Fire, Smoke and Radiation Dampers

Eli Howard
Executive Director Technical Resources
SMACNA

Program

- Code & Regulations
- Terminology
- Testing & Rating
- Damper Installation

Codes and Regulations

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

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

- 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.

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

Where Required

- Fire Barriers – Exceptions
  -Penetration part of ASTM E119 rated assembly
  -Ducts used as part of an approved smoke control system
  -Walls penetrated with less than 1 hour rating & fully sprinkled. Minimum 26 ga thickness

Where Required

- Shaft Enclosures - Exceptions
  -Steel exhaust subducts at least 22 inch
  -ASTM E119 rated assembly
  -Ducts used as part of an approved smoke control system

Where Required

- 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

Where Required

- 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 ga)

Where Required

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

Plans/Specifications/Responsibilities

- Architects – Clearly identify all fire-resistant assemblies and their hourly ratings on the drawings

Plans/Specifications/Responsibilities

- Engineer – Clearly identify on the project's drawings all duct penetrations of fire-resistive assemblies and the details and methods required to maintain the fire-resistive integrity of those assemblies

Plans/Specifications/Responsibilities

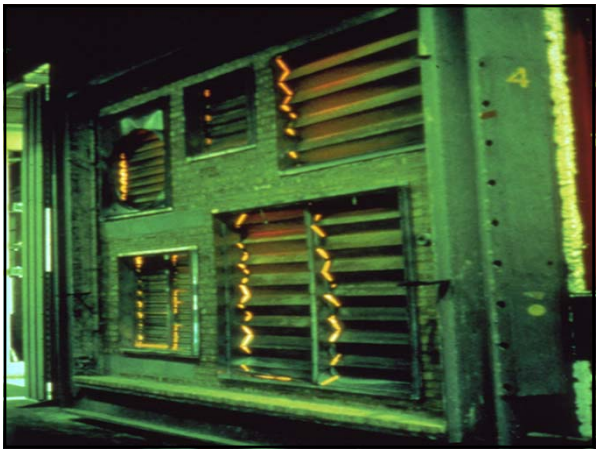
- Code Official – Mandatory that the plans and specifications completely identify all fire-resistant assemblies, and the details of how those penetrations are to be protected

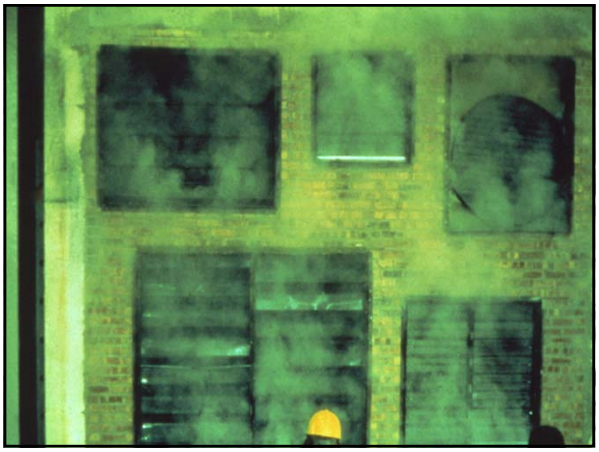
UL555 Fire Dampers

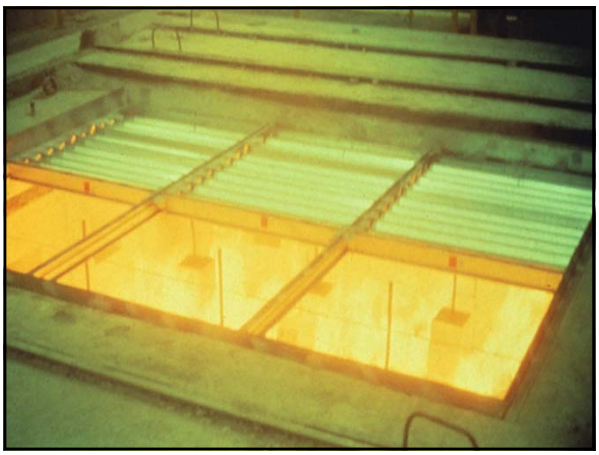
- Fire Test (ASTM E 119)
  - Flame Exposure
  - 1 ½ (1750°) or 3 (1900°) Hour
- Hose Stream Test
  - Explosive Forces
- Dynamic Closure Test
  - Pressure & Velocity & Temperature
- Cycle Test – Salt Spray
  - Operation Reliability
  - Gunking Test

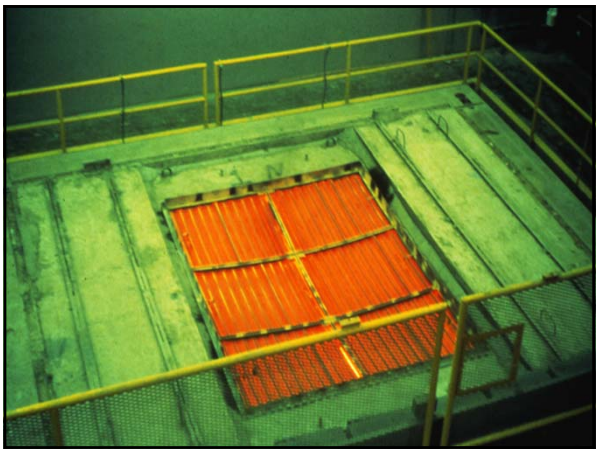
Fire Damper Ratings

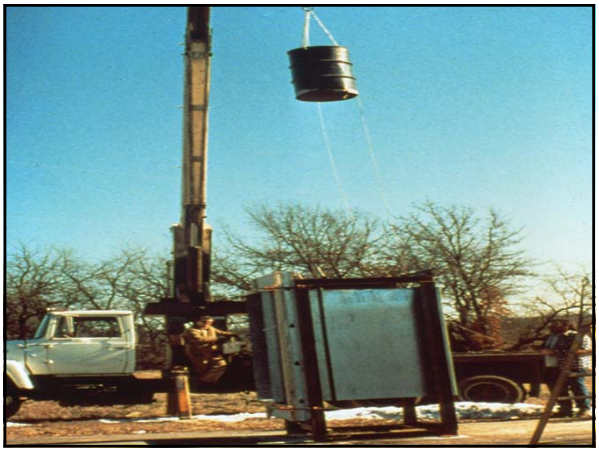
- 1 ½ Hour – Less than 3-hour fire-resistance rated assemblies
- 3 Hour – Fire resistance rated assemblies greater than 3 hour











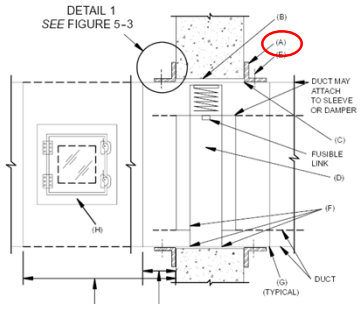
CHAPTER 5

FIRE DAMPER INSTALLATION

TABLE 5-1 REQUIRED FIRE DAMPER INSTALLATIONS

Item	Manufacturer Information to be Provided
1. Damper	a. function b. static or dynamic c. make (mfr.) d. model number
2. Fire Resistance Rating	a. time in hours
3. Approval	a. testing or listing agency
4. Sleeve	a. material b. thickness c. length (maximum) d. maximum distance of sleeve termination from wall (see UL 555)
5. Duct-to-Sleeve (or Frame) Connection	a. method(s) b. locations
6. Damper Attachment to Sleeve	a. method(s) b. locations
7. Retaining Angle	a. size b. material c. fastener locations
8. Maximum Rated Size of Damper	a. dimension
9. Assembly of Multiple Sections	a. methods b. fastener locations
10. Airflow	a. maximum velocity rating b. static pressure rating
11. Damper Orientation for Proper Closure	a. position
12. Illustrations	a. installation arrangement b. clearance category
13. Any Construction Detail Contingent on Approval for Listing by a Rating Authority	a. pertinent data (*e.g.* fusible link rating, opening framing provisions, etc.)

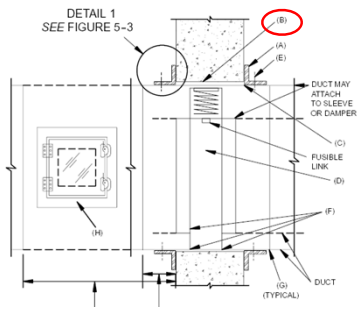
FIGURE 5-1 BASIC FIRE DAMPER INSTALLATIONS



A. Retaining Angles

1. Minimum 1½ × 1½ × 16 ga (40 × 40 × 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.

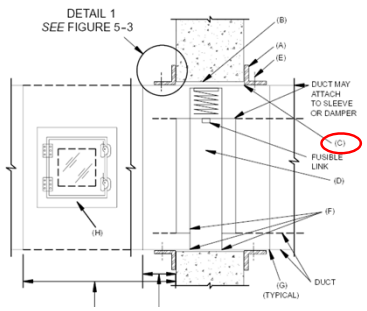
FIGURE 5-1 BASIC FIRE DAMPER INSTALLATIONS



B. Expansion Space

1. Fire Damper Sleeve Clearance within Wall/Floor Opening
   a. Minimum ⅛ inch per linear foot (10 mm per linear meter) of damper — both dimensions. (¼" (6 mm) minimum)
   b. Clearance requirements for damper sleeves within a wall opening are based on ⅛ 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.)

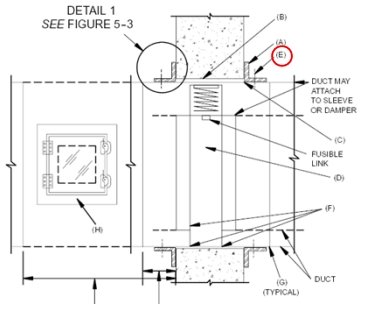
FIGURE 5-1 BASIC FIRE DAMPER INSTALLATIONS



C. Damper Sleeve

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

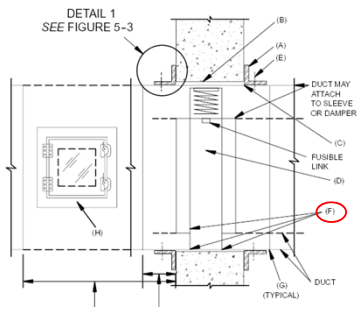
FIGURE 5-1 BASIC FIRE DAMPER INSTALLATIONS



E. Retaining Angles Fastened to Sleeve

1. Secure Retaining Angles to Sleeve ONLY on 8" centers (203 mm) with:
   a. ½" (12 mm) long welds
   b. ¼" (6 mm) bolts and nuts
   c. No. 10 Sheet Metal Screws
   d. Minimum 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

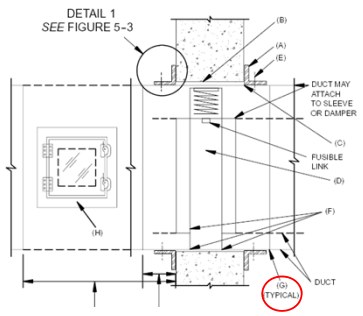


F. Damper Attachment to Sleeve

1. Secure Damper to Sleeve on 8" centers (203 mm) with:
   a. ½" (12 mm) long welds
   b. ¼" (6 mm) bolts and nuts
   c. No. 10 Sheet Metal Screws
   d. Minimum 3⁄16" (5 mm) steel rivets

See note in Item E above.

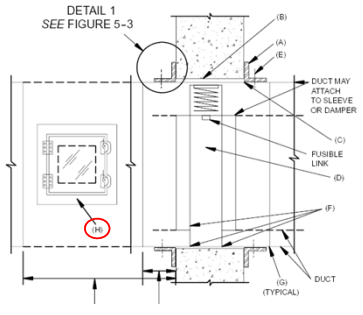
FIGURE 5-1 BASIC FIRE DAMPER INSTALLATIONS



G. Connection to Duct

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

FIGURE 5-1 BASIC FIRE DAMPER INSTALLATIONS



H. Access Door or Panel

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

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* (1.613* mm)
Rigid	Round – Rectangular	over 24 in. (610 mm) diameter over 24 in. (610 mm) height and over 36 in. (915 mm) width	14* (1.994* 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)

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.

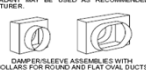
(A) JOINTS USING CONNECTIONS SHOWN IN 1. ABOVE WITH A MAXIMUM OF TWO #10 SHEET METAL SCREWS ON EACH SIDE AND ON THE BOTTOM LOCATED IN THE CENTER OF THE SLIP POCKET AND PENETRATING BOTH SIDES OF THE SLIP POCKET.

(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.

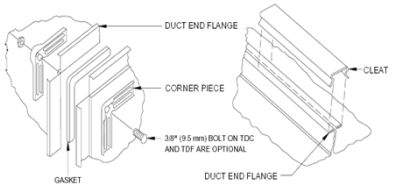
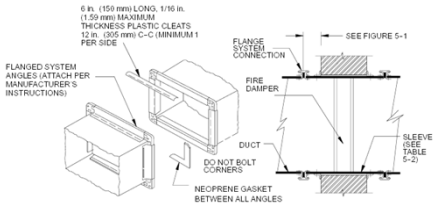


FIG. 5-2 UL DUCT-SLEEVE CONNECTIONS (BREAKAWAY CONNECTIONS)

(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.

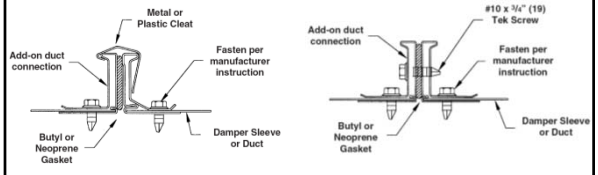
1. Install the manufactured flange system onto the damper sleeve or duct per the manufacturers instructions.
2. Seal the two flange systems together Neoprene or Butyl gasket may be applied to the mating surfaces.
3. Align the two flange systems together. A 3/8 in. (9mm) bolt may be used in the corners 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)

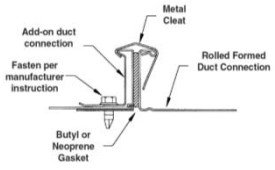
- Width or height less than 24 in. (610mm); use one cleat or screw per side
- Width or height 24 in. (610 mm) to less than 36 in. (914mm); use 2 cleats or screws per side
- Width or height 36 in. (914mm) to less than 54 in. (1372mm); use 3 cleats or screws per side
- Width or height 54 in. (1372mm) to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

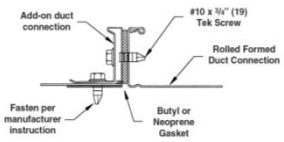
SEE COMPLETE MARKING ON PRODUCT

BREAKAWAY CONNECTIONS (others)



BREAKAWAY CONNECTIONS (others)





BREAKAWAY CONNECTIONS (others)

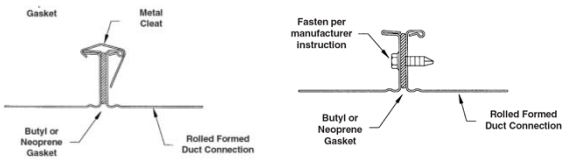


FIGURE 5-3 IMPROPER FIRE DAMPER INSTALLATIONS

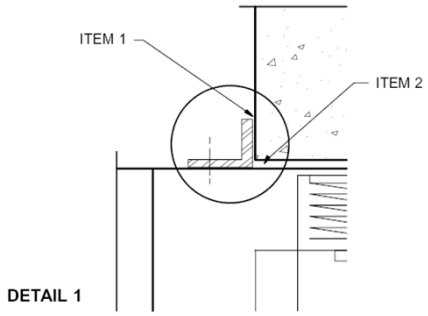
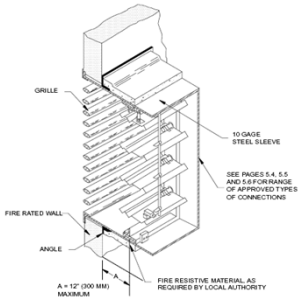


FIGURE 5-5 FIRE DAMPER OUT OF WALL



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

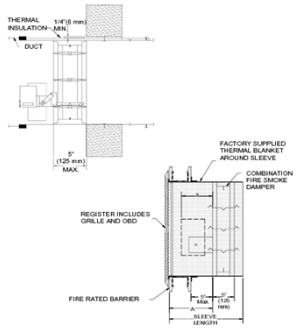


FIGURE 5-8 DUCT LINER INTERRUPTION

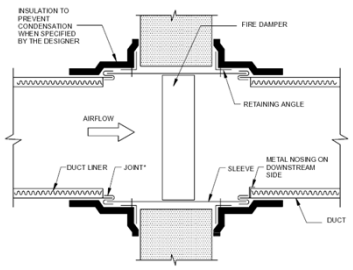


FIGURE 5-9 FIBROUS GLASS DUCT INSTALLATION

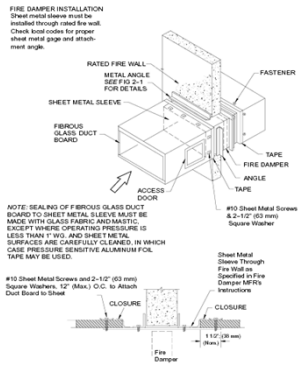
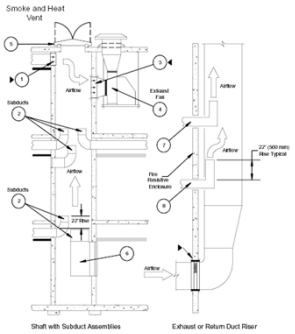


FIGURE 12-1 SUBDUCTS



Testing & Inspection

- Fire/Smoke Dampers
- Smoke Control Systems

NFPA 105 & 80

- Fire/Smoke Dampers
- Chapter 6 &19 Install, Test & Maintenance of Fire Dampers
- Fusible link shall be removed for testing

Inspection, Testing & Maintenance

- Damper 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

Smoke Control Systems

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