

Perimeter Fire-Containment: Common Misconceptions

Presented By: Angie Ogino
Thermafiber/Owens Corning
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Objectives



- Explore fire propagation at the exterior wall in high rise structures and the codes, standards, and listed assemblies that are used to address these fire safety issues.
- Review the basic design features required at the exterior wall to contain a fire to the level of origination.
- Outline the top 5 common misconceptions when it comes to designing and installing perimeter fire containment systems.
- Guidelines on proper design- How can the firestop contractor influence fire safety at the building's perimeter?



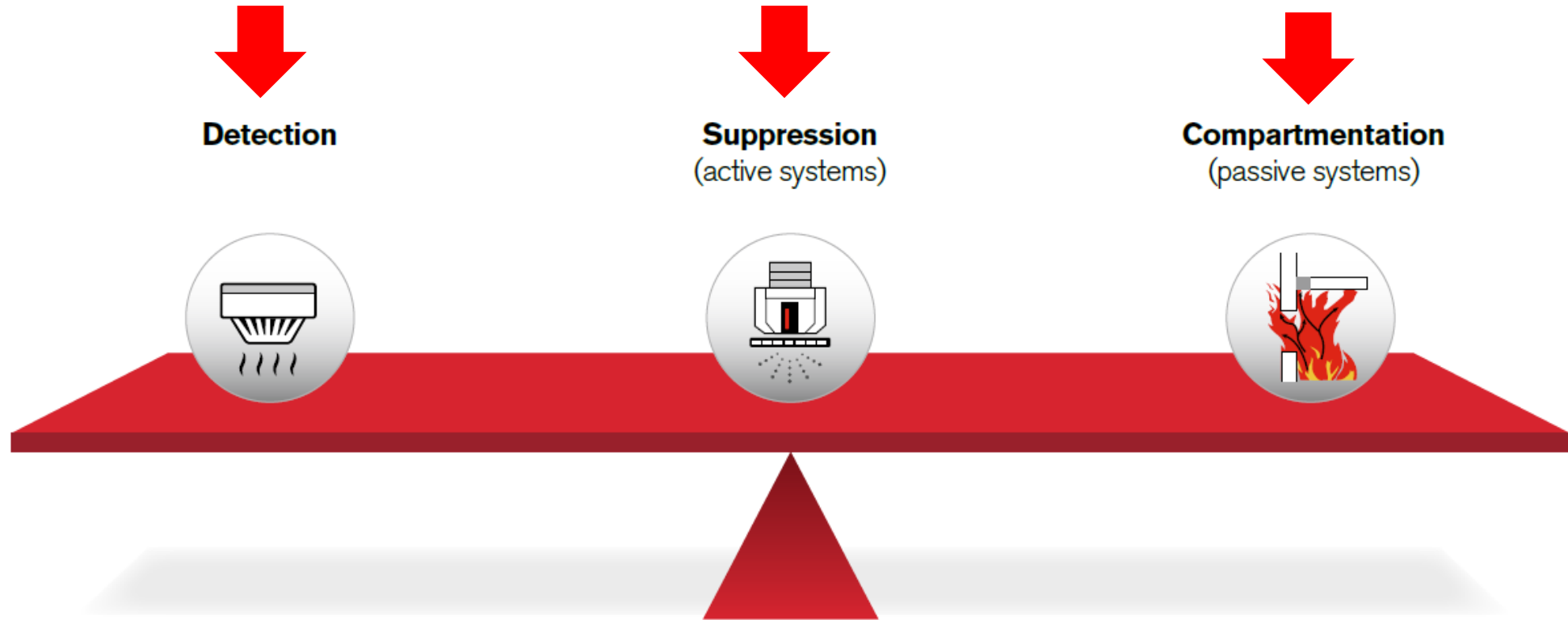
Why is fire
containment
important?

Why taller buildings present unique problems when it comes to protecting occupants

- Size of buildings
- Number of occupants
- Limited means of egress
- Reach of fire services ladder trucks



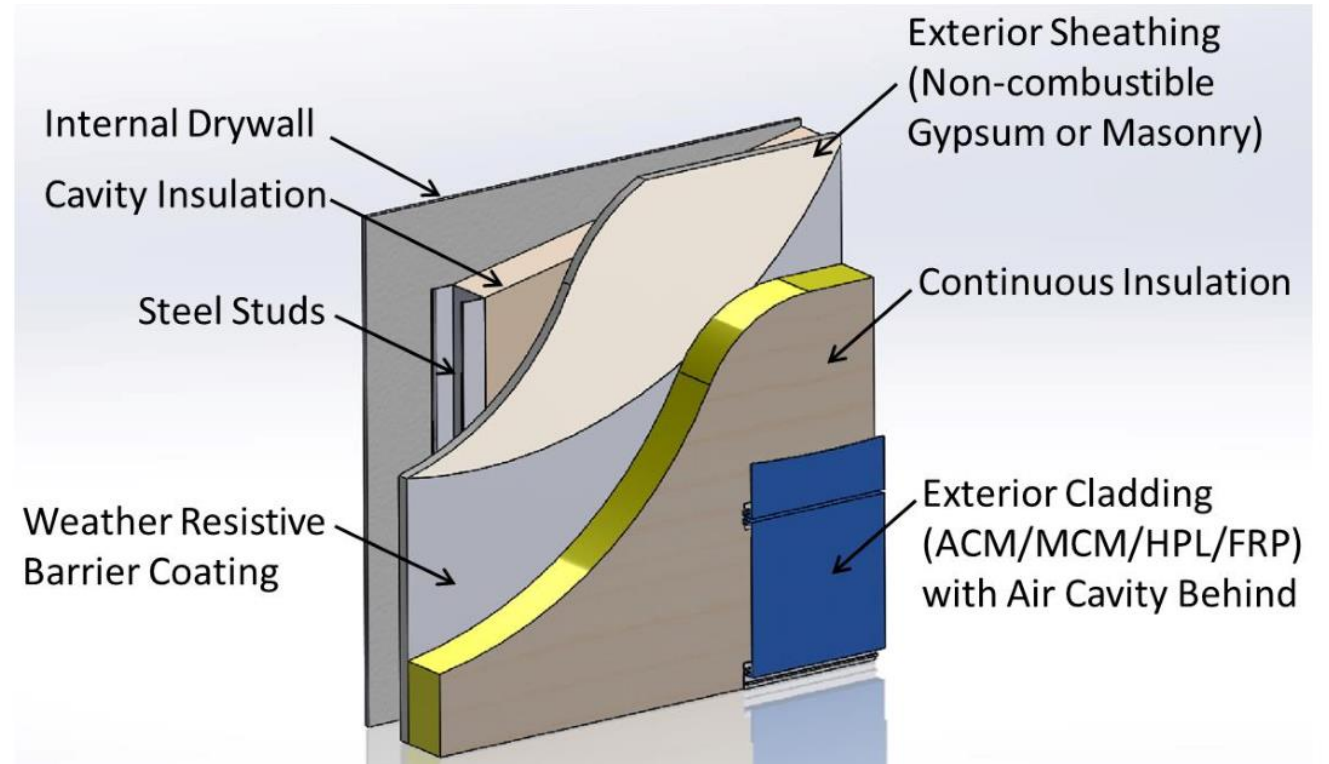
Strategies for Protecting Building Occupants





High Rise Building Facades- Curtain Wall

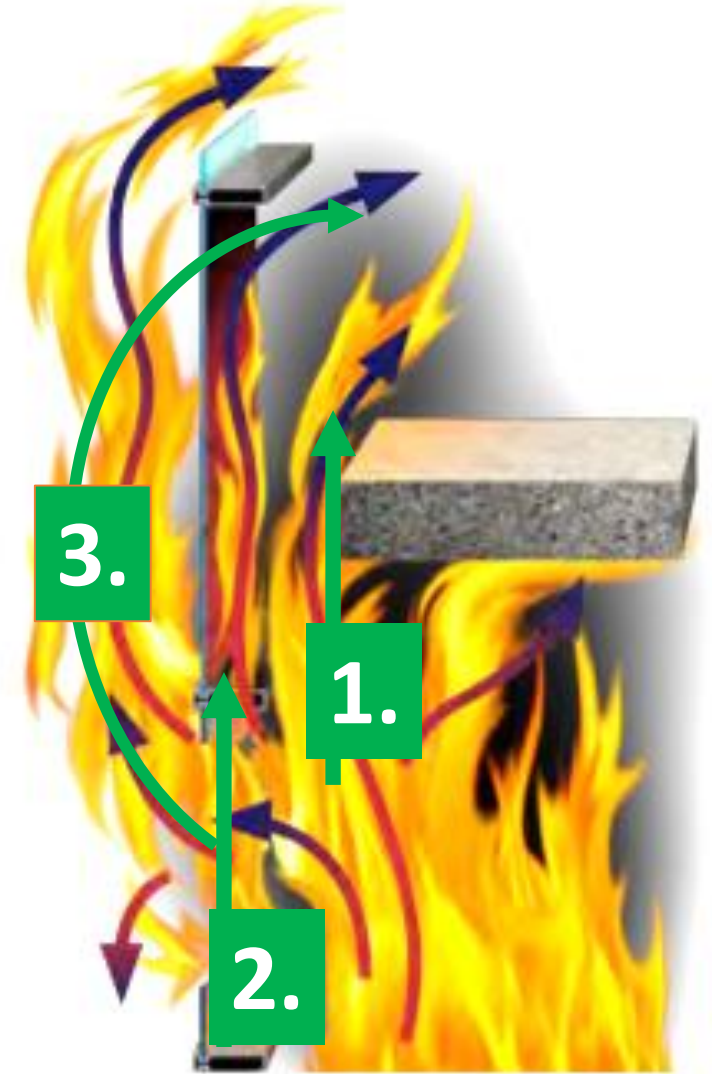
High Rise Building Facades- (EIFS, Stucco, ACM, MCM, HPL, Terracotta)



How Fire Spreads at the Perimeter- Interior /Leap Frog

Paths of Fire Propagation

- 1.** Through interior void
ASTM E2307/ULC S115
- 2.** Through cavity of spandrel **ULC S134**
- 3.** Via Exterior **E2874- Leap Frog**



High Rise Fires

Curtain Wall

- Very tall buildings need sprinkler protection with a reliable water supply
- Curtain walls should be protected to limit fire and smoke spread at joints between floor and exterior walls- **E2307**
- Spandrel protection needed to prevent fire spread from window to window opening- **E 2874**



Windsor Tower- Madrid, Spain 2005

High Rise Fires

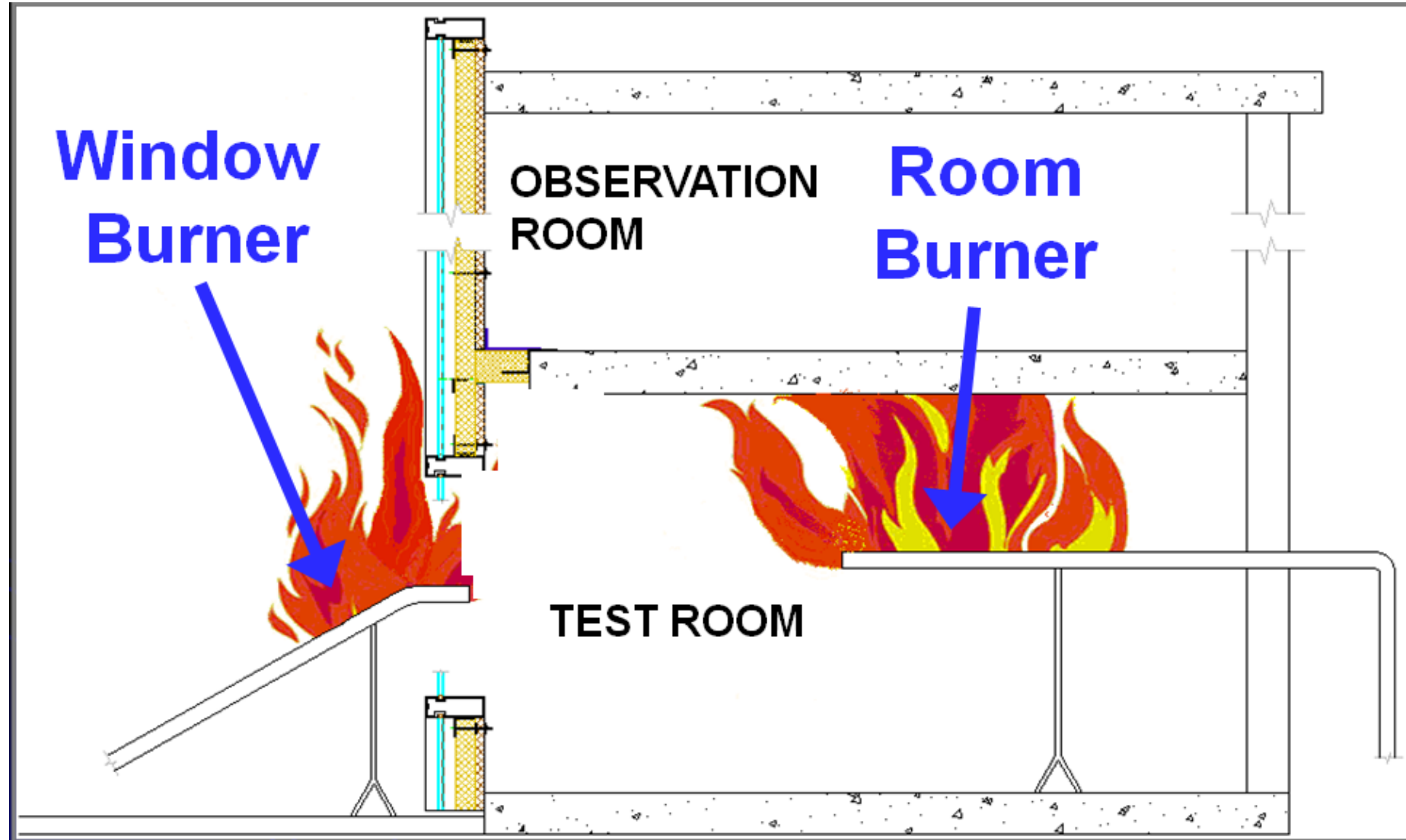
Combustibles in Exterior Wall System



- Buildings using combustible components of a very tall building façade can pose unreasonable risks for significant fire spread
- Façade fire spread characteristics must be understood and substantiated by large-scale tests- **NFPA 285** or **ULC S134** .

Marina Torch Tower Fire- Dubai- 2015 and 2017

ASTM E2307



Building Codes- Exterior Curtain Wall

INTERNATIONAL BUILDING CODES 2015

Section 715.4 Exterior Curtain Wall/Floor Intersection

- Where fire resistance-rated floor or floor/ceiling assemblies are required, **voids created at the intersection of the exterior curtain wall assemblies and such floor assemblies shall be sealed with an approved system** to prevent the **interior spread** of fire. **Such systems shall be securely installed and tested in accordance with ASTM E2307 to provide an F rating for a time period not less than the fire-resistance rating of the floor assembly.** Height and fire-resistance requirements for curtain wall spandrels shall comply with Section 705.8.5.
-
- **Exception:**
 - Voids created at the intersection of the exterior curtain wall assemblies and such floor assemblies **where the vision glass extends to the finished floor level shall be permitted to be sealed with an approved material to prevent the interior spread of fire.** Such material shall be securely installed and capable of preventing the passage of flame and hot gases sufficient to ignite cotton waste where **subjected to ASTM E 119 time-temperature fire conditions** under a minimum positive pressure differential of 0.01 inch (0.254 mm) of water column (2.5 Pa) for the time period equal to the fire-resistance rating of the floor assembly.



Building Codes - Canada

National Building Code of Canada

3.1.8.3. Continuity of Fire Separations

4) The continuity of a fire separation shall be maintained where it abuts another fire separation, a floor, a ceiling, a roof, or an exterior wall assembly. (See Note A-3.8.3.(4).)

A-3.1.8.3.(4) Fire Separation Continuity. The continuity of a fire separation where it abuts against another fire separation, a floor, a ceiling or an exterior wall assembly is maintained by filling all openings at the juncture of the assemblies with a material that will ensure the integrity of the fire separation at that location.

Canadian Firestop Systems tested to:
CAN/ULC-S115 “Standard Method of Fire Tests
for Firestop Systems” - **ASTM E 2307 is referenced.**



Behavior of Curtain Wall Materials Exposed to Fire

Aluminum- Melts at 660°C- 9 minutes into a fire

- CW Framing
- CW Anchors
- Aluminum Fasteners

Glass- Breaks out- 5 Minutes when exposed to fire

Spandrel Insulations-

- Glass Fiber- **Melts within 6 minutes (565°C)** into a fire
- Plastic Foam Insulations- **Flash Point 149 to 200°C**
- Mineral Wool- **Exposed for 5 hours 1100°C-** Remained Fully Intact



Perimeter Fire Containment

THE 6 BASIC DESIGN PRINCIPLES

2. Mineral Wool Insulation - Mechanically Attached

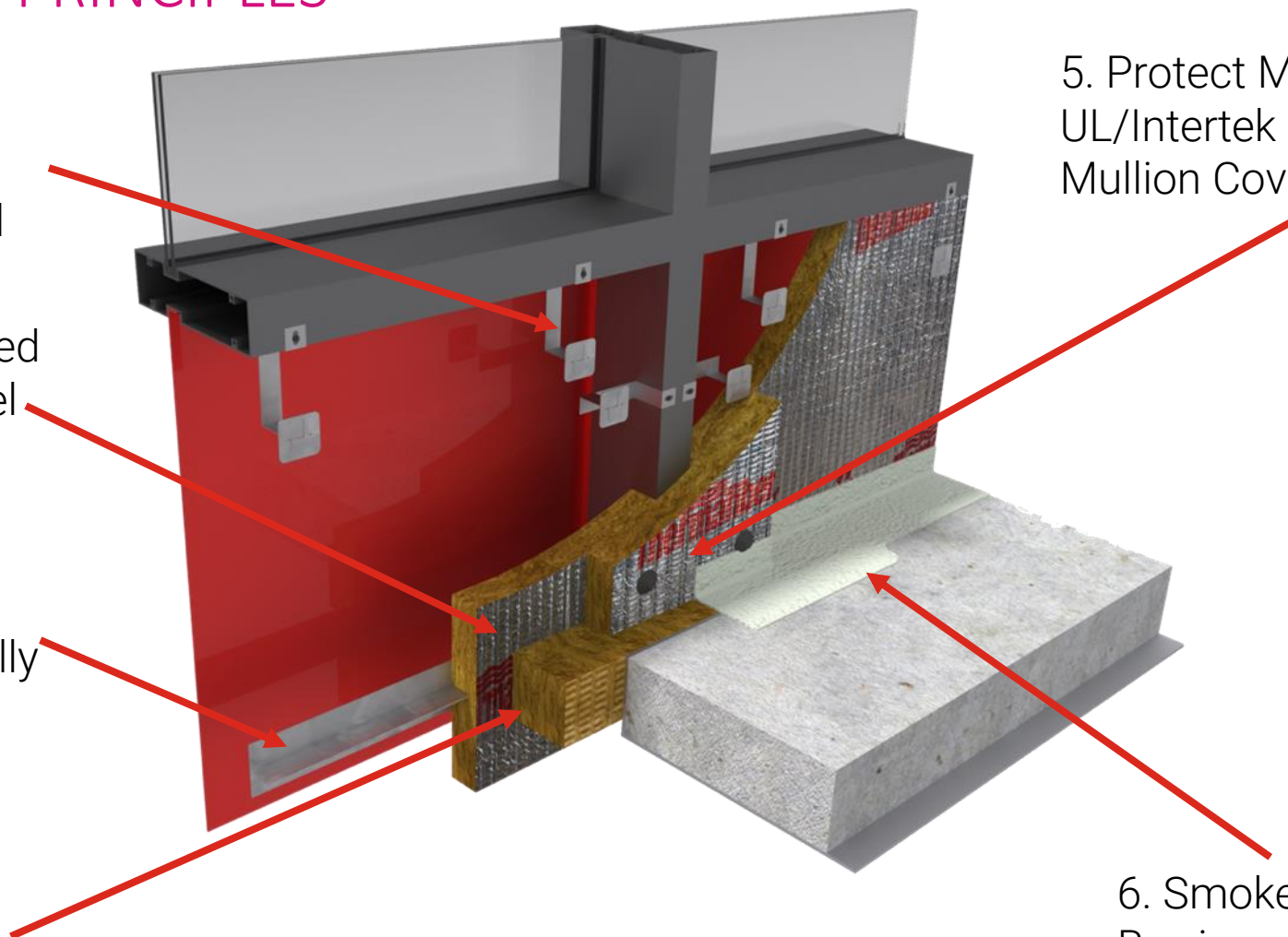
1. UL/Intertek Approved Mineral Wool Spandrel Insulation

3. Reinforcement Member Mechanically Attached

4. Compression-Fit UL/Intertek Approved Mineral Wool Safing Insulation

5. Protect Mullions with UL/Intertek Mineral Wool Mullion Cover Insulation

6. Smoke Barrier



Manufacturing of Mineral Wool

MISCONCEPTION #1

Mineral Wool is Mineral Wool



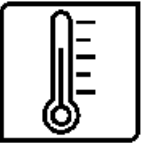
Common Misconceptions about PFC Systems

MISCONCEPTION #1

Mineral Wool is Mineral Wool



Non Combustible



Thermal Performance

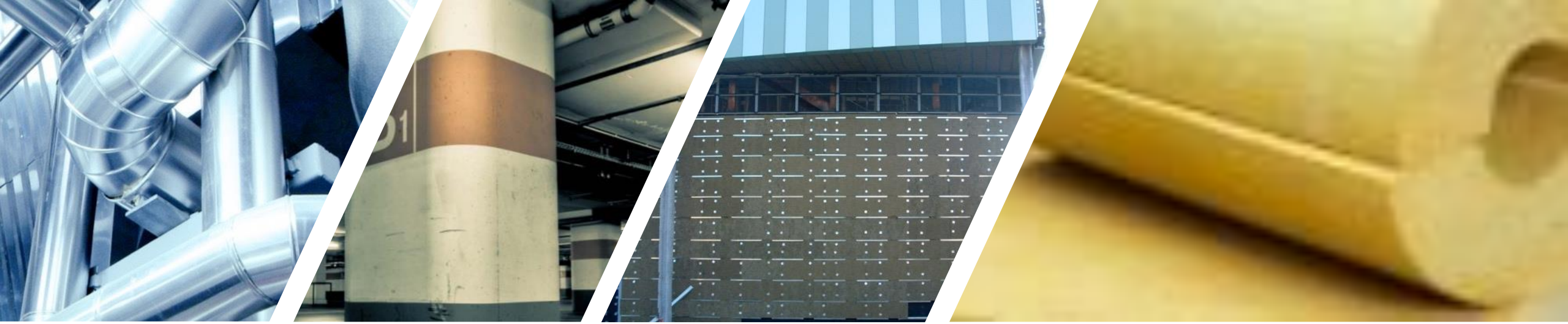


Sound Control



Moisture Performance





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3rd Party Certification of Products & Systems



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G. Curtain Wall Insulation* — Nom 3 in. (76 mm) thick mineral wool batt insulation faced on one side with aluminum foil/scrim vapor retarder. Unfaced mineral wool batt insulation is also acceptable. Insulation batts to be installed with no vertical or horizontal seams, and are tightly-fitted between vertical mullions and the transoms, flush with the interior surface of framing. Score curtain wall insulation panels so that the L-angle stems fit into the score of the insulation, allowing curtain wall insulation panels to fit tightly up against the steel back pan. Insulation panels secured to steel backpan with cup head weld pins (Item 2I) spaced max 12 in. (304 mm) OC both vertically and horizontally, with perimeter weld pins spaced maximum 2 in. (50 mm) from edge of each curtain wall framing member. Cup head weld pins are minimum 12 ga, 3 in. (76 mm) long, with length to match the thickness of the curtain wall insulation, and have a minimum 1-3/16 in. (30.2 mm) diameter head washer.

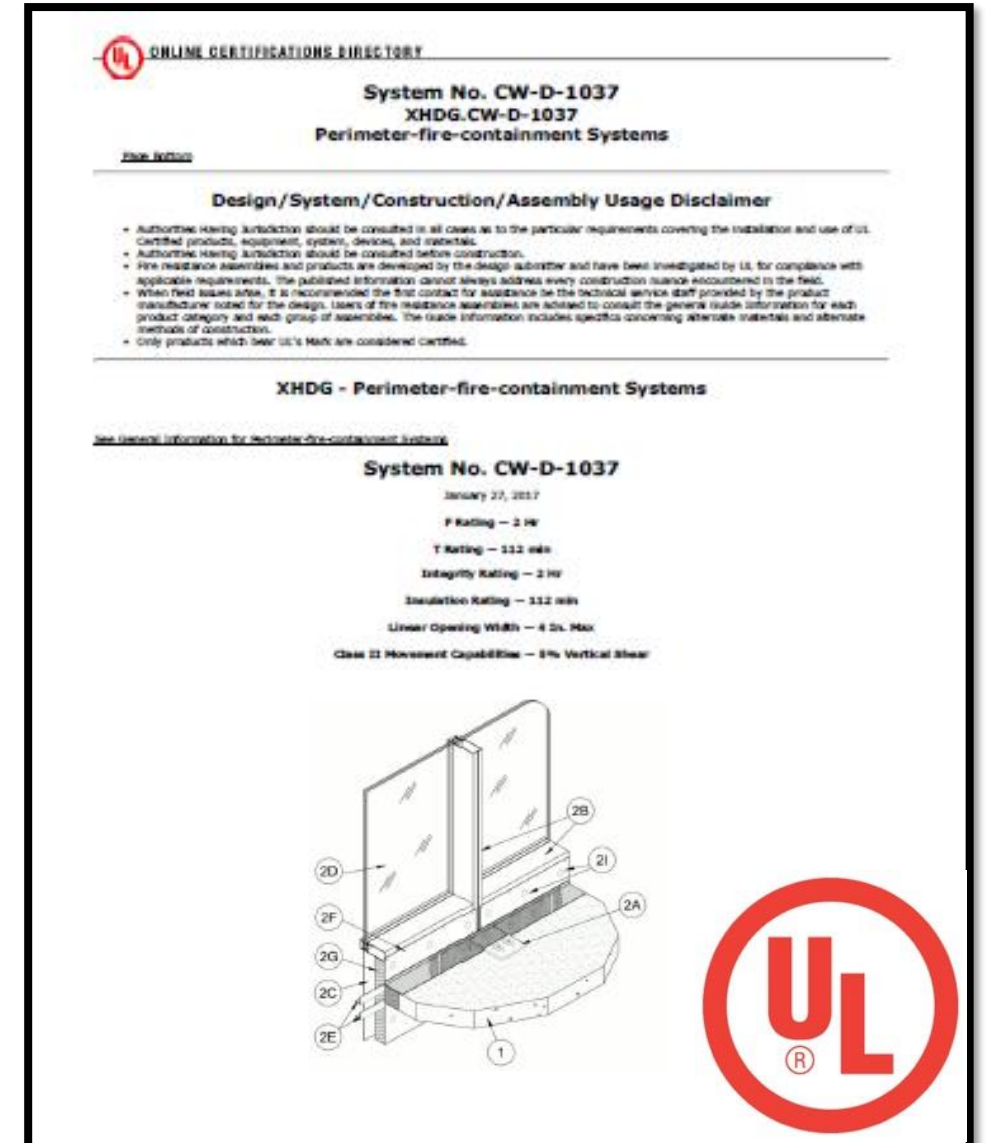
THERMAFIBER INC — Firespan 90

3. Safing System — Max separation between edge of floor assembly and face of framing member at time of installation is 4 in. (102 mm). The safing system is designed to accommodate vertical shear up to 5 percent of its installed width. The safing system shall incorporate the following construction features:

A. Forming Material* — Nom 4 pcf (64 kg/m³) density mineral wool batt insulation. Batt sections cut to a 4 in. (102 mm) width and stacked to a thickness which is min 25 percent greater than the width of the linear gap between the curtain wall insulation and the edge of the concrete floor slab. The forming material is compressed and inserted cut-edge-first into linear gap such that

its top surface is flush with the top surface of the floor assembly. A max of one tightly-buttet seam is permitted between mullions. Additional piece of forming material to be friction-fit into gap between batt sections above mullion mounting clip at each mullion location.

THERMAFIBER INC — SAF



Common Misconceptions about PFC Systems

MISCONCEPTION #1

Mineral Wool is Mineral Wool

3. PERIMETER JOINT PROTECTION: The perimeter joint (linear opening) is not to exceed a 4 in. nominal joint width (joint width at installation). The perimeter joint treatment shall incorporate the following construction features:

A. CERTIFIED MANUFACTURER: Only Intertek

Certified Manufacturer

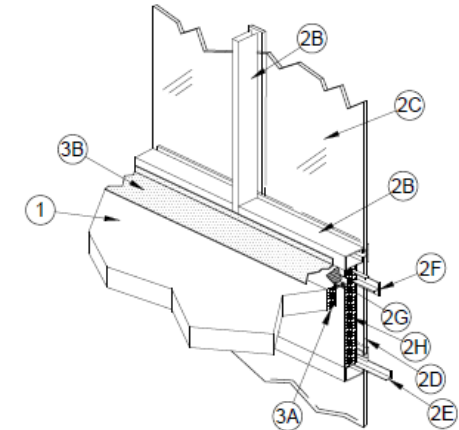
CERTIFIED PRODUCT: Mineral Wool

CERTIFIED MODEL: Only Intertek Certified Manufacturer's product meeting the min. requirements below.

PACKING MATERIAL - Fill the box pan sections to a depth of 2-7/8 in. with 4 pcf density, mineral wool batt insulation installed with the fibers running parallel to the floor. Compress the packing material 25% vertically in the box pans.

Install min. 4 in. thick, 4 pcf density, mineral wool batt insulation in the joint opening, installed with the fibers running parallel to the slab edge and curtain wall. Compress the packing material 25% in the nominal joint width. Compress the batt insulation into the perimeter joint flush with the top surface of the concrete floor slab (Item 1) and its mid-depth is compressed against the interior surface of the insulation-filled box pan (Item 2D). Splices (butt joints) in the lengths of mineral wool batt insulation are to be tightly compressed together.

Design No. STI/JS 120-01
OPL Design No. CEJ 322 P
F Rating - 2 HOUR
L Rating - <1 SCFM/LF
Rated for ±6% horizontal movement @ 33% Compression (See ITEM 3A)
Rated for ±3% vertical shear movement @ 33% Compression (See ITEM 3A)



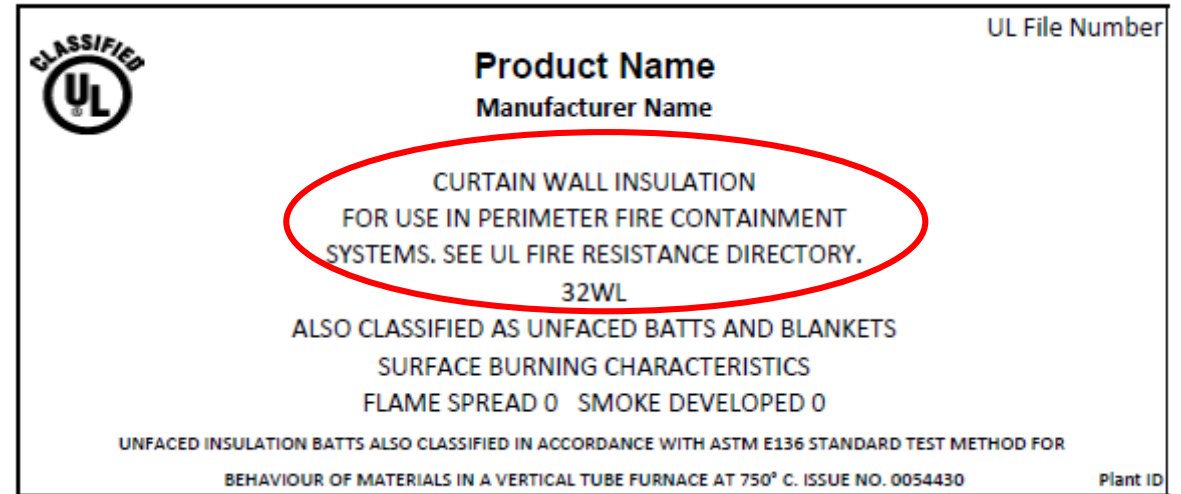
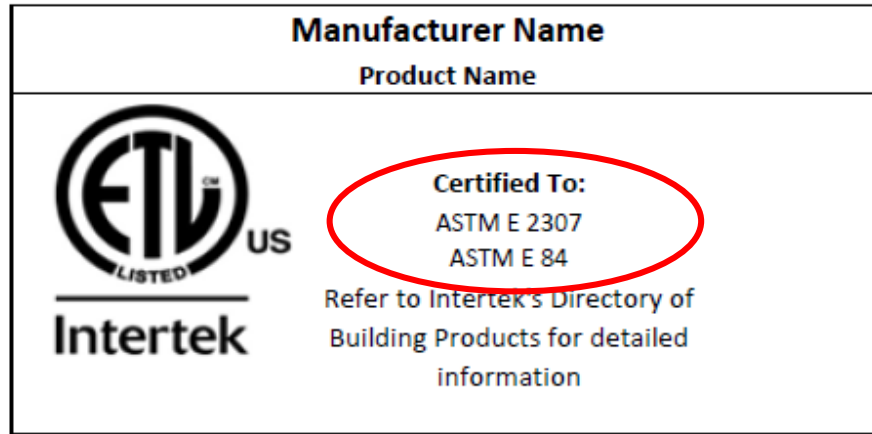
- 1. Concrete Floor Assembly** - Two-hour rated concrete floor assembly made from either lightweight or normal weight concrete with a density of 100-150 pcf, with a min. thickness of 4 in. at the joint face. Overall slab thickness may vary to accommodate various blockout depths (longitudinal recesses) formed in the concrete, to house the architectural cover plate. The blockout width may also vary without restriction.
- 2. Curtain Wall Assembly** - The curtain wall assembly shall incorporate the following construction features:
 - A. Mounting Attachment** - (Not Shown) The mounting attachments to the floor slab shall be connected to the joint face of the floor slab, in accordance with the curtain wall manufacturer's instructions. Attachments are to be secured to each mullion in the perimeter joint protection region at a max. spacing of 80 in. o.c.
 - B. Aluminum Framing** - Size rectangular aluminum tubing mullions and transoms, according to the curtain wall system manufacturer's guidelines. Min. overall dimensions of the extruded framing sections are 0.100 in. thick aluminum with a minimum 3-3/4 in. depth and a minimum of 2-1/2 in. width. Mullion and transom covers are added to the external side of the framing, giving the framing system a total depth of 60 in. o.c. and spandrel transoms are to be spaced a min. 10 in. o.c. Mullions are to be placed a min. of 5-1/2 in. below the concrete floor (as measured from the bottom of the transom) and the upper transom (as measured from the top of the transom) may be located flush with the top surface of the floor, while the lower transom is to be located flush with the bottom surface of the floor.
 - C. Vision Glass Panels** - Size and install panels to curtain wall manufacturer's guidelines. Use min. 1/4 in. thick, clear heat-treated glass.

Intertek

Common Misconceptions about PFC Systems

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Common Misconceptions about PFC Systems

MISCONCEPTION #2

ASTM E 119 Exception can be used in lieu of E2307 tested system

International Building Codes 2015

Section 715.4 Exterior Curtain Wall/Floor Intersection

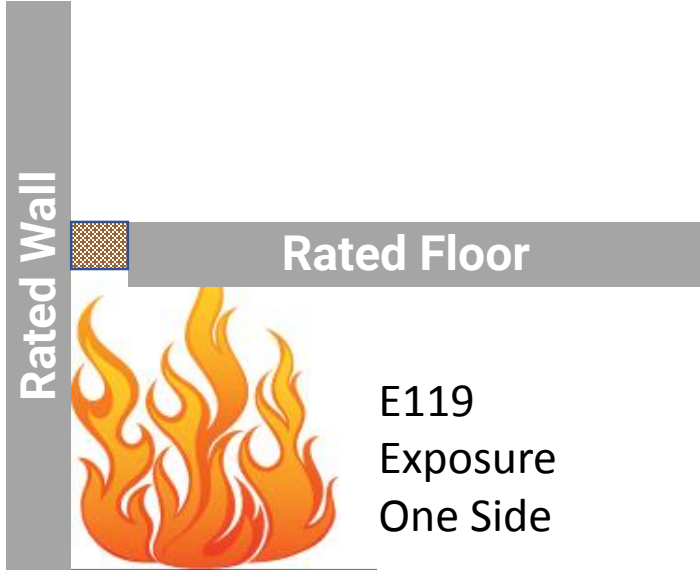
E2307 is Required.

Exception:

Voids created at the intersection of the exterior curtain wall assemblies and such floor assemblies **where the vision glass extends to the finished floor level shall be permitted to be sealed with an approved material to prevent the interior spread of fire.** Such material shall be securely installed and capable of preventing the passage of flame and hot gases sufficient to ignite cotton waste where **subjected to ASTM E 119 time-temperature fire conditions** under a minimum positive pressure differential of 0.01 inch (0.254 mm) of water column (2.5 Pa) **for the time period equal to the fire-resistance rating of the floor assembly.**



E119 Fire Exposure



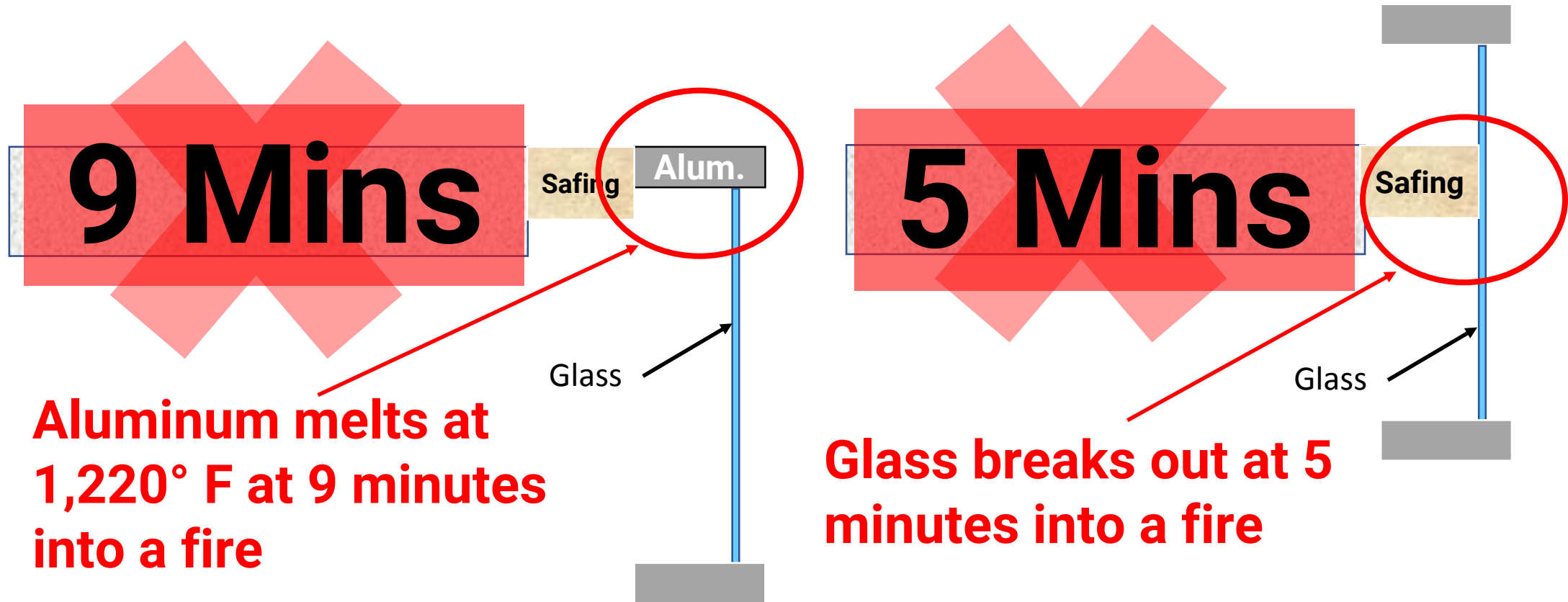
E2307 Fire Exposure

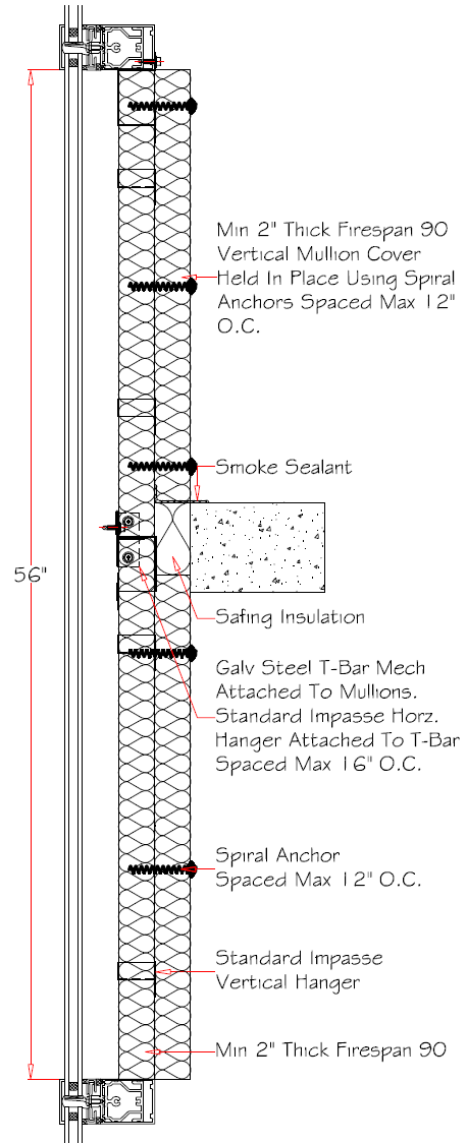


Common Misconceptions about PFC Systems

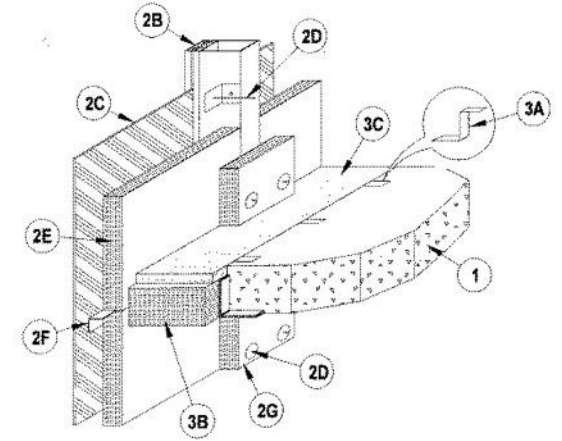
MISCONCEPTION #2

ASTM E 119 Exception can be used in lieu of E2307 tested system





**Underwriters
Laboratories**

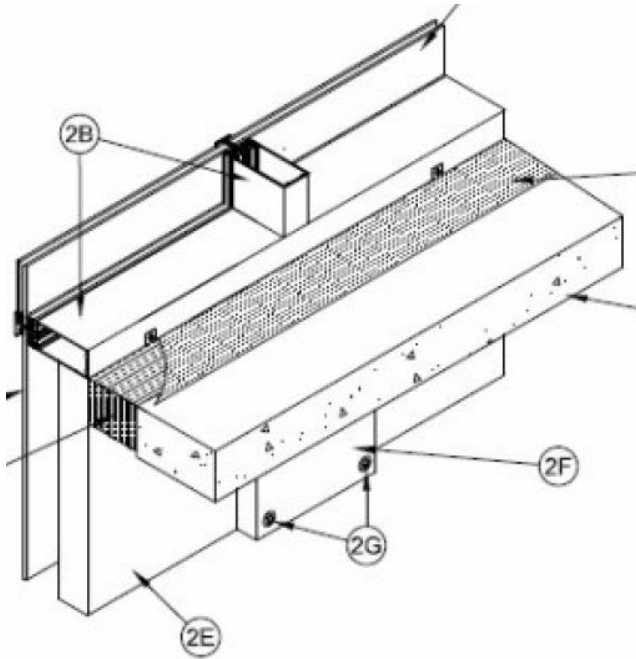


UL's First Published Curtain Wall Assembly: CW-S-2001 Issued: 4/14/97

Common Misconceptions about PFC Systems

MISCONCEPTION #2

ASTM E 119 Exception can be used in lieu of E2307 tested system

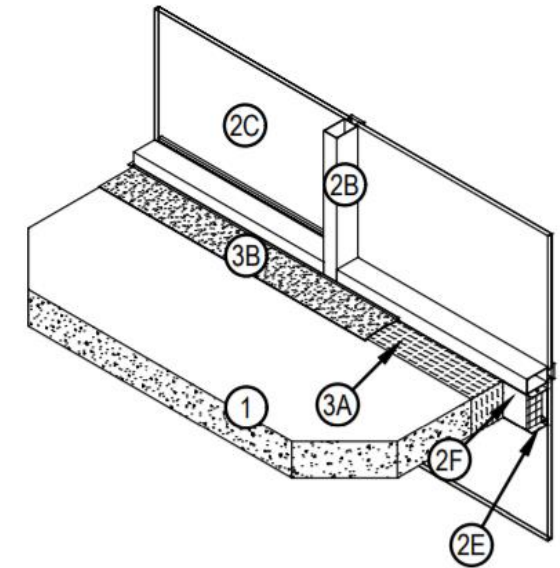


Spandrel Height
of 24"



Spandrel Height
of 10"

Zero Spandrel



Zero Spandrel

Common Misconceptions about PFC Systems

MISCONCEPTION #3

Steel Back Pans Provide the Safest, Most Robust PFC Systems



Common Misconceptions about PFC Systems

MISCONCEPTION #3

Steel Back Pans Provide the Safest, Most Robust PFC Systems

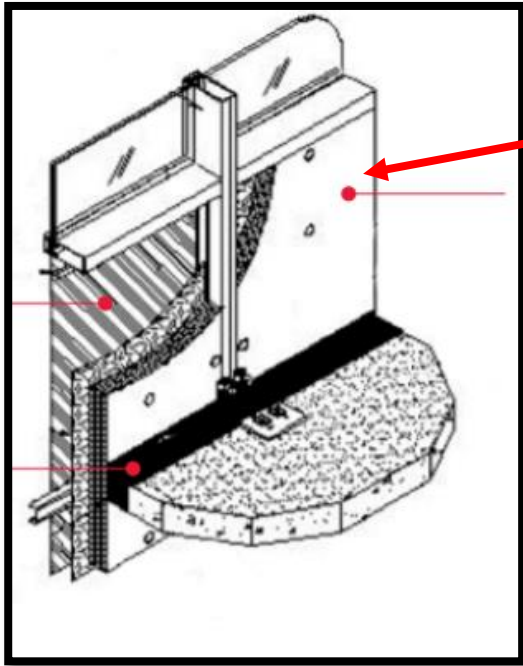
- Popularity because of unitized systems.
- Steel back pan is installed as the vapor barrier to the system.
- When exposed to fire, steel warps.
- Safing insulation can not conform to those peaks and valleys.
- Small seams form at safing line – allowing flame and hot gases to propagate the next floor.
- Mineral wool insulation inside the backpan must match what is listed in the tested system.



Common Misconceptions about PFC Systems

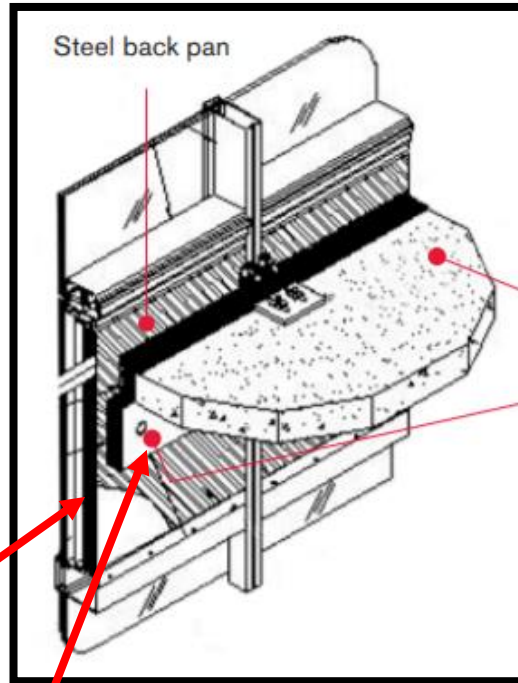
MISCONCEPTION #3

Steel Back Pans Provide the Safest, Most Robust PFC Systems



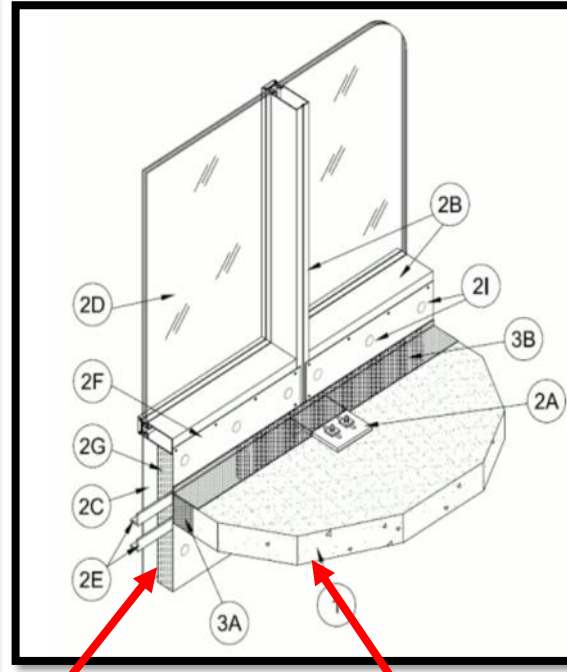
MW on interior side of back pan mech. attached every 12" oc

MW on exterior side, mech. attached every 12" oc



MW Safing Shelf

MW on exterior side, mech. attached every 12" oc

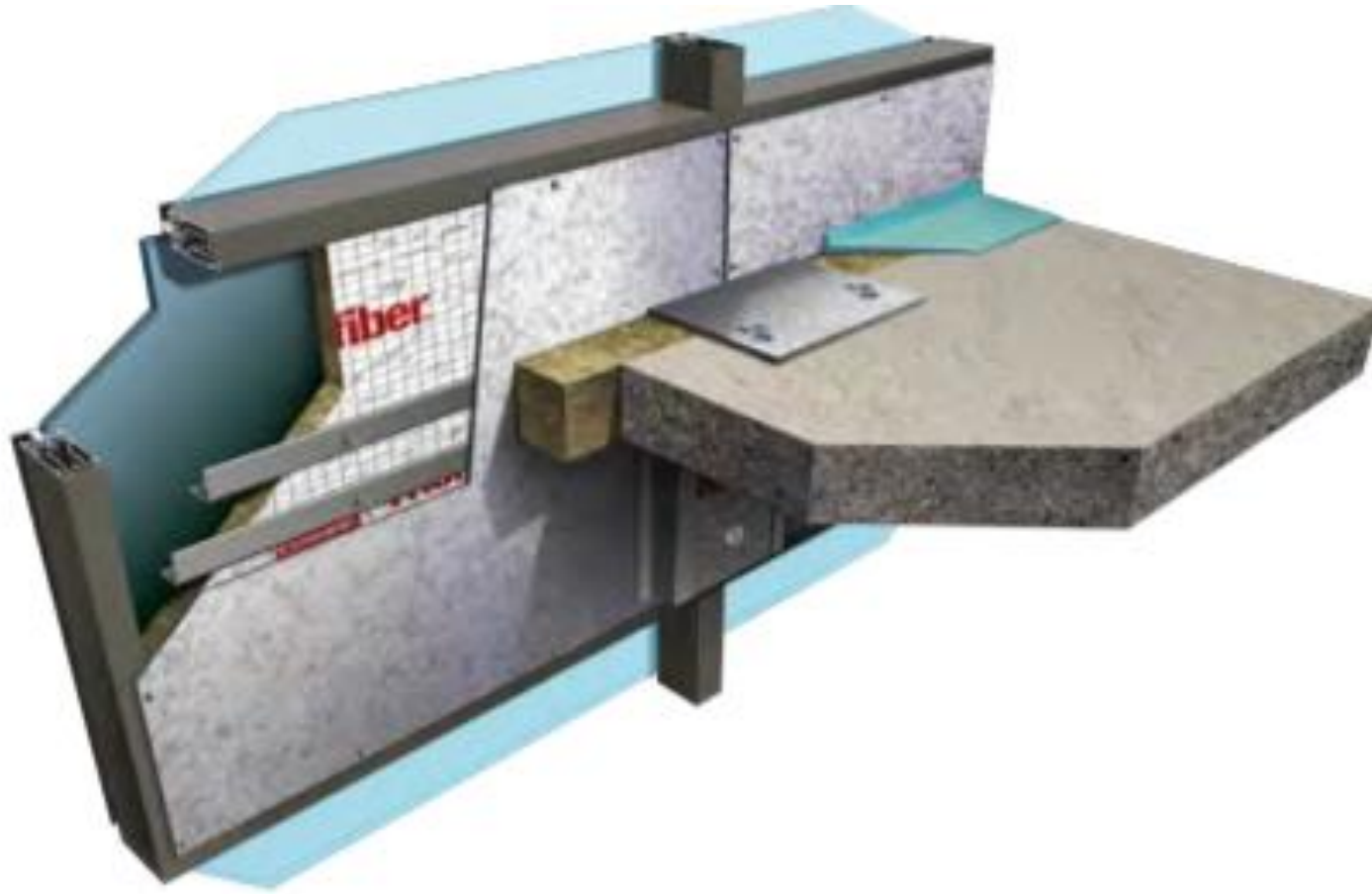


Exposed Interior Back Pan

Min. Requirements:

- Must follow all design criteria of listed system
- Mech. Attachment of Backpan to framing- typically 8" oc
- Min. Gauge of back pan per the listed system

Common Misconceptions about PFC Systems

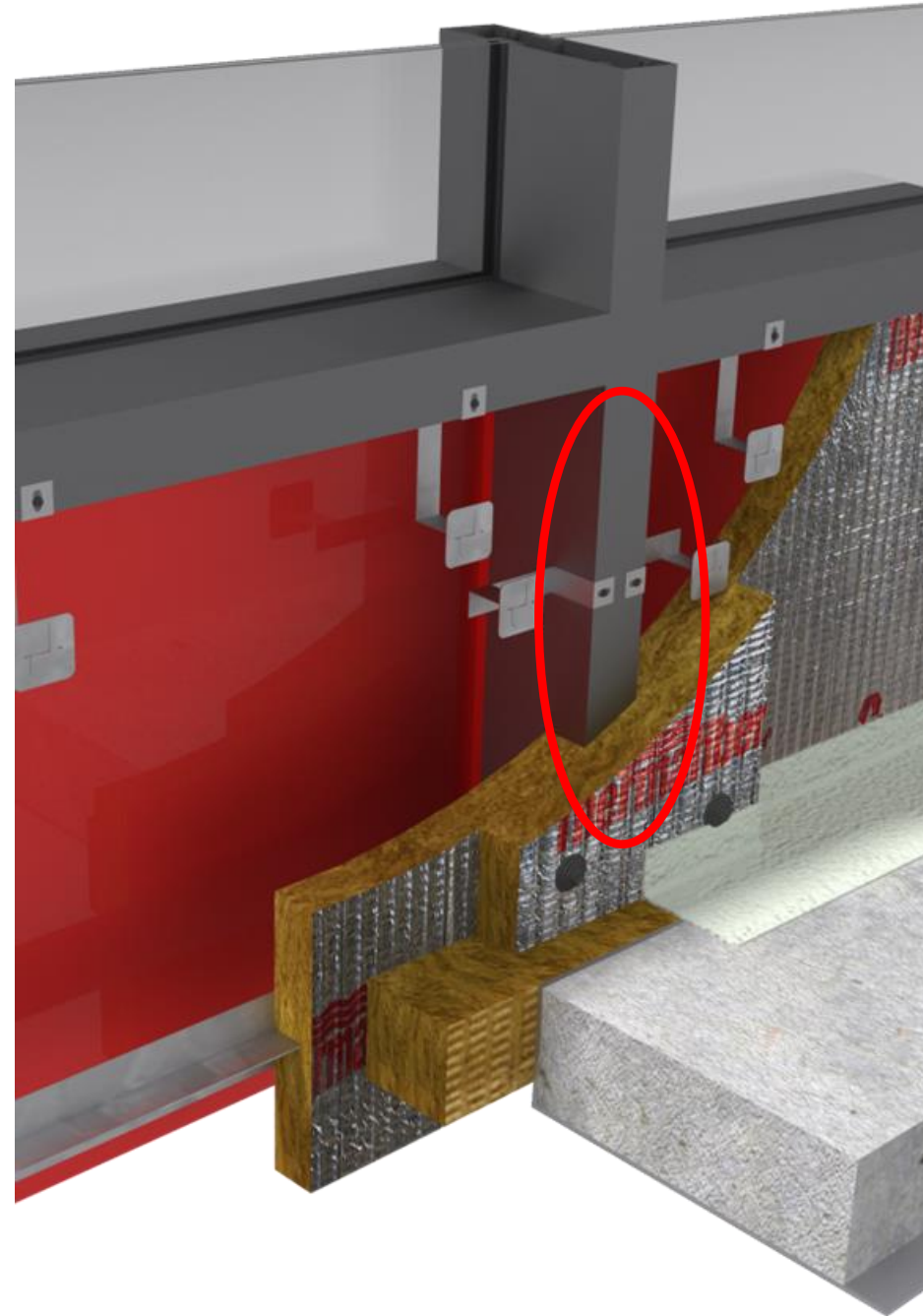


Illustrations of properly protected
Back Pan System

Common Misconceptions about PFC Systems

MISCONCEPTION #4

Vertical Mullion Protection is Not Necessary



Common Misconceptions about PFC Systems

MISCONCEPTION #4

Vertical Mullion Protection is Not Necessary

Vertical
framing
before
the test



Vertical
framing
melting

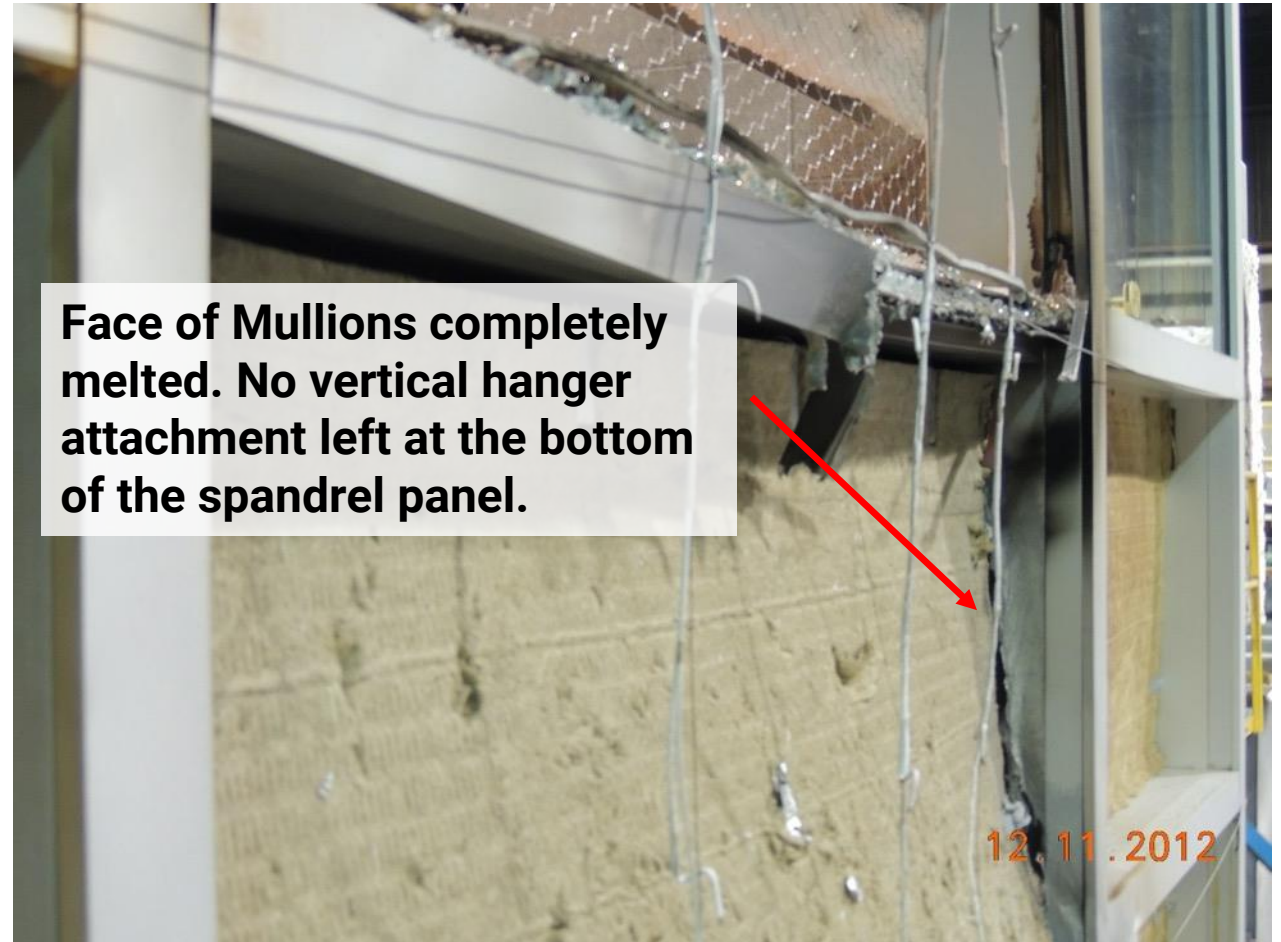
Common Misconceptions about PFC Systems

MISCONCEPTION #4

Vertical Mullion Protection is Not Necessary



Fire Exposure side of Mullion Cover

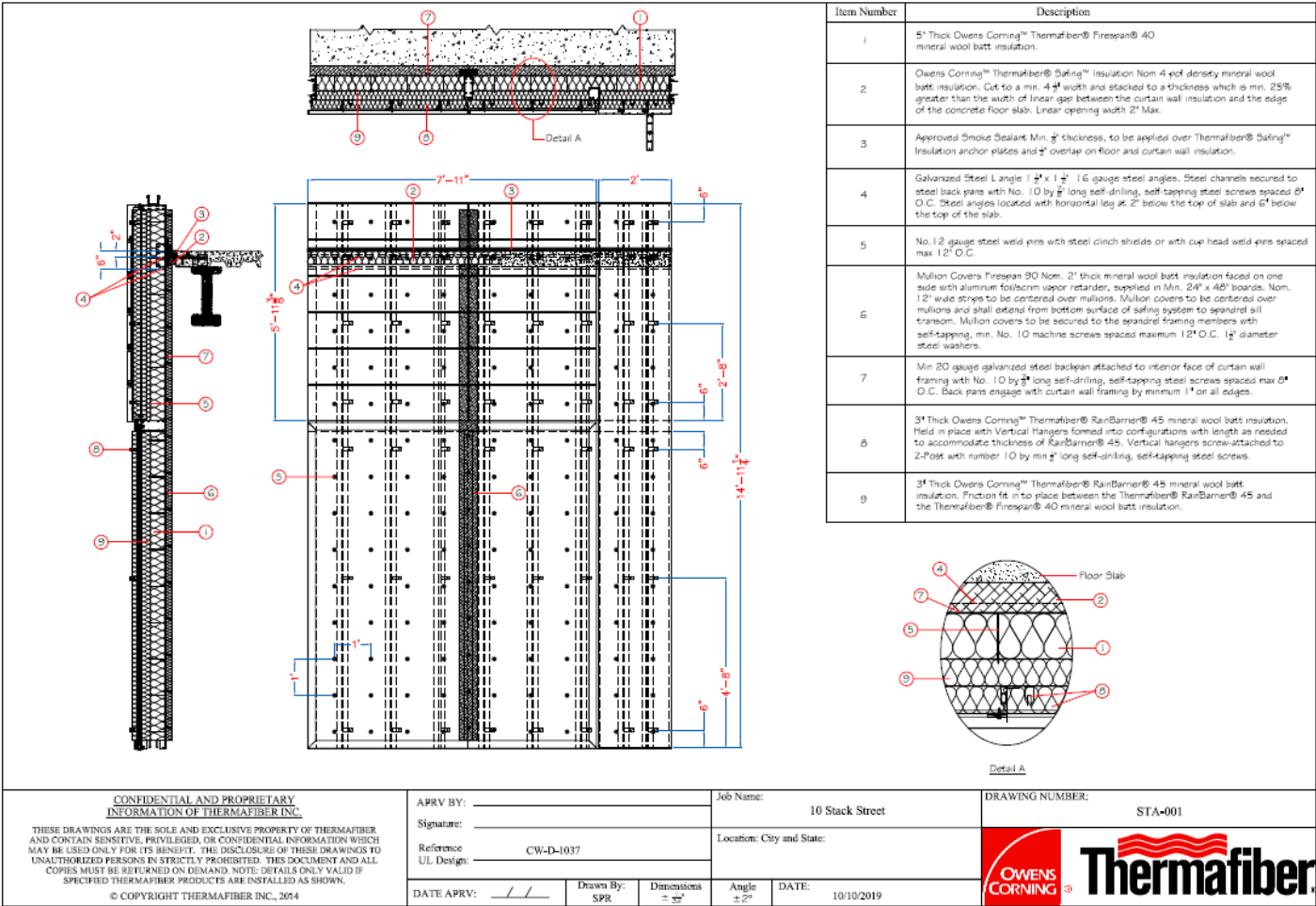


Common Misconceptions about PFC Systems

MISCONCEPTION #5

Fire Performance of Exterior Façade Panels Is Not Critical for PFC

Dual System- PFC and Continuous Insulation Assembly



Common Misconceptions about PFC Systems

MISCONCEPTION #5

Fire Performance of Exterior Façade Panels Is Not Critical for PFC

Combustible Building Materials

- Provide additional fuel load under fire conditions
- Untested exterior facade panels
 - Unknown panel performance when exposed to ASTM E 2307 conditions
 - Should be NFPA 285/ULC S134 compliant, at the very least
 - Should be attached independent from the perimeter fire barrier system
 - Should not provide structural support of the perimeter fire barrier system
- Other untested building materials
 - Materials with known fuel sources should not be installed to a perimeter fire barrier assemblies to achieve targeted thermal values





Questions?



Angela M. Ogino

Owens Corning/ Thermafiber®

Technical Services Leader

Phone: 260-569-8229

Email: angela.ogino@owenscorning.com

