Key Points in Curtain Wall Firestopping

March 24, Fouad Hajj
1. What is Curtain Wall Firestopping?
2. CW Standards
3. What does the UAE code require?
4. CW Testing
5. Failure Points and implications
6. U.L. Systems
7. Installation Issues
8. Inspections
The slot between the slab and the Curtain Wall must be PROPERLY firestopped....
If the Curtain Wall firestopping is not properly installed, in case of fire, the result can be catastrophic...

Windsor Tower, Madrid 2005
Today we will cover...

1. What is Curtain Wall Firestopping?
2. CW Standards
3. What does the UAE code require?
4. CW Testing
5. Failure Points and implications
6. U.L. Systems
7. Installation Issues
8. Inspections
Therefore, it’s crucial that CW designs be tested to the correct standards.

<table>
<thead>
<tr>
<th></th>
<th>IBC</th>
<th>NFPA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Barriers</strong></td>
<td>ASTM E-119</td>
<td>ASTM E-119</td>
</tr>
<tr>
<td></td>
<td>UL 263</td>
<td>UL 263</td>
</tr>
<tr>
<td><strong>Through Penetration</strong></td>
<td>ASTM E-814</td>
<td>ASTM E-814</td>
</tr>
<tr>
<td></td>
<td>UL 1479</td>
<td>UL 1479</td>
</tr>
<tr>
<td><strong>Joints</strong></td>
<td>UL 2079</td>
<td>UL 2079</td>
</tr>
<tr>
<td></td>
<td>ANSI 2079</td>
<td>UBC AC-30</td>
</tr>
<tr>
<td><strong>Safing Slot</strong></td>
<td><strong>ISMA</strong></td>
<td><strong>ISMA</strong></td>
</tr>
<tr>
<td></td>
<td>ASTM E-2307</td>
<td>UBC 29-6</td>
</tr>
</tbody>
</table>
Today we will cover...

1. What is Curtain Wall Firestopping?
2. CW Standards
3. What does the UAE code require?
4. CW Testing
5. Failure Points and implications
6. U.L. Systems
7. Installation Issues
8. Inspections
New UAE Fire Code requires firestopping in Chapter 7, Section 21.

Abu Dhabi Building Code is based on IBC and requires Firestopping in Chapter 7.

Approved Standards For Inspection:

- ASTM E 2174 (through Penetrations)
- ASTM 2393 (Joints and Curtain Wall)
The UAE Code requires testing of the CW Firestop designs to the proper standards.

21.5.4. Perimeter fire barriers / External Curtainwall system

21.5.4.1. This category addresses any gap, joint, or opening, whether static or dynamic, between a fire-rated floor assembly and a non-rated exterior wall assembly.

21.5.4.2. Exterior curtain walls and perimeter joints shall be intended to restrict the interior vertical passage of flame and hot gases from one floor to another at the location where the floor intersects the inside of an exterior curtain wall assembly.

21.5.4.3. A single or combination of materials used to create a firestop assembly at the perimeter gap between a fire resistance rated floor assembly and a non-resistance rated wall assembly, capable of preventing the spread of heat, fire, gases, smoke or other defined hazards through the opening in the wall and floor assembly. Perimeter Fire Barrier System Ratings shall be established in accordance with ASTM E 2307 as the test method (Please refer to section 21.16 for acceptable alternative Test Standards).
Today we will cover...

1. What is Curtain Wall Firestopping?
2. CW Standards
3. What does the UAE code require?
4. CW Testing
5. Failure Points and implications
6. U.L. Systems
7. Installation Issues
8. Inspections
Curtain Wall testing is done by using the Intermediate Scale Multi-storey Apparatus (ISMA)

Pre-Burn
Interior Burner Lit

Time:
0:00
Exterior Burner Lit

Time: 0:05
Melting of Mullions & Transoms

Time: 0:45
Burner off at 2 Hours

Time: 2:00
Today we will cover...

1. What is Curtain Wall Firestopping?
2. CW Standards
3. What does the UAE code require?
4. CW Testing
5. Failure Points and implications
6. U.L. Systems
7. Installation Issues
8. Inspections
Post Test Analysis indicates the failure points that need special protection.

Close up Detail of Mullion and Transom Damage
Today we will cover...

1. What is Curtain Wall Firestopping?
2. CW Standards
3. What does the UAE code require?
4. CW Testing
5. Failure Points and implications
6. U.L. Systems
7. Installation Issues
8. Inspections
STI has invested heavily in Curtain Wall testing:

- UL is the premier fire testing lab in the US
- STI tests mostly at UL
- STI designed and tested the first C.W. System with vision glass
- STI has more UL C.W. tests than all other competitors combined! (93 out of 123)*
- As a result, STI has privileged working relationships with major C.W. designers/engineers around the world

Understanding the UL Directory Numbering System

1. Floor Assembly - Min 4-1/2 in. (114 mm) thick reinforced lightweight or normal weight (190-195 psi or 1900-2000 kg/m3) structural concrete. Perimeter of floor assembly to be provided with min 3 by 1 by 1/4 in. (76 by 76 by 6 mm) thick cast-in-place structural steel angles for weld attachment of mullion mounting clips (item 2A).

2. Curtain Wall Assembly - The curtain wall assembly shall incorporate the following construction features:
   A. Mullion Mounting Clips - Min 4 in. (102 mm) long angles with one 90 deg (90 deg) leg extended to edge of four assembly and the other leg approx 4 in. (102 mm) longer than distance to nearest face of mullion. Clips to be formed of min 1/4 in. (6 mm) thick steel. Clips welded to steel angle edge of assembly (item 1) on each side of vertical mullion (item 2B) at each floor level. Each clip to be provided with elongated holes to accommodate disassembled amount of movement. Top edge of each clip to be secured min 1/2 in. (13 mm) below top surface of floor.
   B. Framing - The rectangular tubing mullions (vertical members) and transoms (horizontal members) shall be min 2-1/2 in. (64 mm) wide (7/8 in. [22 mm] deep) and shall be filled with min 0.95 in. (23.2 mm) thick aluminum. Mullions spaced max 60 in. (152 cm). OC and secured to mullion mounting clips (item 2A) at each floor level with two 3/8-16 by 4 in. (102 mm) long hex head steel bolts in conjunction with Steel nuts and washers. Interior face of mullions to be max 8 in. (203 mm) from edge of floor assembly. Transoms to be spaced min 36 in. (91 cm). OC. The minimum height from the top of the floor to the bottom of the vision panel sill is 6 in. (152 mm).
   C. Spandrel Panels - The spandrel panels shall consist of one of the following types:
      a. Glass Panels - Nom 1/4 in. (6 mm) thick opaque heat-strengthened glass. Each panel secured in position with aluminum pressure plates in conjunction with gaskets and steel screws.
      b. Aluminum Panels - Nom 1/8 in. (3 mm) thick aluminum panels with 1/4 in. (6 mm) thick edges. Each panel secured in position with aluminum pressure plates in conjunction with gaskets and steel screws.
      c. Stone Panels - Nom 1-3/16 in. (46 mm) thick polished granite spandrel panels with 23/32 in. (19 mm) thick gauged edges. Each panel secured in position with aluminum pressure plates in conjunction with gaskets and steel screws.
   D. Vision Panels - Nom 3/8 in. (9 mm) thick transparent heat-strengthened glass or nom 1 in. (25 mm) thick insulated glass units with two layers of min 1/4 in. (6 mm) thick transparent heat-strengthened glass separated by a 1/2 in. (25 mm) air space. Each panel secured in position with aluminum pressure plates in conjunction with gaskets and steel screws.

3. Safing System - Max separation between edge of floor assembly and facia members (at time of installation) is 8 in. (204 mm). The safing system is designed to accommodate vertical shear movement up to a max of 5 percent of its installed width. The safing system shall incorporate the following construction features:
   A. Forelining Material - Nom 4 ft (94 kg/m3) density mineral wood batt insulation. Batt sections out to a min 4 in. (102 mm) width and stacked to a thickness which is min 25 percent greater than the width of linear gap between the curtain wall insulation and the edge of the concrete floor slab. The stacked forelining material is compressed 20 percent in the thickness direction and inserted edge-first into the liner gap such that its top surface is flush with the top surface of the floor assembly. A max of one tightly fitted layer to separate batts and additional materials. Additions of pieces of forelining material to be friction-fit into spaces between mullion mounting clips at each mullion location.
   B. Fill, Void or Cavity Material - Min 18 in. (3 mm) thick chemically curable polyurethane or equivalent material applied over top of forelining material and min 1/2 in. (13 mm) onto the top surface of the floor and onto the curtain wall insulation and framing covers.

Specified Technologies Inc., 210 Evans Way Somervell, NJ 08876
Reprinted courtesy of Underwriters Laboratories, Inc. Created or Revise: May 21, 2008
(908)992-1190 • (908)526-8000 • FAX (908)992-8145 • E-Mail: kensher@stiinfo.com • Website: www.stiinfo.com

Specified Technologies Inc., 210 Evans Way Somervell, NJ 08876
Reprinted courtesy of Underwriters Laboratories, Inc. Created or Revise: May 21, 2008
(908)992-1190 • (908)526-8000 • FAX (908)992-8145 • E-Mail: kensher@stiinfo.com • Website: www.stiinfo.com
CW-D-2042

First Two Alpha Characters “CW”

Identifies the gap between a fire rated floor and a non rated exterior curtain wall

Third Alpha Character is “S” or “D”

“S” Static Joints

“D” Dynamic Joints
CW-D-2042

Number Range = Max Clearance Distance Between Curtain Wall and Perimeter of Floor
0000-0999 = Less Than or Equal to 2”
1000-1999 = Greater than 2” - Less than = to 6”
2000-2999 = Greater than 6” - Less than = to 12”

CW-D-2042

Last Three Numeric Components = Test Number in the Series
Designates 042 as the 42nd test in the 2000-2999 PFCS series
Today we will cover...

1. What is Curtain Wall Firestopping?
2. CW Standards
3. What does the UAE code require?
4. CW Testing
5. Failure Points and implications
6. U.L. Systems
7. Installation Issues
8. Inspections
Aluminum Tubular Mullion

1. Perimeter Angle
2. Stiff-Back Angle
3. Foil Faced Mineral Wool 8PCF
4. Slot Treatment:
   a. Mineral Wool (4 PCF) compressed and fitted tight in safing slot
   b. AS-205 Spray over MW Safing
5. Mullion Covers: Mineral Wool 8PCF

Concrete Slab

Aluminum “tubular Mullion”

and Vision Glass

Panel (aluminum, or stone)
Steel Back-Pan Spandrel Panel
CW-S-0002

Stiff-Back Angle
Additional Insulation

ONLY BACK-PAN TESTED SYSTEM.

PATENDED DESIGN!
Steel Back-Pan CW: A Word of Caution!

January 20, 2011
Specified Technologies Inc.
Mr. James Stahl Jr.
200 Evans Way, Suite 2
Somerville, NJ 08876

Our Reference: File R14288
Subject: Engineering Studies for Perimeter Fire-Containment Systems

Dear Mr. Stahl:

This is to confirm our conversations regarding the Subject. It has come to our attention that engineering judgments for perimeter fire-containment systems incorporating steel back pans are being issued despite having no tested or listed designs for curtain walls with steel back pans to reference as the basis for such judgments.

Based on our previous testing experience, we have found that the steel back pan condition is a critical configuration from a fire test perspective. Testing conducted in accordance with ASTM E2337, Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus, has demonstrated that the thermal expansion of the steel pan can cause it to distort and deflect, stressing the perimeter fire containment system under fire conditions and in some cases causing the perimeter containment system to become dislodged. The fill material applied over the safing system in the perimeter fire-containment system can also be exposed to a significant amount of heat from the steel back pan and could cause ignition of sealants or coatings during the course of fire exposure.

UL has several published designs for steel back pan curtain wall conditions listed in the Fire Resistance Directory. Such published designs diminish the need for engineering judgments for this common yet critical condition.

Should you need any further assistance, please do not hesitate to contact us.

Very truly yours,

STEVEN J. HOFFMAN
Staff Engineer
Fire Protection Division

Reviewed by:

C. J. JOHNSON
Lead Engineering Associate
Fire Protection Division
Reverse Back-Pan (Shadow Box) Spandrel Panel CW-D-1009

Perimeter Angles
Stiff-Back Angle
Shadow Box
In rated construction, **all** floors are rated.

The safing slot **must** be sealed in a manner that extends this rating to the exterior wall surface.
Mineral Wool Installation

Safing is cut slightly oversized and jam fit into the opening foil side up with the grain parallel to the floor.

Z shaped steel safing clips are used to impale the safing and suspend it into the opening.

...Do not adequately protect the safing slot!
Do not adequately protect the safing slot!

Two caulk beads are applied to seal the edges of the foil facing to the adjacent surfaces.
Do not adequately protect the safing slot!

In a Fire...

The insulation is oriented improperly... It lacks resilience and will not rebound.

As it burns, the edges shrink inward creating gaps.
Take advantage of Mineral Wool’s natural resilience to help keep the slot closed during a fire!

Mineral wool safing is oriented with its grain running vertically.
Use Proper Orientation and Compression

Providing maximum compression and extension and a tight fit against the spandrel insulation without the need for safing clips!

Assuring a tighter smoke, gas, and fire seal!
Use Proper Orientation and Compression

It is simple and easy to do!
Benefits of Pro-Actively Designing the Safing Slot

- Maintains compartmentation
- Prevents the migration of smoke through to floors above.
- Buys time for occupants to escape.
- Provides additional protection in the event of a sprinkler failure.
Today we will cover...

1. What is Curtain Wall Firestopping?
2. CW Standards
3. What does the UAE code require?
4. CW Testing
5. Failure Points and implications
6. U.L. Systems
7. Installation Issues
8. Inspections
Steps to Inspect Perimeter Fire Barrier Firestop

Step 1: Verify Documents and submitted Drawings reference Legitimate Perimeter Fire Barrier Systems such as UL. CW-S or CW-D

Step 2: Verify the Rating of the System is Greater than or equal to the rating of the floor

Step 3: Verify Firestop material to be used and listed for use in Perimeter Fire Barrier Systems.

Step 4: Verify Documents reference systems that have been tested with windows or vision glass if the building has glazing close to the safing area.

Step 5: verify Stiff steel reinforcement member, if required, has been placed behind exposed curtain wall panel insulation.
Step 6: verify Insulation and brand used is listed within the tested system. Rock wool is the typical insulation of choice.

---

**ASTM E119 Temperature Curve**

- **2080 °F (5 hours)**
  - Mineral wool still intact

**Glass Melts**
- 1510 °F (25 minutes)
  - Plate glass melts

**Aluminum Melts**
- 1220 °F (3 minutes)
  - Aluminum melts
- 1050 °F (6 minutes)
  - Glass-fiber insulation melts

**Fiberglass Insulation Fails (6 Minutes) at 1050 °F and IS Not To Be Used In a Fire Containment Assembly**
Step 7: Verify Insulation panels are securely fastened with mechanical fasteners per the system, instead of just friction-fitted in place.

Step 8: Verify the exposed mullions, if required by the system are covered with the proper insulating barrier securely fastened with mechanical fasteners per the system design.

Step 9: Verify Sealant is applied to the proper depth.

Step 10: Verify the Parameters indicated in the system are the same as those installed in the field.
The IFC has put out a “Firestopping Inspection Manual” to help field inspectors.
Thanks

Fouad Hajj
Specified Technologies Inc.
District Manager
(Gulf Region)

Tel: +974 558 58 390
fouadh@stifirestop.com