Membrane Penetrations and Engineering Judgments

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AGENDA

- Membrane Penetrations (M.P.’s)
  - Define
  - Standards, Testing & Certification
  - The Future
- Engineering Judgments
- UL Resources
- Q&A
Membrane Penetration Firestop Systems
What are they?
An assemblage consisting of a fire-resistance-rated floor-ceiling, roof-ceiling or wall assembly, one or more penetrating items installed into or passing through the breach in one side of the assembly and the materials or devices, or both, installed to resist the spread of fire into the assembly for a prescribed period of time.
Definition - UL 1479

A specific construction consisting of:

a) The material(s) that fills or covers the opening and that is intended to prevent the passage of flame;

b) The penetrating items, such as outlet boxes, cabinets, pipes, ducts, along with their means of support through the wall or floor opening; and

c) Only penetrates one side of a fire resistive assembly.
Bottom Line

Fire rated system proven by test to prevent the passage of flame from one side of a barrier to the other when one side is interrupted by a penetrant.
UL Listed Membrane Penetration Systems

W-L-1443
UL Listed Membrane Penetration Systems

W-L-2025
UL Listed Membrane Penetration Systems

W-L-7182

Section A-A
Testing of Membrane Penetrations

Code Requirements

714.3.2 – Membrane Penetrations

ASTM E 814 Requirements

UL 1479 Requirements

Limits of test standards (horizontal barriers not covered yet).
Membrane Penetrations – 2012 IBC, 714.3.2

Membrane penetrations shall comply with Section 714.3.1 (through penetrations – tested and listed and = F rating as wall/floor). Where walls or partitions are required to have a fire-resistance rating, recessed fixtures shall be installed such that the required fire-resistance will not be reduced.

Exceptions: Steel Electrical Boxes
- Max 2 hr rated gypsum wall
- Max 16 in², <100 in² in 100 ft² area
- Max 1/8 in space between box and gypsum
- Opposite sides of wall provisions (spacing, listed putty pads etc.)
Membrane penetrations – 2012 IBC, 714.3.2
(cont’d)

2. Membrane penetrations by listed electrical boxes of any material, provided such boxes have been tested for use in fire-resistance-rated assemblies and are installed in accordance with the instructions included in the listing. The annular space between the wall membrane and the box shall not exceed 1/8 inch (3.1 mm) unless listed otherwise. Such boxes on opposite sides of the wall or partition shall be separated by one of the following:

2.1. By the horizontal distance specified in the listing of the electrical boxes;
2.2. By solid fireblocking in accordance with Section 718.2.1;
2.3. By protecting both boxes with listed putty pads; or
2.4. By other listed materials and methods.

3. Membrane penetrations by electrical boxes of any size or type, which have been listed as part of a wall opening protective material system for use in fire-resistance-rated assemblies and are installed in accordance with the instructions included in the listing.

4. Membrane penetrations by boxes other than electrical boxes, provided such penetrating items and the annular space between the wall membrane and the box, are protected by an approved membrane 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 and T rating of not less than the required fire-resistance rating of the wall penetrated and be installed in accordance with their listing.

5. The annular space created by the penetration of an automatic sprinkler, provided it is covered by a metal escutcheon plate.
UL 1479 Requirements – Membrane Penetrations

- Intent is not to de-rate the wall/floor.
- Non boxes – Pipes, ducts, cables etc.
- Outlet Boxes
- Non outlet boxes – dryer vents etc.

Test representative samples and assembly.

Outlet boxes can be tested with or without conduit.

Outlet boxes can be tested in any configuration, not only traditional 3 box configuration.
UL 1479 Thermocouple Locations

On firestop material.
On penetration/box.
On wall on unexposed side of opposite membrane penetration.
UL 1479 Ratings

\( F = \) Fire

\( T = \) Temperature

\( L = \) Air/smoke Leakage

\( W = \) Water Leakage

*Only for horizontal assemblies*
UL 1479 – Conditions of Acceptance

No Passage of Flame
325°F Temperature Rise
Withstand Hose Stream

Rated Wall
Firestop
Penetrant
UL 1479 – Conditions of Acceptance

No Passage of Flame
325°F Temperature Rise
Withstand Hose Stream
UL 1479 – Conditions of Acceptance – Test Both Directions*

No Passage of Flame
325°F Temperature Rise
Withstand Hose Stream
Membrane Penetrations - Horizontal Assembly

What is the impact on the structural elements?

What is the impact on the unexposed surface (top of floor)?

How long will ceiling membrane remain intact and/or in place?

How long can the assembly maintain load?

Penetrant

Rated Floor

Firestop

Penetrant
Ceiling Damper Concept?

1. Use UL floor-ceiling system already tested full scale under load.

   - One side with penetrant.
   - Other side without penetrant.
   - Measure concealed space temperatures.

3. Average temperature of concealed space of the penetrant side shall not be greater than the average temperature of the concealed space of the non-penetrant side.
Next Steps Membrane Penetration Firestop Systems?

- Full scale?
  - Horizontal M.P.’s
  - May look at measuring temperature on structural elements.

- Loaded?
  - May look at temperature of the plenum space.
Is a ½ Through Penetration Firestop Solution Ok?

Can’t interrupt wall/floor rating.

- Is the wall and/or firestop system asymmetrical?
- If penetrant is on non-fire side, need T rating.
- Metallic pipes vs plastic?
- Annular space?
- How does the membrane penetration transition? From plastic box to metallic conduit?

ULTIMATELY UP TO AHJ.
Can a Firestop System Be Installed in Load Bearing Wall?

Can’t interrupt wall/floor rating. Walls need to meet fire and temperature ratings too. Some need to maintain load.

Firestop systems are not tested under load.

How does firestop system impact structural elements?

Other assemblies are tested full scale and under load.

Need to test conditions. Some test methods exist. Expertise exists.

ULTIMATELY UP TO AHJ.
The Bigger Picture

Compartmentation is the goal.
What happens when compartmentation is breached?
Weak link effect?

Lose hourly rating.
Lose structural integrity.
Lose firefighting operations.
Lose defend in place.
This is a life safety job.
Summary

Membrane penetration firestop systems exists to cover various field conditions.

Limited to vertical fire rated assemblies.

Just as important as a through penetration firestop system. Handle with as much attention and detail.

UL and ASTM standards include them and are evolving to cover more configurations.

Engage with the FCIA, firestop manufactures or UL to evolve this program to better meet your needs.
Engineering Judgments
Engineering Judgments (EJ’s)

What are they?
What purpose do they serve?
Are they supported by UL?
What can be done better?
Should EJ’s continue?

Is there a level of credibility an EJ must have?

Who is eligible to produce and EJ?

The future of EJ’s?
Engineering Judgments

What are they?

Firestop solution for a field condition that has not been independently tested or listed.

May be a solution based on a variety of tests, logic, historical practices, studies etc.

What purpose do they serve?

Short term solution for a field condition until the condition can be independently tested and listed.

Used to provide an AHJ with a calculated solution for the field condition.
Engineering Judgments (EJ’s)

- Certification approval by manufacturer?
- Have > 8000 UL systems, should be used.
- Historical data may be in hand for a UL study.
Thoughts on EJ’s.

How should EJ’s be managed?
   Via Standards; 3rd Party; Engineers or Other?
Who takes the liability if the EJ doesn’t work? AHJ?
Are there substitutes to EJ’s other than a full test program?
   Quick test of representative sample?
Should labs monitor EJ’s?
   When and EJ is written for the same condition more than X times should the party in need (firestop manufacture, contractor, etc.) Submit for testing?
Should EJ’s be dated? Expire?
   Technology changes daily.

ULTIMATELY UP TO AHJ.
Summary

EJ’s are a necessary evil.
   Needed at the worst time.
   Always a rush request.
   Getting the job done?

EJ’s should ultimately be tested to give you hard evidence of a tested and listed system.

How can the process improve?
What are the AHJ’s asking for?
How can UL help from a testing and certification perspective?
UL Resources
UL Resources

UL.com (link)
UL Fire Resistance Directory (link)
UL Code Link (link)
Architectural Services (link)
archservices@us.ul.com
UL TSA/FSA Newsletters
UL Fire Wizard (link)
UL Product Spec (link)
UL (+1.877.854.3577)
Questions?
Thank you.