



# **Fire, Smoke, and Radiation Dampers**

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# Today's Program

- **Why Smoke and Fire Dampers?**
- **Code & Regulations**
- **Terminology**
- **Where Required**
- **Testing & Rating**
- **Damper Installation**



# Two Pivotal Events

- **Triangle Shirtwaist Factory Fire – 1911**
  - 146 Deaths mostly smoke inhalation caused by locked exit doors
  - Led to broader scope and adoption for NFPA
- **MGM Grand Fire – 1980**
  - 87 Deaths, 79 from smoke inhalation
  - 650 treated at local hospital, smoke inhalation
  - Fire in 1<sup>st</sup> floor, most deaths on higher floors



# Codes and Regulations

- **NFPA 90A**  
**Standard for the Installation of Air-Conditioning and Ventilation Systems**
- **UMC & IMC**  
**Uniform Mech & International Mech Codes**
- **NFPA 80**  
**Standard for Fire Doors & Other Opening Protectives**
- **NFPA 105**  
**Standard for Smoke Door Assemblies & other Opening Protectives**
- **SMACNA Fire, Smoke & Radiation Damper**



# FIRE, SMOKE AND RADIATION DAMPER INSTALLATION GUIDE FOR HVAC SYSTEMS



SHEET METAL AND AIR CONDITIONING CONTRACTORS'  
NATIONAL ASSOCIATION, INC.



# Caution!

**SMACNA CANNOT JUDGE ANY  
Fire/Damper Combination Fire-  
Smoke Damper Installation as being  
"Approved" or "Acceptable"**

**Installation Instructions of Life Safety  
Products are UL Approved!**



# Who Establishes “Acceptable”?

- **THE DAMPER MANUFACTURER!**
  - Anyone who requires or does any change not specifically shown or defined by the manufacturer is not in compliance with the “AS TESTED” UL safety label of that fire or smoke damper.



# Terminology

- ***Fire Wall*** – A fire resistance rated wall having protected openings, which restricts the spread of fire and 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.





# Terminology

- *Fire barrier wall*, also referred to as a *fire partition*, is a fire rated wall assembly which is not a fire wall. Typically, the main difference is that a fire barrier wall is not structurally self-sufficient, and does not extend through the roof, or necessarily to the underside of the floor above.



# Terminology

- ***Smoke Barrier*** – A continuous membrane, either vertical or horizontal, such as a wall, floor, or ceiling assembly, that is designed and constructed to restrict the movement of smoke. A smoke barrier might or might not have a fire resistance rating. Such barriers might have protected openings.



# Where Required (FSD)

- **Fire Walls – No Exceptions**
- **Fire Barriers - Exceptions**
- **Shaft Enclosures - Exceptions**
- **Fire Partitions - Exceptions**
- **Corridors - Exceptions**
- **Horizontal Assemblies -Exceptions**
- **Membrane Penetrations – No Exceptions**



# Exceptions - Fire Barriers

## Fire Barriers – Exceptions

- Penetration part of ASTM E119 rated assembly *Standard Test Methods for Fire Tests of Building Construction and Materials*
- Ducts used as part of an approved smoke control system
- Walls penetrated with less than 1 hour rating & fully sprinkled. Minimum duct metal thickness is 0.019 inch (26 gage)



# Exceptions – Shaft Enclosures

## Shaft Enclosures - Exceptions

- Steel exhaust sub-ducts extending upward at least 22 inches
- ASTM E119 rated assembly *Standard Test Methods for Fire Tests of Building Construction and Materials*
- Ducts used as part of an approved smoke control system



# Exceptions – Fire Partitions

## Fire Partitions – Exceptions

- Tenant separation or corridor walls within fully sprinkled building
- Duct less than 100 sq. inches
- Duct not having openings that communicate the corridor with adjacent spaces



# Exceptions - Corridors

**Corridors – Exceptions (smoke dampers)**

**-Buildings equipped throughout with an approved smoke control system**

**-Corridor penetrations in which duct is steel not less than 0.019 inch thickness (26 gage)**



# Exceptions

- **Horizontal Assemblies – Exceptions**
  - Duct is permitted to penetrate three floors or less if it meets all of the following
    - \*26 gage minimum (0.019 inch thickness) and located within the cavity of the wall
    - \*Duct shall not exceed 100 sq. inches
    - \*Annular space must be protected per ASTM E119





# Exceptions

- **Grease Duct Enclosures**
  - 2015 IMC
  - Type I Hood Grease Duct
  - Fire Dampers/Smoke Dampers are prohibited!!!



# Plans/Specifications/Responsibilities

- **Architect/Designer – Clearly identify all fire-resistant assemblies and their hourly ratings on the drawings**



# Plans/Specifications/Responsibilities

- **Engineer – Clearly identify on the project drawings all duct penetrations of fire-resistive assemblies and the details and methods required to maintain the fire-resistive integrity of those assemblies**
- **Mandatory via Administrative Section of the Model Building Codes**



# Plans/Specifications/Responsibilities

- **Code Official – Mandatory that the plans and specifications completely identify all fire-resistant assemblies, and the details of how those penetrations are to be protected**



# UL555 Fire Dampers

- **Fire Test (ASTM E 119)**
  - Flame Exposure
  - 1 ½ (1750°) or 3 (1900°) Hour
- **Hose Stream Test**
  - Explosive Forces
- **Dynamic Closure Test**
  - Pressure & Velocity & Temperature
- **Cycle Test – Salt Spray**
  - Operation Reliability
  - Gunking Test



# Fire Damper Ratings

- **1 ½ Hour – 2-hour fire rated assemblies**
- **3 Hour – 4-hour fire rated assemblies**
- **Fire damper 75% of assembly**
- **England = Fire damper 100% of assembly rating**
- **Leakage Class what does it mean?**



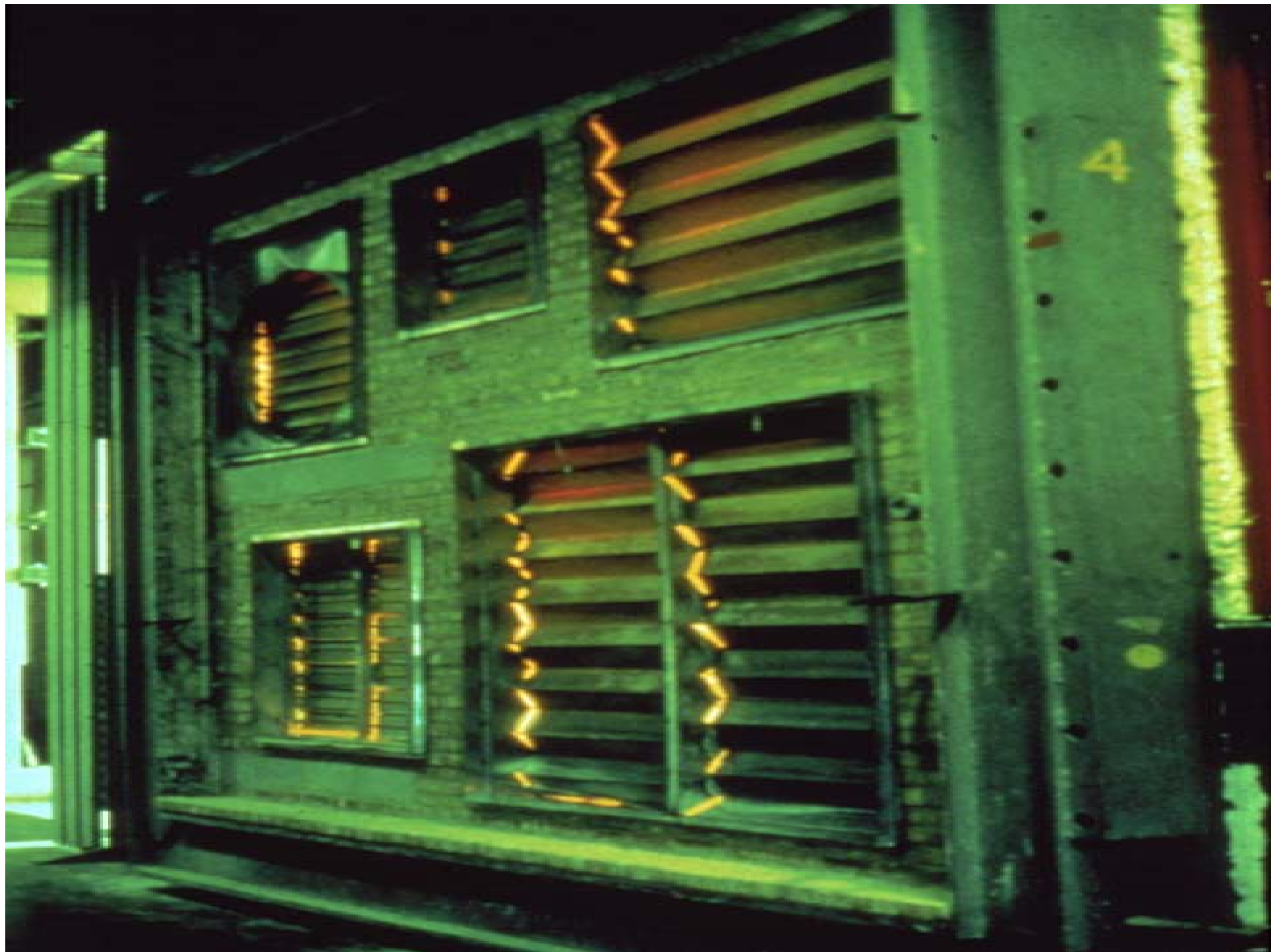
# Leakage Class

- Leakage rate tested across a closed damper
- Tested at 4, 6, 8, 10 & 12 Inch WG.
- Higher leakage class—I, II, or III—represents a higher CFM/FT<sup>2</sup> leakage rate through the closed damper
- Has **NO** relation to air leakage from the overall duct system!



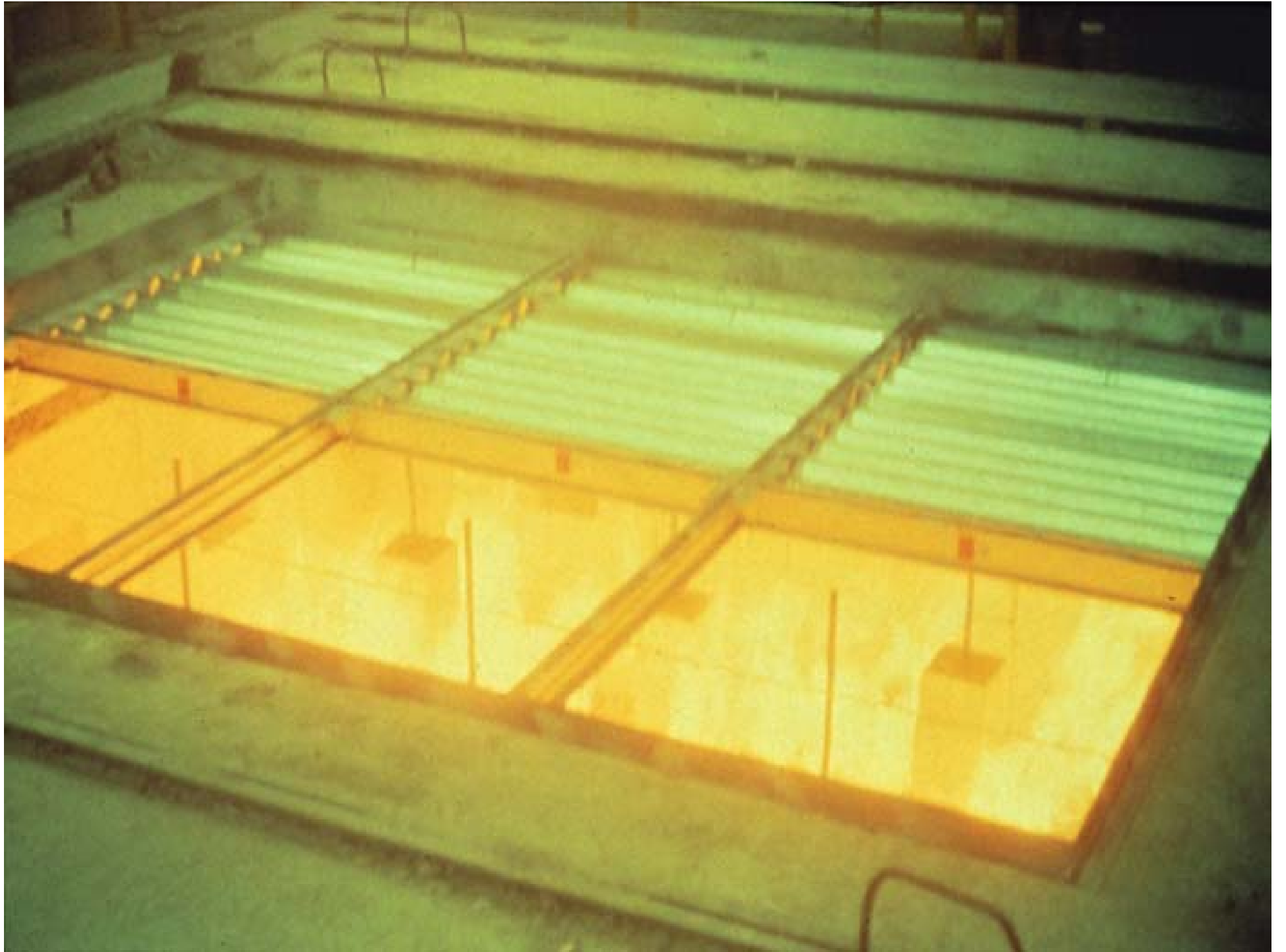


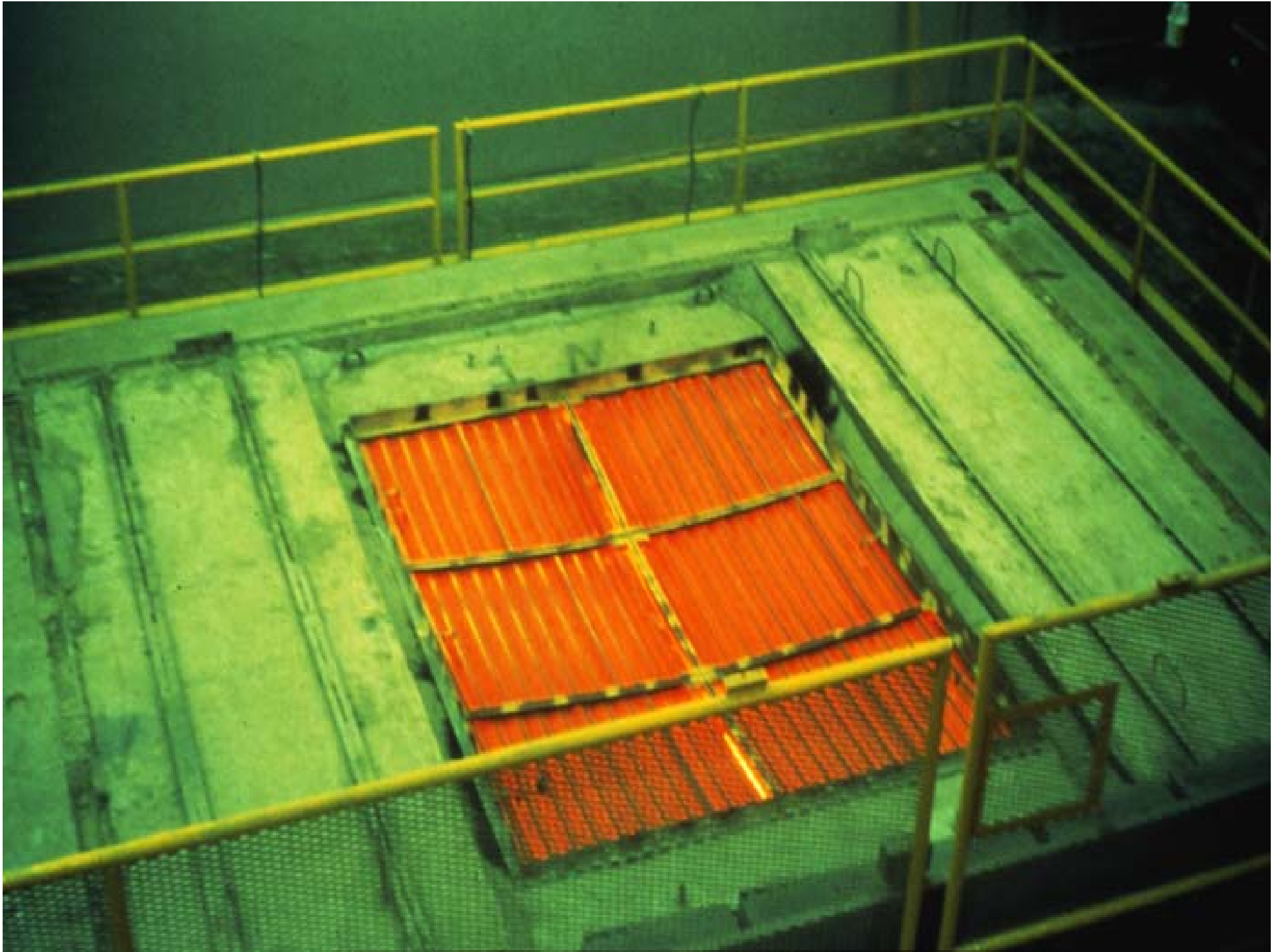


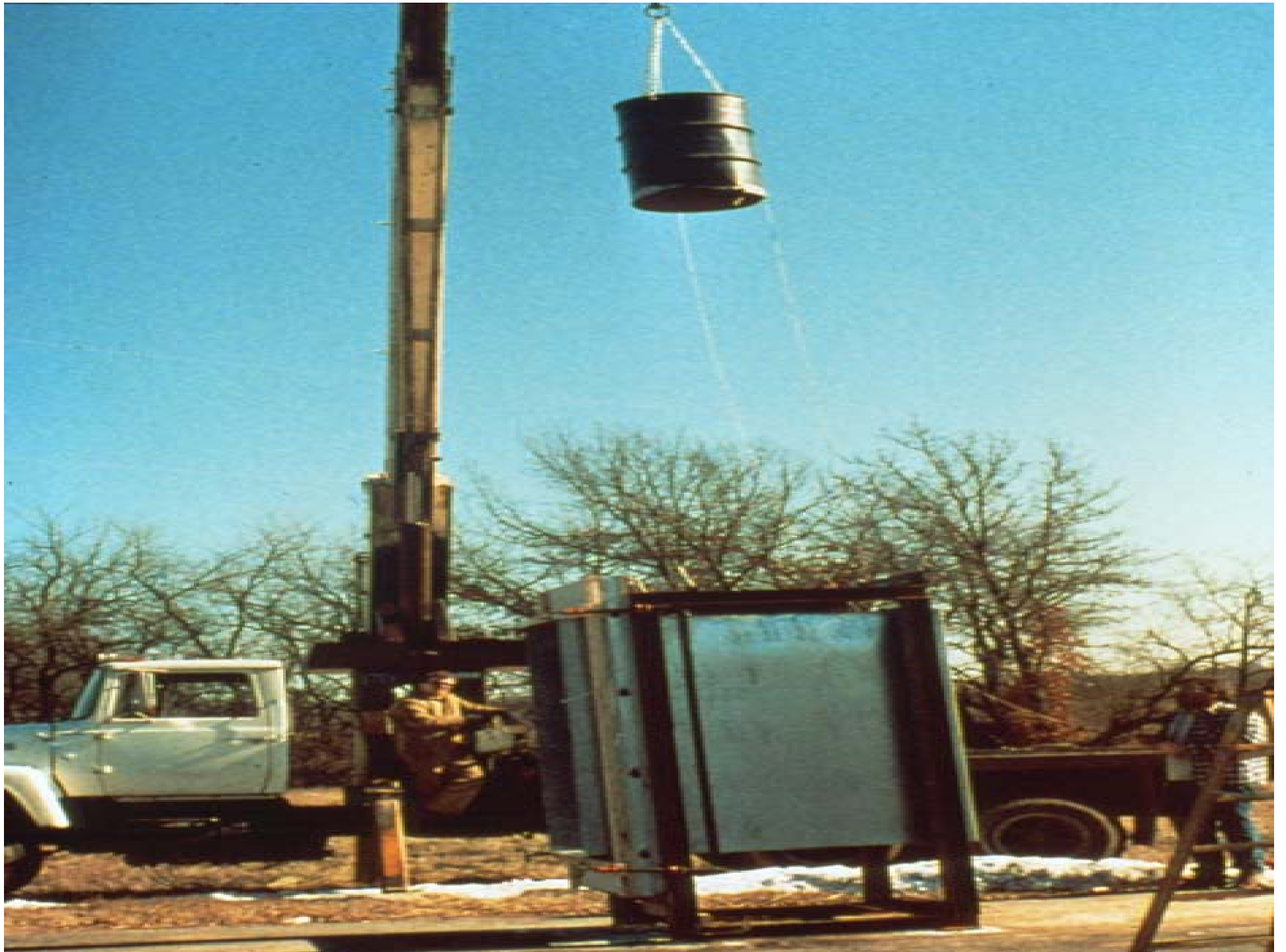


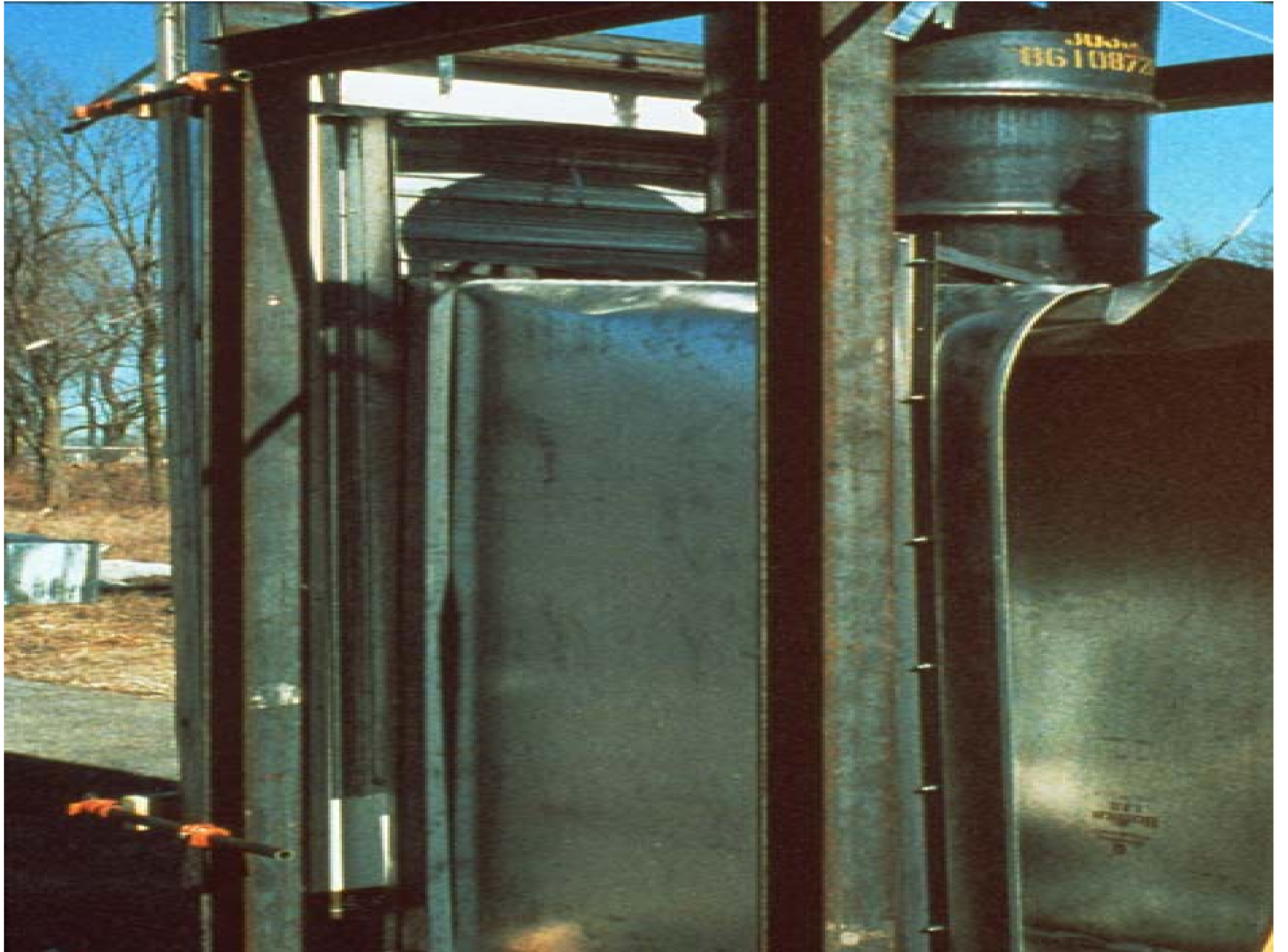












## CHAPTER 5

# FIRE DAMPER INSTALLATION

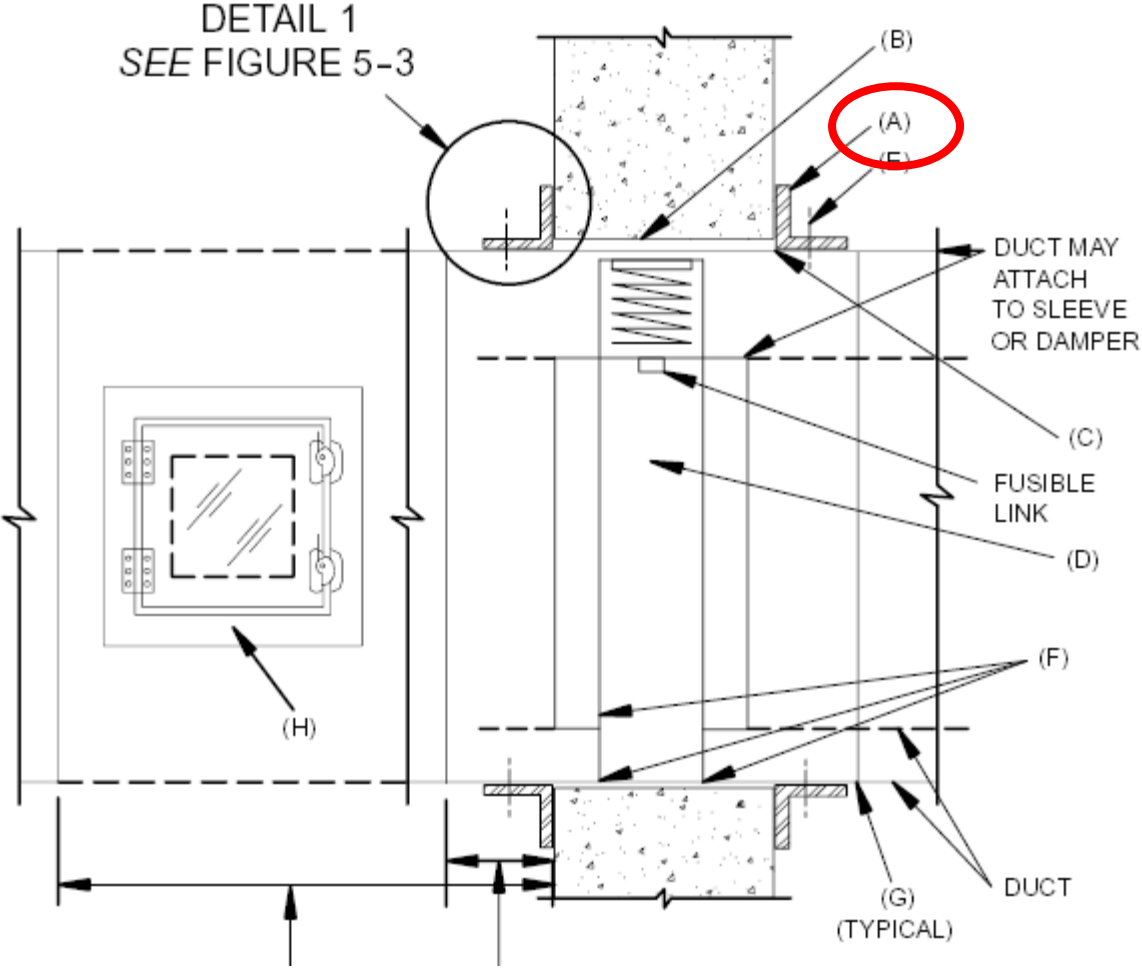




## TABLE 5-1 REQUIRED FIRE DAMPER INSTALLATIONS

Item	Manufacturer Information to be Provided
1. Damper	<ul style="list-style-type: none"> <li>a. function</li> <li>b. static or dynamic</li> <li>c. make (mfr.)</li> <li>d. model number</li> </ul>
2. Fire Resistance Rating	<ul style="list-style-type: none"> <li>a. time in hours</li> </ul>
3. Approval	<ul style="list-style-type: none"> <li>a. testing or listing agency</li> </ul>
4. Sleeve	<ul style="list-style-type: none"> <li>a. material</li> <li>b. thickness</li> <li>c. length (maximum)</li> <li>d. maximum distance of sleeve termination from wall (see UL 555)</li> </ul>
5. Duct-to-Sleeve (or Frame) Connection	<ul style="list-style-type: none"> <li>a. method(s)</li> <li>b. locations</li> </ul>
6. Damper Attachment to Sleeve	<ul style="list-style-type: none"> <li>a. method(s)</li> <li>b. locations</li> </ul>
7. Retaining Angle	<ul style="list-style-type: none"> <li>a. size</li> <li>b. material</li> <li>c. fastener locations</li> </ul>
8. Maximum Rated Size of Damper	<ul style="list-style-type: none"> <li>a. dimension</li> </ul>
9. Assembly of Multiple Sections	<ul style="list-style-type: none"> <li>a. methods</li> <li>b. fastener locations</li> </ul>
10. Airflow	<ul style="list-style-type: none"> <li>a. maximum velocity rating</li> <li>b. static pressure rating</li> </ul>
11. Damper Orientation for Proper Closure	<ul style="list-style-type: none"> <li>a. position</li> </ul>
12. Illustrations	<ul style="list-style-type: none"> <li>a. installation arrangement</li> <li>b. clearance category</li> </ul>
13. Any Construction Detail Contingent on Approval for Listing by a Rating Authority	<ul style="list-style-type: none"> <li>a. pertinent data (e.g. fusible link rating, opening framing provisions, etc.)</li> </ul>

**FIGURE 5-1 BASIC FIRE DAMPER INSTALLATIONS**

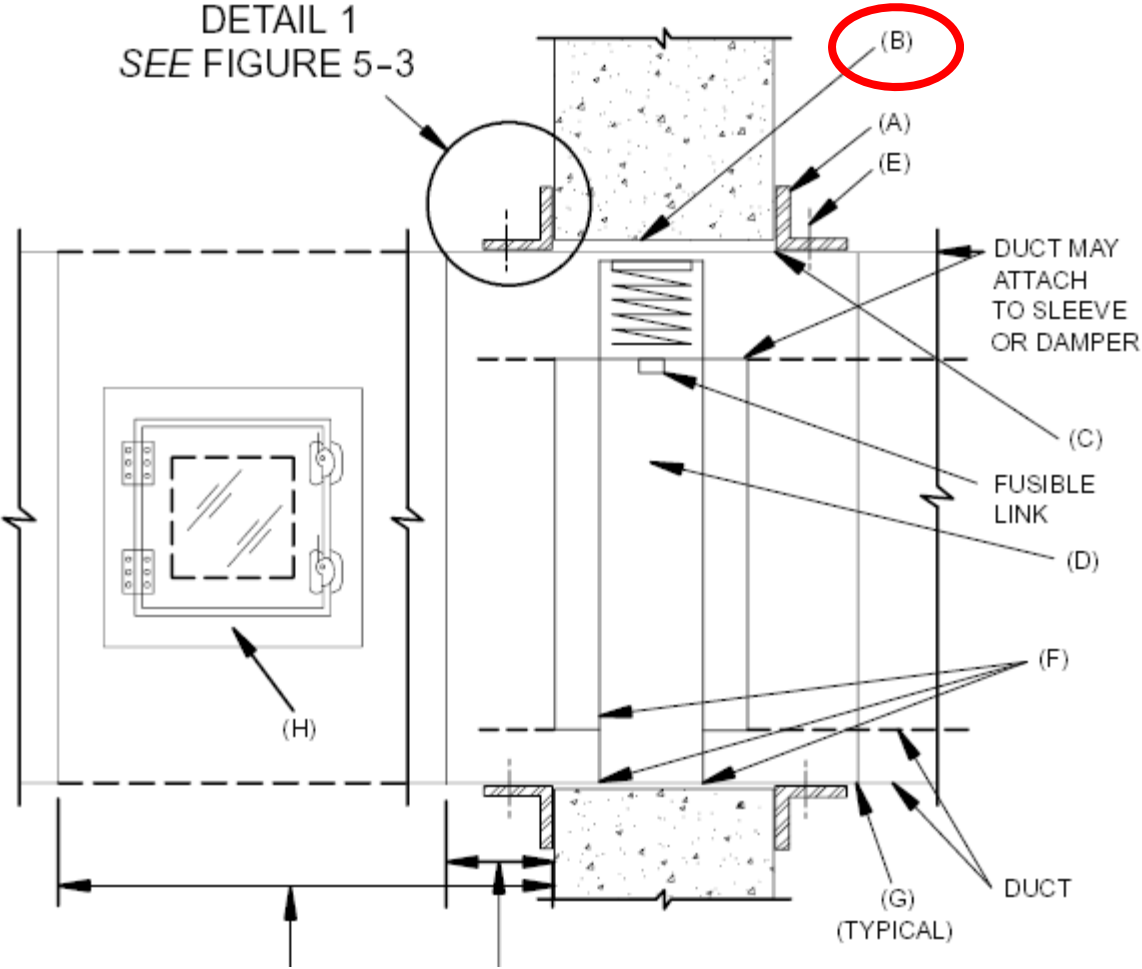


# A. Retaining Angles

1. Minimum  $1\frac{1}{2} \times 1\frac{1}{2} \times 16$  ga ( $40 \times 40 \times 1.6$  mm)
  - a. Retaining angles must overlap structure opening 1 inch minimum and cover corners of openings.
  - b. 16 gage is the most commonly used thickness for the retaining angles. However manufacturers may allow lighter gage angles on some smaller dampers and may require heavier gage angles on larger dampers. Consult the manufacturer's installation instructions for specifics.



**FIGURE 5-1 BASIC FIRE DAMPER INSTALLATIONS**

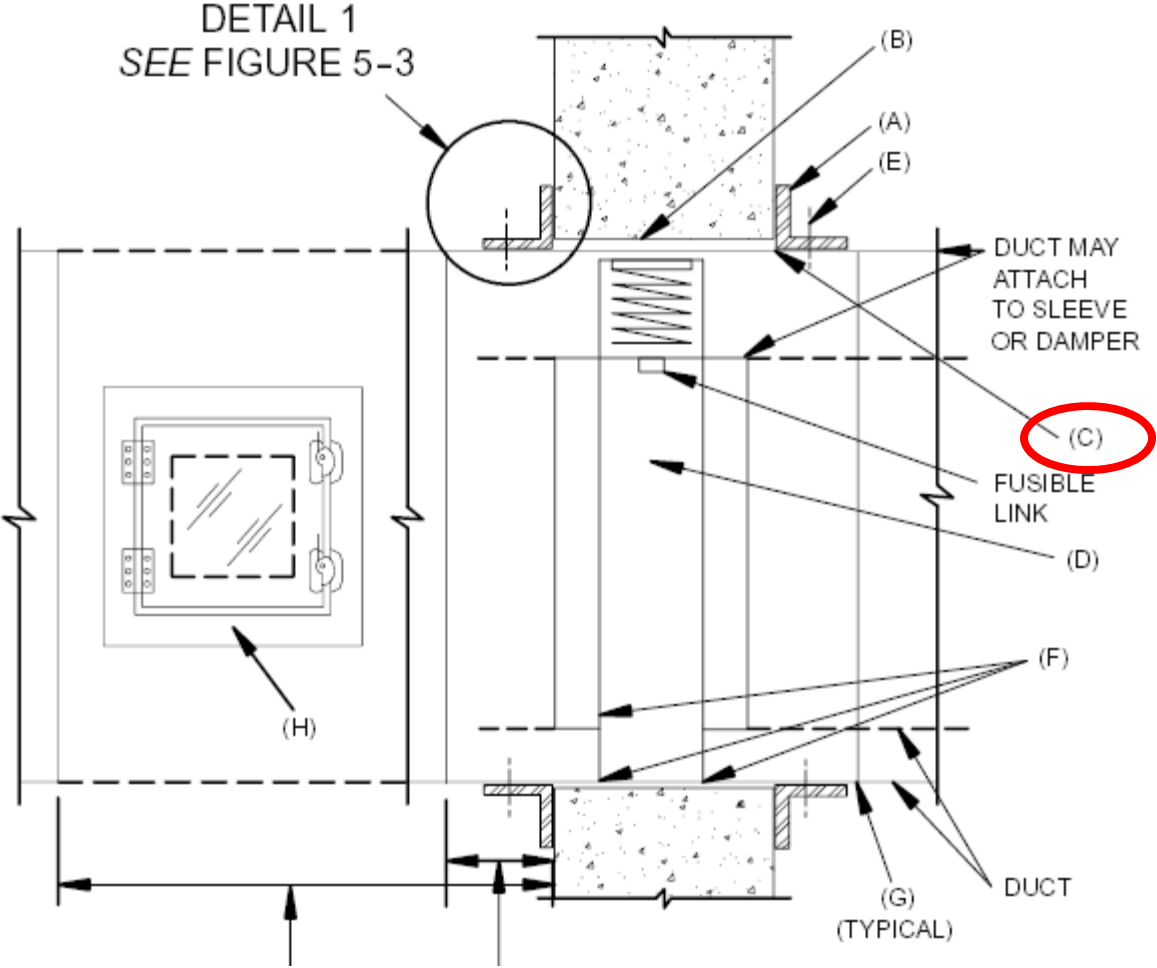


## B. Expansion Space

1. Fire Damper Sleeve Clearance within Wall/  
Floor Opening
  - a. Minimum  $\frac{1}{8}$  inch per linear foot (10 mm per linear meter) of damper — both dimensions. ( $\frac{1}{4}$ " (6 mm) minimum)
  - b. Clearance requirements for damper sleeves within a wall opening are based on  $\frac{1}{8}$  inch per foot (10 mm per meter) of width (or height) unless otherwise stated in the listing of the assembly. The sleeve may rest on the bottom of the opening, and need not be centered. (Fractional dimensions shall be taken as the next largest whole foot.)



**FIGURE 5-1 BASIC FIRE DAMPER INSTALLATIONS**



## **C. Damper Sleeve**

- 1. Steel Sleeve, see Table 5-2 for details.**

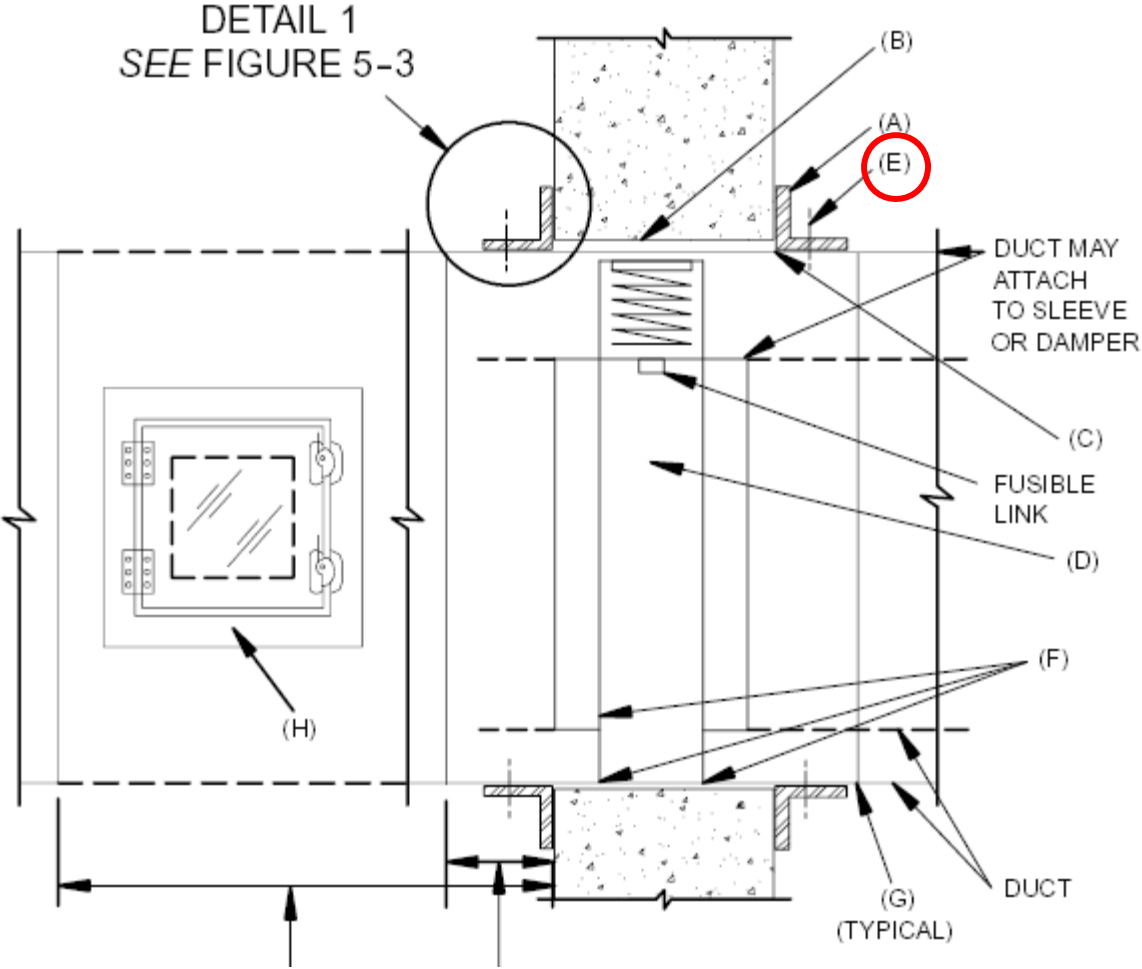


**TABLE 5-2 RECOMMENDED MINIMUM SLEEVE THICKNESS  
FOR FIRE DAMPERS**

Type of Connection	Duct	Duct Dimension	Sleeve Gage
Rigid	Round – Rectangular	24 in. (610 mm) maximum diameter 24 in. (610 mm) maximum height and 36 in. (915 mm) maximum width	16 <sup>+</sup> (1.613 <sup>+</sup> mm)
Rigid	Round – Rectangular	over 24 in. (610 mm) diameter over 24 in. (610 mm) height and over 36 in. (915 mm) width	14 <sup>+</sup> (1.994 <sup>+</sup> mm)
Breakaway (See Figure 5-2 on pages 5.5 and 5.6 )	Round or Rectangular	12 in. (305 mm) and down 13 – 30 in. (330 – 760 mm) 31 – 54 in. (785 – 1370 mm) 55 – 84 in. (1400 – 2130 mm) 85 in. (2160 mm) and up	26 (0.55 mm) 24 (0.70 mm) 22 (0.85 mm) 20 (1.0 mm) 18 (1.3 mm)



**FIGURE 5-1 BASIC FIRE DAMPER INSTALLATIONS**

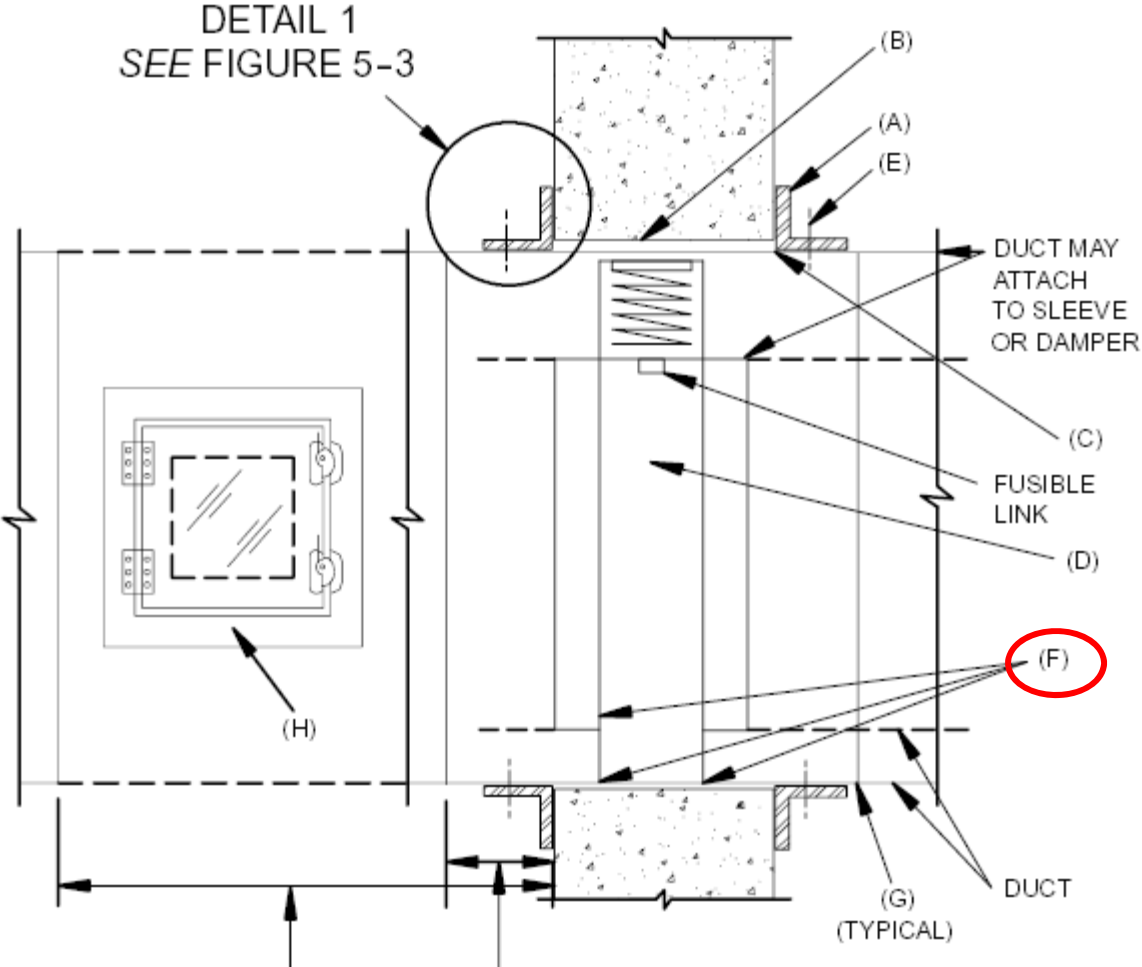


## E. Retaining Angles Fastened to Sleeve

1. Secure Retaining Angles to Sleeve ONLY on 8" centers (203 mm) with:
  - a.  $\frac{1}{2}$ " (12 mm) long welds
  - b.  $\frac{1}{4}$ " (6 mm) bolts and nuts
  - c. No. 10 Sheet Metal Screws
  - d. Minimum  $\frac{3}{16}$ " (5 mm) steel rivets
  - e. *Note:* The size and spacing requirements may differ by damper manufacturer. Consult manufacturer's installation instructions for specifics.



# FIGURE 5-1 BASIC FIRE DAMPER INSTALLATIONS



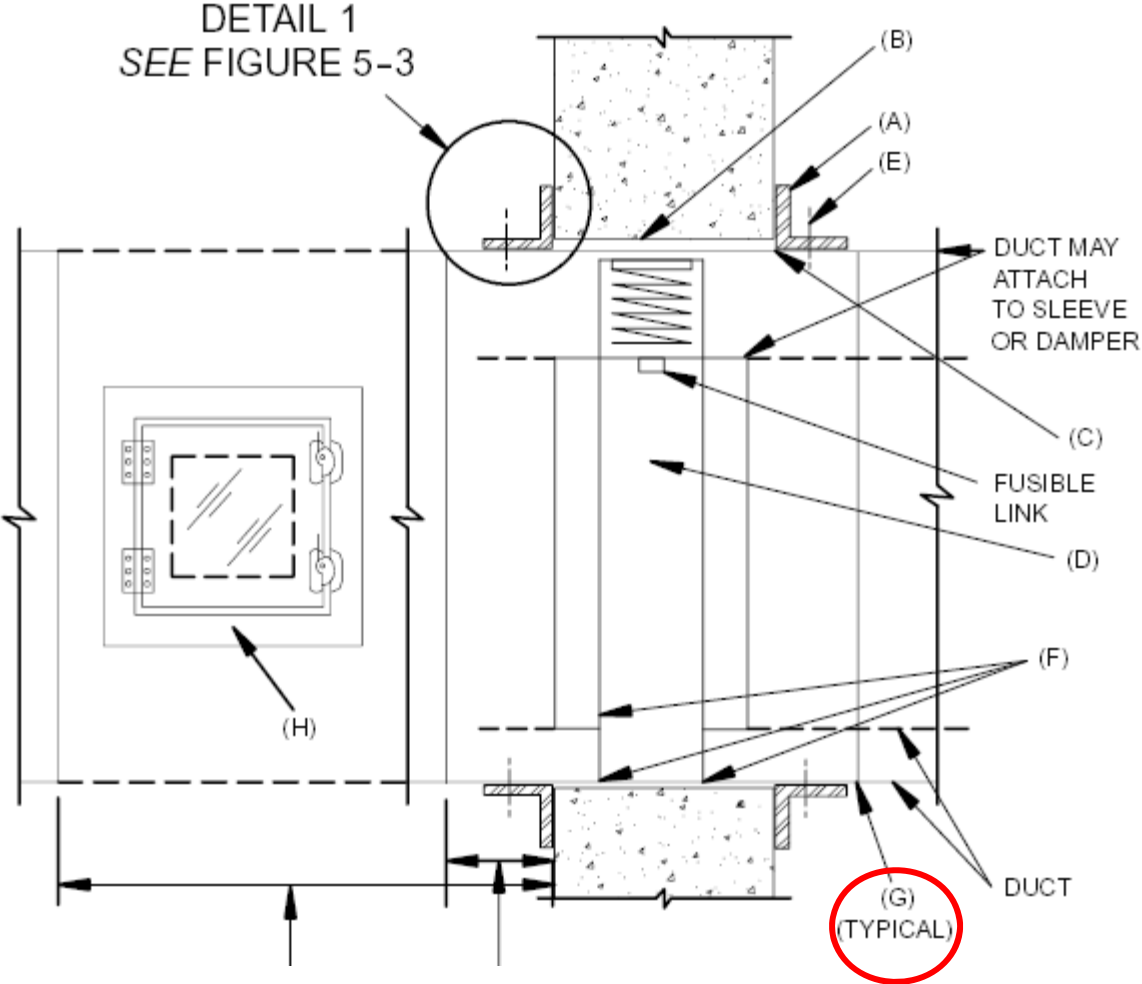
## F. Damper Attachment to Sleeve

1. Secure Damper to Sleeve on 8" centers (203 mm) with:
  - a.  $\frac{1}{2}$ " (12 mm) long welds
  - b.  $\frac{1}{4}$ " (6 mm) bolts and nuts
  - c. No. 10 Sheet Metal Screws
  - d. Minimum  $\frac{3}{16}$ " (5 mm) steel rivets

See note in Item E above.



**FIGURE 5-1 BASIC FIRE DAMPER INSTALLATIONS**



# G. Connection to Duct

1. **Connect Duct to Sleeve as shown in Table 5-2 and as indicated in Figure 5-2**



**TABLE 5-2 RECOMMENDED MINIMUM SLEEVE THICKNESS  
FOR FIRE DAMPERS**

Type of Connection	Duct	Duct Dimension	Sleeve Gage
Rigid	Round – Rectangular	24 in. (610 mm) maximum diameter 24 in. (610 mm) maximum height and 36 in. (915 mm) maximum width	16 <sup>+</sup> (1.613 <sup>+</sup> mm)
Rigid	Round – Rectangular	over 24 in. (610 mm) diameter over 24 in. (610 mm) height and over 36 in. (915 mm) width	14 <sup>+</sup> (1.994 <sup>+</sup> mm)
Breakaway (See Figure 5-2 on pages 5.5 and 5.6 )	Round or Rectangular	12 in. (305 mm) and down 13 – 30 in. (330 – 760 mm) 31 – 54 in. (785 – 1370 mm) 55 – 84 in. (1400 – 2130 mm) 85 in. (2160 mm) and up	26 (0.55 mm) 24 (0.70 mm) 22 (0.85 mm) 20 (1.0 mm) 18 (1.3 mm)

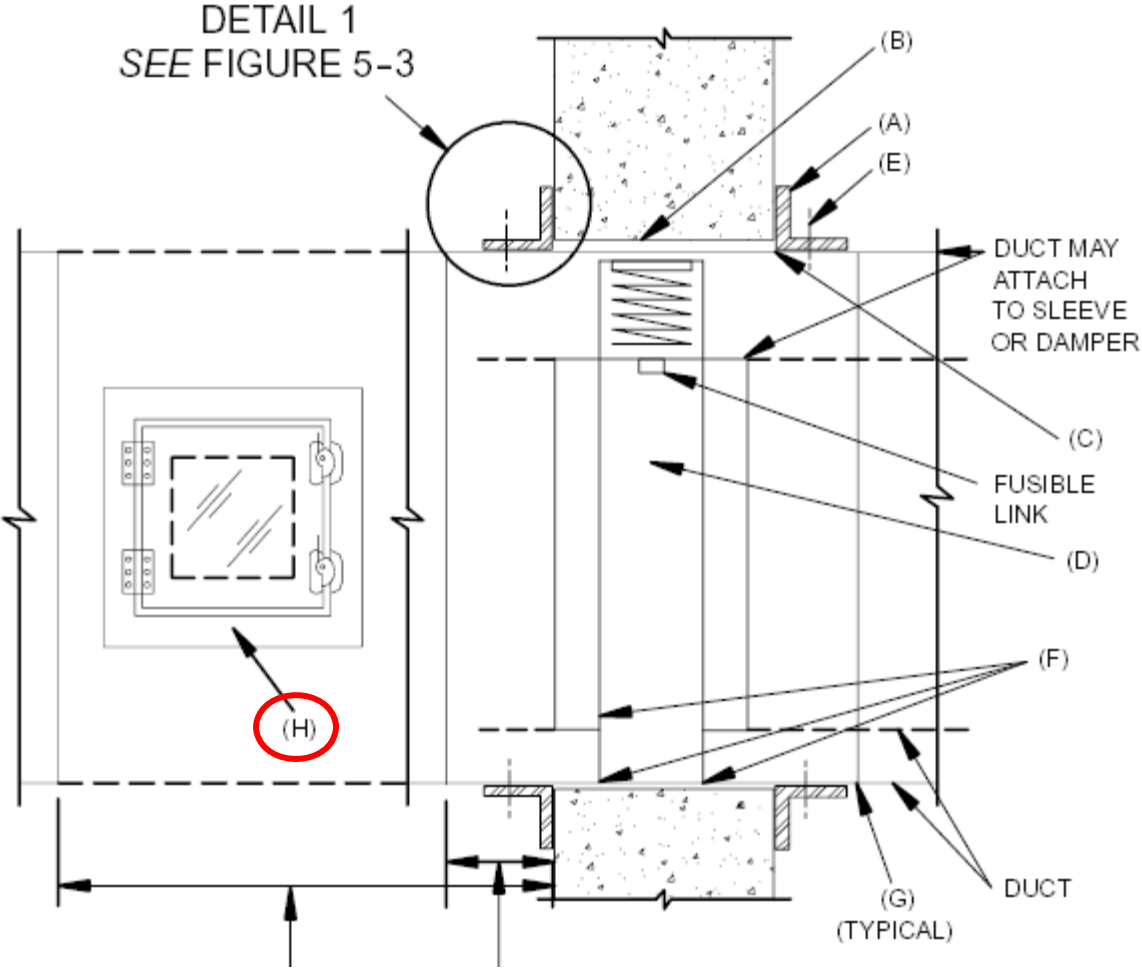
## **H. Access Door or Panel**

- 1. Install as shown in Figure 5-1**



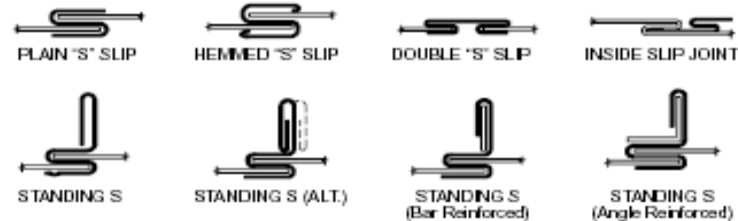


**FIGURE 5-1 BASIC FIRE DAMPER INSTALLATIONS**



## FIG. 5-2 UL DUCT-SLEEVE CONNECTIONS (BREAKAWAY CONNECTIONS)

1. DUCT-SLEEVE CONNECTIONS LISTED IN UL 555, SIXTH EDITION, STANDARD FOR FIRE DAMPERS.



2. ADDITIONAL DUCT-SLEEVE CONNECTIONS WERE TESTED BY SMACNA AND WITNESSED BY UL IN 1991. THE CONNECTIONS PERFORMED WITHIN THE REQUIREMENTS OF THE UL TEST CRITERIA. SEE NOTE 1, FIGURE 5-2 ON PAGE 5.6.

3. FASTENERS MAY BE USED AS FOLLOWS.

(A) JOINTS USING CONNECTIONS SHOWN IN 1. ABOVE WITH A MAXIMUM OF TWO #10 SHEET METAL SCREWS ON EACH SIDE AND ON THE BOTTOM LOCATED IN THE CENTER OF THE SLIP POCKET AND PENETRATING BOTH SIDES OF THE SLIP POCKET.



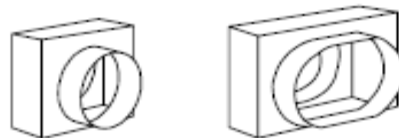
(B) JOINTS USING CONNECTORS OF THE TYPE SHOWN IN 1. ABOVE ON THE TOP AND THE BOTTOM AND USING FLAT DRIVE SLIPS NOT EXCEEDING 20 in. (510 mm) DUCT HEIGHT ON THE SIDES (SEE SKETCH ABOVE).

(C) JOINTS WHERE ROUND OR OVAL SPIRAL DUCTS ATTACH TO ROUND OR OVAL COLLARS WHICH ARE PART OF THE DAMPER SLEEVE AS SHOWN BELOW. #10 SHEET METAL SCREWS ARE SPACED EQUALLY AROUND THE CIRCUMFERENCE OF THE DUCT PER THE FOLLOWING:

- DUCT DIAMETERS 22 in. (560 mm) AND SMALLER—3 SCREWS.
- DUCT DIAMETERS OVER 22 in. (560 mm) TO AND INCLUDING 36 in. (915 mm)—5 SCREWS.

NOTES:

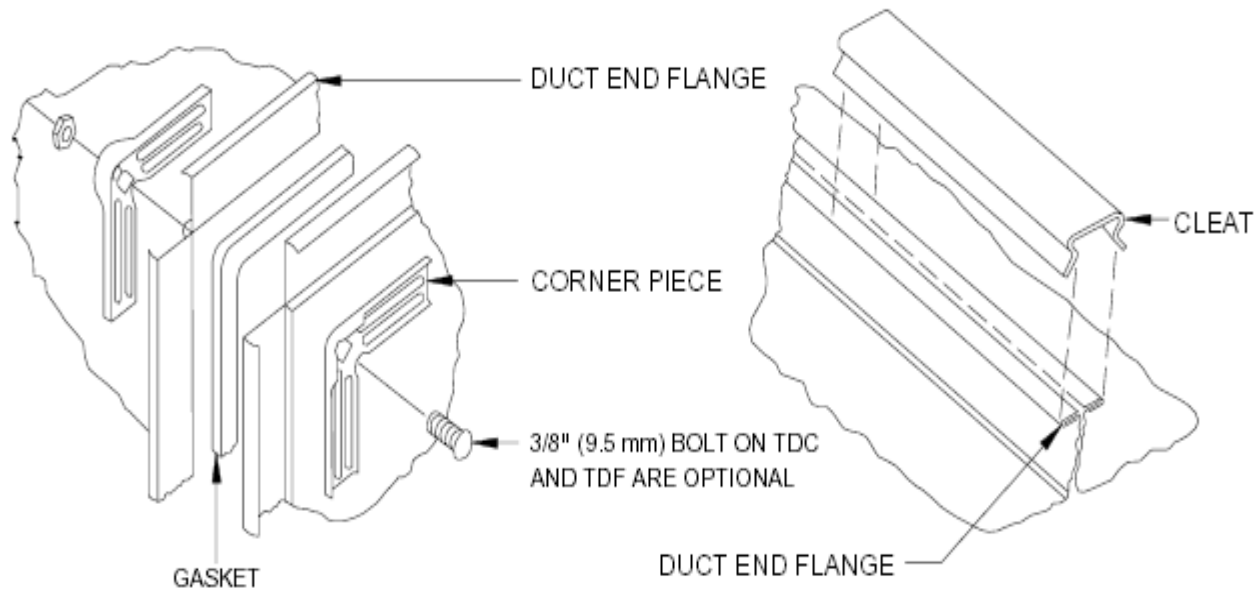
- (1) FOR FLAT OVAL DUCTS, THE DIAMETER SHALL BE CONSIDERED THE LARGEST (MAJOR) DIMENSION OF THE DUCT.
- (2) DUCT SEALANT MAY BE USED AS RECOMMENDED BY THE DAMPER MANUFACTURER.



DAMPER/SLEEVE ASSEMBLIES WITH COLLARS FOR ROUND AND FLAT OVAL DUCTS

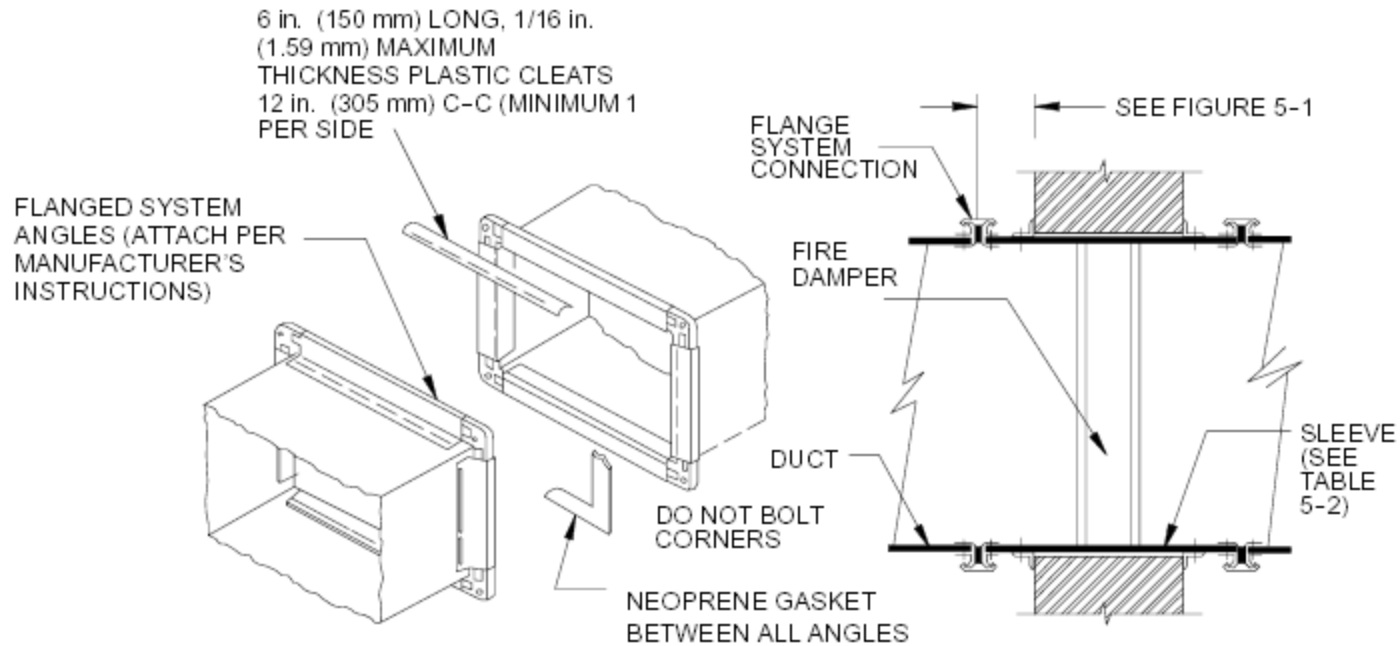
## FIG. 5-2 UL DUCT-SLEEVE CONNECTIONS (BREAKAWAY CONNECTIONS)

(D) TDC AND TDF ROLL-FORMED 4-BOLT FLANGED CONNECTIONS ASSEMBLED PER THE MANUFACTURER'S INSTRUCTIONS USING GASKETS, METAL CLEATS AND FOUR 3/8 in. (9.5 mm) METAL NUTS AND BOLTS.



## FIG. 5-2 UL DUCT-SLEEVE CONNECTIONS (BREAKAWAY CONNECTIONS)

(E) MANUFACTURED SLIP ON 4-BOLT FLANGED CONNECTIONS ASSEMBLED PER THE MANUFACTURER'S INSTRUCTIONS USING GASKETS AND PLASTIC CLEATS AS SHOWN BELOW.



(UL TESTED CONNECTIONS)

## **BREAKAWAY CONNECTIONS (others)**

Flange breakaway connection for fire damper or combination fire smoke damper. These instructions apply to a connection between a manufactured flange system by Ward, Ductmate, Nexus, TDC and TDF. These connections allow the use of combining mixed flange types or like for like. The following instruction depicts the use of Metal or Plastic Cleats, Butyl or Neoprene Gasket, and Bolted or Non-Bolted corners. Also the flanges may be connected with the use of #10 screws without the cleats.

1. Install the manufactured flange system onto the damper sleeve or duct per the manufacturers instructions.
2. Seal the two flange systems together Neoprene or Butyl gasket may be applied to the mating surfaces.
3. Align the two flange systems together. A  $\frac{3}{8}$  in. (9mm) bolt may be used in the corners to help with the alignment. The bolt does not have to be removed. Bolted corners are permitted.
4. Install the cleat or # 10 tek screw, approximately equally spaced, per the schedule described:

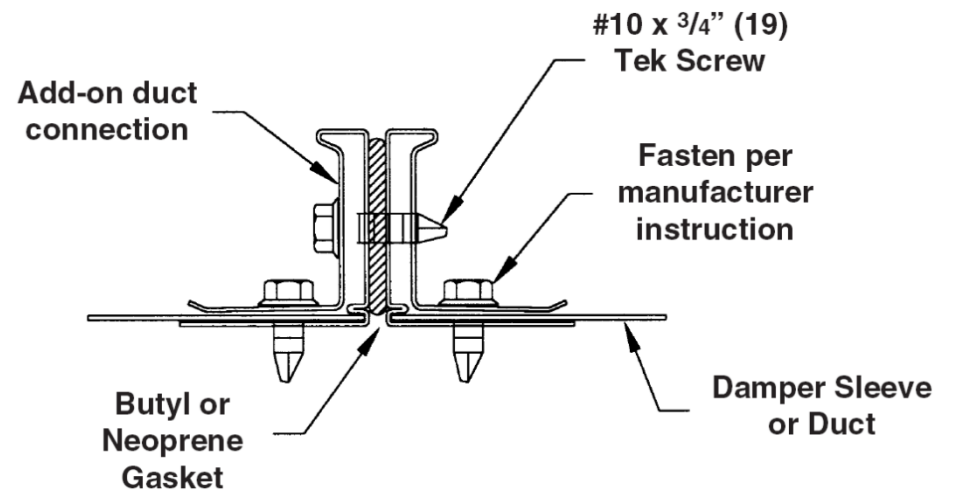
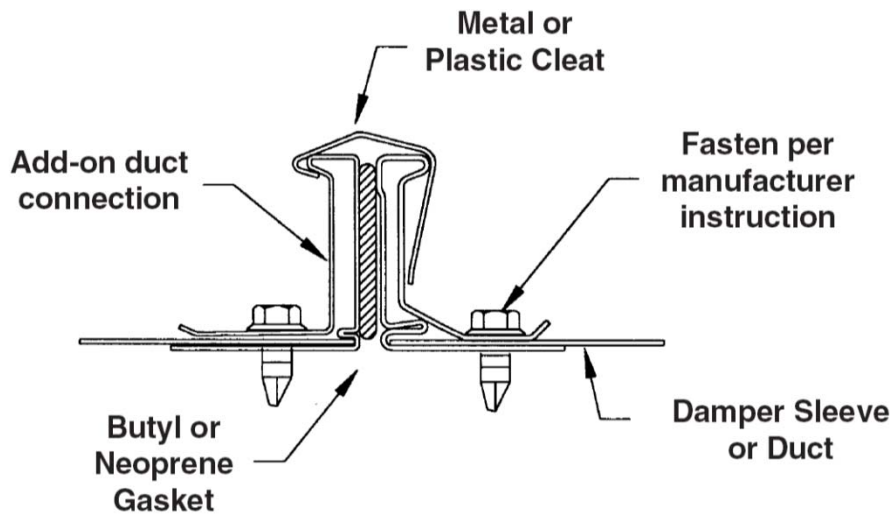
## **BREAKAWAY CONNECTIONS (others)**

- Width or height less than 24 in. (610mm); use one cleat or screw per side
- Width or height 24 in. (610 mm) to less than 36 in. (914mm); use 2 cleats or screws per side
- Width or height 36 in. (914mm) to less than 54 in. (1372mm); use 3 cleats or screws per side
- Width or height 54 in. (1372mm) to less than 72 in. (1829mm); use 4 cleats or screws per side
- Width or height 72 in. (1829mm) or greater; use 5 cleats or screws per side.

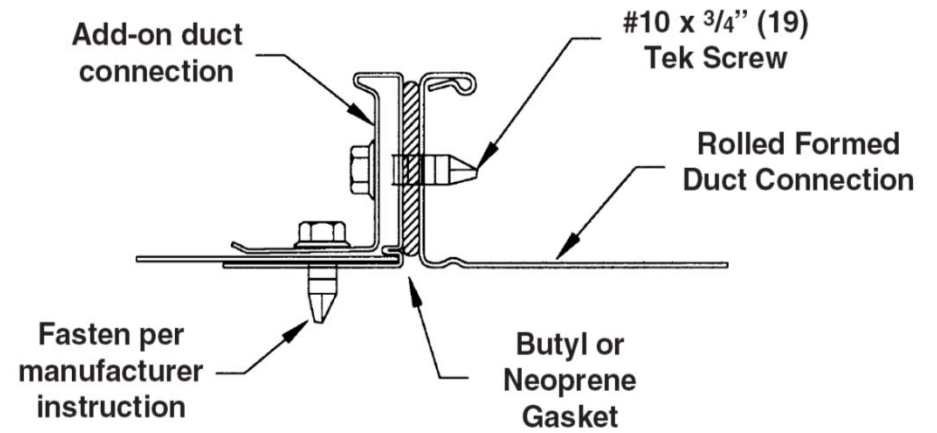
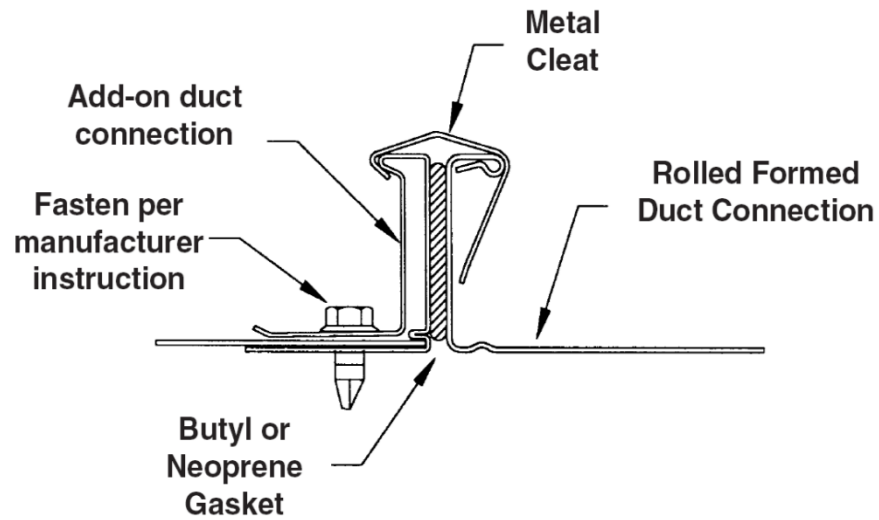


SEE COMPLETE MARKING  
ON PRODUCT

## BREAKAWAY CONNECTIONS (others)

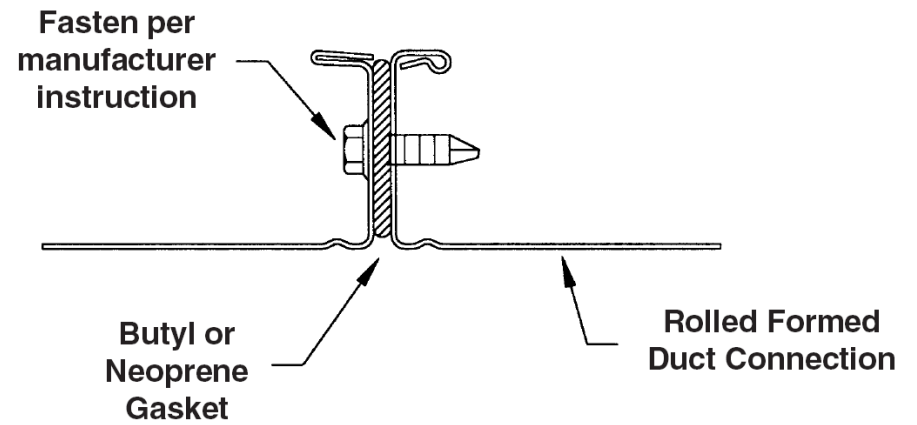
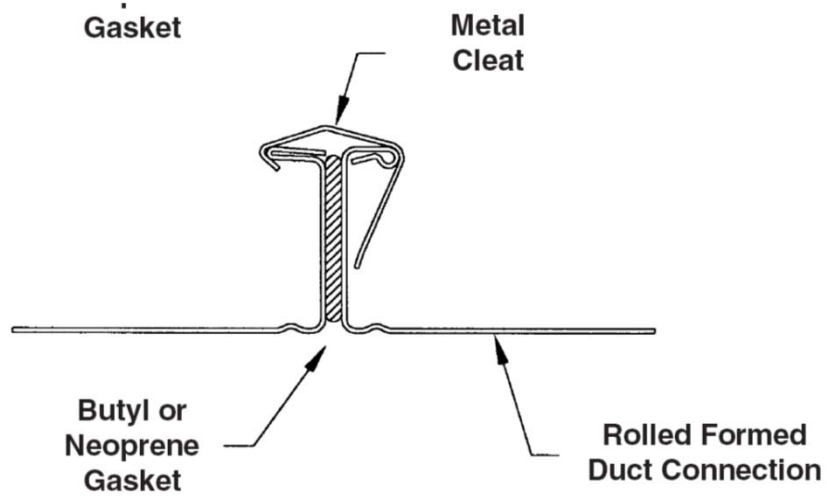


## BREAKAWAY CONNECTIONS (others)

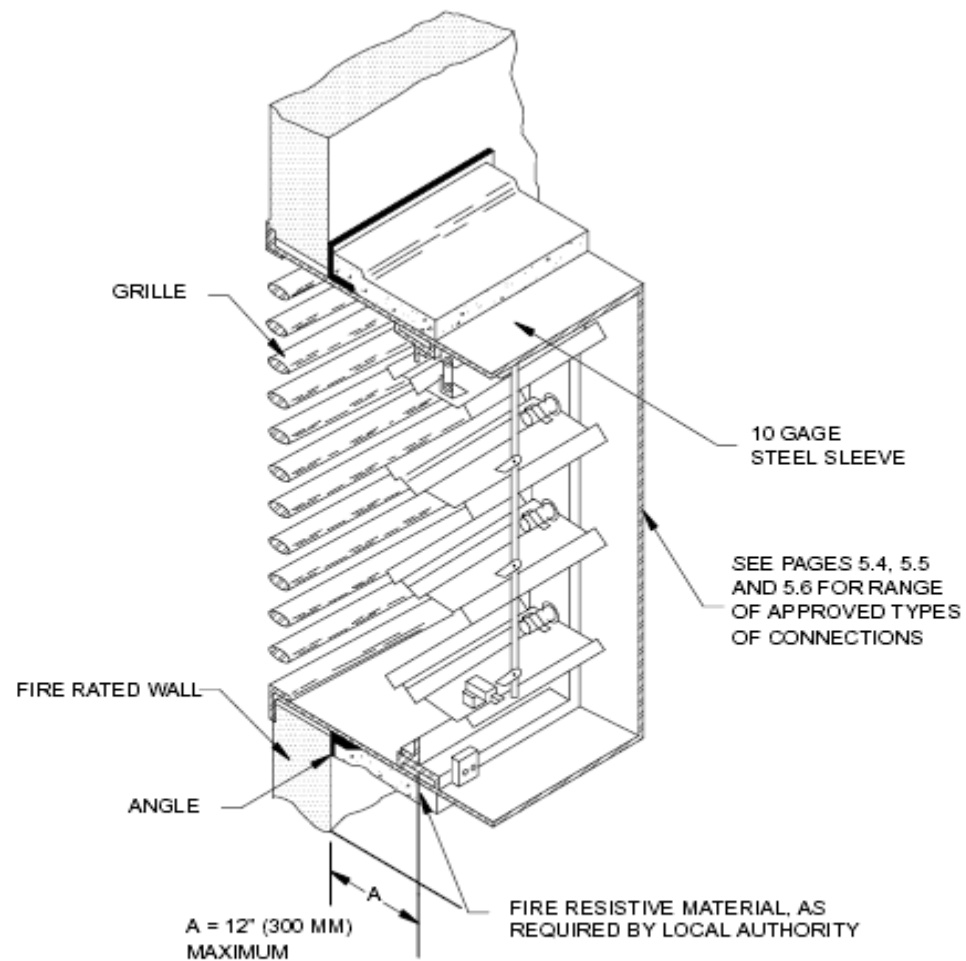




## BREAKAWAY CONNECTIONS (others)

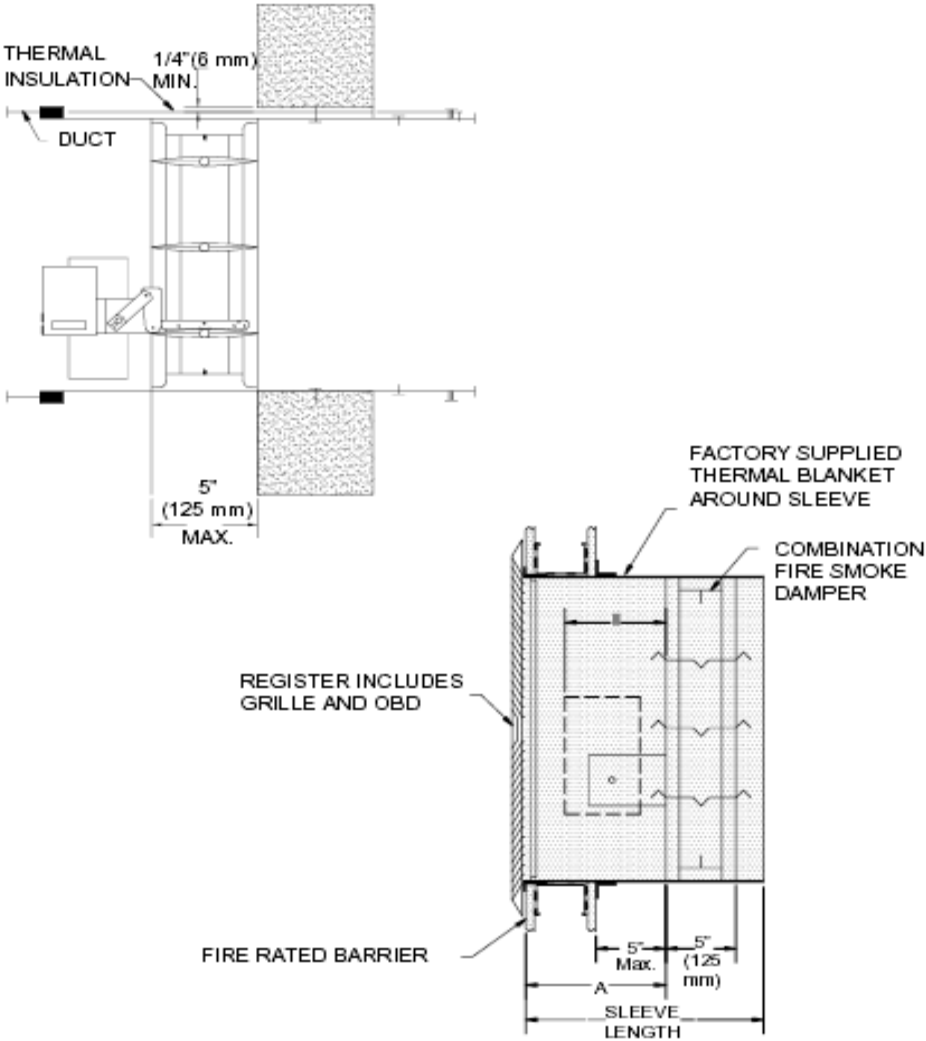


**FIGURE 5-5 FIRE DAMPER OUT OF WALL**



**CAUTION:** USE THIS ARRANGEMENT ONLY WHEN PHYSICAL OBSTRUCTIONS PRECLUDE USE OF METHODS SUCH AS THOSE IN FIGURE 5-4. THE USE OF THIS METHOD REQUIRES THE APPROVAL OF THE LOCAL AUTHORITY.

**FIG. 5-6 COMBINATION FIRE/SMOKE DAMPER OUT-OF-WALL  
INSTALLATION**

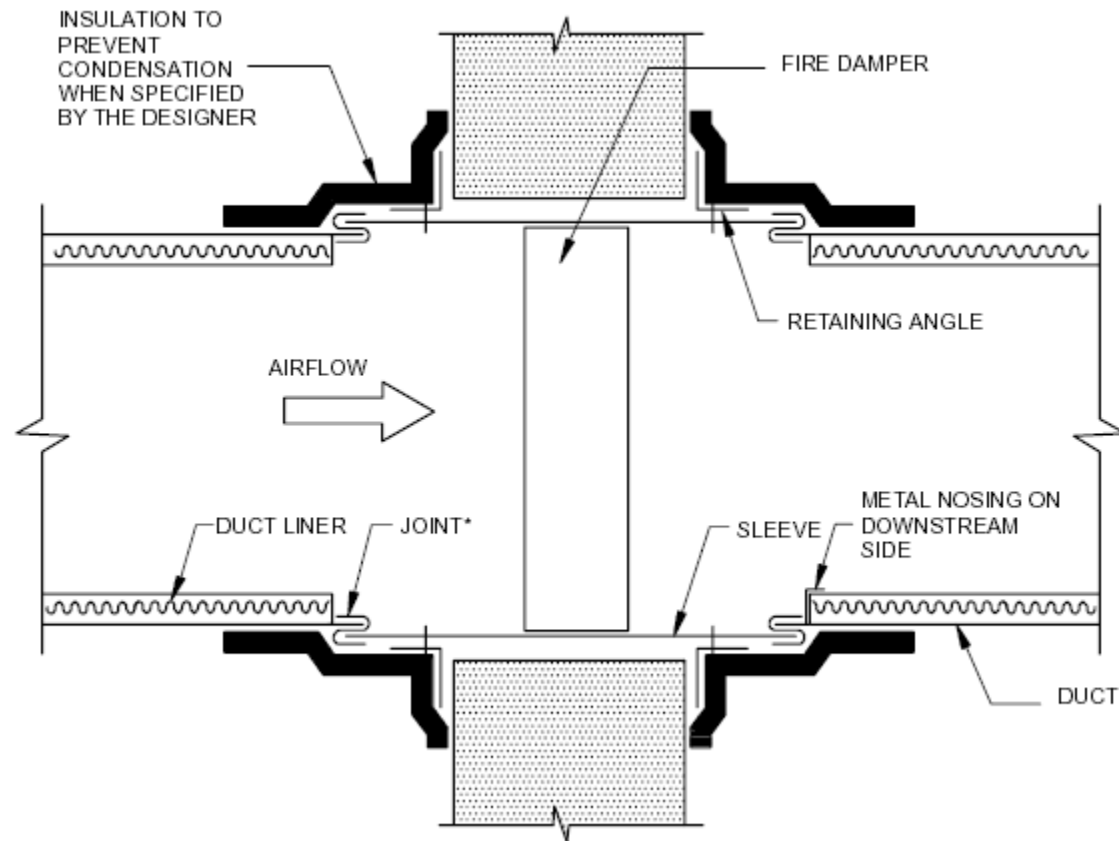


# Insulation Requirements

- Coverings, linings, adhesives must meet flame spread requirements
- Duct covering shall not penetrate fire-resistive rated assemblies or those that require fireblocking
- Nosings are required on the upstream liner interruption



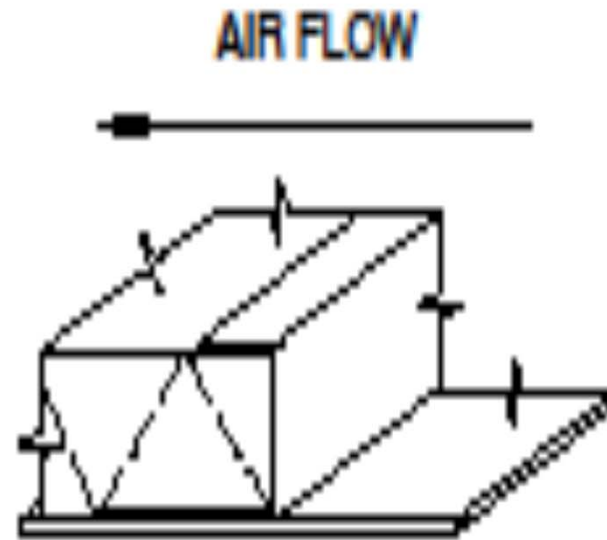
**FIGURE 5-8 DUCT LINER INTERRUPTION**



## METAL NOSING

Metal nosing shall be used on leading edges of each piece of lined duct when the velocity exceeds 4000 fpm otherwise, it shall be used on the leading edge of any lined duct section that is preceded by unlined duct.

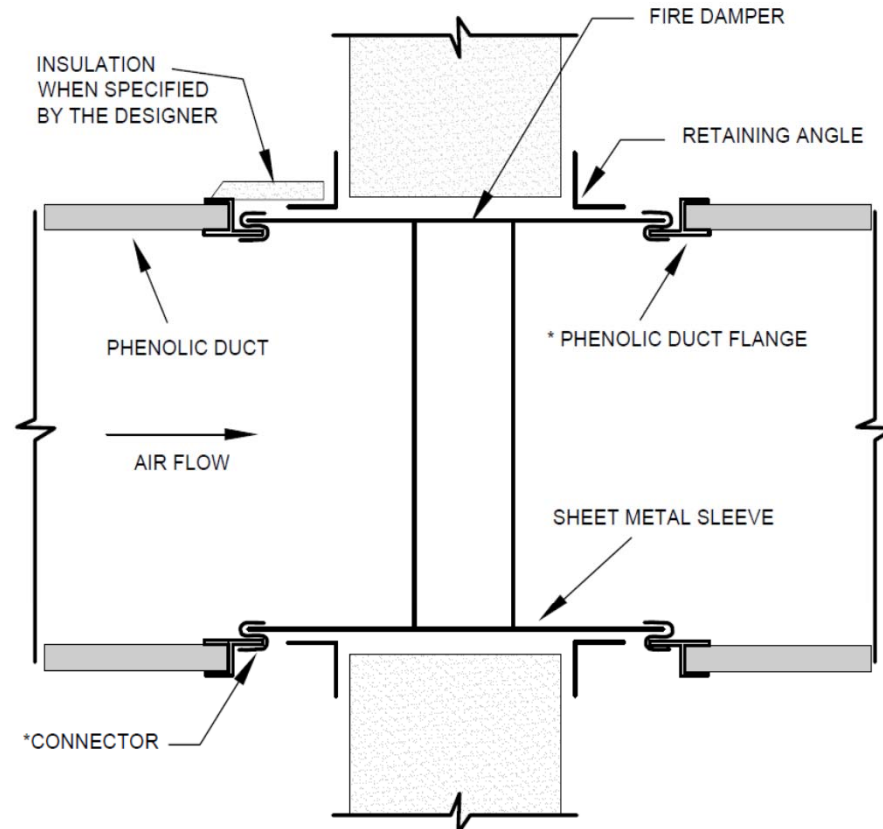
Like the downstream side of a fire damper preceded by lined duct!



DETAIL - A

METAL NOSING  
CHANNEL OR ZEE

# FIGURE 7-11 PHENOLIC DUCT INTERRUPTION

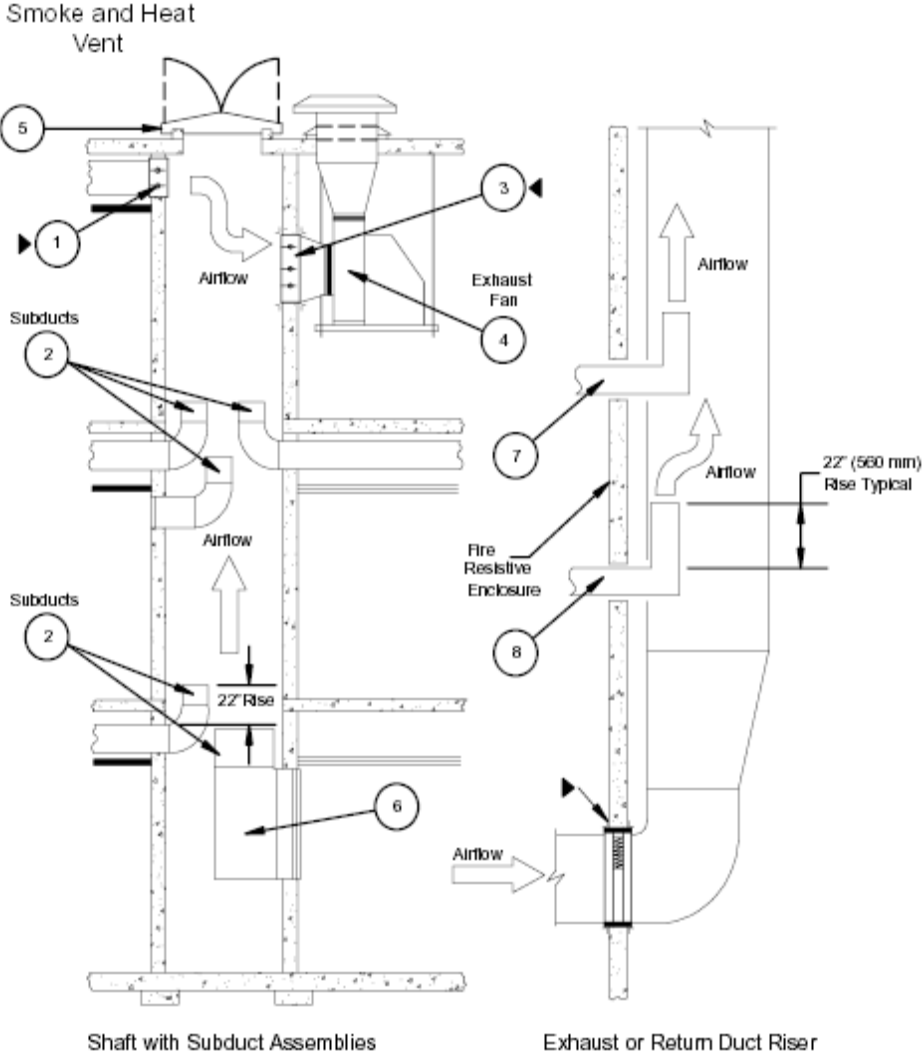


INTERRUPTION OF INTERNAL INSULATION AT THE FIRE DAMPER IS REQUIRED BY NFPA STANDARD 90A. WHERE 90A IS APPLICABLE INSTALLATION SHOULD BE MADE AS SHOWN AND SHOULD OTHERWISE CONFORM TO THE SMACNA HVAC DCS.

THE DESIGNER SHOULD SPECIFY EXTERNAL INSULATION AS SHOWN TO PREVENT CONDENSATION OCCURRING ON UNLINED METAL AT PENETRATIONS. WHERE THE PROVISIONS OF NFPA 90A AS APPLICABLE, NEITHER INSULATION NOR LINER CAN EXTEND THROUGH THE WALLS OF FLOORS.

\* S SLIP IS ILLUSTRATED; SEE SMACNA FIRE, SMOKE AND RADIATION DAMPER MANUAL FOR RANGE OF APPROVED TYPES OF CONNECTOR.

# FIGURE 12-1 SUBDUCTS





# Testing & Inspection

- **Fire/Smoke Dampers**
- **Smoke Control Systems**



# Inspection, Testing & Maintenance

- Dampers to be tested and inspected 1 year after installation
- Test & inspection frequency shall be every 4 years, except in hospitals where frequency is every 6 years
- Operational test after installation for dynamic fire dampers and combination fire smoke dampers



# NFPA 80 Chapter 19

- **19.4.1 Each damper shall be tested and inspected 1 year after installation.**
  - 19.4.1.1 The test and inspection frequency shall then be every 4 years, except in hospitals, where the frequency shall be every 6 years.
- **19.4.4 If the damper is equipped with a fusible link, the link shall be removed for testing to ensure full closure and lock-in-place if so equipped.**



# Smoke Control Systems

- **High-Rise, Hotels, Atriums, Underground Bldgs, etc.**
- **Analysis & Design Factors**
  - Stack Effect
  - Temperature Effect of Fire
  - Wind Effect/Climate
  - HVAC Systems
  - Duration of Operation (20 mins min)



*Questions*  
*Comments*  
*Suggestions*

