Decoding the Test Standards Used by the Air Barrier Industry

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We Appreciate this Opportunity!

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Introduction

Dave Stammen - Principal Engineer (Building Envelope)

- 25 years of Fenestration/Building Envelope Industry experience
- Background in Extrusion, Product Design and Management, as well as manufacturing and code compliance
- BS Mechanical Engineering, MBA (Wright State University)

Dwayne Sloan – Manager of Principal Engineers (Building Materials & Suppression)

- 29 years @ UL… Mostly within Fire Protection & Building Materials
- 3rd Year Member of ABAA
- BS Mechanical Engineering (North Carolina State University)

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Introduction

Who is UL?

- Global independent safety science company
- Over 120 years in developing product standards and conducting evaluations of a wide range of building components, materials and systems
- Focus is promoting safe living and working environments

Our Mission…"Working for a Safer World"

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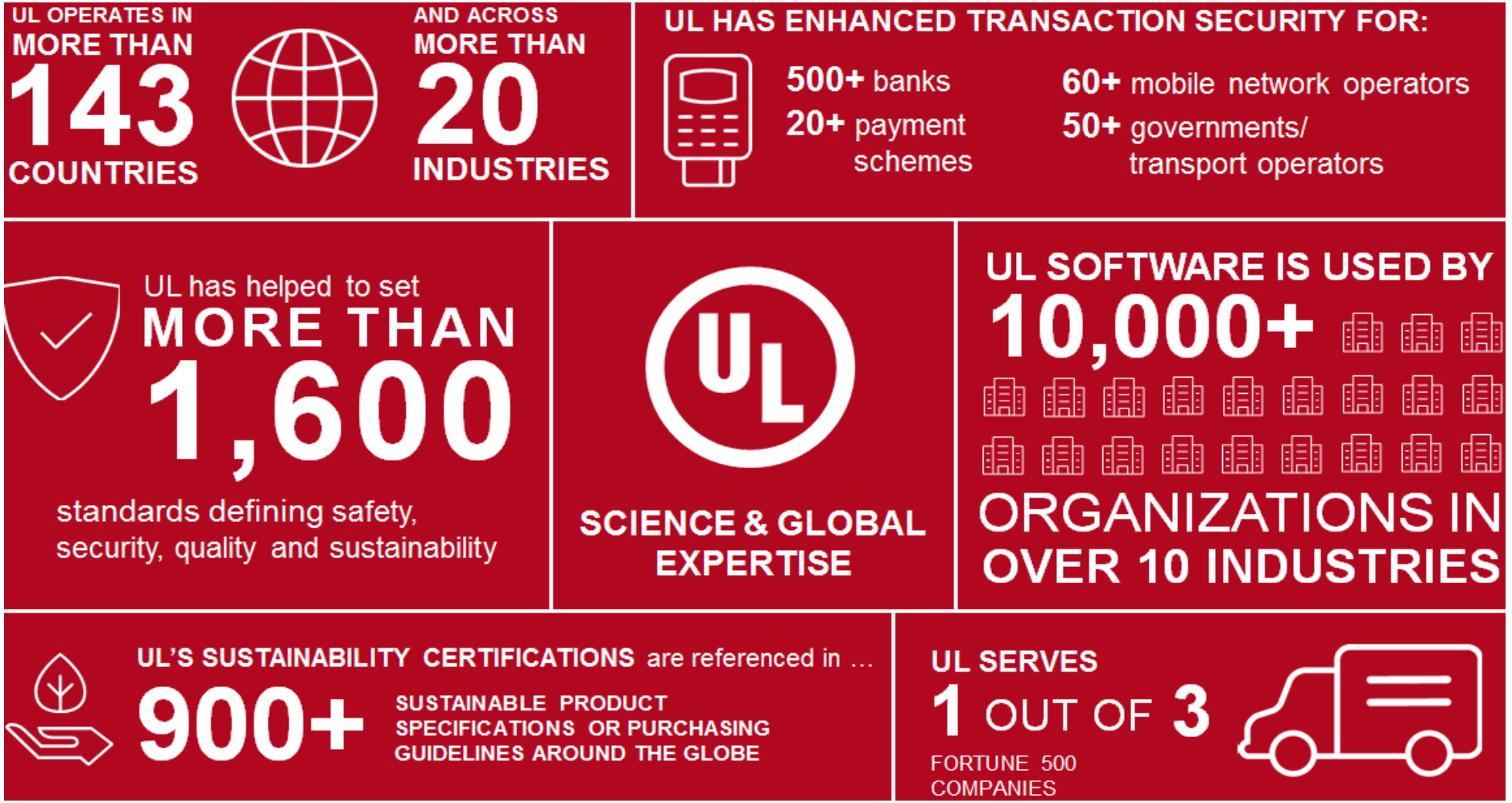
Introduction



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Learning Objectives

Upon completion of this presentation, we hope that each person takes away further knowledge of the following:

- Identify at least 3 different building envelope standards as specified within the I-Codes
- Better understand these standards, and how they relate to the various exterior building envelope products
- Gain a better understanding of the differences between standards that are material tests compared to those that test assemblies
- Gain knowledge about fire tests such as NFPA 285 and UL723 (ASTM E84)

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Agenda

- U.S. Codes Specific to Building Envelope
- Review of Weather Barrier and Air Barrier Performance Standards
- Review of Fire Testing Performance Standards
- Third Party Certification
- Question & Answer

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Agenda

- **U.S. Codes Specific to Building Envelope**
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Various Codes Referencing Air Barriers

- International Code Council (ICC)
- American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
    - 90.1… Section 5.4.3
    - 189.1… Section 7.4.2
- International Green Construction Code (IgCC) - Section 605

Our focus today will be on the ICC!

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U.S. and the International Codes

15 Model Codes (IBC, IRC, IECC, Plumbing, Energy, Green, Existing, more)

- Complete set for building safety and fire prevention
- Benefits public safety and supports the industry's need for one set of codes without regional limitations

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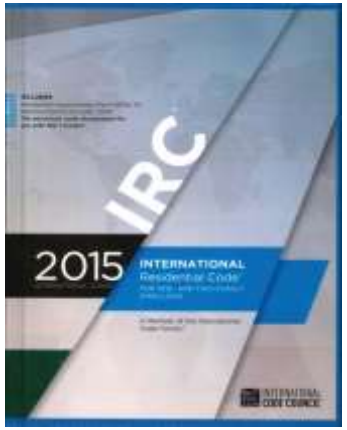
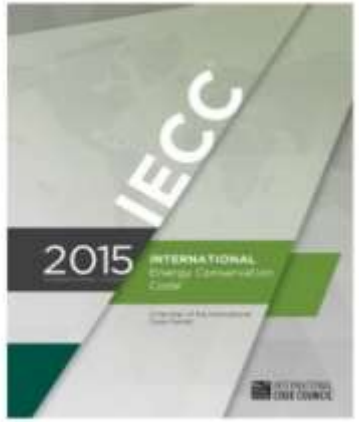
ICC – Model Codes

Model Codes define performance for exterior building envelope performance

- IBC (and IRC) establishes **weather protection performance** (weather barriers)
- IECC establishes **thermal performance** (air barriers)





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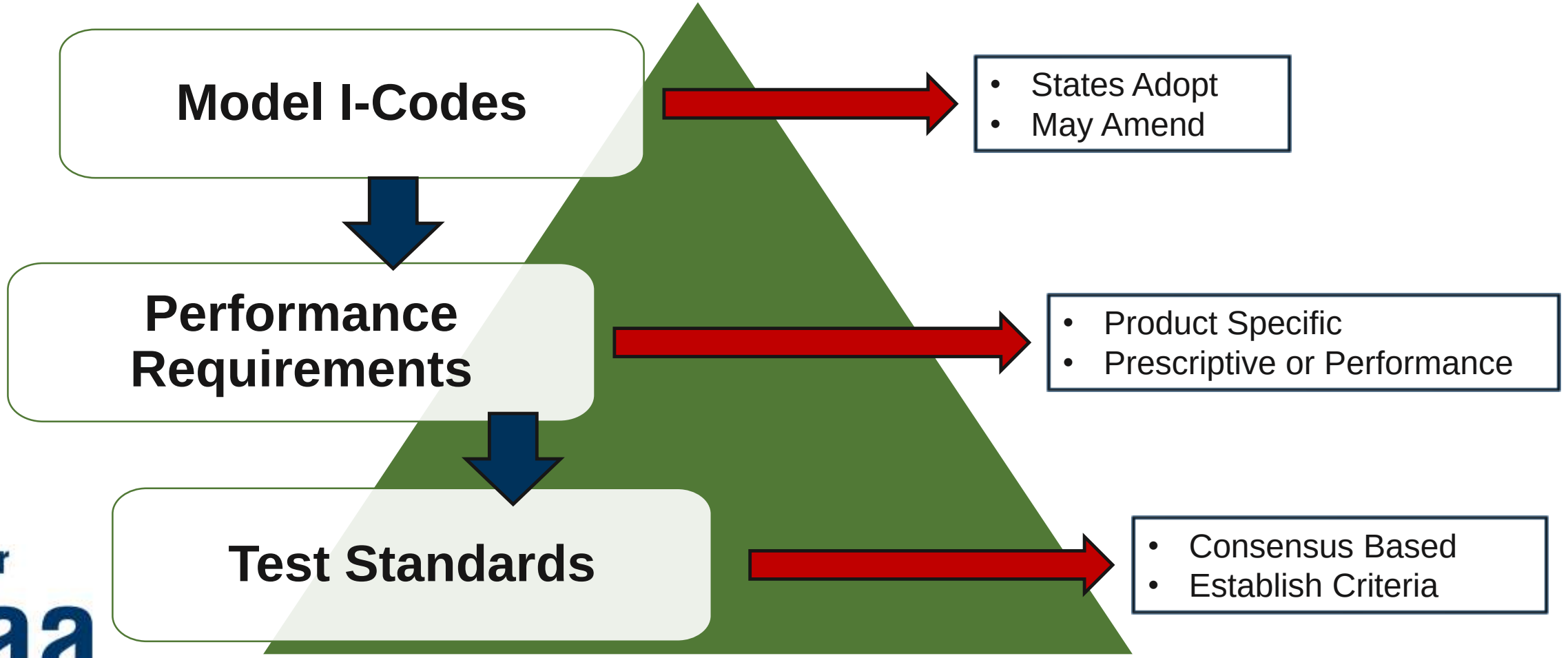
U.S. and the International Codes



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Test Standards Writing Organizations

ANSI

ASHRAE

American Architectural Manufacturers Association

ASME
SETTING THE STANDARD

U.S. GREEN BUILDING COUNCIL

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ASTM INTERNATIONAL
Standards Worldwide

INTERNATIONAL CODE COUNCIL
ICC ES
ICC EVALUATION SERVICE

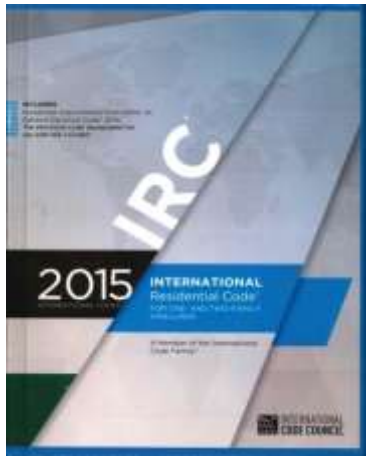
NFPA®

Weather Resistive Construction

First – let's review weather protection performance within IBC & IRC!

Requirements for Building Envelope Weather Protection

Identical reqmt's!



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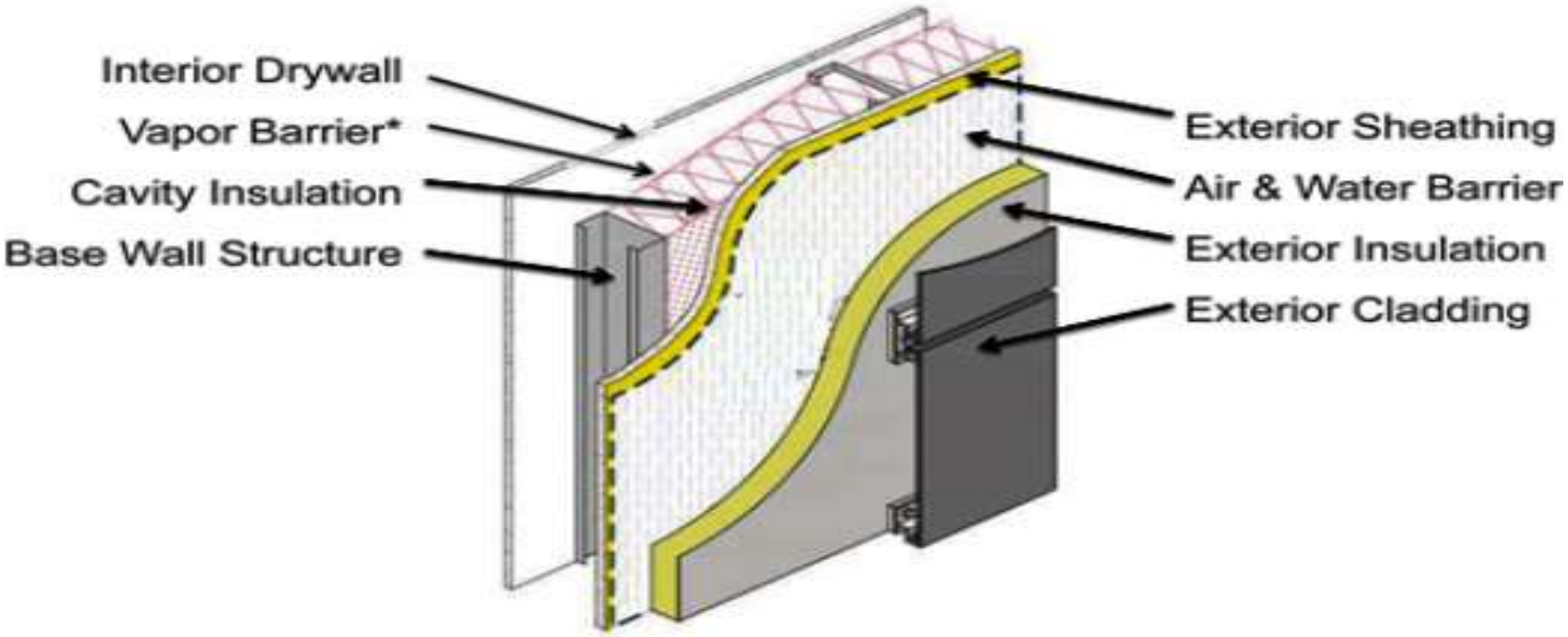
IBC & IRC Definitions

Exterior Wall Envelope. system or assembly of *exterior wall* components that provides protection of building structural members from the detrimental effects of the exterior environment



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IBC & IRC Definitions

***Exterior Wall Covering*.** material or assembly of materials on the exterior side of *exterior walls* for providing a weather-resisting barrier

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IBC & IRC Definitions

***Water-Resistive Barrier*.** material behind an *exterior wall covering* intended to resist liquid water that has penetrated behind the exterior covering from further intruding into the *exterior wall* assembly.

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Building Envelope Weather Protection

The IBC and IRC take a systematic approach to building envelope weather protection:

1. **Passive Protection**
   - Design and Engineering
   - Plan Review

2. **Active Protection**
   - Lab Testing
   - Mock-up Testing
   - Field Testing

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Passive Protection

(IBC & IRC: Code Sections 1403.2 and R703.1)

Exterior walls shall provide the building with a weather-resistant *exterior wall envelope*.

- *Envelope* shall include flashing
- Be designed and constructed to prevent accumulation of water within the wall assembly by providing a *water resistive barrier* behind the exterior veneer

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Passive Protection

(IBC & IRC: Code Sections 1403.2 and R703.1)

2 Exceptions for requiring weather-resistant exterior wall envelope:

1. *Exterior wall envelope* not required over concrete or masonry walls

2. *Exterior wall envelope* tested in accordance with ASTM E331 under **4 conditions**

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Building Envelope Weather Protection

2 Exceptions for requiring weather-resistant exterior wall envelope:

1. *Exterior wall envelope* not required over concrete or masonry walls

2. *Exterior wall envelope* tested in accordance with ASTM E331 under **4 conditions**

Active Protection within IBC & IRC!

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Testing to ASTM E331

So what is ASTM E331?

Designation: E 331 – 00 (Reapproved 2009)

Standard Test Method for
Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference[1]

- Laboratory test procedure for determining the resistance to water penetration under uniform static air pressure differences

- Conducted for a specified duration with water applied at 5.0 gal/ft^2.hr at a specified pressure

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Testing to ASTM E331 – **4 Conditions**

✓***Condition 1:***

- Test specimen to have minimum 1 opening, control joint, wall/eave & wall/sill interface
- Openings/penetrations must represent intended end use

✓ ***Condition 2:***

- Test size = minimum 4’ x 8’

✓ ***Condition 3:***

- Minimum pressure differential of 6.24 psf (Typical test is 2.86 psf)

✓ ***Condition 4:***

- Minimum test exposure = 2 hours (Typical test is 15 minutes)

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Testing to ASTM E331

Pass/Fail Criteria

Results of testing indicate that water did not penetrate through the following:

- ✓ Control joints in the *exterior wall* envelope
- ✓ Joints at the perimeter of openings
- ✓ or intersections of terminations with dissimilar materials

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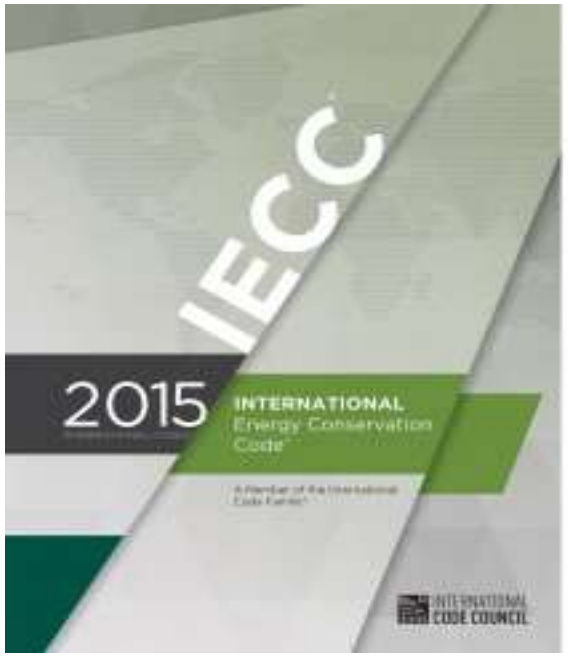
International Energy Conservation Code

Now that we've reviewed weather protection for the Building Envelope, we'll now review the IECC <u>specific to Air Barrier requirements</u>…

Model Code - Requirements for Building **<u>Thermal</u>** Envelope Protection…



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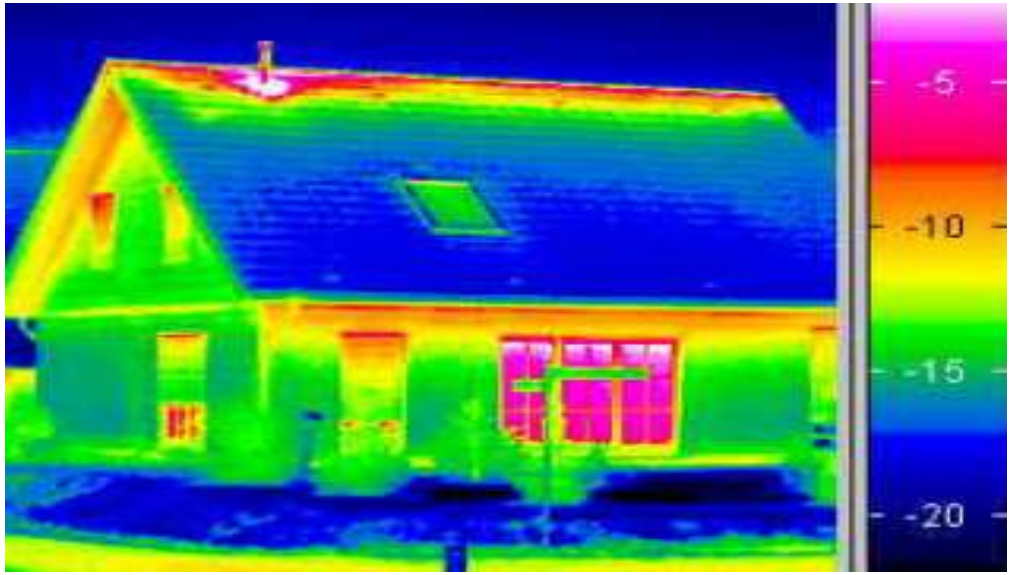
IECC Definitions

***Building Thermal Envelope*.** building elements that enclose conditioned *space* or provide a boundary between *conditioned space* and unconditioned space.



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IECC Definitions

***Air Barrier*.** Material(s) assembled and joined together to provide a barrier to air leakage through the building envelope…may be a single material or combination of materials.

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IECC Definitions

Infiltration. uncontrolled inward air leakage into a building caused by the pressure effects of wind or the effect of differences in the indoor and outdoor air density or both.

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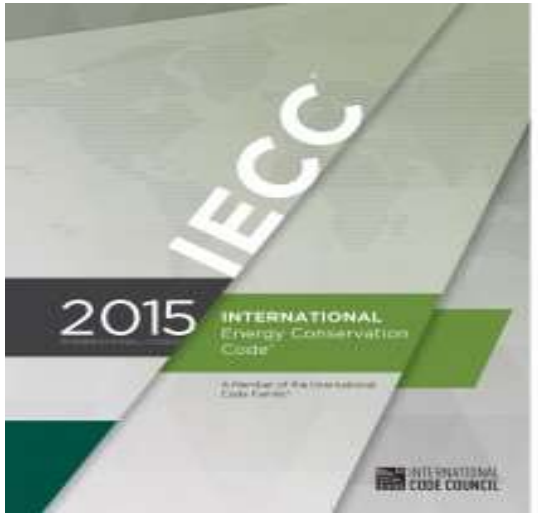
Thermal Protection – Energy Conservation

Now – let's review thermal protection performance within IECC!

IECC has 2 main sections/provisions

Commercial & Residential



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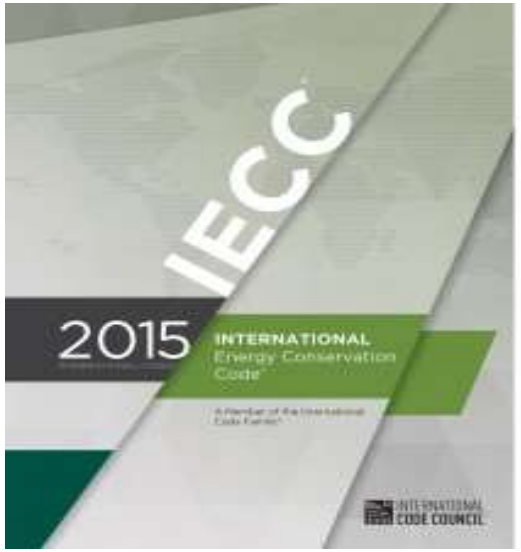
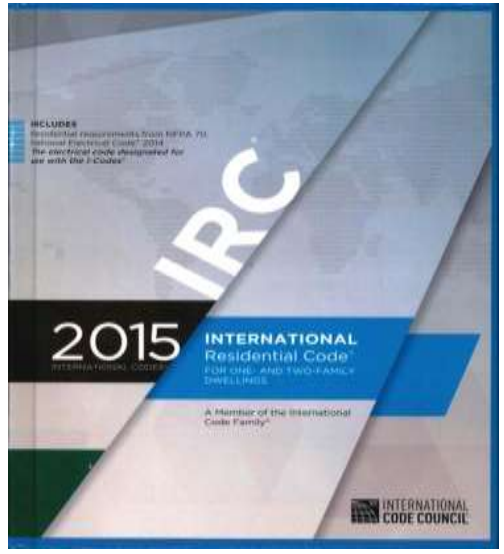
IECC - Residential Provisions

Let's look first at Residential Provisions (Section R402.4)

Residential Provisions of IECC are consistent with the IRC





(Chapter 11)

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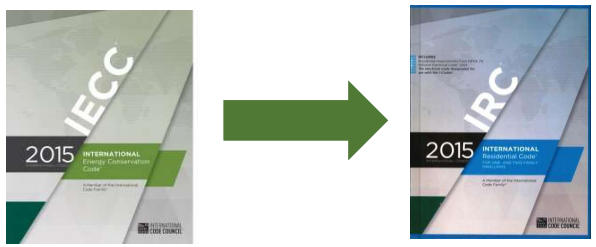
IECC - Residential Provisions

Building thermal envelope <u>shall be</u>:

1. Sealed between dissimilar materials
2. Installed per mfg's instructions
3. Blower door tested



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IECC – Commercial Provisions

Now let's look at the Commercial Provisions of IECC (Section C402)

Prescriptive Building Thermal Envelope Requirements:

- ✓ Insulation – walls, floors and roof
- ✓ Fenestration – maximum area
- ✓ **Air leakage – thermal envelope/air barriers**
- ✓ Air leakage of fenestration

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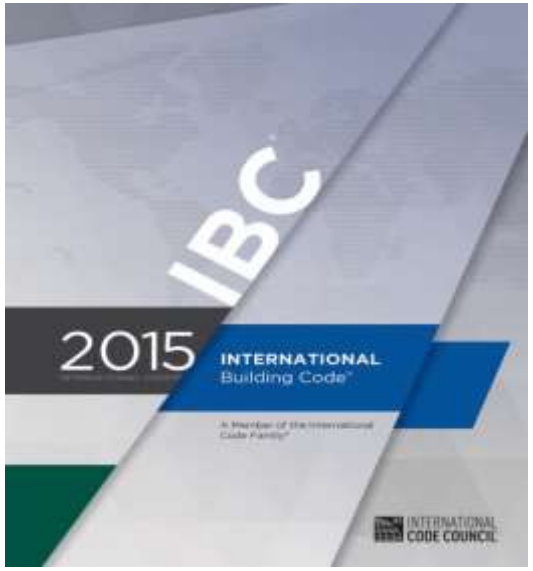
IECC - Commercial Provisions

IBC directly refers use of the Commercial Provisions within the IECC!



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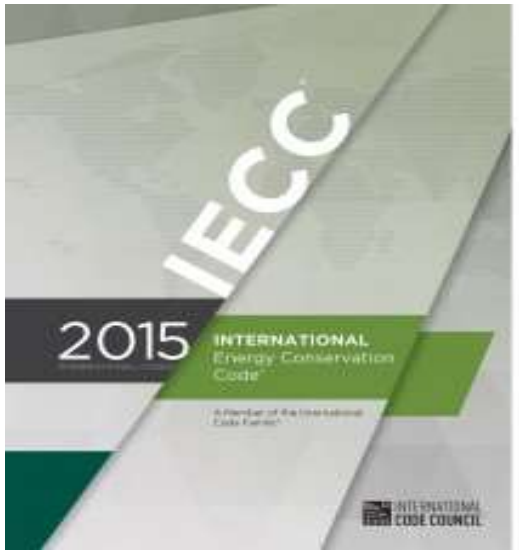
Direct Comparison



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IECC – Commercial Provisions

So within the Commercial Section of IECC…

Section C402.4 – Mandatory Air Leakage

"The thermal envelope of buildings shall comply with Section C402.4.1 through C402.4.9"

So let's review these sections!

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IECC – Commercial Provisions

Section C402.4.1: Continuous air barriers are required, **except** in Climate Zones 1-3

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IECC – Section C402.4

- Air Barriers can be located: inside, outside, within envelope assemblies, or any combination

- Shall comply with 2 Sections: C402.4.1.1 (construction) and C402.4.1.2 (compliance options)

Let’s go into detail of construction and compliance options…

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IECC – Section C402.4.1.1 (Construction)

- Must be continuous and across all joints and assemblies, which must be sealed
- Recessed lighting comply with C402.4.8
- Other penetrations through air barrier shall have provisions to maintain integrity

Exception: if Building Air Leakage test is conducted and complies with Section C402.4.1.2.3…then top 3 reqmt's don't need to be met!

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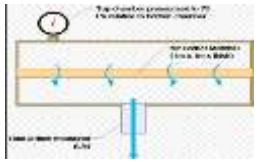
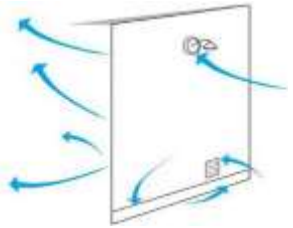
IECC – Section C402.4.1.2 (Compliance Options)

3 ways to comply with air barrier reqmt's…all at 75 Pa (per IECC)!



Material ≤ **.004** cfm/ft^2 } ASTM E2178

OR



Assembly ≤ **.04** cfm/ft^2 } ASTM E2357 or E1677 or E283

→ **Lab Test!**

OR

Building ≤ **.4** cfm/ft^2 } ASTM E779

→ **Field Test!**

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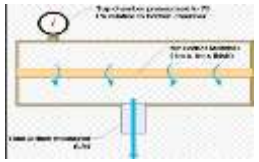
IECC – Section C402.4.1.2 (Compliance Options)

Rule of 4's!



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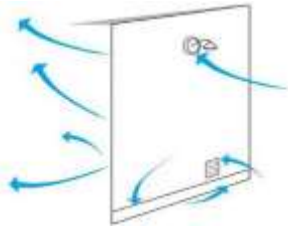

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→ Field Test!

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IECC – Section C402.4.1.2 (Compliance Options)

Let's look at Material Testing First!

✓ **Material** Test = **ASTM E2178**

or

✓ Assembly Test = ASTM E2357, E1677, or E283

or

✓ Building Test = ASTM E779

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Section C402.4.1.2.1 (Material Test)

ASTM E2178: **"Standard Test Method for Air Permeance of Building Materials"**

- At least 5 test samples with sample size = 1m x 1m x thickness
- Varying pressures on 1 side, then measure air flow through specimen…
- ASTM is considering "Air Leakage" vs. "Air Permeance"

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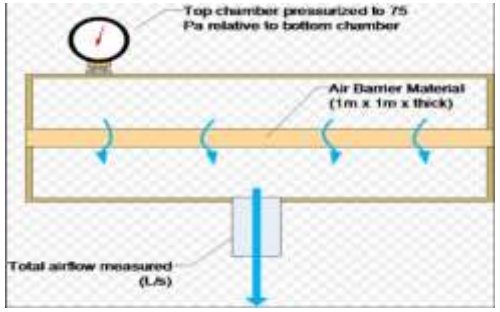
Per IECC Pass = Air Leakage ≤ .004 cfm/ft^2 @ 75 Pa



Section C402.4.1.2.1 (Material Test)

Materials that meet this Requirement*:

Material	Thickness (minimum)
Plywood	3/8 in.
Oriented strand board	3/8 in.
Extruded polystyrene insulation board	½ in.
Foil-faced urethane insulation board	½ in.
Closed cell spray foam minimum density of 1.5 pcf	1-1/2 in.
Open cell spray foam density between 0.4 and 1.5 pcf	4.5 in.
Exterior gypsum sheathing or interior gypsum board	½ in.
Cement board	½ in.
Built up roofing membrane	
Modified bituminous roof membrane	
Fully adhered single-ply roof membrane	
A Portland cement/sand parge, stucco, or gypsum plaster	5/8 in.
Cast-in-place and precast concrete	
Sheet metal or aluminum	

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* Provided joints are sealed and materials installed as air barriers per mfg instructions!

IECC – Section C402.4.1.2 (Compliance Options)

Now we'll review Assembly Testing!

- ✓ Material Test = ASTM E2178

or

- ✓ **Assembly Test = ASTM E2357, E1677, or E283**

or

- ✓ Building Test = ASTM E779

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Section C402.4.1.2.2 (Assembly Test)

3 test standards to comply…
all have same air leakage pass criteria ≤ .04 cfm/ft² @ 75 Pa

Assemblies that meet this Requirement*

- ✓ Concrete masonry walls coated with block filler and 2 coats of paint or sealer

or

- ✓ Portland cement / sand parge, stucco or plaster ≥ ½" thick

* Provided joints are sealed and Construction section reqmt's are met!

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Section C402.4.1.2.2 (Assembly Test)

Let's review each Lab Test for Assemblies!

ASTM E2357

Designation: E2357 – 11

Standard Test Method for
Determining Air Leakage of Air Barrier Assemblies[1]

ASTM E1677

Designation: E1677 – 11

Standard Specification for
Air Barrier (AB) Material or System for Low-Rise Framed
Building Walls[1]

ASTM E283

Designation: E283 – 04 (Reapproved 2012)

Standard Test Method for
Determining Rate of Air Leakage Through Exterior Windows,
Curtain Walls, and Doors Under Specified Pressure
Differences Across the Specimen[1]

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1st Assembly Test (ASTM E 2357)

ASTM E2357: "Standard Test Method for Determining Air Leakage of Air Barrier Assemblies"

- Lab Test that provides a method to evaluate the full air barrier system
- Shows that materials, components, and accessories all work together and stay sealed during building operation

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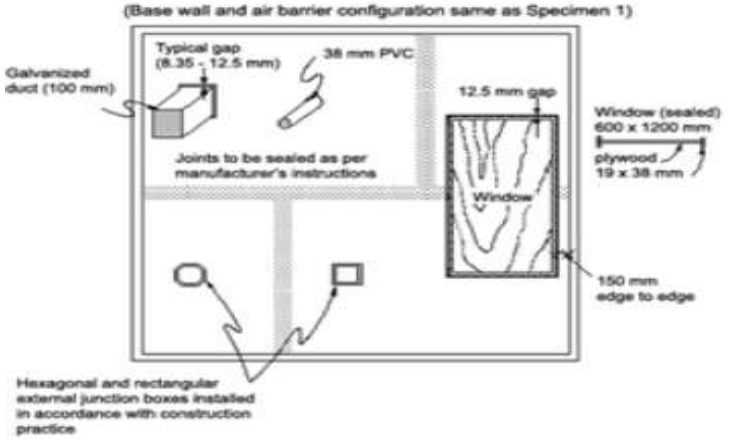
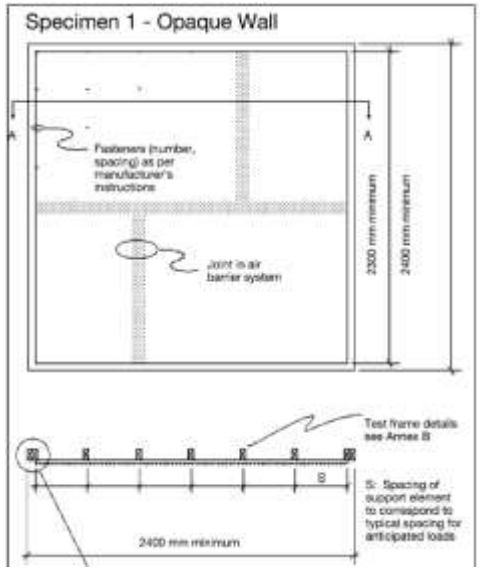
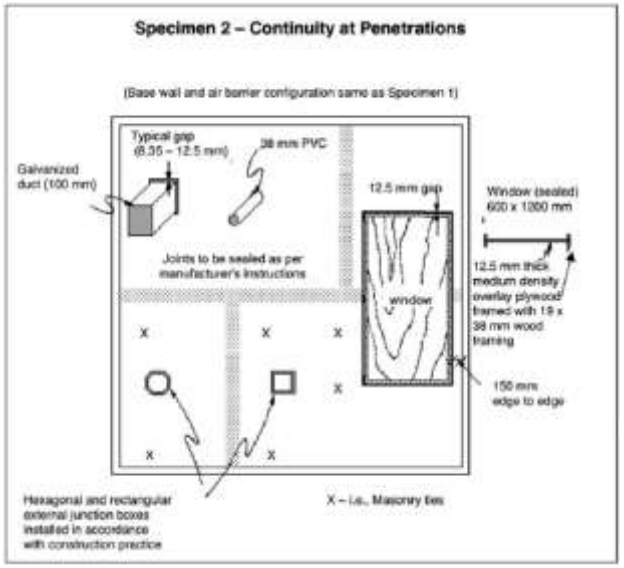
Per IECC Pass = Air Leakage ≤ .04 cfm/ft² @ 75 Pa

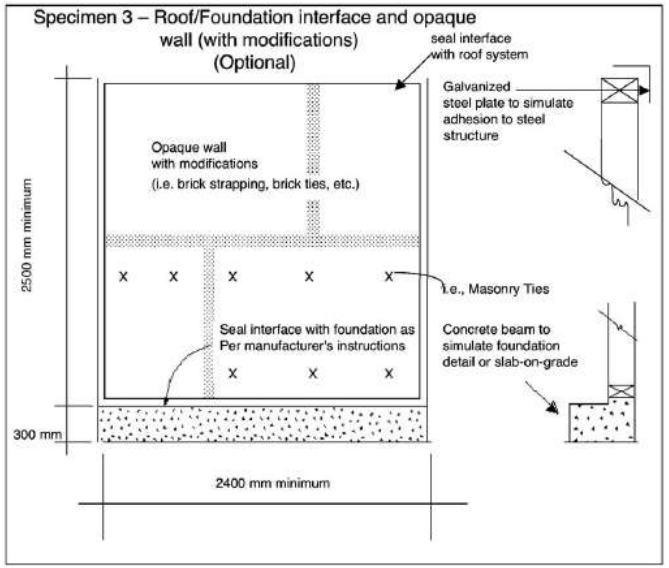


1st Assembly Test (ASTM E 2357)

- At least 2 test samples (8'x8')…1 opaque wall, 2nd with penetrations
- ASTM proposed change that 3rd specimen in std must be tested, or incorporated, into 2nd specimen!







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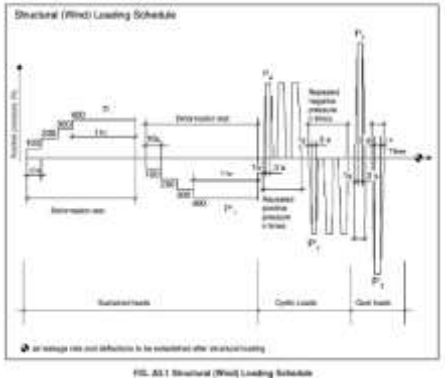
1st Assembly Test (ASTM E 2357)

1st Step = 7 different pressures conducted for air leakage

2nd Step = Structural load sequence (sustained, cycling, then gust loads)



3rd Step = Conduct 7 air leakage pressures again

Air leakage rating is taken after 3 steps at the 75 Pa point!

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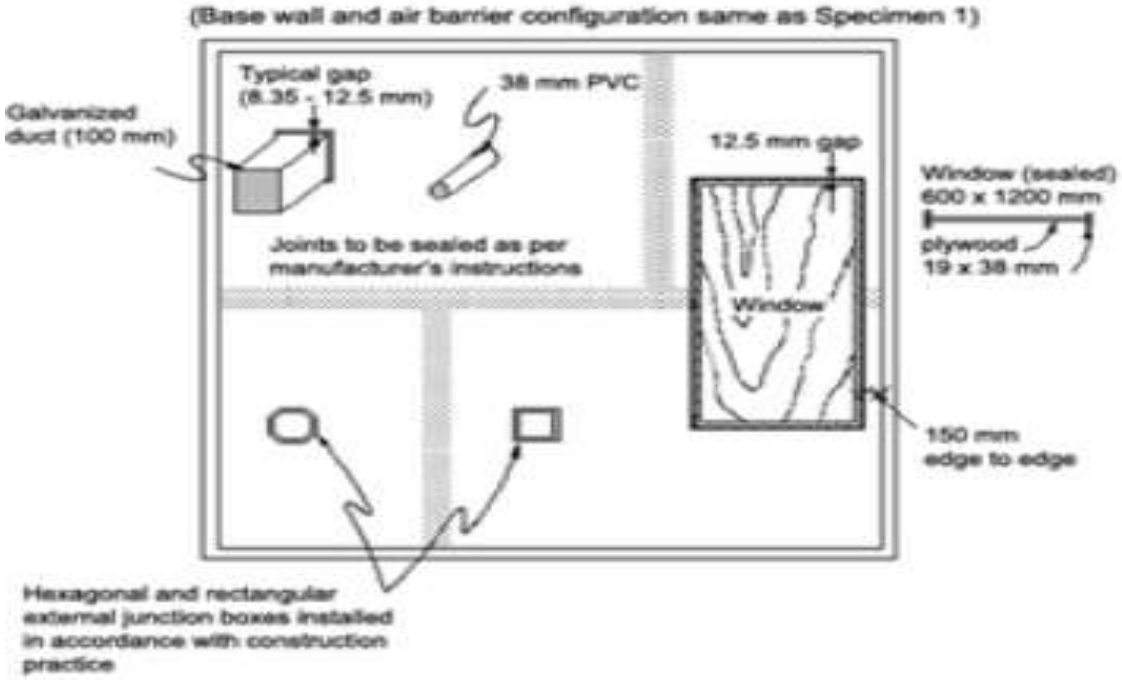
1st Assembly Test (ASTM E 2357)

- Water resistance is not part of this testing
- For Listing on the ABAA website, you must submit an E2357 test report!



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Section C402.4.1.2.2 (Assembly Test)

2nd Alternate Lab Test for Assemblies…

ASTM E2357

Designation: E2357 – 11

Standard Test Method for
Determining Air Leakage of Air Barrier Assemblies[1]

ASTM E1677

Designation: E1677 – 11

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2nd Assembly Test (ASTM E1677)

ASTM E 1677: "Standard Specification for Air Barrier Material or System for Low-Rise Framed Building Walls"

Classifies 2 types of air barriers:

Type I = protects water absorptive building materials from water penetration (passes water test)

Type II = protects building materials that are unaffected by water penetration (no water test)

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Per IECC Pass = Air Leakage ≤ .04 cfm/ft² @ 75 Pa

2nd Assembly Test (ASTM E1677)

- 1 Opaque Test Sample (8’ x 8’)
- Usually sheathing over wood studs (16” o/c)
- If interior wallboard is part of AB, then must install 1 receptacle box w/ wiring holes thru studs
- Pressure testing must simulate use of lap siding or brick veneer exterior finish/cladding

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2nd Assembly Test (ASTM E1677)

Lab Tests Conducted:

- Air Leakage (ASTM E283 using 5 pressures)
- Structural Loading (ASTM E330 at 65 mph)
- Water Resistance (ASTM E331…only Type I)
- Water Vapor Permeance (ASTM E96/E96M)

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TABLE 1 AB Classifications

Performance Properties	Classifications	
	Type I	Type II
Air leakage	in accordance with 5.1.1	in accordance with 5.1.1
Structural integrity	in accordance with 5.1.2	in accordance with 5.1.2
Water resistance	in accordance with 5.1.3	not required
Water vapor permeance	in accordance with 5.1.4	in accordance with 5.1.4
Supplemental requirements	in accordance with Section 6	in accordance with Section 6

Section C402.4.1.2.2 (Assembly Test)

Last Alternate Lab Test for Assemblies…

ASTM E2357

Designation: E2357 – 11

Standard Test Method for
Determining Air Leakage of Air Barrier Assemblies[1]

ASTM E1677

Designation: E1677 – 11

Standard Specification for
Air Barrier (AB) Material or System for Low-Rise Framed
Building Walls[1]

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ASTM E283

Designation: E283 – 04 (Reapproved 2012)

Standard Test Method for
Determining Rate of Air Leakage Through Exterior Windows,
Curtain Walls, and Doors Under Specified Pressure
Differences Across the Specimen[1]

3rd Assembly Test (ASTM E283)

ASTM E283: **"Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen"**

Lab Test conducted on Assembly…

- Specimen size to be specified by authority, or sized to include all typical parts of the system

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Per IECC Pass = Air Leakage ≤ .04 cfm/ft^2 @ 75 Pa

3rd Assembly Test (ASTM E283)

ASTM E283: **"Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen"**

Procedure:

- Seal off test unit, and measure air leakage (extraneous leakage)
- Un-seal test unit, then re-measure (total system)
- Subtract extraneous air from total air = Performance

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Per IECC Pass = Air Leakage ≤ .04 cfm/ft² @ 75 Pa

IECC – Section C402.4.1.2 (Compliance Options)

Reviewed Material and Assembly…now let's review the last option!

- ✓ Material Test = ASTM E2178

or

- ✓ Assembly Test = ASTM E2357, E1677, or E283

or

- ✓ **Building Test = ASTM E779**

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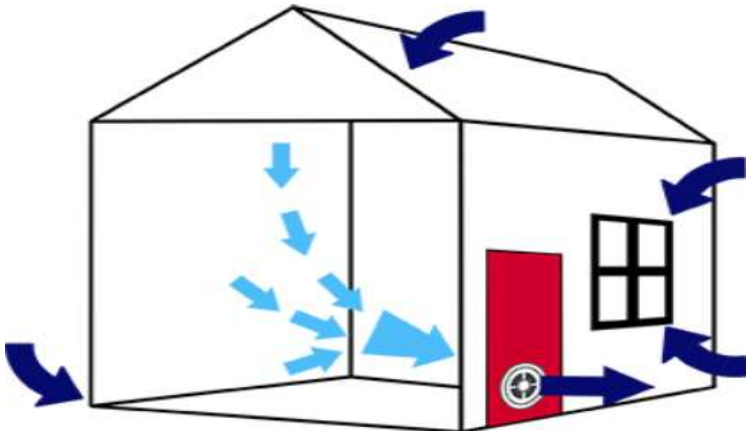
Section C402.4.1.2.3 (Whole Building Test)

ASTM E779: **"Standard Test Method for Determining Air Leakage Rate by Fan Pressurization"**

Field Test to measure air leakage rate (air tightness) of building envelope under controlled pressure

Per IECC Pass = Air Leakage ≤ .4 cfm/ft^2 @ 75 Pa



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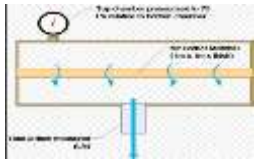
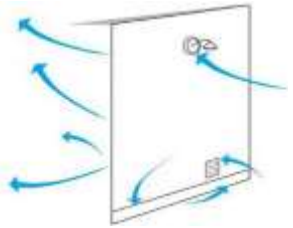
Quick Review for Air Barriers

3 ways to comply with air barrier reqmt's…all at 75 Pa (per IECC)!



Material ≤ **.004** cfm/ft^2 } ASTM E2178

OR



Assembly ≤ **.04** cfm/ft^2 } ASTM E2357 or E1677 or E283

→ **Lab Test!**

OR

Building ≤ **.4** cfm/ft^2 } ASTM E779

→ **Field Test!**

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Building Envelope Weather Protection

Inspection Process

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Inspection of Building Envelope Weather Protection

- Inspections typically done by Code Official but may be inspected by an approved agency or individual
- Verifies:
  - Approved design is being used
  - Assembly is being constructed in accordance with approved design

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Field Testing Prevents & Identifies Problems

Field testing identifies water and air leakage issues for prevention and mitigation

- ✓ ***Water Leakage through the window or wall cavity results in mold, mildew and air quality concerns***
- ✓ ***Water Leakage into the wall cavity results in electrical shorting and fire concerns***
- ✓ ***Water damage on the exterior façade caused by water leakage results in deterioration of the facade***

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Now we'll turn it over to Dwayne

- Key Fire Tests -

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Agenda

- U.S. Codes Specific to Building Envelope
- Review of Weather Barrier and Air Barrier Performance Standards
- **Review of Fire Testing Performance Standards**
- Third Party Certification
- Question & Answer

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Exterior Wall Systems – Why we test?

Torch Tower – Dubai

February 2015

Possible rapid burning of aluminum cladding containing combustible core + high winds

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Exterior Wall Systems – Why we test

Address Hotel Fire – Dubai December 2015

ACM tested to NFPA 285 or ASTM E119?

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Exterior Wall Systems – Why we test

Ajman One Complex

March - 2016

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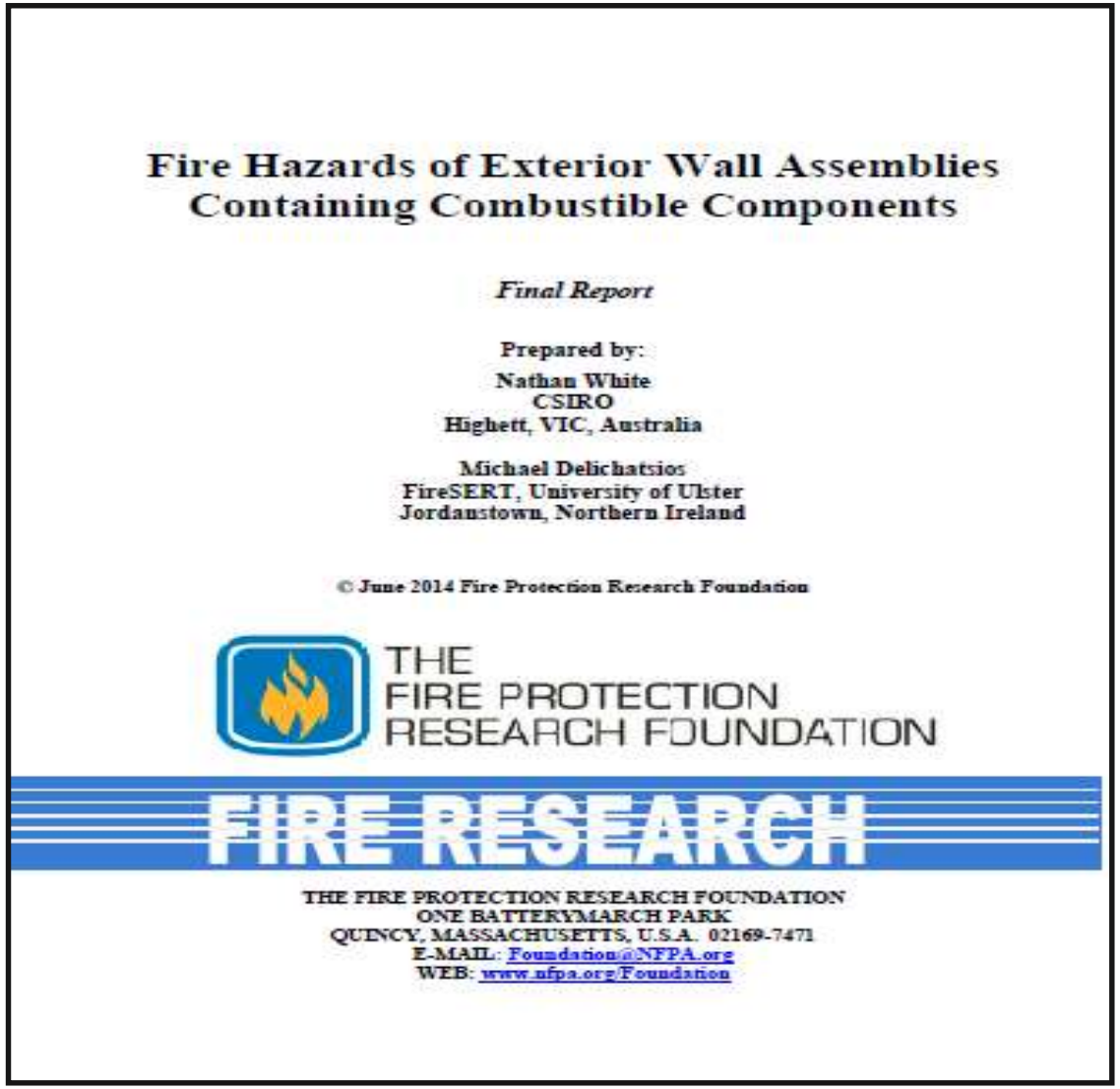
Exterior Wall Systems – Why we test



Fire Hazards of Exterior Wall Assemblies Containing Combustible Components

Final Report

Prepared by:

Nathan White
CSIRO
Highett, VIC, Australia

Michael Delichatsios
FireSERT, University of Ulster
Jordanstown, Northern Ireland

THE FIRE PROTECTION RESEARCH FOUNDATION

FIRE RESEARCH

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WEB: www.nfpa.org/Foundation

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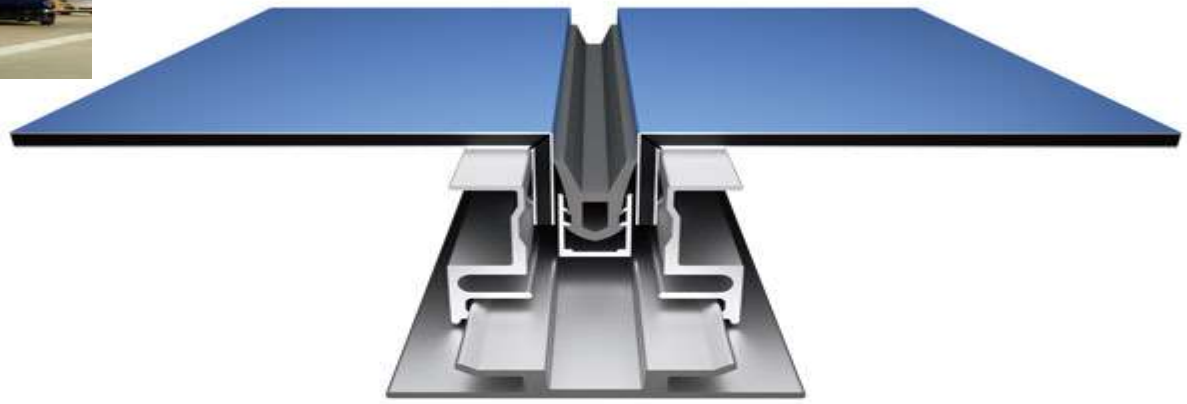
Exterior Wall Systems – Combustible Cladding

Metal Composite Panels

On various metal framing systems, furring, tracks, gasketing, joints, etc.



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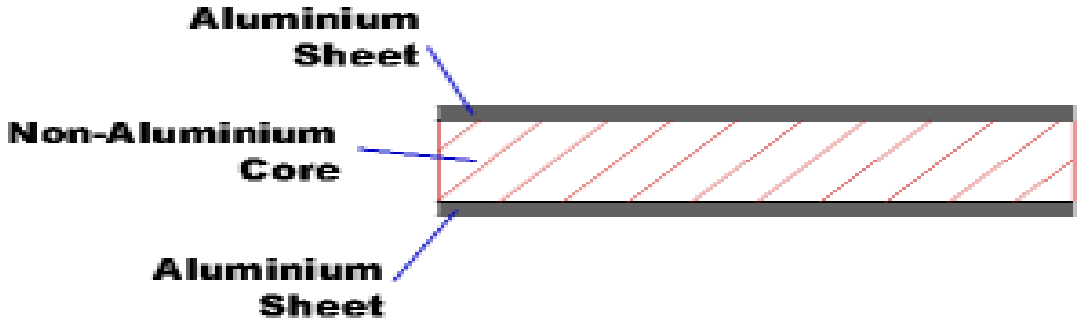
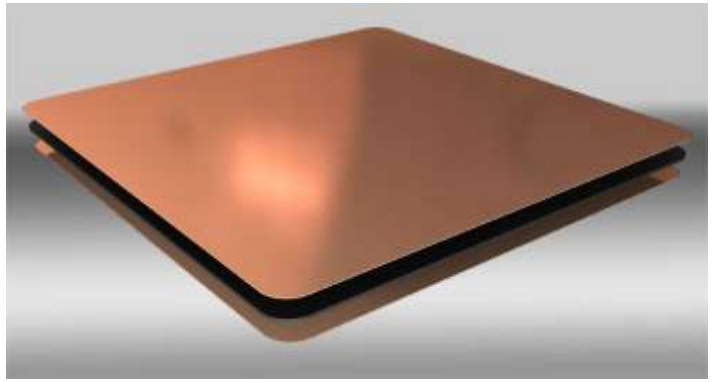
Exterior Wall Systems – Combustible Cladding



Typical Example:

.02 inch aluminum facings chemically bonded to a foam plastic core app. 3 to 6 mm total thickness



Skins: alminum, zinc, copper, stainless steel, and titanium

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NFPA 285

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UL - ISMA

Intermediate Scale Multi-story Apparatus

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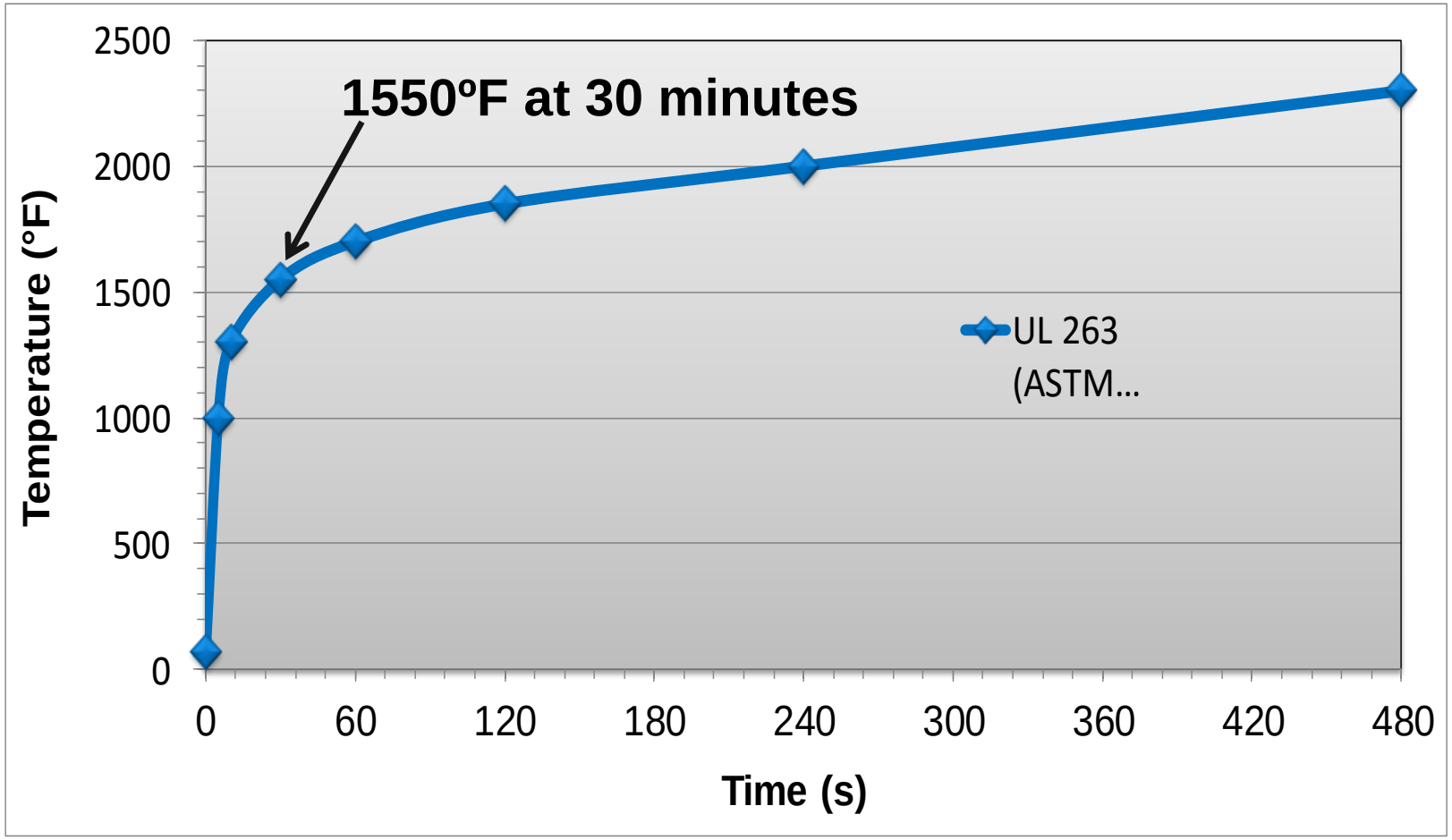
Exterior Wall Systems – Fire Performance



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NFPA 285 – FIRE PROPAGATION

- Test room @ each story – open to the front. Constructed of concrete slabs and walls
- Each test room is app. 3 m x 3 m x 2 m high
- Complete assembly (representative of end use application, including external cladding, insulation, framing and internal wall
- Window opening 0.76 m high × 1.98 m wide; sill located 1.52 m above the top of the first-story test room slab
- Two gas-fired burners
    - ➢One inside the first story room
    - ➢One outside the first story window opening of the wall assembly

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NFPA 285 – Calibration

Table 7.1.11 Calibration Average Values for Time Periods Indicated

Thermocouple Location and Numbers	Temperature											
	0–5 min		5–10 min		10–15 min		15–20 min		20–25 min		25–30 min	
	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C
Test room ceiling: Nos. 18–22	1151	622	1346	730	1482	806	1600	871	1597	869	1648	898
Interior wall surface of test room: Nos. 15–17	1065	574	1298	703	1433	778	1578	859	1576	858	1655	902
1 ft (305 mm) above top of window opening: No. 2	602	317	870	466	952	511	992	533	1046	563	1078	581
2 ft (610 mm) above top of window opening: No. 3	679	359	1015	546	1121	605	1183	639	1245	674	1296	702
3 ft (914 mm) above top of window opening: No. 4	646	341	971	521	1096	591	1174	634	1245	674	1314	712
4 ft (1219 mm) above top of window opening: No. 5	577	302	858	459	982	528	1063	573	1135	613	1224	662
5 ft (1524 mm) above top of window opening: No. 6	521	272	765	407	875	469	949	509	1007	542	1106	597
6 ft (1829 mm) above top of window opening: No. 7	472	244	690	366	787	419	856	458	913	489	1010	543

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NFPA 285 – FIRE PROPAGATION

Table 7.1.11 Calibration Average Values for Time Periods Indicated

Thermocouple Location and Numbers	Temperature											
	0–5 min		5–10 min		10–15 min		15–20 min		20–25 min		25–30 min	
	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C
Test room ceiling: Nos. 18–22	1151	622	1346	730	1482	806	1600	871	1597	869	1648	898
Interior wall surface of test room: Nos. 15–17	1065	574	1298	703	1433	778	1578	859	1576	858	1655	902
1 ft (305 mm) above top of window opening: No. 2	602	317	87[illegible]									[illegible]
2 ft (610 mm) above top of window opening: No. 3	679	3[illegible]	[illegible]	605	1183	639	1245	674	1296	702		
3 ft (914 mm) above top of window opening: No. 4	646		1096	591	1174	634	1245	674	1314	712		
4 ft (1219 mm) above top of window opening: No. 5	577	3[illegible]	[illegible]	528	1063	573	1135	613	1224	662		
5 ft (1524 mm) above top of window opening: No. 6	521	272	[illegible]									
6 ft (1829 mm) above top of window opening: No. 7	472	244	690	366	787	[illegible]			[illegible]89		1010	543

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NFPA 285 – Calibration

Calorimeter Locations and Numbers	Heat Flux (W/cm^2)					
	0–5 min	5–10 min	10–15 min	15–20 min	20–25 min	25–30 min
2 ft (610 mm) above top of window opening: No. C–2ft	0.9 ± 0.2	1.9 ± 0.4	2.5 ± 0.5	2.9 ± 0.6	3.4 ± 0.7	3.8 ± 0.8
3 ft (914 mm) above top of window opening: No. C–3ft	1.0 ± 0.2	2.0 ± 0.4	2.6 ± 0.5	3.2 ± 0.6	3.7 ± 0.7	4.0 ± 0.8
4 ft (1219 mm) above top of window opening: No. C–4ft	0.8 ± 0.2	1.5 ± 0.3	2.0 ± 0.4	2.5 ± 0.5	3.0 ± 0.6	3.4 ± 0.7

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NFPA 285 – FIRE PROPAGATION

Burners are ignited to deliver specified temperatures and heat fluxes over a 30 minute test duration. The window burner is ignited 5 minutes into the test.

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NFPA 285 – FIRE PROPAGATION

NFPA 285 Fire Test Parameters

No flame propagation in second-floor room

Images courtesy of DuPont Building Innovations

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- **No flames in the second floor room**
- **Temperature rise < 278ºC (500ºF)**

NFPA 285 – FIRE PROPAGATION

NFPA 285 Fire Test Parameters

No flame propagation in second-floor room

Inside wall assembly, thermocouples shall not exceed 1000ºF

Images courtesy of DuPont Building Innovations

- **Inside wall cavity air space temperatures shall not exceed 538ºC (1000ºF)**
- **Temperatures on wall cavity & stud cavity insulation shall not exceed a temperature rise of 417ºC (750ºF)**

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NFPA 285 – FIRE PROPAGATION

NFPA 285 Fire Test Parameters

No flame propagation in second-floor room

Inside wall assembly, thermocouples shall not exceed 1000ºF

Externally, flames shall not reach 10 feet above the window's top.

Externally, flames shall not reach 5 feet laterally from the window's centerline.

Images courtesy of DuPont Building Innovations

- **Temperatures at exterior of wall must not exceed 538ºC (1000ºF) at a height of 3 m (10 ft.) above the window opening**
- **Exterior flames must not extend vertically more than 3 m (10 ft.) above the window opening**
- **Exterior flames must not extend horizontally more than 1.5 m from the centerline of the window opening**

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NFPA 285 – FIRE PROPAGATION

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NFPA 285 – FIRE PROPAGATION

Fire Spread Through Cavities

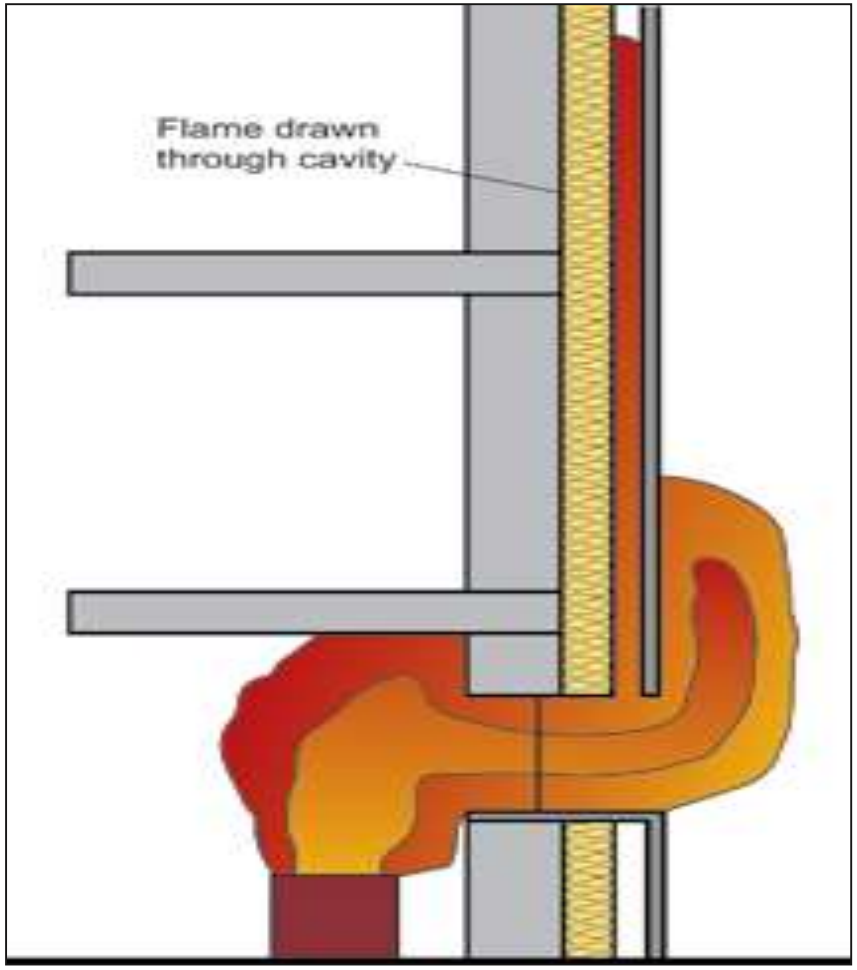

Image courtesy of BRE

Window Detail

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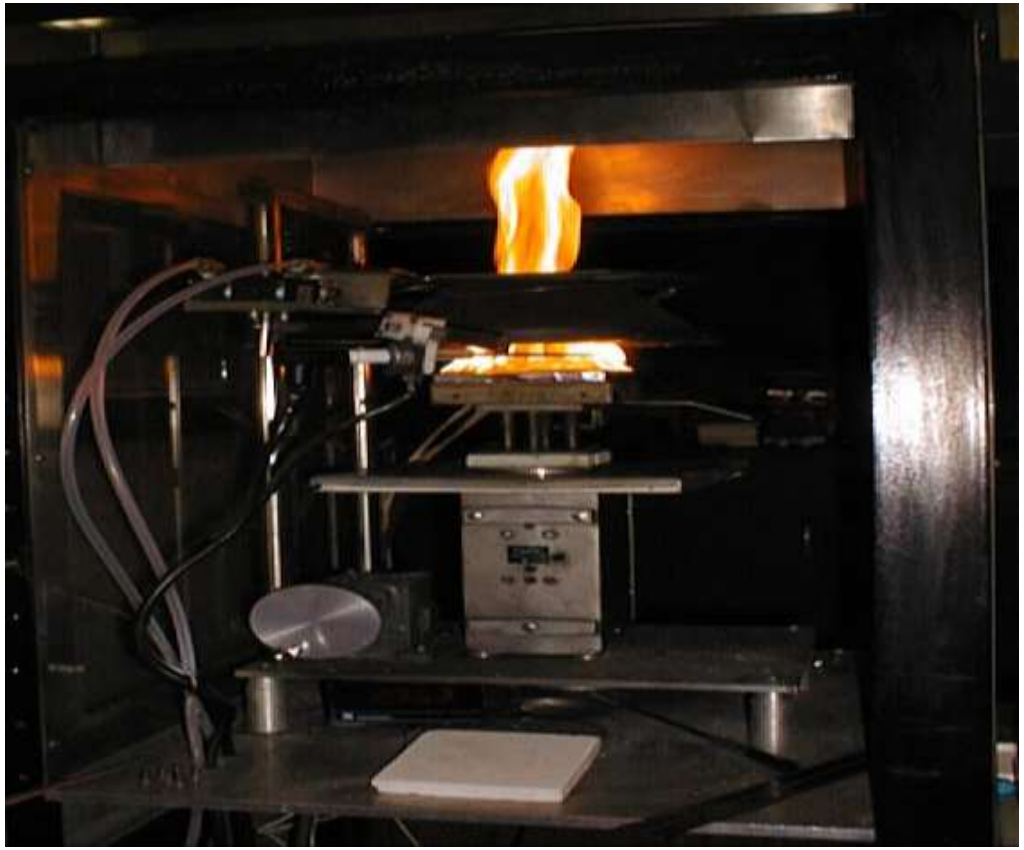
Engineering Analysis

ASTM E1354 Cone Calorimeter



- Time to ignition (s)
- Peak heat release rate (kW/m2)
- Time to Peak heat release rate (s)
- Average heat release rates (kW/m2)
- Effective heat of combustion (MJ/kg)
- Total heat released (MJ/m2)

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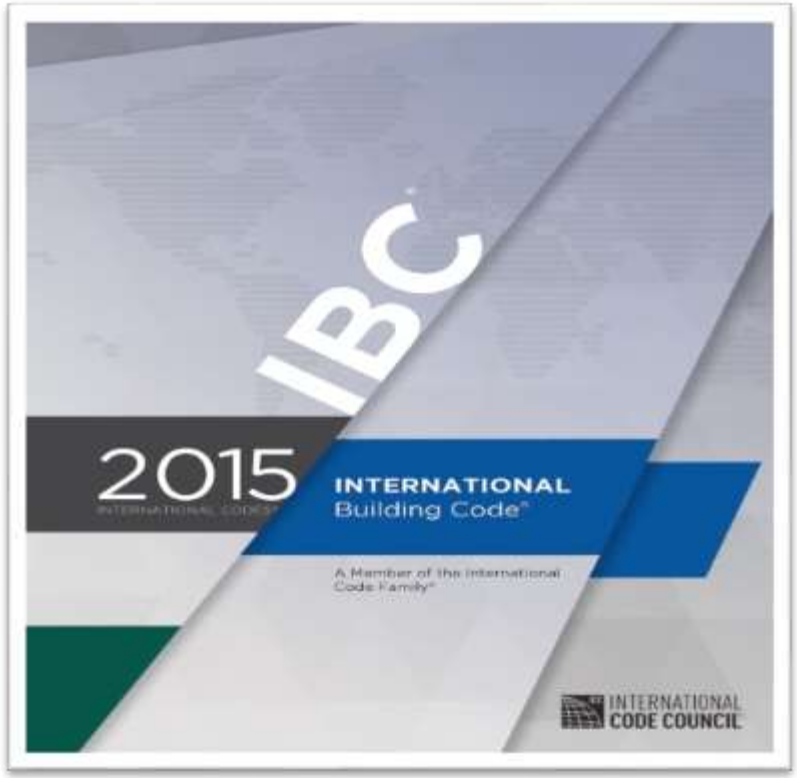
US Code Requirements Drive Safety

Foamed Plastics

Since around 1988 the Codes have addressed exterior wall systems containing combustible foam plastics.

IBC 2603.5.5 - The exterior wall assembly shall be tested in accordance with and comply with the acceptance criteria of NFPA 285



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US Code Requirements Drive Safety

Foamed Plastics – Summary for Exterior Walls

- ANSI/UL 263 / ASTM E119 – if fire rated wall
- ANSI/UL 723 (ASTM E84) – FS 25 / SD 450
- NFPA 268 – Ignitibility of Exterior Walls
- NFPA 285 – Exterior Wall Test – Multistory Test
- NFPA 259 – Potential Heat

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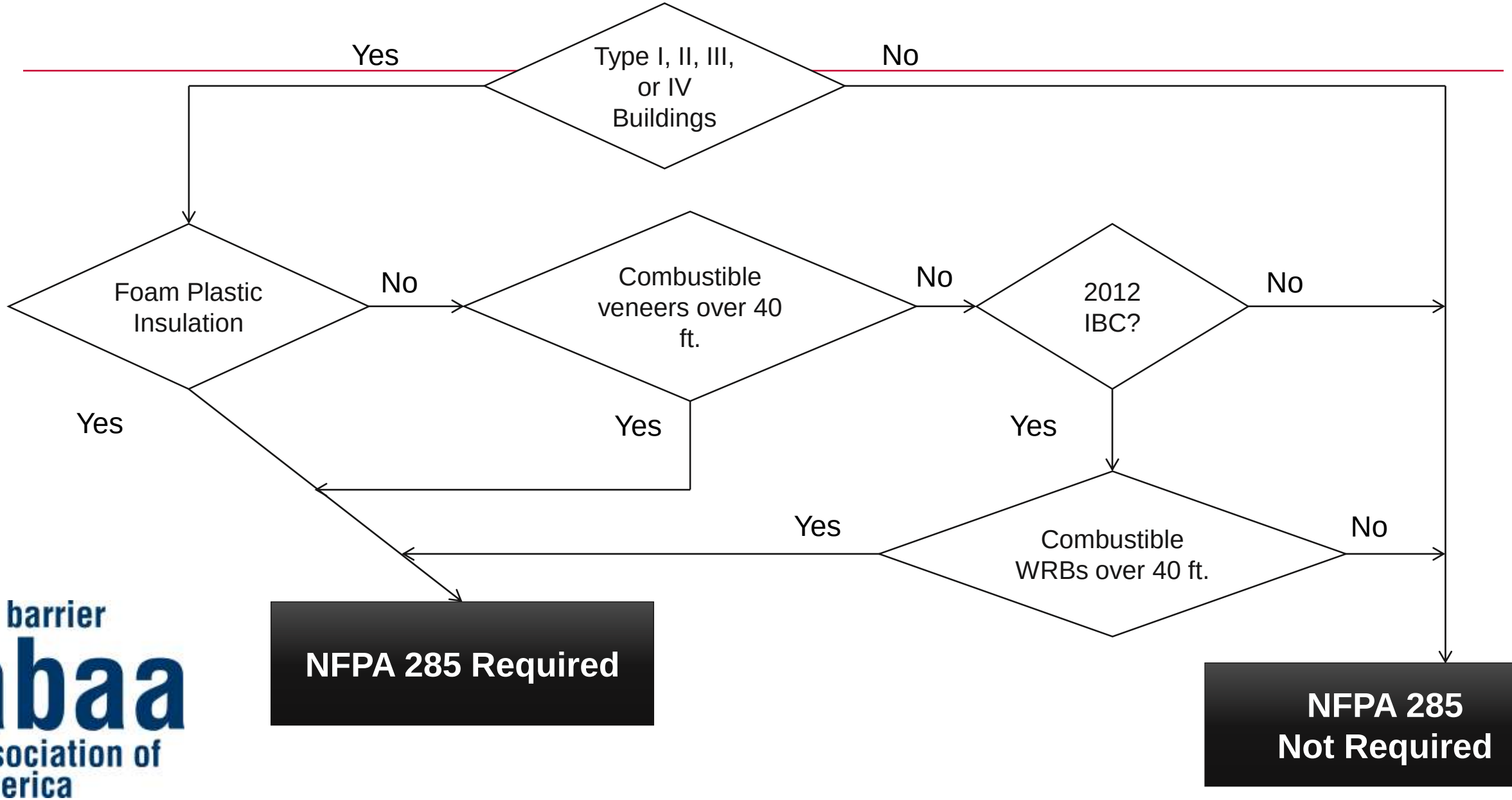
US Code Requirements Drive Safety



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NFPA 285 – FWFO ASSEMBLIES

Currently, there are 28 NFPA 285 UL Assemblies (FWFO)

EWS0001 through EWS0028

- Noncombustible veneers
- ACM panels
- Fluid applied weather barriers
- Various foams & insulation


Search results

You may choose to Refine Your Search.

Company Name	Category Name	Link to File
Guide Information	Exterior Wall Systems	FWFO.GuideInfo
System No. EWS0001	Exterior Wall Systems	FWFO.EWS0001
System No. EWS0002	Exterior Wall Systems	FWFO.EWS0002
System No. EWS0003	Exterior Wall Systems	FWFO.EWS0003
System No. EWS0004	Exterior Wall Systems	FWFO.EWS0004
System No. EWS0005	Exterior Wall Systems	FWFO.EWS0005
System No. EWS0006	Exterior Wall Systems	FWFO.EWS0006
System No. EWS0007	Exterior Wall Systems	FWFO.EWS0007
System No. EWS0008	Exterior Wall Systems	FWFO.EWS0008
System No. EWS0009	Exterior Wall Systems	FWFO.EWS0009

Page: 1 | 2

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OTHER FIRE TEST METHODS MAY NOT FULLY ADDRESS HAZARD

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Steiner Tunnel Test – UL723 / ASTM E84

Measures *Surface Burning Characteristics*

- Flame Spread Index
- Smoke Developed Index

Measures performance of material under test relative to comparative sample of:

- Inorganic reinforced cement board (FSI / SDI = 0)
- Red oak (FSI / SDI = 100)
- Red Oak – Tunnel is Calibrated to travel the flame 19-1/2 ft. in 5-1/2 minutes

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Steiner Tunnel Test – UL723 / ASTM E84

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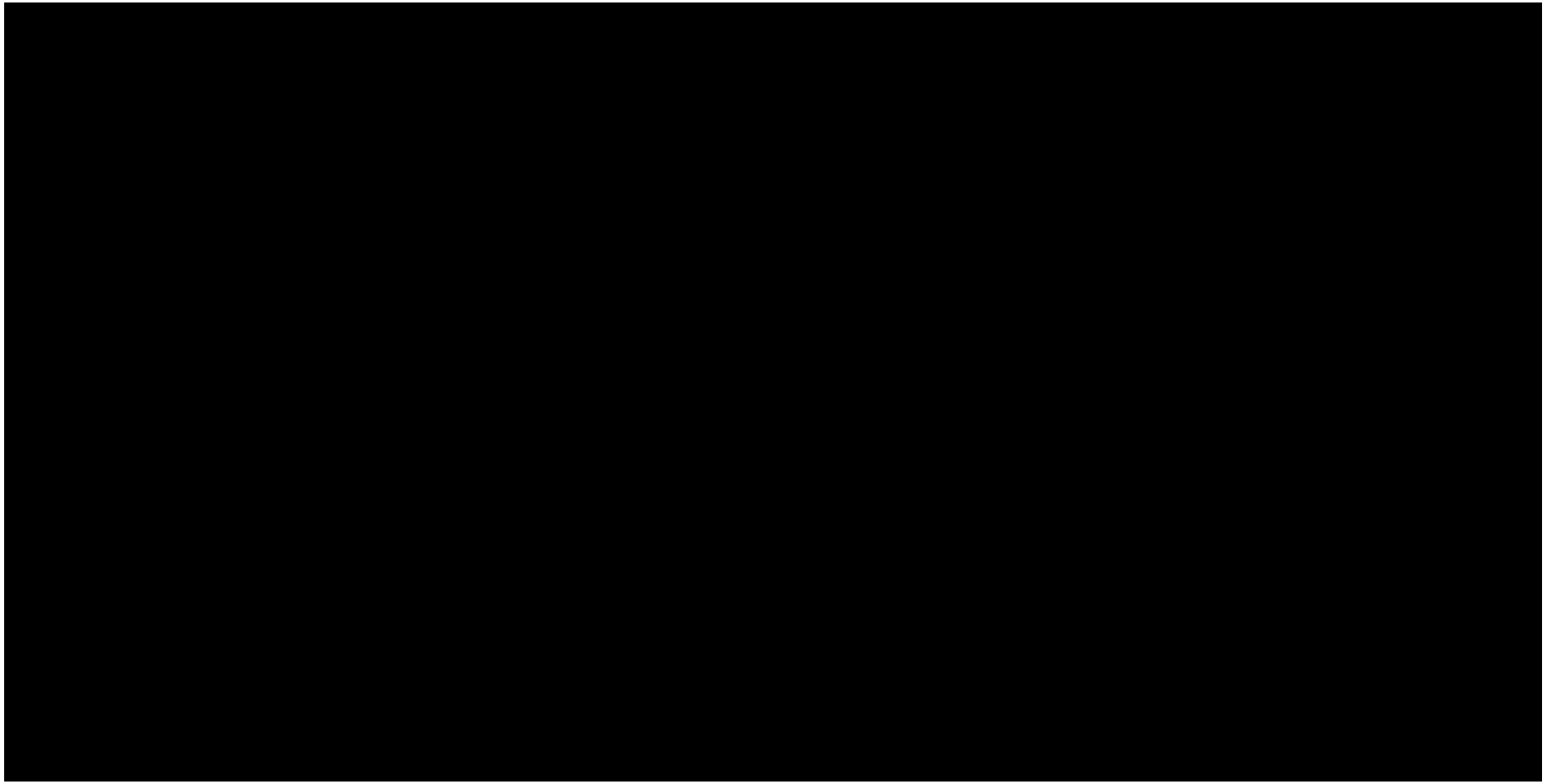
Steiner Tunnel Video



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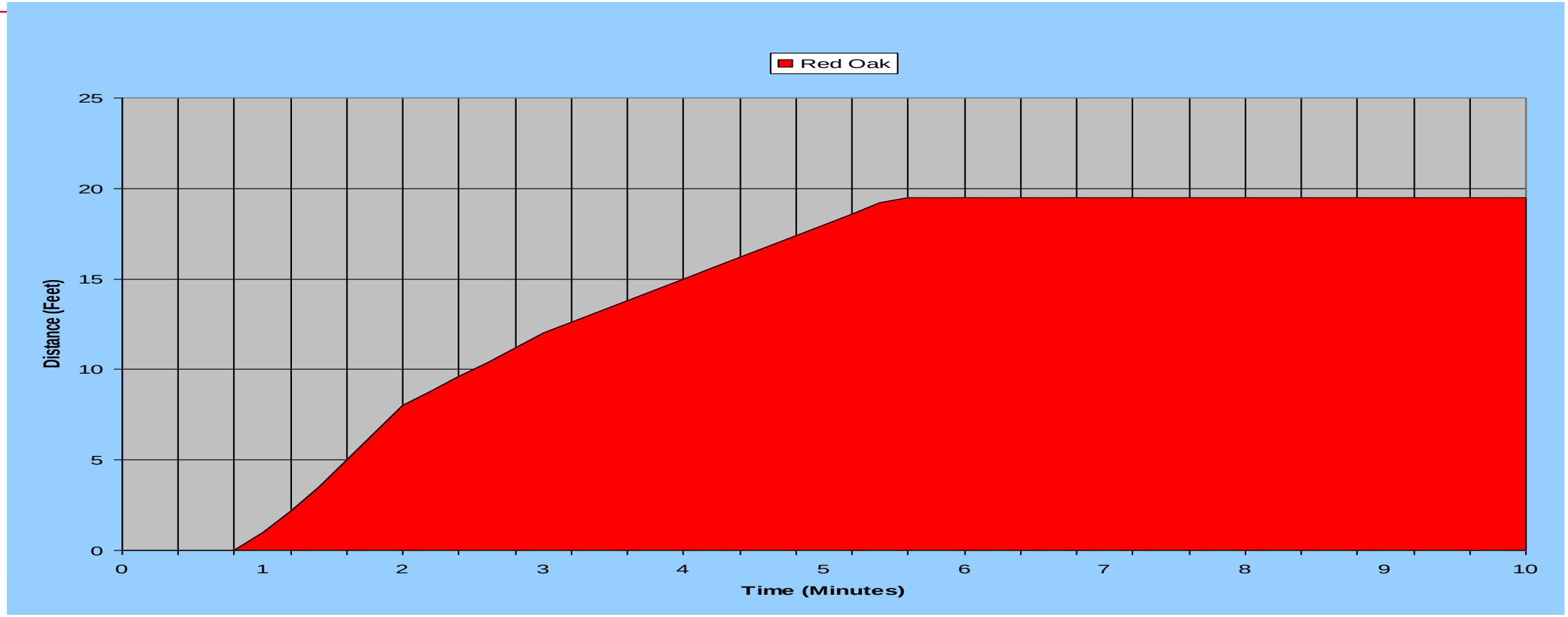
Flame Propagation of Red Oak



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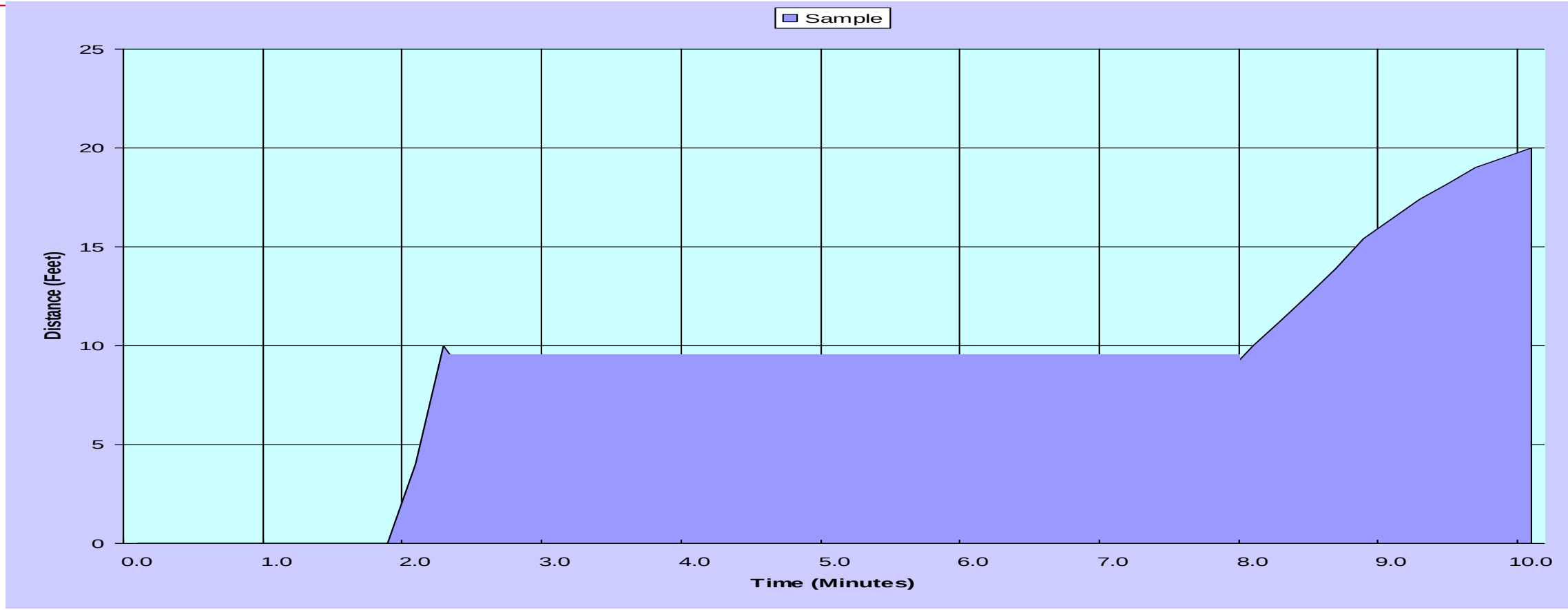
Flame Propagation of Test Sample



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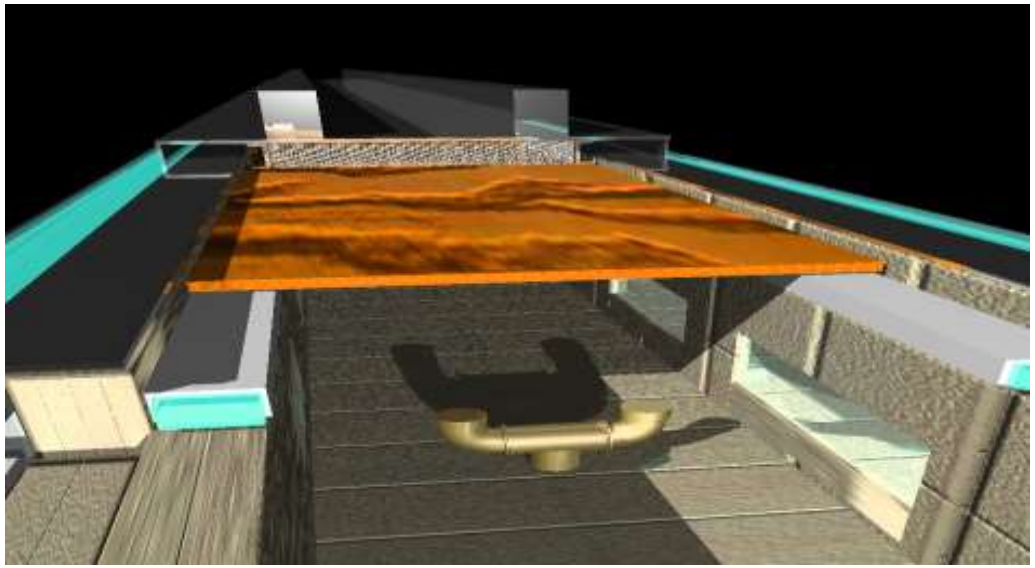
Steiner Tunnel Test – UL723 / ASTM E84



Tunnel Layout

Burner

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Agenda

- U.S. Codes Specific to Building Envelope
- Review of Weather Barrier and Air Barrier Performance Standards
- Review of Fire Testing Performance Standards
- **Third Party Certification**
- Question & Answer

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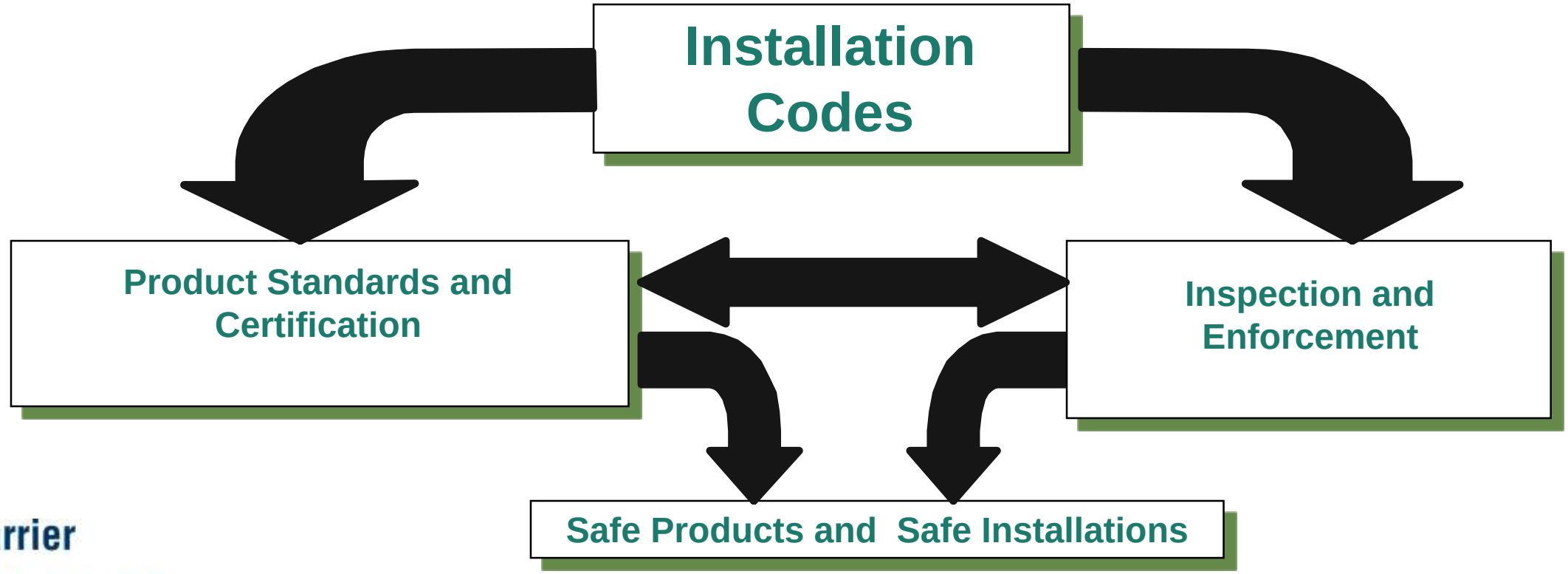
The U.S. Safety System



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Significance of Third Party Certification

- Many municipalities' laws, codes, and regulations require building products be tested, listed, and/or labeled before the products can be installed.

- Some manufacturers make it a company policy to obtain UL certification - minimizes the possibility of non-acceptance by AHJs.

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Significance of Third Party Certification

So, Being UL Certified Means:

- Product has been evaluated and complies with UL's requirements
- Manufactured under UL's Follow-Up Service Program-- not just tested by UL

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UL Online Search Tools

- UL Certifications Directory
- Product Spec ™
- Code Link

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UL Online Certifications Directory

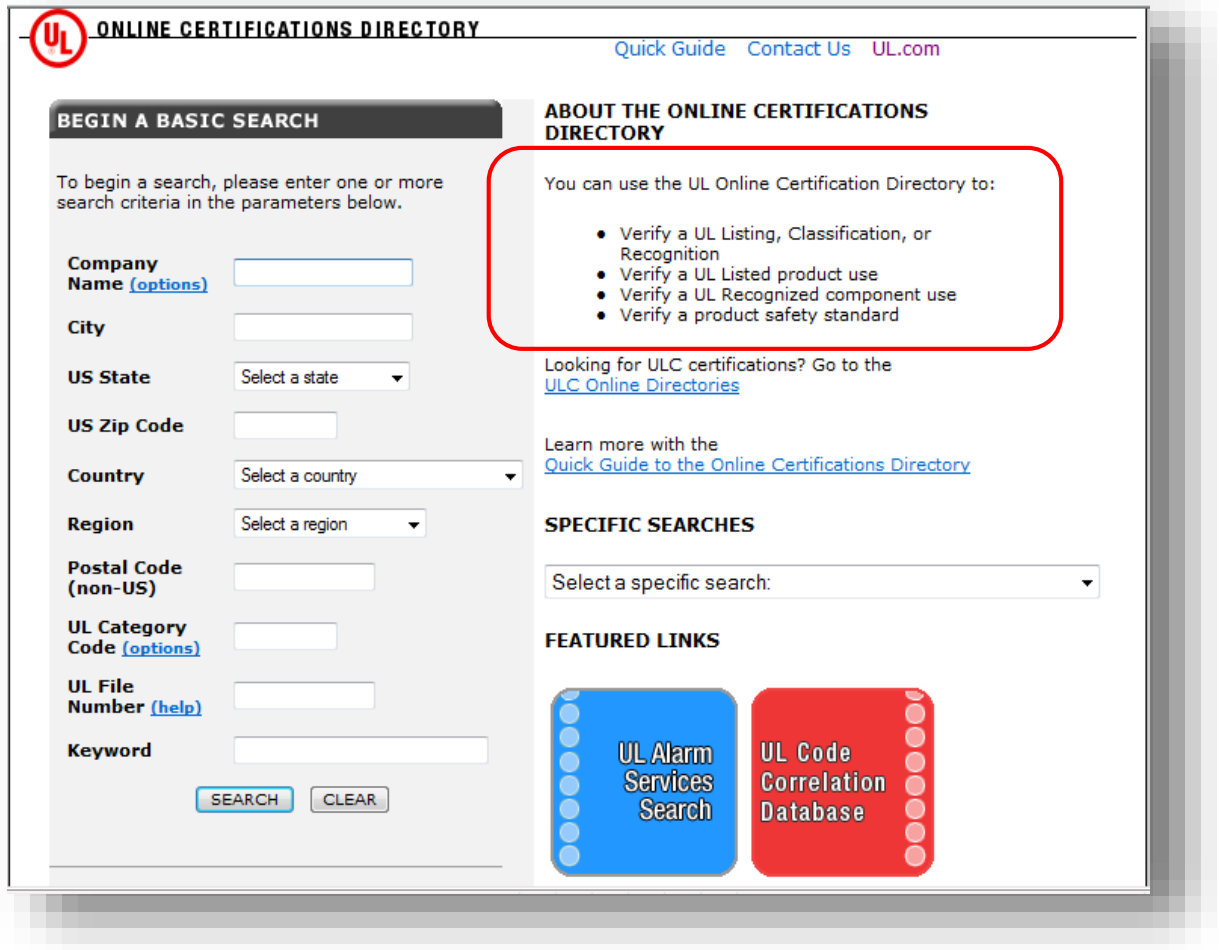
So How Is this Information Accessible within UL?

“UL Online Certification Directory”

Anyone can use
No charge to access
No passwords
Updated daily
Searchable by:

- Keyword
- Manufacturer
- UL File Number
- Standard used for evaluation

www.ul.com/database



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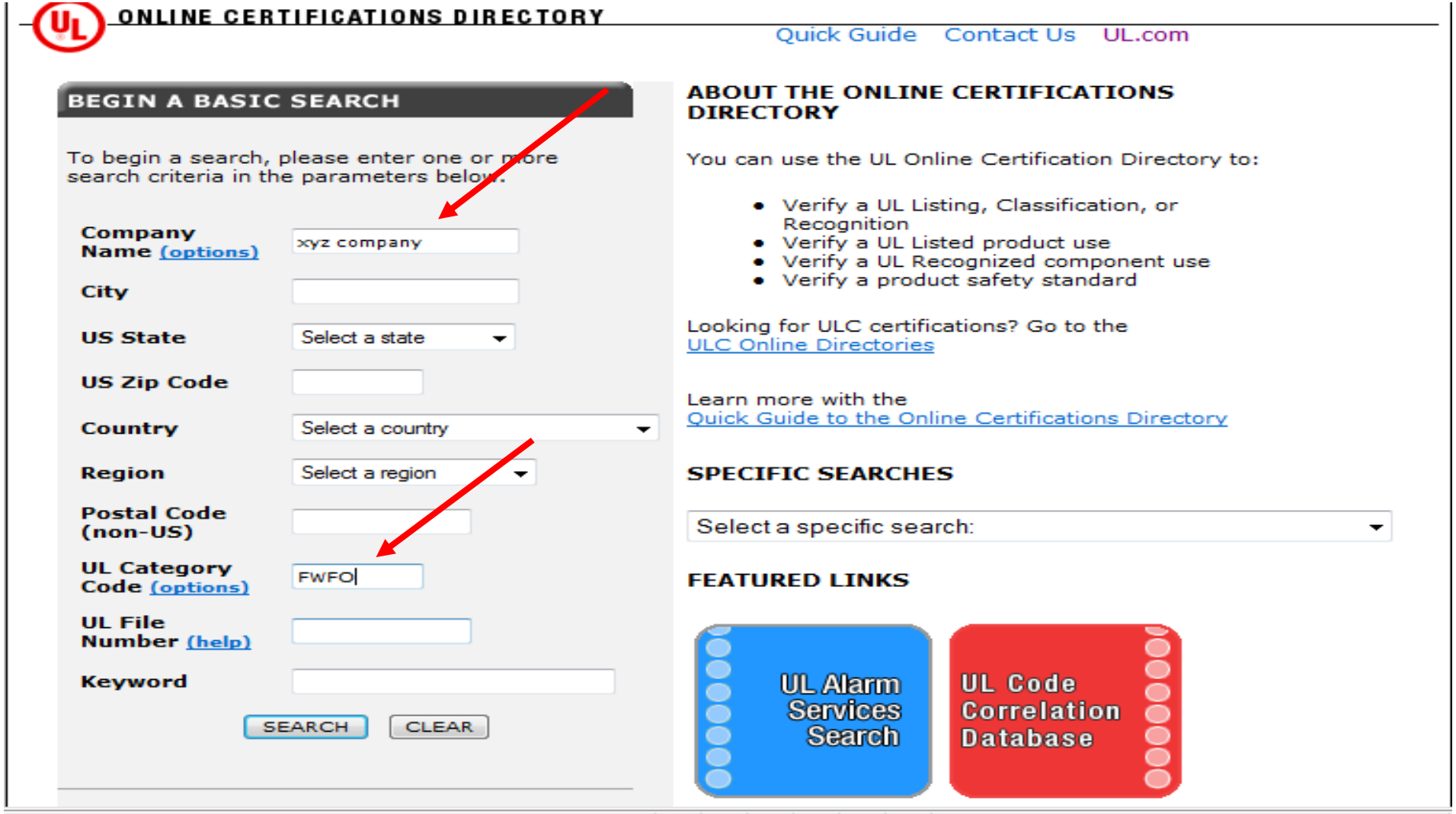
UL Online Certifications Directory



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UL Online Certifications Directory

Search results

You may choose to **Refine Your Search.**

Company Name	Category Name	Link to File
Guide Information	Exterior Wall Systems	*FWFO.GuideInfo*
System No. EWS0001	Exterior Wall Systems	*FWFO.EWS0001*
System No. EWS0002	Exterior Wall Systems	*FWFO.EWS0002*
System No. EWS0003	Exterior Wall Systems	*FWFO.EWS0003*
System No. EWS0004	Exterior Wall Systems	*FWFO.EWS0004*
System No. EWS0005	Exterior Wall Systems	*FWFO.EWS0005*
System No. EWS0006	Exterior Wall Systems	*FWFO.EWS0006*
System No. EWS0007	Exterior Wall Systems	*FWFO.EWS0007*
System No. EWS0008	Exterior Wall Systems	*FWFO.EWS0008*
System No. EWS0009	Exterior Wall Systems	*FWFO.EWS0009*

Page: 1 | 2

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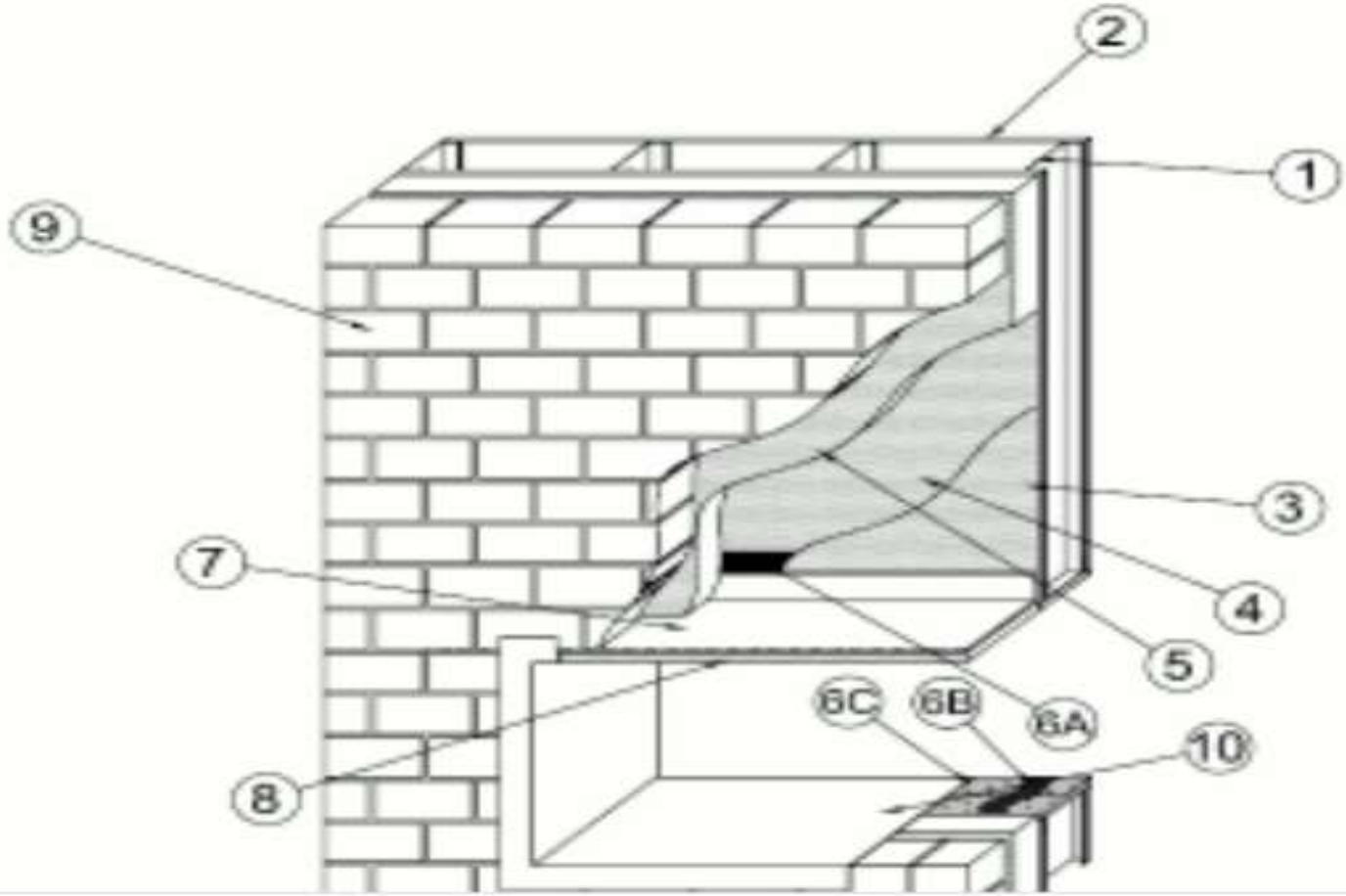
System No. EWS0001

February 21, 2014

Exterior Wall System



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1. **Steel Studs** — Min 3-5/8 in. (92 mm) deep, formed of min 16 ga. galv steel spaced max 16 in. (406 mm) OC. Additional studs to be used to completely frame window openings.

2. **Interior Gypsum Board (BWFR)*** — Min 5/8 in. (16 mm) thick, 4 ft (1.2 m) wide, attached to steel studs with 1 in. (25 mm) long, Type S steel screws spaced max 8 in. (203 mm) OC. Joints oriented vertically and covered with paper tape and joint compound. Screw heads covered with joint compound.

UNITED STATES GYPSUM CO — Type SCX

3. **Exterior Gypsum Sheathing (BWFR)*** — Exterior-grade glass mat sheathing gypsum board, minimum 5/8 in.(16 mm) thick, attached to steel studs with 1 in. (25 mm) long, Type S steel screws spaced max 8 in. (203 mm) OC. Joints oriented vertically or horizontally. Additional sheathing to be used to line framed window openings.

UNITED STATES GYPSUM CO — Type USGX

3A. **Exterior Wall System Component — Sealant*** — (Not Shown) - Sealant applied to all exterior sheathing joints prior to application of air barrier sealant (Item 4).

TREMCO INC — Tremflex 834

4. **Exterior Wall System Component — Combustible Air Barrier Sealant*** — Applied to completely cover the gypsum sheathing at a min thickness of 35 mil (0.9 mm) dry, 70 mil (1.8 mm) wet thickness.

TREMCO INC — ExoAir 230

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5. **Foam Insulation (BRYX)*** — Nom 4 by 8 ft (1.2 by 2.4 m) by 2-1/2 in. (64 mm) thick, min 1.55 pcf (24.8 kg/m^3) extruded polystyrene insulation secured to gypsum sheathing with min No. 8 by 3-1/2 in. (89 mm) self-tapping steel screws in conjunction with 2 in. (51 mm) diameter steel washers.

THE DOW CHEMICAL CO — Styrofoam Scoreboard

AFM CORP — Foam-Control EPS Type IX, Film Faced Foam-Control EPS Type IX, Foam-Control EPS Type XIV or Foam-Control EPS Type XV

ATLAS EPS, DIV OF ATLAS ROOFING CORP — ThermalStar

OWENS CORNING FOAM INSULATION L L C — Foamular 250 or Foamular CC

6. **Window Flashing Materials** — (Optional) - The following items may be used as window flashing materials:

A. **Exterior Wall System Component — Window Flashing Material*** — Nom 6 in. (152 mm) wide extruded silicone rubber flashing attached to gypsum sheathing with sealant (Item 6D) to completely frame window opening.

TREMCO INC — Proglaze ETA

B. **Fiberglass Mesh** — Nom 0.012 in. (0.3 mm) thick open-weave glass-reinforcing fabric embedded within the air barrier sealant (Item 6C).

TREMCO INC — 2011 Mesh

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C. **Exterior Wall System Component — Combustible Air Barrier Sealant*** — Applied to completely cover sheathing lining the window opening in conjunction with a nom 0.012 in. (0.3 mm) thick open-weave glass-reinforcing fabric embedded within the sealant.

TREMCO INC — ExoAir 230

D. **Exterior Wall System Component — Sealant*** — (Not Shown) - Sealant applied to all edges of window flashing material to adhere flashing to gypsum sheathing.

TREMCO INC — Spectrem 1

7. **Steel Lintel** — Nom 7 in. (178 mm) wide by min 3/8 in. (10 mm) thick steel used at top of window opening of brick veneer (Item 9) and extending min 8 in. (203 mm) beyond each side of the opening.

8. **Mineral Wool** — Nom 4 pcf (64 kg/m^3), 1 in. (25 mm) thick mineral batt insulation secured to the underside of steel lintel (Item 8) with two rows of steel batt pins located approx. 1 in. (25 mm) from the edges and spaced a max 8 in. (203 mm) OC.

9. **Exterior Veneer — Brick** — Nominal 4-in.-thick clay brick offset to provide a nom 1 in. air gap between foam insulation (Item 5) and brick veneer with standard type veneer anchors spaced a max 24 in. (610 mm) on center.

10. **Steel Flashing** — Formed of min 22 ga. steel. Formed to completely line window opening and overlap onto both surfaces of the wall assembly a min 1/2 in. (13 mm).

*Bearing the UL Classification Mark

FWFX.R27656
Exterior Wall System Components

Page Bottom

Exterior Wall System Components

See General Information for Exterior Wall System Components

TREMCO INC R27656
4475 E 175TH ST
CLEVELAND, OH 44128-3411 USA

Sealant designated ExoAir 230 for use in System Nos. EWS0001, EWS0002, EWS0003, EWS0004, EWS0005.

Sealant designated Tremflex 834 for use in System Nos. EWS0001, EWS0002, EWS0003, EWS0004, EWS0005.

Window flashing material designated Proglaze ETA for use in System Nos. EWS0001, EWS0002, EWS0003, EWS0004, EWS0005.

Sealant designated Spectrem 1 for use in System Nos. EWS0001, EWS0002, EWS0003, EWS0004, EWS0005.

Last Updated on 2014-02-17

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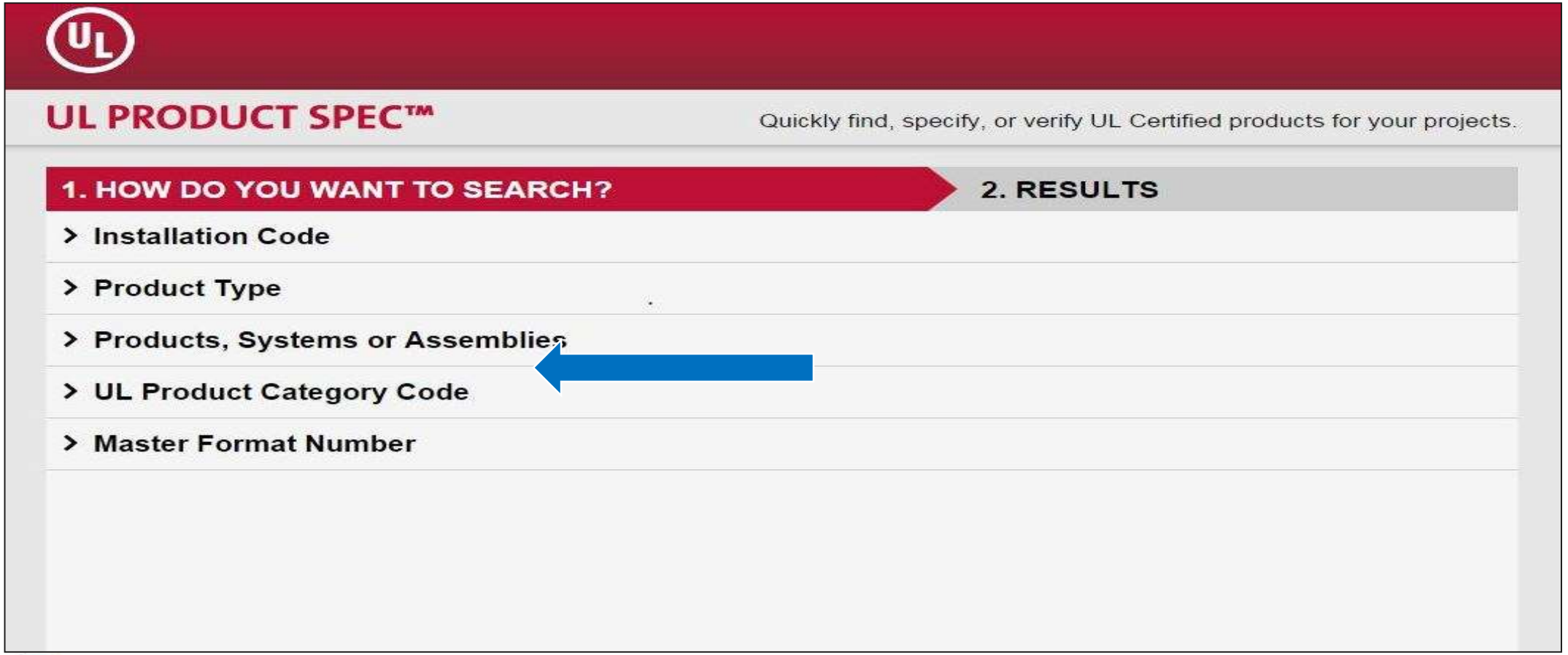

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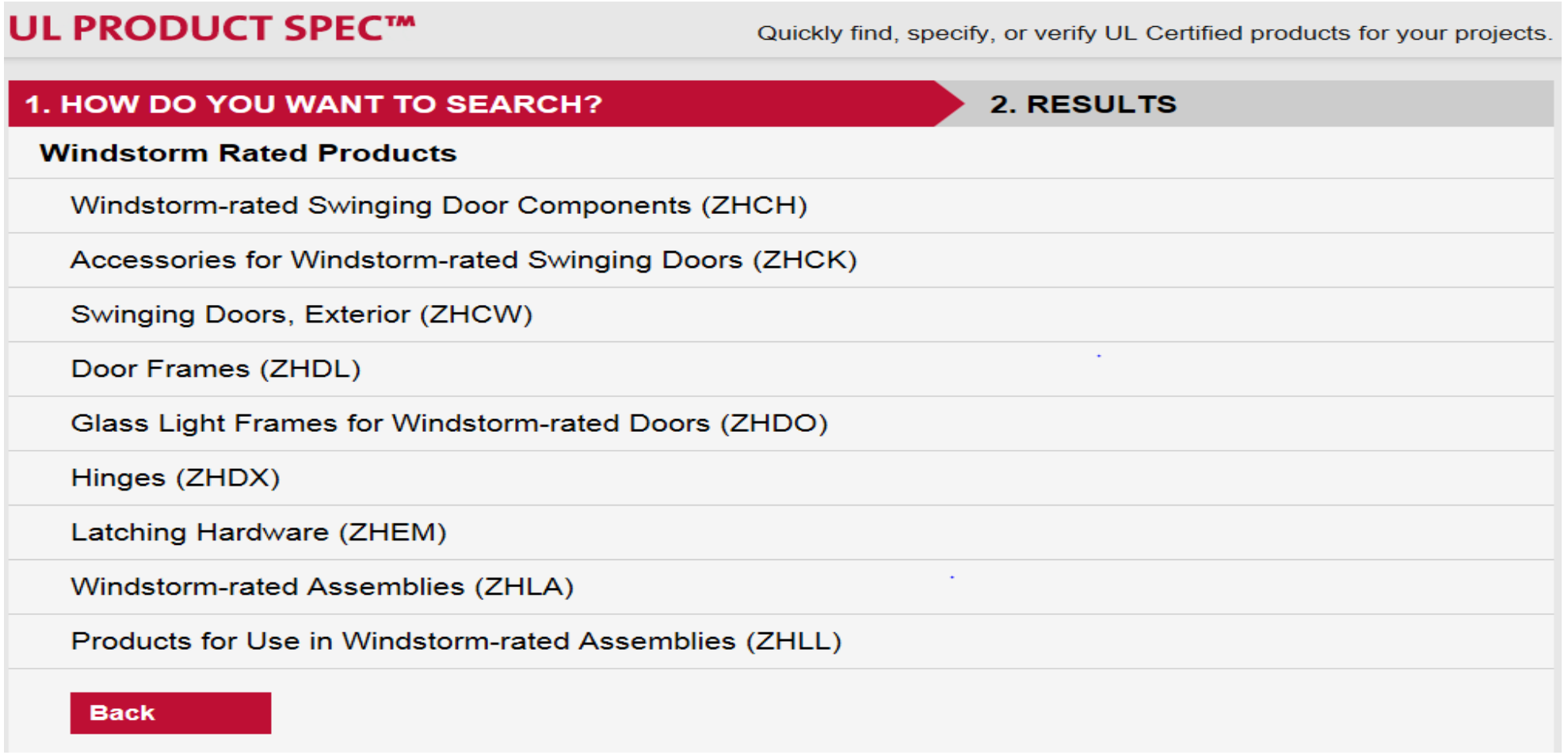

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Code Link

- Correlates model code sections to UL product categories
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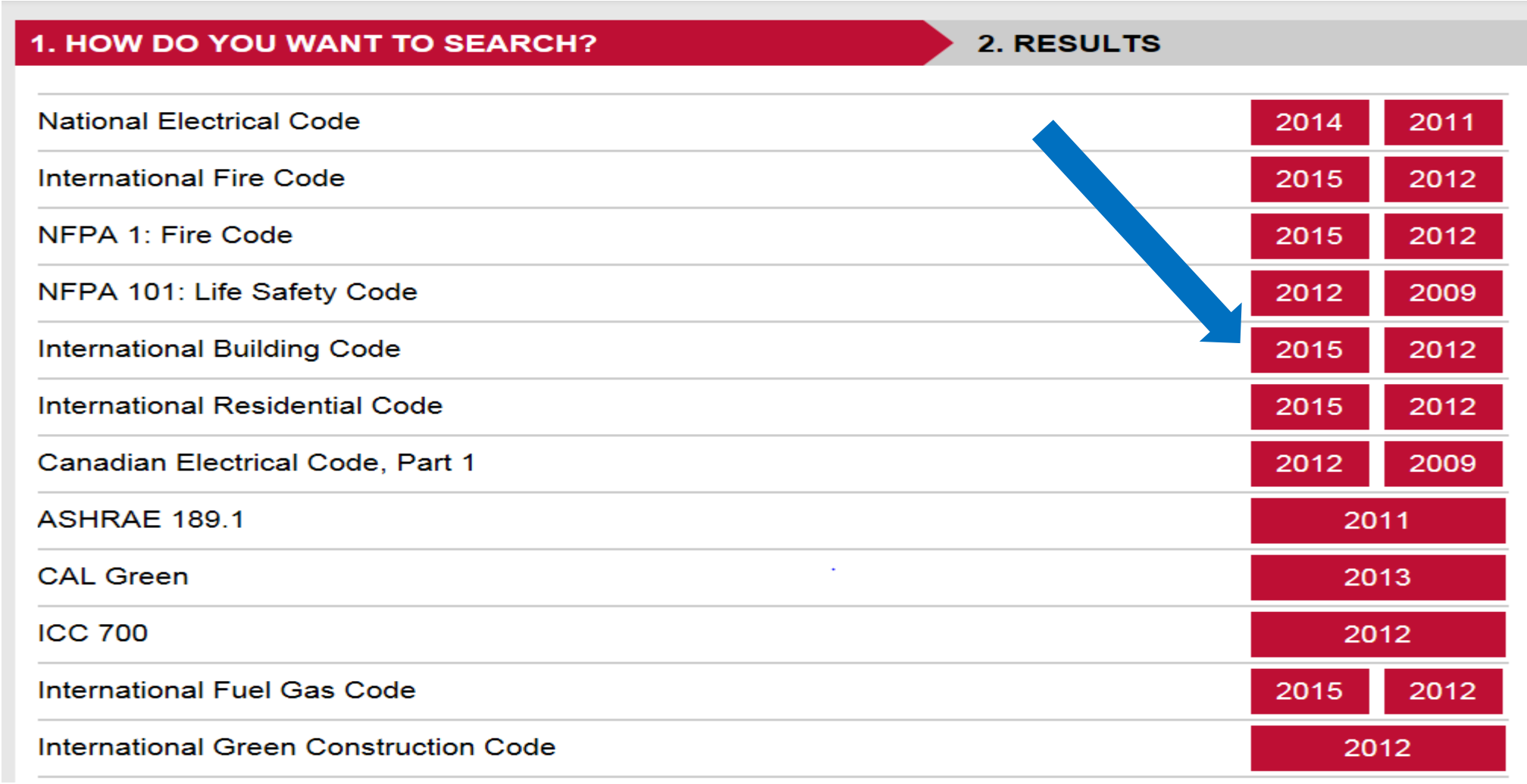

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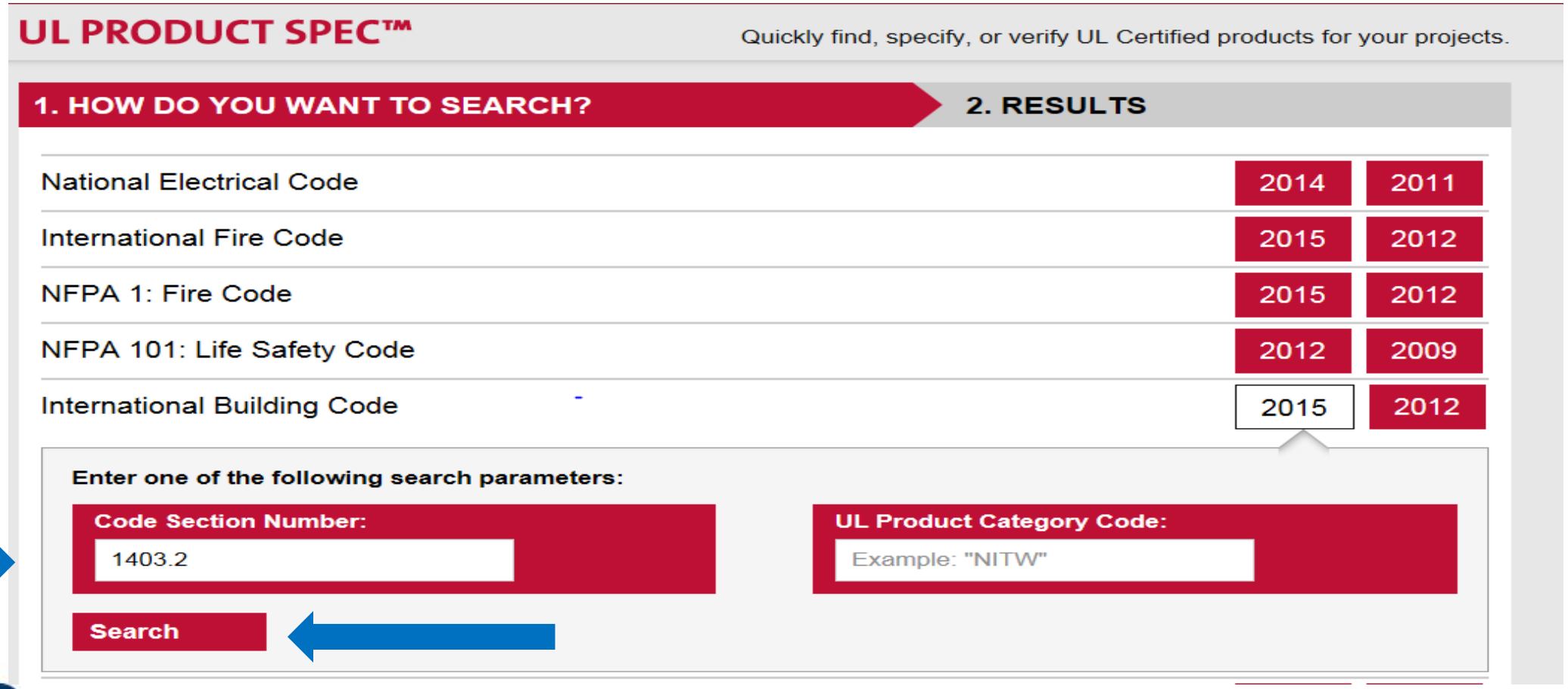

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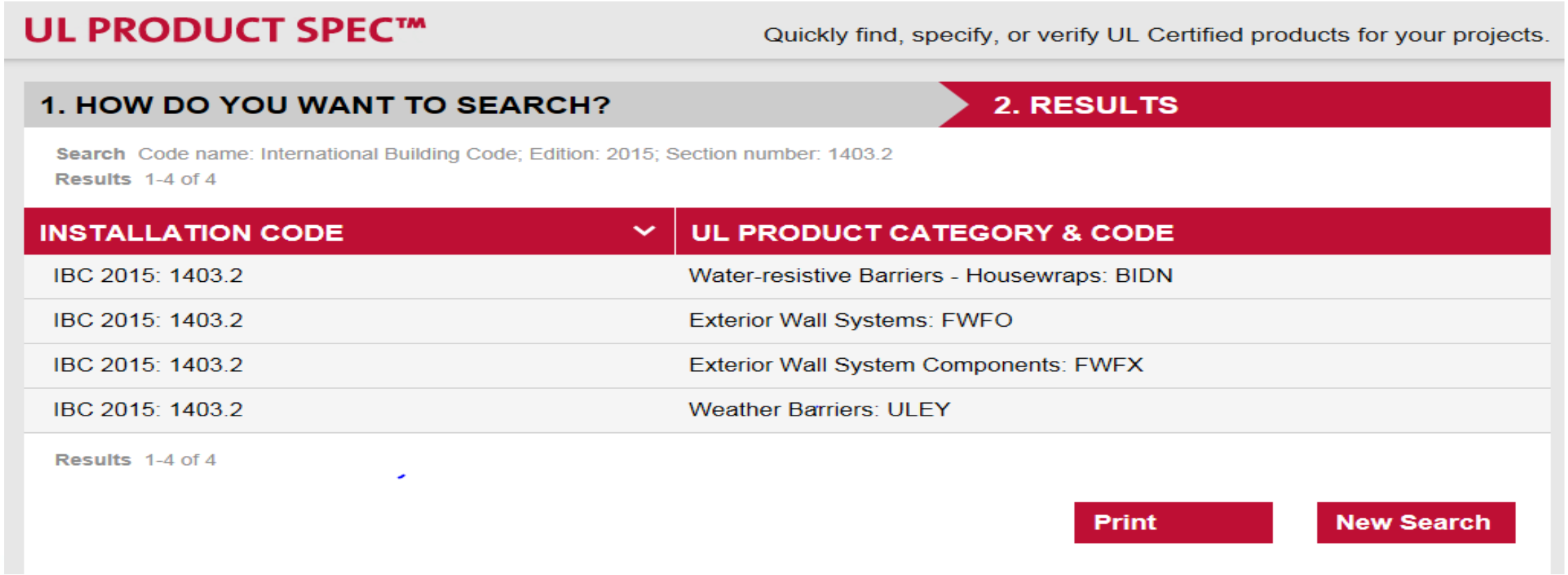

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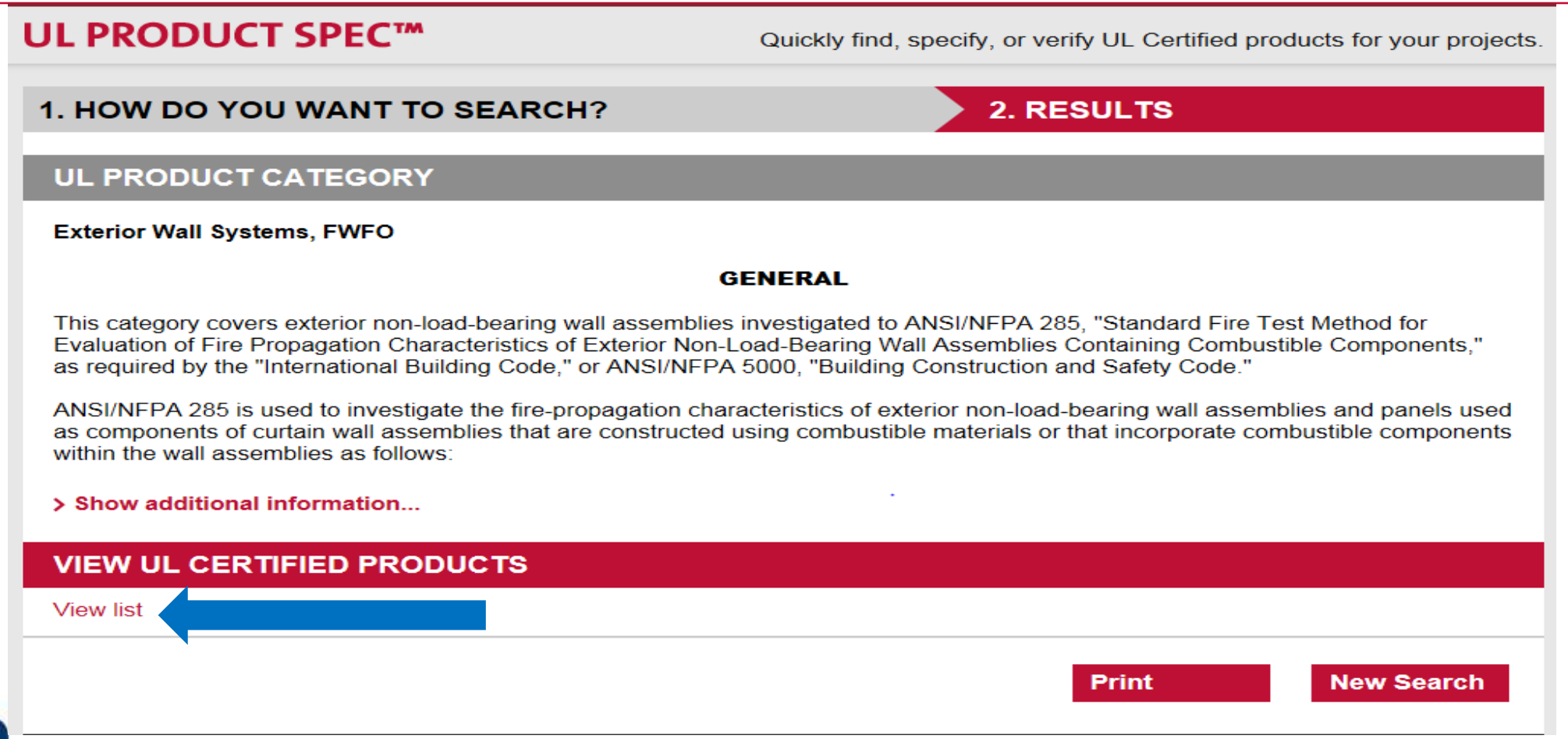

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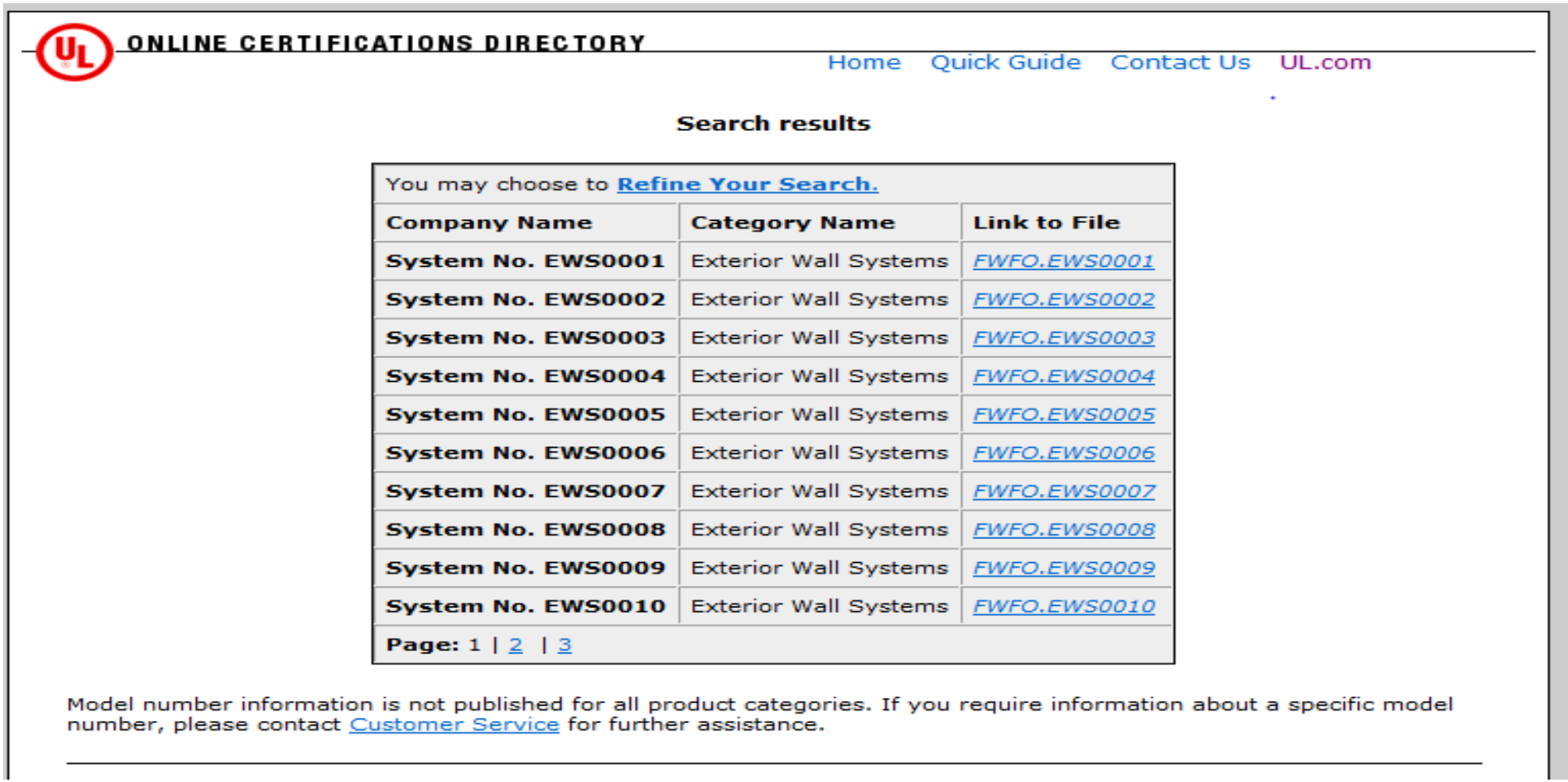

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Search results

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Company Name	Category Name	Link to File
System No. EWS0001	Exterior Wall Systems	*FWFO.EWS0001*
System No. EWS0002	Exterior Wall Systems	*FWFO.EWS0002*
System No. EWS0003	Exterior Wall Systems	*FWFO.EWS0003*
System No. EWS0004	Exterior Wall Systems	*FWFO.EWS0004*
System No. EWS0005	Exterior Wall Systems	*FWFO.EWS0005*
System No. EWS0006	Exterior Wall Systems	*FWFO.EWS0006*
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System No. EWS0008	Exterior Wall Systems	*FWFO.EWS0008*
System No. EWS0009	Exterior Wall Systems	*FWFO.EWS0009*
System No. EWS0010	Exterior Wall Systems	*FWFO.EWS0010*

Page: 1 | 2 | 3

Model number information is not published for all product categories. If you require information about a specific model number, please contact Customer Service for further assistance.

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Learning Objectives - Review

We hope that each of you has gained further knowledge of the following:

- Able to Identify at least 3 different building envelope standards as specified within the I-Codes
- Better understand the standards, and how they relate to the various exterior building envelope products
- Gained a better understanding of the differences between standards that are material tests compared to those that test assemblies
- Gained knowledge about fire tests such as NFPA 285 and UL723 (ASTM E84)

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Questions

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