Containment in construction

Three principles of fire protection

1. Prevention
   – Reduce chances fire starts
   – Plan and rehearse for fire

2. Detection & suppression
   – Early warning for egress & fighting fire
   – Extinguish fire (Active protection)

3. Containment
   – Contain fire to place of origin (Passive)
Buildings are usually required to have fire-rated barriers.

Compartments are six-sided fire-rated boxes.

Compartmentation stops the propagation of fire, smoke and gasses.
Essential services often compromise fire and life safety

Openings are needed to run essential services...

...But if they stay unsealed, fire, smoke and gasses will spread
Regulations therefore require “firestopping”

Firestopping = sealing the opening to restore the hourly rating to fire barrier
Firestopping is required for ALL openings…

- Top of Wall
- Through-Penetrations
- Duct Enclosures
- Cables Penetrations
- Curtainwall
# How Firestopping solutions are tested

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<thead>
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<tbody>
<tr>
<td>Barriers</td>
<td>ASTM E-119</td>
<td>UL 263</td>
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<tr>
<td>Through Penetration</td>
<td>ASTM E-814</td>
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<td>Joints</td>
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<td>Safing Slot</td>
<td>ISMA</td>
<td>ASTM E-2307</td>
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- **Third-Party Testing To Standards**
- **Ratings:**
  - F Ratings
  - T Ratings
  - L Ratings (Optional)
  - W Rating (optional)
Tests with a 3rd party testing laboratory
Firestopping is a technical business requiring tested Systems

Drawing showing system

System Number

System Description
How Through-Penetrations are tested

ASTM E814  Fire Tests of Through-
UL 1479   Penetration Firestop Systems
Side View of A Slab (During)
ASTM E 119 Time – Temperature curve

- **2080 °F (5 hours)**: Mineral wool still intact.
- **Fiberglass Insulation Fails (6 Minutes) at 1050 F and IS Not To Be Used In a Fire Containment Assembly**

- **Glass Melts**
- **Aluminum Melts**
The Hose-Stream Test...
Example of a Through-Penetration System

Drawing showing system

System Number

System Description

1. Floor or Wall Assembly — Min 2½ in. or 4 in. thick reinforced lightweight or normal weight (100-150 psi) concrete. Wall may also be constructed of any UL classified Concrete Block. Floor may also be constructed of any UL classified Hollow-Core Precast Concrete Block.

2. Sleeves — Min 6 in. diam. (or smaller) Schedule 10 (or smaller) steel pipe sleeve or ann. 6 in. diam. (or smaller) Schedule 40 polyvinyl chloride (PVC) pipe sleeve cast or grouted into floor or wall flush with floor or wall surfaces. Steel sleeve may be projected to project a max of 2 in. beyond the floor or wall surface.

3. Cables — Aggregate cross-sectional area of cables in sleeve to be max 45 percent of the cross-sectional area of the sleeve. See Item 5 for specific cable size requirements. Tight bundle of cables to be installed in the steel sleeve. The annular space within the fin system shall be a min of 2 in. (point center to point center) to a max of 3 in. in 4-Hr fire rated assemblies. The annular space within the fin system shall be a min of 1½ in. to a max of 2 in. in 2½-Hr fire rated assemblies. Sleeve to be tightly supported on both sides of the floor or wall assembly. Any combination of the following types and sizes of cables may be used.

- PVC cable: Max 2½ in. (or smaller) copper conductor cable with polyvinyl chloride (PVC) jacketing and insulation.
- Copper cable: Max 0½ in. (or smaller) aluminum or copper conductor service entrance cable with PVC insulation and jacket.
- Copper cable: Max 0½ in. (or smaller) copper conductor PVC jacketed aluminum clad or steel clad (TEC) R cable.

4. PVC Cable Systems Inc.

5. Filling Material — Segment or Putty — Min 1½ in. thickness of fill material applied within the annulus for 4-Hr Ratings. Min 3½ in. thickness of fill material applied with the annulus for 2½-Hr Ratings. In floors, fill material to be installed flush to top edge of sleeve in top surface of floor. In walls, fill material to be installed flush with both ends of sleeve or both surfaces of assembly. F and T Ratings of fin system are dependent upon the opening size, thickness of concrete sleeve type and percent cable fill, as shown in the following table:

<table>
<thead>
<tr>
<th>Min Concrete Sleeve Thickness</th>
<th>Optional Concrete Type</th>
<th>Optional Cable Type</th>
<th>Cable Fill</th>
<th>F Rating</th>
<th>T Rating</th>
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<tr>
<td>2 in.</td>
<td>PVC</td>
<td>A-TH-A</td>
<td>0.35</td>
<td>2.0</td>
<td>0.0</td>
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<td>PVC</td>
<td>A-TH-A</td>
<td>0.35</td>
<td>2.0</td>
<td>0.0</td>
</tr>
<tr>
<td>3 in.</td>
<td>PVC</td>
<td>A-TH-A</td>
<td>0.45</td>
<td>2.5</td>
<td>0.0</td>
</tr>
<tr>
<td>4 in.</td>
<td>PVC</td>
<td>A-TH-A</td>
<td>0.45</td>
<td>2.5</td>
<td>0.0</td>
</tr>
<tr>
<td>2 in.</td>
<td>Steel</td>
<td>A-TH-A</td>
<td>0.35</td>
<td>3.0</td>
<td>0.0</td>
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* | Specified Putty may be used.

** | Specified Putty may be used.
Example of a Through-Penetration System

System No. C-AJ-2297
F Ratings — 2 and 3 Hr (See Item 4C)
T Ratings — 0, 1, 2 and 3 Hr (See Item 4C)
L Rating At Ambient — Less Than 1 CFM/sq ft
L Rating At 400 F — Less Than 1 CFM/sq ft
W Rating — Class 1 (See Item 4B)
Example of a Through-Penetration System

System No. C-AJ-3154
F Ratings — 2, 3 and 4 Hr (See Item 5)
T Ratings — 0, 1/2 and 2-3/4 Hr (See Item 5)
How Construction joints are tested

UL 2079  Tests for Fire Resistance
ASTM E1966  of Building Joint Systems

Static  Joints that do not move
Dynamic  Joints that move
Five Types of Construction Joints

- Wall to Wall
- Floor to Floor
- Floor to Wall
- Wall to Floor
- Bottom of Wall
Cycling the Joint Prior to Burning
Exposed Face After the Test
An Immediate Hose Stream
Example of a joint system

Drawing showing system

System Number

System Description

System No. FW-D-1006
Assembly Rating — 2C
Nominal Joint Width — 4 In.

Class II Movement Capabilities — 15% Compression or Extension

1. Wall Assembly — Min 4-1/2 in. (114 mm) thick reinforced lightweight or normal weight (100-150 pcf or 1600-2400 kg/m³) structural concrete. Wall may also be constructed of any UL Classified Concrete Blocks*.

See Concrete Blocks (CAZT) category in the Fire Resistance Directory for names of manufacturers.

2. Floor Assembly — Min 4-1/2 in. (114 mm) thick reinforced lightweight or normal weight (100 - 150 pcf or 1600-2400 kg/m³) structural concrete.

3. Joint System — Max separation between edge of floor and face of wall (at time of installation of joint system) is 4 in. (102 mm). The joint system is designed to accommodate a max 15 percent compression or extension from it’s installed width. The joint system shall consist of the following:

A. Forming Material* — Min 4 pcf (64 kg/m³) mineral wool batt insulation installed in joint opening as a permanent form. Pieces of batt cut to min width of 4 in. (102 mm) and installed edge-first into joint opening, parallel with joint direction, such that batt sections are compressed min 33 percent in thickness and such that the compressed batt sections are recessed from top surface of the floor as required to accommodate the required thickness of fill material. Adjoining lengths of batt to be tightly-buttied with butted seams spaced min 16 in. (406 mm) apart along the length of the joint.

FIBREX INSULATIONS INC — FBX Safing Insulation.
IIG MINIWOLL LLC — Safing Insulation/MW
ROCK WOOL MANUFACTURING CO — Delta Board
ROXUL INC — SAFE
THERMAFIBER LLC — Type SAF

B. Fill, Void or Cavity Material* — Spray — Min 1/8 in. (3.2 mm) wet thickness or 1/16 in. (1.6 mm) dry thickness of fill material applied within the joint, flush with top surface of floor and lapping a min 1 in. (25 mm) onto the top surface of the floor and side of wall.

SPECIFIED TECHNOLOGIES INC — SpecSeal AS200 Elastomeric Spray

*Bearing the UL Classification Mark
Example of a joint system

System No. FF-D-0005
Assembly Rating - 3 Hr
Nominal Joint Width - 1 In.
L Rating At Ambient - Less Than 1 CFM/Lin Ft
L Rating At 400°F - Less Than 1 CFM/Lin Ft
Class II Movement Capabilities - 12.5% Compression Or Extension
How Curtain wall systems are tested

ASTM 2307  Determining the Fire Endurance of Perimeter Firebarrier Systems Using the Intermediate Scale Multi-Story Test Apparatus
The Basics of a Fire Containment System
STI Curtain Walls designs are tested according to ASTM 2307
Curtain Walls designs are tested according to ASTM 2307

1. Interior burner lit
2. Exterior burner lit
3. Flames climbing exterior
4. Melting of mullions & transoms

Time: 0:00
Time: 0:05
Time: 0:15
Time: 0:45
Post Test Analysis indicates the failure points that need special protection

Exterior view

Interior view

- Transom melted
- Mullion melted
- Mullion cover
- Curtain wall insulation
- STI AS Spray
- Mullion cover
Curtainwall and Safing Insulation

The Backbone of the System

- Curtainwall Insulation is always **128 kg/cm mineral wool** due to the high melt point and rigidity.

- Safing is installed between the face of slab and the inboard side of the curtainwall insulation, closing off the construction gap.

- **Safing is 64 kg/cm** and can be compressed to up to 50% and will expand and contract with movement of the wall.

System designed to maintain integrity of this intersection.
Use proper orientation and compression

Compression and installation of mineral wool into joint
Mineral wool to be installed with fibers running parallel to the joint edge
New design v/s traditional design
Example of a curtain wall system

System Number

Drawing showing system

System Description
System Components

- Transom and Vision Glass
- Perimeter Angle 22 Ga
- Spandrel Panel (Glass, aluminum, or stone)
- Stiff-Back Angle 22 Ga
- Aluminum “tubular Mullion”
- Vertical Components
  - Foil Faced Mineral Wool 8 PCF
  - Mullion Covers
  - AS-205 Spray over Safing
- Horizontal Components
  - Slab
Questions
Thank you
 شكرا

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