

# CodeNotes™

## Through-Penetration Firestop System Requirements for Heating, Ventilation, Air Conditioning

Based on the 2018 *International Building Code*® and the 2018 *International Mechanical Code*®



### Life Safety for Duct Systems

The control of fire and smoke is a major concern in the *International Building Code* (IBC®) and *International Mechanical Code* (IMC®). The IBC and IMC have detailed requirements on these issues from an overall building construction viewpoint. The IBC and IMC contain many requirements and construction techniques intended to limit or control the spread of fire and smoke within a building. These techniques or methods include the use of fire suppression systems (sprinklers), the use of smoke management and control systems, and the construction of walls, floors, partitions, ceiling assemblies, etc. designed to limit the spread of fire and smoke.

In virtually every building, the installation of HVAC systems requires the penetration of fire resistive assemblies (by ducts, pipes, etc.). The IBC and IMC contain language that mandates the maintenance of the fire resistance rating of those assemblies (walls, floors, etc.) when they are penetrated in the course of the distribution of HVAC services. In most cases, penetrations of fire rated assemblies by duct systems require the use of fire or combination fire/smoke dampers, however, when it is applicable a through-penetration firestop system can be used.

### What is a Through-Penetration Firestop System?

A through-penetration firestop system is a specific field-erected construction of an assemblage of materials designed to prevent the spread of fire and its byproducts for a prescribed period of time through openings made in fire rated floors and walls to accommodate through-penetrating items such as ducts, metal and plastic pipes, electrical conduit, cables, cable trays, etc. A firestop system consists of three components:

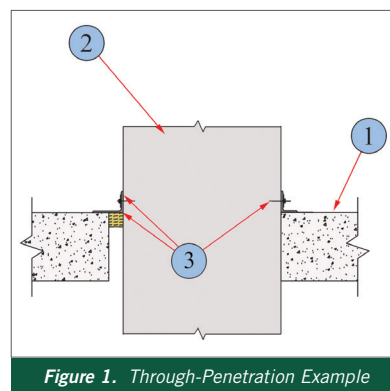


Figure 1. Through-Penetration Example

1. A fire resistive assembly (wall, floor, etc.)
2. Penetrating items (ducts, pipes, conduits, etc.)
3. Firestop materials (packing, sealant, retaining angle, etc.)

The use of firestopping materials is not intended to be a substitution for fire dampers when required by code.

## What codes address firestopping penetration for ducts?

The IBC and IMC requirements clearly define fire-resistant construction, the requirements for through-penetration firestopping, the details of fire-resistant design, and the responsibility of the design professionals. The specific codes for through-penetration firestop systems are as follows:



### 2018 International Building Code

#### 714.4 Fire-resistant-rated walls.

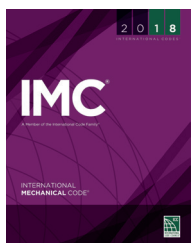
##### 714.4.1.2 Through-penetration firestop system.

*Through penetrations shall be protected by an approved penetration firestop system installed as tested in accordance with [ASTM E 814](#) or [UL 1479](#), with a minimum positive pressure differential of 0.01 inch (2.49 Pa) of water and shall have an *F* rating of not less than the required *fire-resistance rating* of the wall penetrated.*

#### 714.5 Horizontal assemblies.

##### 714.5.1.2 Through-penetration firestop system.

*Through penetrations shall be protected by an approved through-penetrations firestop system installed and tested in accordance with [ASTM E 814](#) or [UL 1479](#), with a minimum positive pressure differential of 0.01 inch of water (2.49 Pa). The system shall have an *F* rating/*T* rating of not less than 1 hour but not less than the required of the floor penetrated.*



### 2018 International Mechanical Code

**607.1.2 Ducts that penetrate fire-resistance-rated assemblies without dampers.** Ducts that penetrate fire-resistance-rated walls and are not required by this section to have dampers shall comply with the requirements of Sections 714.3 through 714.4.3 of the *International Building Code*. Ducts that penetrate horizontal assemblies not required to be contained within a shaft and not required by this section to have fire dampers shall comply with the requirements of Section 714.5 of the *International Building Code*.

## How are the firestop systems approved?

Approval of through-penetration firestop systems is obtained when a specific combination of the above factors is tested in accordance with the methods indicated in [UL 1479](#) or [ASTM E814](#). The [UL Fire Resistance Directory](#) contains a comprehensive listing of tested materials applied in a specific assembly with a specific penetrant. This combination of assembly, penetrant, and fill materials is given the ratings as determined by the test and assigned an alpha-numeric “system number.” This “system number” and its ratings are specific to the assembly, the penetrant, and the fill materials installed in accordance with the manufacturer’s directions.

It is important to note while several “systems” may be approved for a combination of assemblies and penetrations, the fill materials and their installation are not interchangeable between approved systems. In some instances, the UL directory contains additional information on the specific details of each system.

## What happens if the system cannot be installed per the approved details?



Figure 2. Design recommendation

When jobsite conditions do not meet the details shown in a listed system there are methods for determining fire resistance in [Section 703.3](#) of the IBC. The International Fire Council (IFC) and firestopping industry commonly use the term Engineering Judgement or EJ, which is a design recommendation, by qualified personnel, to propose an alternative method, based on previously tested systems, that ensures the recommended firestop system will perform as designed. EJs are issued for a specific jobsite and application, therefore they cannot be transferred to another job unless reviewed by the same qualified personnel who made the EJ. EJs can only be accepted if the local authority having jurisdiction deems them suitable to meet building code requirements.

[Engineering Judgment Guidelines - International Firestop Council](#)

## Applicable use of a Through-Penetration Firestop System

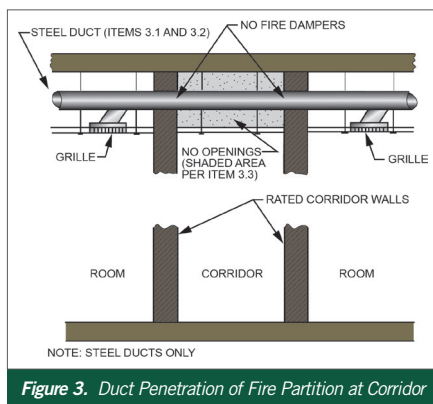


Figure 3. Duct Penetration of Fire Partition at Corridor

First, it needs to be determined if the installation of a Through-Penetration Firestop System is allowed. Many fire-resistance-rated assemblies have exceptions, depending on the group, as to when a fire damper is required. It is when

there are exceptions that the through-penetration firestop systems would be used in order to maintain the rating of the assembly being penetrated. These exceptions can be found in the IBC Sections 717.5 through 717.6. Let's take a look at the exceptions noted under Section 717.5.4 *Fire Partitions*.

### Fire Partitions

Ducts and air transfer openings that penetrate fire partitions shall be protected with listed fire dampers installed in accordance with their listing.

Exceptions: In occupancies other than Group H, fire dampers are not required where any of the following apply.

1. Corridor walls in buildings equipped throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1 or 903.3.1.2 and the duct is protected as a *through penetration* in accordance with Section 714.
2. Tenant partitions in *covered and open mall buildings* where the walls are not required by provisions elsewhere in the code to extend to the underside of the floor or roof sheathing, slab or deck above.
3. The duct system is constructed of approved materials in accordance with the *International Mechanical Code* and the duct penetrating the wall complies with all of the following requirements:
  - 3.1. The duct shall not exceed 100 square inches (0.06 m<sup>2</sup>).
  - 3.2. The duct shall be constructed of steel not less than 26 Gauge having a nominal thickness of 0.0179 in. (0.455 mm).

Note: 0.0217 inch is the minimum thickness required by the code and that thickness corresponds to 26 Gauge galvanized sheet steel duct.

- 3.3. The duct shall not have openings that communicate the *corridor* with adjacent spaces or rooms.
- 3.4. The duct shall be installed above a ceiling.
- 3.5. The duct shall not terminate at a wall register in the fire-resistance-rated wall.

- 3.6. A minimum 12-inch-long (305 mm) by 0.060-inch-thick (1.52 mm) steel sleeve shall be centered in each duct opening. The sleeve shall be secured to both sides of the wall and all four sides of the sleeve with minimum 1 ½ inch by 1 ½ inch by 0.060-inch (38 mm by 38 mm by 1.52 mm) steel retaining angles. The retaining angles shall be secured to the sleeve and the wall with No. 10 (M5) screws. The *annular* space between the steel sleeve and the wall opening shall be filled with mineral wool batting on all sides.

4. Such walls are penetrated by ducted HVAC systems, have a required *fire-resistance rating* of 1 hour or less, and are in buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2. For the purposes of this exception, a ducted HVAC system shall be a duct system for conveying supply, return or exhaust air as part of the structure's HVAC system. Such a duct system shall be constructed of sheet steel not less than No. 26 gauge having a nominal thickness of 0.0179 in. (0.455 mm) and shall be continuous from the air-handling appliance or equipment to the air outlet and inlet terminals.



Figure 4. Correct installation is critical

There have been differing interpretations on exception 4. A ducted HVAC system in the context of exception 4 does not contain flexible ducts except where a steel duct passes through a fire barrier and then converts to a flexible duct to only serve an air terminal device. In such case, the steel duct could have terminated at an air terminal device on the wall, thus, extending the duct run further into the room to a ceiling air terminal device using flexible duct has no effect on the integrity of the fire barrier penetration.



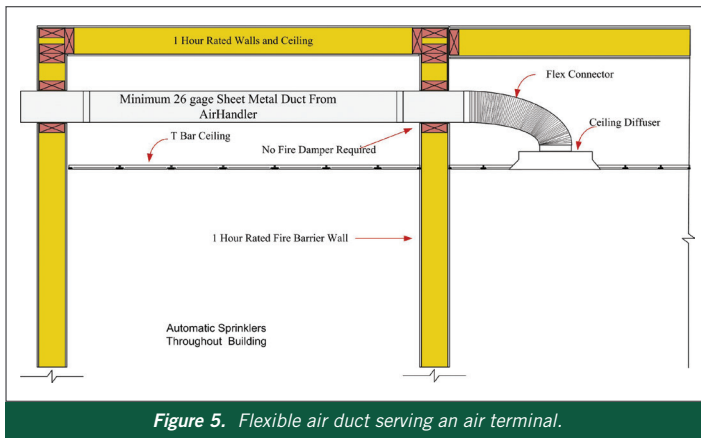


Figure 5. Flexible air duct serving an air terminal.

Once determined that it is the appropriate location for Through-Penetration Firestop System, there are four major factors that need to be understood so that the correct through-penetration firestop system or assembly is installed:

1. Is the system designed for the material and construction type (wall, floor, etc.) of the fire-resistant assembly being penetrated?
2. Is the system designed for the type of penetrating item?
3. Is the system designed for the relative geometry of the opening and the penetrating item?
4. Are the ratings of the firestop system correctly chosen for the rating of the penetrated assembly?

- Required

- **F rating** (hours) - Indicates the specific length of time that a barrier can withstand fire. (Must withstand Hose Stream test)
- **T rating** (hours) - Indicates the length of time that the temperature on the non-fire side of the penetration does not exceed 325°F (163°C) above the ambient temperature.
- **L rating** (cfm/ft<sup>2</sup>) (m<sup>3</sup>/s per m<sup>2</sup>) – System's ability to restrict the movement of smoke and is the qualification for fire resistance rated smoke protection.

- Optional

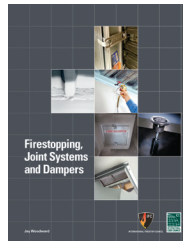
- **W rating** – System's ability to resist water passage through a floor assembly. Provides protection against water from floor to floor.

## Firestopping with Fire Damper Applications

It is important that fire dampers and firestop materials be installed in accordance with their listing and the manufacturer's instructions. There are approved fire damper and combination fire/smoke damper products that, per their listing and installation instructions, do not allow the application of a firestop material as follows:

- Caulks, etc., on fire damper retaining angles at the wall, floor, or partition surface.
- Mineral, wool, or other packing materials between the damper sleeve and the wall, floor, or partition cavity.

To note that the application of *firestop materials* as described above could be a violation of the conditions of test and listing which could void the listing of the damper. (Some damper manufacturers allow the application of specific silicone-based sealants around damper retaining angles; consult damper manufacturers for specific details.)



For more information regarding code required firestopping of plumbing systems, it is recommended that you refer to the ICC publication *Firestopping, Joint Systems and Dampers*. Online classes and webinars based on this publication are available at <https://learn.iccsafe.org/ihhtml/application/student/interface.icc/index.htm>