION FIRE SMOKE AND CEILING RADIATION DAMPERS

UL 555C Ceiling Radiation Dampers

Here is a summary of the major tests required to qualify dampers to these standards:

- **Fire Endurance Test (UL 555C)**

Ceiling dampers are installed in a type of ceiling previously tested in a rated fire resistive floor-ceiling or roof-ceiling assembly for 4 hours. Each test assembly includes a reference damper installed in a similar construction. This standard test is controlled to follow the time temperature curve. The average temperatures in the concealed space above the ceiling of the assembly of the ceiling dampers shall not exceed the average temperature of the reference damper. The closing of the ceiling radiation damper is not to cause disruption of the ceiling membrane during the fire test.

- **Closing Reliability Test (UL 555C)**

Ceiling dampers must close and latch (if a latch is provided) automatically from the open position during each of 250 operations throughout the test and show no evidence of damage which impairs the fire performance of the ceiling damper or ceiling air diffuser.

- **Salt Spray Exposure Test (UL 555C)**

The test sample is to be installed in a test chamber with the damper open and is to be supported in the position of intended use. It is then exposed to salt spray for 120 hours. At the end of the test, the damper is removed from the chamber and allowed to dry for a minimum of 24 hours at room temperature. The sample is then placed in its intended mounting position and tested for closing and latching (if a latch is provided).

- **Spring Closing Force Test (UL 555C)**

A spring operated ceiling damper is to employ a spring or springs capable of exerting a force of 2½ times that is required to close the damper. The force is measured at a series of positions from fully open to closed.

MODIFICATIONS TO LIFE SAFETY DAMPERS

Field Modifications

The UL mark applies to the product as it is originally manufactured when shipped from the factory. UL does not know what the effect of a modification may have on the safety of the product or the continued validity of the UL certification mark unless the field modifications have been specifically investigated by UL. Unless UL investigates a modified product, UL cannot indicate that the product continues to meet UL's safety requirements.

Design Modifications

Careful considerations need to be given to alterations or modifications of the fire resistance assemblies. When field issues arise, it is recommended the first contact for assistance be the technical staff provided by the product manufacturer noted for the design. Users of fire resistance assemblies are advised to consult the general Guide Information for each product category and each group of assemblies. The Guide Information includes specifics concerning alternate materials and alternate methods of construction.

Contacting UL

UL provides assistance to the users of fire resistance assemblies and products, which includes clarification of the published information.

UL also provides a service to investigate modifications to the fire resistance assemblies when requested by the design submitter. Requests for clarification should describe the change and include drawings, if necessary.

Requests for clarifications or investigations can be made by contacting UL at:

- Phone 1-877-ULHELPS (1-877-854-3577) ext. 49590
- Email: archservices@ul.com or
- Website: www.ul.com.

MOST COMMONLY ASKED QUESTIONS

Q. Are pneumatic actuators available on smoke and combination fire smoke dampers?

- A.** Smoke and combination fire smoke dampers are available with pneumatic or electric actuators (internal or external mount).

Reference: [Actuator Selection](#) - Page 7

Q. Does the smoke and combination fire smoke damper actuator have to be factory mounted by the damper manufacturer?

- A.** Yes. The 7th Edition of UL 555 and 4th Edition of UL 555S require all actuators on smoke and combination fire smoke dampers to be factory mounted.

Reference: [Actuator Mounting Options](#) - Page 8, [Actuator Installation](#) - Page 15

Q. Are there any specific sleeve gauge requirements for combination fire smoke damper installation?

- A.** Sleeve gauge or thickness requirements depend on damper size and the type of duct-to-sleeve connections used.

Reference: [Sleeve Requirements](#) - Page 9

Q. Is there any approved way of installing combination fire smoke dampers in openings that are larger than the maximum UL listed damper sizes?

- A.** There is no limit on the size of a static fire damper assembly made using approved section sizes. However, when installing combination fire smoke dampers, smoke dampers and dynamic fire dampers, AMCA steel mullion systems cannot be used to divide wall openings that exceed the maximum **UL Approved** size for the model being installed.

Reference: [What if a Damper Cannot be Installed Per the Manufacturer's Installation Instructions?](#) - Page 19, [AMCA Mullion System](#) - Page 18

Q. How much space outside the damper sleeve is required to accommodate the actuator installation? Can the actuators be installed inside the sleeve to eliminate external space requirements?

- A.** Clearance requirements for externally mounted actuators vary with actuator type. Enough space should be provided to allow for connection of wiring or piping and the replacement of the actuator and/or control components. If clearance is potentially a problem, the damper manufacturer should be contacted for specific clearance requirements. Installing the actuators internally should be considered only as a last resort, as it creates wiring/piping and service difficulties.

Reference: [Space Required for Actuators for Proper Installation?](#) - Page 10

Q. How should combination fire smoke dampers be installed?

- A.** Combination fire smoke dampers must always be installed in accordance with the manufacturer's installation instructions.

References: [Installation Requirements](#) - Page 15, [What if a Damper Cannot Be Installed per the Manufacturer's Installation Instructions?](#) - Page 19

Q. Is there any fire, smoke or combination fire smoke dampers that can be used in corrosive environment applications?

- A.** Greenheck has Severe Environment dampers that are constructed out of 316 stainless steel for this application.

References: [Model Definition - Damper Model Number Code](#) - Page 26

Q. When do I use a ceiling radiation damper versus a fire damper?

- A.** Both dampers are intended to protect opening in horizontal fire barriers. A fire damper is required in a fire rated wall, floor/ceiling or partition when it is penetrated by air ducts or other air transfer openings. A ceiling radiation damper, according to the 2015 IBC (International Building Code) should be used in the following situations:
1. A ceiling radiation damper installed where a duct penetrates the ceiling of a fire resistance rated floor/ceiling or roof/ceiling assembly.
 2. A ceiling radiation damper installed at the ceiling line where a diffuser with no duct attached penetrates the ceiling of a fire resistance rated floor/ceiling or roof/ceiling assembly.

References: [Ceiling Radiation Dampers](#) - Page 20, [2015 IBC section 717.6](#)

MODEL DEFINITION - Damper Model Number Code

A	Product Type
CFSD	Corridor Ceiling Combination Fire Smoke Damper
DFD	Dynamic Fire Damper
DFDR	Round Dynamic Fire Damper
FD	Static Fire Damper
FDR	Round Static Fire Damper
FSD	Combination Fire Smoke Damper
FSDR	Round Combination Fire Smoke Damper
GFSD	Grille Access Combination Fire Smoke Damper
HSD	Heavy Duty Smoke Damper
ODFD	Out of Wall Dynamic Fire Damper
OFD	Out of Wall Static Fire Damper
OFSD	Out of Wall Combination Fire Smoke Damper
SEDFD	316 Stainless Steel Dynamic Fire Damper
SEFSD	316 Stainless Steel Combination Fire Smoke Damper
SEFSDR	Round 316 Stainless Steel Combination Fire Smoke Damper
SESMD	316 Stainless Steel Smoke Damper
SESMDR	Round 316 Stainless Steel Smoke Damper
SMD	Smoke Damper
SMDR	Round Smoke Damper
SSDFD	304 Stainless Steel Dynamic Fire Damper
SSDFDR	Round 304 Stainless Steel Dynamic Fire Damper
SSFD	304 Stainless Steel Static Fire Damper
SSFDR	Round 304 Stainless Steel Static Fire Damper
SSFSD	304 Stainless Steel Combination Fire Smoke Damper
SSFSDR	Round 304 Stainless Steel Combination Fire Smoke Damper
SSSMD	304 Stainless Steel Smoke Damper
SSSMDR	Round 304 Stainless Steel Smoke Damper
B	Blade Style
1	Curtain style
2	Fabricated Steel with Triple Vee Reinforcements (3V)
3	Fabricated Steel Airfoil
4	Extruded Aluminum Airfoil
5	Round
C	Fire Rating
0	Smoke Damper – No fire rating
1	1½ hours
3	3 hours
D	Leakage
1	Leakage Class I
2	Leakage Class II
3	Leakage Class III

FSD-311V

(A)

(B)

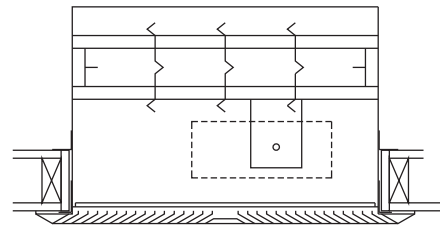
(C)

(D)

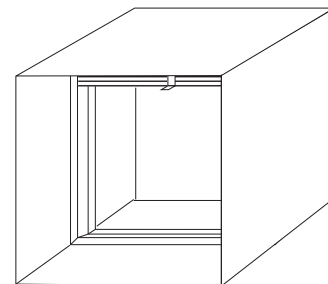
V = Vertical Blade

M = Modulating Blade

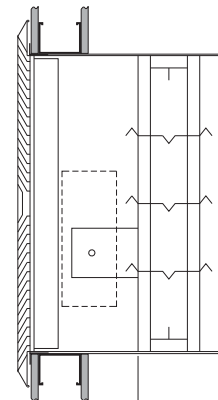
EXAMPLE: Combination Fire-Smoke Damper with Vertical Steel Airfoil Blades
1½ Hour Fire Rating
Class I Leakage



CFSD series



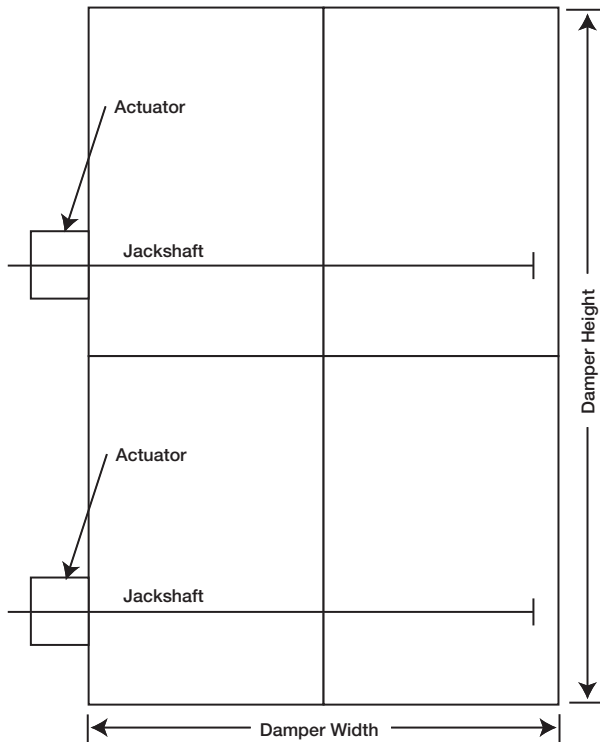
DFD-150X series



OFSD series

DRIVE ARRANGEMENT DEFINITION

The following breakdown of a drive arrangement code is a good reference in understanding what each number and letter signifies.



22-2FEL-2

1 2 3 4 5 6 7

1	Number of sections wide
2	Number of sections high
3	Number of actuators
4	Who supplies the actuators F = Factory (<i>always</i>) on UL dampers
5	Actuator mounting E = External I = Internal B = Both internal and external
6	Actuator location (viewed from jackshaft side) L = Left hand drive R = Right hand drive B = Both right and left
7	Number of jackshafts

THE GREENHECK DIFFERENCE

Greenheck dampers bring the same quality engineering and manufacturing that has earned Greenheck its position as an industry leader. Aggressive research and development keeps Greenheck a major player in the damper and louver industry. Greenheck has the most UL Classified dampers and largest selection of AMCA Licensed dampers and louvers in the industry.

In-House Testing

Our state-of-the-art laboratory and testing facilities have always been important to our business success. Our laboratory facility is devoted exclusively to the development and testing of damper and louver related products to the latest testing standards of AMCA, ANSI, ASHRAE, UL, Miami-Dade County, and other industry standards of performance.



Customer Service

Your local Greenheck representative has a wealth of industry and product knowledge to answer your questions. Our representatives receive the latest product information and can have orders processed direct to our factory. With our advanced order processing system, we can ship orders as fast as the next day. With Greenheck's experienced staff, we can answer questions and provide solutions to your unique damper application. With our dedicated engineering staff, we will work to develop a custom solution to meet your needs.

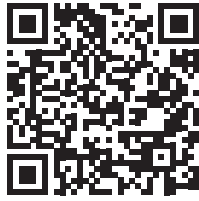


Life Safety Damper Videos

Greenheck has numerous videos for your viewing on Life Safety Dampers.



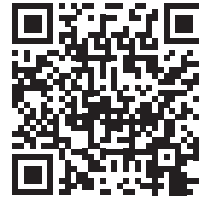
Fire Smoke Damper in a Non-Concrete Barrier
<https://www.youtube.com/watch?v=FrER0DVqoLo>



UL 555 Damper Fire Test
https://www.youtube.com/watch?v=ZMgwjBI_mFQ



UL 555 Duct Impact Test
<https://www.youtube.com/watch?v=9kpwfLE0no>



Greenheck Damper Installation Time Savings
<https://www.youtube.com/watch?v=h-uTBoMygul>



Proper Damper Installation
https://www.youtube.com/watch?v=0XL_tzpNBrM

Complete Line of Dampers For Your Needs

- Life Safety Dampers
 - Ceiling Radiation
 - Combination Fire Smoke
 - Fire
 - Smoke
 - Access Doors
 - Air Measuring Dampers
 - Backdraft Dampers
 - Balancing Dampers
 - Barometric Relief Dampers
 - Commercial Control Dampers
 - Insulated Thermally Broken
 - Pressure Relief Doors
- Heavy Duty/Industrial Dampers
 - Backdraft
 - Blast
 - Bubble Tight
 - Control
 - Pressure Relief
 - Smoke
 - Tornado
 - Tunnel Transit

Our Commitment

As a result of our commitment to continuous improvement, Greenheck reserves the right to change specifications without notice.

Specific Greenheck product warranties are located on greenheck.com within the product area tabs and in the Library under Warranties.



*Prepared to Support
Green Building Efforts*

