Introduction to Life-Safety Dampers

Michael Bulzomi, product manager, commercial dampers, Greenheck

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Product Manager – Commercial Dampers, AMCA Member Company

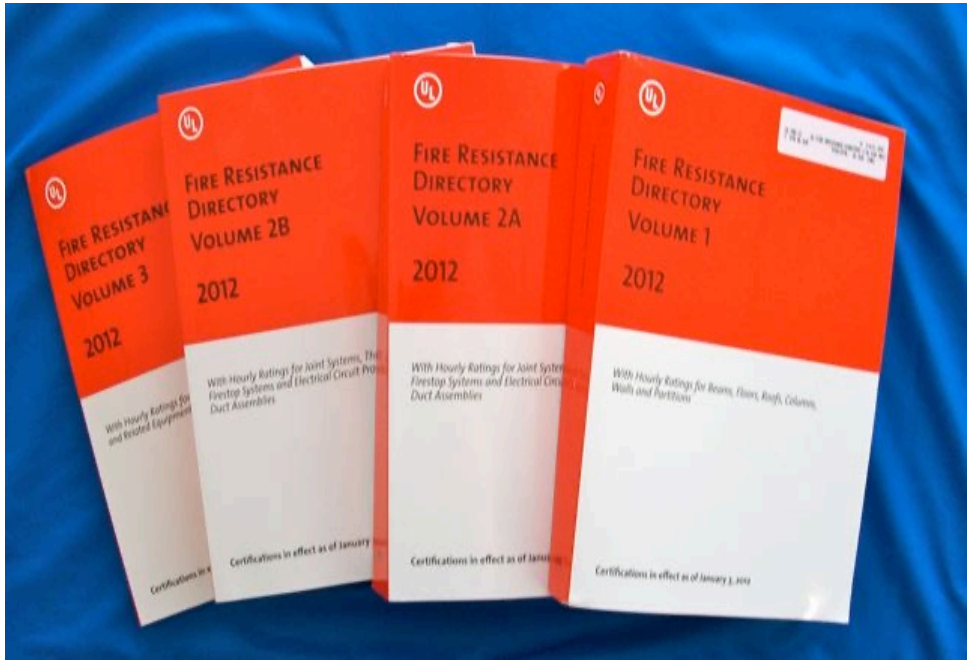
- Over 16 years experience in the HVAC industry
- Has held positions in sales, marketing and application engineering across the U.S. for HVAC product manufacturers and Sales Reps
- Holds an MBA, and a Bachelors in Earth Science and Atmospheric Science
- Active member of ASHRAE, NFPA, and AMCA, serving on multiple committees

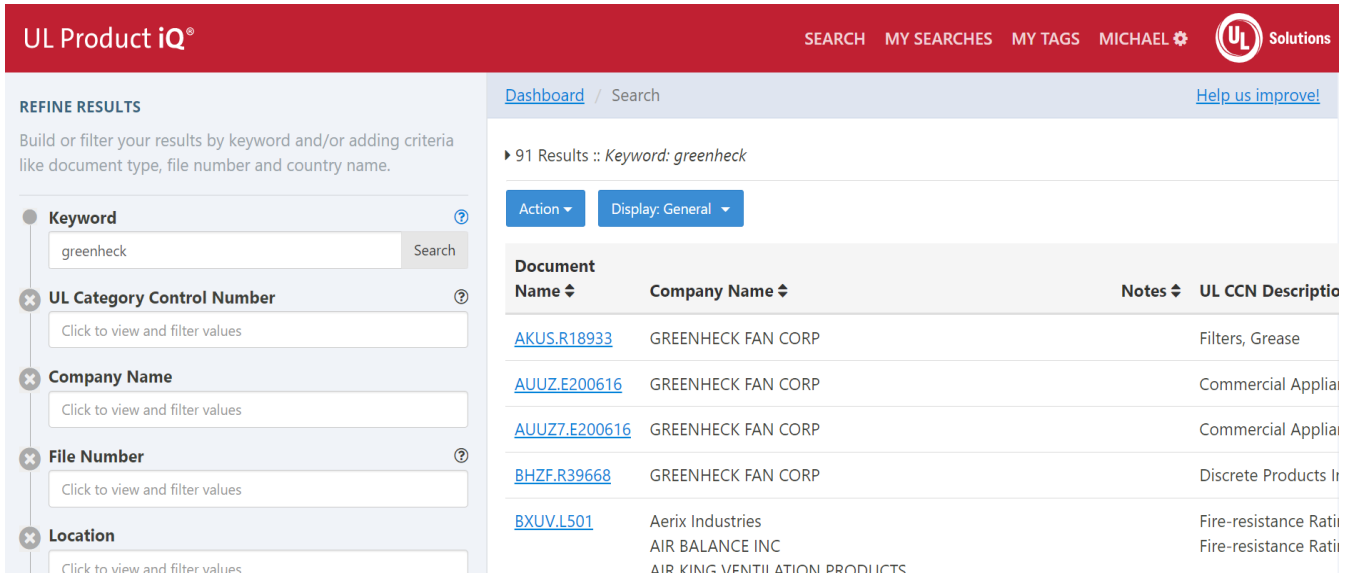
Learning Objectives

The purpose of this presentation is to provide an overview of the different types of Life Safety Dampers available and building code requirements governing their use, installation, and inspection.

- Explain the differences between Fire, Smoke, and Combination Fire/Smoke Dampers.
- Understand the code mandated testing & inspection requirements
- Describe various rating criteria for Life Safety Dampers.
- Identify proper and improper installation methods

Underwriters Laboratories (UL) Directory





All UL life-safety products are listed in the UL directory

www.UL.com

Purpose of Life-Safety Dampers

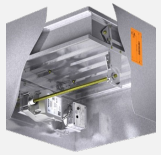
- Containment
  - Building codes require life-safety dampers to protect duct penetrations through rated construction
  - Fire- and smoke-rated construction is used to “compartmentalize” a building into fire & smoke zones to prevent the spread of fire
- Engineered Smoke-Control Systems
  - Smoke and fire/smoke dampers can be used as part of an engineered smoke-control system to evacuate smoke and/or pressurize zones adjacent to a fire

Life-Safety Damper Types

Fire Dampers

Smoke Dampers

Combination Fire/Smoke Dampers



Corridor Dampers

Ceiling Radiation Dampers

Fire Dampers

"A device, installed in an air distribution system, designed to close automatically upon detection of heat, to interrupt migratory airflow, and to **restrict the passage of flame**." (NFPA 80)

Why Do We Need Fire Dampers?

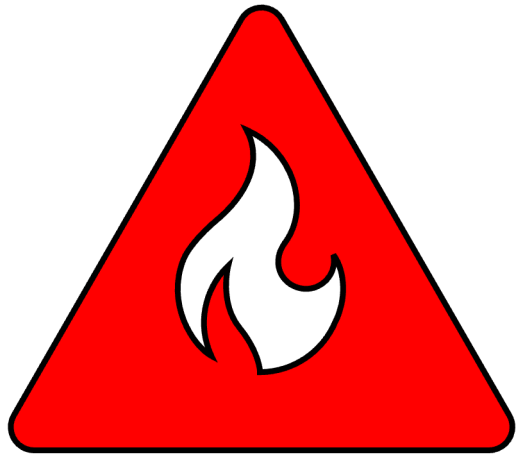
Principles of Protection:

- Containment and Compartmentation – *limit spread of fire*
- Provide effective fire-resistive continuity to *allow for egress* in fire event
- "*Defend in place*" strategy, especially in healthcare and similar occupancies

Lessons Learned…

Major U.S. fire incidents shaped modern-day code requirements:

- MGM Grand Hotel Fire (1980)



MGM Grand Hotel Fire

Nov. 21, 1980

85 people died, more than 700 injured

~$223 million in legal settlements

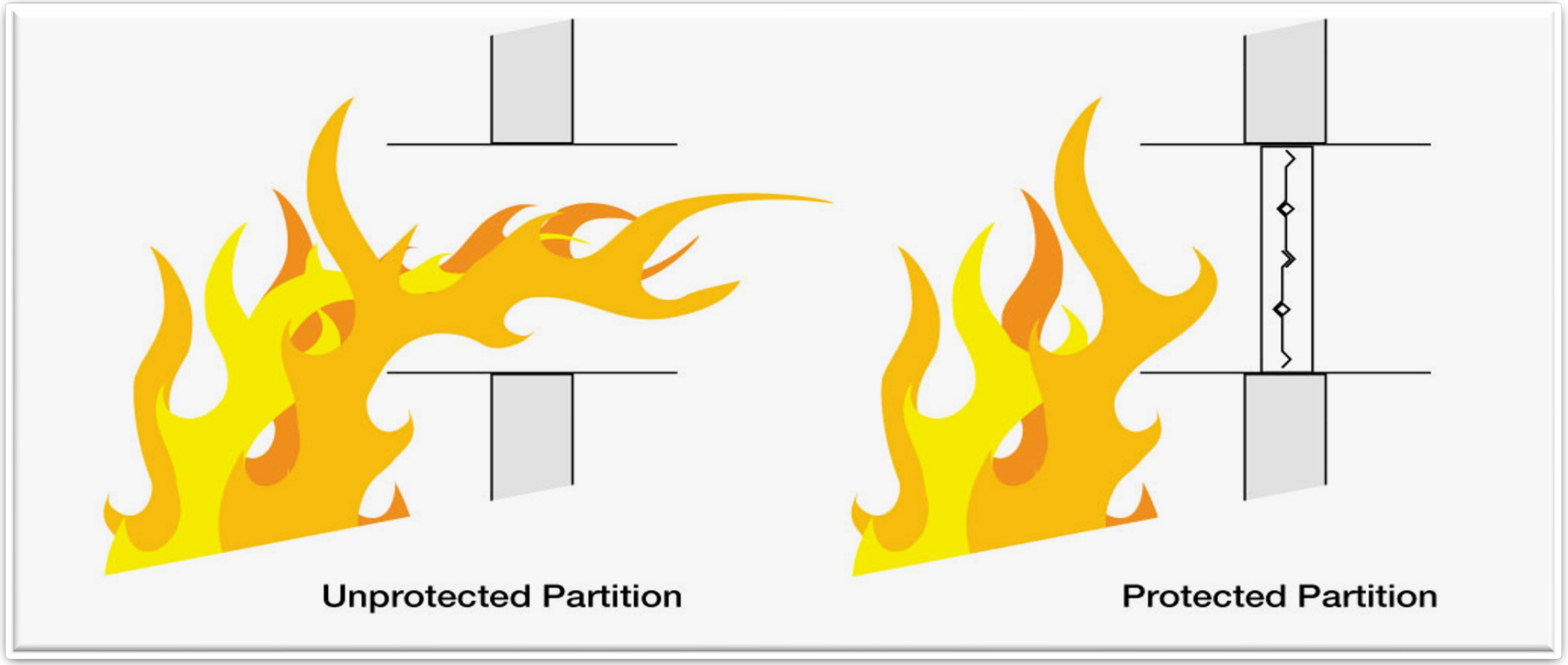
- Area of origin was “The Deli,” an area that was vacant and closed. Faulty wiring in a display case caused the initial fire.
- Fire spread rapidly because of the ignition of wallpaper, PVC piping, glue, and plastic mirrors.
- Toxic fumes/smoke spread because of faulty smoke dampers within the ventilation ductwork and throughout the air-circulation system.

  “Dampers in the main unit over the casino were … bolted in such a manner as to make them inoperable.”

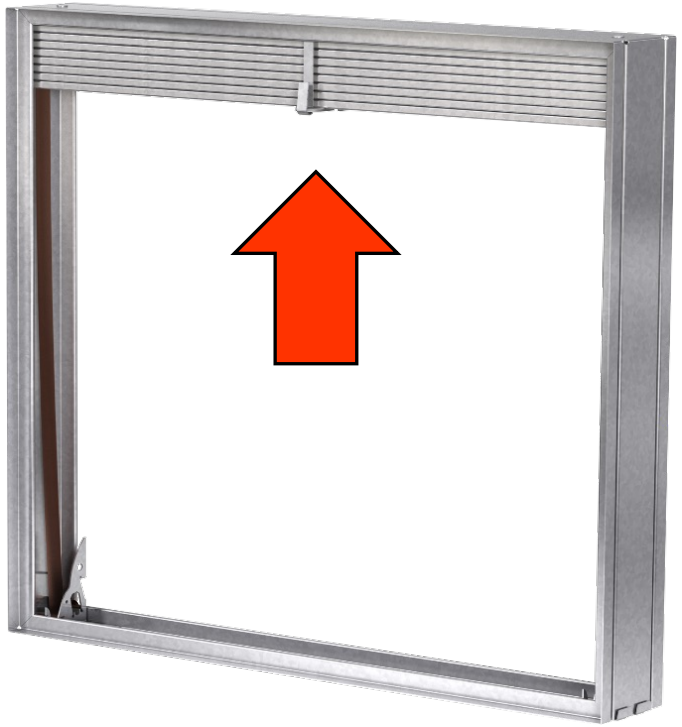
Source: "MGM Fire Investigation Report“, Clark County Fire Department

Fire Dampers

Maintain the fire-resistance rating of fire walls, barriers, and partitions when penetrated by air-duct or transfer openings.

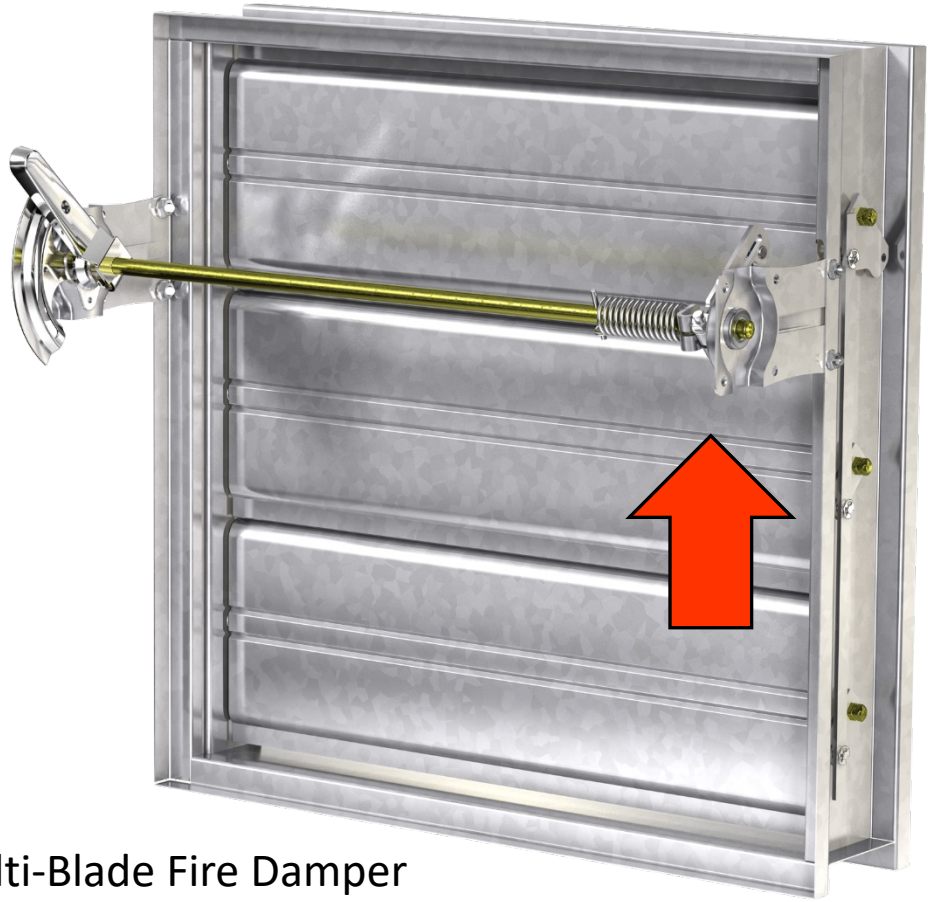


Fire Dampers: How do they work?



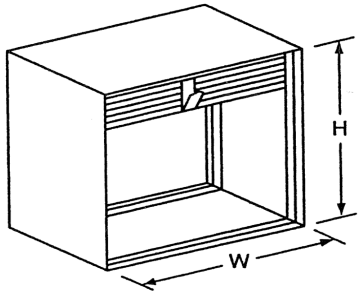
Curtain Fire Damper

Typical Fusible Link



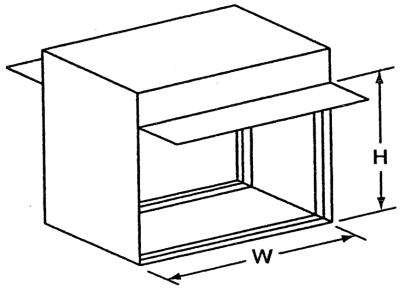
Multi-Blade Fire Damper

Fire Damper Transition Types



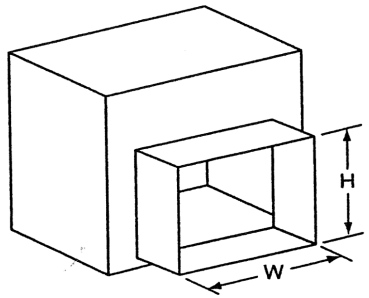
Type A (No Transition)

Frame and blades in the air stream



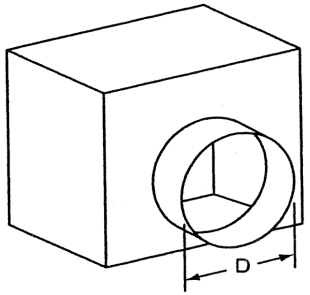
Type B

Blades out of the airstream



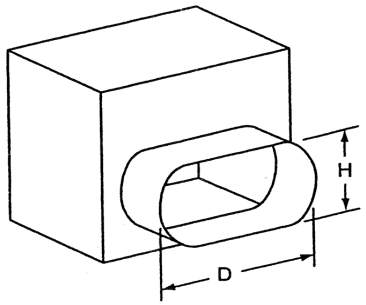
Type C

Square Transition collar



Type CR

Round transition collar



Type CO

Flat oval transition collar

Type C damper have blades and frame out of the airstream for maximum free area. They are available in low pressure and high pressure (sealed) casings.

Fire Dampers: UL Rating Qualifications

Static or Dynamic

Hourly Rating

1-1/2 hr. or 3 hr.

Mounting Position

Vertical (Walls/Partitions) or Horizontal (Ceilings/Floors)

Installation

“In Wall” or “Out of Wall”

Fire Dampers: Static vs. Dynamic

"**Fans Off**" during fire emergency = **STATIC** System

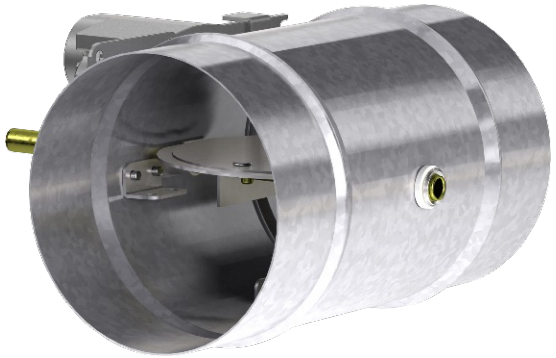
"**Fans On**" during fire emergency = **DYNAMIC** System

(i.e. Smoke Control system)

Velocity/Pressure Rating – min. 2000 fpm @ 4 in. w.g.

Smoke Dampers

"A device within the air distribution system to **control the movement of smoke**." (NFPA 105)



Why Do We Need Smoke Dampers?

According to NFPA, smoke is the major killer in fire-related deaths (i.e., MGM Grand Casino).

Building occupants can be jeopardized by smoke traveling far from a fire's origin.

Sprinklers certainly help to extinguish a fire, but they cannot contain the smoke generated by the fire.

Smoke Dampers: UL Rating Qualifications

Leakage Class

I, II (or III*)

Velocity

2000, 3000, 4000 fpm

Pressure

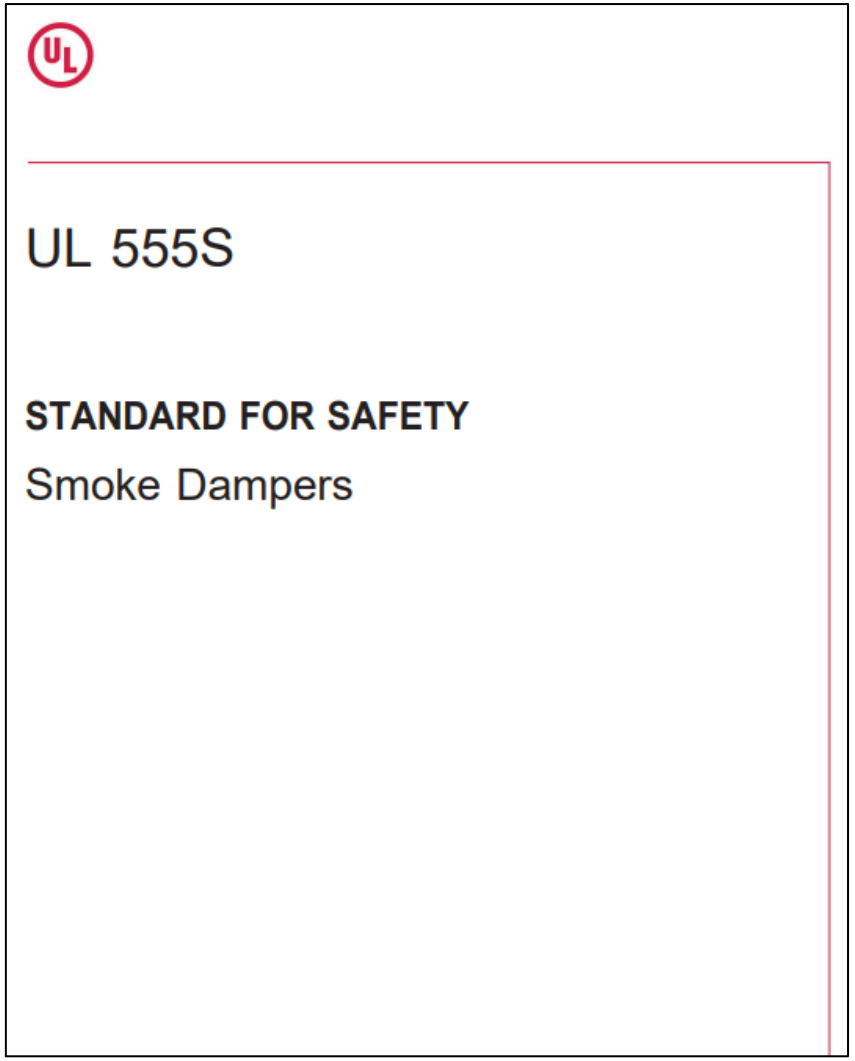
4, 6, 8 in w.g.

Operational Temperature

250 °F or 350 °F

Fail Position

Open or Closed

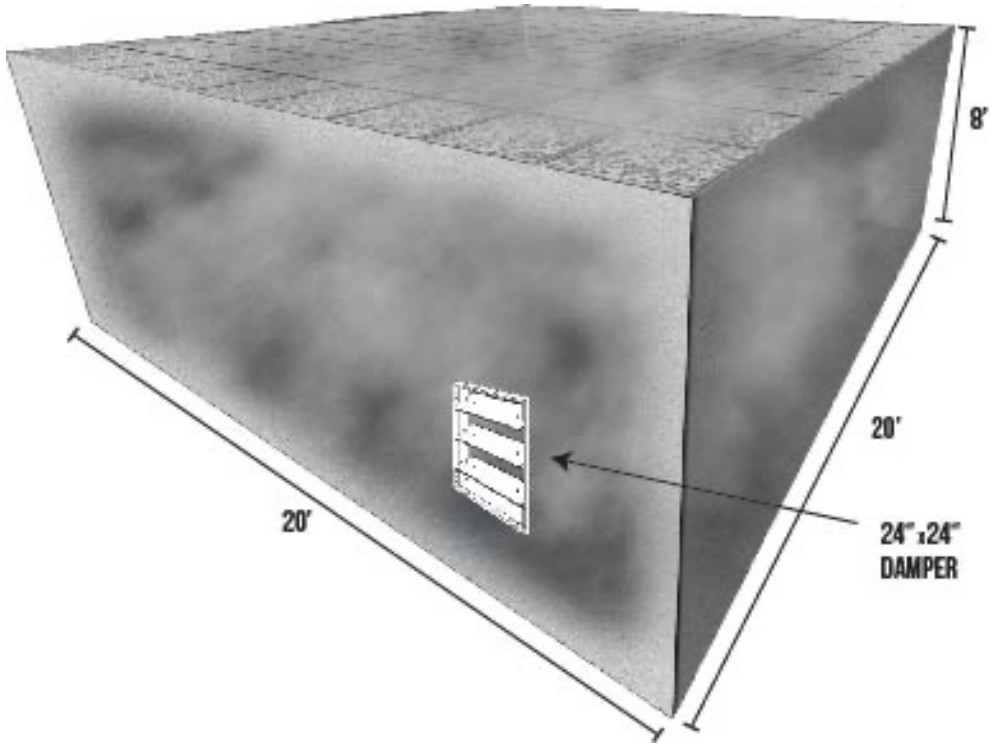


Smoke Dampers: Leakage Class

UL 555S classifications:

- Class I (8 cfm/sq ft @ 4 in. w.g.)
- Class II (20 cfm/sq ft @ 4 in. w.g.)
- Class III* (80 cfm/sq ft @ 4 in. w.g.)

“Amount of Time” to Fill a Room with Smoke Based on Leakage Class



Class I = **100 minutes**

Class II = **40 minutes**

Class III = **10 minutes**

Passive Smoke Control System

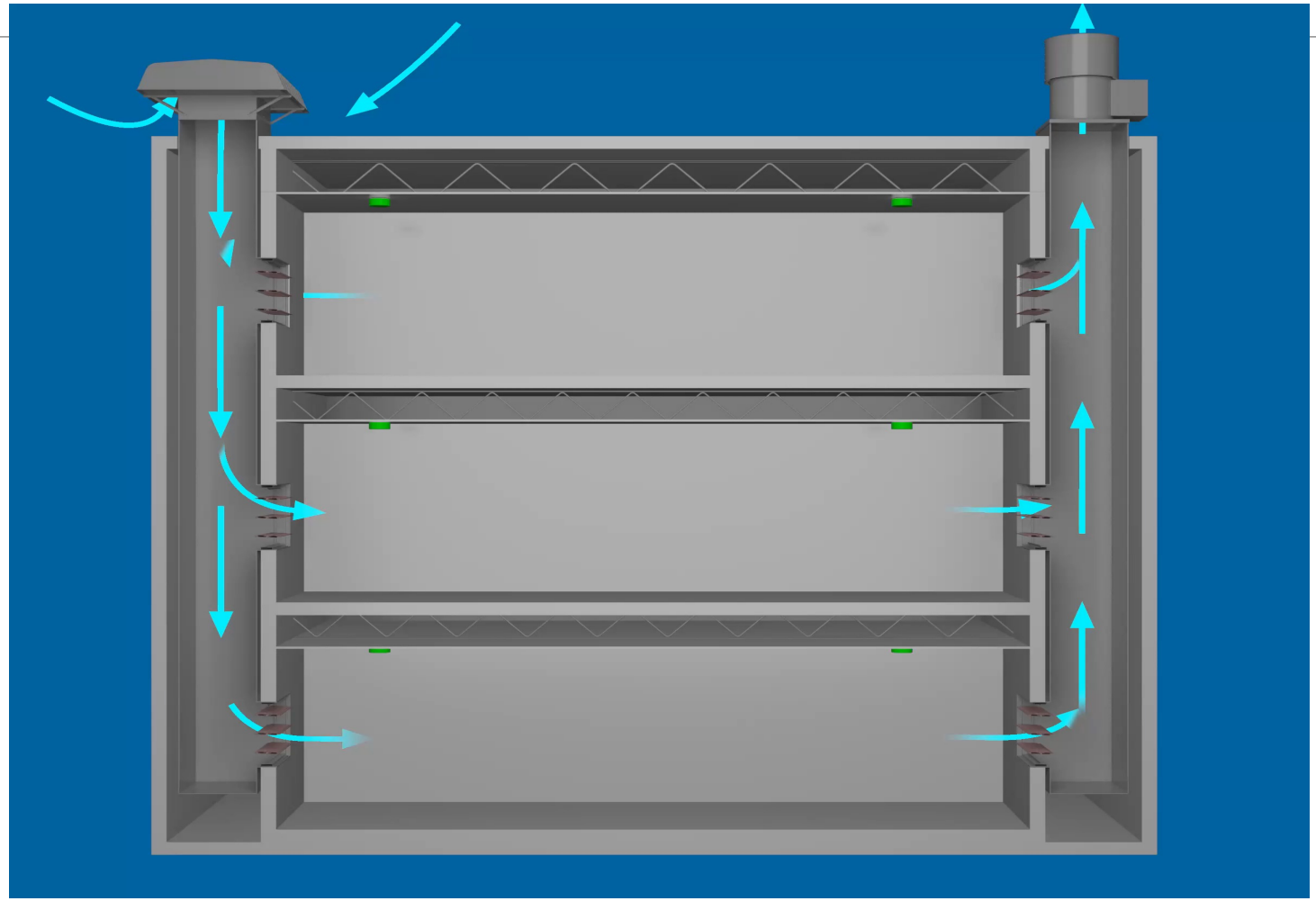
Compartmentation (containment) has a long history of providing protection from the passage of heat, flame, and smoke.

- Implemented by use of walls, floor-ceiling assemblies, doors, dampers, and other building elements with fire resistance ratings of ½ hour, 1 hour, 2 hours, and so on…

Compartmentalize the building into individual zones, each of which establishes a passive barrier to smoke.

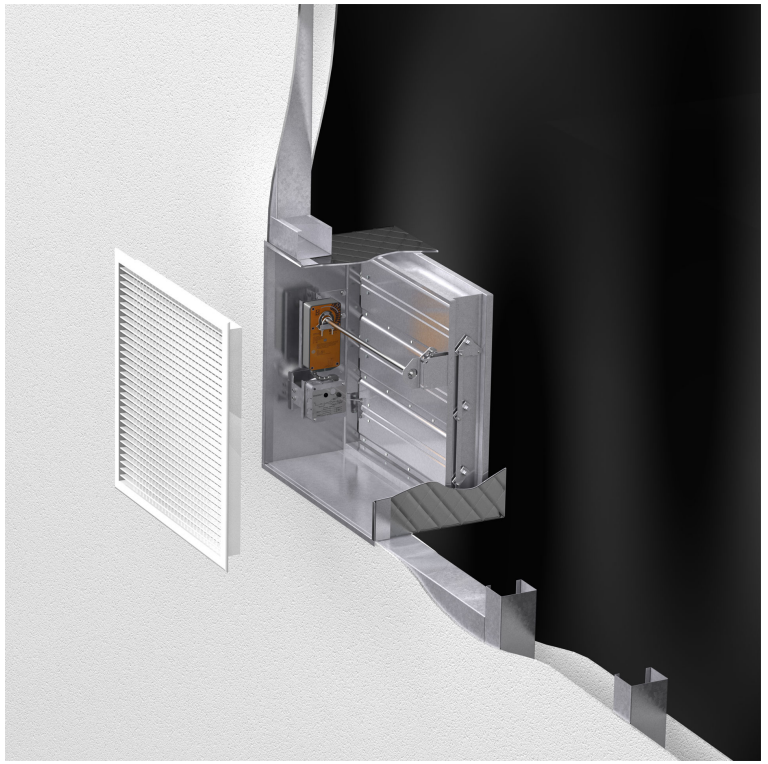
- Shutdown fans
- Close smoke dampers and smoke doors
- Prevents the circulation of air and smoke through the HVAC system.

Engineered Smoke-Control System



Combination Fire/Smoke Dampers

"A device that meets **both the fire damper and smoke damper requirements**." (NFPA 80/105)



Purpose of Fire/Smoke Damper

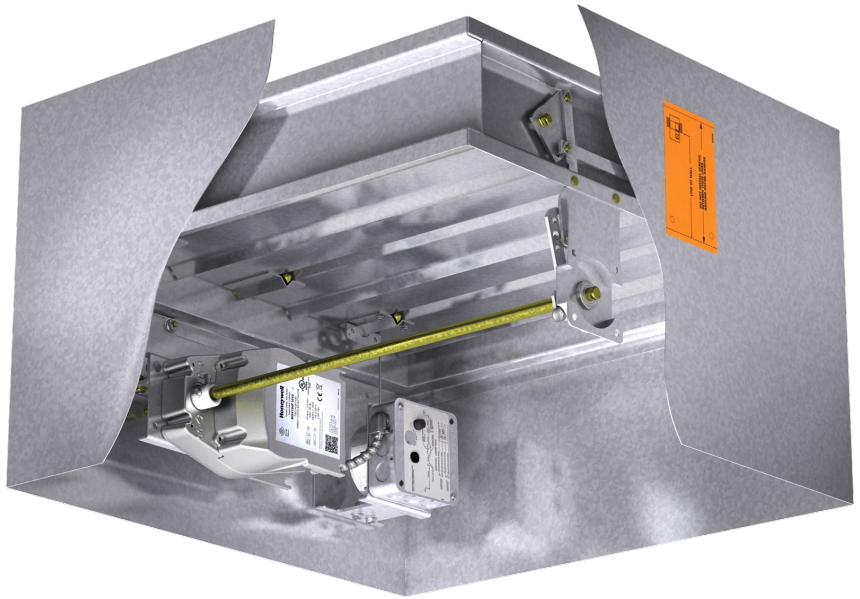
- Provide the same level of protection as individual fire and smoke dampers
  - Fire rating – UL 555
  - Leakage rating – UL 555S
- Always supplied with factory-mounted actuator
- Always dynamically rated

Fire/Smoke Dampers: UL Rating Qualifications

- Static or Dynamic
- Hourly Rating
  - 1-1/2 hr. or 3 hr.
- Mounting Position
  - Vertical (Walls/Partitions) or Horizontal (Ceilings/Floors)
- Installation
  - “In Wall” or “Out of Wall”
- Leakage Class
  - I, II (or III*)
- Velocity
  - 2000, 3000, 4000 fpm
- Pressure
  - 4, 6, 8 in w.g.
- Operational Temperature
  - 250 °F or 350 °F
- Fail Position
  - Open or Closed

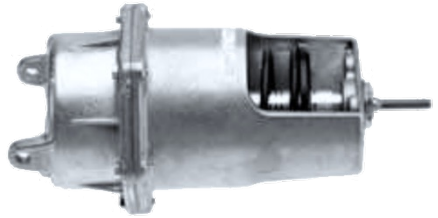
Corridor Dampers

- Fire/smoke dampers that have been designed for use in corridors.
  - “Corridor” is a means of egress travel to an exit, typically found in hospitals.
- There are additional test requirements for Corridor Dampers in UL555 and they carry a 1-hr rating when certified.
- Most commonly used in California.



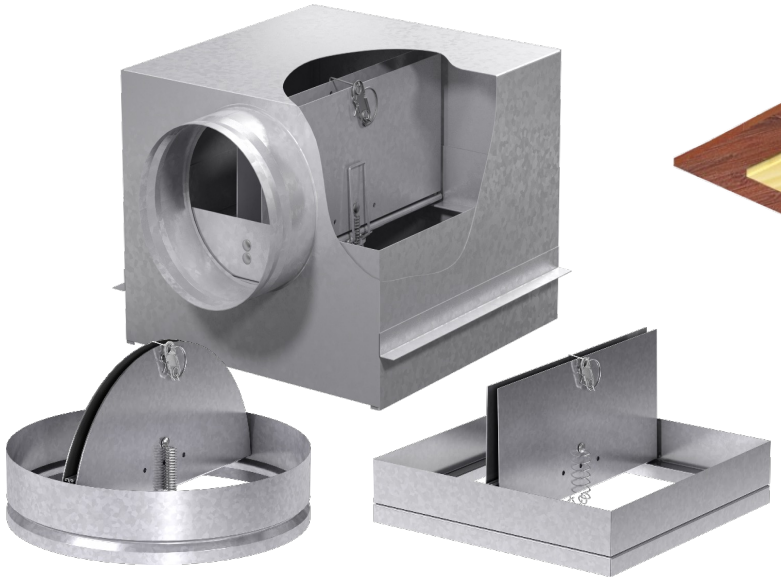
Smoke & Fire/Smoke Actuators

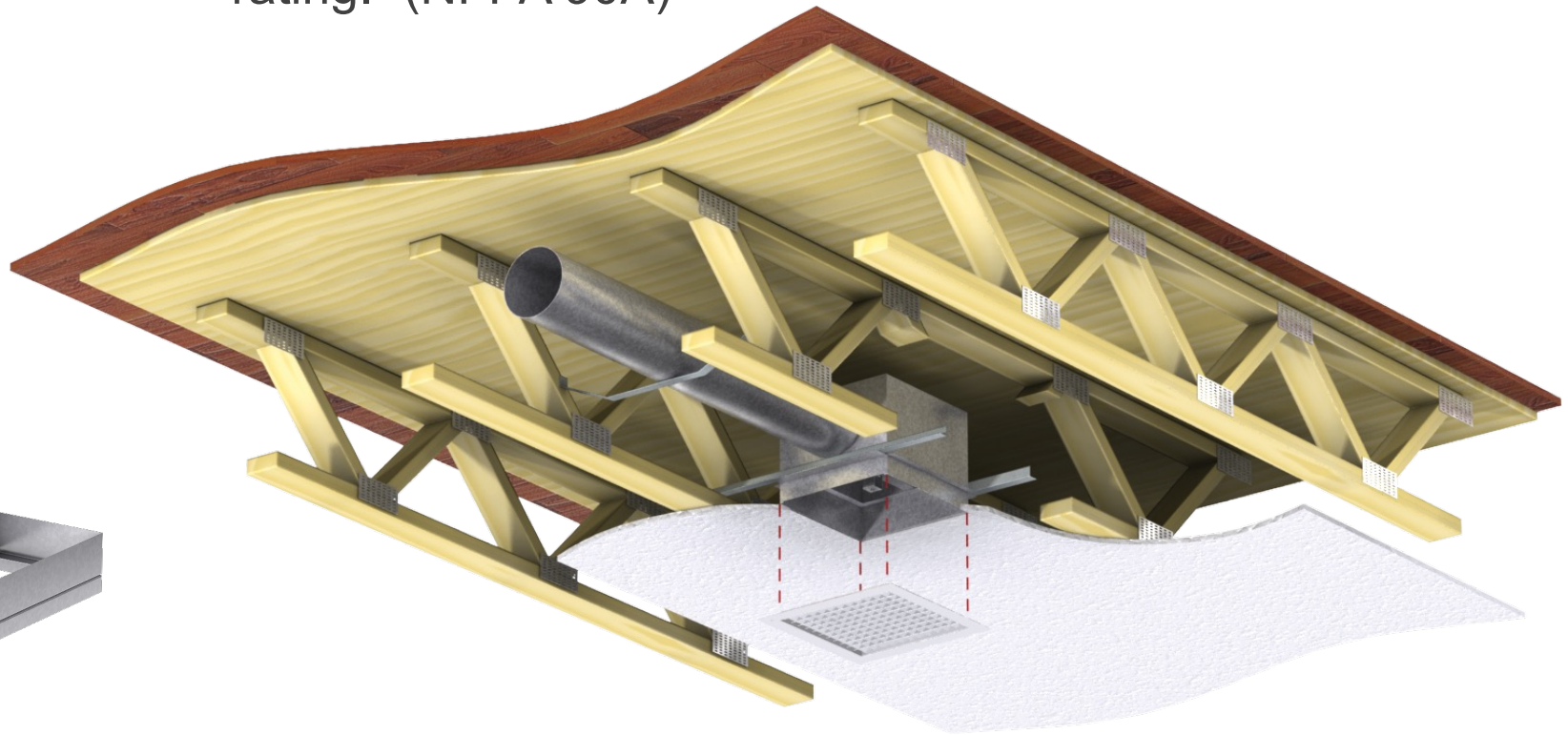
- Actuators must be **factory installed,** per UL.
- Electric (120V, 24V, 230V) or Pneumatic.
- Two position (open/closed) and Modulating (Balancing) types.
- Different torque ratings, selection based on tested size of assembly.
- May be externally or internally mounted.

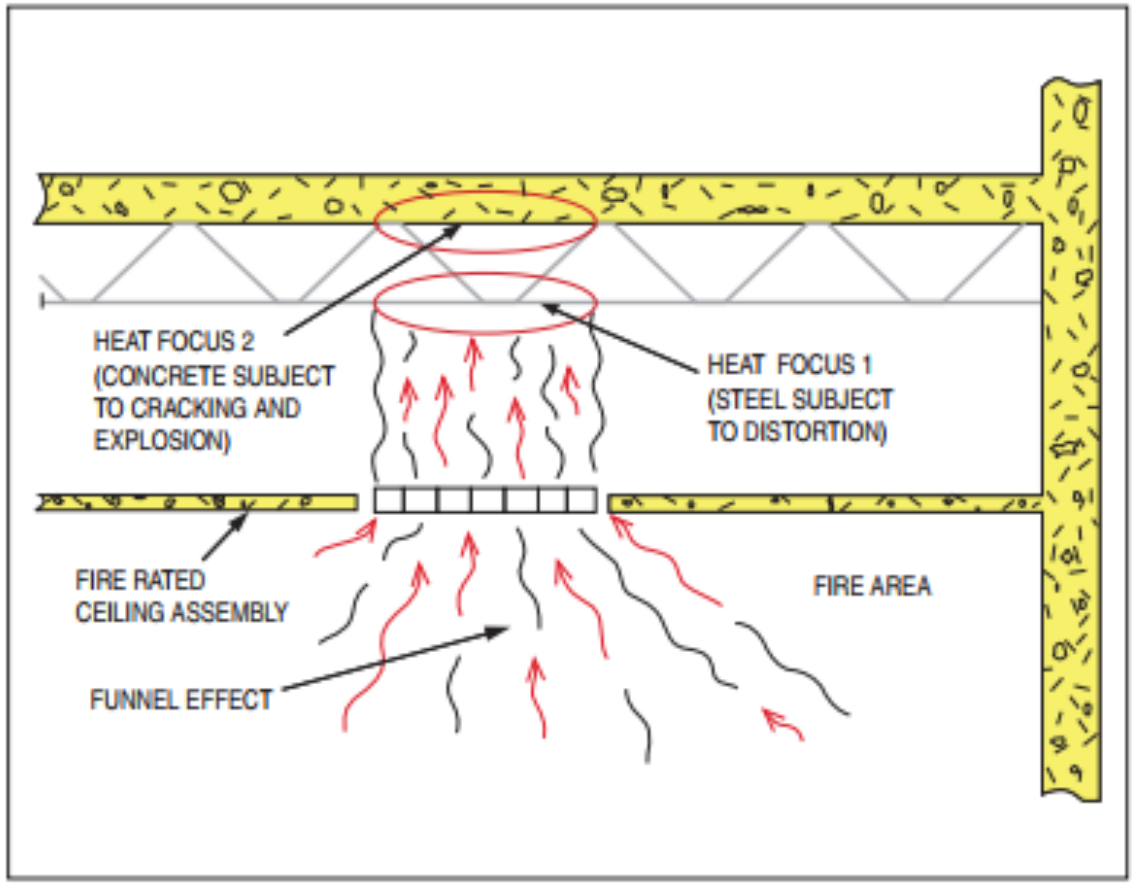


Ceiling Radiation Dampers

"A device installed to **limit radiant heat transfer through an air outlet or air inlet opening in the ceiling of a floor or roof-ceiling assembly** having not less than a 1 hour fire resistance rating." (NFPA 90A)







Why Do We Need Ceiling Dampers?

Ceiling radiation dampers protect the structural integrity of floor/ceiling or roof/ceiling assemblies.

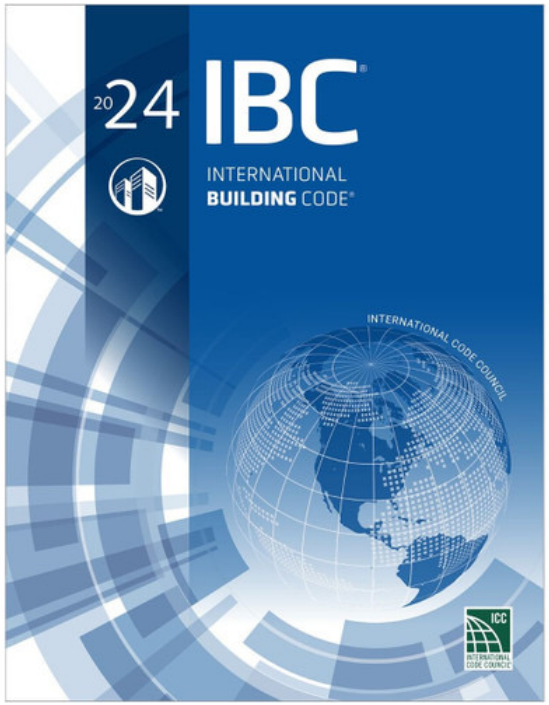
Falling through roofs/floors is a common cause of injury and death among firefighters.

Fire Damper vs. Ceiling Damper

- Limits spread of flame (UL 555)
- Rated walls/floors/partitions

- Limits radiant heat (UL 555C /UL 263)
- Approved floor/ceiling or roof/ceiling assemblies only

Codes & Standards



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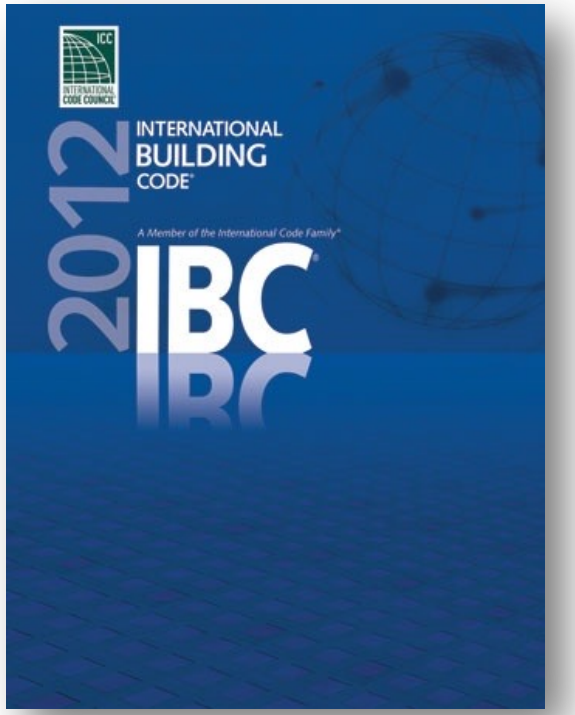
“I” Codes



- First published in 2000, combo of 3 legacy codes: BOCA National Building Code (BOCA/NBC), Uniform Building Code (UBC) & Standard Building Code (SBC)
- IBC – design of building; IMC – design of mechanical systems; IFC – regulate fire hazards, testing, maintenance in existing buildings

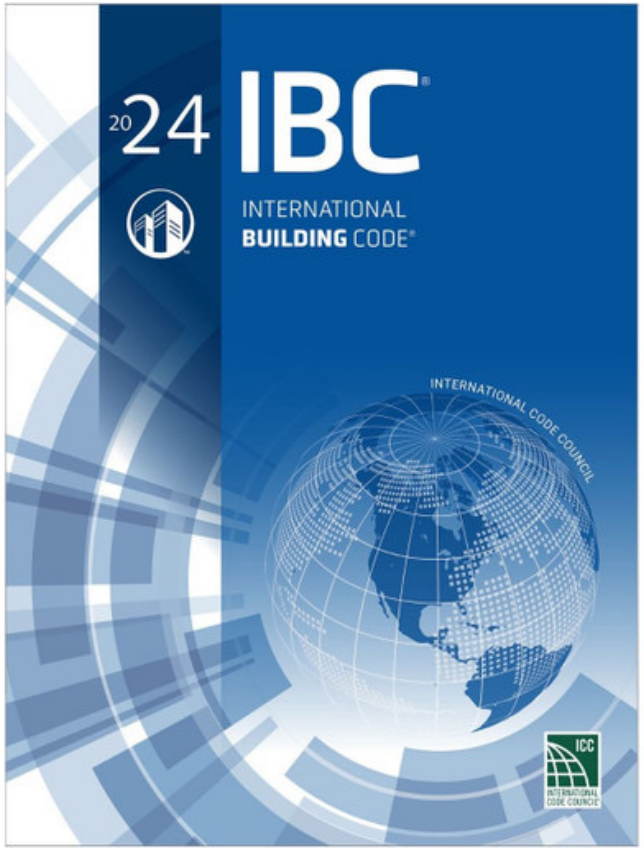
International Building Code (IBC)

→ **Ch. 7 – Fire & Smoke Protection Features**

→ **Sec. 717 – Ducts & Air Transfer Openings**

- Baseline requirements:
  - Dampers must be listed & labeled to applicable UL standard
  - Dampers must be installed in accordance with manufacturer's instructions

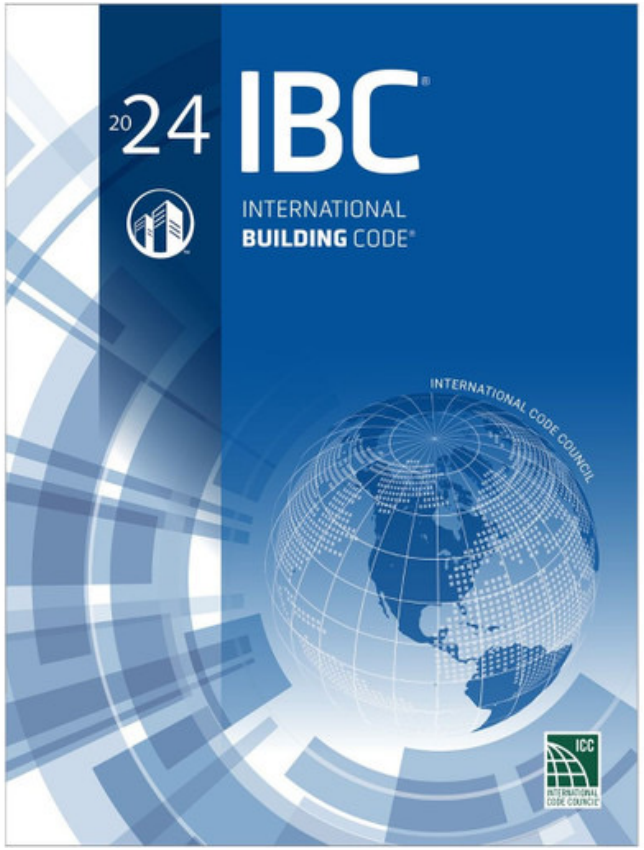
- Defines the type of damper required to protect penetrations through each type of rated building element



Where Life-Safety Dampers Are Required

Sec. 717.5

- 717.5.1 Fire Walls
- 717.5.2 Fire Barriers
- 717.5.3 Shaft Enclosures
- 717.5.4 Fire Partitions (includes corridors)
- 717.5.5 Smoke Barriers
- 717.5.6 Exterior Walls
- 717.5.7 Smoke Partitions



IBC - Chapter 7 Section 717.5 Ducts & Air Transfer Openings

"The provisions of this section shall govern the protection of duct penetrations and air transfer openings in assemblies required to be protected and duct penetrations in non-fire-resistance-rated floor assemblies".

SECTION	WALL TYPE	REFERENCED FROM	TYPE OF DAMPER
717.5.1 (IMC 607.5.1)	Fire walls	706.11	Fire damper
717.5.1.1 (IMC 607.5.1.1)	Fire wall – Horizontal exits	706.11	Fire damper, Smoke damper
717.5.2 (IMC 607.5.2)	Fire barriers	707.10	Fire damper
717.5.2.1 (IMC 607.5.2.1)	Fire barriers – Horizontal exits	707.10	Fire damper, Smoke damper
717.5.3 (IMC 607.5.5)	Shaft enclosures	713.10	Fire damper, Smoke damper
717.5.4 (IMC 607.5.3)	Fire partitions	708.9	Fire damper
717.5.4.1 (IMC 607.5.3 and 607.5.4)	Fire partitions – Corridors	708.9	Fire damper, Smoke damper
717.5.5 (IMC 607.5.4)	Smoke barriers	709.8	Smoke damper
717.5.6 (IMC 607.5.6)	Exterior walls	705.10	Fire damper
717.5.7 (IMC 607.5.7)	Smoke partitions	710.8	Smoke damper

Damper Test Requirements - IBC

717.3.1 Damper testing.

Dampers shall be *listed* and *labeled* in accordance with the standards in this section.

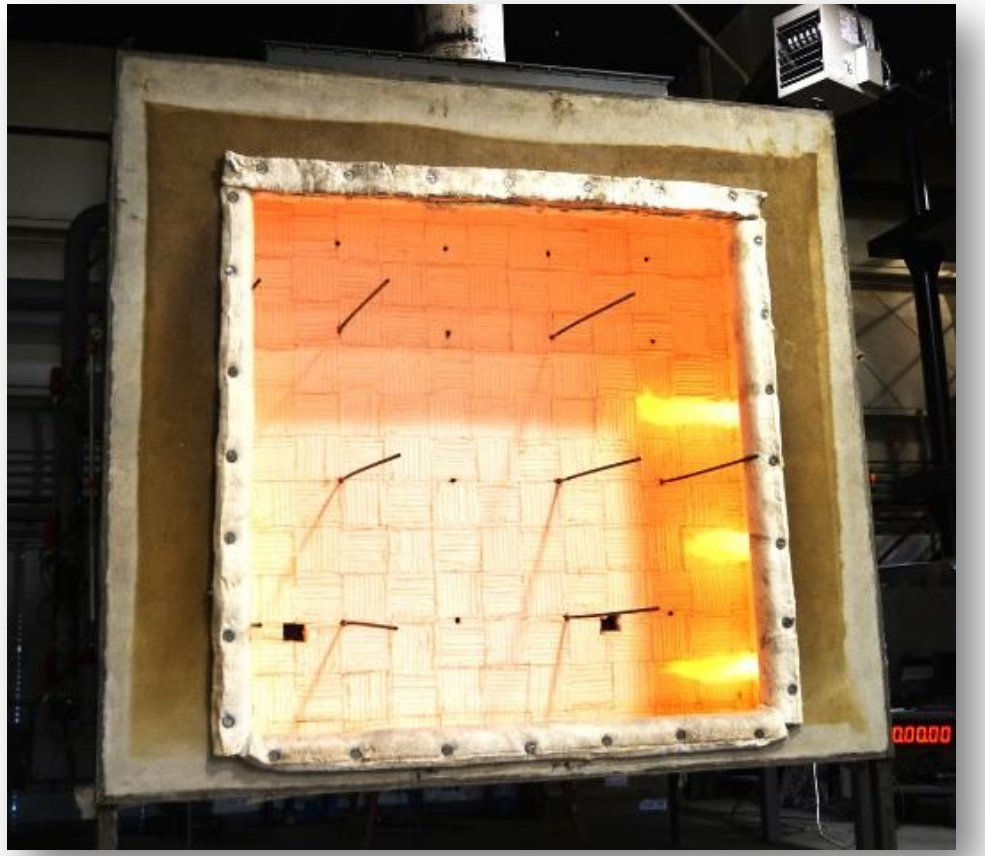
1. *Fire dampers* shall comply with the requirements of UL 555.
2. *Smoke dampers* shall comply with the requirements of UL 555S.
3. *Combination fire/smoke dampers* shall comply with the requirements of both UL 555 and UL 555S.
4. *Ceiling radiation dampers* shall comply with the requirements of UL 555C or shall be tested as part of a fire-resistance-rated floor/ceiling or roof/ceiling assembly in accordance with ASTM E119 or UL 263.
5. *Corridor dampers* shall comply with requirements of both UL 555 and UL 555S. *Corridor dampers* shall demonstrate acceptable closure performance when subjected to 150 feet per minute (0.76 mps) velocity across the face of the *damper* during the UL 555 fire exposure test.

Underwriters Laboratories (UL)

Testing, evaluation, and certification

- **UL 555** - Standard for Fire Dampers
- **UL 555S** - Standard for Smoke Dampers
- **UL 555C** - Standard for Ceiling Radiation Dampers

UL's "follow-up service" ensures that dampers are factory built as they were tested



Ceiling Damper Test Standards

Tested and listed to either UL 555C or UL 555C & UL 263.

UL 555C

CRDs listed to this standard can be used anywhere “hinged-door” type dampers are allowed.

Intended for use in sheet-metal-air-duct outlets, typically in suspended ceilings.

UL 263

Part of a complete assembly, which includes all of the elements of the floor or roof/ceiling design. Only the specified damper can be used in that specific design.

Intended for use in wood-truss or wood-joist ceilings.

Hourly Fire-Resistance Ratings

IBC Table 717.3.2.1

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

2-hour assembly rating = **1.5**-hour-rated damper

3-hour assembly rating = **3**-hour-rated damper

4-hour assembly rating = **3**-hour-rated damper

Fire Damper Operation

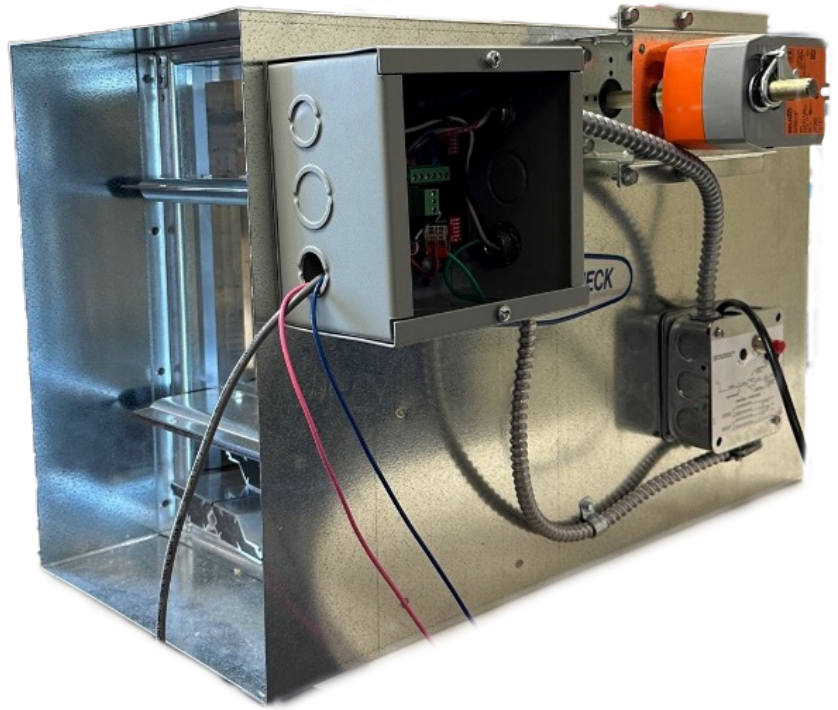
- Static
  - Used in duct systems or penetrations where the HVAC system is automatically shut down in the event of a fire.
- Dynamic
  - To be used in applications where fans will be on during a fire incident.

Air-Transfer Opening

717.2.3 Static dampers.

Fire dampers and *ceiling radiation dampers* that are *listed* for use in static systems shall only be installed in heating, *ventilation* and air-conditioning systems that are automatically shut down in the event of a fire.

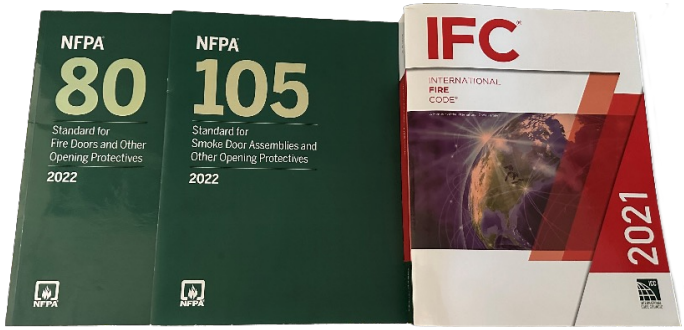
Periodic Testing & Inspection Requirements



Periodic Testing & Inspection Requirements

International Fire Code (IFC)

Requires fire dampers to be maintained in accordance with NFPA 80 and smoke dampers to be maintained in accordance with NFPA 105.



SECTION 706
DUCT AND AIR TRANSFER OPENINGS

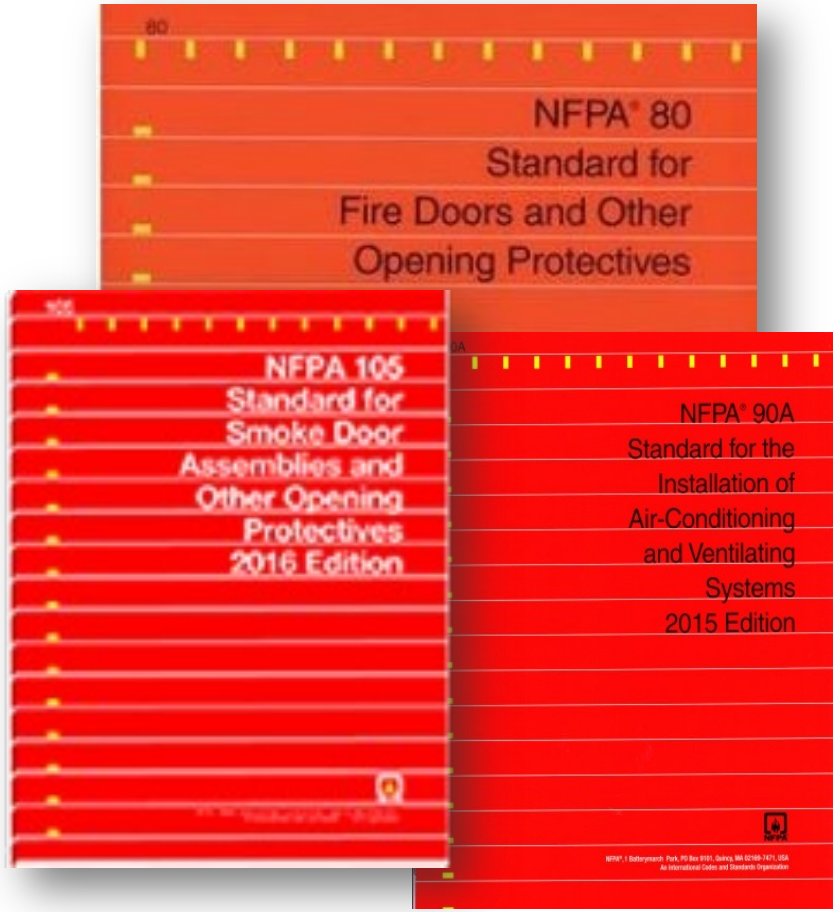
706.1 Maintaining protection.

Dampers protecting ducts and air transfer openings shall be inspected and maintained in accordance with NFPA 80 and NFPA 105. Other products or materials used to protect the openings for ducts and air transfer openings shall be securely attached to or bonded to the construction containing the duct or air transfer opening, without visible openings through or into the cavity of the construction. Any damaged products or materials protecting duct and air transfer openings shall be repaired, restored or replaced.

National Fire Protection Association

Installation, testing, and maintenance:

- **NFPA 80 Standard for Fire Doors**
- **NFPA 105 Standard for Smoke Doors**
- NFPA 90A Standard for Installation of Air-Conditioning and Ventilating Systems
- NFPA 92 Standard for Smoke-Control Systems



Operational Testing

NFPA 80 – Fire Dampers

"After the installation of a damper is completed, an operational test shall be conducted."

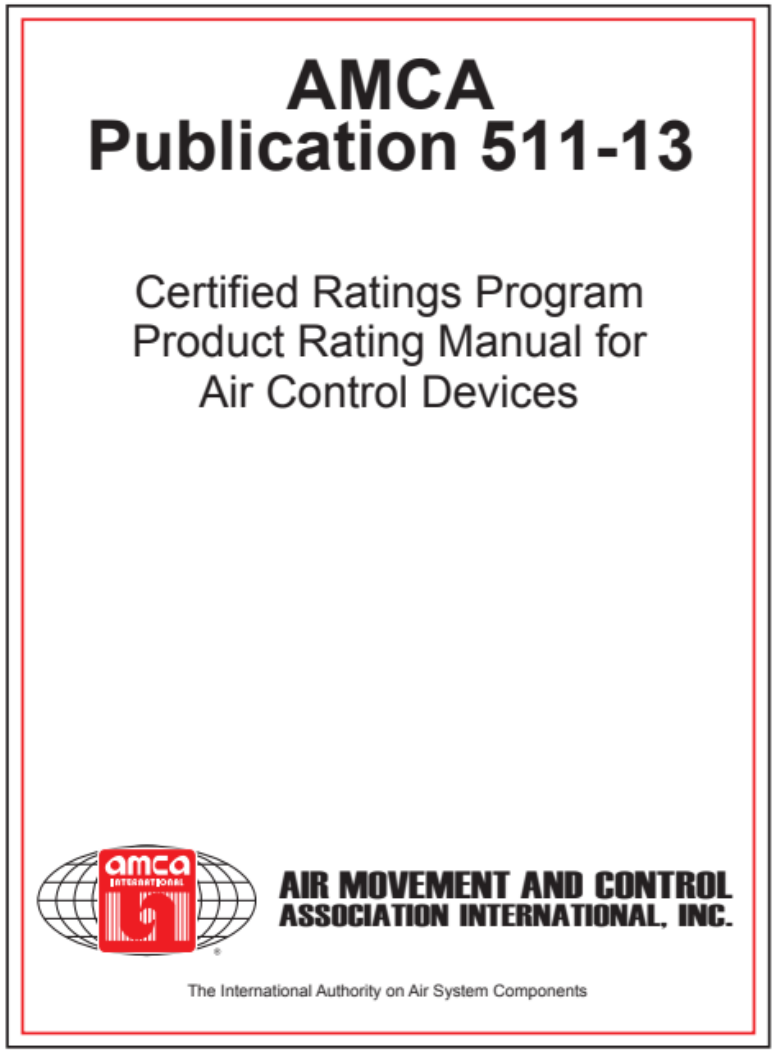
NFPA 105 – Smoke Dampers

"An operational test shall be conducted after the building's HVAC system has been balanced."

Periodic Testing

Frequency

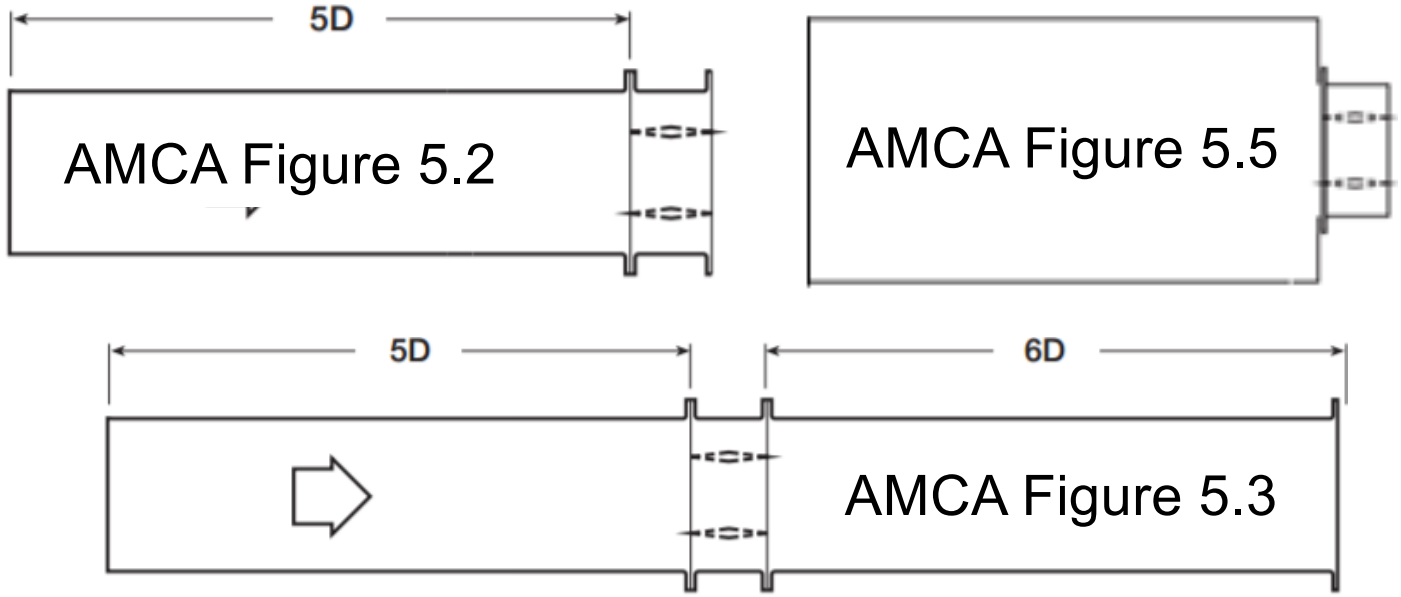
- “Each damper shall be tested and inspected 1 year after installation.”
- “The test and inspection frequency shall then be every 4 years, except in buildings containing a hospital, where the frequency shall be every 6 years.”



Damper Performance

Damper Pressure Drop

AMCA-Certified Pressure-Drop Data



Five tested sizes

- 12”x12”
- 24”x24”
- 36”x36”
- 12”x48”
- 48”x12”

Damper Pressure Drop

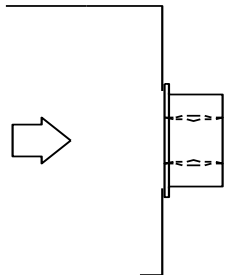


Fig. 5.5
(Plenum Mount)

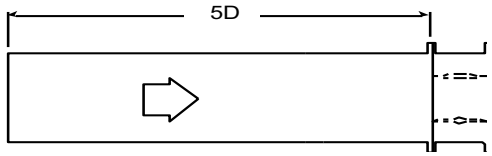


Fig. 5.2
(Ducted Inlet)

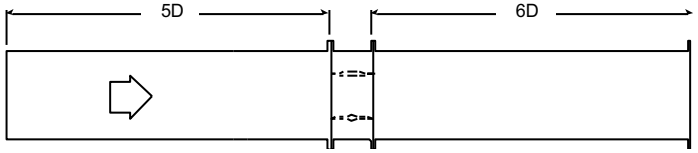
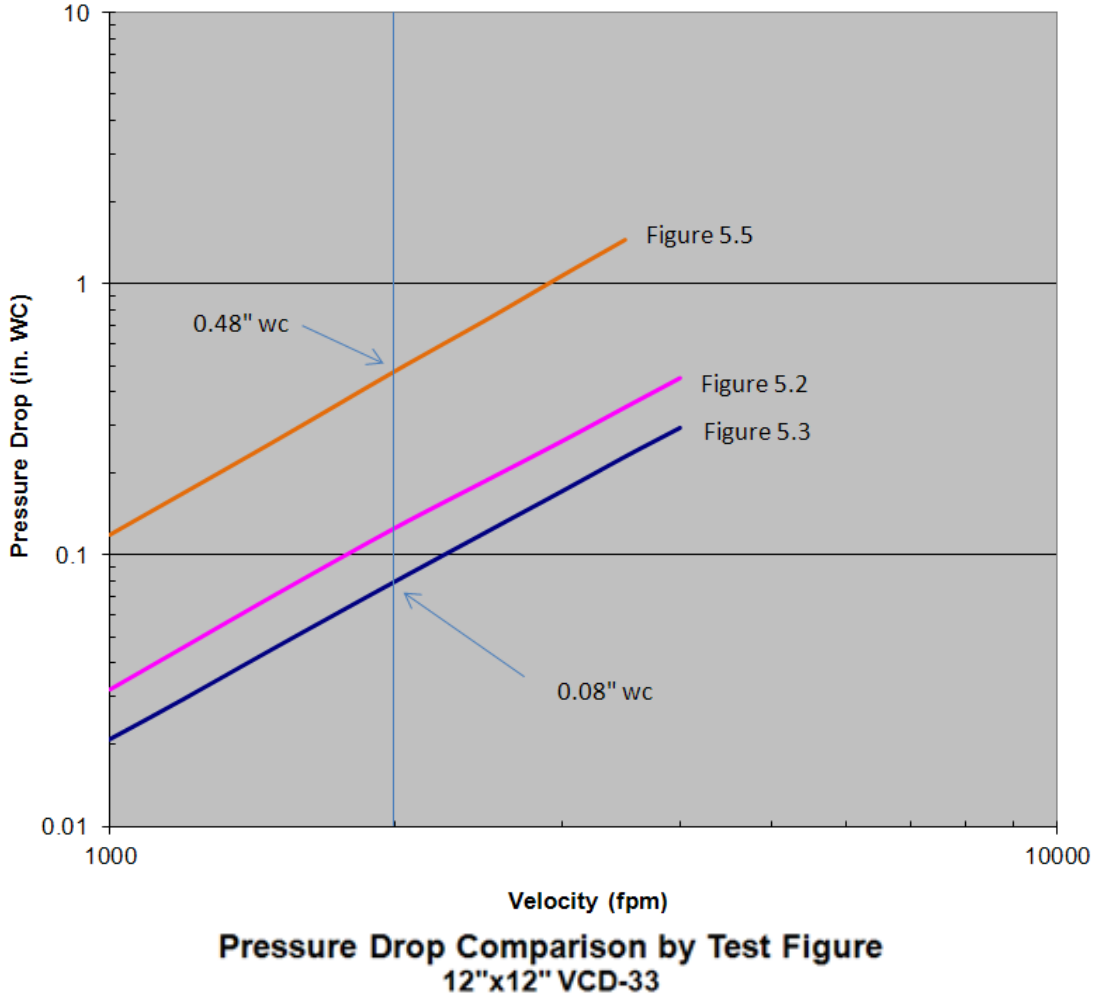


Fig. 5.3
(Ducted Inlet & Outlet)

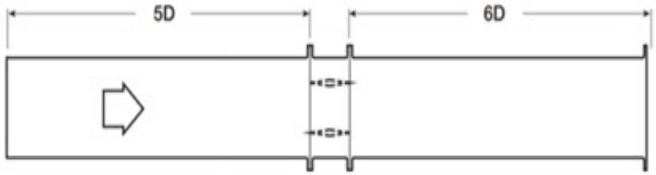


Damper Pressure Drop

- Example Pressure-Drop Specification:

  *Pressure drop shall not exceed **0.08" wc at 2,000-fpm** velocity for a **12" x 12"** damper tested to AMCA Figure 5.3. Dampers shall bear the AMCA Certified Ratings Program seal for Air Performance in accordance with AMCA 511.*

AMCA Figure 5.3



12 in. x 12 in. (305mm x 305mm)

Velocity (fpm)	Pressure Drop (in. wg)
500	0.01
1000	0.02
1500	0.05
2000	0.08
2500	0.12
3000	0.17
3500	0.23
4000	0.30

24 in. x 24 in. (610mm x 610mm)

Velocity (fpm)	Pressure Drop (in. wg)
500	0.01
1000	0.01
1500	0.03
2000	0.05
2500	0.09
3000	0.13
3500	0.17
4000	0.22

36 in. x 36 in. (914mm x 914mm)

Velocity (fpm)	Pressure Drop (in. wg)
500	0.01
1000	0.01
1500	0.02
2000	0.04
2500	0.06
3000	0.08
3500	0.12
4000	0.15

12 in. x 48 in. (305mm x 1219mm)

Velocity (fpm)	Pressure Drop (in. wg)
500	0.01
1000	0.02
1500	0.04
2000	0.08
2500	0.12
3000	0.17
3500	0.22
4000	0.29

48 in. x 12 in. (1219mm x 305mm)

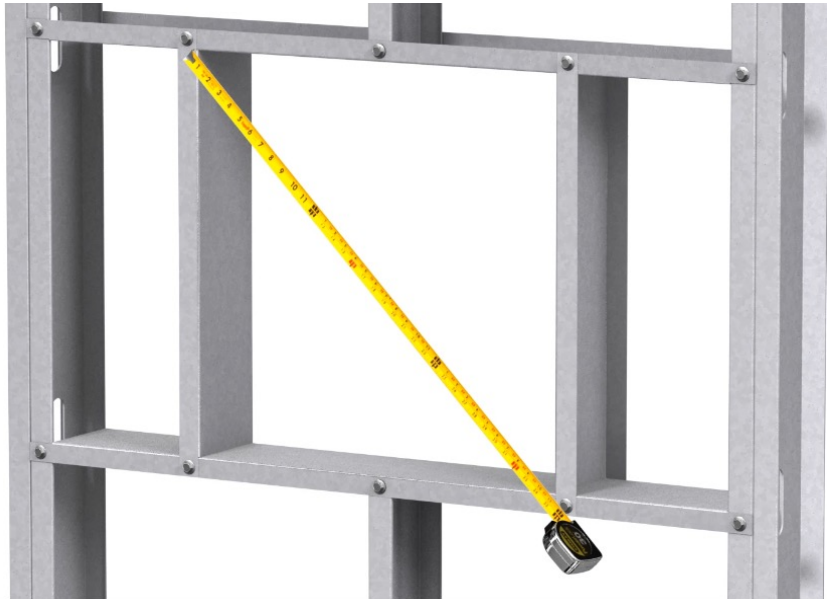
Velocity (fpm)	Pressure Drop (in. wg)
500	0.01
1000	0.02
1500	0.04
2000	0.07
2500	0.11
3000	0.15
3500	0.20
4000	0.25

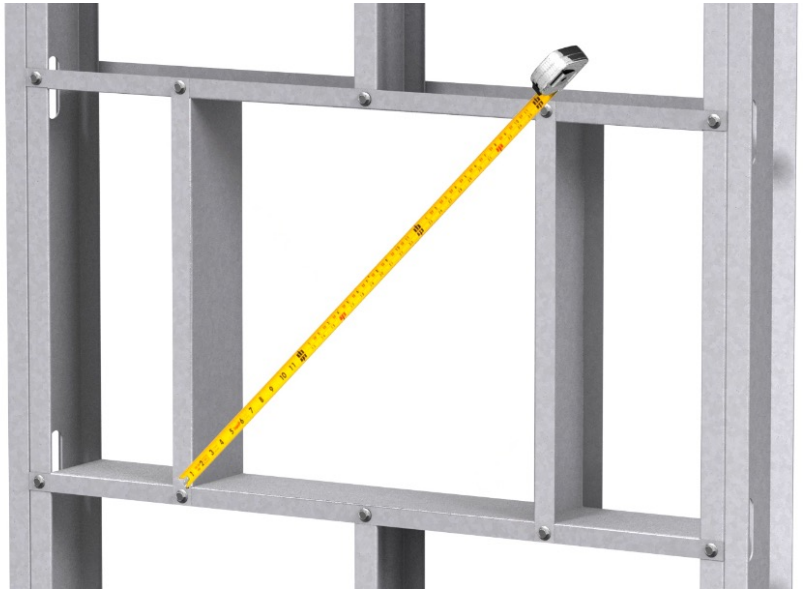
Damper Installation

Required Elements of an "Approved" Life-Safety-Damper Installation

1. **Rated barrier**
2. **Listed product**
3. **Installation requirements**

Square Opening

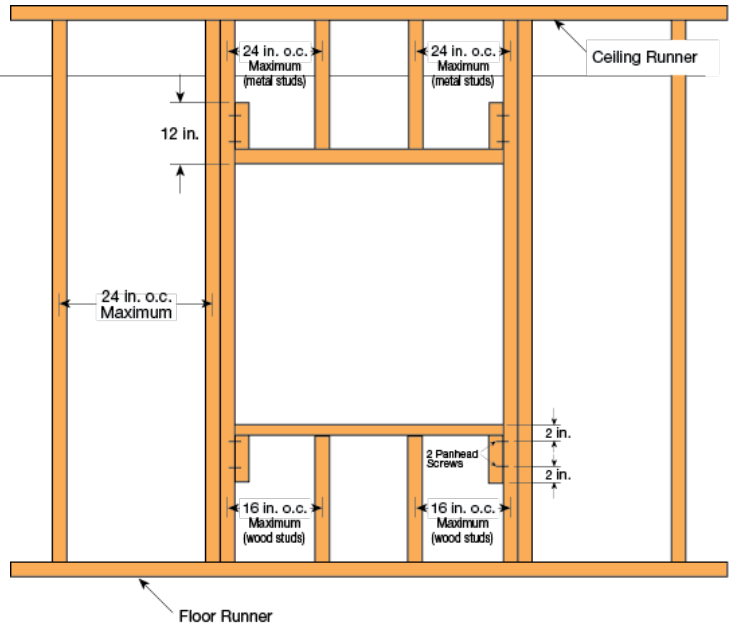


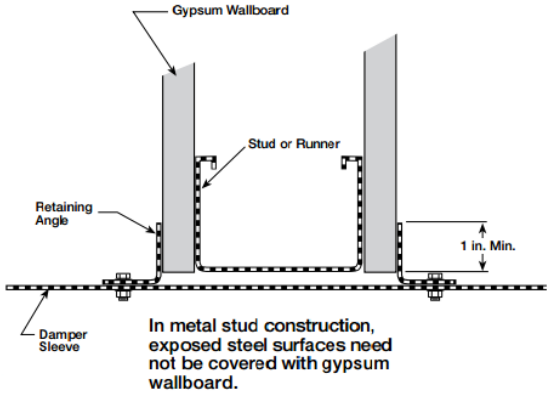


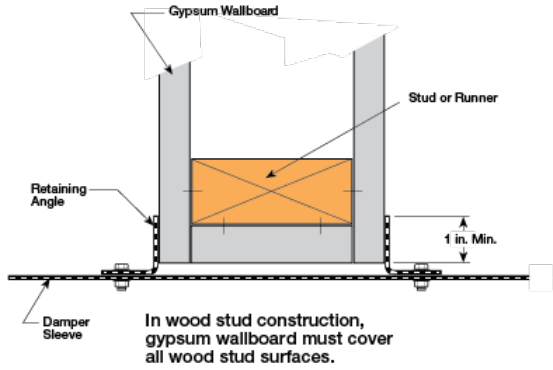
Framing Requirements

Framing of Opening

- Vertical studs must run floor to ceiling
- Double vertical over 36 in. x 36 in.
- Wood studs must be covered with sheet rock
- Steel studs do not need to be covered with sheet rock







Typical Installation – Fire Damper

① **UL-Classified Fire Damper - Dynamic or Static**

1-1/2-hr label—for fire separations up to 2 hr

3-hr label—for fire separations up to 4 hr

② **Fire Separation**

③ **Retaining Angles**

④ **Breakaway Joint**

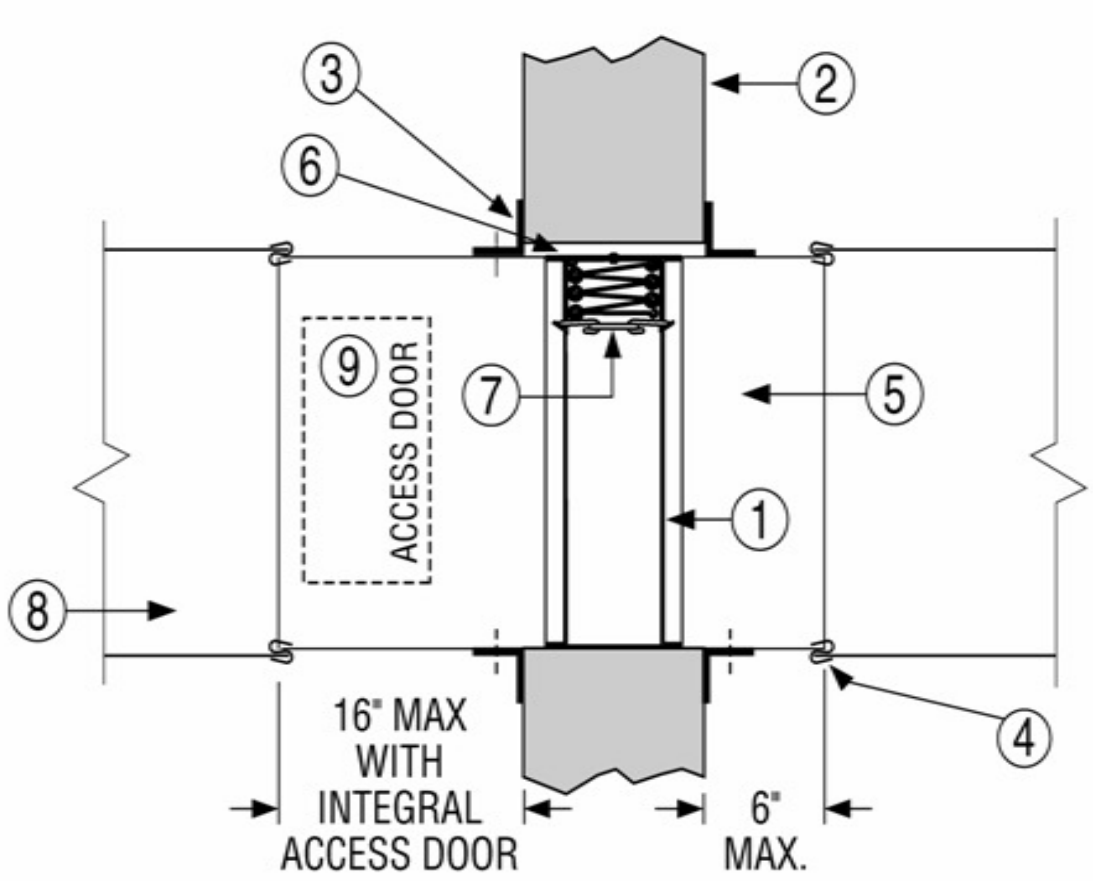
⑤ **Sleeve** (duct gauge min. SMACNA/NFPA 90A spec.)

⑥ **Expansion Clearance**

⑦ **UL-Listed Heat-Responsive Device** (fusible link)

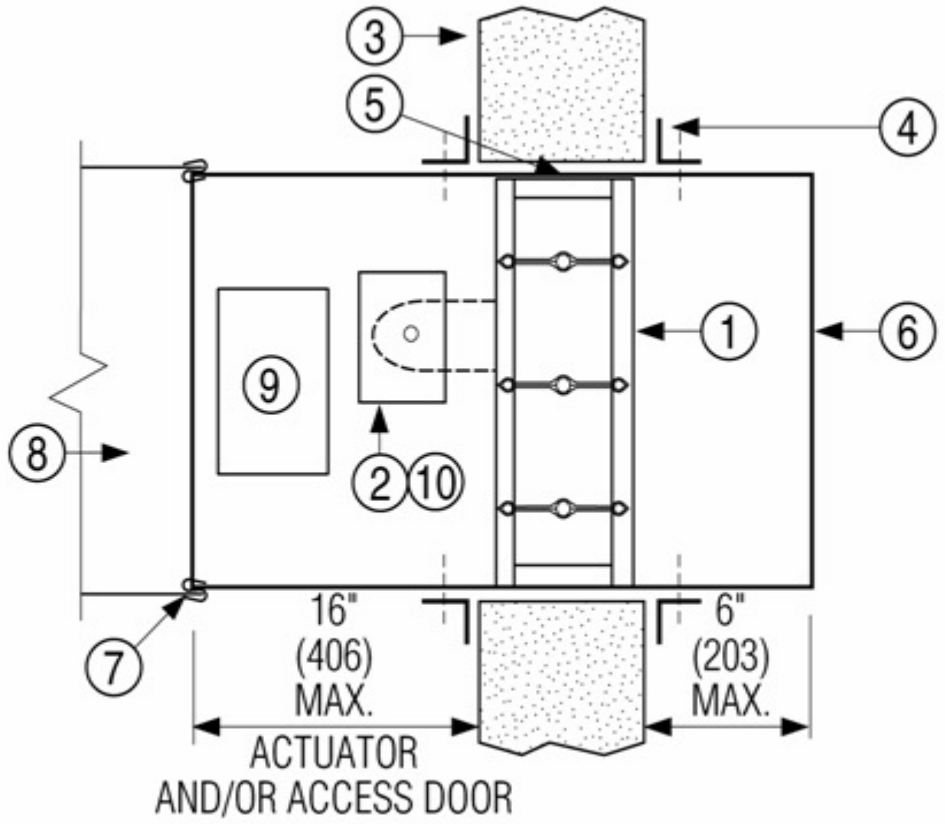
⑧ **Duct**

⑨ **Access Door**



Typical Installation – Fire/Smoke Damper

1. UL-classified as both a dynamic fire damper and a leakage-rated smoke damper
2. UL-qualified damper/actuator assembly
   Pneumatic or Electric Actuators
3. Fire separation and smoke barrier
4. Retaining angles
5. Expansion clearance
6. Sleeve
7. Breakaway joint
8. Steel duct
9. Access door
10. UL-listed heat-responsive device



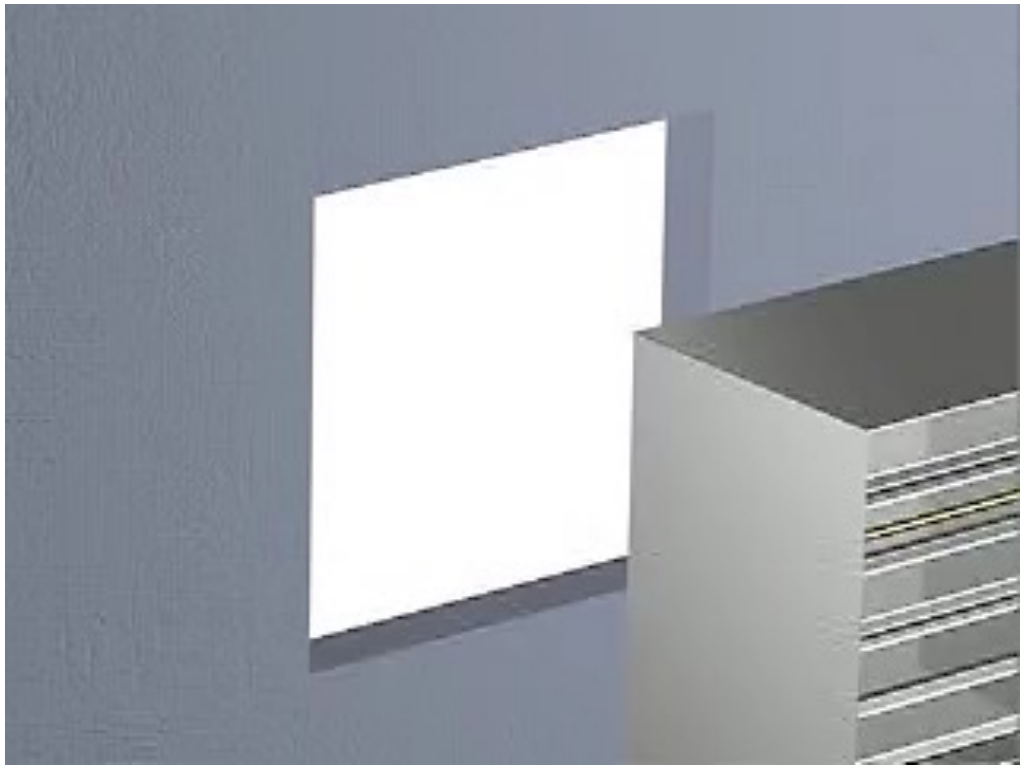
Retaining Angle

Two sided

- Attached to the damper sleeve on both sides

Single sided

- Attached to the damper sleeve and wall/floor
- 80 x 50 or 50 x 80 or
  40 x 100 on vertical mount
- 144 x 96 on horizontal mount



Typical Installation – Smoke Damper

① **UL-classified leakage-rated smoke damper**

② **UL-qualified actuator/damper assembly**

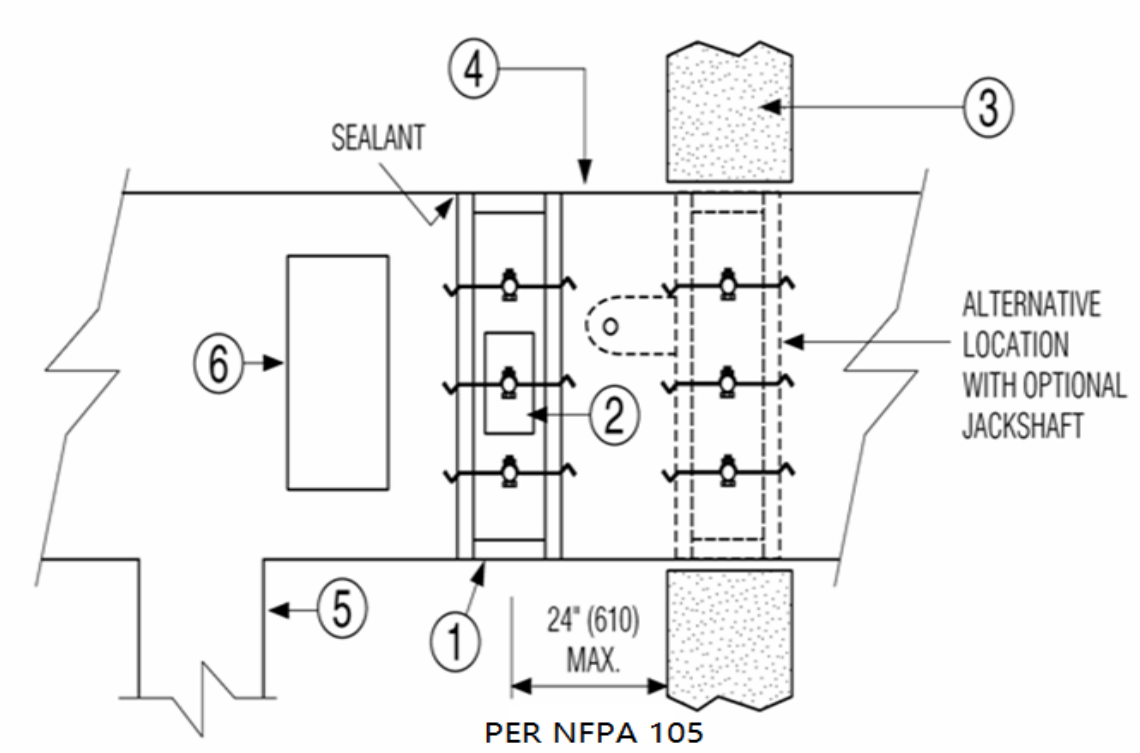
Pneumatic or Electric Actuators

③ **Smoke barrier**

④ **Duct**

⑤ **First duct outlet**

⑥ **Access door**



Access Doors

NFPA 105

- Dampers equipped with fusible links and/or internal operators shall be provided with an access door that is not less than 12 in.^{2} or provided with removable duct section.

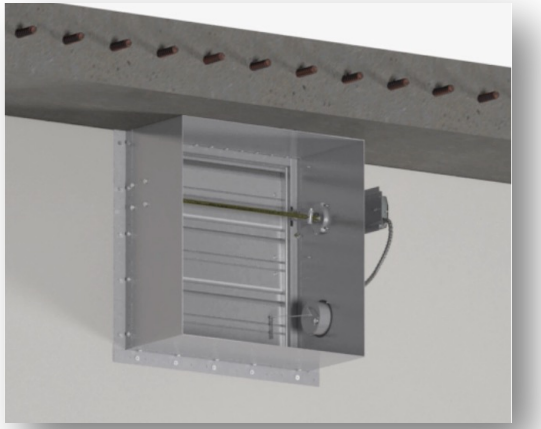
NFPA 80

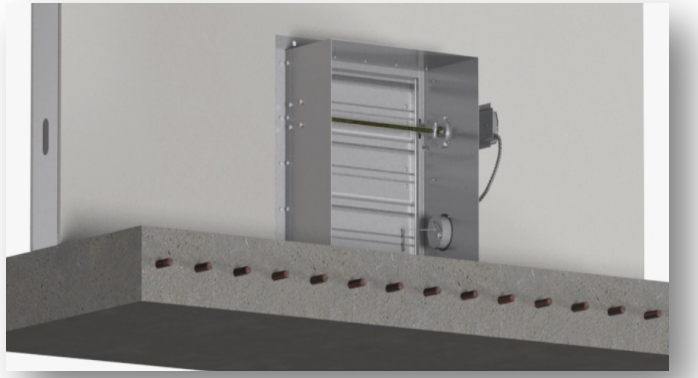
- The damper access panel shall be labeled the words “Fire Damper”, “Smoke Damper”, or “Fire Smoke Damper” in letters not less than 1 in. height.

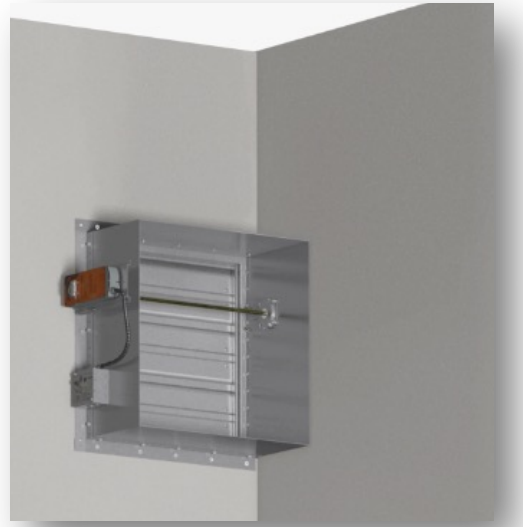
Alternative Installation Methods

3 Sided Retaining Angle Installation Method

- The retaining angle may be omitted from any of the four sides
- **UL approved**

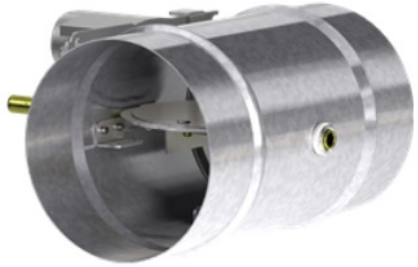




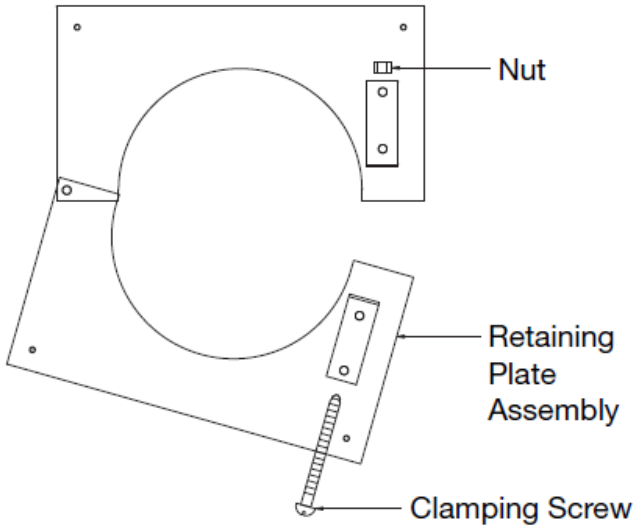


True Round Life-Safety Dampers

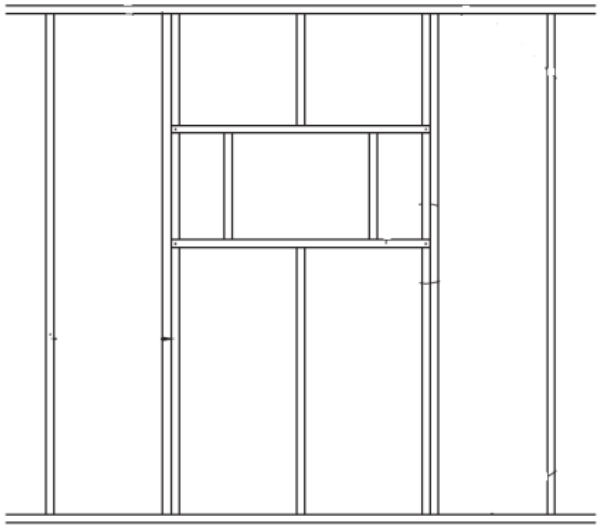
DFDR-510
True Round
Dynamic Fire Damper



FSDR-510
True Round
Fire Smoke Damper



Retaining Plate
Included with the Damper



The Opening in the Wall
Does Not Have to be
Round!

Installation Books & QR codes

GREENHECK
Building Value in Air.

Document 481318
MULTI-BLADE FIRE AND COMBINATION FIRE SMOKE DAMPERS
DFD-XXX, DFDAF-XXX, DFDTF-XXX, FSD-XXX, FSD-XXXV, IMO-XXX,SEDFD-XXX, SEFSD-XXX, AND SSFSD-XXX
1½ and 3 Hour Fire & Combination Fire Smoke Dampers
(with factory installed sleeve and actuator)
Vertical and Horizontal Mount

Installation, Operation and Maintenance Manual

Please read and save these instructions for future reference. Read carefully before attempting to assemble, install, operate or maintain the product described. Protect yourself and others by observing all safety information. Failure to comply with instructions could result in personal injury and/or property damage!

These instructions apply to 1½ and 3 hour rated fire and combination fire smoke dampers mounted in: 1) masonry, block, or stud walls and 2) concrete floors. Specific requirements in these instructions are mandatory. Dampers must be installed in accordance with these instructions to meet the requirements of UL 555 and/or UL 555S.

Note: Combination fire smoke and fire dampers are manufactured and labeled for either vertical or horizontal installation. The dampers must be installed in accordance with labeling.

Table of Contents

Receiving and Handling

Upon receiving dampers, check for both obvious and hidden damage. If damage is found, record all necessary information on the bill of lading and file a claim with the final carrier. Check to be sure that all parts of the shipment, including accessories, are accounted for.

Dampers must be kept dry and clean. Indoor storage and protection from dirt, dust and the weather is highly recommended. Do not store at temperatures in excess of 100°F (38°C).

Safety Warning

Improper installation, adjustment, alteration, service or maintenance can cause property damage, injury or death. Read the installation, operating, and maintenance instructions thoroughly before installing or servicing this equipment.

This manual is the property of the owner and is required for future maintenance. Please leave it with the owner when the jobs is complete.

GREENHECK
Building Value in Air.

Document number 481324
CURTAIN FIRE DAMPERS
DFD, DFD-150X, FD, FD-150X, SSDFD, SSFD, AND KFD Series
1½ and 3 Hour Curtain Fire Dampers

Vertical and Horizontal Mount

Installation, Operation and Maintenance Manual

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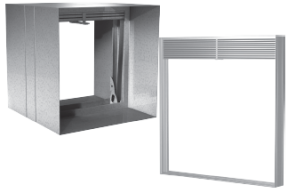
These instructions apply to 1½ and 3 hour rated fire dampers mounted (blades must be horizontal) in: 1) masonry, block, or stud walls and 2) concrete floors. Specific requirements in these instructions are mandatory. Dampers must be installed in accordance with these instructions to meet the requirements of UL 555.

Note: Fire dampers are manufactured and labeled for either vertical or horizontal installation. The dampers must be installed in accordance with labeling.



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Questions

To receive PDH credit, you must complete the post-course evaluation