

**Firestopping
& Standards**

**Product and System
Suitability for Use**

Rich Walke, Consultant to FCIA

FCIA – Firestop Contractors International Association

- **Thanks FCIA Members**
 - Firestop Contractors
 - Manufacturers, Consultants
 - Firestop Distributors, Reps, Friends
- **FREE PDF MOP/ Word Doc Spec** - Specifiers @ AE, Independents, AHJ's with Jurisdictions, More
- **FREE Life Safety Digest**

FCIA – Firestop Contractors International Association

- **FREE Life Safety Digest**
- UL/ULC, FM Contractor Programs,
**IAS Inspection Agency Accreditation
Program**, Individual Knowledge
- **ASTM Inspection Standards**
- **Tools @ FCIA.org** for Specifiers, AHJ's, Building Owners,
Firestop Contractors & Inspection Agencies



“TOTAL FIRE PROTECTION”

- **Effective Compartmentation**

- Fire Barriers, Fire Walls/Floors, Smoke Barriers
- Firestopping, Fire Dampers, Swinging and Rolling Fire Doors, Fire Rated Glazing

- **Detection & Alarm Systems**

- **Sprinkler Suppression Systems**

- **Education for Safety**

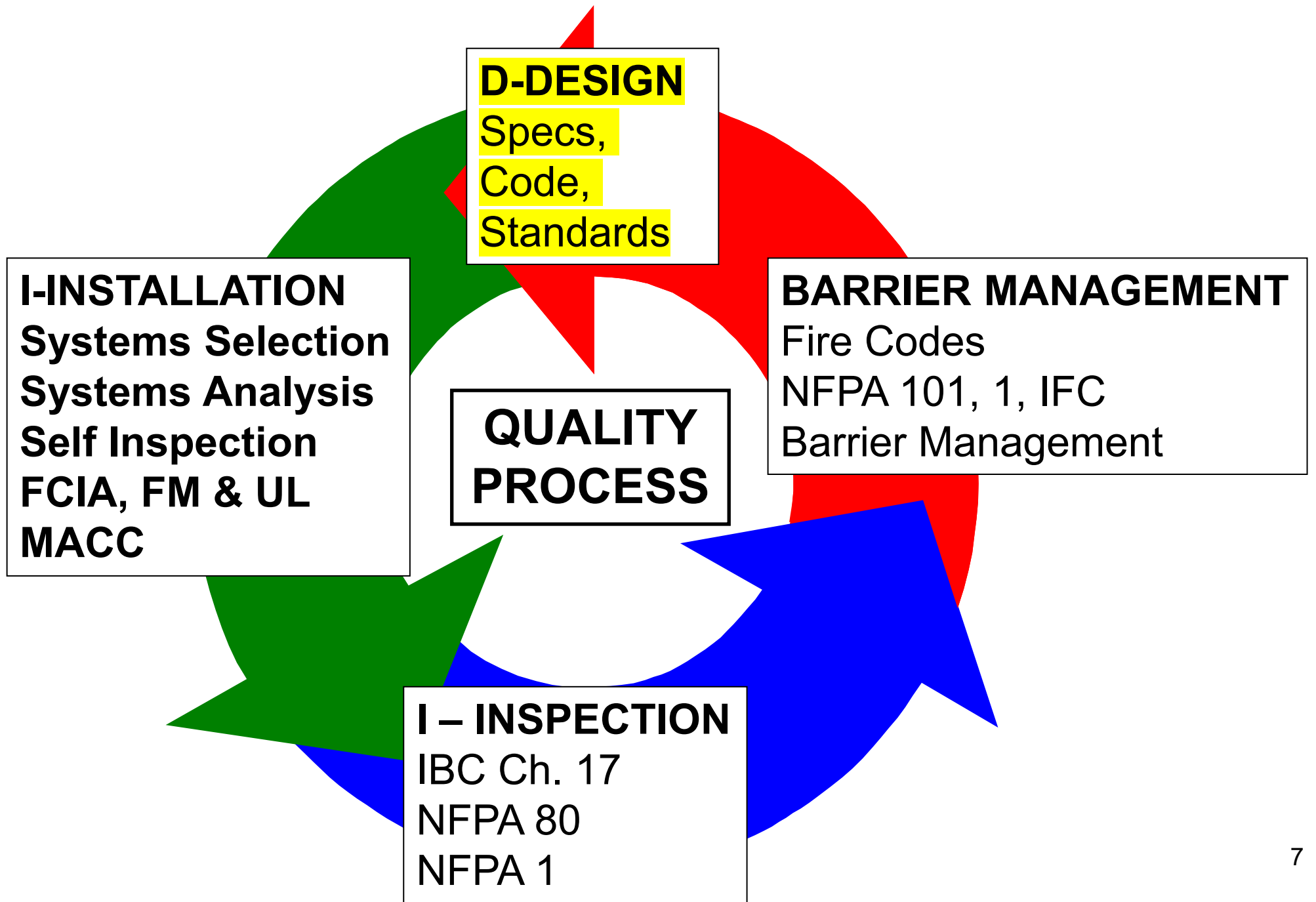
- Building Owners & Managers, Building Occupants and Firefighters

“DIIM” – Design, Install, Inspect, Maintain

- Fire Resistance & Smoke Resistant Firestopping
 - Properly *Designed* Building Codes
 - FCIA - 07-84-00 – Specification – **CCS**
 - **Tested and Listed Systems** – ASTM E814, UL1479, ASTM E1966, UL2079, E2307, E2837, E2874, E3037
 - Movement, (M) Smoke (L), Water (W)
 - Professional *Installation* –
 - FCIA Member, UL/ULC Qualified Contractors, FM 4991 Approved
 - Properly *Inspected* –
 - ASTM E2174 / E2393, by IAS-AC291 Agency, UL/ULC, IFC, FM Exam
 - **Protection Maintained** – Annually – by FCIA Members

FCIA Actions - 2021

- Conferences
- Webinars
- Symposiums
- Code Hearings
- Standards Discussions
- Committees
- International Discussions



Introduction

- Today's Webinar
 - ASTM E119 / UL 263 - Baseline for all other fire resistive standards
 - *Overview* of complimentary standards and ratings developed on each unique method for protecting breaches in or through hourly rated assemblies
- 2021 Series of Webinars
 - Multiple webinars which will address the *details* of the standards and ratings developed on each unique method for protecting breaches in or through hourly rated assemblies

Maintaining Compartmentalization Through Fire-Resistive Construction



Images credit to Etex Building Performance Limited

Fire-Resistance-Rated Construction

- Scope
 - Columns
 - Beams
 - **Floor/Ceilings or Roof/Ceilings**
 - **Walls**
- Considered the starting point for all other items bearing an hourly rating, including methods of protecting breaches, electrical circuit protective systems, duct wrap systems, and fuel piping protection systems

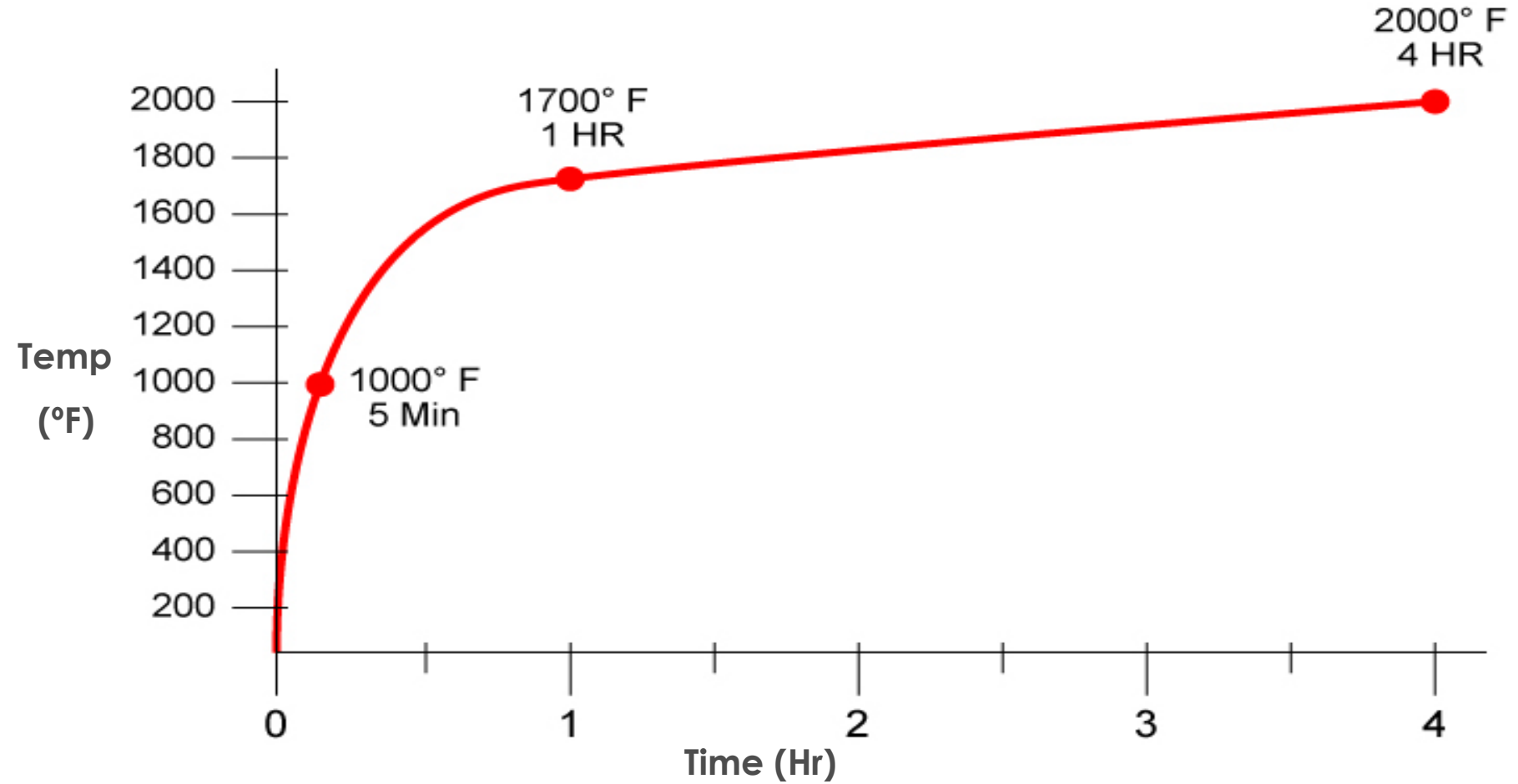


Standards

- UL 263
- ASTM E119
- NFPA 251 (Withdrawn)

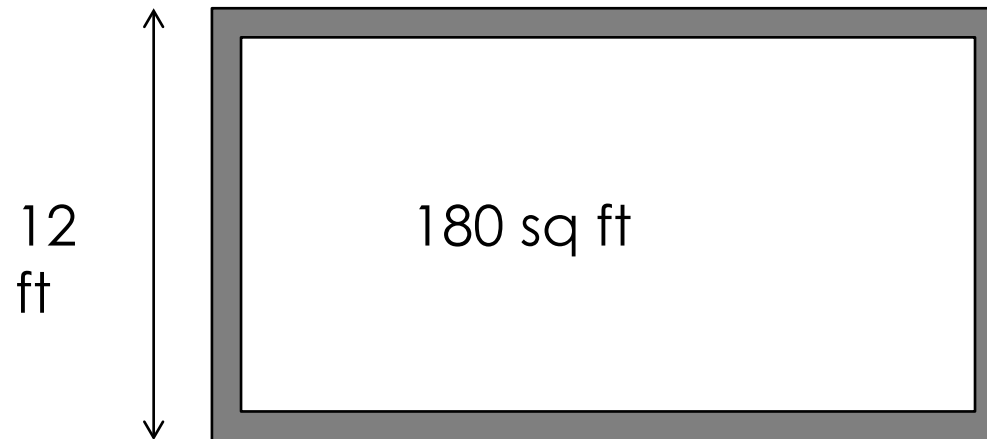


Time - Temperature Curve



Floor/Ceiling or Roof/Ceilings

- Sample size – 180 sq ft / 12 ft
- Load applied – Per design





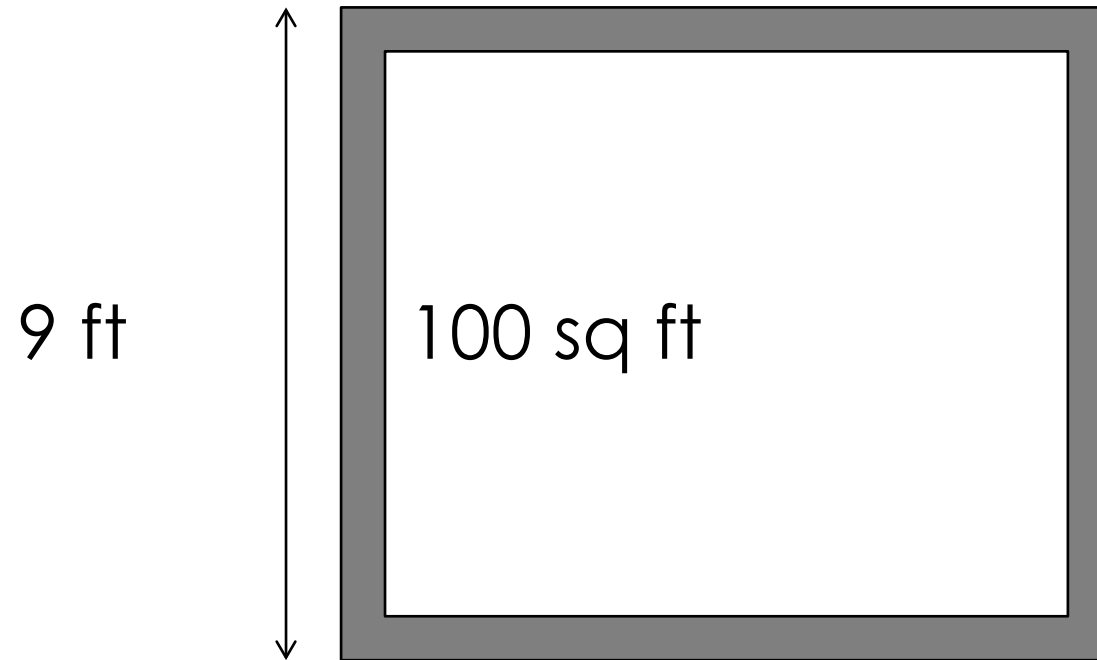
UL Image



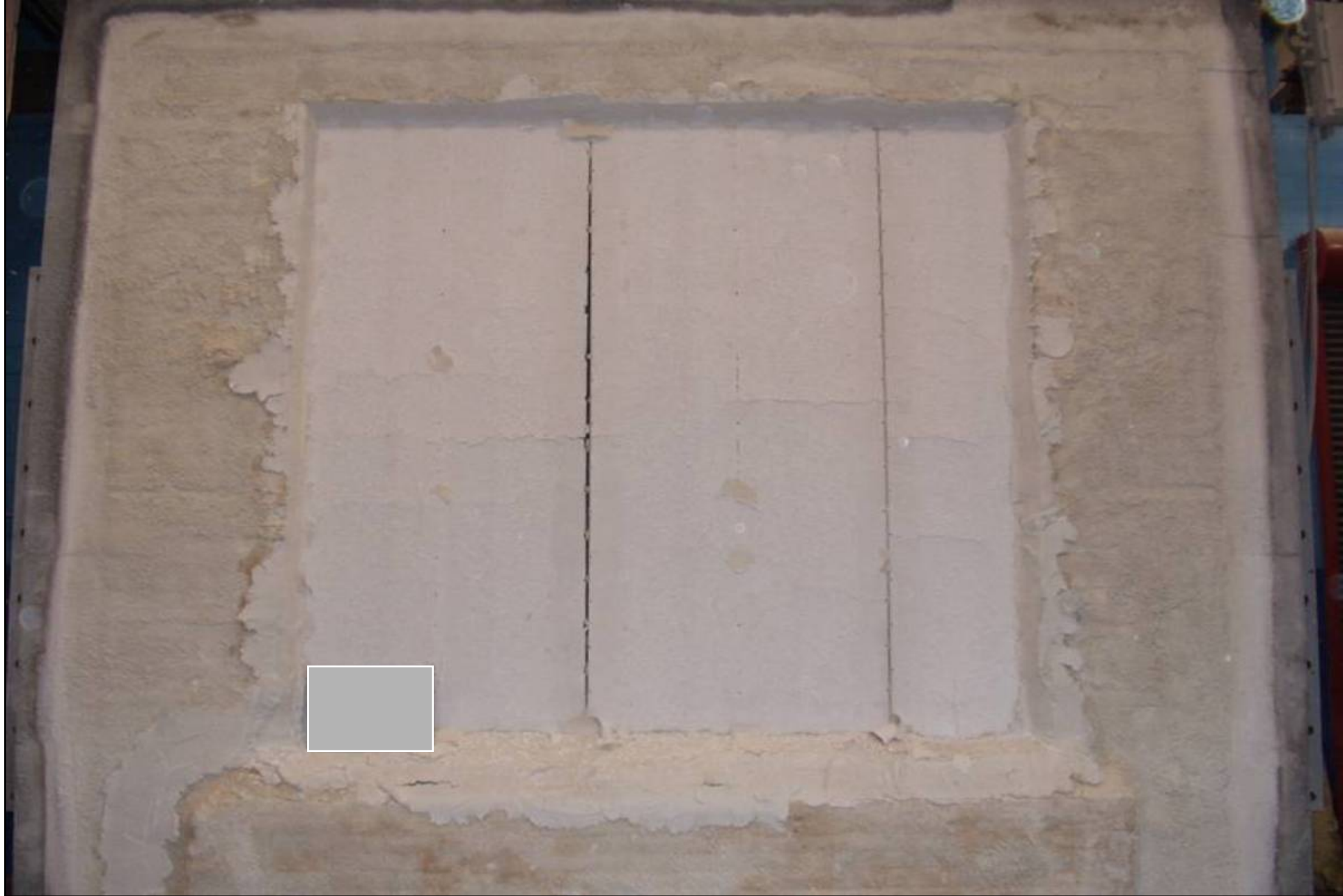
UL Image

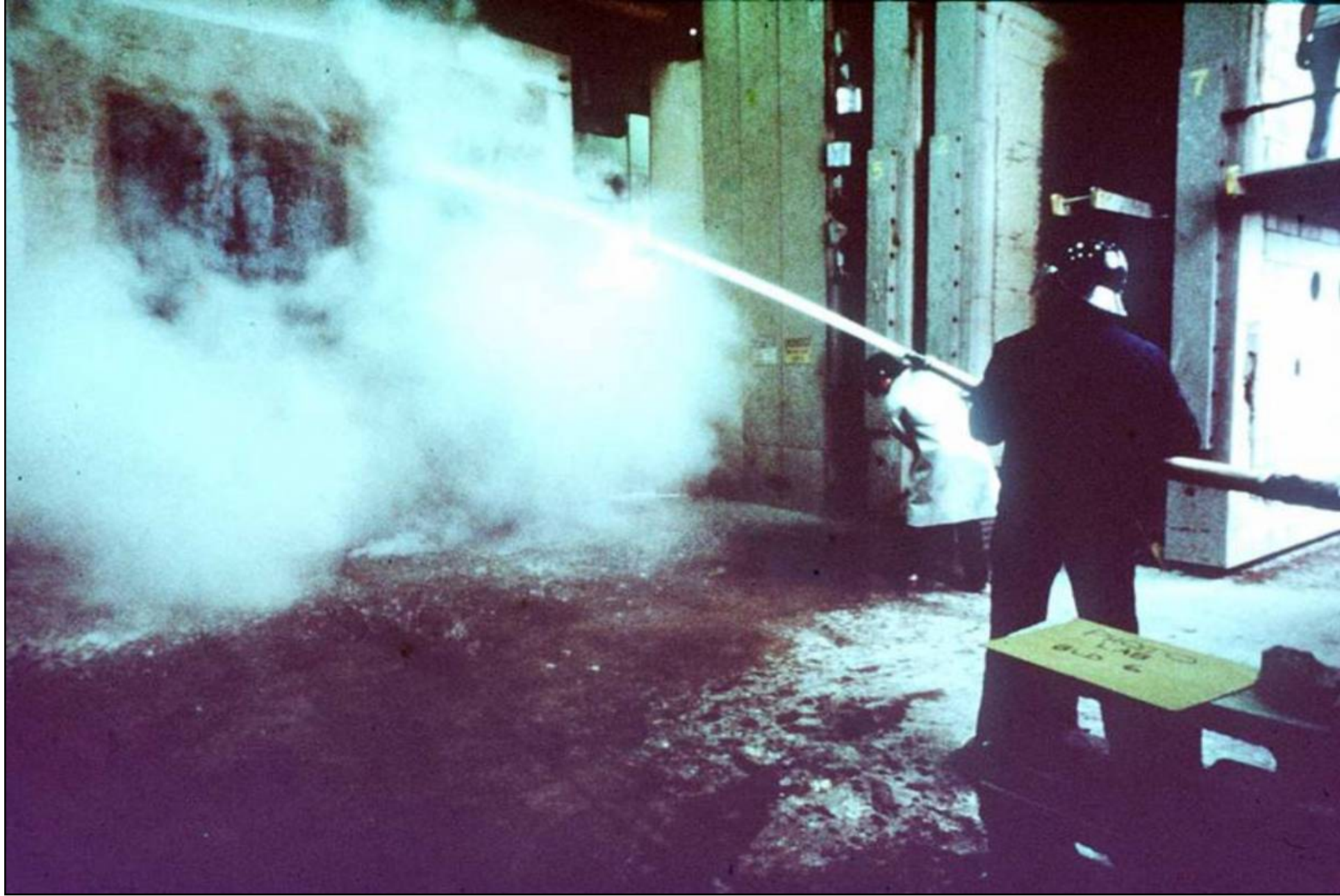
Walls

- Sample size – 100 sq ft / 9 ft
- Load applied – Per design









Conditions of Acceptance

Floor/Ceilings, Roof/Ceilings and Walls

- Support load (F/C, R/C and load bearing walls)
- Flame passage
- 250°F / 325°F Temperature Rise on Unexposed Side
- Support temperatures (F/C and R/C)
- Hose stream test (walls only)



Related Items Requiring Hourly Fire Ratings

Penetrations

Joint and Voids

Opening Protectives

Ducts and Air Transfer Openings

Requirements for Protecting Breaches or Other Hourly Rated Construction Feature

- Each type of breach or hourly rated construction feature has a unique fire test standard associated with it which compliments UL 263 and ASTM E119. In addition, each breach has various ancillary standards which relate to other characteristics of the protection materials.

Standards Relating to Penetrations

- **Penetrations**

- Fire / Hose Stream Test Standards

- ASTM E814 / UL 1479 / ULC-S115 (Fire Testing), ASTM E2226 (Hose Stream)

- Smoke Leakage Standard

- UL 1479 / ULC-S115

Standards Relating to Penetrations Cont.

- Fitness for Use Standards
 - UL 1479 (Water Leakage), UL 1479 (Aging), ASTM E3037 (Movement), ASTM E2923 (Aging), ASTM E2785 (Environmental Exposure)
- Applications Standards
 - ASTM E2750 (Extension of Data), ASTM E3157 (Firestop Installations)
- Inspections Standard
 - ASTM E2174

Ratings of Firestop Systems

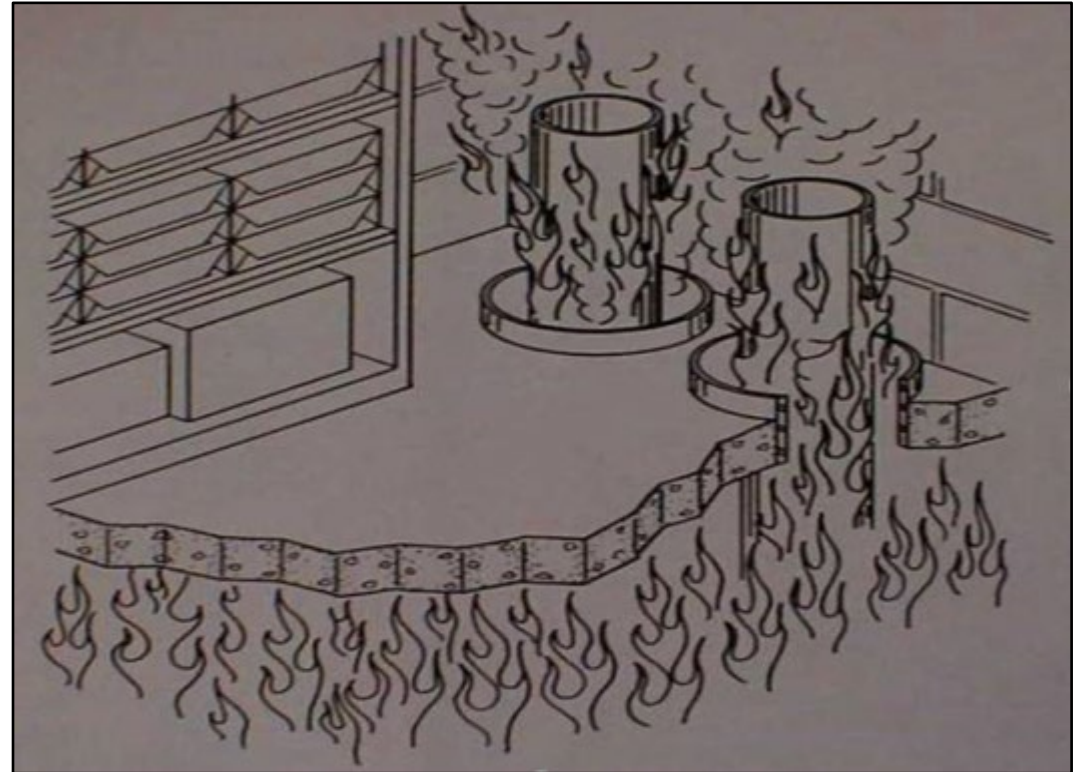
- F (Fire) Rating
- T (Temperature) Rating
- L (Smoke Leakage) Rating
- W (Water Leakage) Rating
- M (Movement) Rating
- *A (Aging) Rating*
- *E (Environmental Exposure) Rating*
- *Dream big – What else is needed?*



Affinity Firestop Photo

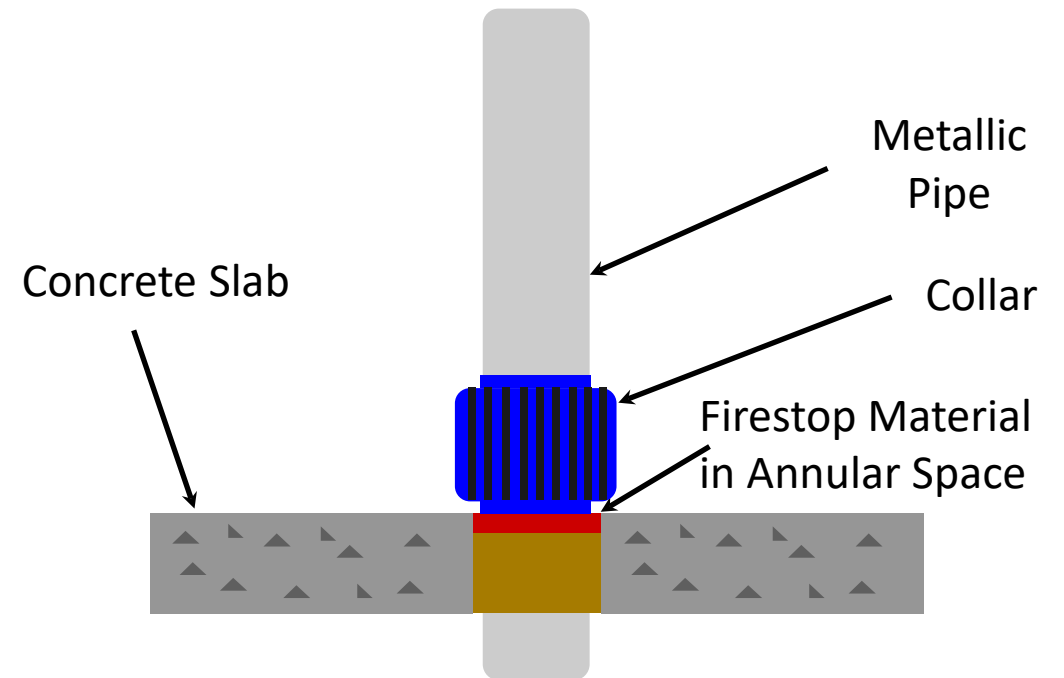
F (Flame) Rating of Firestop Systems

- Passage of Flame
- Hose Stream



T (Temperature) Rating of Firestop Systems

- Passage of Flame
- 325°F Temperature Rise
- Hose Stream



L (Leakage) Rating (Optional, Based on UL 1479)

- Air Leakage Rate at Ambient Temperature
- Air Leakage Rate at 400°F
- Firestop system assigned an L Rating at both temperatures



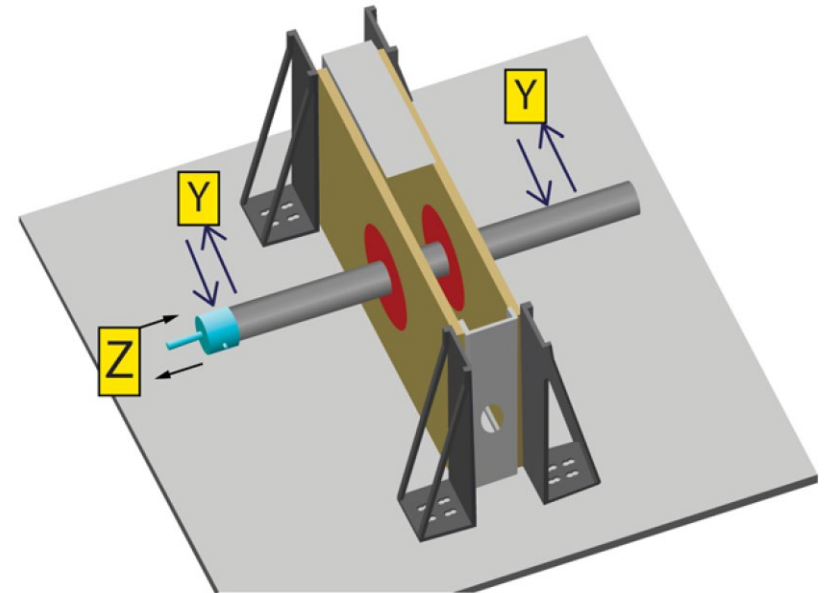
W (Water) Rating (Optional, Based on UL 1479)

- Optional W Rating methodology added to UL 1479 in 2004
- Applicable to incidental water
- 3 Ft. WC Pressure Head / 72 Hr Exposure
- Firestop subjected to water exposure, followed by standard fire and hose stream tests
- Firestop systems assigned a W Rating



M (Movement) Rating (Optional, Based on ASTM E3037)

- Applicable to movement of penetrating item with respect to the barrier
- Penetrating item move perpendicular and/or in plane of barrier – ASTM E3037
- After movement, firestop subjected to standard fire and hose stream tests
- Firestop systems – M Rating
 - Rating within plane based on percentage of the minimum annular space of the field installation
 - Rating perpendicular to barrier based on dimension



A (Aging) Rating (Required by UL 1479)

- UL Requirements
 - Evaluates ability of firestop system to maintain its performance over time
 - Added to UL 1479 in 2000 as mandatory requirement. As such, it is not a true “Rating”
 - Requires intumescent firestopping materials to maintain their intumescent performance after aging and high humidity exposure
 - After exposure, materials are subjected to intumescent expansion pressure and expansion factor testing
 - Product must maintain it’s performance as compared to unconditioned sample
 - If performance deteriorates, entire firestop system subjected to conditioning, followed by standard fire exposure and hose stream tests to establish F and T Ratings

A (Aging) Rating (Optional, Based on ASTM E2923)

- ASTM Standard E2923
 - Could be used in the future as the basis for an A Rating
 - Evaluates whether firestopping materials are expected to maintain their performance characteristics over time
 - Uses a Differential Scanning Calorimeter conducted on samples exposed to a pure dry air and exposed to an airflow that is saturated with water. Following the scanning, the conversion rate of the firestopping material is calculated at a time of 270 days at 70°C and at 30 years at 50°C.
 - When minimal differences in the conversion rates are determine, it can be reasonably assumed the firestop material would provide acceptable performance for 30 years if the temperature did not exceed 50°C
 - Testing using this method is not required by certification organizations or codes

E (Environmental Exposure) Rating (Optional, Based on ASTM E2785)

- ASTM Standard E2785
 - Could be used in the future as the basis for an E Rating
 - Evaluates ability of firestop system to maintain their physical properties after exposure to various environments
 - Individual samples of the firestopping materials are subjected to environment exposures consisting of an elevated temperature exposure, a high humidity exposure, a CO₂ and SO₂ exposure, a water immersion exposure, a temperature cycling exposure, a wet-freeze-dry cycling exposure and a weathering exposure
 - After exposure, materials are subjected to physical property testing to determine the change in performance as compared to unconditioned control samples
 - Testing using this method is not required by certification organizations or codes

Standards Relating to Joints and Voids

- **Joints and Voids**

- Fire / Hose Stream Test Standards

- ASTM E1966 / UL 2079 / ULC-S115 (Fire Testing of Construction Joints), ASTM E2226 (Hose Stream), ASTM E2837 (Cont. HW Joints), ASTM E2307, (Perimeter Fire Containment), ASTM E2874 (Leap-Frog Perimeter Fire Containment)

- Smoke Leakage Standard

- UL 2079 / ULC-S115

Standards Relating to Joints and Voids Cont.

- Fitness for Use Standards
 - UL 2079 (Water Leakage Ratings), UL 2079 (Aging)
- Inspections Standard
 - ASTM E2393

Fire-Resistant Joint Systems



Forces Which Induce Movement

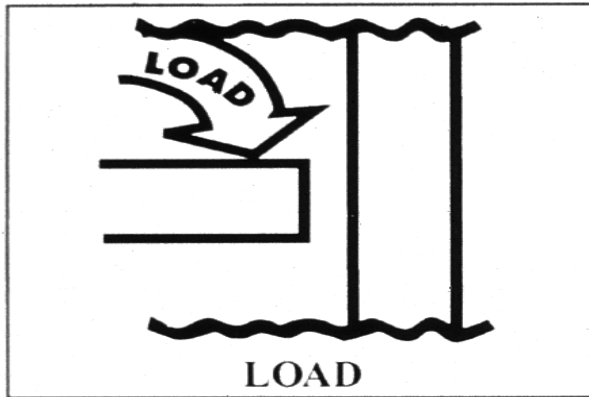


Fig. 1

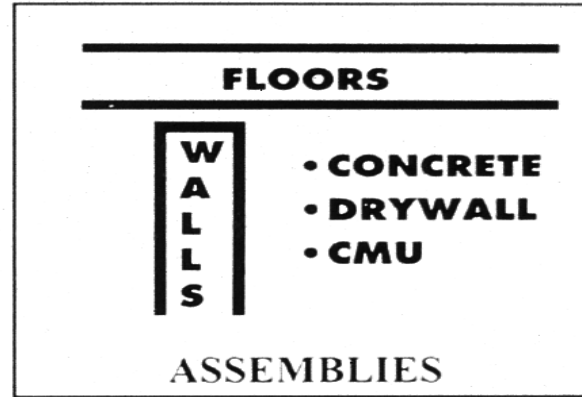


Fig. 3

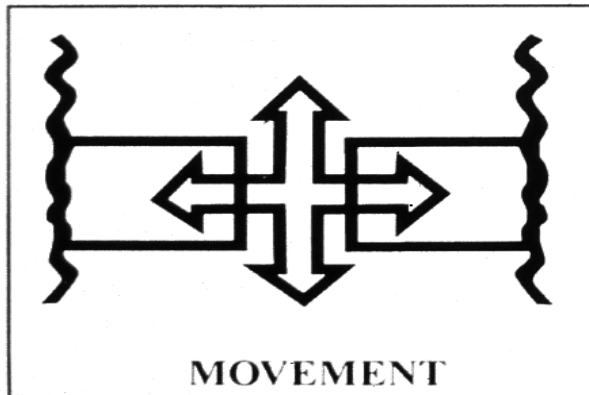


Fig. 2

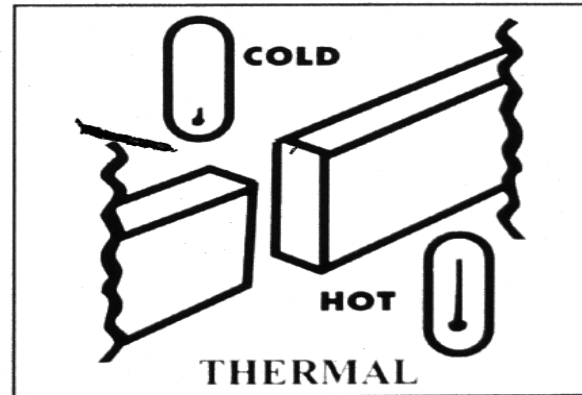


Fig. 4

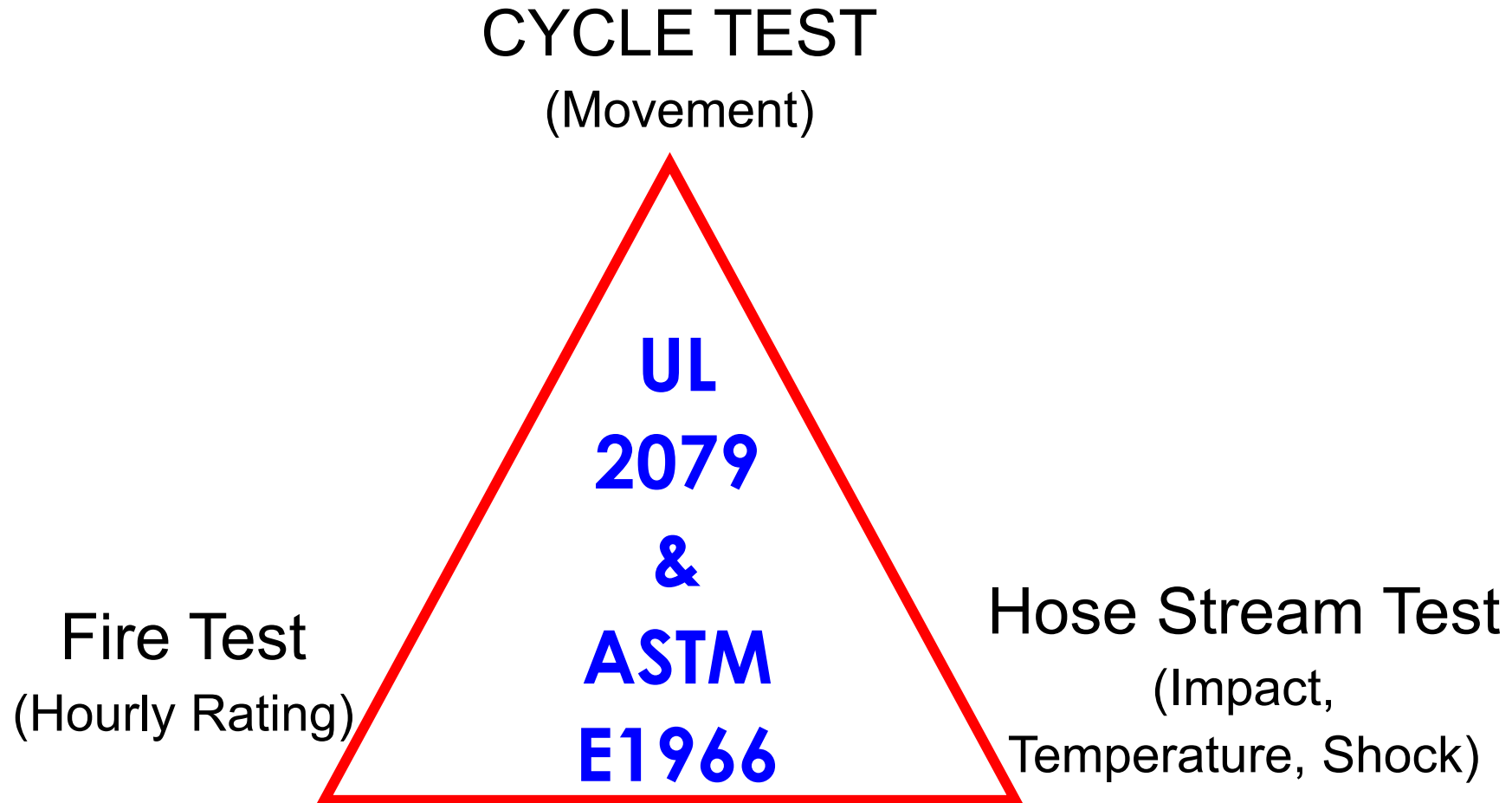
Thermal

Wind Sway

Seismic

Load

Test Standards / Components



UL 2079 / ASTM E1966 Ratings



Assembly Rating

- Evaluates both passage of fire and temperature on the non-fireside (i.e. F and T Ratings)
- Hose stream is only required for head-of-wall and wall-to-wall joints

L Rating (Optional, Based on UL 2079)

- The amount of air leakage through the joint system at ambient and 400°F. IBC requires an L rating of 5 cfm / lineal ft or less

UL 2079 / ASTM E1966 – Ratings Cont.



W Rating (Optional, Based on UL 2079)

- Water Leakage, applicable to incidental water
- In Standard, but currently there are no listings

A Rating (Based on UL 2079)

- Added to UL 2079 in 2015 as mandatory requirement. Not a true “Rating”.
- Testing scheme is identical to that of UL 1479

Continuity Head-of-Wall Joint Systems

Test Method



Designation: E2837 – 11

An American National Standard

Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed Between Rated Wall Assemblies and Nonrated Horizontal Assemblies¹

This standard is based under the fixed designation E2837; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last approval. A superscript symbol (S) indicates an editorial change since the last revision or approval.

INTRODUCTION

Wall continuity is required by various model codes at joint openings, which are linear voids, gaps, openings, or other discontinuities between or bounded by a rated wall assembly and nonrated horizontal assemblies, to ensure that the protected joint opening has the same fire resistance rating as the rated wall assembly. The joint opening at the termination at the top of the rated wall assembly below the nonrated horizontal assembly must be protected by a continuity head-of-wall joint system, which has a fire resistance rating, in order to maintain continuity established by the rated wall assembly. This test method is not required when the rated wall assembly contains nonrated horizontal assemblies when there is no joint opening. Normally such joint openings are denoted as "lines" because the length is normally greater than their width, which is defined by a typical ratio of at least 10:1 as in practice. Joint openings are present in buildings as a result of (1) Design to accommodate various movements induced by thermal differentials, seismicity, and wind loads and exists as a clearance separation, (2) Acceptable dimensional tolerances between two or more building elements, for example, between non-load-bearing walls and roof, (3) Inadequate design, inaccurate assembly, repairs or damage to the building. There are many unique applications for joint systems in buildings. To address this issue there are different types of continuity head-of-wall joint systems. It is not possible to test all fire-resistant joint systems using the same test apparatus or method of test, for example, Test Method E2307 employs the ISMA test apparatus. A continuity head-of-wall joint system is a particular type of fire-resistant joint system that provides fire resistance to prevent passage of fire from compartment to compartment within the building at the joint opening between a rated wall assembly and a nonrated horizontal assembly. A continuity head-of-wall joint system is a unique building construction detail not addressed by other fire test methods such as Test Method E1966 that tests joint systems installed between two assemblies that are fire-resistance rated.

1. Scope

1.1 This fire test response test method measures the performance of a unique fire-resistant joint system called a continuity head-of-wall joint system, which is designed to be used between a rated wall assembly and a nonrated horizontal assembly during a fire resistance test.

1.2 This fire test response standard does not measure the performance of the following:

1.2.1 The rated wall assembly, which is already established by other test methods, such as Test Method E119, or

1.2.2 The nonrated horizontal assembly, which would be established by other test methods such as Test Method E119.

Note 1.—Typically, rated wall assemblies obtain a fire resistance rating after being tested to Test Method E119, NFPA 251, UL 263, CANULC S100, or other similar fire-resistant test methods.

1.3 This fire test response standard is not intended to evaluate the connections between rated wall assemblies and nonrated horizontal assemblies unless part of the continuity head-of-wall joint system.

¹ This test method is under the jurisdiction of ASTM Committee E06 on Fire Standards and is the direct responsibility of Subcommittee E06.03 on Fire Resiliency.

Current edition approved Dec. 1, 2011. Published December 2011. DOI: 10.2556/ASTM.E2837-11.

Continuity Head-of-Wall Joint Systems Cont.

- E2837-11: Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed Between Rated Wall Assemblies and Nonrated Horizontal Assemblies
- Scope – Covers rated wall intersecting bottom of non-fire-resistance-rated roof/ceiling or floor/ceiling assembly
- Testing similar to that done for Head-of-Wall Joint Systems per ASTM E1966 and UL 2079

Continuity Head-of-Wall Joint Systems Cont.

- Major differences between ASTM E2837 and UL 2079:
 - No thermocouples on roof or floor
 - As roof/floor may sag in a “real” fire, test protocol does not rigidly support the roof/floor

ASTM E2837 – Ratings



F Rating

- Passage of Flame
- Hose Stream

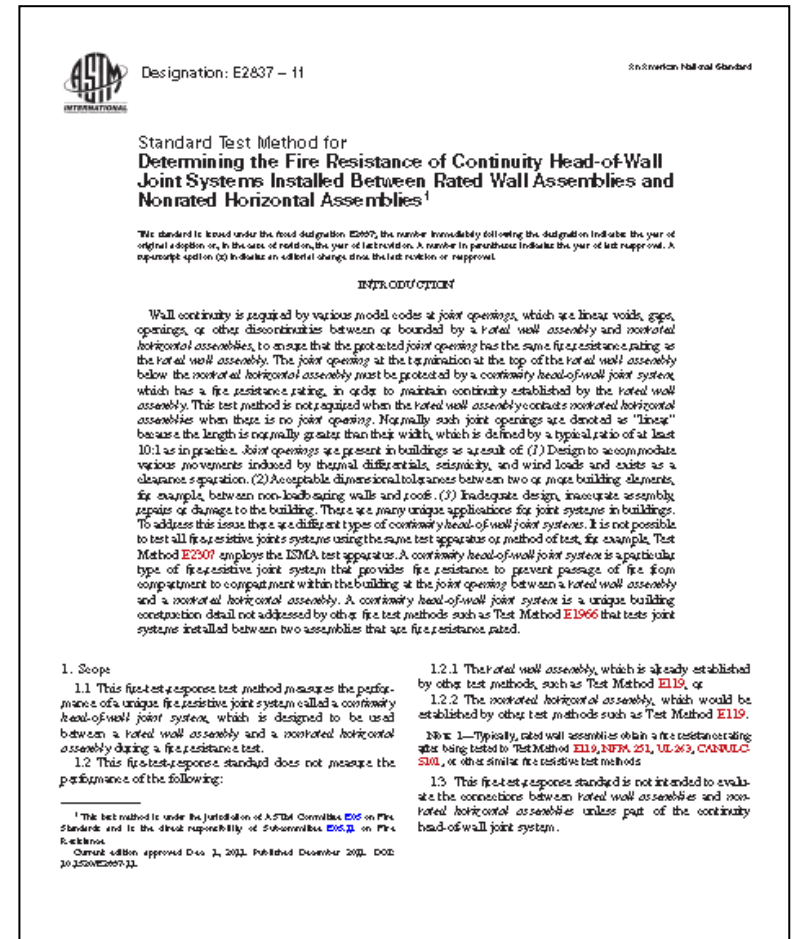
T Rating

- Passage of Flame
- 250°F / 325°F Temperature Rise on Unexposed Side
- Hose Stream

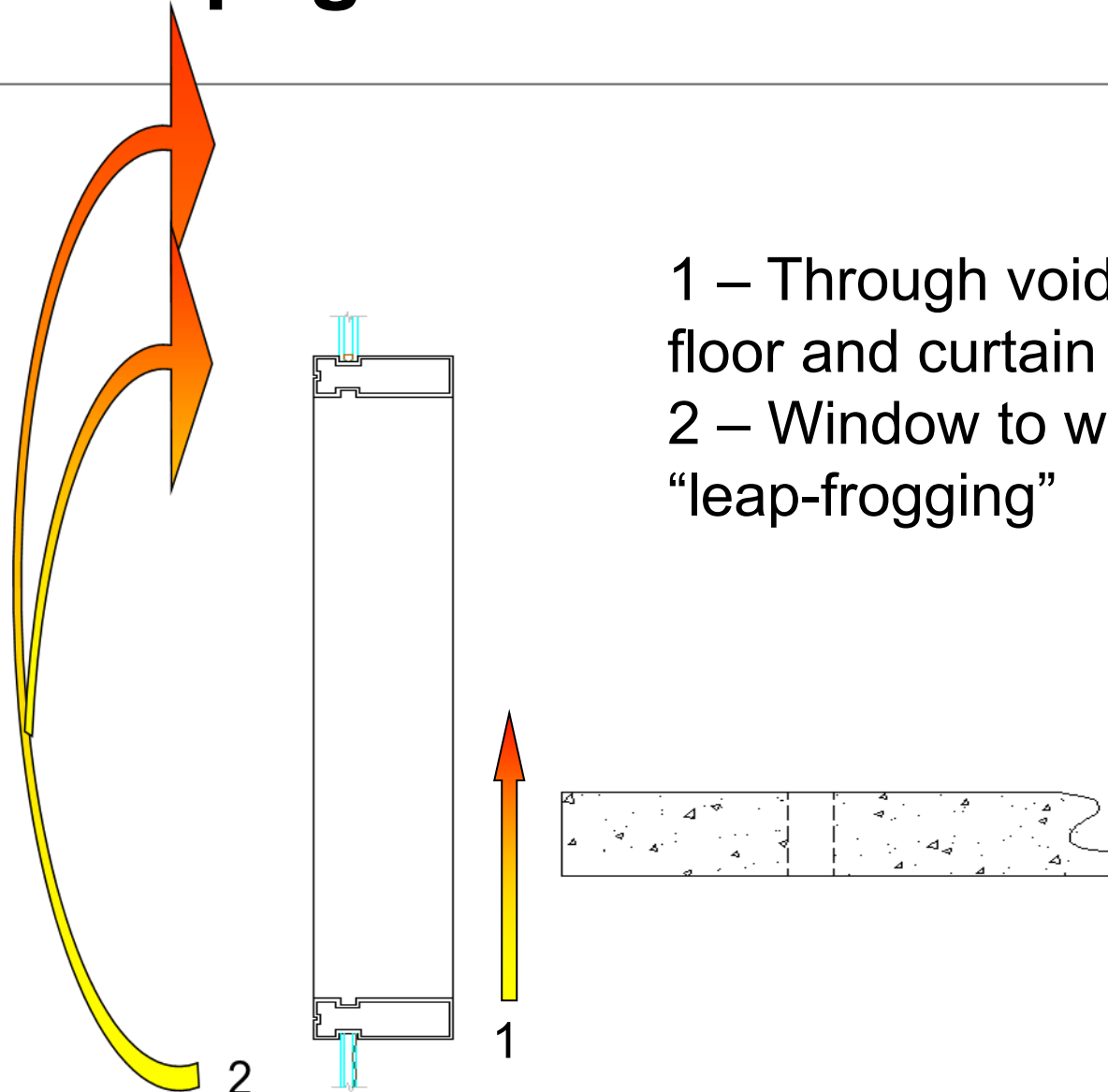
Perimeter Fire Containment Systems

Three Test Methods:

- Code based method – ASTM E2307
- UL Method – “Enhanced” ASTM E2307 – Includes leap-frog criteria and temperature requirements on curtain wall
- ASTM Leap-Frog Method – ASTM E2874



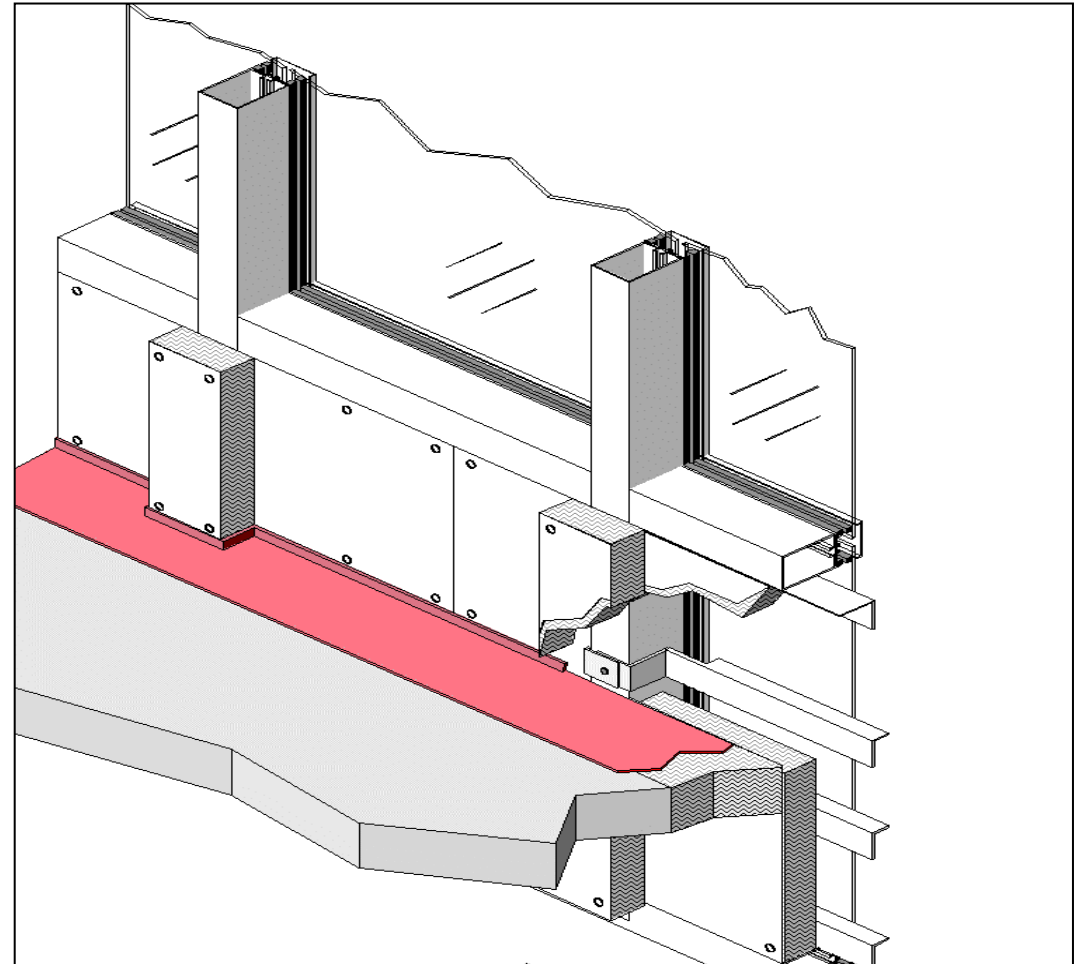
Paths of Fire Propagation



- 1 – Through void between floor and curtain wall
- 2 – Window to window “leap-frogging”

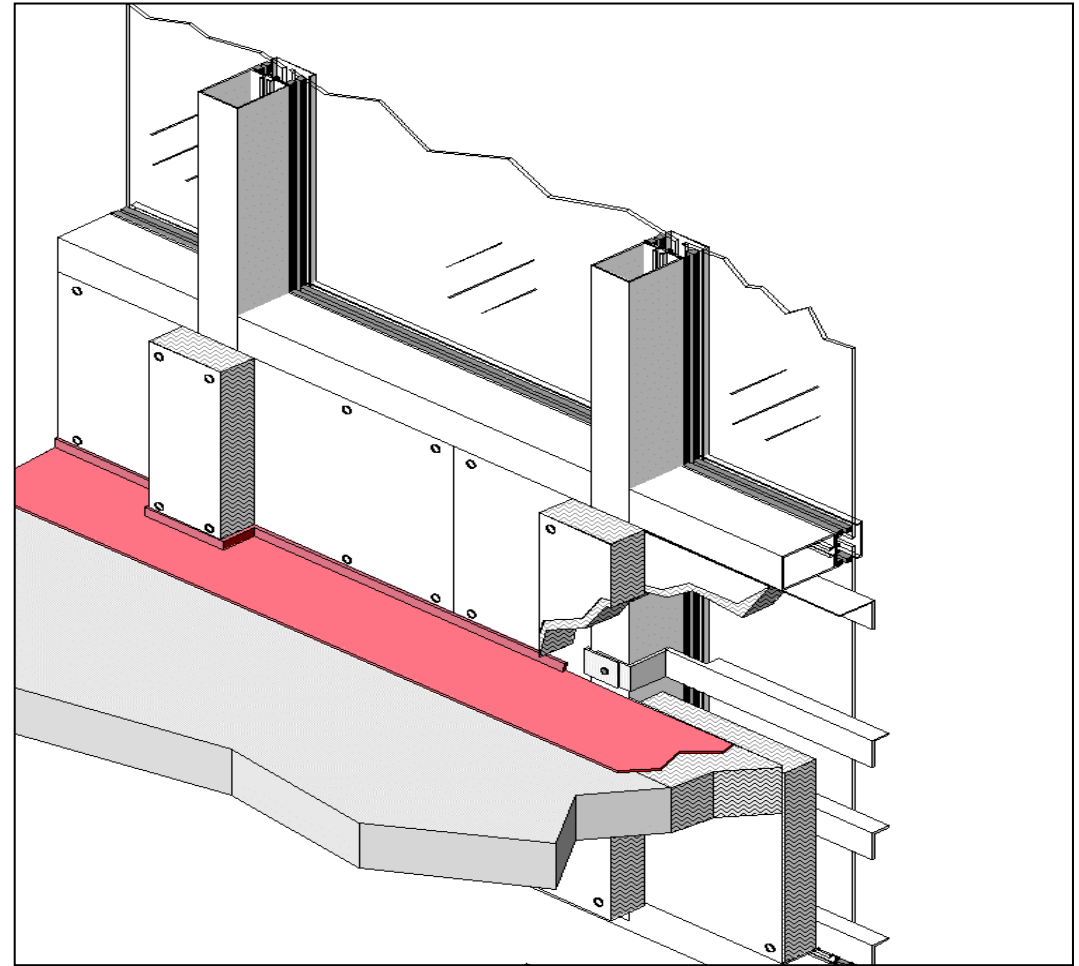
F (Flame) Rating by ASTM E2307

- No passage of flames through protected void (i.e. Path 1). Flame passage anywhere else is acceptable.



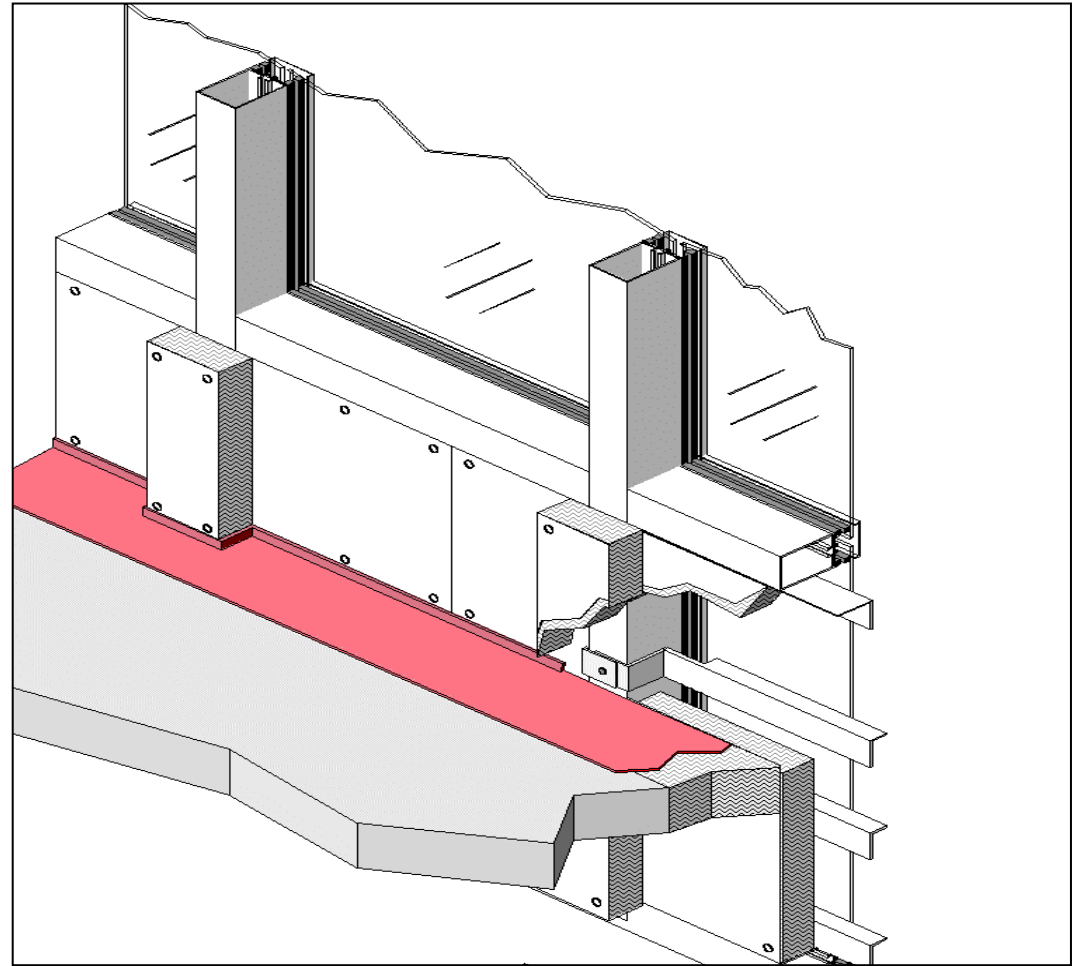
T (Temperature) Rating by ASTM E2307

- No passage of flames through protected void (i.e. Path 1). Flame passage anywhere else is acceptable.
- 250°F / 325°F Temperature Rise



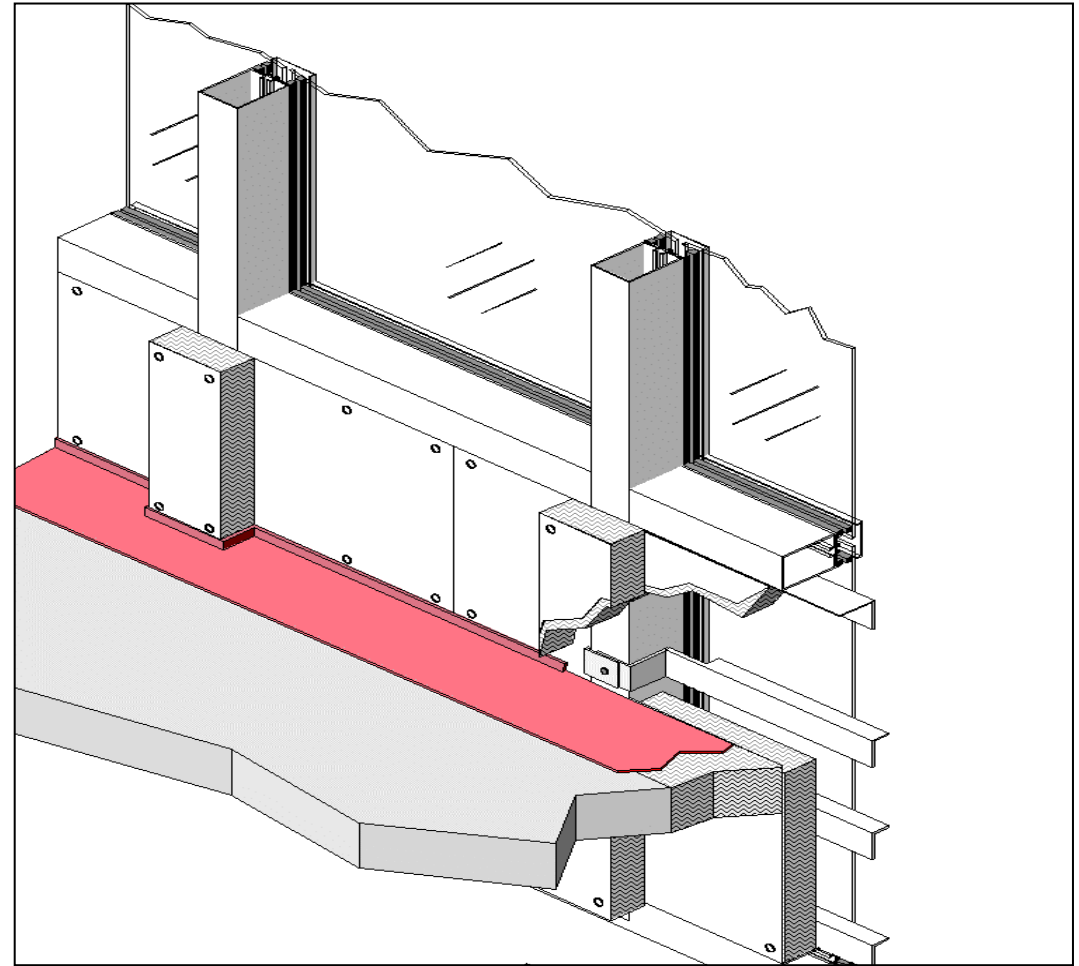
Integrity Rating by UL's Enhanced ASTM E2307 Method

- No passage of flames through protected void (i.e. Path 1), internal to insulated curtain wall or via “leap-frogging” (Path 2)



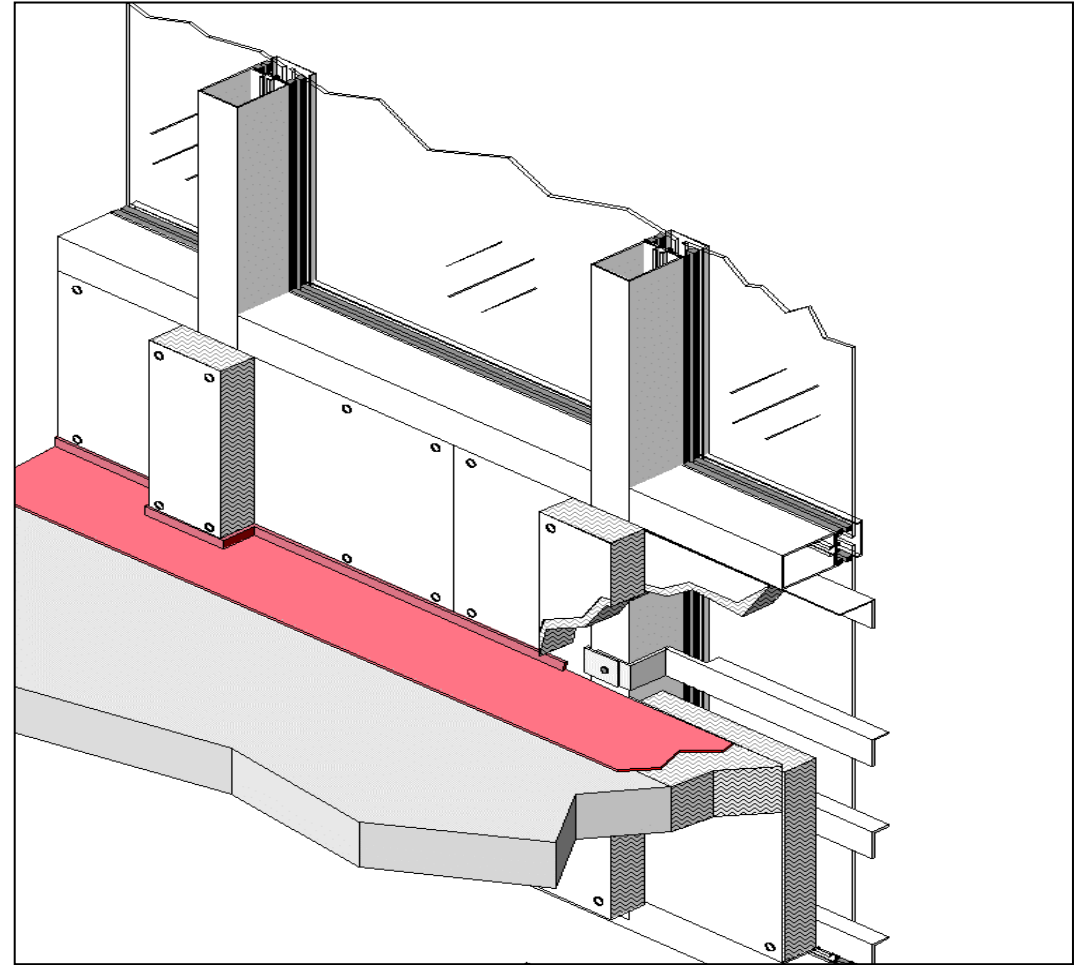
Insulation Rating by UL's Enhanced ASTM E2307 Method

- No passage of flames through protected void (i.e. Path 1), internal to insulated curtain wall or via “leap-frogging” (Path 2)
- 250°F / 325°F Temperature Rise on protected void.
325°F Temperature Rise anywhere else on second floor of assembly



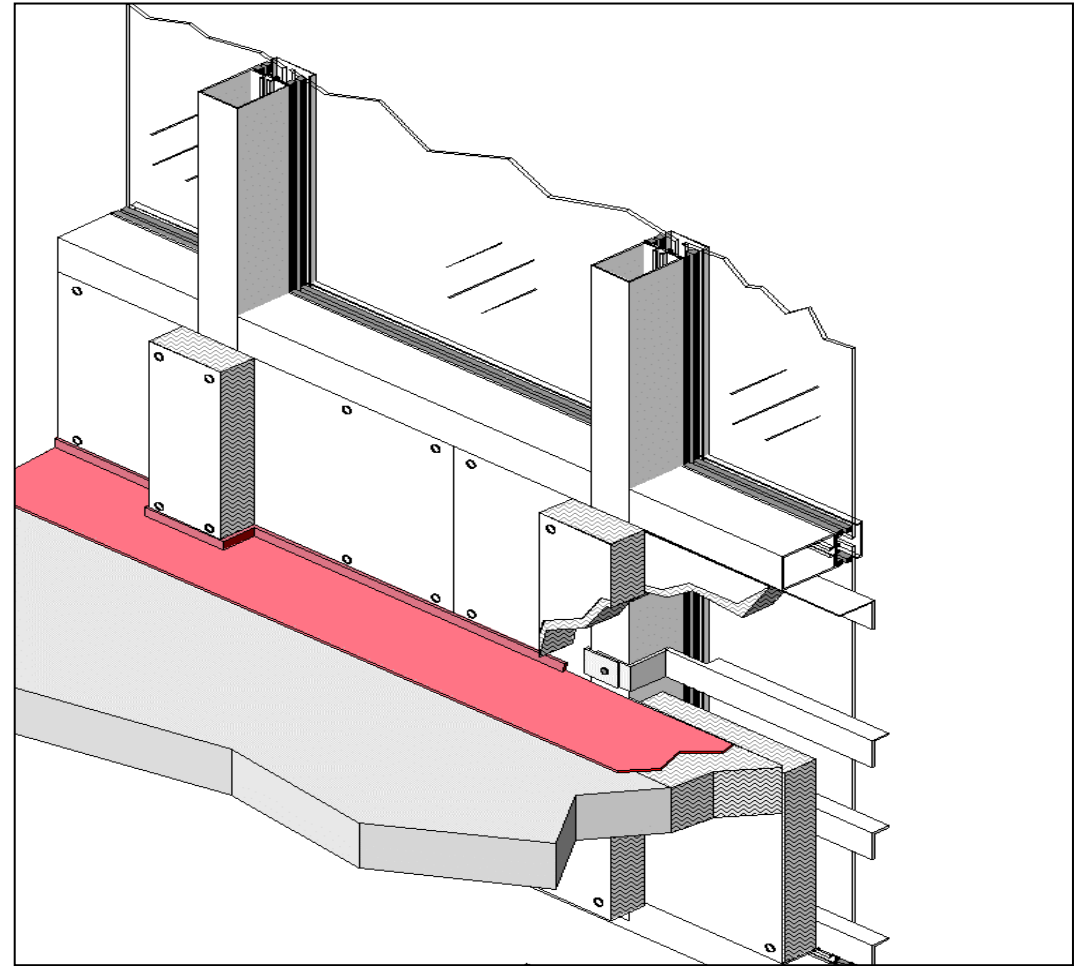
F (Fire) Rating by ASTM E2874

- No passage of flames through protected void (i.e. Path 1), or internal to insulated curtain wall



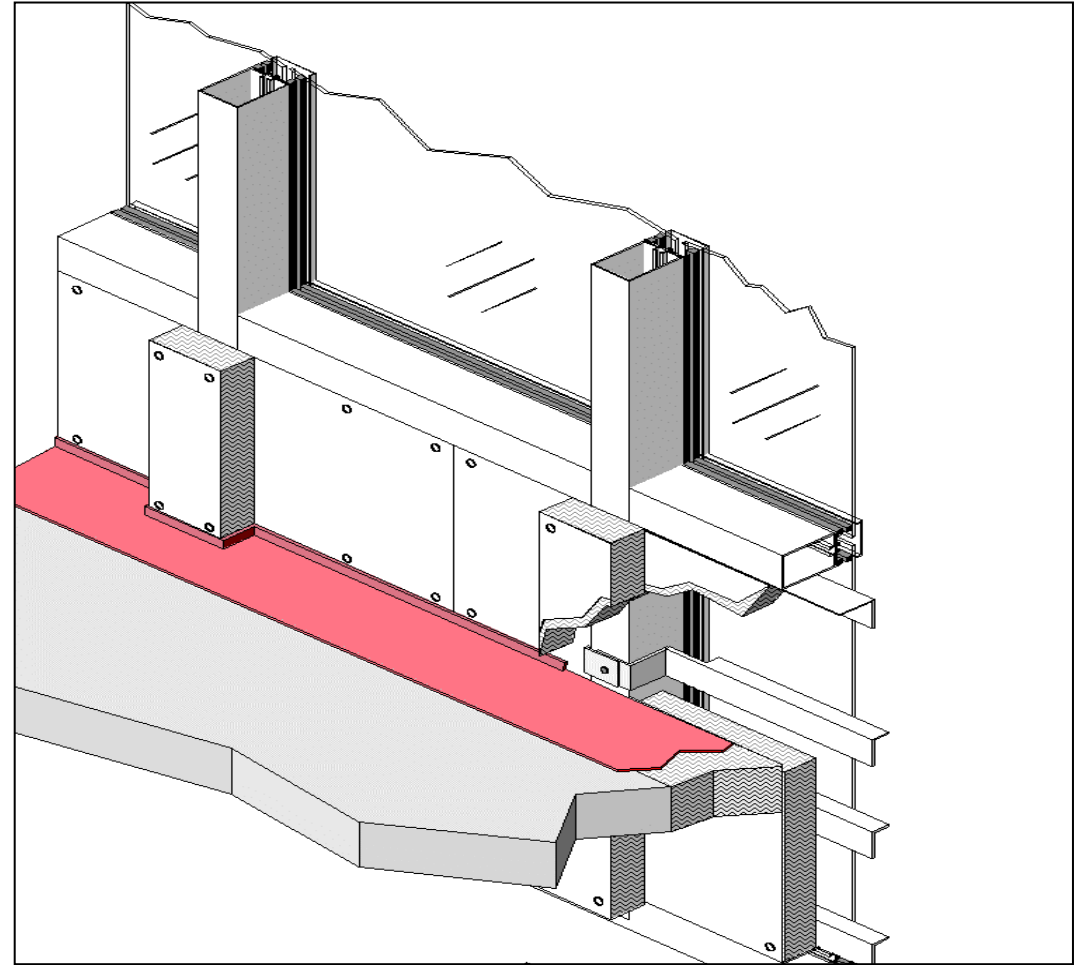
I (Integrity) Rating by ASTM E2874

- No passage of flames through protected void (i.e. Path 1), internal to insulated curtain wall or via “leap-frogging” (Path 2)
- Total heat flux shall not exceed $3\text{KW}/\text{m}^2$ on the vision glass



T (Temperature) Rating by ASTM E2874

- 250°F / 325°F Temperature Rise anywhere on protected void and spandrel panel



Opening Protectives

- Fire Door Assemblies
 - Fire Door Frames
 - Fire Doors
 - Hardware
 - Glazing within Fire Doors
- Fire Window Assemblies
 - Fire Window Frames
 - Glazing



Standards Relating to Opening Protectives

- **Opening Protectives**

- Fire / Hose Stream Test Standards

- NFPA 252 (Fire Doors), NFPA 257 (Fire Windows, FPR Glazing), UL 9 (Fire Windows, FPR Glazing), UL 10B and 10C (Fire Doors), UL 263 (FRR Glazing), ASTM E119 (FRR Glazing)

- Smoke Leakage Standard

- UL 1784

- Installation and Maintenance Standards

- NFPA 80 (Fire Doors and Fire Windows), NFPA 105 (Smoke Rated Doors)

Component Approach Used for Fire Door and Fire Window Assemblies

- The IBC and NFPA 101 prescribe a component approach for testing fire door and fire window assemblies
- By referencing NFPA 80, the codes require fire door and fire window components to be Listed and Labeled
- Individual listed and labeled components are installed together in the field to form the complete opening protective
- Approval of the finished opening protective relies on Listing and Labeling of individual components with the final approval up to the Code Official

Fire Door and Shutter Assemblies

- Code Referenced Standards
 - Side-hinged or pivoted swinging doors shall be tested to UL 10C or NFPA 252 (positive pressure)
 - Tin-clad fire door assemblies shall comply with UL 10A, UL 14B, and UL 14C
 - Other types of doors shall be tested to UL 10B or NFPA 252 (neutral pressure)
- All the above standards establish a “Fire-Protection Rating”
- For a Fire-Protection Rating, the fire door assembly must:
 - Prevent passage of flame through the door assembly during the fire exposure
 - Prevent a through projection of water through the door assembly during the hose stream test conducted after the full duration fire exposure

Fire Door and Shutter Assemblies

- Fire door assemblies are typically glazed with a fire-protection-rated glazing
- Code limits the maximum size (individual panel size) and maximum rating of fire-protection-rated glazing that may be used in fire door assemblies
- Where required size or rating exceeds code allowance, a fire-resistance-rated glazing may be utilized in fire door assemblies
- Such glazing must meet the requirements for both a fire-protection rating and a fire-resistance rating

Fire Door and Shutter Assemblies

- For a Fire-Resistance Rating, the glazing within the fire door assembly must:
 - Prevent passage of flame through the glazing during the fire exposure
 - Limit the temperature rise through the glazing to 250°F / 325°F
 - Prevent a through projection of water through the glazing during the hose stream test conducted after the full duration fire exposure

Fire Window Assemblies

- Code Referenced Standards
 - Fire Window assemblies shall be tested to UL 9 or NFPA 257 (positive pressure)
- The above standards establish a “Fire-Protection Rating”
- For a Fire-Protection Rating, the fire window must:
 - Prevent passage of flame through the window assembly during the fire exposure
 - Prevent a through projection of water through the window assembly during the hose stream test conducted after the full duration fire exposure

Fire Window Assemblies

- Fire window assemblies are typically glazed with a fire-protection-rated glazing
- Code limits the maximum size (individual panel size and total cumulative area) and maximum rating of fire window assemblies
- Where required size or rating exceeds code allowance or when a fire window assembly is not permitted, a fire-resistance-rated window assembly may be utilized
- A fire-resistance-rated window assembly meets the same requirements as any other wall assembly (ASTM E119 / UL 263)
- A fire-resistance-rated window utilizes a “non-conductive” frame and fire resistance-rated glazing

Fire Window Assemblies

- For a Fire-Resistance Rating, the fire window assembly must:
 - Prevent passage of flame through the window assembly during the fire exposure
 - Limit the temperature rise through the fire window frame and glazing to 250°F / 325°F
 - Prevent a through projection of water through the window assembly during the hose stream test conducted after the reduced duration fire exposure

Ducts and Air Transfer Openings

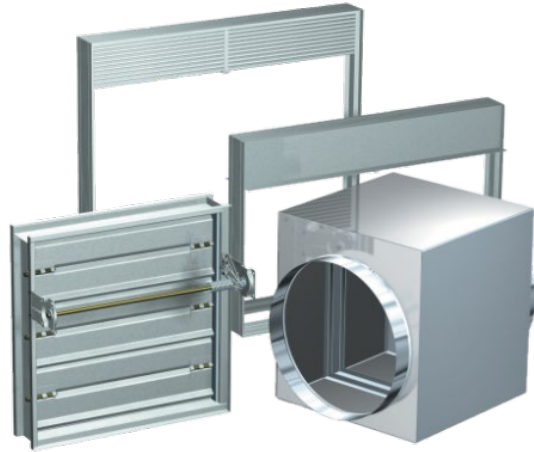
- Fire Dampers
- Smoke Dampers
- Combination Fire / Smoke Dampers
- Corridor Dampers
- Ceiling Radiation Dampers



Standards Relating to Ducts and Air Transfer Openings

- **Duct and Air Transfer Openings**
 - Fire / Hose Stream Test Standards
 - UL 555 (Fire, Combination and Corridor Dampers), UL 263 and 555C (Ceiling Radiation Dampers)
 - Smoke Leakage Standard
 - UL 555S (Smoke, Combination and Corridor Dampers)
 - Installation and Maintenance
 - NFPA 80 (Fire, Combination, Corridor and Ceiling Radiation Dampers), NFPA 105 (Smoke, Combination and Corridor Dampers)

Ratings for Fire Dampers



- Tested and listed to UL 555
- Fire Rating
 - No passage of flames through interior of damper or through annular space around damper
 - No through projection of water during the hose stream test conducted after the full duration fire exposure test

Ratings for Fire Dampers Cont.

- UL 555 differentiates between static and dynamic dampers
 - Static – For use in HVAC systems designed to shutdown upon detection of fire or smoke
 - Dynamic – For use in HVAC systems designed to remain operational during a fire situation. All combination fire / smoke dampers are dynamic. Dynamic fire dampers are assigned a maximum pressure rating and a maximum air flow rating.

Ratings for Fire Dampers Cont.

- UL 555 describes many tests, including the fire exposure test, hose stream test, airflow test, temperature test, duct breakaway test, corrosion protection test, durability tests, dynamic closure test, etc., etc.

Ratings for Smoke Dampers



- Tested and listed to UL 555S
- Leakage Rating
 - Standard defines a Class I, II or III Leakage Rating with Class I being the most restrictive
 - Required by code to be rated for Class I or II leakage at a temperature rating of not less than 250°F (121°C)
 - Smoke dampers are assigned a maximum pressure rating and a maximum air flow rating

Ratings for Smoke Dampers Cont.

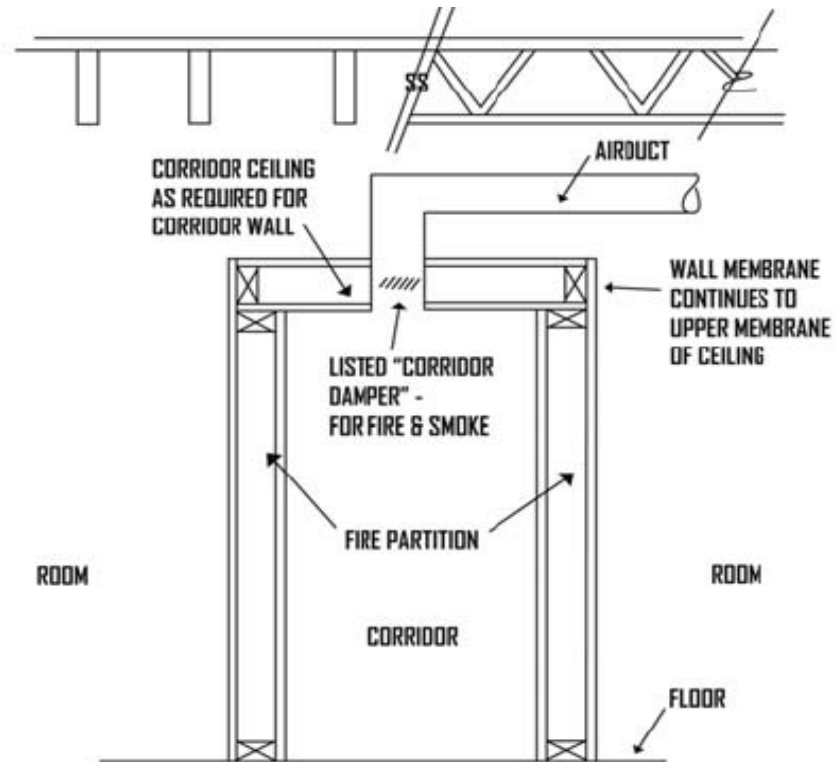
- UL 555S describes many tests, including leakage test, temperature test, pressure test, air velocity tests, duct breakaway test, corrosion protection test, durability tests, etc., etc.

Ratings Combination Fire and Smoke Dampers



- Tested and listed to both UL 555 and UL 555S
- Required by code to meet requirements for both a fire damper and a smoke damper
- Ratings are as required for both a fire and a smoke damper

Corridor Dampers



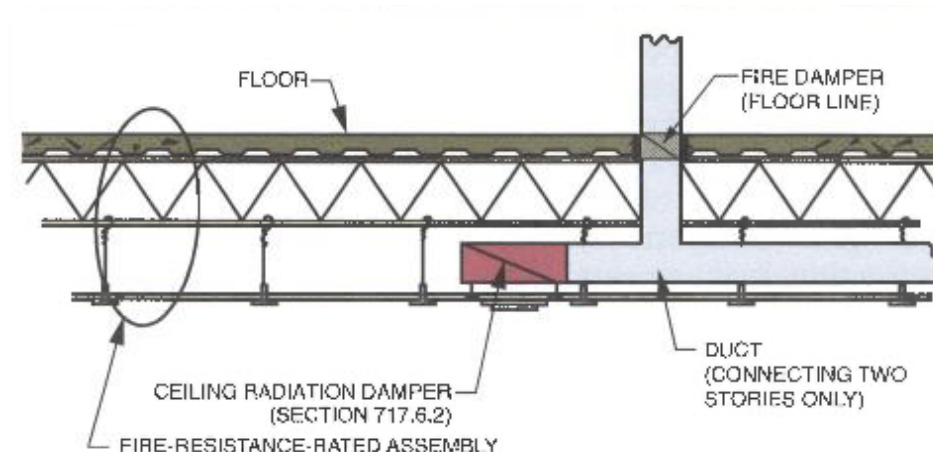
- Section 717 of the IBC
 - Used in ceilings of exit corridors where ceiling is constructed as required for corridor walls per Section 708.4, Exception 3
 - Designed to be installed in horizontal "wall"

Ratings for Corridor Dampers

- Corridor dampers shall be listed and labeled in accordance with UL 555 and UL 555S. Corridor dampers shall also demonstrate acceptable closure under air flow conditions.
 - Shall meet the rating requirements for both fire and smoke dampers
 - 1 hr fire rated
 - Leakage rating shall be Class I or II with a temperature rating of not less than 250°F (121°C)

Ceiling Radiation Dampers

- Used in fire resistive floor-ceiling and roof-ceiling assemblies where duct penetrates membrane ceiling
- Intent is to minimize heat transfer into concealed space



Ratings for Ceiling Radiation Dampers



- Ceiling radiation dampers shall be listed and labeled, and tested in accordance with UL 555C or as part of a floor/ceiling or roof/ceiling assembly in accordance with UL 263 or ASTM E119
- Rating of damper related to rating of overall assembly in which is it installed

Questions??



Thanks for Attending!!!

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