



STOP

by Riley Archer

Fire in Its Tracks

You may have heard the word *firestopping* thrown around the construction industry to describe any material used to prevent the spread of fire—but what is it really? A firestop is a material or combination of materials designed to reestablish the fire-resistance rating of rated assemblies such as fire-rated walls, floors, and ceilings. These materials or systems are required to be fire tested and listed by an accredited, independent testing agency as proof of their performance in fire conditions.

Understanding what a firestop is as well as where and why it is required helps ensure that it is correctly installed. The use of firestopping is different than the use of fireproofing, fireblocking, and firesafing, but unfortunately these terms often are confused and incorrectly used as interchangeable. Fireproofing applications deal primarily with the passive fire protection of the structural steel elements of a building. Fireblocking is the process of installing materials to resist the free passage of flames in a building through concealed spaces. Firesafing generally refers to the fire-resistant insulation that sometimes is used as part of a firestop system.

When a fire resistance-rated assembly is penetrated or a void is created due to the inclusion of a construction joint, a firestop system must be installed properly to reinstate the original fire-resistance rating of that assembly. Such situations occur on almost every commercial construction project. It is important to remember that firestopping is designed to perform as tested only once in its lifetime, and to do so it must be properly installed.

Passive fire protection, which encompasses firestop systems as well as other methods designed to prevent the spread of fire in a building, plays a key role in protecting life safety and property by preventing the passage of flames and smoke through rated assemblies. Using fire-resistant rated

assemblies and firestop systems is a basic element of passive fire protection known as compartmentation. Creating fire-rated compartments within a building by constructing and maintaining the fire-resistance ratings of wall, floor, and ceiling assemblies prevents the rapid spread of fire throughout a structure. These fire-rated compartments are constructed of rated assemblies that are tested to resist the passage of hot gases, flames, and smoke for a minimum amount of time, and the firestop systems are installed and tested in these assemblies to prevent flame spread for the same duration as the assembly itself.

TESTING

To create a firestop system, all of the materials must be installed in a rated assembly and fire tested for integrity in the exact configuration in which they will be installed. The most widely recognized third-party agency for fire testing is Underwriters Laboratories (UL), which tests, classifies, and lists firestop systems and materials as well as numerous other products used on a daily basis.

The fire test standards used to determine the performance of the firestopped assemblies differ between penetration firestop applications (ASTM E814: *Standard Test Method for Fire Tests of Penetration Firestop Systems* and ANSI/UL 1479: *Standard for Fire Tests of Through-penetration Firestops*) and construction joints (ASTM E1966: *Standard Test Method for Fire-resistive Joint Systems* and ANSI/UL 2079: *Tests for Fire Resistance of Building Joint Systems*). The ASTM and UL test standards dictate a temperature rise over time for the assemblies being tested. This time/temperature curve is universally applied for all materials being tested to that particular standard no matter the agency doing the testing.



Figure 1 Assemblies are tested in a furnace to determine their fire rating.

Fire Rating

The duration of the fire exposure testing depends on the rating of the assembly construction and the desired hourly rating of the system that is being tested. For example, if a two-hour fire resistance-rated concrete floor assembly is penetrated by a metallic pipe, the desired fire duration for the firestop test would be a minimum of two hours to match the rating of the floor. This provides hourly ratings for firestop systems that are equal to the hourly rating of the rated assembly that is being penetrated.

Water Hose Stream Test

Direct fire exposure and temperature measurements are not the only test criteria to which firestop systems are subjected in ASTM E814 and UL 1479 testing. The assemblies also must pass a water hose stream test. Immediately after the assemblies are removed from the test furnace (see Figure 1), they are exposed to a 30-pound-per-square-inch (psi) or 45-psi pressurized stream of water (see Figure 2). The pressure level depends on the fire exposure duration. The hose stream is similar in appearance to that of a fire hose when the pass/fail test is performed. After exposure to the hose stream, if any water has passed through the assembly or any light is visible through the assembly, the tested assembly has failed.

The hose stream is an extremely difficult criterion to pass and demonstrates the overall assembly integrity after fire exposure. Only after successfully passing the fire exposure and hose stream portions of testing for penetrations can a system be listed by the testing agency as an approved firestopping method.

Time and Temperature Ratings

Penetration fire tests provide data on the duration of time for which the assembly prevents the passage of flames, or F rating, as well as the duration of time during which the non-fire side of the assembly and penetrant reach 325°F over ambient temperature, or T rating. F and T ratings are mandatory measurements for ASTM E814 and UL 1479 testing, and every listed system will provide verification of the time (in hours) in which the firestop system will prevent the passage of flames (F rating) and the temperature (T rating, also in hours). The significance of the T rating is that it provides a point at which combustible materials on the non-fire side of the rated assembly will catch fire due to temperature rise. Theoretically, this temperature rise may allow fire to spread from one area to another by heat only, without any actual flames passing through a rated assembly.

Water- and Air-leakage Testing

Two optional ratings also are available through the UL 1479 test standard: a W rating, provided by a water-leakage test, and an L rating, provided by air-leakage testing.

If a firestop system is W rated, it means the system has a water-resistive seal while still maintaining the fire-resistance rating of the assembly. The water-leakage test is conducted

using a minimum pressure of 3 feet of water for a duration of 72 hours. Successfully passing the water-leakage test using these test criteria provides firestop systems with a Class I W rating, allowing the system to be published with a W rating as well as F and T ratings.

Air-leakage testing is a little more involved than the W rating and requires a pressurized testing chamber onto which the firestopped assemblies are mounted. The L rating measures the air movement through the firestop assembly at ambient air temperature (75°F) and at a temperature elevated to 325°F above ambient (400°F). The internal air pressure within the test chamber is maintained at a constant 0.3 inch of water column during the testing, and the amount of air that leaks through the firestopped application is measured. The air-leakage rate is represented in cubic feet per minute per square foot. Ratings less than 1 L are the highest or best performing, and increasing numbers denote decreased performance, which is undesirable if you are trying to stop smoke.

Although the L and W ratings are optional when testing firestop systems, many building codes now require L ratings for smoke barrier assemblies of less than 5 cubic feet per minute per square foot, and some jurisdictions may require W ratings for floor penetrations.

CODE REQUIREMENTS

Requirements for firestopping in building codes date to before the development of the International Building Code (IBC), which most states and local authorities follow today. Although the IBC has gone through significant changes since its advent and not all types of construction require firestopping or fire-rated assemblies, one item that has stayed constant is that firestopping is required if a fire resistance-rated assembly is penetrated.

IBC Chapter 7, "Fire and Smoke Protection Features," outlines the requirements for fire resistance-rated assemblies and passive fire protection including firestopping for the various construction types. The sections in Chapter 7 provide detailed information on the minimum requirements for fire and smoke protection. (It is important to note that the IBC varies in content and requirements from version to version. The International Code Council, which develops the IBC, currently maintains a code-development cycle of three years. Because of the gap between code development and jurisdictional code adoption, the requirements will vary from state to state. Although the 2009 IBC is now available, some states are still using the 2003 or 2006 versions.)

The 2009 International Building Code provides requirements for firestopping in Sections 713 and 714, but in previous versions firestopping was located in Sections 712 and 713. The protection of penetrations of horizontal assemblies and fire resistance-rated wall assemblies is described in Section 713. Section 714 governs joints installed in or between fire resistance-rated assemblies and requires an approved fire resistance-rated system to be installed. The code requirements for firestop and smoke stop installations provide



Figure 2 Assemblies are subject to a hose stream test to determine overall integrity.



Figure 3 An intumescent electrical box insert

protection of the structure, and they also help maintain a minimum degree of protection for occupants who live or work in a structure and for fire safety personnel who must enter the building if a fire occurs.

Penetrations

A closer look at IBC (2009) Section 713 shows exactly what is required for protection when fire-resistant assemblies are penetrated. Section 713.3.1.2 states that through-penetrations shall be installed and protected with an approved firestop system tested to ASTM E814 or UL 1479. The section also states that the fire-resistance rating of the firestop system (F rating) must be at least equal to the fire-resistance rating of the assembly penetrated. In Section 713.4.1.1.2, the code goes further to state that through-penetrations of fire resistance-rated floors must have F and T ratings of at least one hour, but not less than the fire-resistance rating of the floor penetrated.

The code contains an exception for the T rating if the penetrating item is concealed in a wall cavity. However, when selecting systems for floor penetrations, it is necessary to find an approved firestop system that satisfies the F rating as well as the T rating when both are required.

Smoke Barriers

Section 710 in the 2009 IBC explains the protection requirements for smoke barriers in construction. It seems simple enough that a smoke barrier just needs to stop smoke, correct?

Unfortunately, life is never that simple and neither is the building code. Smoke barriers are required to restrict the movement of smoke by definition, but when you look more closely you will see that Section 710.3 requires smoke barriers to also maintain a one-hour fire-resistance rating. Thus,

if the smoke barrier assemblies must have a minimum one-hour fire-resistance rating and must stop the movement of smoke, then what are the requirements for penetrations?

All penetrations through smoke barrier assemblies must comply with Section 713, which, as mentioned, governs all firestopping for penetrations in the IBC. All penetrations in smoke barriers must be firestopped, but they also must stop smoke, which means that they need to have an L rating. Section 713.5 states that penetrations of smoke barriers must be tested to UL 1479 air-leakage testing and maintain an L rating of no more than 5 cubic feet per minute per square foot or 50 cubic feet per minute per any 100 square feet.

Understanding the specific requirements for construction that are prescribed in the building code is an elemental part of the construction process. Codes dictating passive fire protection ensure a minimum standard for passive life safety and property protection. The building codes are effective only when properly followed and enforced. No one wishes to be trapped in a burning building that was not firestopped to code. Maintaining minimum safety standards is what the building codes do for all of us.

FIRESTOP APPLICATIONS

Now that you know that the code requires a firestop to be installed and that the system needs to be tested to ensure that it performs as required, what is the next step?

Installation is the final chapter for firestopping. Once installed, the firestop material must stay in place until it is needed to perform its function. Providing passive fire protection and life safety is possible only if the firestop material is installed correctly. Remember that the material itself has no real rating—only the tested system provides safety. For instance, a plumbing contractor who is installing supply and wastewater systems on a project will make holes through fire-resistance rated assemblies, run the necessary piping through the penetrations, and then close the holes with the appropriate firestop system. This process involves understanding what the building code requires, knowing the rating of the assembly, and selecting the appropriate tested and listed firestop system to install in conjunction with the correct material required by that system.

Although in many cases firestopping systems are installed by the contractor who is performing the actual work, it is possible for many different types of contractors to install a firestop. It is fairly common for general contractors to take on the responsibility for installing the firestop, and sometimes projects require all of the firestop to be installed by a single contractor or even by a specialty contractor whose primary business is firestop installation.

A contractor installing firestop must select products that are appropriate to the specific application. Many different types of firestopping materials and products are available today. Understanding that no universal product will work for every firestop application is the first step to selecting the right product. While some fairly general statements can be made about firestop materials and their appropriate uses, keep in

mind that every tested system is manufacturer or product specific. One product cannot be interchanged with another firestop manufacturer's material.

Intumescent Materials

A fundamental concept to understand about firestop products is intumescent materials. Intumescent refers to a material that expands when exposed to sufficient heat (see Figure 3). A good way to describe this action is to consider black snake fireworks. When ignited, black snakes continuously create ashes that look like snakes due to intumescent reaction.

Intumescent firestop materials are one of the primary groups of products utilized in applications where one of the components in the assembly will deteriorate or burn away during fire exposure. The intumescent activity of the firestop closes the void that is created when the item melts or burns away, thus maintaining the integrity of the rated assembly. Intumescent firestop materials can come in many forms, from caulks to metallic collars with intumescent strip linings, with each product being designed for a specific purpose.

Sealants

Simple mastics or sealants commonly are used to seal penetration firestopping as well as construction joint firestop applications. These sealants are available in various forms and chemical formulations, but the one thing they all have in common is that their performance is solely dependant on the system in which they are tested.

Firestop sealants in caulk, self-leveling, and spray grade are readily available in silicone, latex, and solvent-based products. They often require the addition of a backing material in the system for support. Sealants are probably the most recognized group of firestop products as firestop caulk is common to most construction projects because of its numerous applications.

Firestop Devices

Another common product group is firestop devices, which range from simple collars to more complex sleeves and cast-in-place devices that are stand-alone firestop products.

A firestop collar or pipe collar usually consists of a metallic ring with an intumescent strip applied to the interior circumference of the metal housing. The collar is placed around a penetrating item, usually a non-metallic pipe, and permanently affixed to the fire-rated assembly.

Firestop intumescent sleeves are metallic sheets with intumescent material adhered to one side. These sleeves can be placed around penetrating items and inserted into the wall to provide passive fire protection. One of the benefits of this type of device is that it allows for protection where collars cannot, such as when a penetration is at an angle.

A cast-in-place firestop device usually has a plastic outer housing similar to a concrete sleeve with the addition of

intumescent material affixed to the interior of the sleeve. These devices are attached to the form decking of poured-in-place concrete structures prior to the concrete floor being poured. The devices have a built-in firestop and are cast into the concrete to create the necessary hole through the concrete floor for the penetrating item.

FOR MORE INFORMATION

There are numerous types of firestop products and even more firestop applications in the ever-changing world of commercial construction. The best place to find in-depth information about products is the firestop manufacturers' websites. These websites provide detailed information about products, testing requirements, systems, and specifications.

It is exceedingly important to remember that passive fire protection is a process in which identifying key features of the application helps match the right system and product with the firestop need. Everything in passive fire protection is system dependent and must reference tested passive fire protection systems and listed fire protection products.

One of the key points is that firestop products have no rating by themselves. The hourly rating of a tube of firestop caulk is zero, and the only way it has validity as a firestop product is when it is installed exactly as it was tested in a system. Testing standards are dictated by the building code and specific to the firestop application. The building code dictates the minimum standards to follow for passive fire protection and is the law that must be followed. When you utilize tested applications and correctly install the firestop product, you ensure life safety for the people occupying the building. **PSD**



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