Firestop Testing – FCIA

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Fire Resistance and Containment – UL LLC
Agenda

Code Requirements

Test Standards

Firestop Ratings

Testing and Certification

Future

UL Resources

Q&A
Why is proper firestopping needed?

Protect Life
• Building Occupants
• First Responders

Protect Property
• Maintain building integrity.
• Limit collateral damage.
When proper fire protection is not used.

<table>
<thead>
<tr>
<th>Fire Event</th>
<th>Loss of Life or Cost (year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effingham Hospital, Illinois</td>
<td>77</td>
</tr>
<tr>
<td>Mercy Hospital, Davenport, Iowa</td>
<td>41</td>
</tr>
<tr>
<td>Guatemala City Hospital</td>
<td>225</td>
</tr>
<tr>
<td>One Meridian Plaza – Philadelphia, PA</td>
<td>$325M (1991)</td>
</tr>
<tr>
<td>Buenos Aires Hospital, Argentina</td>
<td>79</td>
</tr>
</tbody>
</table>
Code Requirements
Code Requirements

Chapter 2 – Definitions
Chapter 3 – Occupancy Type
Chapter 4 – Special Requirements
Chapter 5 – Heights and Areas
Chapter 6 – Types of Construction, Ratings
Chapter 7 – Fire Protection Features
Chapter 17 – Special Inspection

Other codes may apply.
IBC Firestop Requirements

Section 714 – *Through penetrations* shall be protected by an *approved* penetration firestop system installed as tested in accordance with UL 1479 or ASTM E814.

Section 715 – *Fire-resistant joint systems* shall be tested in accordance with the requirements of either UL 2079 or ASTM E1966.

Section 706 – Fire Walls
Section 707 – Fire Barriers
Section 708 – Fire Partitions
Section 709 – Smoke Barriers
Section 710 – Smoke Partitions
Hospital (I2) Code Requirements

IBC Section 407
Several FR requirements (fire walls, barriers and partitions)
Refuge Areas
Between care floors – smoke barriers
Corridors – smoke partitions
Care suites – smoke partitions

Smoke Barriers – 1 hour FR required, horizontal or vertical, continuous, L rating

Smoke Partitions – no FR required, terminate at ceiling membrane, approved material to limit smoke
Test Standards
# Relevant Firestop Standards

<table>
<thead>
<tr>
<th>Standard Type</th>
<th>Standard Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penetration Firestop Systems</td>
<td>UL 1479, ULC S115, ASTM E814</td>
</tr>
<tr>
<td>Firestop Joints</td>
<td>UL 2079, ULC S115, ASTM E1966, ASTM E2837</td>
</tr>
<tr>
<td>Perimeter Firestop Systems</td>
<td>ASTM E2307</td>
</tr>
<tr>
<td>Aging</td>
<td>ASTM E2923</td>
</tr>
<tr>
<td>Shrinkage</td>
<td>ASTM C1241</td>
</tr>
</tbody>
</table>
Fire Testing
Fire Testing - Full-Scale Wall Assembly
Fire Testing

Samples construction as intended for field installation.

Test assembly mounted on furnace.

Fire test initiated.

Monitored for conditions of acceptance.
Time (t) – Temperature (T) Curve

Temperature (°F)

0  500  1000  1500  2000  2500

Time (s)

0  60  120  180  240  300  360  420  480
Differential pressure

Min. 0.01 inch of water (2.5 Pa) at a distance of 12 inches (305 mm) from the surface of horizontal test assemblies.

Min. 0.01 inch of water (2.5 Pa) at a level 0.78 inch (20 mm) below the lowest level of materials.
Hose Stream

- Measures assembly durability from impact.
- Uniform and remote.
- Mandated by code and test standard.
- Not required for all fire tests or fire ratings (e.g. Europe, Canada)

<table>
<thead>
<tr>
<th>Desired F rating (F), minutes</th>
<th>Water pressure at base of nozzle, PSI (kPa)</th>
<th>Duration of application, seconds per square feet (s/m²) of exposed area³</th>
</tr>
</thead>
<tbody>
<tr>
<td>240≤F&lt;480</td>
<td>45 (310)</td>
<td>3.0 (32)</td>
</tr>
<tr>
<td>120≤F&lt;240</td>
<td>30 (210)</td>
<td>1.5 (16)</td>
</tr>
<tr>
<td>90≤F&lt;120</td>
<td>30 (210)</td>
<td>0.90 (9.7)</td>
</tr>
<tr>
<td>F&lt;90</td>
<td>30 (210)</td>
<td>0.60 (6.5)</td>
</tr>
</tbody>
</table>

³Water pressure and duration requirements may vary based on specific test conditions and standards.
Hose Stream Requirements

UL 1479

• Mandatory

• A duplicate is permitted to be subjected to a fire exposure test for a period equal to one-half of the desired F rating but not more than 60 minutes.

ULC S115

• Optional hose stream.

• Same parameters when conducted.
Hose Stream Test
Firestop Shrinkage

Shrinkage testing for latex based firestop sealants.

- ASTM C1241
- Moisture loss creates sealant to shrink.
- Published in firestop manufacturers Classification cards.
- Identifies amount of shrinkage for a latex based sealant.

Wall

Penetrant

Sealant
Firestop Shrinkage

The latex firestop products below have been investigated to ASTM C1241, "Standard Test Method for Volume Shrinkage of Latex Sealants During Cure," at 73°F ± 3.6°F (23°C ± 2°C) and 50% ± 5% relative humidity.

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Average Volume Shrinkage Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>XYZ Firestop</td>
<td>XX %</td>
</tr>
</tbody>
</table>
Performance after Environmental Exposure Conditioning

Applies to intumescent firestopping materials only.
Products exposed to Accelerated Aging and High Humidity environments
Acceptance Criteria based on Expansion Pressure and Expansion Factor bench-scale testing, with full-scale fire testing as back-up

Environmental Exposure Conditions:

• Accelerated Aging – Samples exposed at 158 ± 5 °F for 270 days
• High Humidity – Samples exposed to 97 – 100 % RH at 95 ± 3 °F for 180 days
Performance after Environmental Exposure Conditioning Cont.

• Five Optional Exposure conditions:
  - Industrial Atmosphere (Sulfur Dioxide SO$_2$ and Carbon Dioxide CO$_2$) – 30 days
  - Salt Spray – 90 days
  - Combination Wet, Freeze and Dry Cycling – 72 hours, 24 hours, 72 hours
  - Acid Spray (Diluted HCl) – 5 days
  - Solvent Spray (Acetone and/or Toluene) – 100 hours

• Performance of conditioned samples compared to control samples
  - Conditioned sample shall be within 90% of mean of control samples
Firestop Ratings
Firestop System Ratings

F – Fire
T – Thermal
FT – Fire and Thermal – Canada Only
FH – Fire and Hose Stream, No Thermal – Canada Only
FTH – Fire and Thermal and Hose Stream – Canada Only
L – Air Leakage
W – Water Tightness
Firestop System Ratings

F Rating – The time period that the through-penetration firestop system limits the spread of fire through the penetration when tested in accordance with UL 1479/ASTM E814.

T Rating – The time period that the penetration firestop system, including the penetrating item, limits the maximum temperature rise to 325 °F (180 °C) above its initial temperature through the penetration on the nonfire side when tested in accordance with UL 1479/ASTM E814.

L Rating – The air leakage rate through a penetration firestop system.

W Rating – The ability for a firestop system to prevent water leakage from one side to another.
## Firestop Standards Ratings Matrix

<table>
<thead>
<tr>
<th>Rating</th>
<th>Penetrations</th>
<th>Joints</th>
<th>Perimeter</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>UL 1479</td>
<td>ASTM E814</td>
<td>ULC S115</td>
</tr>
<tr>
<td>F</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>T</td>
<td>X</td>
<td>X</td>
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</tr>
<tr>
<td>FT</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>FTH</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>FH</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>L</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>W</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cyclic Movement</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
Conditions of Acceptance

F Rating

No Passage of Flame

Withstand Hose Stream
Conditions of Acceptance

T Rating

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

Concrete Deck

Pipe

Firestop System
**T Rating**

Options:

- Use firestop system having the required T Rating
- Enclose pipe within cavity of wall
- Wrap metallic pipe with mineral wool or ceramic insulation
- Add a device around pipe that will cool pipe during a fire
Thermocouple Locations - T Rating
2079/S115 Thermocouple Locations
Leakage Rating (L Rating)

• Air Leakage Rate at Ambient Temperature 70°F
• Air Leakage Rate at 400°F
• L Rating methodology added to ANSI/UL 1479 in 1993
• Leakage determined at 0.3 in. WC
• Results published in either CFM or CFM per sq. ft.
Leakage Rating Test Procedure

Incidental chamber leakage determined using blank slab

Air leakage of test sample determined at ambient temperature

Air leakage of test sample determined at 400°F

Incidental chamber leakage rechecked after cooling
Leakage Rating

- Firestop system assigned L Rating at ambient and 400°F, by subtracting incidental chamber leakage from test sample leakage.

- L Ratings of firestop systems published in UL Fire Resistance Directory along with F and T Ratings.

- Added benefits – Infection control, hazardous gas containment, climate control.
Water Leakage Rating (W Rating)

Optional program, applicable to incidental water

Two Purposes of W Rating

- Evaluate ability of firestop system to prevent incidental leakage of water
- Evaluates ability of firestop system to maintain its F and T Ratings after exposure to water
W Rating – Test Chamber

Water leakage test chamber sealed to test assembly away from test sample

Test chamber filled with water with permanent dye to attain required pressure head (mln 36 in. water or 1.3 psig)

White indicating medium beneath test sample
W Rating

Firestop subjected to 3 ft. water column for 72 hrs.

No water leakage whatsoever is permitted.

Test assembly subjected to ANSI/UL 1479 fire exposure and hose stream tests after water exposure.
Firestop Testing and Certification Future
Future Testing and Certification Requirements

What's next?
Movement – ongoing.
Sequential environmental testing?
Product standards?
Field testing?
Expiration?

What's missing?
More details in designs?
More communication?
More training?
Who is UL?

- Accredited 3\textsuperscript{rd} party testing and certification laboratory.
- Advancing safety science through investigation, testing and research.
- Standards development organization (SDO).
- Quality assurance.
- Market surveillance.
- Training/consultants.

- Know by test and state the facts.
UL Firestop Resources

UL.com (link)
UL fire resistance directory (link)
Code correlation database (link)
Architectural services (link)
archservices@us.ul.com
UL TSA/FSA Newsletters
UL Fire Wizard (link)
UL (+1.877.854.3577)
Our Value
Questions
Thank You

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