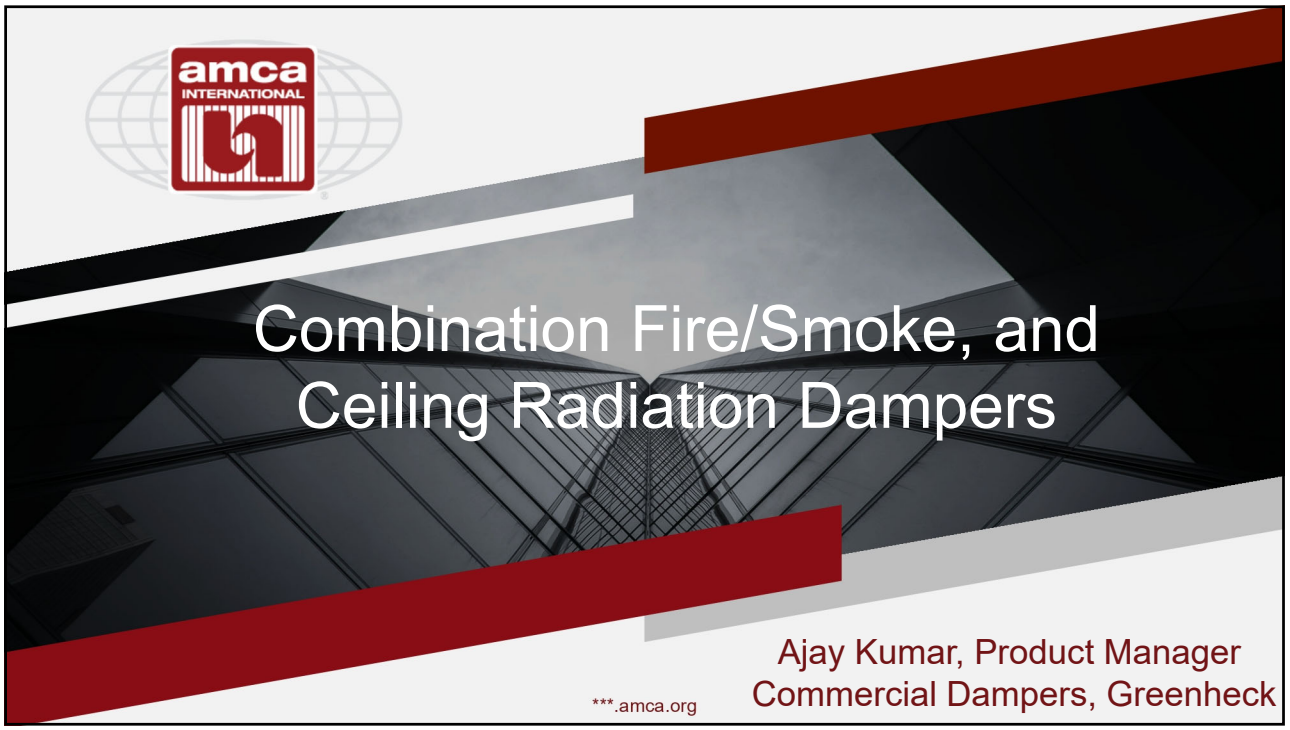



1

# Ajay Kumar

Product Manager, Greenheck

- Over 9 years experience in the HVAC industry.
- Product Vertical Head – Dampers at Greenheck India Pvt. Ltd.
- Holds Bachelors Degree in Mechanical Engineering.



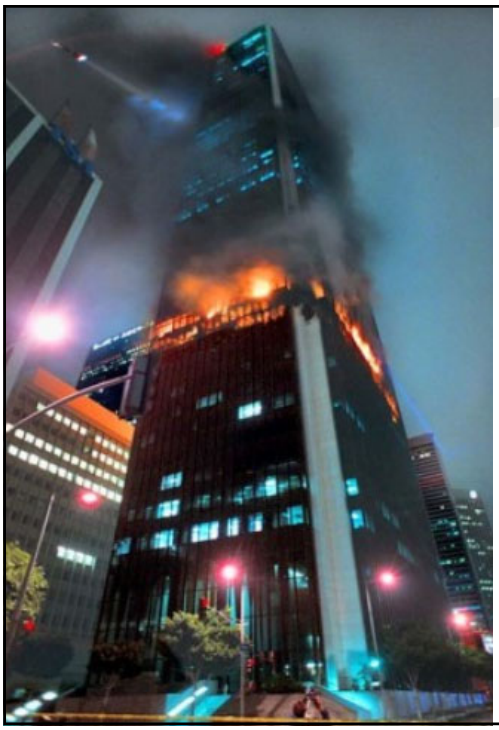
2

# Learning Objectives

- Provide an overview of the different types of Dampers available – Life safety and volume control.
- Discuss building code requirements governing their use, installation, and inspection.
- Understand the code required periodic testing requirements.
- Investigate damper performance and installation criteria.
- Understand the basics of damper installation requirements.



3



# Purpose of Life-Safety Dampers

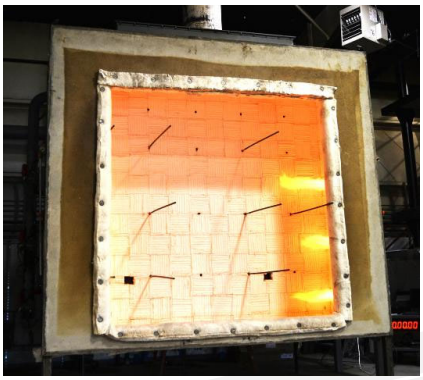
- Containment
  - Building codes require life-safety dampers to protect duct penetrations and air transfer openings in rated construction.
  - Fire- and smoke-rated construction is used to “compartmentalize” a building into fire & smoke zones to prevent the spread of fire and smoke.
- Engineered Smoke-Control 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.



4

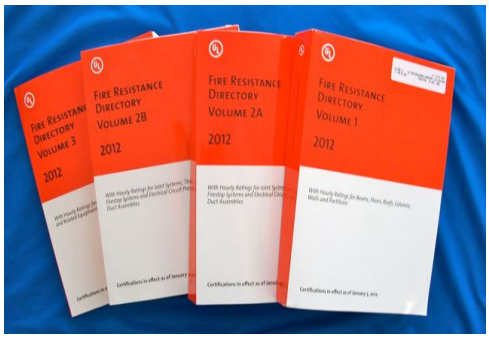
# Underwriters Laboratories (UL)

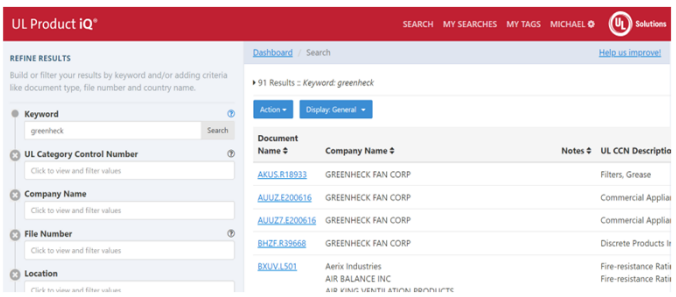
- Testing, evaluation, certification:
  - **UL 555** - Standard for Fire Dampers
  - **UL 555S** - Standard for Smoke Dampers
  - **UL 555C** - Standard for Ceiling Radiation Dampers
- UL's "follow-up service" ensures that dampers are factory built as they were tested.





# Underwriters Laboratories Directory




All UL labeled products are listed in the UL directory

**www.UL.com**

## Life-Safety Damper Types


Fire Dampers


Smoke Dampers


Combination Fire/Smoke Dampers


Corridor Dampers


Ceiling Radiation Dampers



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## 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)





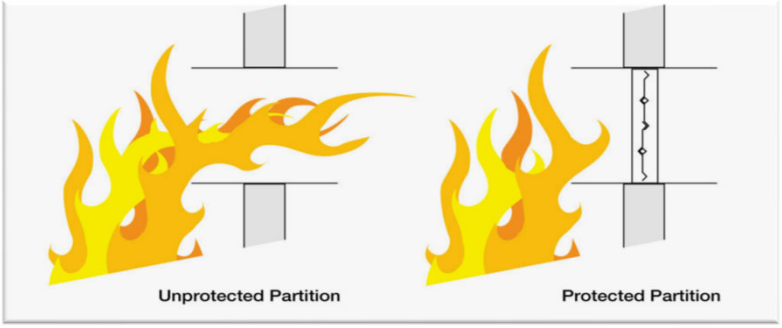




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# Fire Dampers

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




9



9

# 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)**

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# Fire Dampers: How do they work?



Curtain Fire Damper



Typical Fusible Link

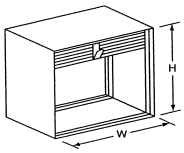


Multi-Blade Fire Damper

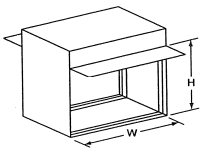


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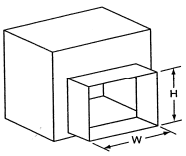
# Fire Damper Sleeve/Transition Types



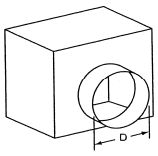

Type A (No Transition)
Frame and blades in the air stream



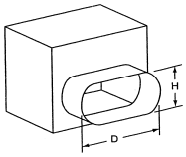

Type B
Blades out of the airstream




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.



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# Fire Dampers: UL Rating Qualifications

- Static or Dynamic
- Hourly Rating: 1-1/2 hr. or 3 hr.
- Mounting Position: Vertical (Walls/Partitions) or Horizontal (Floors)
- Installation: "In Wall" or "Out of Wall"



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# Fire Dampers: Static vs. Dynamic

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

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

(i.e. Smoke Control system)
Velocity/Pressure Rating – min. 2000 fpm @ 4 in. w.g.

**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.



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# 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

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# Smoke Dampers

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



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# Why Do We Need Smoke Dampers?



**According to NFPA, smoke is the major killer in fire-related deaths**

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.**



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# 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



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UL 555S

**STANDARD FOR SAFETY**
Smoke Dampers

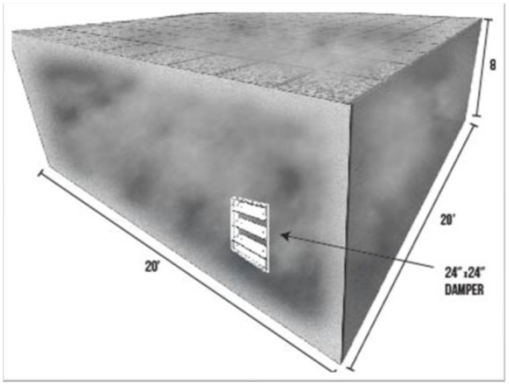
# Smoke Dampers: What is Leakage Class?

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

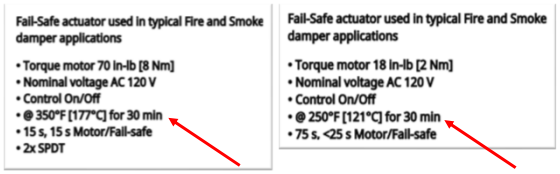



- Class I = **100 minutes**
- Class II = **40 minutes**
- Class III = **10 minutes**

# Temperature Rating for Smoke Dampers

Operational Temperature:
250 °F or
350 °F

- Actuators can be tested for operation up to 250 or 350 °F.
- Actuators have a max rating, but individual damper manufacturer assembly ratings depend on what was tested.






# 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.

# Combination Fire/Smoke Dampers

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



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# 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 (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

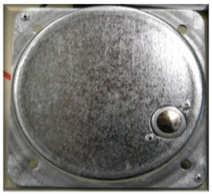
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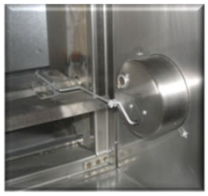


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# How does an FSD work?







Respond to heat sensing device, smoke detector, control signal







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# Fire/Smoke Damper Accessories



Momentary Test Switch




Remote Test Switch



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# Smoke & Fire/Smoke Damper Actuators

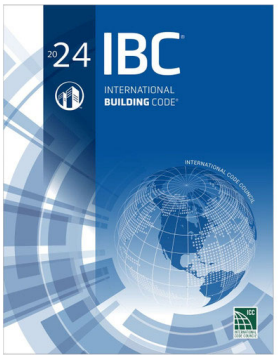
- Actuators must be **factory installed,** per UL.
- Electric (120V, 24V, 230V) or Pneumatic.
- Two position (open/closed) and Modulating (Balancing) types.
- Different torque ratings, selection based on tested size of assembly.
- May be externally or internally mounted.





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# Codes & Standards




amca INTERNATIONAL

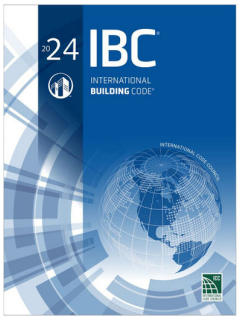
NFPA®

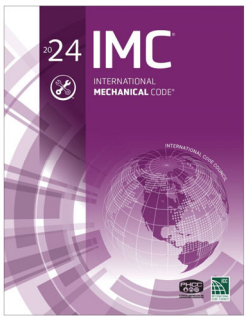
UL® Underwriters Laboratories

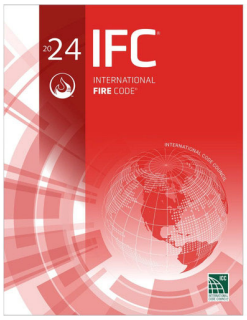


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# International Code Council: "I" Codes




- First published in 2000, combination of legacy building codes: BOCA National Building Code (BOCA/NBC), Uniform Building Code (UBC), Standard Building Code (SBC)



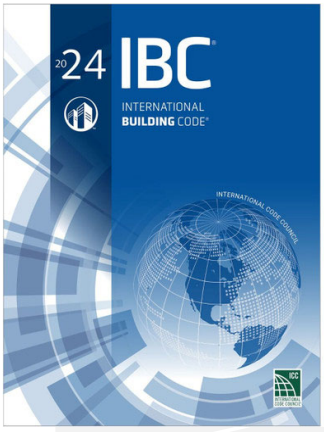
29

# 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






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# IBC Test Standard Requirements

**717.3.1 Damper testing.**

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

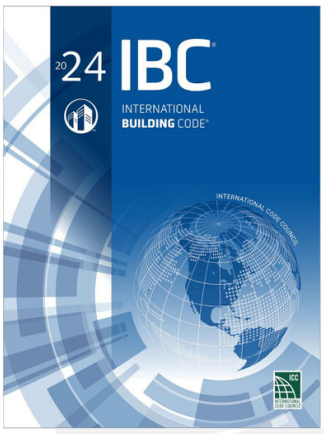
1. *Fire dampers* shall comply with the requirements of UL 555.
2. *Smoke dampers* shall comply with the requirements of UL 555S.
3. *Combination fire/smoke dampers* shall comply with the requirements of both UL 555 and UL 555S.
4. *Ceiling radiation dampers* shall comply with the requirements of UL 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.



# 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 |

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## 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

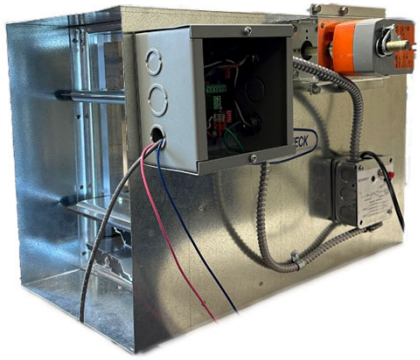


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# Periodic Testing & Inspection Requirements





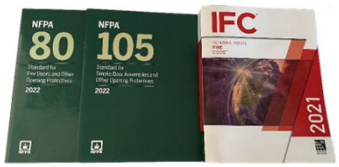
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# Periodic Testing & Inspection Requirements



**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**

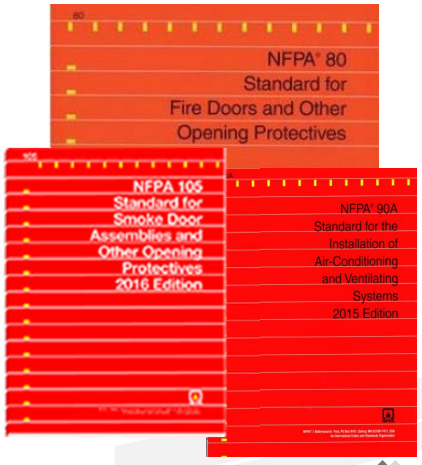
**706.1 Maintaining protection.**
Dampers protecting ducts and air transfer openings shall be inspected and maintained in accordance with NFPA 80 and NFPA 105. Other products or materials used to protect the openings for ducts and air transfer openings shall be securely attached to or bonded to the construction 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.



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# 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




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# 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."



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# 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."

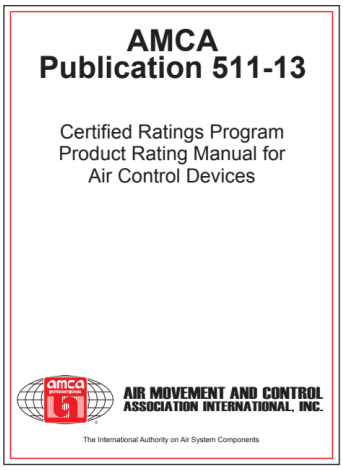


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# Damper Performance: Pressure Drop and Leakage



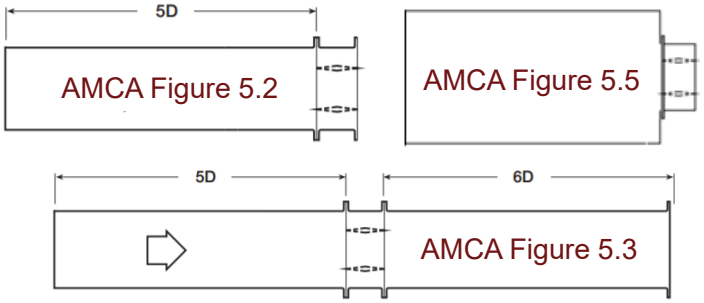

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# Damper Pressure Drop

AMCA-Certified Pressure-Drop Data




Five tested sizes

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



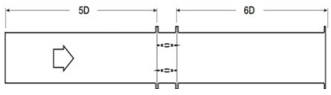
41

# 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 | 0.06 |
| 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 |



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# Installation Matters!

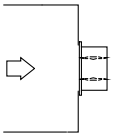


Fig. 5.5
(Plenum Mount)

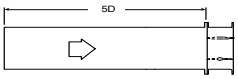



Fig. 5.2
(Ducted Inlet)

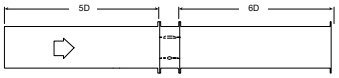
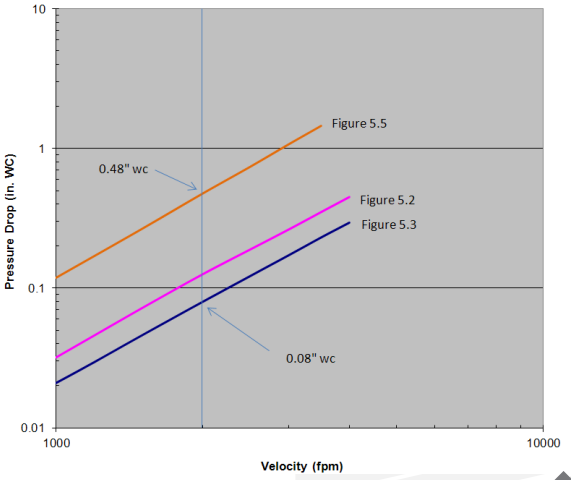



Fig. 5.3
(Ducted Inlet & Outlet)




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# Why AMCA is important

AMCA (Air Movement and Control Association) is important for dampers because it provides a standardized testing and certification process that ensures dampers meet specific performance and quality standards, verifying their ability to control airflow effectively with minimal air leakage, which is crucial for proper HVAC system operation and energy efficiency; essentially, an AMCA certified damper signifies a reliable and well-performing product within the industry

Salient Features about AMCA and Dampers

1. Quality Assurance
2. Independent Testing
3. AMCA seal
4. Better system efficiency

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# Life Safety Damper Installation



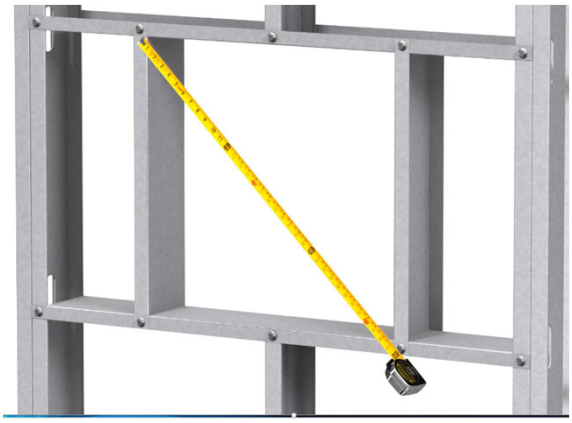


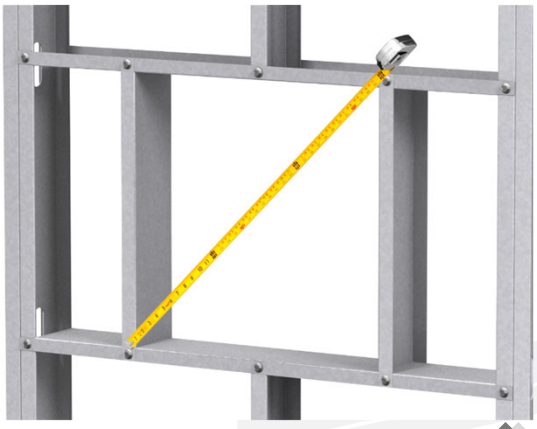
# Required Elements of an "Approved" Life Safety Damper Installation

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



# Square Opening





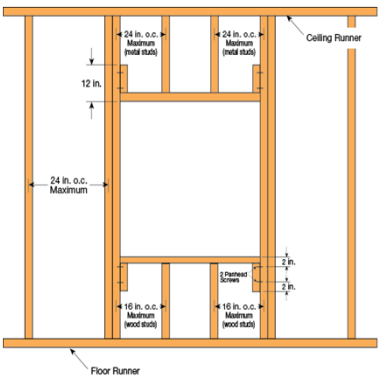
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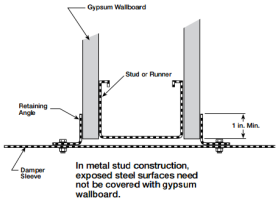


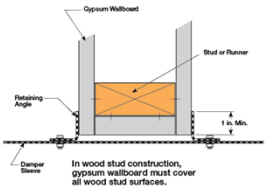
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# Framing Requirements

- Framing of Opening
  - 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



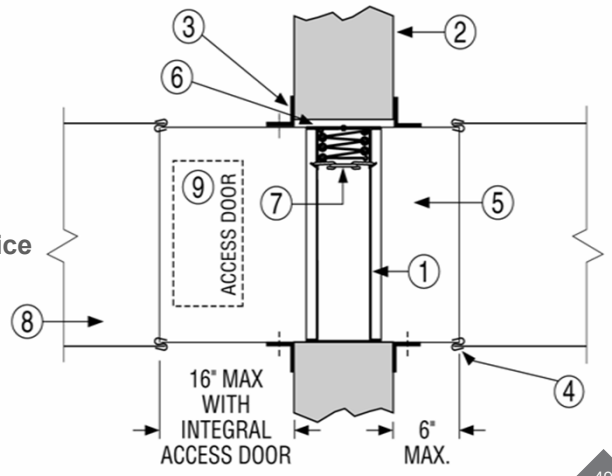

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# Typical Installation – Fire Damper

① **UL-Classified Fire Damper**
③ **Retaining Angles**
④ **Breakaway Joint**
⑤ **Sleeve**
⑥ **Expansion Clearance**
⑦ **UL-Listed Heat-Responsive Device**
⑧ **Duct**
⑨ **Access Door**

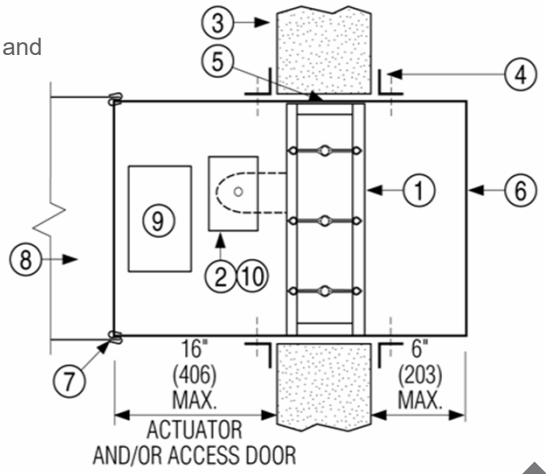






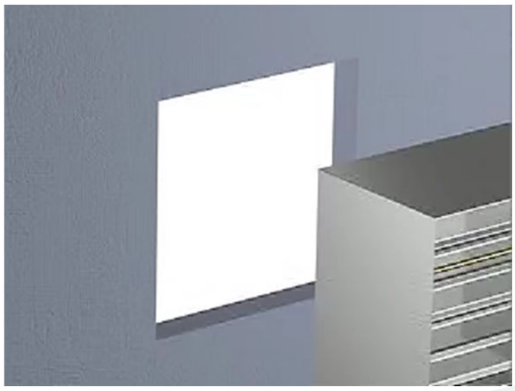

# Typical Installation – Fire/Smoke Damper

1. UL-classified as both a dynamic fire damper and a leakage-rated smoke damper
2. UL-qualified damper/actuator assembly
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 Angles

- Two sided
  - Attached to the damper sleeve on both sides
- Single sided
  - Attached to the damper sleeve and wall or floor
  - Vertical: 80x50 or 50x80 or 40x100
  - Horizontal:144x96



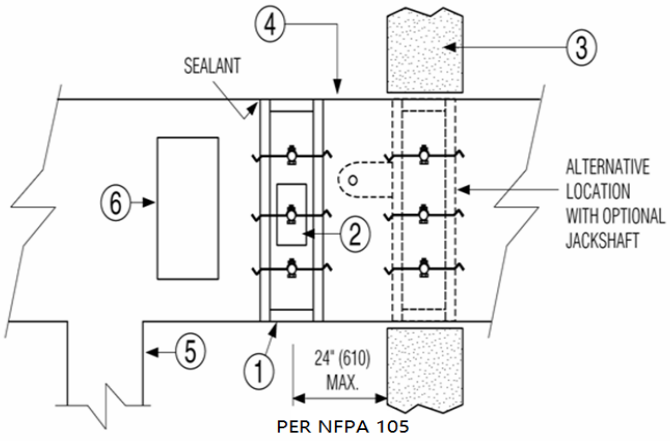
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# Typical Installation – Smoke Damper

1. **UL-classified smoke damper**
2. **UL-qualified actuator**
3. **Smoke barrier**
4. **Duct**
5. **First duct outlet**
6. **Access door**




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# Resources

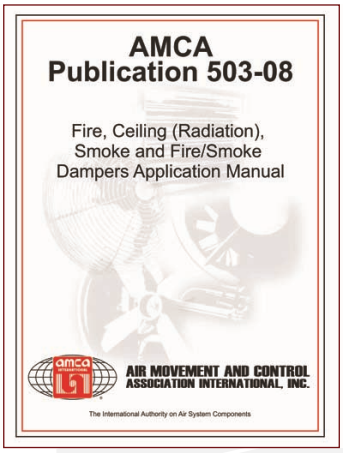





# Air Movement and Control Association International, Inc. (AMCA )

"Publication 503: Fire, Ceiling (Radiation), Smoke, and Fire/Smoke Dampers Application Manual

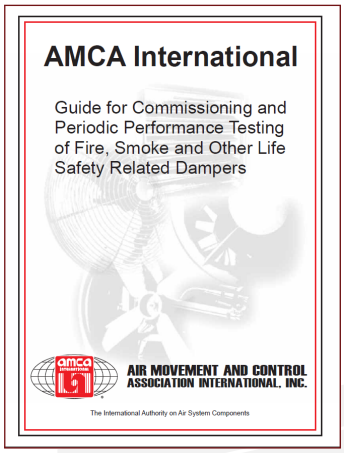
- **Currently being updated!**



## Air Movement and Control Association International, Inc. (AMCA )

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

- Will be added to AMCA Publication 503 as an annex



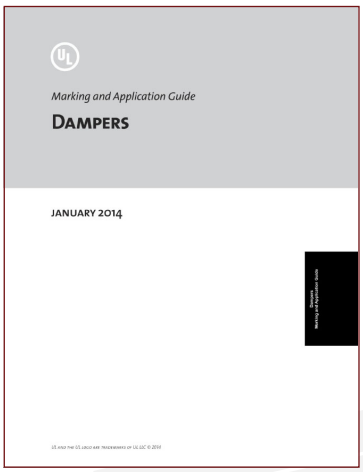

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## Underwriters Laboratories (UL)

"Marking and Application Guide: Dampers"

- **Free!!**
- "…intended to assist code 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."




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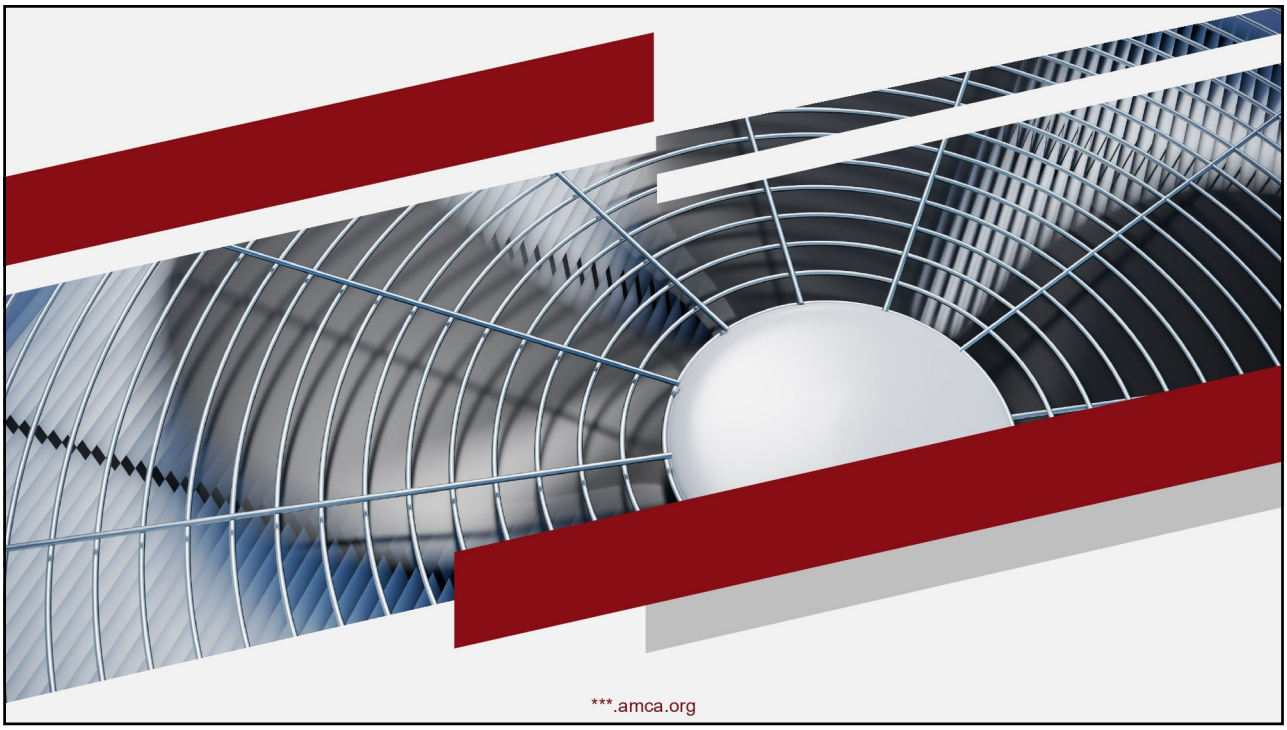
## Questions?



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ajay.kumar@greenheck.com



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