

DECODING THE CODE

L-Rating

Many people involved in commercial construction understand firestopping is required by the individual building codes. However there are many misunderstandings as to what is required by the code, including a requirement for smoke seals, defined by the IBC 2006 as an L-Rating.

The ASTM E 814, which is referenced in all of the codes has three parts, the F-Rating (prohibits flame passage through the system), the T-Rating (prohibits flame passage through the system and requires the maximum temperature rise on the unexposed surface of the wall or floor assembly, on the penetrating item and on the fill material not to exceed 325°F (181°C) above ambient), and the hose stream exposure (passage of this requirement requires the system doesn't develop an opening, sufficient for the projection of water, through the assembly).

No where does this test standard address smoke. That is because smoke can come from several sources. It can come from the furnace through a leak in the penetration. If there is a smoke leak, there is probably going to be a flame leak, and thus a failure because the furnace is operating under a positive pressure, trying to force the fire through the penetration. If there is any flame appearing on the cold side of the assembly, it fails the test.

Some jurisdictions require firestop systems to provide a cold smoke seal, also not defined in the building codes. An inspector might require additional caulking, even though the system tested passes this test without caulk.

If the pipe is insulated, smoke can come from burning or smoldering insulation on the cold side of the assembly. Fiberglass insulation, when heated, can break down and the binders used to make it can smoke. Other types of insulation are also affected due to the large amount of heat conducted through the penetration along the pipe.

Smoke can come from the pipe itself. During the manufacture of all pipes there is an oily residue and other coatings that can be deposited on the pipe. When

heated to the extreme temperatures encountered in this test, these coatings will smoke.

If smoke were part of this test how would you measure it? How would you determine where it was coming from? How would you know if it was dangerous?

For reasons stated above, the L-Rating system was developed through the STP process at UL.

The Standards Technical Panels (STPs) are an important part of the process by which UL develops and maintains its Standards for Safety. An STP is a group of individuals, representing a variety of interests, formed to review proposals related to UL Standards for Safety. When the American National Standards Institute (ANSI)/UL Standard for Safety is involved, an STP serves as the consensus body to review and vote on proposals prior to publication.

The development of ANSI/UL Standards for Safety greatly benefits from the expertise of individuals interested in the products affected by ANSI/UL Standards.

UL Standards are recognized nationally and internationally as the benchmarks for product safety. The Standards Technical Panels (STPs) provide UL with the means to receive early input from those who are interested in the standards development process.

The L-rating is designed to simulate smoke leakage (although smoke is never mentioned) and is measured at ambient, at 400 ° F, and under a positive pressure of 0.30 inches of water. The results obtained from the air leakage tests are expressed in cubic feet per minute (cubic meter per second) per square foot (square meter) of opening. The results are intended to develop data to assist authorities having jurisdiction, and others, in determining the acceptability of through-penetration firestops with reference to the control of air movement through the assembly.

Once combustion occurs, it is assumed that the firestop seal is activated providing a smoke seal or a seal against the passage of flame and hot gasses. This is assured by the requirement on the ASTM standard which requires that positive furnace pressure be maintained. If positive furnace pressure is not maintained the assembly fails the test.

Excerpt from International Building Code--IBC Chapter 7

712.4.1.1.1 Installation. Through penetrations shall be installed as tested in the approved fire-resistance-

rated assembly.

712.4.1.1.2 Through-penetration firestop system.

Through penetrations shall be protected by an approved through-penetration 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 and a T-rating of not less than 1 hour but not less than the required rating of the floor penetrated.

Exception: Floor penetrations contained and located within the cavity of a wall do not require a T- rating.

If the furnace had a negative pressure, the fire wouldn't escape through any of the openings. One wouldn't know whether or not the seal really worked.

The following is an excerpt from the IBC 2006 which illustrates the requirement for an L-Rating.

712.5 Penetrations in smoke barriers. Penetrations in smoke barriers shall be tested in accordance with the requirements of UL 1479 for air leakage. The air leakage rate of the penetration assembly shall not exceed 5.0 cfm per square foot (0.025m³ / s ⊕ m²) of penetration opening at 0.30 inch (7.47 Pa) of water for both the ambient temperature and elevated temperature tests.

Smoke requirements are important for a few reasons. Everyone knows that people don't die from the fire, they die from smoke inhalation.

3/4 of all fire deaths are caused by smoke inhalation. Source: Hall, Jr. John R. NFPA Fire Analysis & Research, Quincy, MA. "Burns, Toxic Gases, and other Hazards".

Approximately 57% of people killed in fires are not in the room of the fire's origin. Source: NFPA Fire Protection Handbook, 18th Ed. Table 1-1P. Pg. 1-15.

Visibility - 47% of survivors caught in a fire could not see more than 12 feet. Source: NFPA Fire Protection Handbook, 18th Ed. Table 8-1P. Pg. 8-17.

Smoke travels 120-420 feet per minute under fire conditions. Source: Estimate based upon ceiling jet velocity calculations for typical ceiling heights and heat release rates.

Based on these facts smoke seals are very important. Also, gases that are noxious and obnoxious, travel through these pipe openings. For instance, if apartments or offices are built above a parking garage, the exhaust gases from the cars can travel up into the apartments above. Undesirable cooking odors from neighboring apartments can also travel through these openings.

No one has determined the efficacy of these L-Ratings, how much smoke is bad, how much smoke is acceptable, or how much leakage is tolerable. However, the

code groups have decided that a leakage of 5.0 cfm per square foot is a place to start. This leakage rate is based on requirements for fire doors.

710.5.2 Smoke and draft control doors. Where required elsewhere in the code, doors in smoke partitions shall be tested in accordance with UL 1784 with an artificial bottom seal installed across the full width of the bottom of the door assembly during the test. The air leakage rate of the door assembly shall not exceed 3 cubic feet per minute per square foot [$\text{ft}^3/(\text{min} \oplus \text{ft}^2)$]($0.015424 \text{ m}^3/\text{s} \oplus \text{m}^2$) of door opening at 0.10 inch (24.9Pa) of water for both the ambient temperature test and the elevated temperature exposure test.

It is interesting that a penetration is allowed to leak more volume than a fire door. Imagine for a moment that is 100 feet of wall you have one fire door and 100 penetrations. Which is worse? UL systems, for the most part have L-ratings of less than one cubic foot per minute per square foot of the assembly, probably a more realistic rating to require on a project.

If a contractor is required to provide an L-Rating, special notice must be given to the UL system. Many of the UL systems require additional materials or techniques be used to provide the L-Rating, including caulking, mineral wool, or mechanical plugs.

The L-Rating test procedure, at the writing of this paper, is unique to UL. Other testing agencies cannot test to the ANSI/UL 1479 because it is proprietary to UL. Therefore products which may have met earlier code requirements that were tested to ANSI/UL 1479 and ASTM E814 may not meet IBC 2006. Special attention must be given to assure that the L-Rating requirements are met.

With systems that require caulking, care must be taken to provide clean and dry surfaces so the caulking will bond well. Caulking must be flexible enough to maintain the seal over the life of the building. Caulking must also remain undisturbed during the curing period. Otherwise, the seal could easily be compromised.

With mechanical systems such as firestop sleeves, extra care is required to ensure all installation instructions are followed. For instance, if a smaller pipe is inserted into a sleeve, additional caulk, mineral wool, or both may be required to provide the L-Rating. If caulk is required, the same standards for a clean and dry surface also apply to the penetration opening and the penetrating item. The increase in

steps to meet these new requirements makes the overall installation of Firestop more labor intensive and also increases the risk that a step may not be followed or omitted.

The probability of a contractor ever cleaning pipes or openings, or even drying them out is pretty slim. Therefore, choosing systems that do not require any additional materials or labor intensive cleaning steps increases the likelihood that a system will actually function as intended. One such system is the new water/smoke tight pipe sleeve system.

This system provides a L-Rating by simply inserting the pipe into the sleeve.