

Firestopping & Standards

An In-Depth Look at the Standards and Ratings Used for the Protection of Joints and Voids

Rich Walke, Consultant to FCIA

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“TOTAL FIRE PROTECTION”

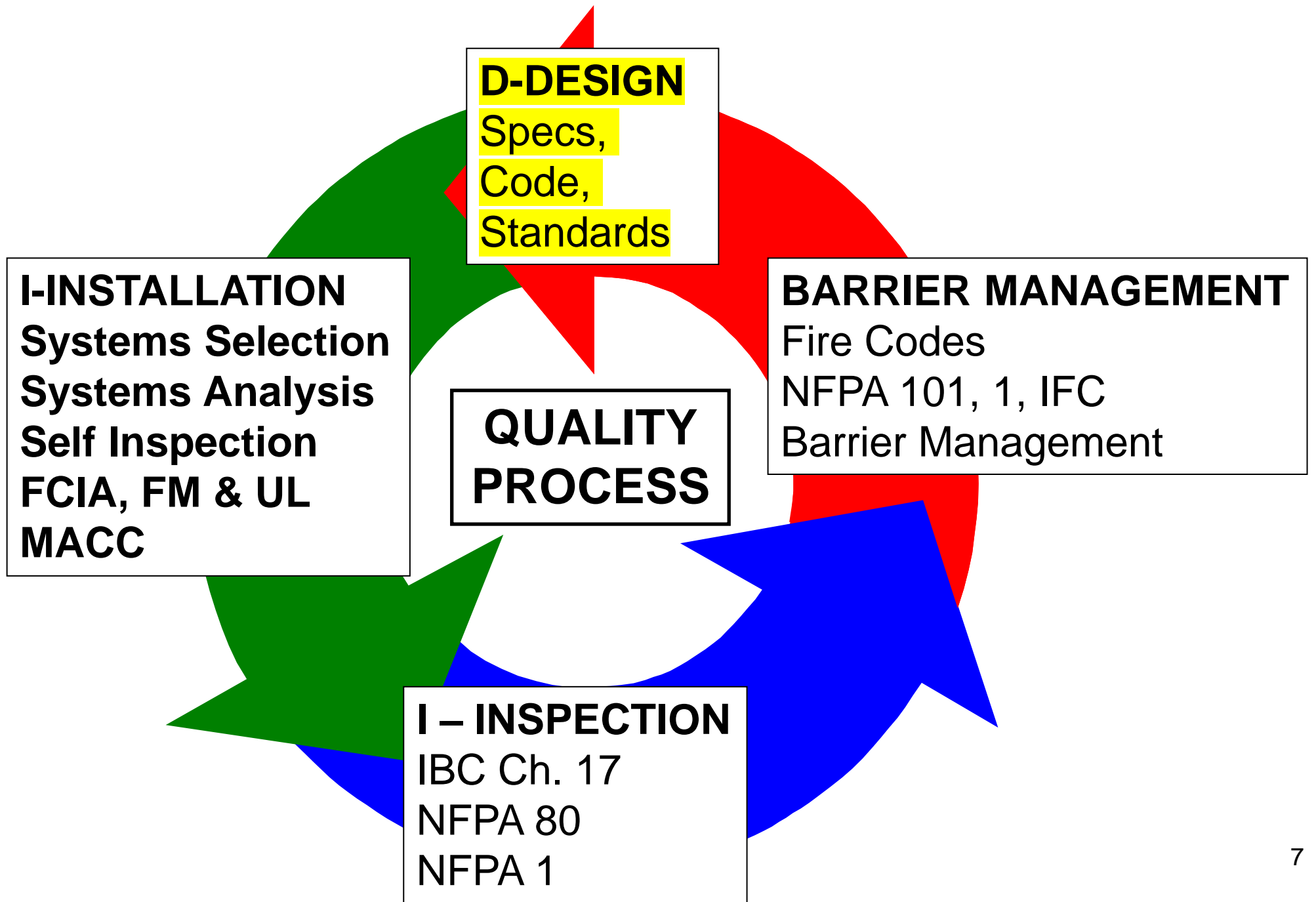
- **Effective Compartmentation**
 - Fire Barriers, Fire Walls/Floors, Smoke Barriers
 - Firestopping, Fire Dampers, Swinging and Rolling Fire Doors, Fire Rated Glazing
- **Detection & Alarm Systems**
- **Sprinkler Suppression Systems**
- **Education for Safety**
 - Building Owners & Managers, Building 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, UL 2079, E2307, E2837, E2874, E3037
 - **Movement (M), Smoke (L), Water (W)**
 - Professional *Installation* –
 - FCIA Member, UL/ULC Qualified Contractors, FM 4991 Approved Contractors
 - Properly *Inspected* –
 - ASTM E2174 / E2393, by IAS-AC291 Agency, UL/ULC, IFC, FM Exam
 - **Protection Maintained** – Annually – by FCIA Members

FCIA Actions - 2021

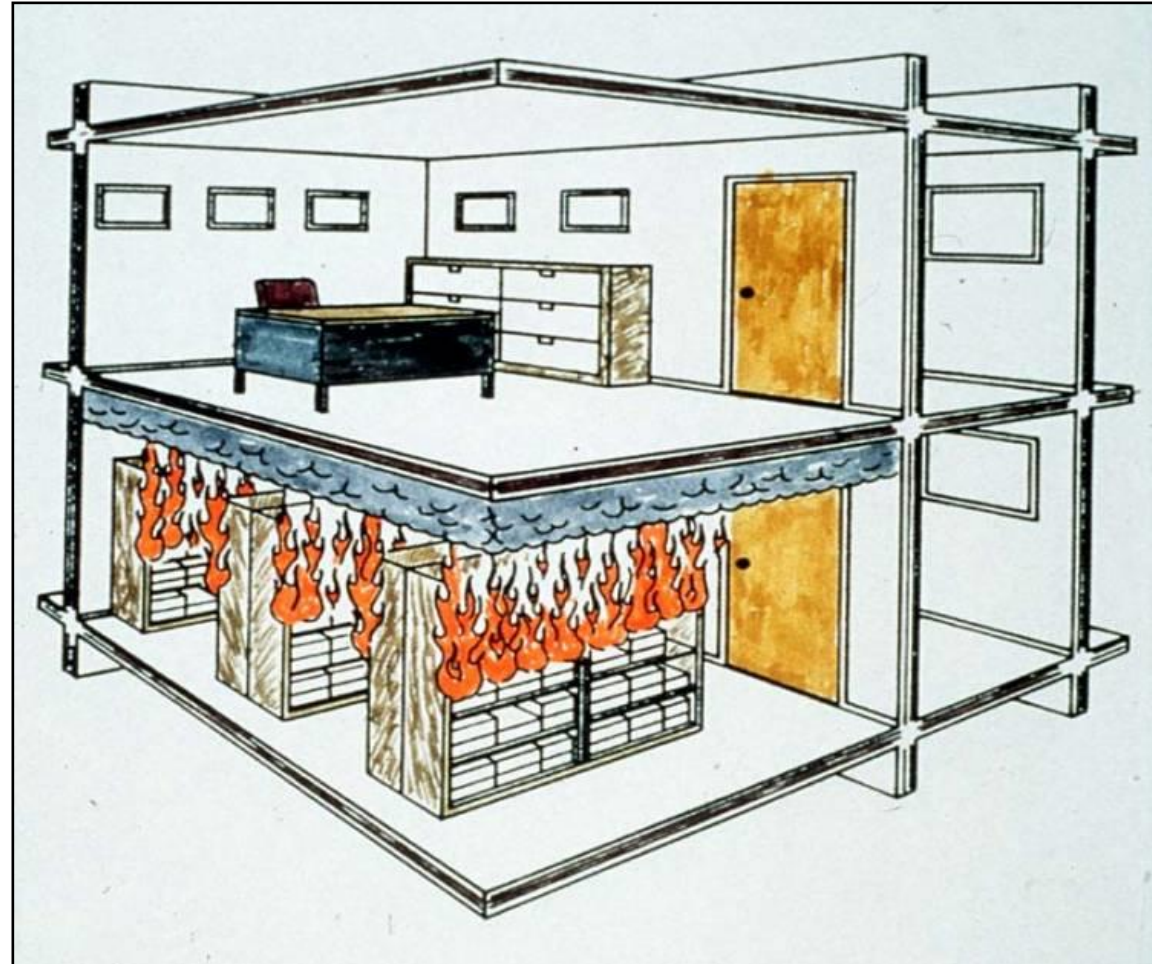
- Conferences
- Webinars
- Symposiums
- Code Hearings
- Standards Discussions
- Committees
- International Discussions
- New Education for Careers in Firestopping!!



Introduction

- Previous Webinar – December 16, 2020
 - ASTM E119 / UL 263 – Baseline for 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
- Today's Webinar – Protection of Joints and Voids

Maintaining Compartmentalization Through Use of Fire-Resistive Construction



Requirements for Protecting Breaches In or Through Fire-Resistance-Rated Construction

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

What is a Joint and a Void?

- **JOINT.** The opening in or between adjacent assemblies that is created due to building tolerances, or is designed to allow independent movement of the building in any plane caused by thermal, seismic, wind or any other loading. [2021 IBC, Section 202]
 - By the IBC, a joint is thought of as occurring between two rated assemblies. A joint may be static or dynamic.
 - By the IBC, a void is thought of as occurring between a rated and a nonrated assembly, or two nonrated assemblies. A void may be static or dynamic.

Practical Definition of Joint and Void

- **JOINT.** An opening in or between adjacent fire-resistance-rated assemblies that is created due to building tolerances, or is designed to allow independent movement of the building in any plane caused by thermal, seismic, wind or any other loading.
- **VOID.** An opening between a fire-resistance-rated assembly and a nonfire-resistance-rated assembly, or in or between two nonfire-resistance-rated assemblies that is created due to building tolerances, or is designed to allow independent movement of the building in any plane caused by thermal, seismic, wind or any other loading.

Types of Joints and Voids

- **Fire-Resistant Joint System** – Joint between two fire-resistance-rated building element. May be either static or dynamic.
- **Perimeter Fire Containment System** – Void between an exterior curtain wall assembly and a fire-resistance-rated floor or floor-ceiling assembly. May be static or dynamic.
- **Exterior Curtain Wall / Nonfire-resistance-rated Floor** – Void between an exterior curtain wall assembly and a nonfire-resistance-rated floor or floor-ceiling assembly.

Types of Joints and Voids Cont.

- **Exterior Curtain Wall / Vertical Fire Barrier Intersection** – Void between an exterior curtain wall assembly and a vertical fire barrier.
- **Nonfire-resistance-rated roof / Vertical Fire Barrier Intersection** – Void between an nonfire-resistance-rated roof assembly and a vertical fire barrier. Also known as a Continuity Head-of-Wall System. May be static or dynamic.

Standards Relating to Joints and Voids

- Fire / Hose Stream Test Standards
 - Fire Resistant Joint Systems – ASTM E1966 / UL 2029 / ULC-S115 (Fire Testing), ASTM E2226 (Hose Stream)
 - Perimeter Fire Containment Systems – ASTM E2307 / ULC-S115 (Fire Testing)
 - Continuity Head-of-Wall Systems – ASTM E2837 (Fire Testing), ASTM E2226 (Hose Stream)
 - Other Voids – Generic protection with materials which will stay in place and prevent passage of flames and hot gases

Standards Relating to Joints and Voids Cont.

- Smoke Leakage Standard
 - UL 2079 / ULC-S115
- Fitness for Use Standards
 - UL 2079 (Water Leakage), UL 2079 (Aging)
 - Inspections Standard
 - ASTM E2393

Why Do Joints and Voids Exist?

- To accommodate relative movement between two building elements
- As a result of building tolerances

Forces Which Induce Movement

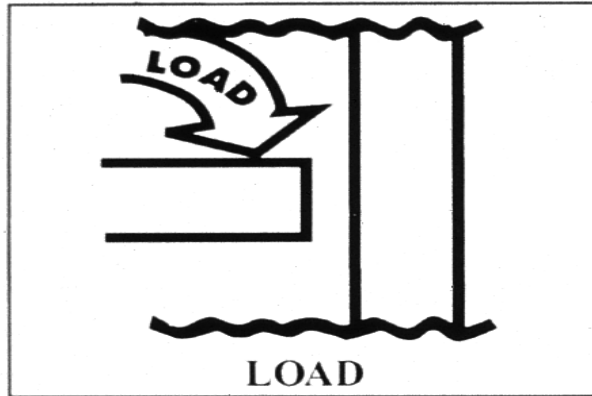


Fig. 1

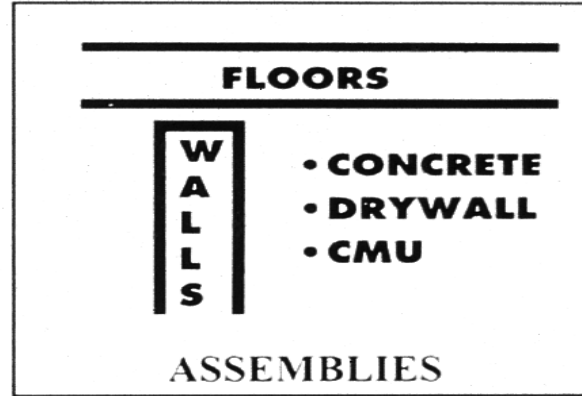


Fig. 3

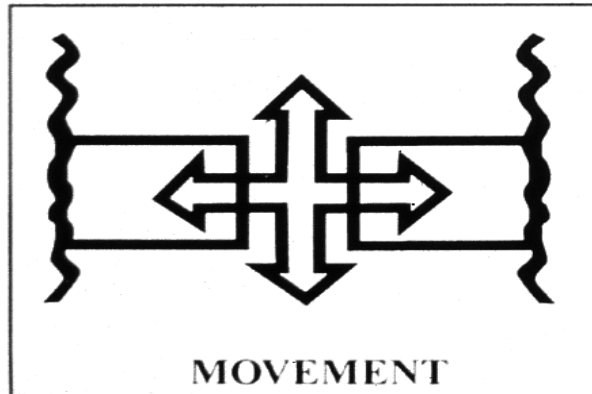


Fig. 2

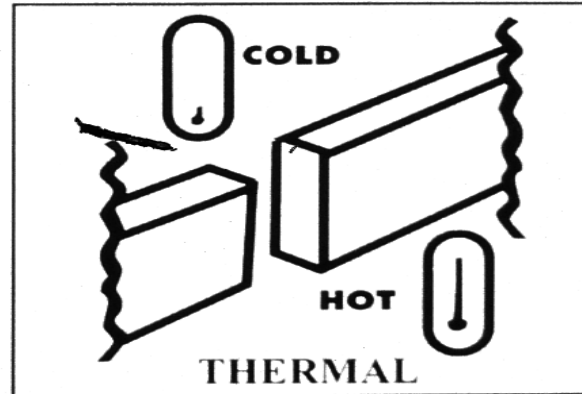


Fig. 4

Thermal

Wind Sway

Seismic

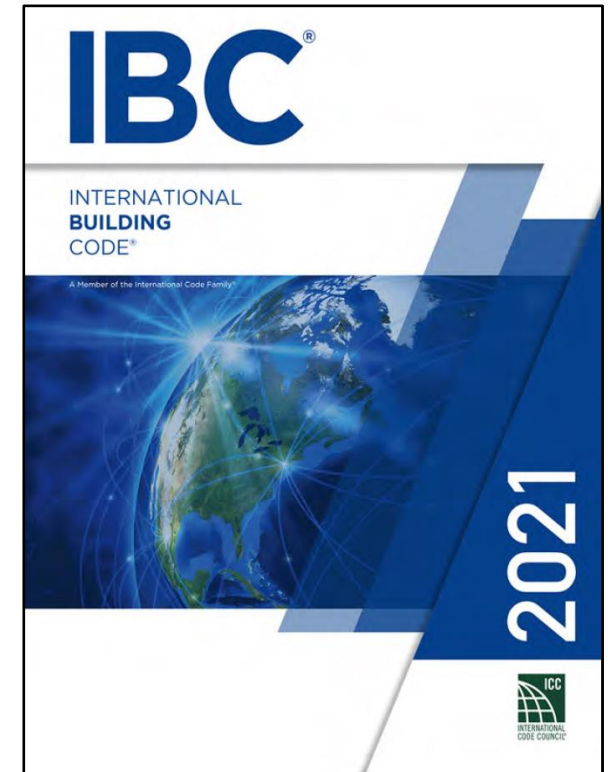
Load

Fire-Resistant Joint Systems

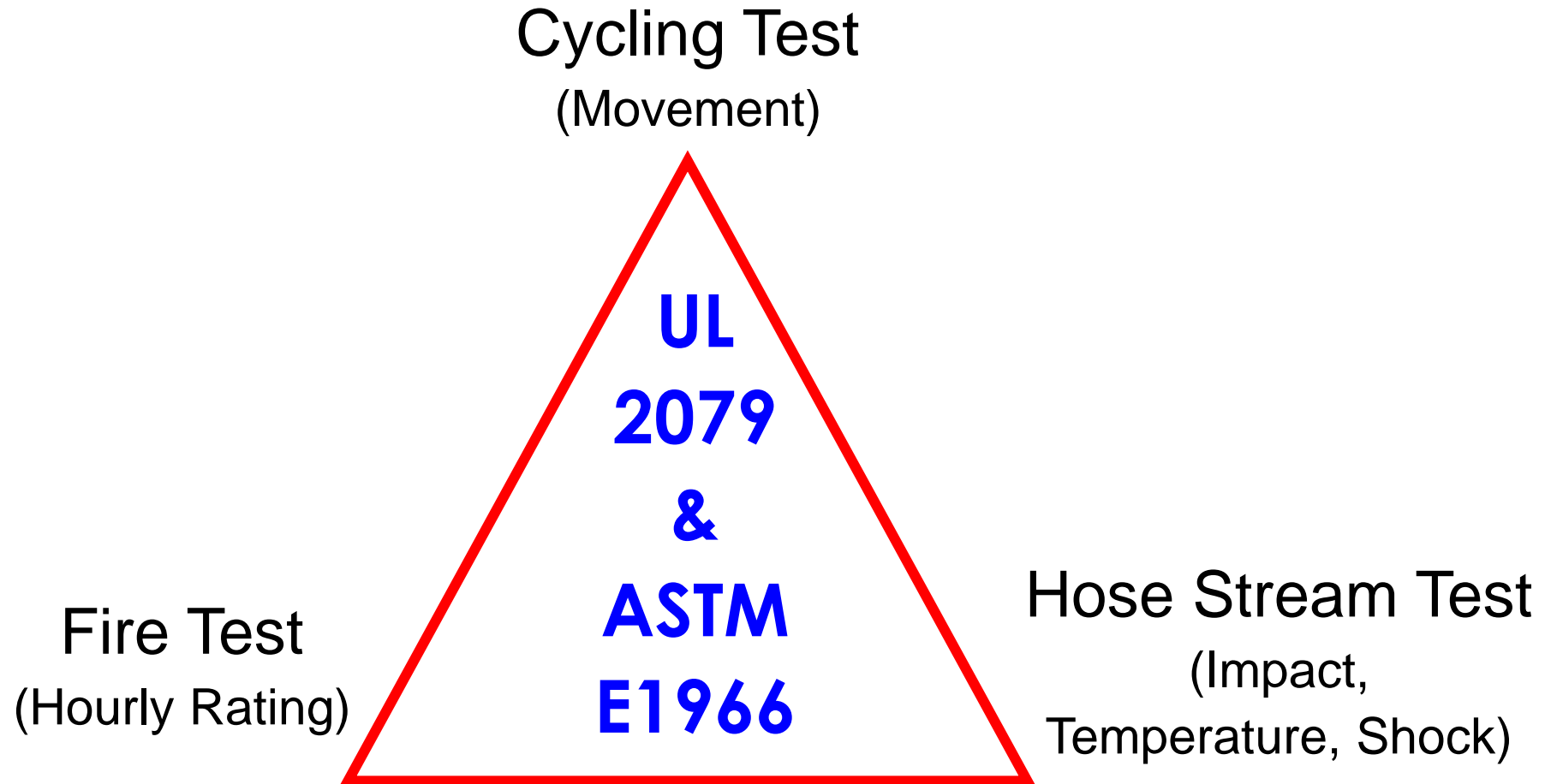


Code Requirements

- *Joints* installed in or between fire-resistance-rated walls, floor or floor/ceiling assemblies and roofs or roof/ceiling assemblies shall be protected by an approved *fire-resistant joint system* ...
- *Fire-resistant joint systems* shall be tested in accordance with the requirements of either ASTM E1966 or UL 2079.



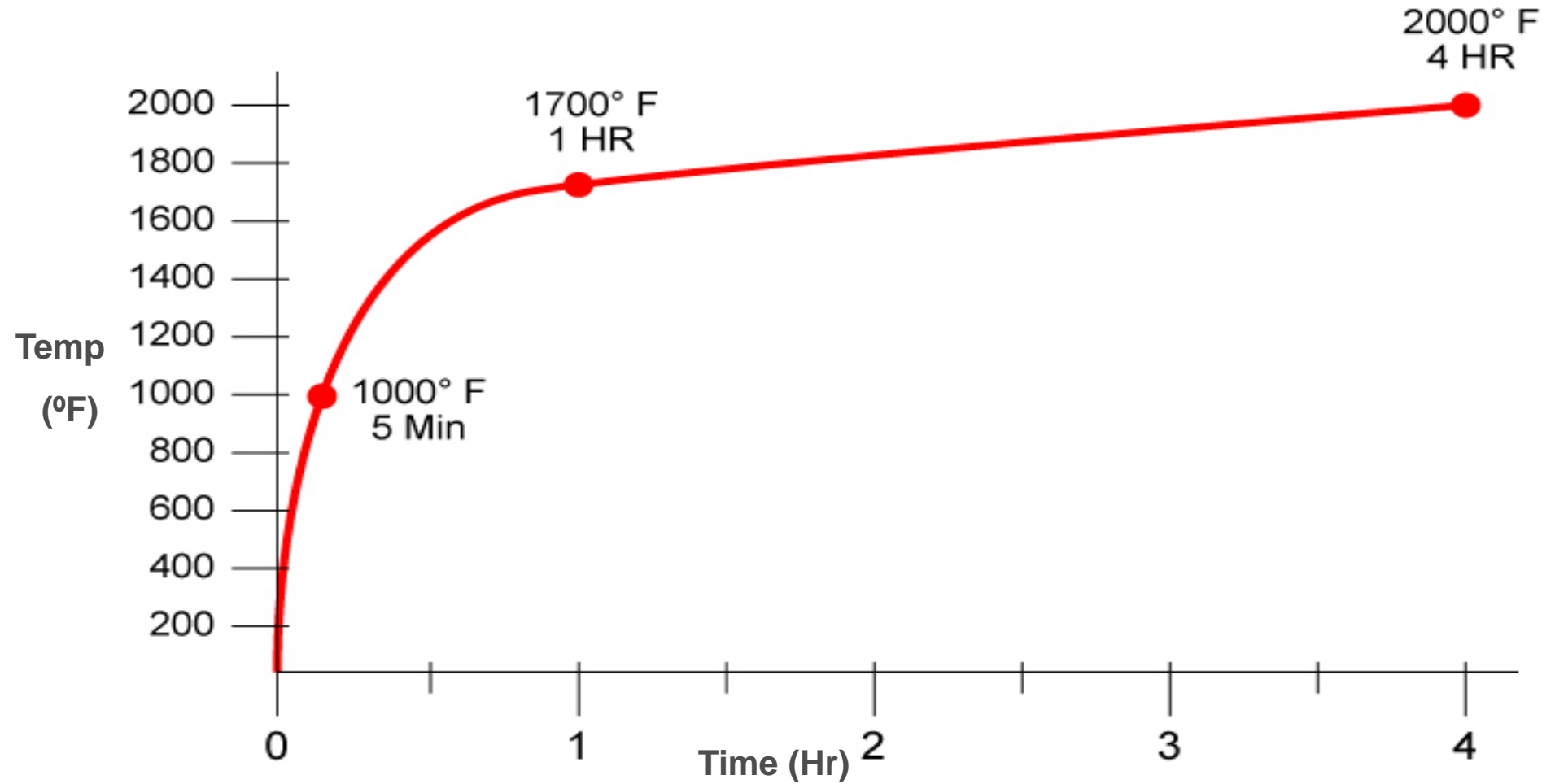
Test Standards / Components



Conditioning Prior to Fire Test

Movement Class	Min. No. of Cycles	Min. Cycling Rate (Cycles / Minutes)
Class I (Thermal)	500	1
Class II (Wind Sway)	500	10
Class III (Seismic)	100	30

Time-Temperature Curve



Fire Test



Hose Stream Test



UL 2079 / ASTM E1966 – Test Standards For Building Joint Systems



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

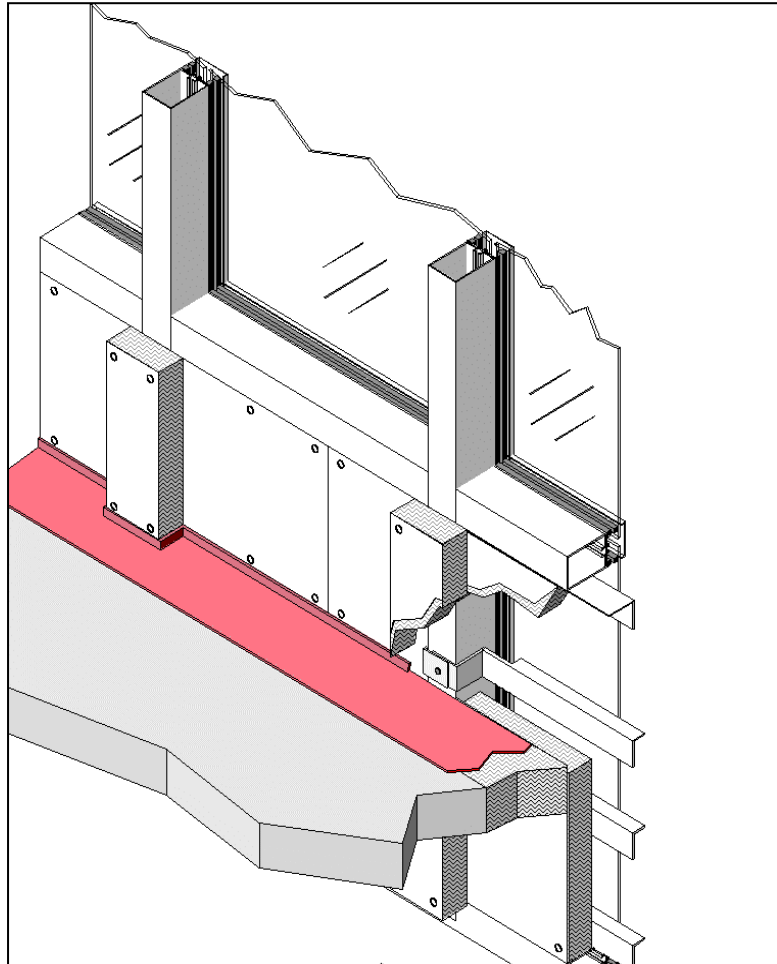
L Rating (New in 2006 Code)

- The amount of air leakage through the joint system at ambient and 400°F (204°C). IBC requires an L rating of 5 cfm / lineal ft or less.

W Rating

- Water Leakage

Perimeter Fire Containment Systems



Designation: E2637 – 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 issued under the fixed designation E2637; 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 superscripted delta (δ) indicates editorial changes 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 contacts nonrated horizontal assemblies when there is no joint opening. Normally such joint openings are denoted as "linear" 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 resistive joint systems using the same test apparatus or method of test, for example, Test Method E2637 employs the ISMA test apparatus. A continuity head-of-wall joint system is a particular type of fire resistive 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 connection 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 first test response test method measures the performance of a unique fire resistive 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 93, CANULC 2501, or other similar fire resistive test methods.

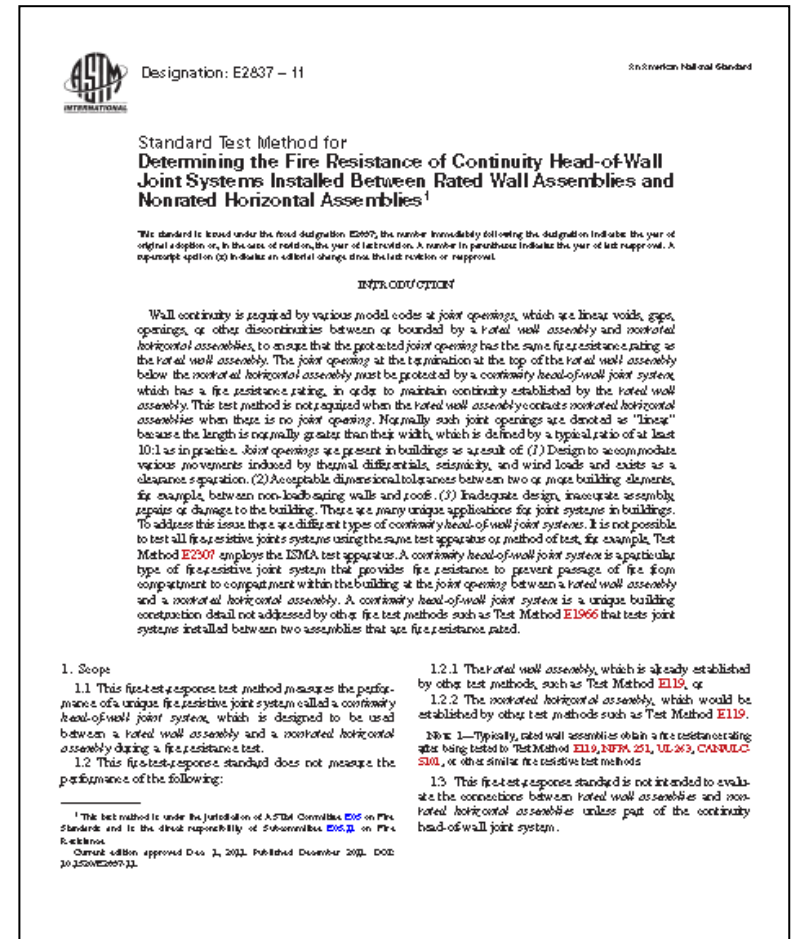
1.3 This first test response standard is not intended to evaluate the connections between rated wall assemblies and nonrated horizontal assemblies unless part of the continuity head-of-wall joint system.

¹ This test method is under the jurisdiction of ASTM Committee E08 on Fire Standards and is the direct responsibility of Subcommittee E08.2 on Fire Retardancy. Current edition approved Dec. 1, 2011. Published December 2011. DOI: 10.2556/E2637-11.

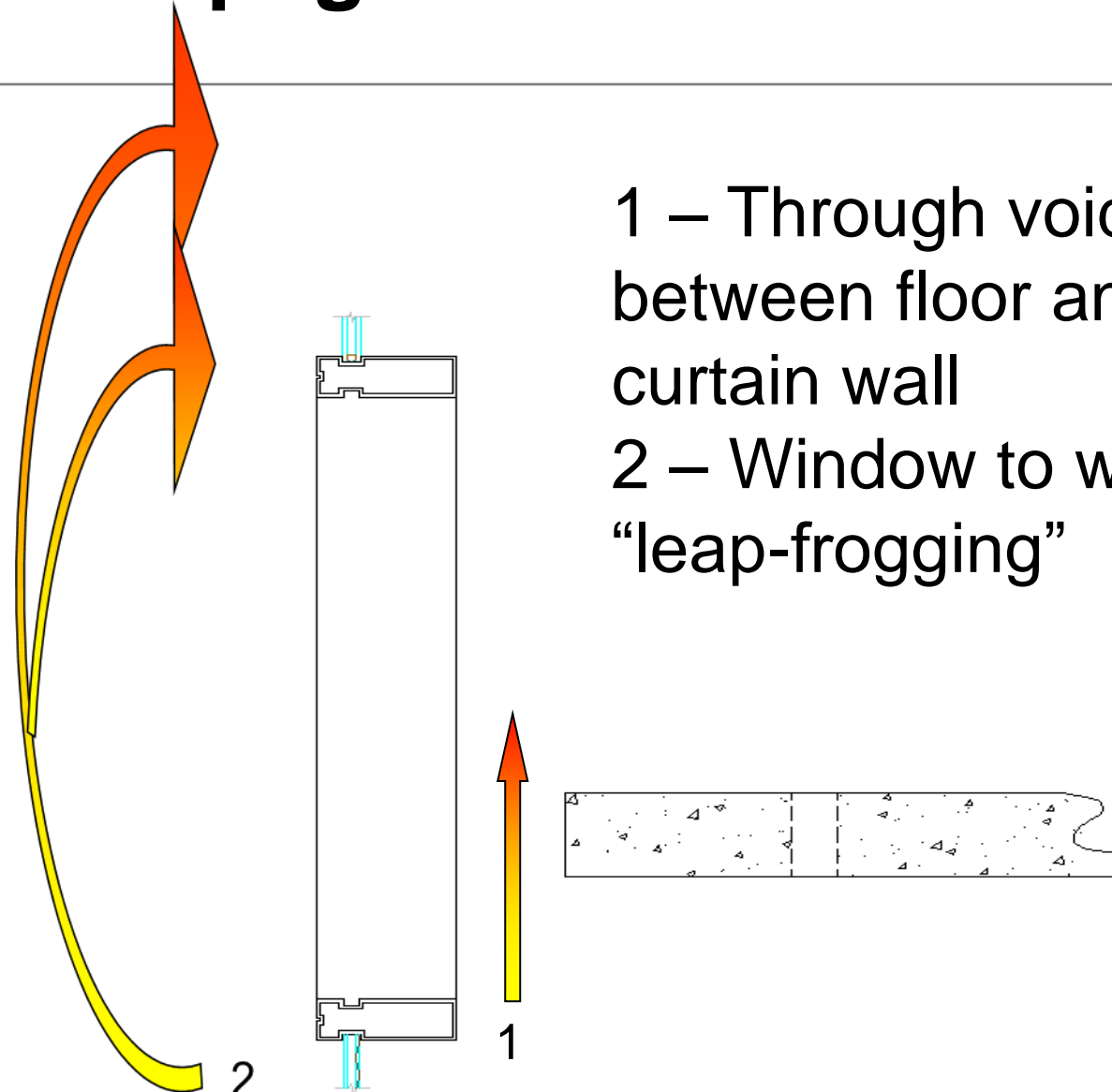
Perimeter Fire Containment Systems Cont.

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 – Uses a Spandrel Panel tested in accordance with ASTM E2874 to prevent leap-frogging



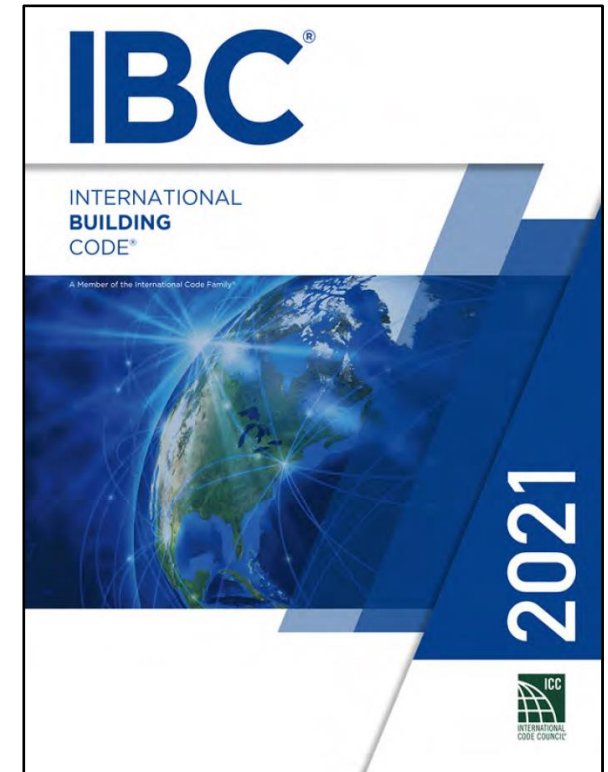
Paths of Fire Propagation



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

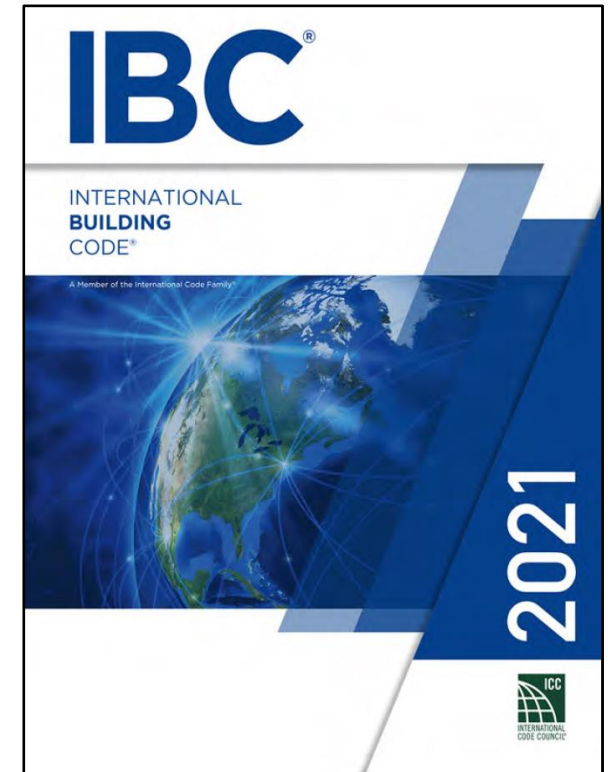
Code Requirements

- Voids created at the intersection of exterior curtain wall assemblies and fire-resistance-rated floor or floor/ceiling assemblies shall be protected with an *approved perimeter fire containment system* to prevent the interior spread of fire. Such systems shall provide an *F rating* for a time period not less than the *fire-resistance rating* of the floor or floor/ceiling assembly.



Code Requirements Cont.

- *Perimeter fire containment systems shall be tested in accordance with the requirements of ASTM E2307.*



First Floor – Underside of Void



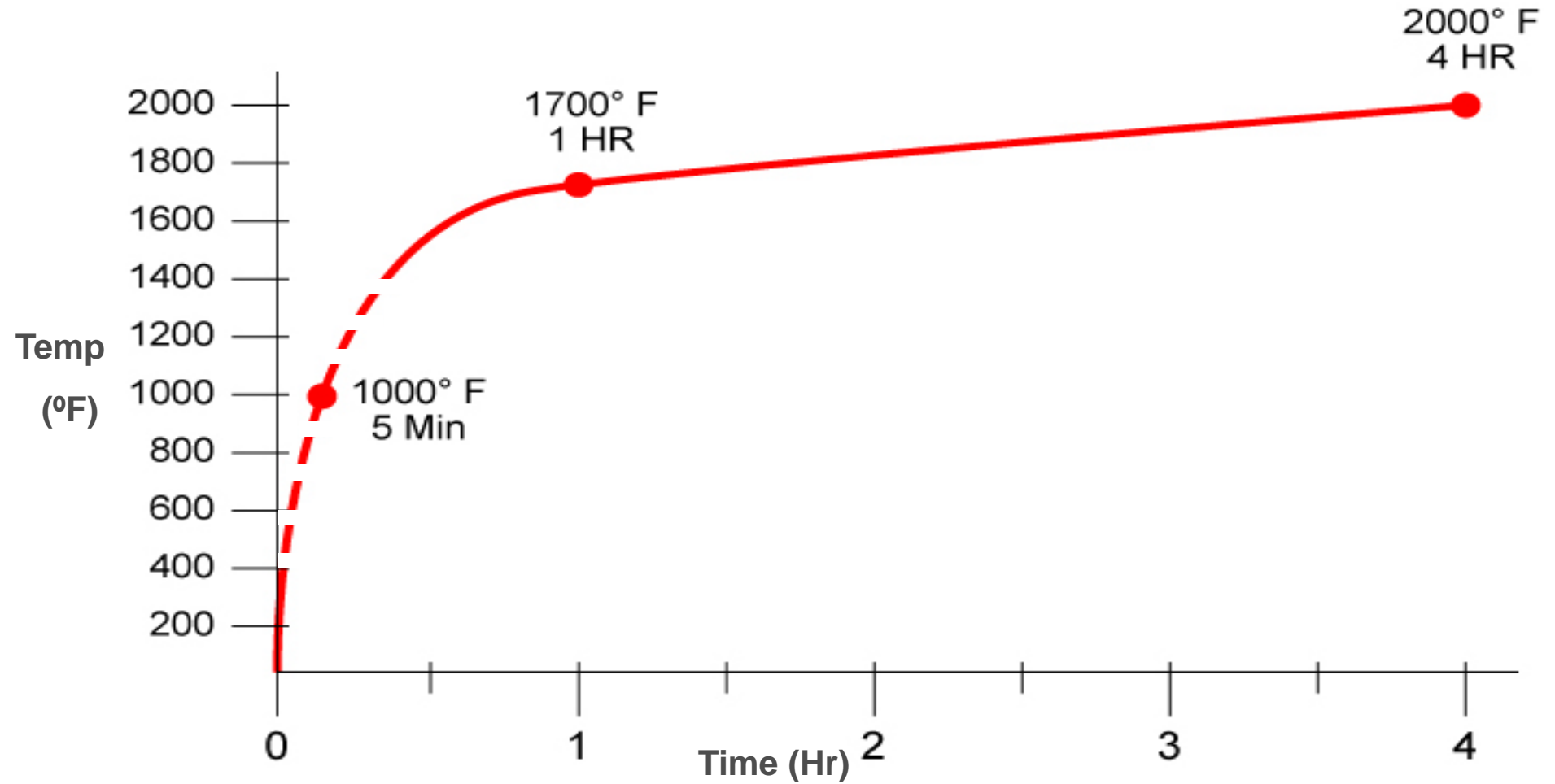
Second Floor – Top of Void



Conditioning Prior to Fire Test

Movement Class	Min. No. of Cycles	Min. Cycling Rate (Cycles / Minutes)
Class I (Thermal)	500	1
Class II (Wind Sway)	500	10
Class III (Seismic)	100	30

Time-Temperature Curve



Approximately 2 Minutes



Approximately 60 Minutes

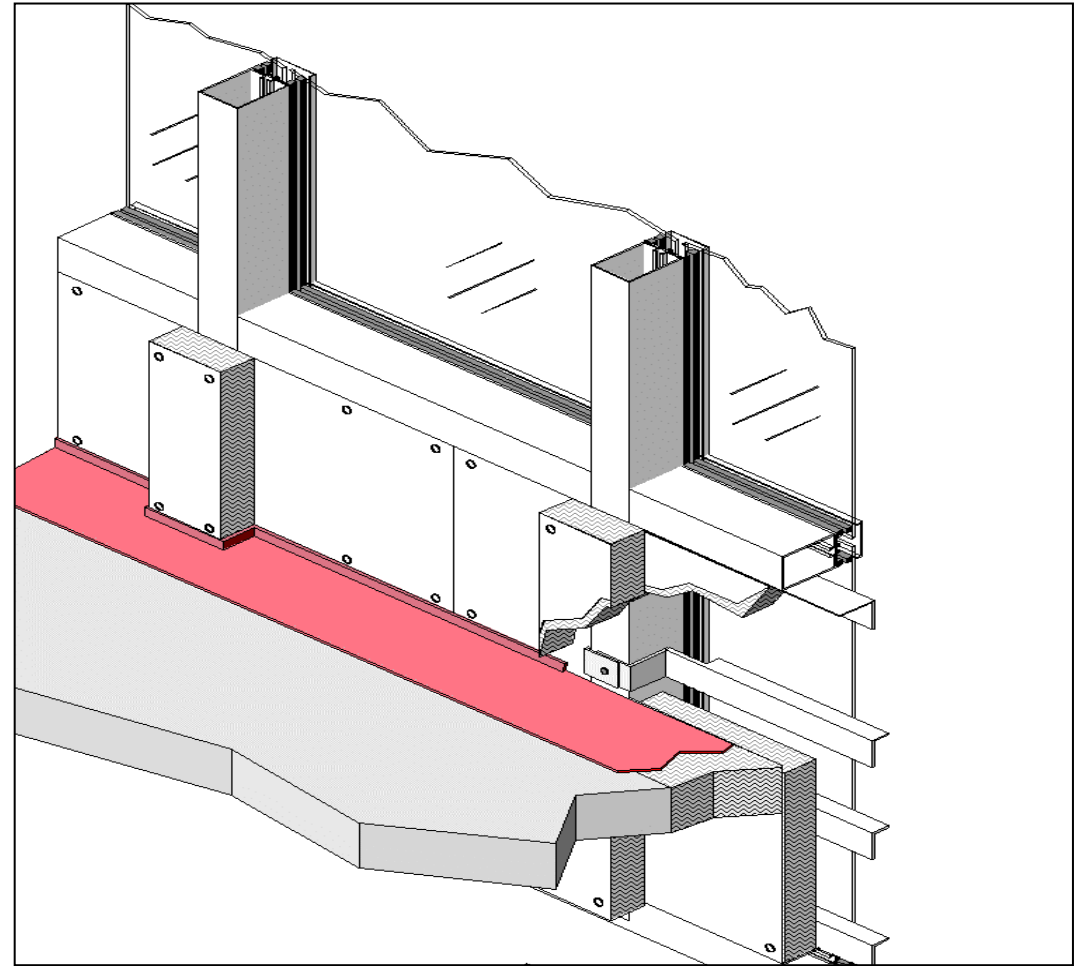


Approximately 120 Minutes



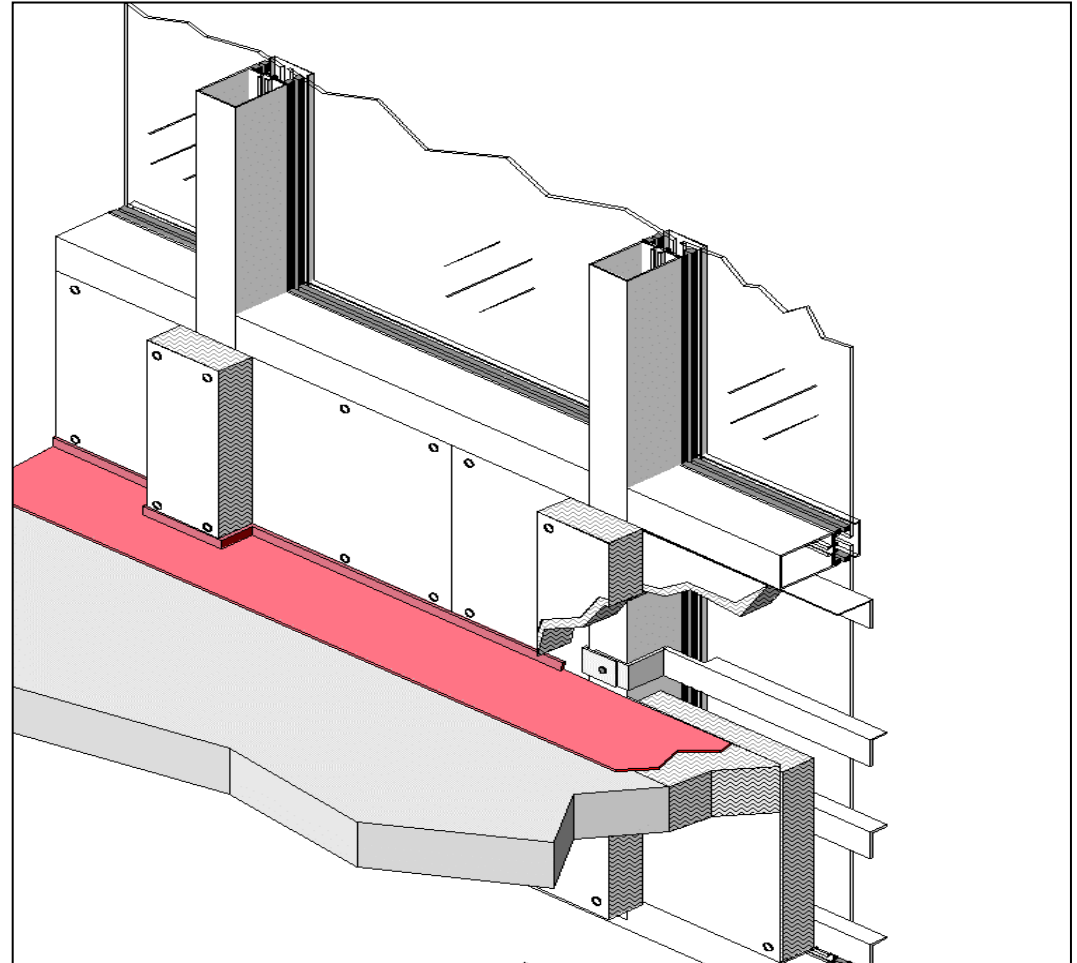
F (Flame) Rating by ASTM E2307

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



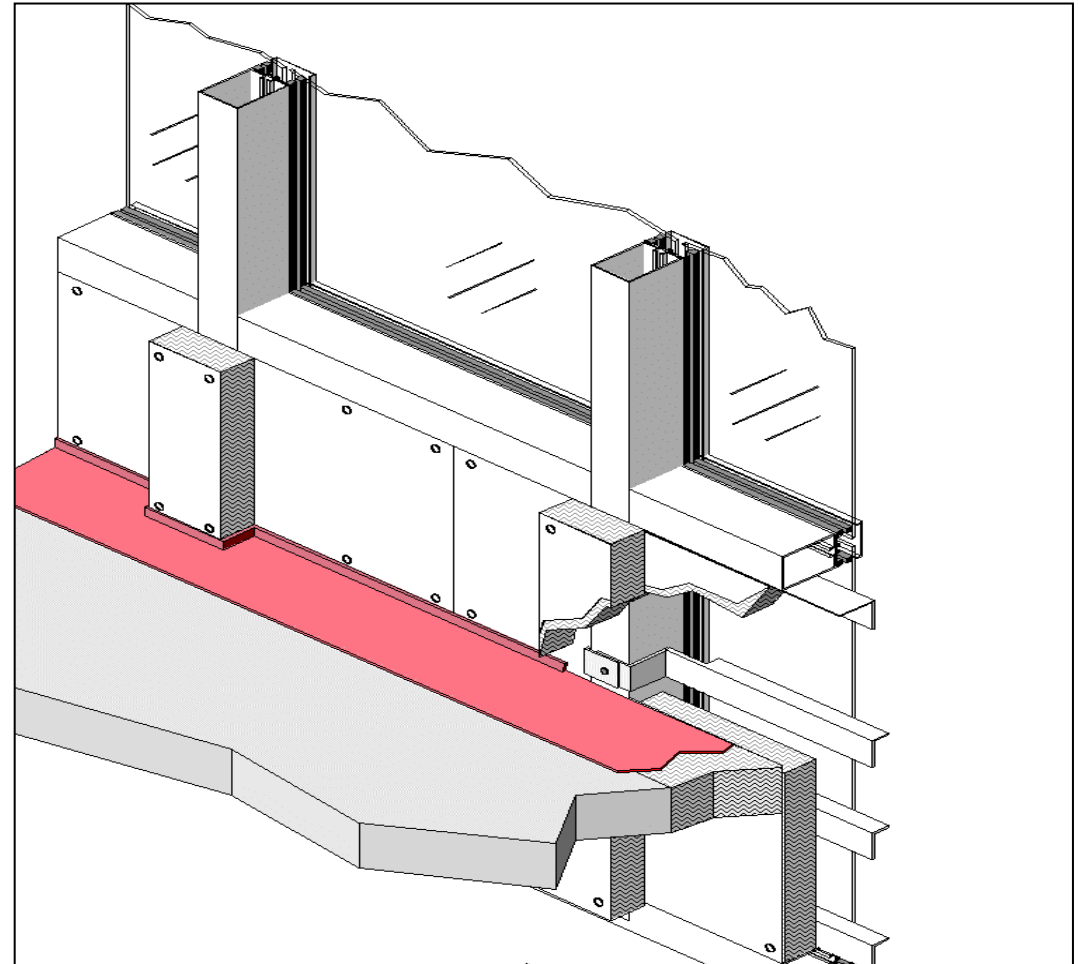
T (Temperature) Rating by ASTM E2307

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



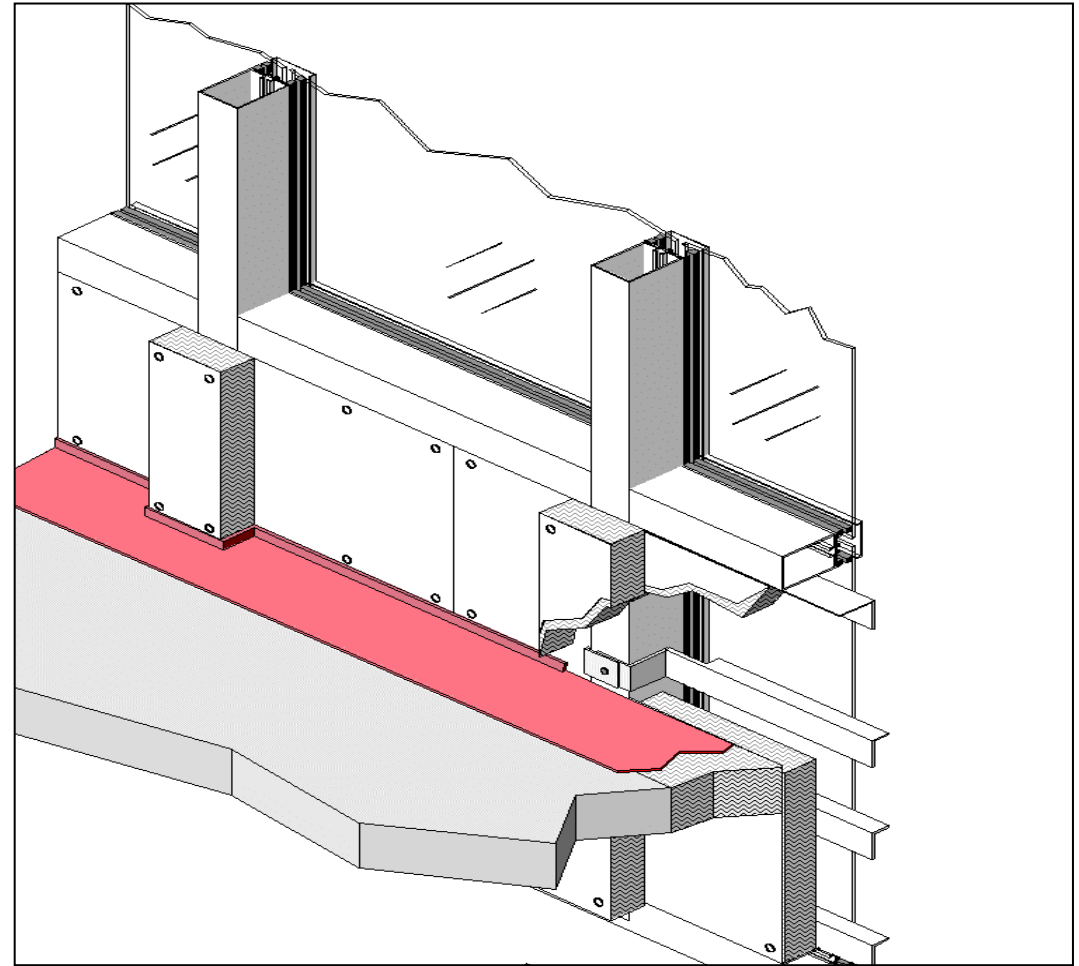
Integrity Rating by UL's Enhanced ASTM E2307 Method

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



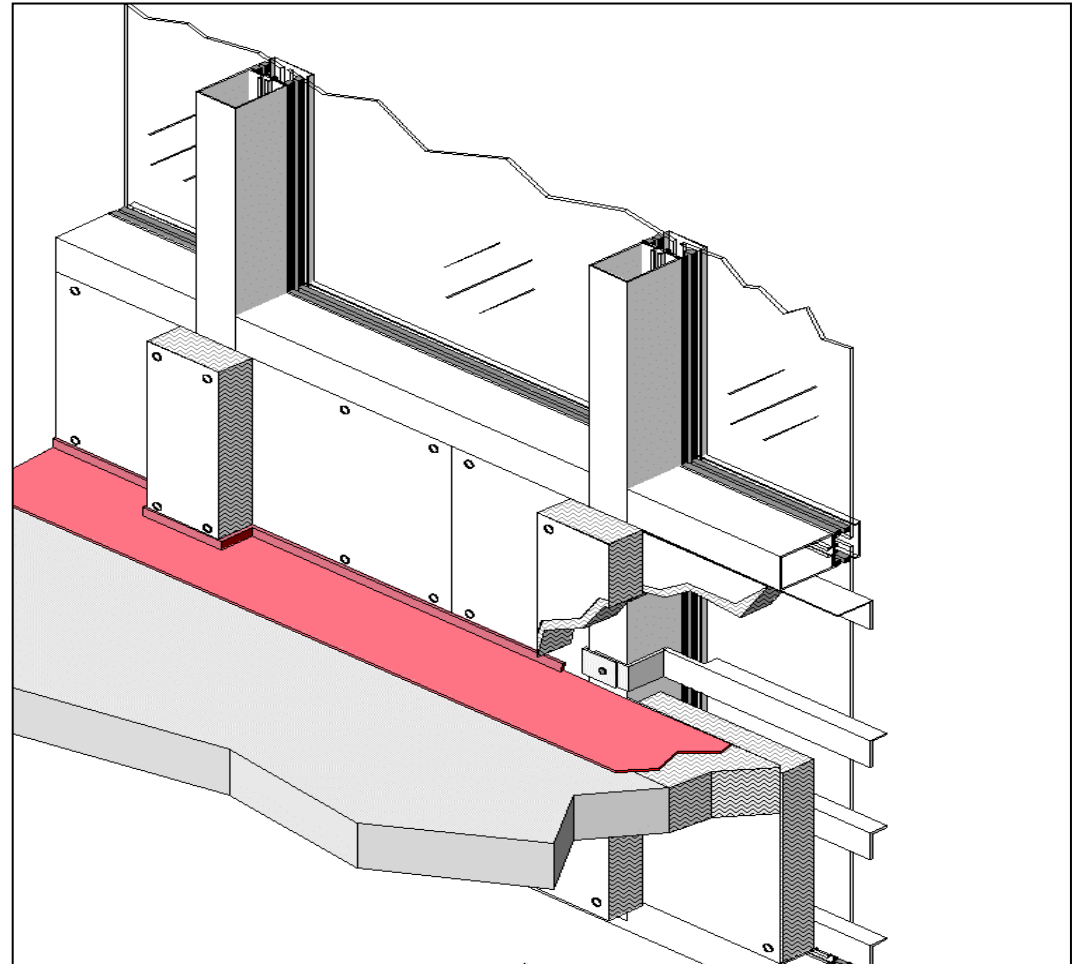
Insulation Rating by UL's Enhanced ASTM E2307 Method

- 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



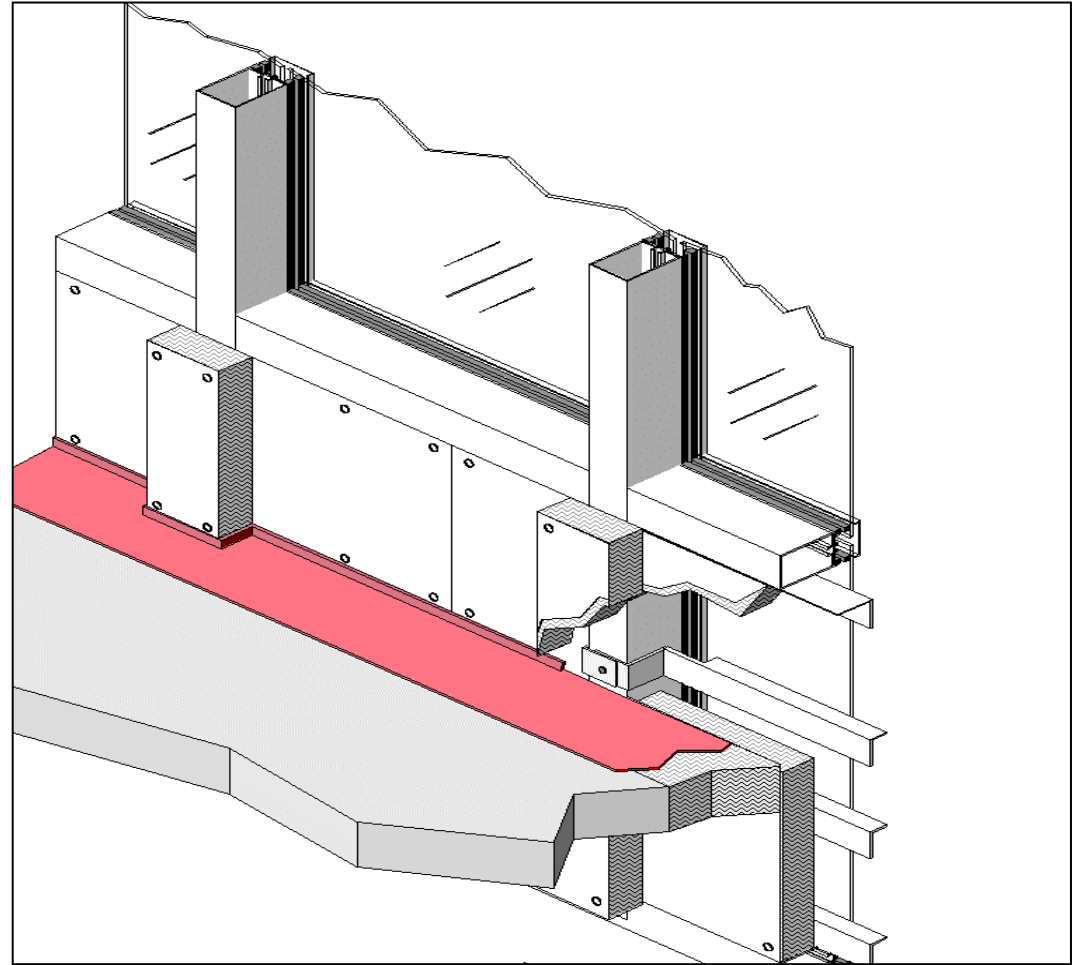
F (Fire) Rating by ASTM E2874

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



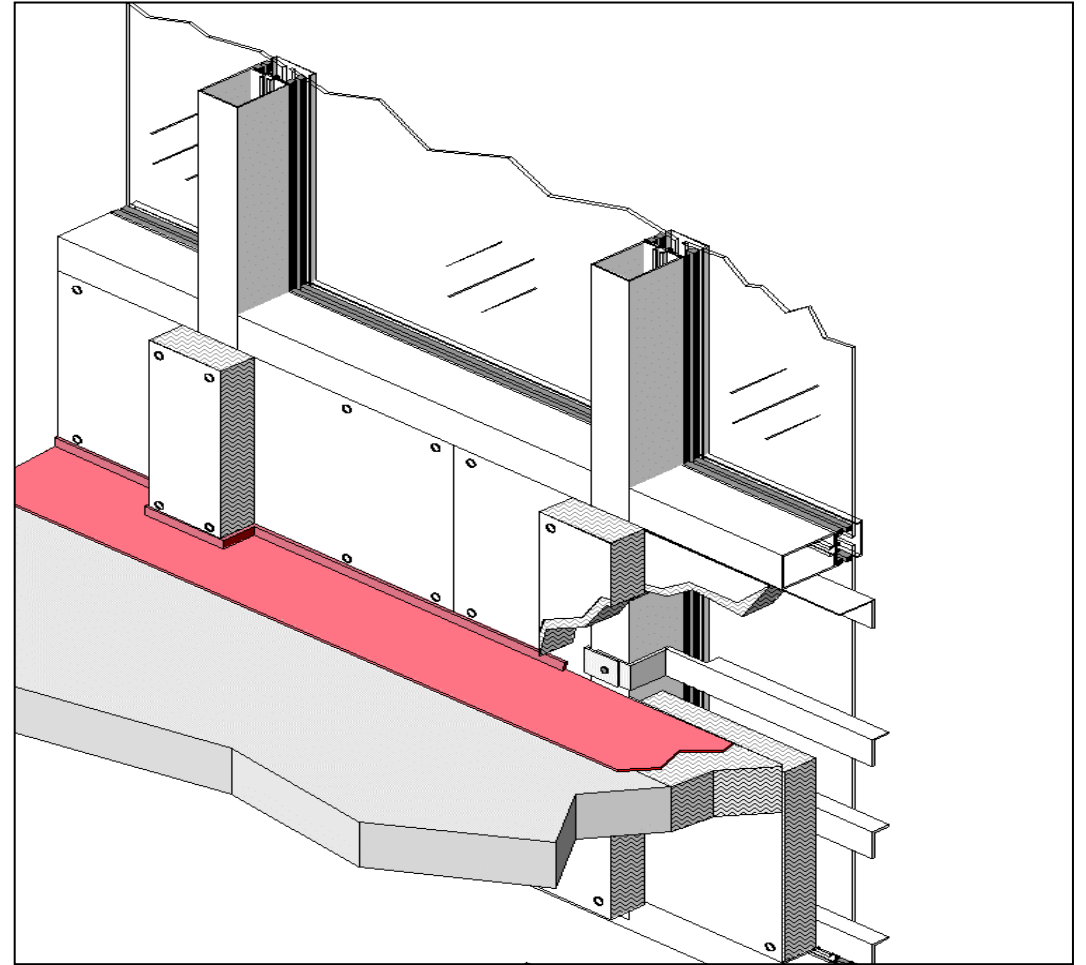
I (Integrity) Rating by ASTM E2874

- 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



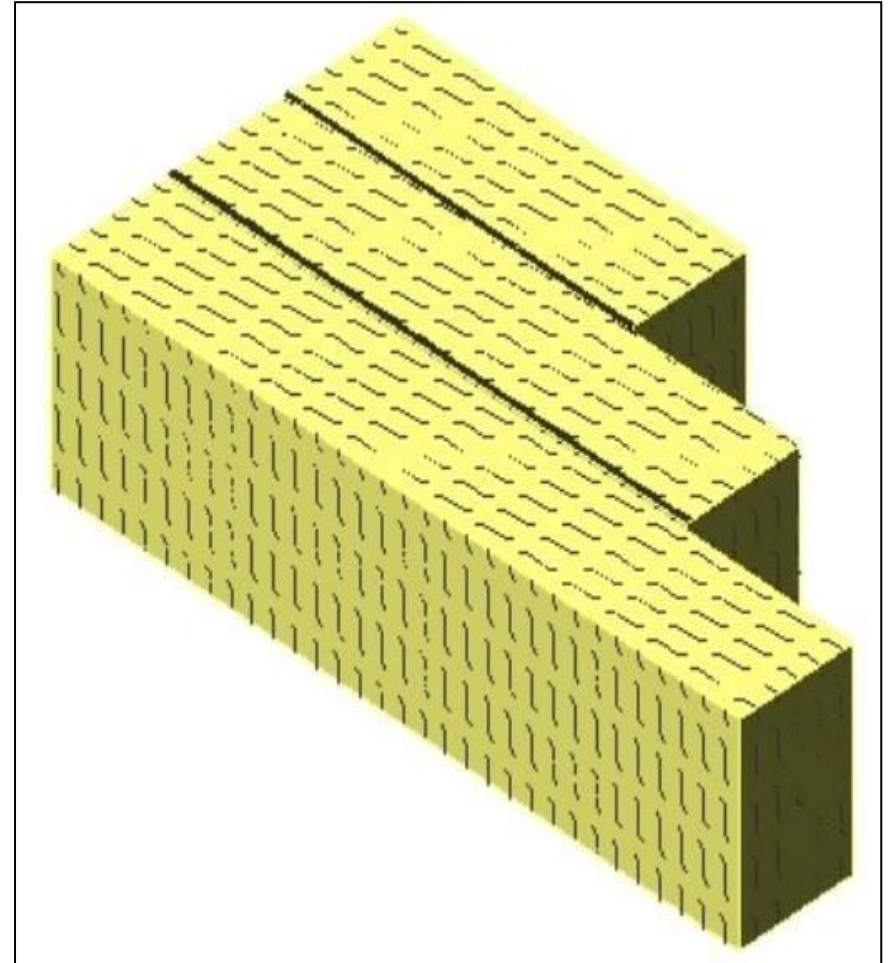
T (Temperature) Rating by ASTM E2874

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



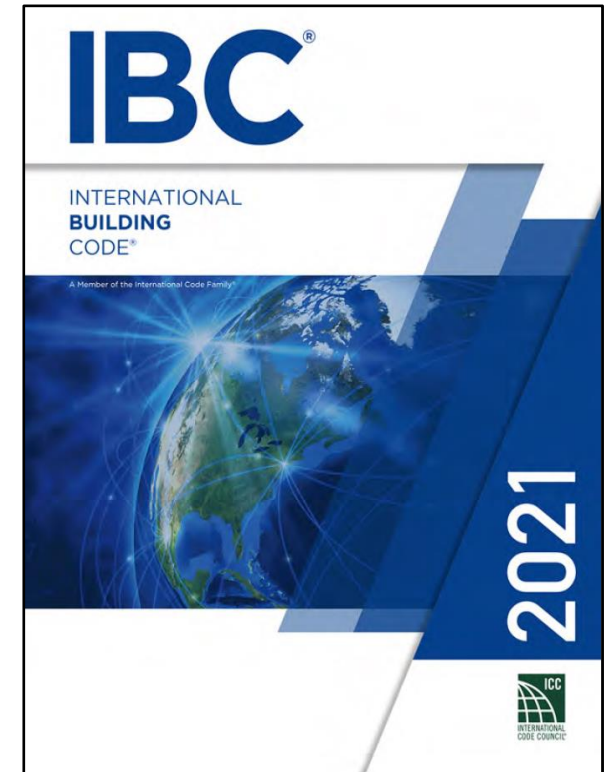
Exterior Curtain Wall / Nonfire-resistance-rated Floor Void

Protecting Void at Intersection of
an Exterior Curtain Wall / Nonfire-
resistance-rated Floor Assembly



Exterior Curtain Wall / Nonfire-resistance-rated Floor Void Cont.

- Voids created at the intersection of exterior curtain wall assemblies and nonfire-resistance-rated floor or floor/ceiling assemblies shall be filled with an *approved* material or system to retard the interior spread of fire and hot gases between *stories*.

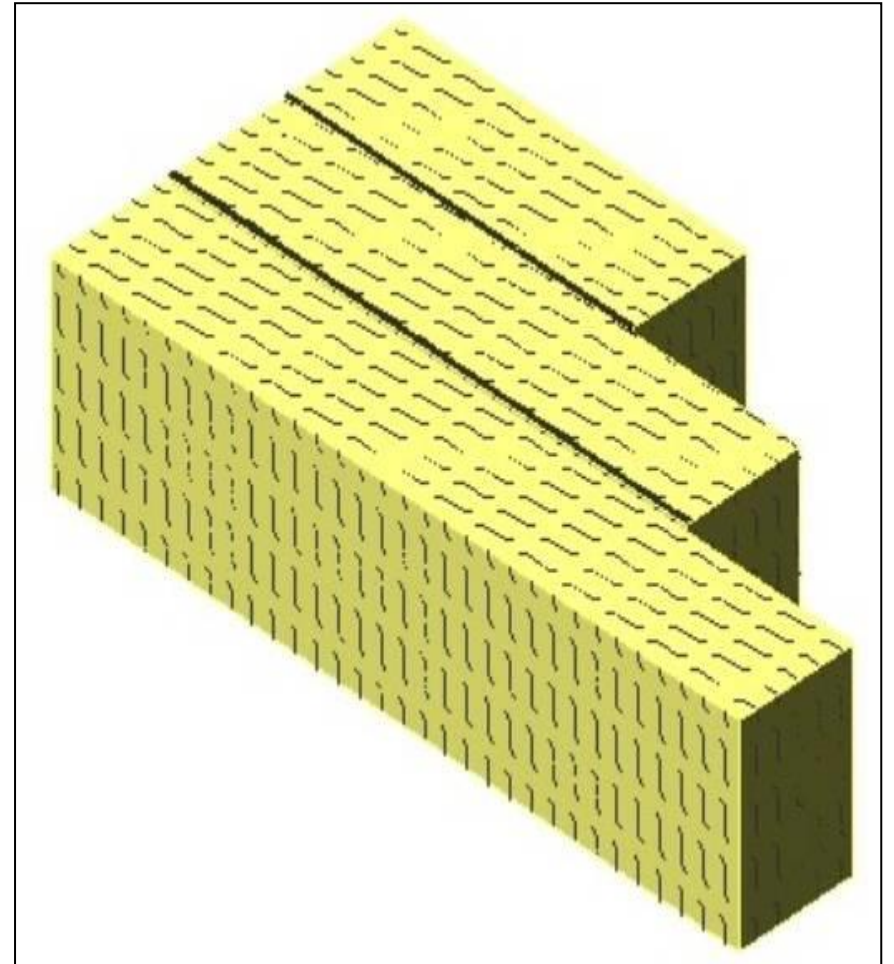


Exterior Curtain Wall / Nonfire-resistance-rated Floor Void Cont.

- Code does not reference required material, test standard, etc. Code does require material to be installed in accordance with the manufacturer's installation instructions so as to remain in place and not impair movement.
- Code official must approve material or system.
- Most frequently protected with mineral wool.

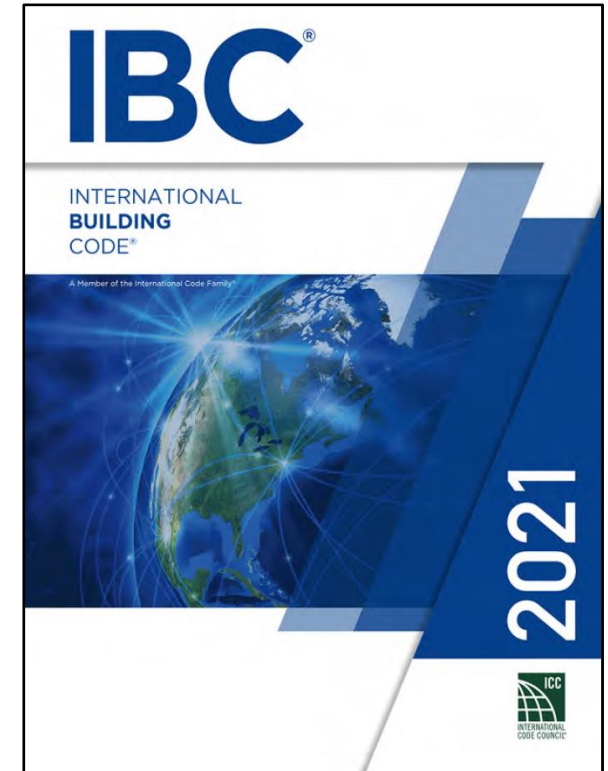
Exterior Curtain Wall / Vertical Fire Barrier Void

Protecting Void at Intersection of
an Exterior Curtain Wall / Vertical
Fire Barrier



Exterior Curtain Wall / Vertical Fire Barrier Void Cont.

- Voids created at the intersection of exterior curtain wall assemblies and vertical fire barrier shall be filled with an *approved* material or system to retard the interior spread of fire and hot gases.




Exterior Curtain Wall / Vertical Fire Barrier Void Cont.

- Code does not reference required material, test standard, etc. Code does require material to be installed in accordance with the manufacturer's installation instructions so as to remain in place and not impair movement.
- Code official must approve material or system.
- Most frequently protected with mineral wool in conjunction with some sort of decorative cover.

Continuity Head-of-Wall Systems

Protecting Void at Intersection of a Fire Barrier and a Nonfire-resistance-rated Roof Assembly



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

The standard is based under the fixed designation E2837, the number immediately following the designation indicate 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 plus sign (+) 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-loadbearing walls and roof, (3) Inadequate design, inaccurate assembly, joints of 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-resistive joint systems using the same test apparatus or method of test. For example, Test Method E2837 employs the ISMA test apparatus. A continuity head-of-wall joint system is a particular type of fire-resistive 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 first test response test method measures the performance of a unique fire-resistive 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 first 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-resistive test methods.

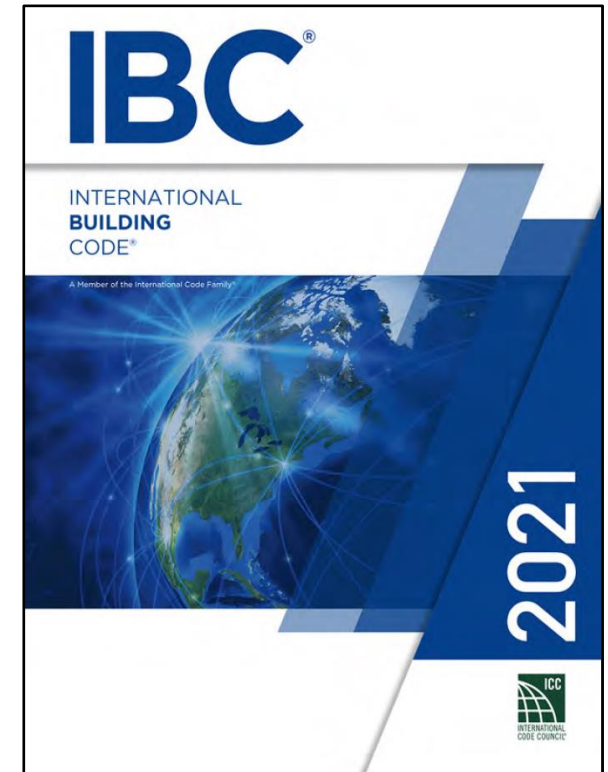
1.3 This first test response standard is not intended to evaluate the connections between rated wall assemblies and nonrated horizontal assemblies unless part of the continuity head-of-wall joint system.

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 Retardancy.

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

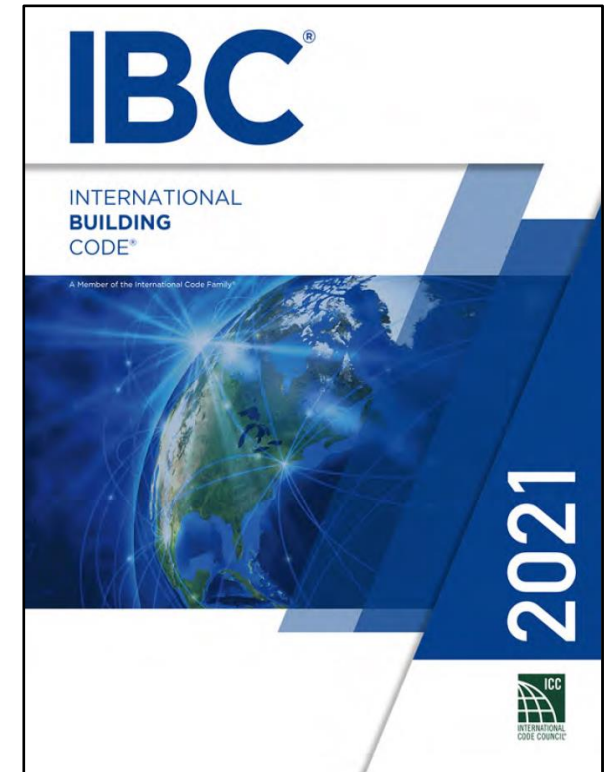
Code Requirements

- **Voids at intersections.** The voids created at the intersection of a *fire barrier* and a nonfire-resistance-rated *roof assembly* ... shall be filled. An *approved* material or system shall be used to fill the void, and shall be securely installed in or on the intersection for its entire length so as not to dislodge, loosen or otherwise impair its ability to accommodate expected building movements and to retard the passage of fire and hot gases.



Code Requirements Cont.

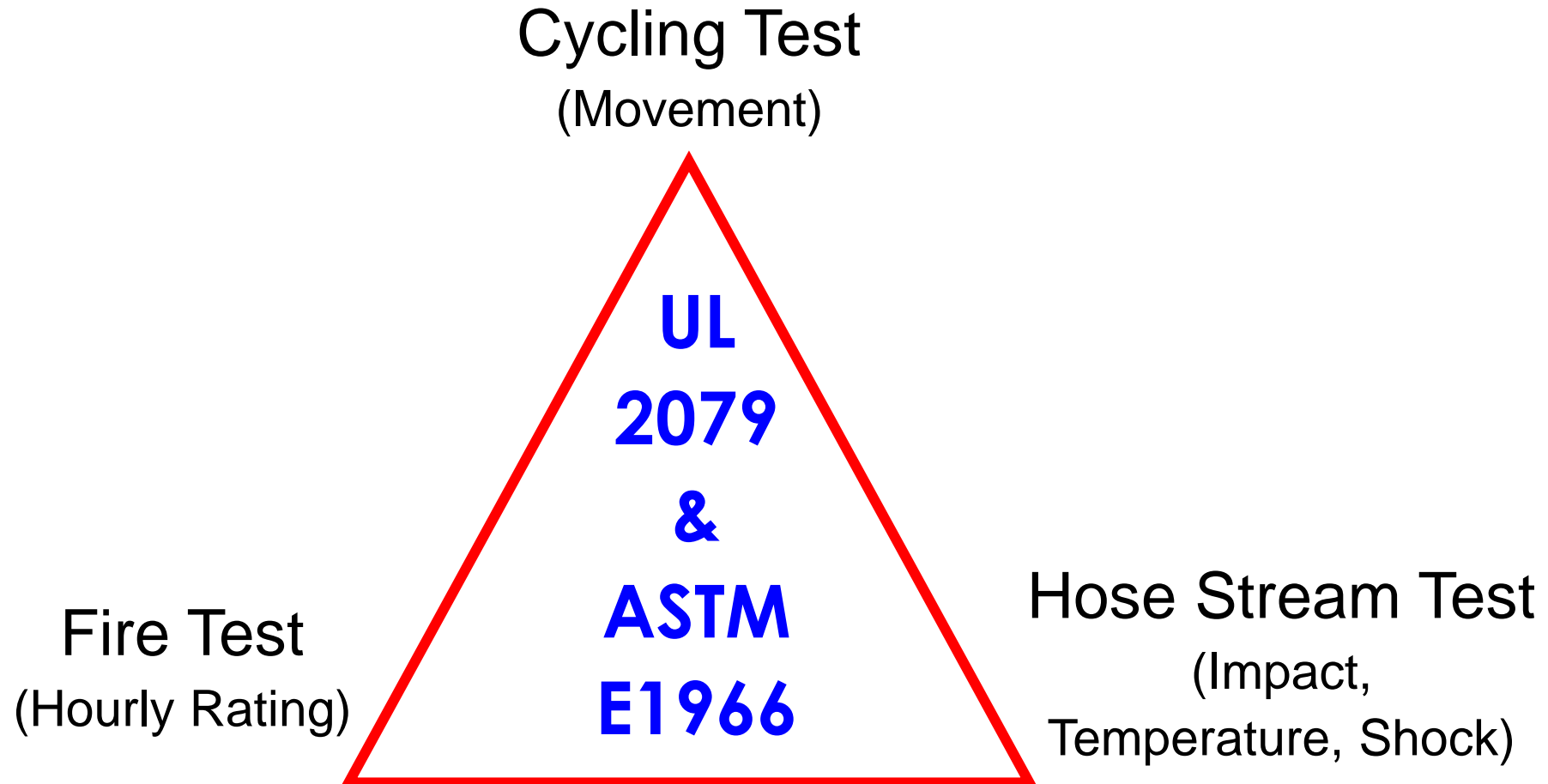
- Currently the code requires these voids to be filled with an approved material.
- Proposal to be heard in three weeks at ICC Committee Hearing to add option of protecting this void with a Continuity Head-of-Wall System tested to ASTM E2837.
- A second proposal will expand the code to require protect of void beneath nonfire-resistance-rated floor assemblies.



Continuity Head-of-Wall Systems

- E2837-17: 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

Test Standards / Components



Conditioning Prior to Fire Test

Movement Class	Min. No. of Cycles	Min. Cycling Rate (Cycles / Minutes)
Class I (Thermal)	500	1
Class II (Wind Sway)	500	10
Class III (Seismic)	100	30

General Layout and Conditioning

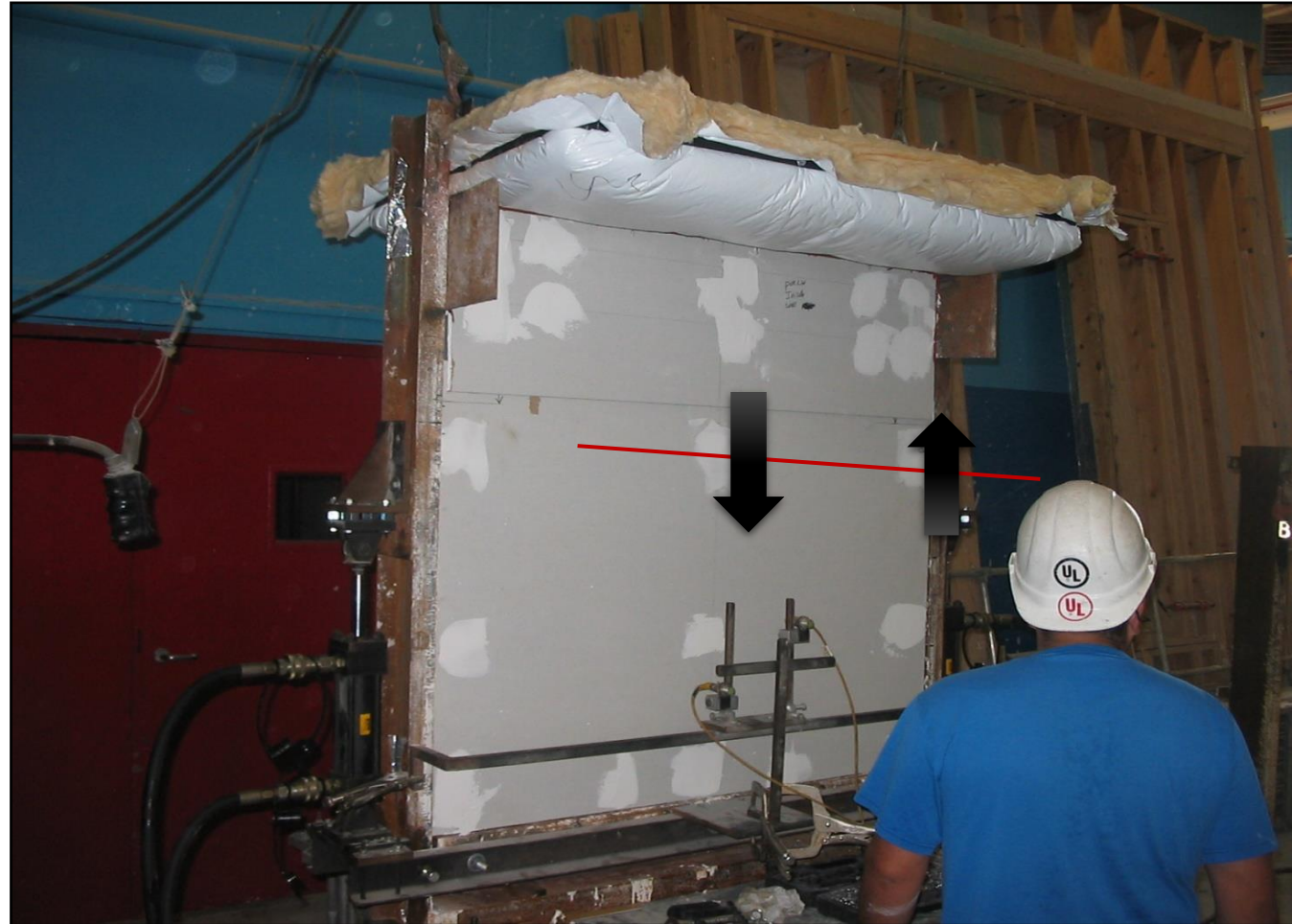


Photo courtesy of the Metal Building Manufacturers Association

Thermocouples on Assembly

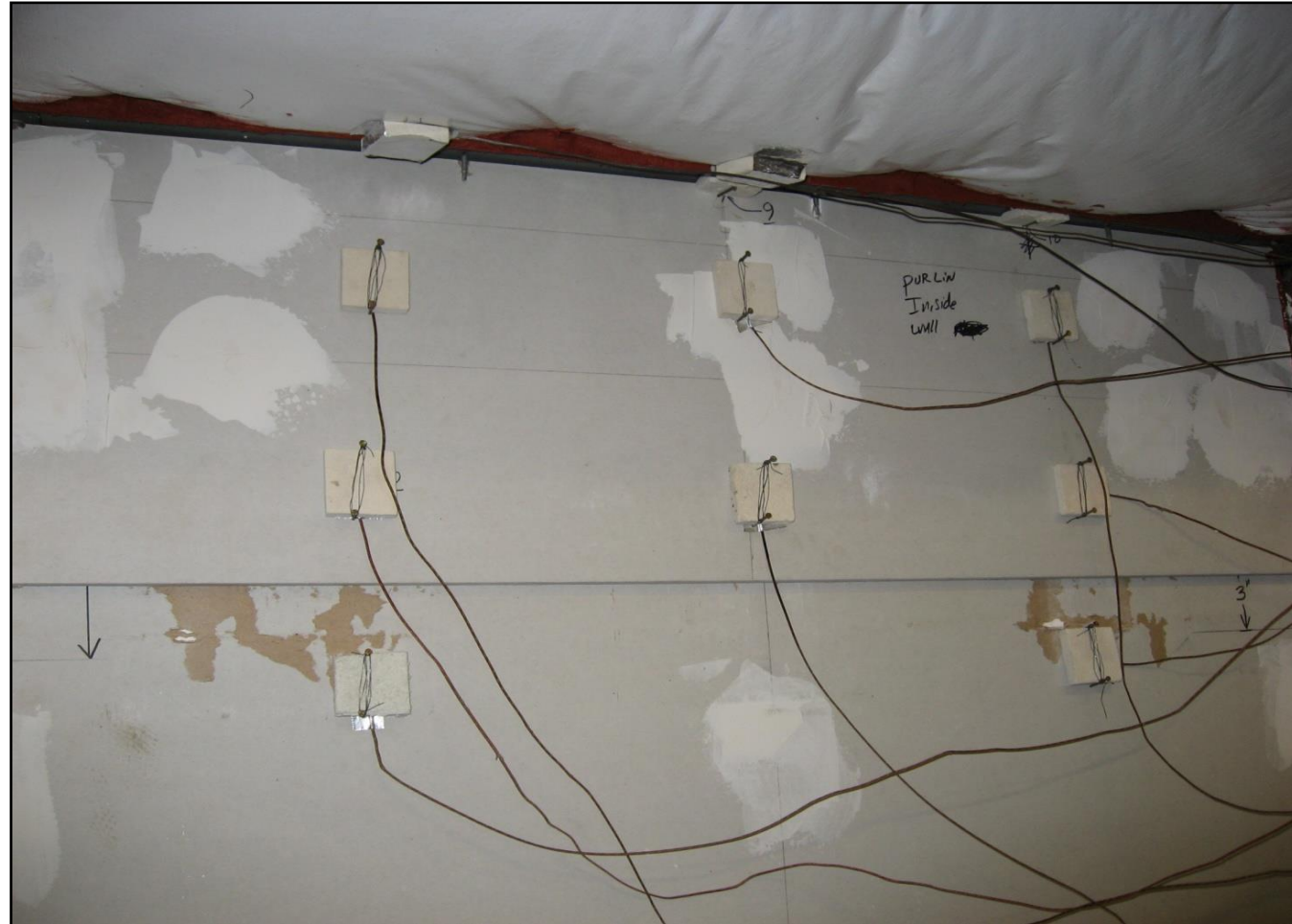
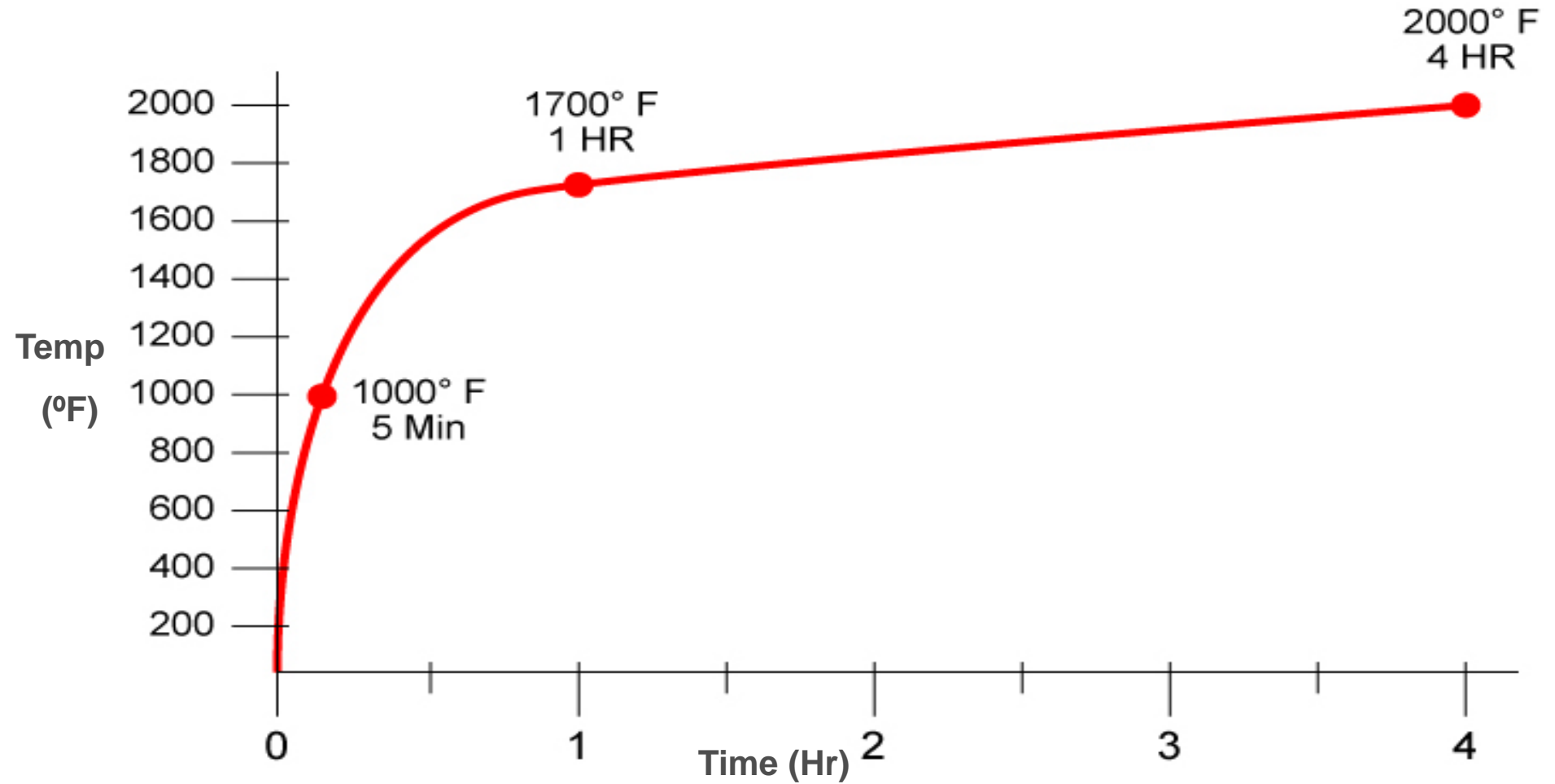


Photo courtesy of the Metal Building Manufacturers Association

Time-Temperature Curve



Hose Stream Test



Photo courtesy of the Metal Building Manufacturers Association

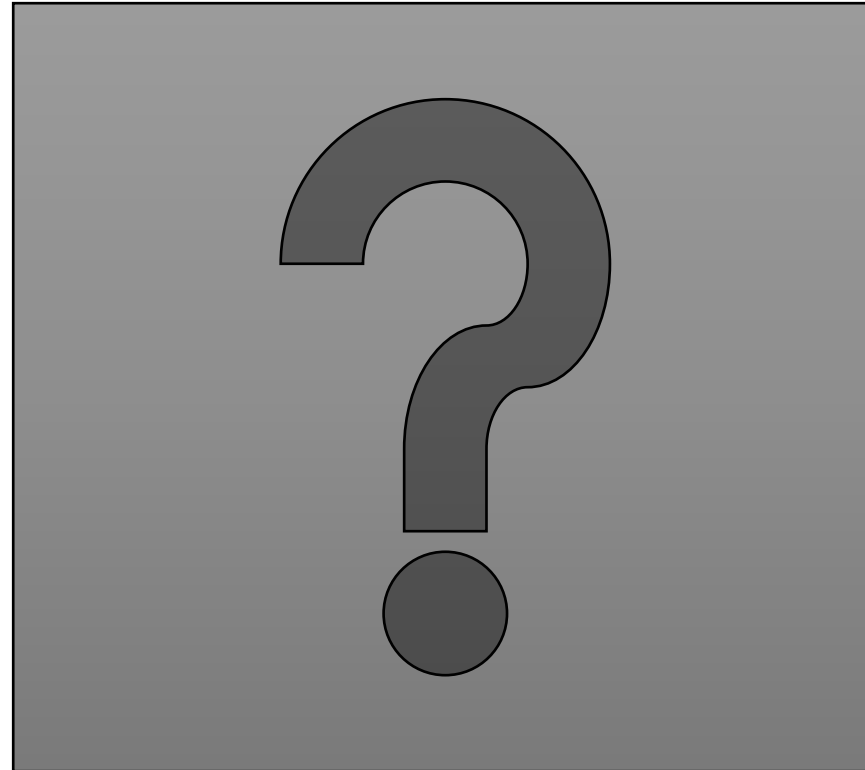
Continuity Head-of-Wall Systems Cont.

- F Rating
 - Passage of Flame
 - Hose Stream
- T Rating
 - Passage of Flame
 - Temperature Rise on the Unexposed Surface of System
 - Hose Stream

Continuity Head-of-Wall 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

Questions??



Thanks for Attending!!!

Rich Walke, Consultant to the FCIA
Firestop Contractors International Association
4415 W. Harrison St., #540
Hillside, IL 60162
(708) 202 - 1108