

# Fire Engineering®

## Penetrations of Rated Wall and Floor Assemblies

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December 2016

Building and fire codes require the construction of some interior walls and floor-ceiling assemblies to resist the passage of fire for a certain length of time, usually expressed in hours. These rated assemblies usually separate rooms, apartments, means of egress (including exit corridors and stairways), and the different levels (floors) of the building. The resistance of the assembly to the passage of fire is rated in hours, and is determined from tests like ASTM E-119 (also listed as National Fire Protection Association (NFPA) 251, *Standard Methods of Tests of Fire Resistance of Building Construction and Materials*, through the 2006 edition), which uses a fire of increasing temperature over time as shown in the Time-Temperature Curve, Figure 4.1.1, in NFPA 251—2006.

A building's utilities--including heating, ventilation, air conditioning, electrical, plumbing, fire protection, data, and communications--rarely originate and terminate in the same fire-rated compartment; but usually pass from compartment to compartment, penetrating both rated and non-rated partitions and floor-ceiling assemblies.

The method of preventing the passage of fire and products of combustion around and through pipes, electrical conduits, ducts, and cables is usually determined in new construction and remodeling by the architect and fire protection engineer, based on building, fire, and NFPA 101 *Life Safety Code* requirements. Usually, they select tested and approved methods and materials from the *UL Certifications Directory*, available online at <http://database.ul.com/cgi-bin/XYV/template/LISEXT/1FRAME/fireressrch.html>. During repairs and building and systems maintenance, the Authorities Having Jurisdiction (AHJ) expect that the same level of protection will be maintained as in the original construction.

In most types of construction and occupancies, these penetrations of non-rated partitions and floor-ceiling assemblies require no special procedures; although some occupancies and AHJ will require smoke seal or fire caulk around each pipe, conduit, duct, and cable on both sides of the penetration. The methods and materials used to seal around these penetrations may vary between listings in the *Certifications Directory*.



Photo 1 shows a one-hour-rated masonry wall with several types of penetrations. Some architects, fire protection engineers, AHJ, and occupancies now require each fire-rated assembly to be labeled above removeable ceilings and in unfinished spaces, as this one is labeled “1 HOUR FIRE WALL”.

- The ducts passing through this wall have the space between the ducts and the masonry packed with one of the mineral wool products specified in the *Certifications Directory* listing, and covered with a sheet metal flange on both sides of the wall.
- The insulated pipes passing through this wall are sealed on both sides of the masonry wall with one of the fire caulks specified in the *Certifications Directory* listing.
- The electrical conduit passing through this wall was mortared into the wall by the masons who constructed it, an acceptable practice.

Two-hour, three-hour, and four-hour rated walls require additional protection of penetrations, since they must resist higher temperatures than a one-hour rated wall, and for a longer time.



Photo 2 shows a fire damper unit that has been installed in a two-hour-rated masonry wall. The fusible link holding the damper open is visible inside the top of the damper unit. This damper unit was installed in the opening in the wall left by the masons. The space between the damper unit and the masonry was packed with one of the mineral wool products specified in the *Certifications Directory* listing before the sheet metal flanges were installed. Some listings or fire protection engineers may require the use of fire caulk before installing the flanges. The heating, ventilating, and air conditioning (HVAC) contractor will connect the ductwork to both ends of the damper unit. The duct on one side of the wall will include an access door for inspecting and cleaning the damper unit, and for replacing the fusible link if it is necessary.



Photo 3 shows pipes and cables penetrating a two-hour-rated masonry wall. Penetrations in two-hour, three-hour, and four-hour rated walls usually require the use of metal sleeves cemented into the masonry, which may be of steel pipe or galvanized sheet metal, depending on the listing. From the left above the suspended ceiling:

- A metallic-sheathed cable (or flexible conduit), which has not yet had its sleeve and sealant installed.
- An empty sleeve for future use
- A steel pipe passing through a sheet metal sleeve, without pipe insulation or sealant applied to close the space between the inside of the sleeve and the pipe insulation.
- Two insulated pipes passing through sheet metal sleeves, after the space between the pipe insulation and the sleeve has been packed with mineral wool insulation and sealed with fire caulk
- A steel pipe passing through a sheet metal sleeve that has not yet been cemented into the masonry; without pipe insulation or sealant applied to close the space between the inside of the sleeve and the pipe insulation.
- Data cables passing through steel conduit sleeves that have not yet been cemented into the masonry; and without the sealant applied to close the space between the cables and the inside of the sleeves.



Photo 4 shows four pipes penetrating a two-hour-rated structural concrete floor, each with its own steel pipe sleeve. The space between the pipes and sleeves has been packed with mineral wool insulation; the tops of the sleeves have been sealed with cement grout; and the bottoms of the sleeves have been sealed with fire caulk.

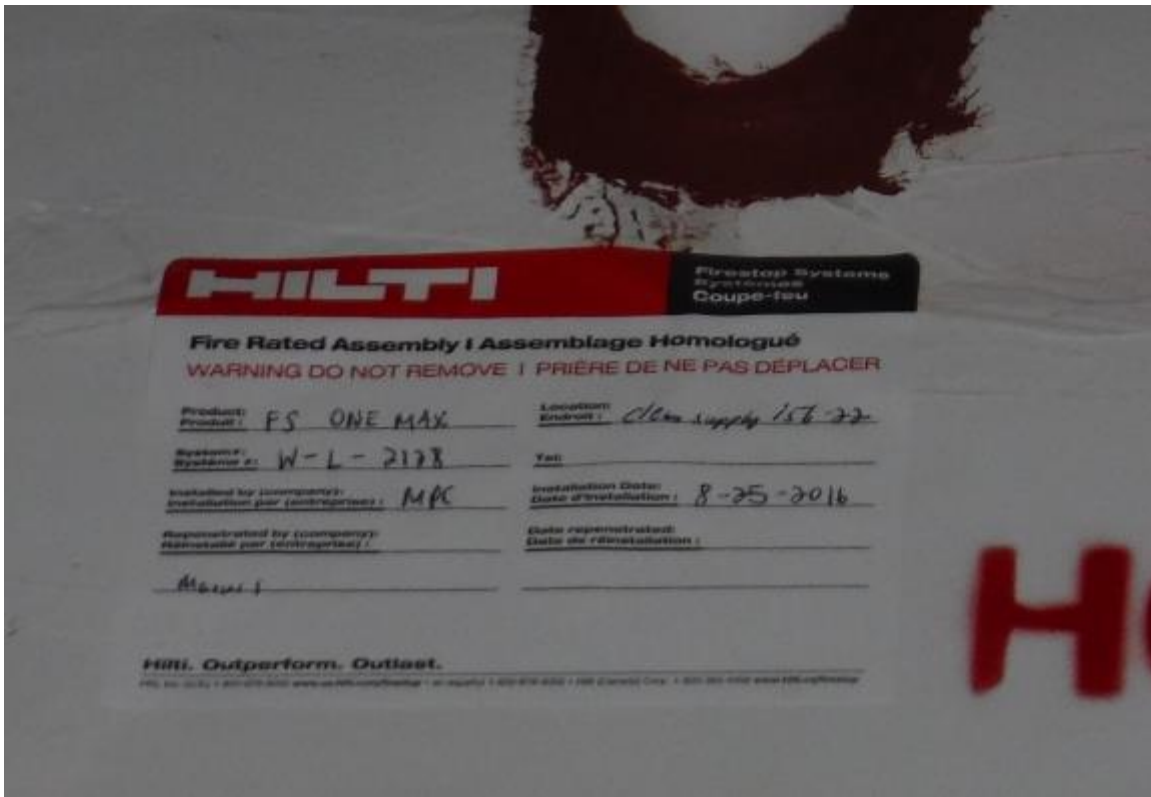


Photo 5 shows a label at a penetration that indicates the manufacturer and brand of the sealant product; the manufacturer's penetration listing; the installing contractor and installer; the location in the building; and the installation date. Some occupancies, AHJ, fire protection engineers, and facilities managers now require these labels for new installations. They are likely to become part of the building and fire codes in the future for new construction, remodeling, and maintenance work.

Although firefighters are not often involved with the inspection of penetrations of fire-rated walls and floor-ceiling assemblies as they are installed, we need to be concerned that they have been installed as they have been tested and approved. If there is a fire in the building, we often select a fire-rated partition beyond which we do not intend the fire to spread. If the penetrations in this fire-rated assembly were not properly installed and sealed, they will be breaches in the assembly, and will allow the fire to burn past us.

We must be familiar enough with the proper treatment of these penetrations that we can recognize one that may be deficient, and bring it to the attention of the facilities manager, or to the building department.



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