



Marking and Application Guide

DAMPERS

JANUARY 2013

Dampers
Marking and Application Guide

PREFACE

Fire and smoke protection - Building codes rely on fire and smoke protection features to safeguard the public from fire hazards and hazards associated with smoke and hot gases attributed to the built environment during a fire situation and to provide safety to fire fighters and emergency responders during emergency operations. One aspect of this protection is based on limiting the movement of fire, along with the associated smoke and toxic gases, through the building using a compartmentation approach. This includes requiring fire-resistance-rated assemblies, such as fire walls, fire barriers, fire partitions, smoke barriers, shaft enclosures and horizontal assemblies be provided to limit the spread of fire. Building codes also include requirements designed to limit the movement of smoke and toxic gases through the building using smoke barriers and partitions. This passive protection is an integral part of the overall safety scheme included in the codes.

An important aspect of limiting the spread of fire, smoke and toxic gases is protecting openings in fire and smoke rated assemblies that are provided to allow the building to be functional. Dampers are often used to protect openings for heating, ventilation and air conditioning (HVAC) ducts through these rated assemblies. This includes fire, smoke, combination fire-smoke, ceiling radiation and corridor dampers. UL certifies all five of these types of dampers in accordance with the requirements in building codes. These dampers and the applications for which they are certified are covered in detail in this guide. More information on those products is located on the UL Online Certifications Directory.

UL has developed this guide for use by code and inspection authorities, architects, contractors, installers and other interested parties. It is intended to aid in understanding the types of dampers which exist, in association with the applicable codes and standards to facilitate safe, code-compliant installations.

UL Marking and Application Guides are updated as necessary due to new product development, changes in the codes, or the need for clarification. To confirm the current status of any UL Marking and Application Guide, please consult the Code Authorities page of the UL Web site at www.ul.com/codeauthorities.



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1. INTRODUCTION

A. USE OF THIS GUIDE

This guide is intended to assist regulatory authorities, architects, contractors, installers and other interested parties in determining the suitability of fire, smoke, combination fire-smoke, ceiling radiation and corridor dampers in a particular installation and use, and to address concerns related to fire and smoke related performance.

Products are Listed or Classified by UL under an appropriate product category. A four-letter code (shown in parenthesis) following every category title in this guide is the UL product category code designation. A list of damper related product categories, along with the applicable category code and standard(s), can be found in Appendix A.

Each UL product category code provides a direct link to the Guide Information for the product category. The Guide Information includes the scope of the products covered, information relating to limitations or special conditions applying to the product, the requirements used for the investigation of the products, general installation and use information, and information on product markings and the UL Mark to be used on the product. Guide information is available in the UL Online Certifications Directory at www.ul.com/database.

The product markings identified in this guide do not include every possible marking that could be provided either on a product or in its installation or operation instructions. The purpose of these markings is to provide you with an indication of the type of text and location of markings that address features that may be critical in determining if a product is certified and / or if it is installed correctly. Refer to the specific Guide Information for the product category for additional marking information.

The numbering for code sections used in this document may change as the code is updated. A list of model codes and standards applicable for products covered by this guide can be found in Appendix B.

B. INFORMATION ON LISTING VERSUS CLASSIFICATION

Most codes and regulations require the certification of products to applicable safety-related standards. They also may require these products to be certified to performance standards as well. Products that are certified to safety-related standards have been evaluated with regard to all reasonably foreseeable safety-related hazards, including fire, electrical shock and mechanical hazards. Such products are termed “UL Certified” or “UL Listed.” Products that are certified to a limited range of hazards, or for use under specific conditions are termed “UL Classified”.

It is important to distinguish the difference between “UL Certified” or “UL Listed” and “UL Classified” and the relation these terms have with the term “listed,” as used in various codes. The term “listed” in the codes generally indicates that the product is required to be evaluated in accordance with the appropriate standard(s) by an independent third party certification organization such as UL. The term “listed” in the codes should not be confused with the term “UL Listed,” as explained above. It is important to recognize that not all certification agencies make this distinction in their certification services.

C. UL MARK CONSIDERATIONS

There are several types of UL Marks that are utilized for building products. General information on the UL Marks is provided below. Each has its own specific meaning and significance. The only way to determine if a product has been certified by UL is to look for the UL Mark on the product itself.

The UL Mark on a product means that UL has tested and evaluated representative samples of that product and determined that they meet the requirements in the applicable standard(s). Under a variety of UL programs, certified products are periodically checked by UL at the manufacturing facility to determine that they continue to comply with the standard(s).

The UL Marks may only be used on, or in connection with products certified by UL, and under the terms of a written agreement between the manufacturer and UL. All listed dampers are identified with the UL Classification Mark.

UL Listing Mark

This is one of the most common UL Marks. If a product carries this Mark, it means UL found that representative samples of this product met UL's *safety* requirements. These requirements are primarily based on UL's own published Standards for Safety, or other recognized third party standards. The UL Listed Mark includes the UL symbol, the word "Listed," the product or category name, and a control number assigned by UL.



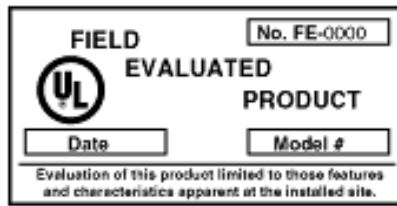
UL Classification Mark

This Mark appears on representative samples of products that UL has evaluated but only with respect to specific properties, a limited range of hazards, or suitability for use under limited or special conditions. The UL Classification Mark includes the UL symbol, the word "Classified," a statement of the scope of evaluation, the product or category name, and a control number assigned by UL.



D. FIELD ENGINEERING SERVICES

You may encounter situations in which you are unable to determine if a product has been listed by a third-party organization. Or in other situations you might encounter a product bearing a listing label that may have been modified in the field, and now you question whether or not the product still complies with the applicable standard. UL offers a field engineering services that provides data to assist you in making your decision whether to accept the product and/or approve the installation. Anyone directly involved with a product – including manufacturers, owners, contractors, and regulatory authorities – can request a field inspection or field evaluation. Detailed information for these programs can be found on UL's Web site at www.ul.com/field.



2. CODES AND STANDARDS

A. MODEL CODES

Dampers have been investigated for installation in accordance with the following model codes, among others:

- The International Building Code
- The International Mechanical Code
- The NFPA 101 Life Safety Code
- The NFPA 5000 Building Construction and Safety Code

Among other things these codes specify the locations in which these products are to be installed, the ratings required for each installation, the standards with which the products must comply, the related installation standards, and other details.

B. INSTALLATION STANDARDS

As compared to model codes, which generally describe where dampers are to be installed, installation standards provide more detailed information on how the products are intended to be installed and maintained. Model codes often require dampers to be installed in accordance with installation standards, such as NFPA 90A, NFPA 80 and NFPA 105. A brief summary of these standards is noted below.

NFPA 90A - NFPA 90A is the Standard for the Installation of Air-Conditioning and Ventilating Systems. It regulates the installation, control and acceptance testing of fire, smoke, combination fire-smoke and ceiling dampers used to protect ducts and air transfer openings in walls, floors, and ceilings against the spread of fire and smoke within, into, or out of buildings. The standard addresses products that have been subjected to standardized fire tests, including UL fire and smoke leakage tests.

The installation requirements of NFPA 90A include topics such as where dampers are required, testing requirements, rating requirements, installation requirements and requirements for maintenance in accordance with NFPA 80, the Standard for Fire Doors and Other Opening Protectives, and NFPA 105, the Standard for Smoke Door Assemblies and Other Opening Protectives. The control requirements of NFPA 90A include provisions for manual and automatic control of smoke and combination fire-smoke dampers. Acceptance testing shall demonstrate the damper functions as intended prior to occupancy of the building.

NFPA 80 - NFPA 80 is the Standard for Fire Doors and Other Opening Protectives. It regulates the installation, operational testing, periodic inspection and maintenance of fire, combination fire-smoke and ceiling radiation dampers used to protect ducts and air transfer openings in walls, floors, and ceilings against the spread of fire within, into, or out of buildings. The standard addresses products that have been subjected to standardized fire tests, including UL fire tests.

The installation requirements of NFPA 80 include topics such as damper location, listing and labeling requirements, preparation of openings, securement, access to fusible links and serviceability. Operational test shall demonstrate the damper is installed and functions as intended. Periodic inspection and testing requirements include the required inspection and testing, the required frequency and the required documentation. The maintenance requirements include topics such as the changes in the airflow and noise from the duct, lubrication and required documentation.

Combination fire-smoke dampers are also required to comply with NFPA 105, the Standard for Smoke Door Assemblies and Other Opening Protectives.

NFPA 105 - NFPA 105 is the Standard for Smoke Door Assemblies and Other Opening Protectives. It includes requirements for smoke and combination fire-smoke dampers used to restrict the movement of smoke through duct assemblies in order to maintain a tenable environment. It does this by regulating the installation, operational testing, periodic inspection and maintenance of these dampers. It is also applicable to dampers intended to restrict the passage of smoke through ducts and for dampers used in smoke control systems.

The installation requirements of NFPA 105 include topics such as damper location, damper actuator and linkage, access to fusible links and serviceability. The operational test shall demonstrate the damper is installed and functions as intended. Periodic inspection and testing requirements include the required inspection and testing, the required frequency and the required documentation. The maintenance requirements include topics such as changes in the airflow and noise from the duct, lubrication and required documentation.

Combination fire-smoke dampers are also required to comply with NFPA 80, the Standard for Fire Doors and Other Opening Protectives.

C. PRODUCT SAFETY STANDARDS

In many cases installation codes require products to comply with UL Standards for Safety, such as the Standard for Fire Dampers, [UL 555](#), Standard for Smoke Dampers, [UL 555S](#) or the Standard for Ceiling Dampers, [UL 555C](#). These are product safety standards that include a comprehensive set of construction and performance requirements that products must comply with in order to be certified by a product certification organization such as UL.

Manufacturers also use UL product safety standards to design their products so they comply with the applicable requirements. Product testing and certification organizations such as UL use these standards to evaluate the products and determine their compliance with the product standards.

When UL has determined that a product complies with all applicable product safety standards, the manufacturer is authorized to apply a UL Certification Mark (Listing or Classification) to production of the product. The standard(s) used to investigate UL Certified products are identified in the product category guide information found in the UL Online Certifications Directory at www.ul.com/database. The product safety standard may also be marked on the product or indicated in the manufacturer's installation instructions.

When an installation code or standard requires a product, system or assembly to comply with a UL standard, designers, contractors and code authorities are encouraged to look at the certification mark on the product and the corresponding guide information to identify the product safety standard used during the investigation. It is not generally necessary, or useful, for designers, contractors and code authorities to obtain a copy of the UL product safety standard.

3. TYPES OF FIRE-RESISTANCE-RATED ASSEMBLIES

Model codes include requirements to restrict the spread of fire through a building using assemblies with specific requirements concerning their construction and placement.

A. FIRE WALLS, FIRE BARRIERS, FIRE PARTITIONS AND SHAFT ENCLOSURES

Fire walls and fire barriers are both fire-resistance-rated vertical assemblies which restrict the spread of fire from one side to the other. A fire wall extends continuously from the foundation to or through the roof, with sufficient structural stability under fire conditions to allow collapse of construction on either side without collapse of the wall. In comparison a fire barrier is only required to extend from the top of the foundation or floor/ceiling assembly below to the underside of the floor or roof sheathing, slab or deck above. Fire barriers are used to protect areas such as shafts, exit passageways, horizontal exits and atriums. Openings in fire walls and fire barriers may have maximum individual size and aggregate width requirements, as specified in the code.

Fire partitions are generally required to have a fire-resistance rating of not less than 1 hour and are used to provide protection between dwelling units, sleeping units, stores in malls, corridors and elevator lobbies. They must extend from the top of the foundation or floor-ceiling below to (1) the underside of the floor or roof sheathing, deck or slab above or to (2) the fire-resistance-rated floor-ceiling or roof-ceiling assembly above.

Shaft enclosures are generally used to protect openings and penetrations through floor-ceiling and roof-ceiling assemblies. Shaft enclosures are constructed of fire barriers and horizontal assemblies. When constructed of fire barriers, the shaft enclosure shall extend from the top of the foundation or floor/ceiling assembly below to the underside of the floor or roof sheathing, slab or deck above. When constructed of horizontal assemblies, the shaft enclosure shall be continuous without unprotected openings.

B. HORIZONTAL ASSEMBLIES

Horizontal assemblies are fire-resistance-rated floor-ceiling or roof-ceiling assemblies which restrict the vertical spread of fire from the underside to the top. A horizontal assembly shall be continuous without unprotected openings.

C. SMOKE BARRIERS AND SMOKE PARTITIONS

Model codes also include requirements to restrict the spread of smoke through a building. This is done by using the concept of smoke compartments, which are spaces within a building enclosed by smoke barriers on all sides, including the floor and ceiling of the room.

A smoke barrier is a continuous membrane designed and constructed to restrict the movement of smoke. Smoke barriers are generally required to have a minimum one hour fire-resistance rating. They must form an effective membrane continuous from outside wall to outside wall and from the top of the foundation or floor/ceiling assembly below to the underside of the floor or roof sheathing, deck or slab above, including continuity through concealed spaces, such as those found above suspended ceilings, and interstitial, structural and mechanical spaces.

In comparison smoke partitions are not usually required to have a fire-resistance rating. They must extend from the top of the foundation or floor below to (1) the underside of the floor or roof sheathing, deck or slab above or to (2) the underside of the ceiling above where the ceiling membrane is constructed to limit the transfer of smoke.

D. CORRIDORS

Corridors are intended as a means of egress in the event of a fire emergency. A corridor is an enclosed exit access component that defines and provides a path of egress travel to an exit. The model codes define the use and location of corridors in building construction. The model codes should be consulted for construction specifications for corridor ceilings. One specific construction described is a tunnel corridor where the ceiling of the corridor is constructed as required for the walls.

4. DAMPER TYPES

In order to provide for an acceptable level of life safety and property protection, model codes require the use of fire-resistance-rated assemblies, and smoke barriers and partitions to form compartments to keep fire and smoke from readily moving throughout the building. However, in order for the building to serve the needs of its occupants, openings in these fire and smoke rated assemblies are required to serve the heating, ventilation and air conditioning needs of the building. Model codes require these openings to be protected with dampers. Dampers fall into five types, each with a specific function. Types of dampers include fire dampers, smoke dampers, combination fire-smoke dampers, ceiling radiation dampers and corridor dampers. Their functions vary depending on the damper type.

A. FIRE DAMPERS

Fire dampers are used to restrict the spread of fire where ducts and air transfer openings penetrate fire walls, fire barriers, fire partitions, horizontal assemblies and shaft enclosures. They can also be employed in air transfer openings in walls and partitions. The building codes specify where fire dampers are required. Fire dampers are available in two types, static fire dampers and dynamic fire dampers. Both fire dampers for use in static systems and dynamic systems are certified by UL to carry an hourly fire-protection rating, usually 1-1/2 or 3 hours.

Fire dampers for use in static systems, as their name implies, are used in duct systems or penetrations where the HVAC system is automatically shut down in the event of a fire.

Fire dampers for use in dynamic systems are required at locations in which fan pressure and airflow will be on during a fire incident, and as such, the dampers are expected to operate (close) against the air velocity and pressure produced by the system fan. In addition to an hour fire-protection rating, fire dampers for use in dynamic systems are also provided with an airflow rating which indicates the maximum velocity and static pressure that the damper is designed for. Refer to the section in this guide entitled Airflow Ratings for a more detailed explanation of the limitations of the ratings.

Fire dampers are tested as part of fire-resistance rated vertical or horizontal assemblies in accordance with the Standard for Fire Dampers, [UL 555](#), and are covered under the Dampers for Fire Barrier and Smoke Applications ([EMME](#)) category. Fire dampers are investigated for use in specific fire-resistive vertical or horizontal assemblies as specific in the installation instructions supplied with the product. Each listing is specific with respect to (1) construction details of the assembly in which the damper is installed, (2) the hourly fire-protection rating, (3) the damper mounting position (i.e. vertical or horizontal), (4) the maximum size of a single section, and (5) the maximum size of multiple damper sections. In addition, listings of fire dampers for use in dynamic systems also include the maximum air flow and maximum static pressure for which the damper is designed.

B. SMOKE DAMPERS

Smoke dampers are used to restrict the movement of smoke where ducts and air transfer openings penetrate assemblies that are designed to restrict the movement of smoke. The devices are installed to operate automatically, controlled by a smoke detection system, and where required, capable of being positioned from a remote command station.

Smoke dampers may be required where ducts penetrate through smoke barriers or smoke partitions, or at other locations within an engineered smoke control system. Smoke dampers can be used in HVAC systems where the fans are shut down in the event of fire, and can also be used in smoke control systems designed to operate during a fire incident. Smoke dampers are designed to operate against air velocity and fan pressure.

Smoke dampers certified by UL carry a leakage class rating that indicates the level of air leakage measured through the damper under test conditions. Leakage ratings are identified as Class Designation I, II or III as shown in the following table. Leakage ratings of the dampers are established at a minimum differential pressure of 4 in. water gauge (WG), across the closed damper. Leakage rates may also be established at higher differential pressures, in increments of 2 in. water gauge.

Maximum Leakage (CFM/ft²)

Class	4 In. WG	6 In. WG	8 In. WG	10 In. WG	12 In. WG
I	8.0	9.5	11.0	12.5	14.0
II	20.0	24.0	28.0	31.5	35.0
III	80.0	96.0	112.0	125.0	140.0

Smoke dampers are also provided with an airflow rating which indicates the maximum velocity and static pressure for which the damper is designed. Refer to the section in this guide entitled Airflow Ratings for a more detailed explanation of the limitations of the ratings.

Smoke dampers are tested as part of a vertical or horizontal assemblies in accordance with the Standard for Smoke Dampers, [UL 555S](#), and are covered under the Dampers for Fire Barrier and Smoke Applications ([EMME](#)) category. Smoke dampers are investigated for use in specific vertical or horizontal assemblies as specific in the installation instructions supplied with the product. Each listing is specific with respect to (1) construction details of the assembly in which the damper is installed, (2) the leakage rating, (3) the damper mounting position (i.e. vertical or horizontal), (4) the minimum and maximum sizes of a single section, and (5) the maximum size of multiple damper sections.

C. COMBINATION FIRE-SMOKE DAMPERS

Combination fire-smoke dampers are used to restrict the spread of fire and movement of smoke where ducts and air transfer openings penetrate assemblies that are designed to restrict the passage of both fire and smoke. Dampers that are marked as combination dampers comply with both the Standard for Fire Dampers, [UL 555](#) and the Standard for Smoke Dampers, [UL 555S](#).

D. CEILING RADIATION DAMPERS

Ceiling radiation dampers are used to limit the passage of heat in fire-resistance-rated floor-ceiling or roof-ceiling assemblies where ducts or air transfer openings are made only through a ceiling membrane which is providing the fire performance for the assembly. Fire resistive ceiling membranes are part of floor-ceiling or roof-ceiling assemblies that have been evaluated in accordance with the Standard for Fire Tests of Building Construction and Materials, [UL 263](#). The construction of floor-ceiling or roof-ceiling assemblies evaluated by UL are published in the [UL Online Certifications Directory](#).

Ceiling radiation dampers are intended to function only as heat barrier to limit heat transfer into the concealed space of a floor-ceiling or roof-ceiling assembly. As such, the building codes have not defined the use of these products in so far as their use as smoke barriers, nor do the UL certification include the use of these products to limit the migration of smoke. Ceiling radiation dampers are evaluated by UL in one of two ways as explained below.

Ceiling Radiation Dampers For Use In Lieu Of Hinged Door Type Dampers – Where floor-ceiling or roof-ceiling designs contain air ducts and specify the use of hinged door type dampers over each duct outlet, ceiling radiation dampers are investigated for use in lieu of the specified hinged door type dampers.

The basic Standard used to evaluate ceiling radiation dampers for use in lieu of hinged door type dampers is The Standard for Ceiling Dampers, [UL 555C](#). It is important to note that ceiling radiation dampers covered by this scheme are only intended for use in those UL fire resistance designs that indicate the use of a hinged door type damper in the design. This information is located in the [UL Online Certifications Directory](#) in the text and drawings of the specific designs. The UL Classification of ceiling radiation dampers does not cover the products for general installation in any floor-ceiling or roof-ceiling design. Examples of this scenario can be found in UL Fire Resistance Design Nos. [G214](#), [G526](#) and [L201](#).

Ceiling radiation dampers evaluated in this fashion are covered under the product categories Air Terminal Units ([BZGU](#)), Ceiling Air Diffusers ([BZZU](#)) and Ceiling Dampers ([CABS](#)). The Classification text for ceiling radiation dampers evaluated in this manner will specify the types of designs in which they may be used and the conditions under which they may be substituted for the hinged door type dampers.

Ceiling Radiation Dampers For Use In Specific Fire Resistance Designs – Alternatively, some floor-ceiling or roof-ceiling ceiling designs specify one or more specific ceiling radiation damper. Dampers covered by this method of evaluation are generally tested along with the specific design construction in accordance with the Standard for Fire Tests of Building Construction and Materials, [UL 263](#). Information describing the installation of ceiling radiation dampers covered under this scheme, including a reference to the specific ceiling radiation damper model, is included in the text and drawings for the specific designs in the UL [Online Certifications Directory](#). Examples of this scenario can be found in UL Fire Resistance Design Nos. [L501](#), [L521](#) and [L550](#).

Ceiling radiation dampers evaluated in this fashion are covered under the Ceiling Dampers ([CABS](#)) category. The Classification text for the ceiling radiation dampers will make reference to the specific floor-ceiling or roof-ceiling designs in which they are intended to be installed.

The application of ceiling radiation dampers versus horizontal fire dampers, smoke dampers, combination fire-smoke dampers and corridor dampers are distinctly different. Refer to the section in this guide entitled Horizontal Dampers under Installation Considerations for a detailed explanation of these differences.

E. CORRIDOR DAMPERS

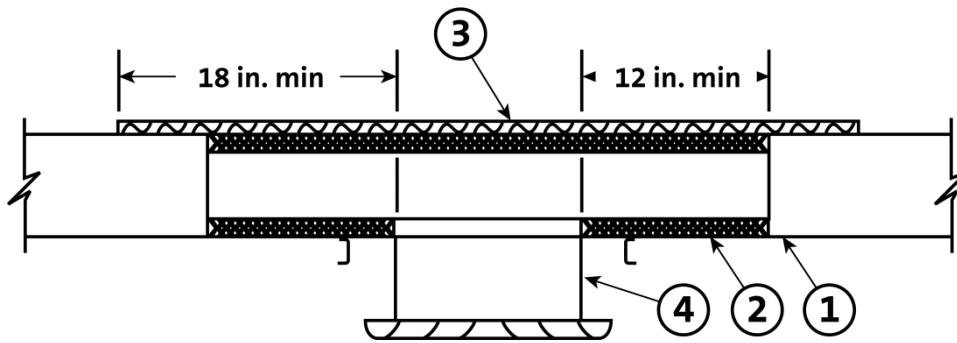
Corridor dampers are combination fire-smoke dampers that have been evaluated for mounting only in specific tunnel corridor ceiling constructions. In most cases, the ceiling construction of a tunnel corridor will be as required for the corridor walls.

Corridor dampers are tested horizontally as installed in specific tunnel corridor ceiling constructions and are covered under the Dampers for Fire Barrier and Smoke Applications ([EMME](#)) category. Corridor dampers are investigated for both a fire-resistance rating of 1 h, and a Class I or II leakage rating as defined under SMOKE DAMPERS. Leakage ratings of corridor dampers are determined at an elevated temperature 250°F or 350°F. Leakage ratings of corridor dampers are established based on test conditions using air. Corridor dampers have also demonstrated acceptable closure performance when subjected to 150 fpm velocity across the face of the damper during fire exposure. Corridor dampers are investigated for use in specific horizontal ceiling constructions as specific in the installation instructions supplied with the product. Each listing is specific with respect to (1) construction details of the ceiling in which the damper is installed, (2) the hourly fire-protection rating, (3) the damper leakage Class, (4) the damper mounting position (i.e. vertical or horizontal), and (5) the minimum and maximum size of a single damper section.

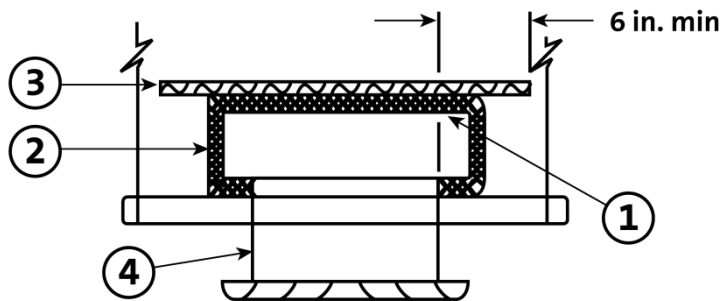
5. ALTERNATE TYPES OF PROTECTION

Under certain specific conditions, openings through the ceiling membrane of a fire resistance-rated ceiling may be protected using Duct Protection Systems A or B, as described in the Guide Information for the Fire Resistance Ratings – ANSI/UL 263 ([BXUV](#)) category. Below is information on the use of Duct Outlet Protection Systems A and B.

A. DUCT OUTLET PROTECTION SYSTEM A



Longitudinal Cross-Section

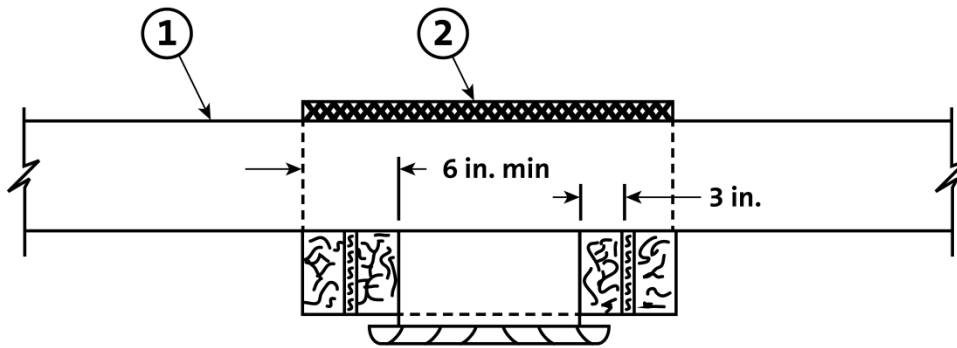


Transverse Cross-Section

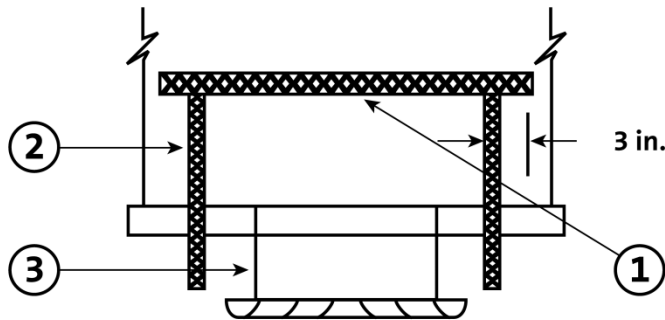
- Item 1 – Steel Duct
- Item 2 – Glass Fiber Duct Lining
- Item 3 – Acoustical Lay-in Panel
- Item 4 – Ceramic Paper

Duct Outlet Protection System A may only be used when specified in the individual design. This method of construction consists of a combination of protecting the inside of rectangular shaped steel ducts with a minimum 1 in. thick, 3.0 to 5.0 pcf glass fiber duct lining, applying an acoustical ceiling lay-in panel on top of the duct and protecting the duct outlet with ceramic paper where specified in the individual design. See the Guide Information for the Fire Resistance Ratings – ANSI/UL 263 ([BXUV](#)) category for further details on the use of this protection method.

B. DUCT OUTLET PROTECTION SYSTEM B



Longitudinal Cross-Section



Transverse Cross-Section

- Item 1 – Steel Air Duct
- Item 2 – Mineral Wool Batts
- Item 3 – Ceramic Paper

Duct Outlet Protection System B may be used in any design which contains a steel duct with the duct outlet protected by a hinged door damper, for equal or smaller outlet size. This system has been investigated for effectiveness in retarding the transfer of heat into the concealed space above the ceiling. This method of construction consists of protecting the outside of rectangular shaped steel ducts with a minimum 1-1/4 in. thick, 3.5 to 8.0 pcf mineral wool batts and protecting the duct outlet with ceramic paper where specified in the individual design. See the Guide Information for the Fire Resistance Ratings – ANSI/UL 263 ([BXUV](#)) category for further details on the use of this protection method.

6. INSTALLATION CONSIDERATIONS

In order to function properly, a damper must be installed in accordance with the applicable code requirements and its listing. Below are some installation considerations which should be considered prior to installation of the damper.

A. DAMPERS IN HORIZONTAL ASSEMBLIES

Since there are multiple types of dampers for use in protecting openings in horizontal assemblies, it is important to carefully consider the proper damper for each application. The correct damper depends on the application.

The model codes provide guidance for ducts penetrating through fire-resistance-rated horizontal assemblies. As a general rule, vertical ducts rising through fire rated floors are to be protected within fire rated shaft enclosures. As the fire resistive shaft rises through the structure, it is not necessary to protect the opening at the floors the duct passes through because the duct is located in a fire rated shaft. The shaft should be penetrated horizontally so that vertical dampers can be used to protect the penetration through the shaft.

The model codes contain several exceptions to the shaft enclosure requirements. Where a vertical duct penetrates a horizontal assembly without a shaft enclosure, a horizontal fire damper is required. If the horizontal assembly is also a smoke barrier, a combination fire-smoke damper is required.

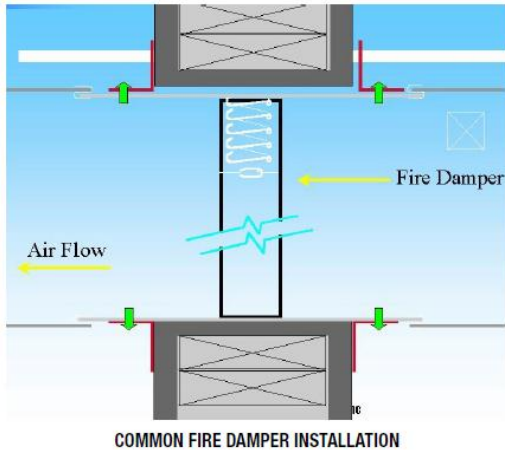
When the duct penetrates through the membrane ceiling of a fire-resistance-rated floor-ceiling or roof-ceiling assembly, but not through the floor or roof, then a ceiling radiation damper is used. The intent of the lower ceiling membrane is to retard the passage of heat into the concealed space. As such, the ceiling radiation damper must likewise retard the passage of heat. The certification of ceiling radiation dampers does not cover the product for general installation in any floor-ceiling or roof-ceiling design. Refer to the section in this guide entitled Ceiling Radiation Dampers under Damper Types for a detailed explanation of the limitations of the certifications applied to ceiling radiation dampers.

Openings entirely through the ceiling of a tunnel corridor, where the ceiling is constructed as required for the walls, are protected with corridor dampers. These dampers must restrict the spread of fire and the movement of smoke through the ceiling assembly.

In all cases, the damper manufacturer's installation instructions depict the appropriate installation parameters and limitations.

B. INSTALLATION INSTRUCTIONS

Each damper shipment is supplied with a copy of the installation instructions appropriate for the specific damper model. These instructions are an integral part of the UL certification on the dampers. The instructions contain the information necessary to properly install the damper as well as limitations on the installation of the product such as the type of floor or wall construction that is required for the correct installation.



Example of a common fire damper installation:

The damper shall be secured in the opening using retaining angles. Ducts are attached to the damper sleeve using breakaway methods. A remote sensor device may activate the damper actuator.

Some manufactures elect to provide basic instructions that cover only common installations, and then rely on supplemental instruction pages that cover unique installation scenarios. As with the basic installation instructions, the supplemental instructions are also an integral part of the UL certification program.

C. MULLIONS

The certifications covering fire dampers are limited to the single and/or multiple assembly sizes that are evaluated. The size limitations are specified in the published certification information for each damper model.

In certain circumstances, steel mullions can be used to divide a large wall or vertical partition opening into smaller individual openings, allowing fire dampers for use in static systems to be sized and installed within the limitations of the certification. These mullions are generally fabricated in the field. Damper manufacturers can provide installation details covering the fabrication, installation and use of mullions.

Because airflow ratings of fire dampers for use in dynamic systems and combination fire-smoke dampers are size dependent, the use of the mullions discussed herein are only intended for application with fire dampers for use in static systems. Further, the mullions are limited to use in vertical partitions.

D. DAMPER ACTUATORS

Smoke dampers and combination fire-smoke dampers are equipped with factory installed electric or pneumatic actuators which remotely control the dampers. The airflow and pressure ratings marked on the dampers are dependent upon the particular combination of damper type, actuator type and linkages between the damper blades and actuator. As such, field mounting or substitution of actuators is not covered within the scope of the UL certification of the product. However, this does not necessarily preclude replacement of actuators in the field. Like any appliance, field servicing of these products is not covered under the scope of the UL certification program. As with any part of the damper, it is expected that replacement of actuators in the field be done in accordance with the damper manufacturer's normal field servicing program.

Under certain circumstances, UL can conduct a field evaluation on products that have been modified in the field. For additional information on field evaluations, refer to the section in this guide entitled Field Engineering Services.

E. DETECTORS AND SMOKE DAMPERS

Smoke dampers may be required by the model or installation codes to be closed when smoke detectors operate.

Duct type smoke detectors have a minimum and maximum airflow rating. The ratings must be compatible with the ratings of the smoke damper. Smoke dampers have a minimum airflow rating of 0 fpm and a maximum airflow rating as marked on the damper. Duct type smoke detectors typically have a minimum airflow rating of 300-500 fpm. However, there are duct type smoke detector models available that are rated for use at zero airflow. For HVAC systems that are shut down in the event of a fire, smoke dampers equipped with duct type smoke detectors with a greater than zero minimum airflow rating, may also need to be controlled with a device that will close the damper in the event that the damper is in the open position and the fans are shut down.

F. AIRFLOW RATINGS

Dynamic fire dampers, smoke dampers and combination fire-smoke dampers are marked with airflow and closure pressure ratings. These ratings represent the maximum airflow and closure pressure ratings tested for that product. The closure pressure rating is not the pressure drop across an open damper.

Maximum airflow ratings are marked in 1000 fpm increments with a minimum rating of 2000 fpm. Maximum closure pressure ratings are marked in increments of 2 in. WG with a minimum closure pressure rating of 4 in. WG.

The end user needs to analyze the expected airflow across an open damper in the design of the HVAC system. There are many permutations of opened and closed dampers that may occur under different fire scenarios. The airflow rating for a particular application is not necessarily one that matches the normal design airflow within the ducts. Some dampers may become fully isolated against the fan pressure. Authorities having jurisdiction should field-test various combinations of opened and closed dampers to represent the worst expected condition across the damper.

Similarly, closed dampers may be isolated against the fan pressure and have a pressure higher than the rating. These dampers would be unable to be opened. This has significance for system designs that require dampers to be opened under fire and/or smoke conditions.

G. METHODS USED TO REDUCE OR LIMIT THE MOVEMENT OF SMOKE

In order to determine the proper damper to use, some background information on the methods used to limit smoke movement is necessary. There are design guides published that provide specific information on the design of systems such as smoke control systems. This guide provides only an overview of the different designs with an emphasis on the role that a damper may have on the system.

There are different methods used to limit the movement of smoke through the HVAC system. The amount of smoke generated from a fire can be quite substantial. It is important to recognize that the goal of the system designer is to reduce the migration of smoke to other parts of a building to

prolong evacuation time. An improper damper use can be detrimental to the performance of the system. This guide is not intended to advocate one type of method over another.

There are three different basic approaches used to limit smoke migration. First, a passive or barrier system use solid barriers, with protected openings to limit the movement of smoke. When this approach is used, model and installation codes recommend that the fans should be shut down in the event of a fire. Second, a smoke control system utilizes fans to create pressure differentials across smoke boundaries. Third, a smoke management system uses a variety of methods to reduce or confine smoke movement in large spaces such as malls and atria.

For passive systems, consideration should be given for how smoke dampers are to close in the event of a fire and/or the presence of smoke in the HVAC duct. The user should be aware of the limitations of the different devices used to signal the damper to move to the closed position. See the section on Detectors and Smoke Dampers for a further explanation. The user should decide on the basic strategy to reduce smoke migration such as only closing the dampers adjacent to the fire or to close all of the dampers in the system. The building control strategy then should match the control strategy for the dampers.

For smoke control and smoke management systems, the dampers may be used to assist with the development of the pressure differentials in the different smoke zone boundaries. The user needs to determine the expected performance of the dampers in the system and match the control system accordingly. Consideration should be given for the mode of damper failure (open or closed) in the event that the fire scenario exceeds the limitations of the dampers or control system.

The smoke dampers are tested to the elevated temperature noted on the Classification Mark. The dampers will continue to operate under elevated temperatures and can be used by firefighters to adjust smoke control strategies but the dampers will not operate indefinitely. Extreme heat and fire conditions can damage control systems and render the dampers without power. There are significant fire related safety issues with respect to having dampers fail (loss of power, etc.) in the open position. Heat, fire and smoke could travel beyond the open damper.

An analysis of different fire scenarios can be conducted to estimate the airflow and pressure conditions across different dampers within the system. The airflow and pressure ratings of the dampers should exceed the worst case projections from the analysis. Controlling smoke movement during a fire is a complex engineering task. Model codes generally provide equivalency clauses that allow for other engineered methods to control the movement of smoke. Smoke dampers can also be used in these systems, provided that the designer of such a system is cognizant of the limitations of the individual components that make up the system.

H. MAINTENANCE

Like any mechanical device, dampers require periodic maintenance to ensure continued proper operation. The level of maintenance required is dependent on several factors including the product manufacturer's and system designer's recommendations, code requirements, and the complexity of the system in which the damper is installed.

Periodic maintenance of dampers should include the following:

- Removal of debris buildup from the damper and surrounding area
- Manual cycling of dampers released by fusible links
- Cycling of damper and actuator assemblies

Additional information on periodic testing can be found in the model codes and installation standards.

I. DAMPER MARKINGS

The UL Classification Mark is the only method used by UL to identify products that have been produced under UL's Classification and Follow-Up Service Program. In addition to the UL Classification symbol, additional information is located on the label that has significance towards the installation and use of the damper. Examples of markings used on dampers are shown below:

Fire Dampers for use in Static Systems

UL Classification Marking



FIRE DAMPER FOR USE IN STATIC SYSTEMS
FIRE RESISTANCE RATING 1-1/2 HOUR
No. _____

Fire Dampers for use in Dynamic Systems

UL Classification Marking



FIRE DAMPER FOR USE IN DYNAMIC SYSTEMS
FIRE RESISTANCE RATING 1-1/2 HOUR
No. _____

Additional Marking

Airflow rating (2000 fpm minimum, and 1000 fpm increments); Closure pressure rating (4 in. WG minimum and 2 in. WG increments)

Smoke Dampers

UL Classification Marking



SMOKE DAMPER
LEAKAGE RESISTANCE CLASS I - 350°F
No. _____

Additional Marking

Airflow rating (2000 fpm minimum, and 1000 fpm increments); Closure pressure rating (4 in. WG minimum and 2 in. WG increments)

Combination Fire and Smoke Dampers

UL Classification Marking



COMBINATION FIRE AND SMOKE DAMPER
FIRE RESISTANCE RATING 1-1/2 HOUR
LEAKAGE RESISTANCE CLASS I - 350°F
No. _____

Additional Marking

Airflow rating (2000 fpm minimum, and 1000 fpm increments); Closure pressure rating (4 in. WG minimum and 2 in. WG increments)

Corridor Dampers

UL Classification Marking



CORRIDOR DAMPER
FIRE RESISTANCE RATING 1 HOUR
LEAKAGE RESISTANCE CLASS I - 350°F
No. _____

Additional Marking

Airflow rating (2000 fpm minimum, and 1000 fpm increments); Closure pressure rating (4 in. WG minimum and 2 in. WG increments)

Ceiling Radiation Dampers

UL Classification Marking



AIR TERMINAL UNITS
FIRE RESISTANCE CLASSIFICATION
SEE UL FIRE RESISTANCE DIRECTORY
No. _____

Or



AIR TERMINAL UNITS
FIRE RESISTANCE CLASSIFICATION
DESIGN NO(S). _____
SEE UL FIRE RESISTANCE DIRECTORY
No. _____

Or



CEILING AIR DIFFUSER
FIRE RESISTANCE CLASSIFICATION
SEE UL FIRE RESISTANCE DIRECTORY
No. _____

Or



CEILING AIR DIFFUSER
FIRE RESISTANCE CLASSIFICATION
DESIGN NO(S). _____
SEE UL FIRE RESISTANCE DIRECTORY
No. _____

Or



CEILING DAMPER
FIRE RESISTANCE CLASSIFICATION
SEE UL FIRE RESISTANCE DIRECTORY
No. _____

Or



CEILING DAMPER
FIRE RESISTANCE CLASSIFICATION
DESIGN NO(S). _____
SEE UL FIRE RESISTANCE DIRECTORY
No. _____

Because the hourly rating of ceiling radiation dampers is dependent on the specific fire resistance designs in which it can be installed, an hourly fire resistance rating is not marked on the product. Therefore, the marking of ceiling dampers consists of the UL Classification symbol, the product category Air Terminal Units ([BZGU](#)), Ceiling Air Diffusers ([BZZU](#)) or Ceiling Damper ([CABS](#)), and a reference to the product category description in UL's Fire Resistance Directory. For those ceiling radiation dampers intended only for use in one or more specific designs, the marking includes a reference to those designs.

7. DAMPER SELECTION AND INSTALLATION

In order to properly select a UL Classified damper one needs to know and understand the building design criteria and applicable model code requirements. The following steps provide a systematic approach that can be followed to provide a safe, code compliant installation. This process can also be used by code authorities during the building approval process.

- 1. Determine the size and location of dampers** – A number of factors dictate the design of the building heating, ventilation and air conditioning system. These may be driven by code requirements or by the needs of the occupants and tenants. Prior to selecting the appropriate dampers, the size and location of the basic system needs to be identified, and size and routing of the supply and return ducts needs to be identified.
- 2. Confirm if dampers are required to limit the passage of fire, smoke, or both** – The fire safety system embodied in building code requirements is based on the use of walls and partitions, and horizontal floor-ceiling and roof-ceiling assemblies designed to contain fires and the resulting smoke and products of combustion in certain areas within the building. This concept is often referred to as compartmentation (e.g. containing fires within various compartments). The codes require HVAC openings to be protected to restrict the passage of fire and smoke. One of the options within the codes to protect these openings in walls and horizontal assemblies is the use of dampers which are required to comply with specific UL standards, and to have certain ratings.

To determine the standards and ratings these dampers must meet, one first needs to determine if the walls and horizontal assemblies in which they installed are covered by code requirements.

Fire Walls, Fire Barriers and Fire Partitions

These are all fire-resistance-rated vertical assemblies designed to restrict the spread of fire in which continuity is maintained. However the hourly rating, construction, extent of continuity and support for these assemblies varies.

Ducts and air transfer openings in these assemblies are required to be protected against the spread of fire in accordance with the requirements included in the code. As such, the code requires the use of fire dampers in these openings.

Fire dampers installed in assemblies having a fire-resistance rating of less than 3 hours shall have an hourly fire-protection rating of 1-1/2 hours. Fire dampers installed in assemblies having a fire-resistance rating of 3 hours or greater shall have an hourly fire-protection rating of 3 hours.

Horizontal Assemblies

Horizontal assemblies are fire-resistance-rated floor-ceiling and roof-ceiling assemblies designed to restrict the spread of fire in which continuity is maintained. However, the hourly rating, construction and support for these assemblies varies.

Ducts which pass through these assemblies are required to be protected against the spread of fire in accordance with the requirements included in the code. As such, the code requires the use of fire dampers in these openings.

Fire dampers installed in horizontal assemblies having a fire-resistance rating of less than 3 hours shall have an hourly fire-protection rating of 1-1/2 hours. Fire dampers installed in assemblies having a fire-resistance rating of 3 hours or greater shall have an hourly fire-protection rating of 3 hours.

Ducts and air transfer openings which penetrate only the ceiling membrane of a floor-ceiling or roof-ceiling assembly where the ceiling is providing the fire protection are required to be protected so as to limit the passage of heat into the concealed space of the assembly. As such, the code requires the use of ceiling radiation dampers in these openings.

Shaft Enclosures

Shaft enclosures are constructed using fire-resistance-rated fire barriers and horizontal assemblies designed to restrict the spread of fire and movement of smoke in which continuity is maintained.

Ducts and air transfer openings in shaft enclosures are required to be protected against the spread of fire and movement of smoke in accordance with the requirements included in the code. As such, the code requires the use of individual fire and smoke dampers, or a combination fire-smoke damper.

To determine the appropriate ratings for dampers in shaft enclosures, refer to the specific code requirements covering ducts and air transfer openings in shaft enclosures. This will include a leakage rating in conjunction with an hourly fire-protection ratings.

Smoke Barriers and Smoke Partitions

Smoke barriers are continuous membranes, either vertical or horizontal, such as a wall, floor or ceiling assembly, that are designed to restrict the movement of smoke through a building. In addition to restricting the movement of smoke, smoke barriers have a fire-resistance rating as specified in the code. Smoke partitions are continuous vertical membranes, such as a wall, that are also designed to restrict the movement of smoke through a building, but are not required to have a fire-resistance rating.

Ducts and air transfer openings in smoke barriers are required to be protected against the spread of fire and movement of smoke in accordance with the requirements included in the code. As such, the code requires the use of individual fire and smoke dampers, or a combination fire-smoke damper in these assemblies.

Openings in smoke partitions are required to be protected to restrict the movement of smoke in accordance with the requirements included in the code. As such, the code requires the use of smoke dampers in these openings.

To determine the appropriate ratings for dampers in these assemblies, refer to the specific code requirements covering ducts and air transfer openings in these wall assemblies. This will include a leakage rating for dampers used in smoke barriers and partitions, in conjunction with hourly fire-protection ratings for dampers in smoke barriers.

Corridors

Corridors are constructed using fire-resistance-rated fire partitions designed to restrict the spread of fire and movement of smoke in which continuity is maintained. However, the hourly rating, construction and support for these assemblies varies.

Ducts and air transfer openings in these assemblies are required to be protected to resist the spread of fire and movement of smoke in accordance with the requirements included in the code. As such, the code requires the use of combination fire-smoke dampers.

To determine the appropriate ratings for dampers in corridors, refer to the specific code requirements covering ducts and air transfer openings in these assemblies. This will include a leakage rating in conjunction with hourly fire-protection ratings.

Ducts and air transfer openings which penetrate only the ceiling of a corridor where the ceiling is constructed as required for the walls, shall be protected to resist the spread of fire and movement of smoke with a corridor damper.

3. Determine if static or dynamic fire dampers are needed – If fire dampers are determined to be required in the HVAC system, determine if the system is to be automatically shut down in the event of a fire. If it is, either static or dynamic fire dampers may be utilized. If the system is not shut down, dynamic fire dampers shall be specified. The specified dynamic fire damper must have a maximum airflow and static pressure consistent with the design of the HVAC system.

4. Determine the type of actuator to be utilized – Smoke dampers and combination fire-smoke dampers are equipped with factory installed electric or pneumatic actuators which remotely control the dampers. The airflow and pressure ratings are dependent on the particular combination of damper type, actuator type, and linkage between the damper blades and the actuator. The specified damper and actuator combination specified must have a maximum airflow and static pressure consistent with the design of the HVAC system.

5. Identify the barrier construction – Once the size, location, type, rating, actuator and airflow requirements for the dampers are established, the next step is identify the construction of the barriers into which they will be mounted. It is imperative that the barrier construction match the barrier construction which is specified in the damper installation instructions.

If ceiling radiation dampers are required, it is important to know the UL fire-resistance-rated Design No. which is being used for the floor-ceiling or roof-ceiling assembly. If a damper is not specified in the design being utilized, no HVAC penetrations of the ceiling membrane are permitted. If an HVAC penetration is permitted, there are two methods by which ceiling radiation dampers are specified in the designs. First, if a hinged door type damper is specified in the design, then either the hinged door type damper may be used, or a listed Air Terminal Units ([BZGU](#)), Ceiling Air Diffusers ([BZZU](#)) or Ceiling Dampers ([CABS](#)) may be substituted for the hinged door type damper in accordance with the provisions of the listings. It is imperative that the ceiling radiation damper selected be used as specified in its listing. Second, if one or more specific ceiling radiation damper(s) is specified by manufacturer and model number, then only the specified damper(s) may be used and it must be used in accordance with the provisions stated in the design and in its listing.

As an alternate to the use of a listed Air Terminal Units ([BZGU](#)), Ceiling Air Diffusers ([BZZU](#)) or Ceiling Dampers ([CABS](#)), Duct Outlet System B may be used in accordance with the provisions of the Guide Information for the Fire Resistance Ratings – ANSI/UL 263 ([BXUV](#)) category. Duct Outlet Protection System B may be used in any design which contains a steel duct with the duct outlet

protected by a hinged door damper, for equal or smaller outlet sizes. Duct Protection System A may only be used when specified in the individual design.

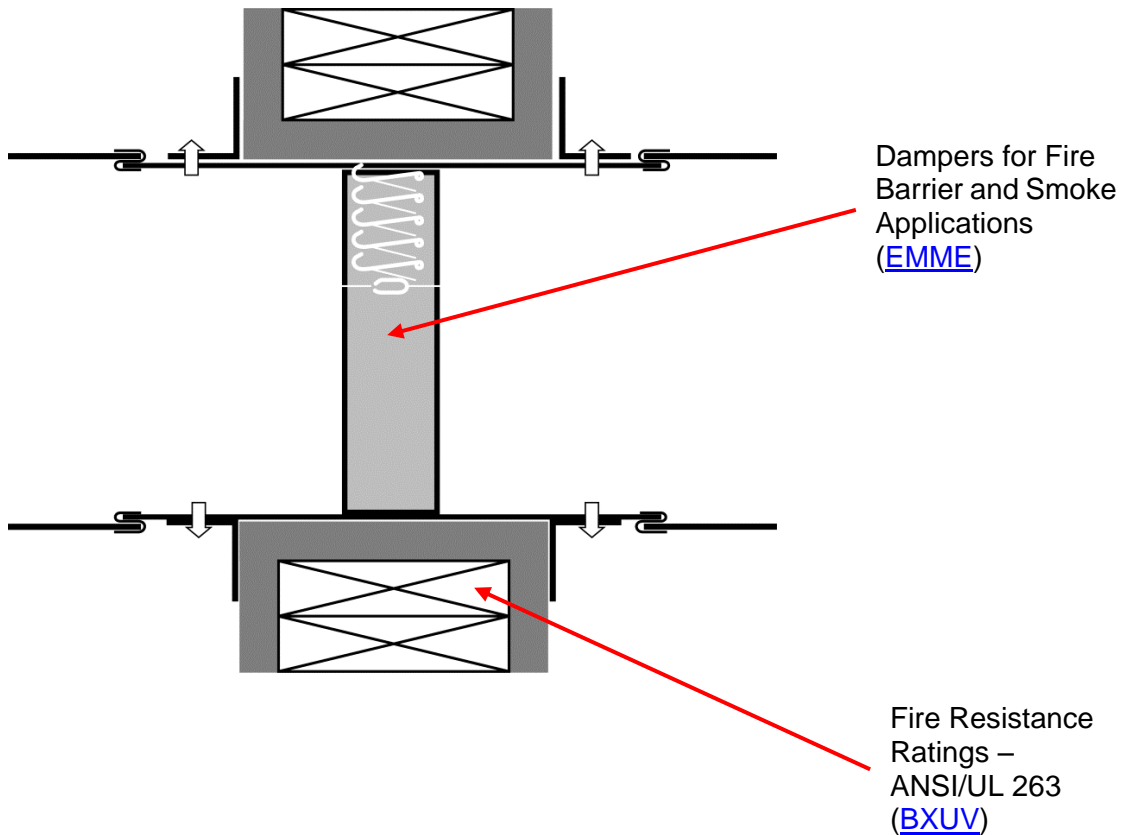
6. Putting it all together – In order to provide for a damper installation that complies with applicable code requirements it is important to identify the size, location, type, rating, actuator, airflow and pressure requirements, along with the specific type of construction the damper will be installed in. This information can then be used to identify the specific dampers required using the [UL Online Certifications Directory](#) in conjunction with the manufacturer’s installation instructions.

Care should be taken to verify that the dampers are installed in accordance with the manufacturer’s installation instructions, and in accordance with NFPA 90A, NFPA 80 and NFPA 105 requirements.

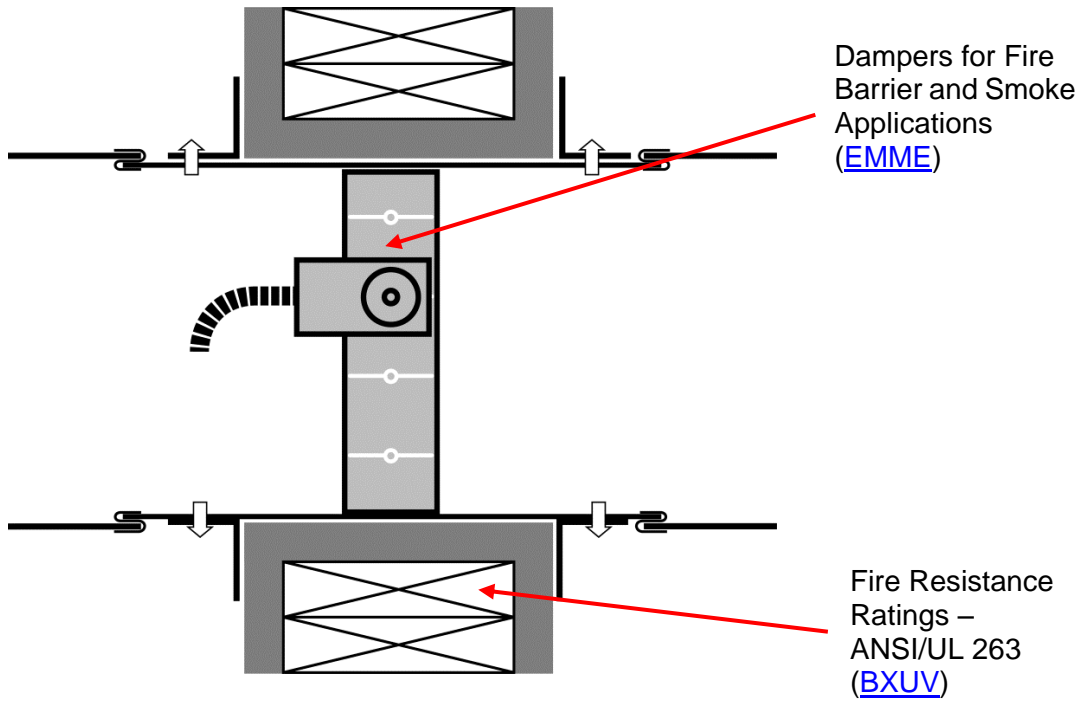
8. DIAGRAMS OF COMPLETE ASSEMBLIES

The following diagrams identify the components that make up complete assemblies, along with links to the guide information for the various product categories. Refer to Appendix for a complete list of related product categories.

A. FIRE DAMPER ILLUSTRATION

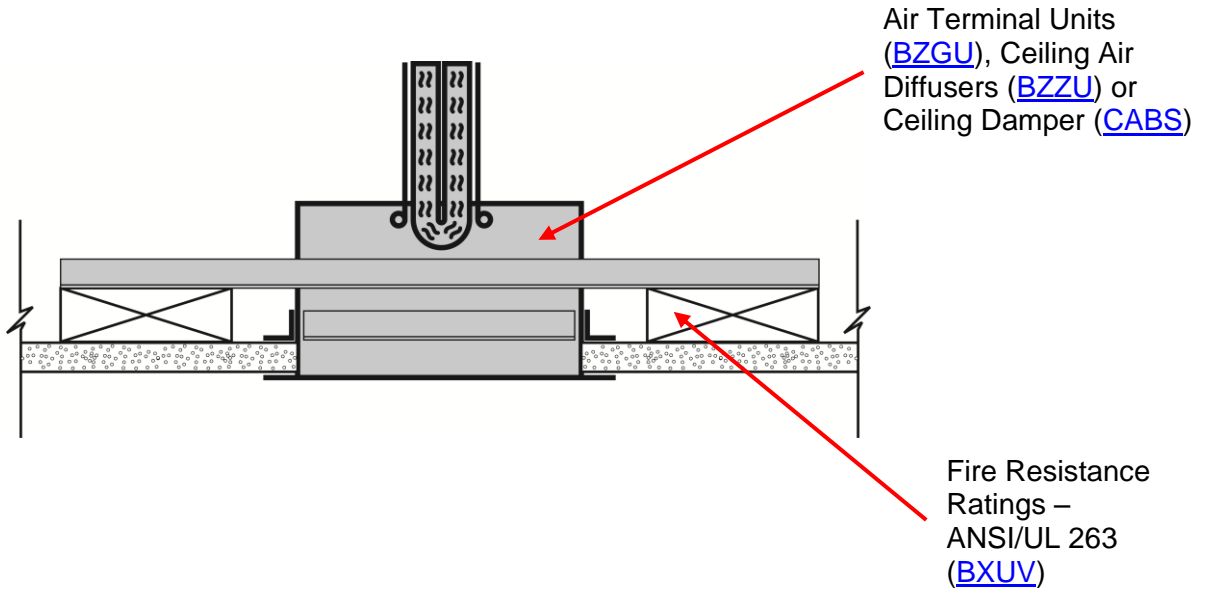


B. SMOKE AND COMBINATION FIRE-SMOKE DAMPER ILLUSTRATION

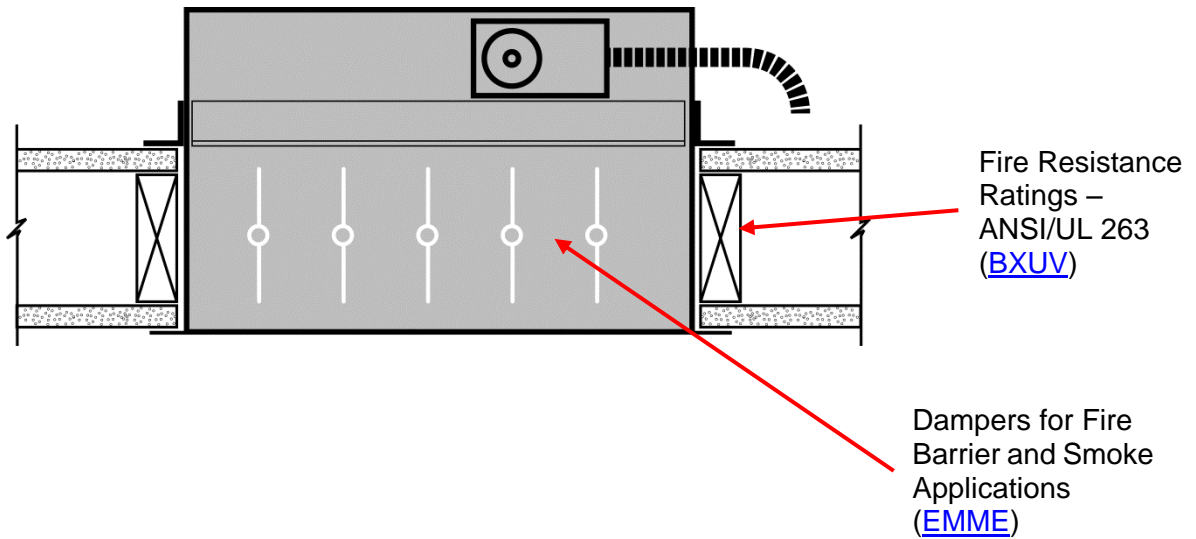


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C. CEILING RADIATION DAMPER ILLUSTRATION



D. CORRIDOR DAMPER ILLUSTRATION



APPENDIX A – DAMPER RELATED CATEGORIES

UL certifies dampers under the following product categories. Click on Category Code links to view UL Guide Information for the product category. The Guide Information also has links to manufacturers whose products are certified under the category. To view all UL certifications (e.g. Listings and Classifications) see the UL Online Certifications Directory at www.ul.com/database.

Category Code	Category Name	Standard Used
BZGU	Air Terminal Units	UL 263 and UL 555C
BZZU	Ceiling Air Diffusers	UL 263 and UL 555C
CABS	Ceiling Dampers	UL 263 and UL 555C
EMME	Dampers for Fire Barrier and Smoke Applications	UL 555 , UL 555S and UL 555C

APPENDIX B – DAMPER CODES AND STANDARDS

Dampers are intended to be installed in accordance with model codes and installation standards. The model codes require these products to be listed and labeled in accordance with applicable product standards.

UL standards are typically identified as Standards for Safety and contain the construction, performance and marking criteria used by UL to investigate a product. Limitations applicable to the products covered by the standard are delineated in the Scope section of the standard. UL standards are intended to:

- Identify requirements for evaluation of products and provide consistency in the application of these requirements.
- Provide guidance for development of products by manufacturers.
- Provide requirements compatible with nationally recognized installation codes.

ASTM E 119	Standard Test Methods for Fire Tests of Building Construction and Materials
IBC	International Building Code
NFPA 80	Standard for Fire Doors and Other Opening Protectives
NFPA 90A	Standard for the Installation of Air-Conditioning and Ventilating Systems
NFPA 101	Life Safety Code
NFPA 105	Standard for Smoke Door Assemblies and Other Opening Protectives
NFPA 5000	Building Construction and Safety Code
UL 263	Fire Tests of Building Construction and Materials
UL 555	Fire Dampers
UL 555C	Ceiling Dampers
UL 555S	Smoke Dampers

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