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# Fenestration/Curtain Wall Requirements in the 2015 *IBC*

Presented by:

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# Presentation Objectives

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- Review of IBC Basics
- Overview of IBC Requirements for Weather Protection
  - Air
  - Water
- IECC Requirements for *Thermal* Performance
- Review of Applicable Standards Referenced for Building Envelope Protection
- Review Testing Methods for Code Compliance
- Review Importance of Field Testing – Case Studies

# Learning Objectives

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Upon completion of this course, participants should be able to:

- Understand the weather and thermal protection requirements of the 2015 IBC and IECC for the building envelope
- Understand the methods to ensure code compliance
- Understand the purpose of air and water field testing
- Understand and identify the correct test standards and methods to be used to conduct field testing for specific information and situations
- Understand the test results that are obtained and how that information can be used to positively impact a building project

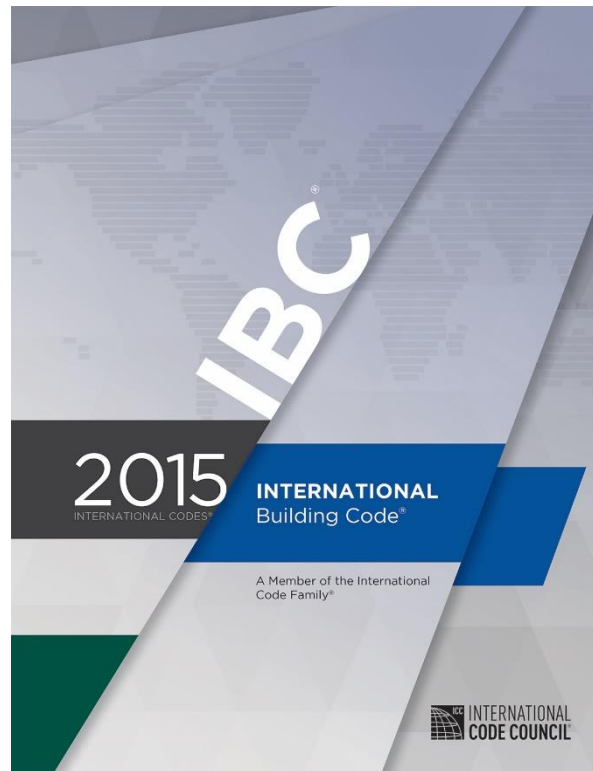
# Questions / Comments



# IBC Basics

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## Some Fundamentals



# Use of the IBC

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- *Definitions* – Chapter 2
- Occupancy Classification
- Use of Tables – Scoping Section
- Table Footnotes
- Code Exceptions
- Reference Standards
- Index and Glossary
- Identifying Changes in Code Text



# Questions / Comments



# Building Envelope Weather Protection

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The IBC Chapter 14 (Exterior Walls) and Chapter 15 (Roofs) takes a **systematic** approach to building envelop weather protection:

## 1. Design is Combination of many Components

**Design and Engineering – Performance Based**

**Plan Review for Code Compliance (performance verification)**

## 2. Design Vs. Actual Assembly & Installation

**Mock-up Testing**

**Field testing and Commissioning (Inspection)**



# Important IBC Definitions

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***Exterior Wall Envelope.*** A system or assembly of *exterior wall* components, including *exterior wall* finish materials, that provides protection of the building structural members, including framing and sheathing materials, and conditioned interior space, from the detrimental effects of the exterior environment

# More Definitions

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***Exterior Wall Covering.*** A material or assembly of materials applied on the exterior side of *exterior walls* for the purpose of providing a weather-resisting barrier, insulation or for aesthetics, including but not limited to, *veneers*, siding, *exterior insulation and finish systems*, architectural *trim* and embellishments such as *cornices*, soffits, fascias, gutters and leaders.

# More Definitions

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***Fenestration.*** Skylights, roof windows, vertical windows (fixed or moveable), opaque doors, glazed doors, glazed block and combination opaque/glazed doors. Fenestration includes products with glass and nonglass glazing materials.

# More Definitions

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

# Questions / Comments

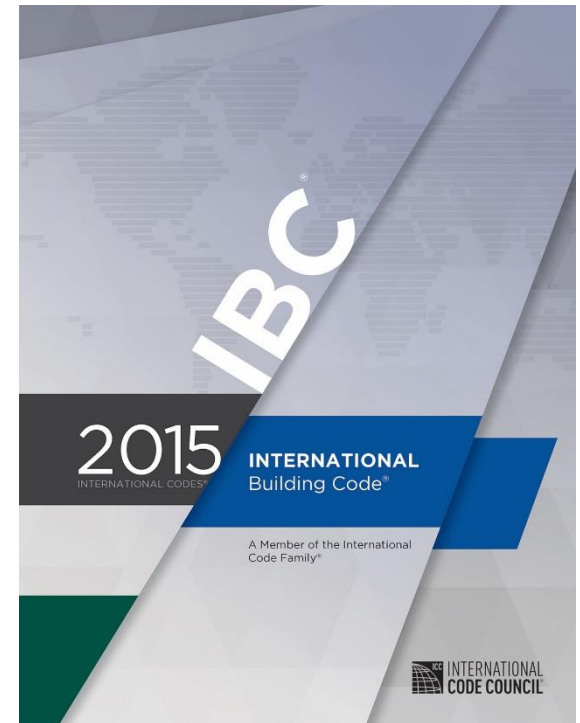


# Weather Resistive Construction

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## *International Building Code*

### Requirements for Building Envelope Weather Protection



# IBC Code Requirements

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- Chapters 3 and 4 – Defines Occupancies
- Chapter 5 – General Building Heights and Areas
- Chapter 6 – Types of Construction
- Chapter 13 – Energy Efficiency
- Chapter 14 – Exterior Walls
- Chapter 15 – Roof Assemblies & Rooftop Structures
- Chapter 17 – Special Inspections



# IBC Chapter 14 Requirements

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**1403.2 Weather protection.** Exterior walls shall provide the building with a weather-resistant *exterior wall envelope*.

The *exterior wall envelope* shall include flashing, as described in Section 1405.4.

The *exterior wall envelope* shall be designed and constructed in such a manner as to prevent the accumulation of water within the wall assembly by providing a *water resistive barrier* behind the exterior veneer





# IBC Chapter 14 Requirements

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## Exterior Wall Envelope

System or assembly of wall components that includes exterior wall finish materials to:

- Provide protection of structural members
- Provide protection of framing and sheathing materials
- Provide protection of conditioned interior space

From the detrimental effects of the exterior environment

# IBC Chapter 14 Requirements

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## Exterior Wall Envelope

Must be designed and constructed to prevent damage from:

- Rain
- Wind
- Snow
- Other weather events

# IBC Chapter 14 Requirements

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## ***Prescriptive Requirements***

### Exceptions to IBC 1403.2

A weather-resistant *exterior wall envelope* shall not be required over concrete or masonry walls designed in accordance with Chapters 19 and 21, respectively.

# IBC Chapter 14 Requirements

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## ***Prescriptive Requirements***

### Exceptions to IBC 1403.2

Exterior insulation and finish systems (EIFS) complying with Section 1408.4.1.

# IBC Chapter 14 Requirements

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## ***Performance Based Requirements***

### Exceptions to IBC 1403.2

*Exterior wall envelope* that has been demonstrated through testing to resist wind-driven rain, including joints, penetrations and intersections with dissimilar materials, in accordance with ASTM E 331 under the following conditions:

# Testing to ASTM 3 331 – 4 Conditions

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## Exceptions to IBC Prescriptive Requirements for Water-resistive barrier and Flashing

An *exterior wall envelope* testing to ASTM E 331:

### ***Condition 1***

- *Exterior wall envelope* test assemblies shall include at least one opening, one control joint, one wall/eave interface and one wall sill.
- Tested openings and penetrations shall be representative of the intended enduse configuration

# Testing to ASTM 3 331 – 4 Conditions

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## Exceptions to IBC Prescriptive Requirements for Water-resistive barrier and Flashing

An *exterior wall envelope* testing to ASTM E 331:  
***Condition 2***

- *Exterior wall envelope* test assemblies shall be at least 4 feet by 8 feet (1219 mm by 2438 mm) in size.

# Testing to ASTM 3 331 – 4 Conditions

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## Exceptions to IBC Prescriptive Requirements for Water-resistive barrier and Flashing

An *exterior wall envelope* testing to ASTM E 331:  
***Condition 3***

- *Exterior wall envelope* assemblies shall be tested at a minimum differential pressure of 6.24 pounds per square foot (psf) (0.297 kN/m<sup>2</sup>).



# Testing to ASTM 3 331 – 4 Conditions

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## Exceptions to IBC Prescriptive Requirements for Water-resistive barrier and Flashing

An *exterior wall envelope* testing to ASTM E 331:  
***Condition 4***

- *Exterior wall envelope* assemblies shall be subjected to a minimum test exposure duration of 2 hours.

# Testing to ASTM 3 331 – 4 Conditions

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An *exterior wall envelope* testing to ASTM E 331:  
The *exterior wall envelope* design shall be considered to resist wind-driven rain where the results of testing indicate that water did not penetrate:

- control joints in the *exterior wall envelope*
- joints at the perimeter of openings
- or intersections of terminations with dissimilar materials.

# Other IBC Requirements

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## Other Performance Requirements of Exterior Wall Envelope:

- Structural (Chapter 16)
- Flood Resistance (Chapter 16)
- Seismic (Chapter 16)

# Other IBC Requirements

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## Other Performance Requirements of Exterior Wall Envelope:

Fire resistance (Chapter 7) – Exterior walls tested to NFPA 285



# IBC Chapter 14 Requirements

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## Section 1404 Materials

- Section 1404.2 Requires water-resistive barrier
- Balance of section covers specific requirements for various construction materials:
  - ✓ Wood
  - ✓ Masonry
  - ✓ Metal
  - ✓ Concrete
  - ✓ Plastics
  - ✓ EFIS (Exterior Insulation and Finish Systems)
  - ✓ Vinyl or Polypropylene Siding



# IBC Chapter 14 Requirements

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## Section 1405 Installation of Wall Coverings

- Section 1405.2 requires Weather Protection
- Section 1405.3 Requires Vapor Retarders
- Section 1405.4 Requires Flashing
- Balance of section covers specific requirements for various construction materials:

# IBC Chapter 14 Requirements

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## Section 1406 Combustible Materials

This section covers specific requirements for various combustible exterior wall coverings:

- ✓ Plastics complying with Chapter 26, permitted
- ✓ Limitations based on separation distances (5 ft. or less/greater than 5 ft.)
- ✓ Materials with an ignition resistance in accordance with NFPA 268, permitted



# IBC Chapter 14 Requirements

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**Section 1407** Metal Composite Materials (MCM)

**Section 1408** Exterior Insulation & Finish Systems (EIFS)

**Section 1409** High-Pressure Decorative Exterior Grade Compact Laminates (HPL)

**Section 1410** Plastic Composite Decking





# Questions / Comments



# IBC Chapter 15 Requirements

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## Section 1503 Weather Protection

- Requires *approved* roof coverings
- Shall serve to protect the building or structure
- Minimum Requirements:
  - ✓ Flashing
  - ✓ Coping
  - ✓ Roof drainage: scuppers, gutters

# IBC Chapter 15 Requirements

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## Section 1504 Performance Requirements

- Wind Resistance of Roofs
- Physical properties = physical integrity over the working life of the roof based on 2000 hours of exposure to accelerated weathering tests in accordance with applicable standards
- Impact Resistance = in accordance with applicable standards

# IBC Chapter 17 Requirements

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## ➤ **Section 1705.11.3 Special Inspections for Wind Resistance**

- ✓ Wind Exposure Category B is 120 MPH
- ✓ Wind Exposure category C or D is 110 MPH

## ➤ **Section 1705.11.3 Wind-resisting components.**

*Periodic special inspection* is required for fastening of the following systems and components:

- ✓ Roof covering, roof deck and roof framing connections.
- ✓ Exterior wall covering and wall connections to roof and floor diaphragms and framing.

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# IBC Chapter 17 Requirements

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## SECTION 1707

### ALTERNATIVE TEST PROCEDURE

- **1707.1 General.** In the absence of *approved* rules or other *approved* standards, the *building official* shall make, or cause to be made, **the necessary tests and investigations**; or the *building official* shall accept **duly authenticated reports** from *approved agencies* in **respect to the quality and manner of use of new materials or assemblies** as provided for in Section 104.11. The cost of all tests and other investigations required under the provisions of this code shall be borne by the owner or the owner's authorized agent.



# IBC Chapter 17 Requirements

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## SECTION 1709

### PRECONSTRUCTION LOAD TESTS

**Section 1709.4** Load-bearing wall and partition assemblies with and without window framing

**Section 1709.5.1** Exterior windows and doors tested and labeled to AAMA/WDMA/CSA 101/I.S.2A440 *OR*

**Section 1709.5.2** Exterior windows and door not covered by 1709.5.1 shall be tested in accordance with ASTM E330 or ANSI/DASMA 108



# IBC Chapter 17 Requirements

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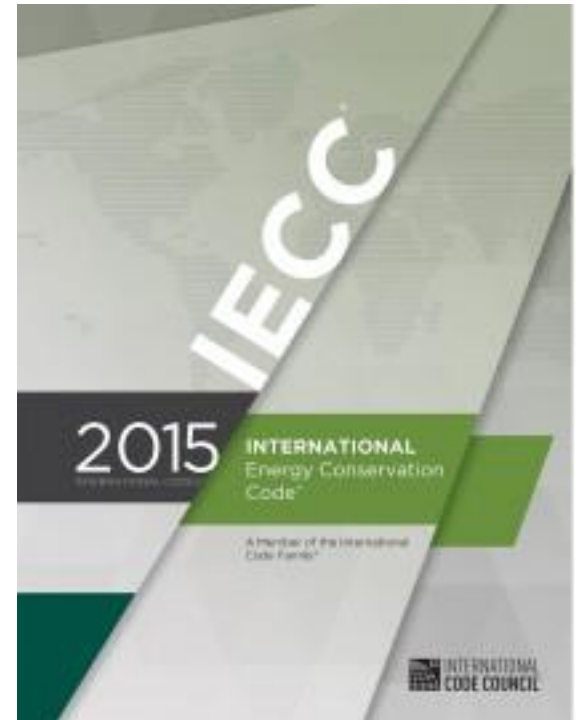
## 1709.7 Test specimens

- Test specimens and construction shall be representative of the materials, workmanship and details normally used in practice.
- The properties of the materials used to construct the test assembly shall be determined on the basis of tests on samples taken from the load assembly or on representative samples of the materials used to construct the load test assembly.
- Required tests shall be conducted or witnessed by an *approved agency*.

# Thermal Protection – Energy Conservation

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## *International Energy Conservation Code Requirements for Building Thermal Envelope Protection*





# IECC Definitions

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***Building Thermal Envelope.*** The basement walls, exterior walls, floor, roof and any other building elements that enclose *conditioned space* or provide a boundary between *conditioned space* and exempt or unconditioned space.

# More Definitions

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***Curtain Wall.*** Fenestration products used to create an external nonload-bearing wall that is designed to separate the exterior and interior environments.

***Infiltration.*** The 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.

# IECC Building Envelope Requirements

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## **Section C402 General (Commercial)**

*Prescriptive Building Thermal Envelope Assembly Requirements:*

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

# Questions / Comments



# Building Envelope Weather Protection Construction

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Establishing  
Weather  
Resistance



# Standards Writing Organizations

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## American National Standards Institute (ANSI)

- ASTM International (ASTM)
- American Architectural Manufacturers Association (AAMA)

# IBC Referenced Testing Standards

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**AAMA/WDMA/CSA 101/I.2.2/A440** *North American Fenestration Standard/Specifications for Windows, Doors and Skylights*

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

**ASTM E330** *Test Method for Structural Performance of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference*



# IBC Referenced Testing Standards

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**ASTM E331** *Test Method for Water Penetration of Exterior Windows, Skylights, Doors and Curtain Walls by Uniform Static Air Pressure Difference*

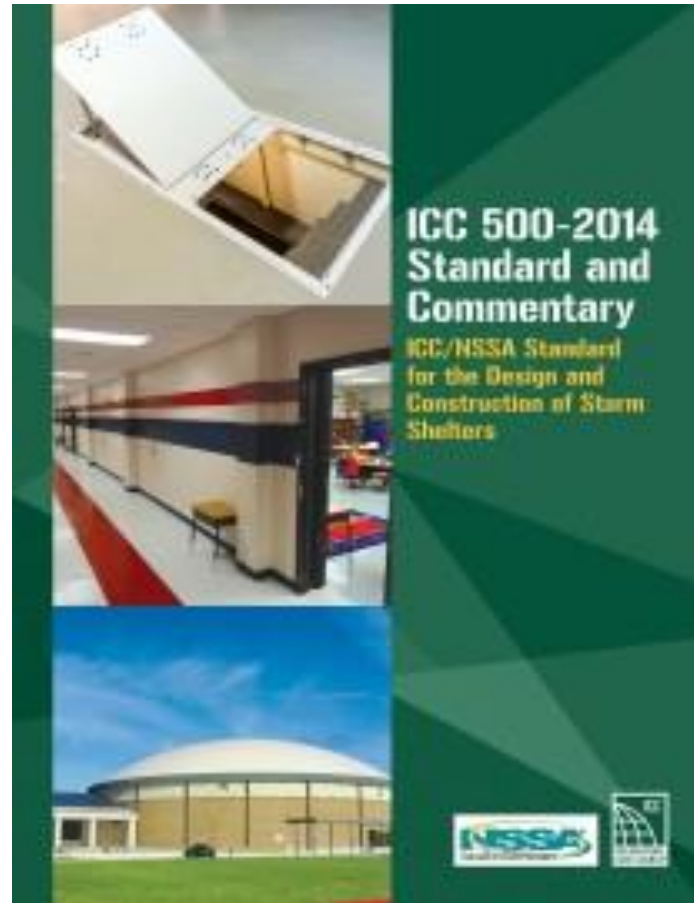
**ASTM E1886** *Test Method for Performance of Exterior Windows, Curtain Walls, Doors and Storm Shutters Impacted by Missiles and Exposed to Cyclic Pressure Differentials*





# ICC-500

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# Standing Up to the Elements



# ICC-500 Tornado Impact Testing

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# Building Envelope Weather Protection

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## Plan Review



# Plan Review

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Section 107.2.1 - Construction documents shall be of sufficient clarity to indicate the location, nature and extent of the work proposed and show in detail that it will conform to the provisions of this code ...

# Plan Review Cont.

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- Details showing compliance with the weather resistance requirements of the IBC should be included on the plans and in the specifications
- Results of Mock-up testing of ***Assemblies***

# Plan Review Cont.

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- Review proposed weather resistance *Exterior Wall Envelope Assemblies* for compliance with code
  - Type of Construction
  - Details of assemblies proposed relative to actual construction
- Consider need for special inspections as required by code and/or by department policy

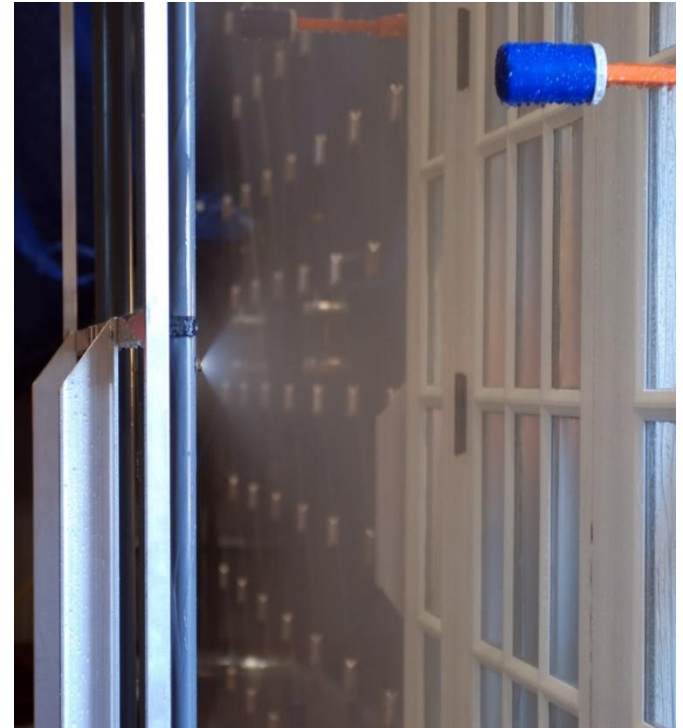
# Methods of Showing Code Compliance

Job specifications require windows to be tested and labeled to the NAFS standard under laboratory conditions as required by the IBC

## Testing required:

- Air infiltration - ASTM E283
- Water penetration – ASTM E331
- Structural performance – ASTM E330
- Forced entry – ASTM F588
- Operational force testing – ASTM E2068
- Operational cycling performance
- Many other tests dependent on Class

## • Typical Label on windows:





# IECC Thermal Performance Requirements

- **Performance Requirements:**
- U-Factor
- SHGC – Solar Heat Gain Coefficient
- VT – Visible Transmittance
- Condensation (optional)
  
- **National Fenestration Rating Council Standards:**
- NFRC 100
- NFRC 102
- NFRC 500
  
- **Testing required:**
- Thermal simulation testing
- Thermal Performance testing to validate simulation results



World's Best Window Co.  
Millennium 2000+  
Vinyl-Clad Wood Frame  
Double Glazing • Argon Fill • Low E  
Product Type: **Vertical Slider**

ENERGY PERFORMANCE RATINGS	
U-Factor (U.S./I-P)	Solar Heat Gain Coefficient
<b>0.30</b>	<b>0.30</b>
ADDITIONAL PERFORMANCE RATINGS	
Visible Transmittance	Air Leakage (U.S./I-P)
<b>0.51</b>	<b>0.2</b>

Manufacturer stipulates that these ratings conform to applicable NFRC procedures for determining whole product performance. NFRC ratings are determined for a fixed set of environmental conditions and a specific product size. NFRC does not recommend any product and does not warrant the suitability of any product for any specific use. Consult manufacturer's literature for other product performance information.  
www.nfrc.org



Typical Label on windows:

# Windstorm Resistance Requirements

- **Performance Requirements:**
  - Structural integrity from impact and high velocity wind pressures
- **Standards:**
  - ASTM E330
  - ASTM E1886
  - ASTM E1996
  - TAS 201/202/203 (Miami-Dade)
  - FEMA Publication 320 and 361 (safe rooms)
  - ICC 500 (storm shelters)
- **Testing required:**
  - Large & small missile impact testing
  - Cyclic Pressure testing
- **Typical UL Mark on windstorm-rated products:**

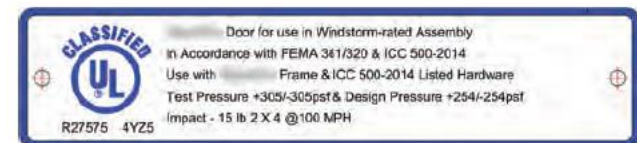


Figure B1-7. Example door label for a product that has been tested to safe room criteria

# Mock-up Testing Requirements

## •Typical Job Specifications

- Prior to installing glazed aluminum curtain wall system, construct mockups for each form of construction and finish
- Notify Architect 7 days in advance and obtain Architect's approval of mockups before start of Work.
- Provide materials and related accessories to construct testing mock-up(s) that represent the identical elements which will be used in the final work.
- Provide personnel to install wall mock-up(s) who will be performing the actual Work.
- Simulate actual construction conditions as accurately as possible in every way.
- Where mock-up specimens are constructed with corner sections (either inward or outward), both elevations shall be tested simultaneously wherever possible, with all surfaces exposed to air, water and structural test requirements.
- Provide extra materials as may be required to replace materials which fail during tests
- Pre-Test Meeting: Prior to the start of construction of mock-up assembly meet to review methods and sequence of the mock-up construction.
- Testing Laboratory: Recognized independent AAMA approved testing agency which is equipped and experienced in conducting the required tests and approved by the Owner.
- Submit three (3) copies of test report, prepared by the testing agency, for each specified test showing required performance criteria and test results

# Exterior Wall System Mock-Up Sample

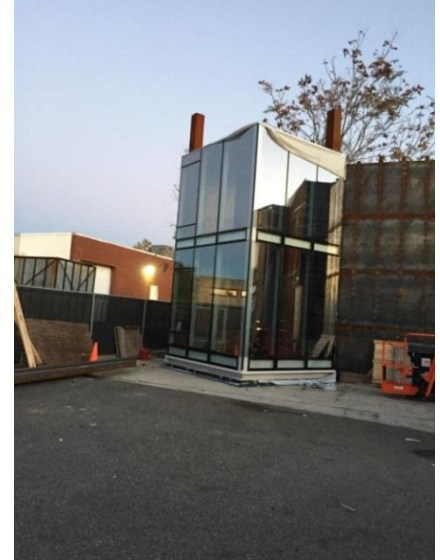


•A pre-construction exterior wall system constructed to evaluate air and water resistance, structural, thermal & seismic performance

# Mock-Up Testing Procedures

## Mock-up testing sequence typically required:

- ✓ Air Infiltration as per ASTM E283
- ✓ Water Penetration under Static Pressure as per ASTM E331
- ✓ Dynamic Resistance Test as per AAMA 501.1
- ✓ Inter-story Vertical Displacement as per AAMA 501.7
- ✓ Structural Performance as per ASTM E330
- ✓ Inter-story Horizontal Displacement as per AAMA 501.4
- ✓ Thermal Cycling as per AAMA 501.5
- ✓ Condensation Resistance Testing
- ✓ Seismic Displacement Testing
- ✓ Anchor Bolt Testing
- ✓ Washer Bolt Testing

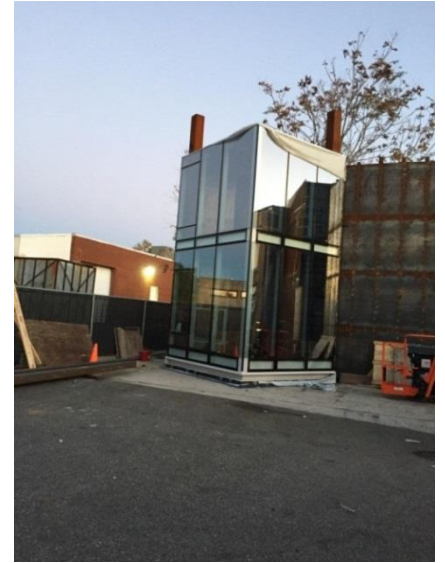


# Mock-Up Testing Results

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**Typical issues or challenges identified in Mock-up samples:**

- ✓ **Incompatibility of materials**
- ✓ **Materials don't meet the performance requirements of the project**
- ✓ **Sealants or gaskets missing or needed**
- ✓ **Sealants or gaskets incompatible with substrates**
- ✓ **Lack of installation instructions**
- ✓ **Incomplete installation instructions**
- ✓ **Materials difficult or time consuming to install in the field**



# Mock-Up Testing at UL Facility

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# Building Envelope Weather Protection

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## Inspection Process





# Inspection of Building Envelope Weather Protection

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- Inspections typically done by Code Official but may be inspected by an approved agency or individual
- Verifies approved design is being used  
Verifies assembly is being constructed in accordance with the approved design
- Verifies installation is in accordance with instructions and design criteria

# For the Architect / Contractor

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Approved mock-up testing serves two roles:

Evidence of code compliance

Set-of build instructions

# For the Building Code Official

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Approved mock-up testing serves two roles:

Evidence of code compliance

Documentation by which to inspect

# Field Testing Prevents & Identifies Problems

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- ✓ ***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***



# Test Standards for Field Testing

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## ➤ **AAMA 502 Field Testing**

- ✓ Required for newly installed products to verify installed performance of the product and the installation (ASTM E783 & ASTM E1105)

## ➤ **AAMA 503 Field Testing**

- ✓ Required for newly installed storefronts, curtain walls and sloped glazing systems (ASTM E783 & ASTM E1105)

## ➤ **AAMA 501.2 Nozzle Testing**

- ✓ Required to evaluate joints, gaskets, and sealant details in the glazing designed to remain permanently closed and water tight.

## ➤ **AAMA 511 Forensic Testing**

- ✓ Required to evaluate wall assemblies with known water control problems to accurately identify suspect wall construction components and details.

## ➤ **AAMA 501.1 Dynamic Wind Driven Rain Testing**

- ✓ Required to evaluate newly installed products to verify installed performance when exposed to high velocity dynamic wind driven rain

# Test Methods for Field Testing

## ➤ **ASTM E783**

*Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors*

## ➤ **ASTM E1105**

*Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference*



# Field Testing

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# ***AAMA 501.2-15 – Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls and Sloped Glazing Systems***

## **Scope:**

- ✓ This document provides a quality assurance and diagnostic field water penetration check method for installed storefronts, curtain walls and sloped glazing systems.
- ✓ It is not intended to test the rated or specified water performance representative of wind driven rain or operable windows.
- ✓ It is intended that this procedure aid in evaluating joints, gaskets, and sealant details in the glazing which are designated be water tight.

## **Background:**

- ✓ This spec was developed to aid in Quality Assurance and Diagnostic circumstances.
- ✓ It was never intended to replace the AAMA 502 or the AAMA 503 field testing standards.





# ***AAMA 507-15 – Standard Practice for Determining the Thermal Performance Characteristics of Fenestration Systems in Commercial Buildings***

## **Scope:**

- ✓ This document covers glazed fenestration systems i.e.. windows, curtain walls, window walls, sloped glazing, storefronts, doors, and other glazed products that are installed into commercial buildings other than low-rise residential buildings.
- ✓ This document provides manufacturers, architects, builders and code authorities with a means to verify product thermal performance.

## **Background:**

- ✓ This document provides a uniform standard method for determining the thermal performance of building specific fenestration systems that are installed in commercial buildings. (U factor, SHGC, VT, Air Leakage, CRF)



# ***AAMA 501.1 – Standard Test Method For Water Penetration of Windows, Curtain Walls And Doors Using Dynamic Pressure***

## **Scope:**

- ✓ This test method establishes the equipment procedures for testing exterior windows, curtain walls, and doors for water penetration using dynamic pressure.

## **Background:**

- ✓ This standard was developed to simulate wind driven rains. At this time the standard is also being expanded upon to include dynamic water testing for the field.



# Considerations for Field Testing Readiness

## ➤ **Readiness Considerations:**

- ✓ Know your standards, specifications and building codes
- ✓ Know the pressure requirements and allowable pressures
- ✓ Verify sufficient water and electrical supply available on site
- ✓ Verify scaffolding or lift apparatus available and effectively placed near specimens
- ✓ Verify if booster pump is needed
- ✓ Verify curtain wall systems have end caps
- ✓ Verify caulk has been cured and fully applied
- ✓ Verify curtain wall systems to be tested
- ✓ Weather conditions can affect testing - rain & ice

## ➤ **Time saves money – Discuss with your team ahead of time**

- ✓ Keep in contact with your lab
- ✓ Ask your testing agent questions
- ✓ Reach out to those whom have experience
- ✓ Know what areas are best for testing



# Questions / Comments

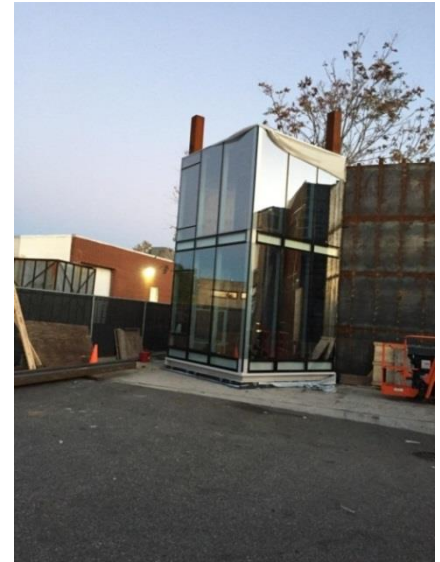


# UL Service Offerings

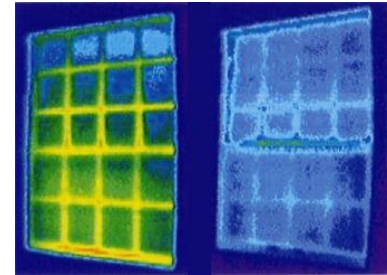
Exterior wall system mock-ups are evaluated for air and water resistance & structural integrity to validate design, workmanship & material selection and workability prior to job site construction

## Mock-up testing procedures conducted:

- ✓ Air Infiltration as per ASTM E283
- ✓ Water Penetration under Static Pressure as per ASTM E331
- ✓ Dynamic Resistance Test as per AAMA 501.1
- ✓ Inter-story Vertical Displacement as per AAMA 501.7
- ✓ Structural Performance as per ASTM E330
- ✓ Inter-story Horizontal Displacement as per AAMA 501.4
- ✓ Thermal Cycling as per AAMA 501.5
- ✓ Condensation Resistance Testing
- ✓ Seismic Displacement Testing
- ✓ Anchor Bolt Testing
- ✓ Washer Bolt Testing
- ✓ Air leakage testing of air barriers per ASTM 2387
- ✓ Flame propagation of exterior envelope to NFPA 285



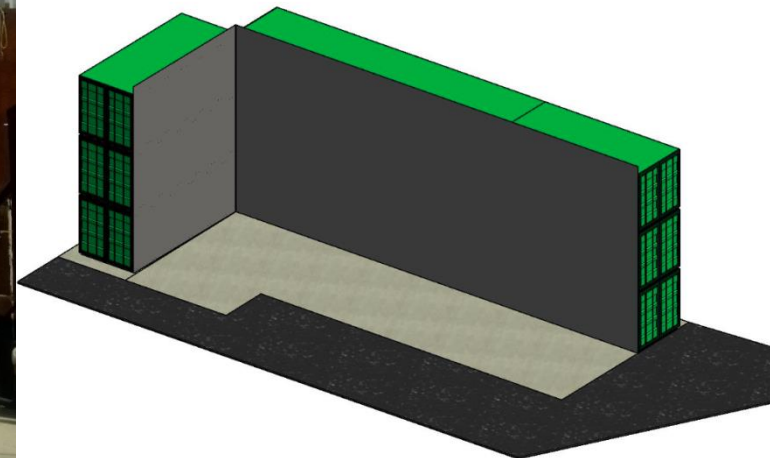
# UL Curtain Wall Testing Capabilities



# UL Curtain Wall Mock-Up Testing Capabilities

## 25' High Outdoor Mock-Up Test Facility

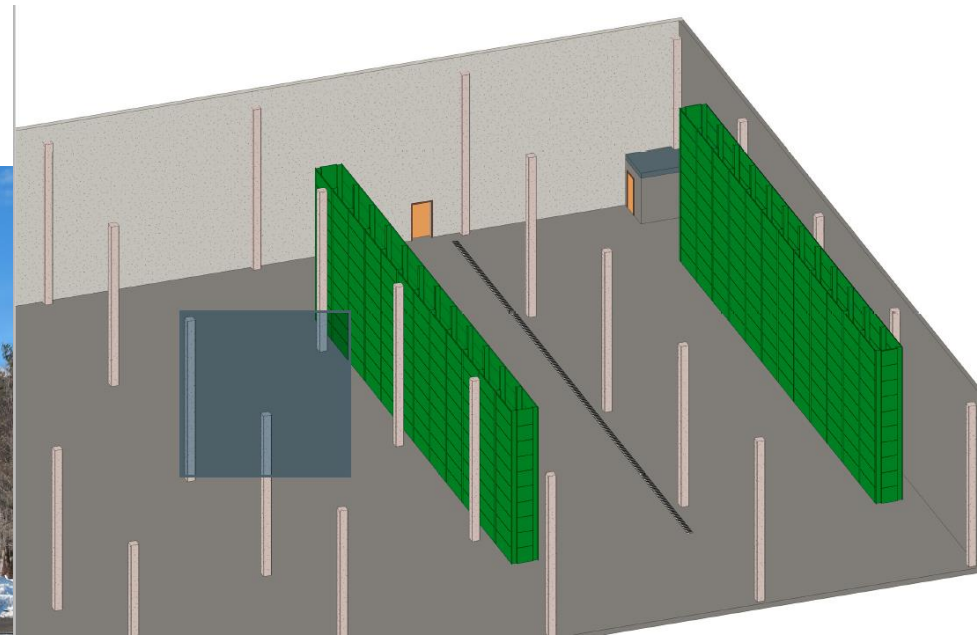
- 2000 SF (186 SM) of curtain wall space
- Mock-ups tested to 30' height



# UL Curtain Wall Mock-Up Testing Capabilities

## 30' High Indoor Mock-Up Test Facility in Chicago area

- 65,000 SF
- Indoor dynamic testing
- Dedicated customer office & meeting space with viewing areas
- March 2016





# Benefits of using UL

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1. **Recognition – UL has over 120 years in developing product standards and conducting evaluations of a wide range of building components, materials and systems**
2. **Knowledge and Experience – Technical staff with over 25 years of experience in evaluating building envelope products and buildings**
3. **Chicago area test location - Allows for viewing construction, installation, testing and design changes in a local venue**



# Contacts

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# Air and Water Field Testing Case Studies

## Why is Field testing conducted:

- ✓ Eliminate the potential for building damage caused by air and water leakage
- ✓ Ensure the quality of installation and performance of installed products
- ✓ Verify compliance with architect and industry specifications
- ✓ Forensics investigations to identify the source of problems in the field



# Air and Water Field Testing Case Studies

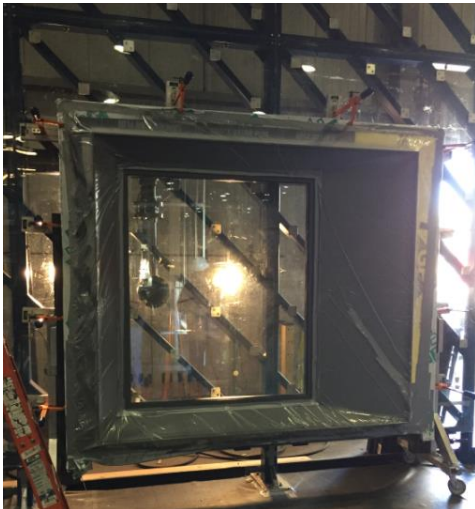
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## European window system for commercial high-rise

- Testing: AAMA 101

### Issues:

- Lack of coordination between architect, consultant, window system supplier, window broker and window manufacturer.
- Lack of detailed installation instructions
- Window system was installed out of square resulting in primary seal not performing its function



# Air and Water Field Testing Case Studies

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Testing: AAMA 501.1 wind driven rain testing modified for field conditions

**Issues:** Glass thickness not installed to specification resulting in water leakage



# Air and Water Field Testing Case Studies

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## Public School Building

Testing: AAMA 503 modified so as not to include perimeter sealant

**Issue:** Installation procedures resulted in air and water leakage problems



# Air and Water Field Testing Case Studies

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## Ambulatory Health Care Center

- Testing: AAMA 503
- **Issues:** Testing revealed that water barrier sealant was not installed on sill of curtain wall in accordance with the specifications resulting in water leakage



# Available Resources

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UL – Third party testing lab

[www.ul.com/windows](http://www.ul.com/windows)

*American Architectural Manufacturers  
Association (AAMA)*

<http://www.aamanet.org>





# Knowledge Check

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Ask participants these questions to check knowledge:

- ✓ Where are weather resistance requirements for commercial buildings found?
- ✓ Where are thermal envelope and energy requirements for commercial buildings found?
- ✓ Why is air and water field testing conducted on buildings today?
- ✓ What type of testing do project specifications frequently require related to windows, curtain walls and glazing?
- ✓ What are the test standards and methods used to conduct field testing of installed windows and curtain walls?
- ✓ What test data is obtained when conducting air infiltration testing and water penetration testing and how is that data used to positively impact a building project?

# Questions / Comments



# Building Envelope Weather Protection

## UL's Online Search Tools



# UL's Online Search Tools

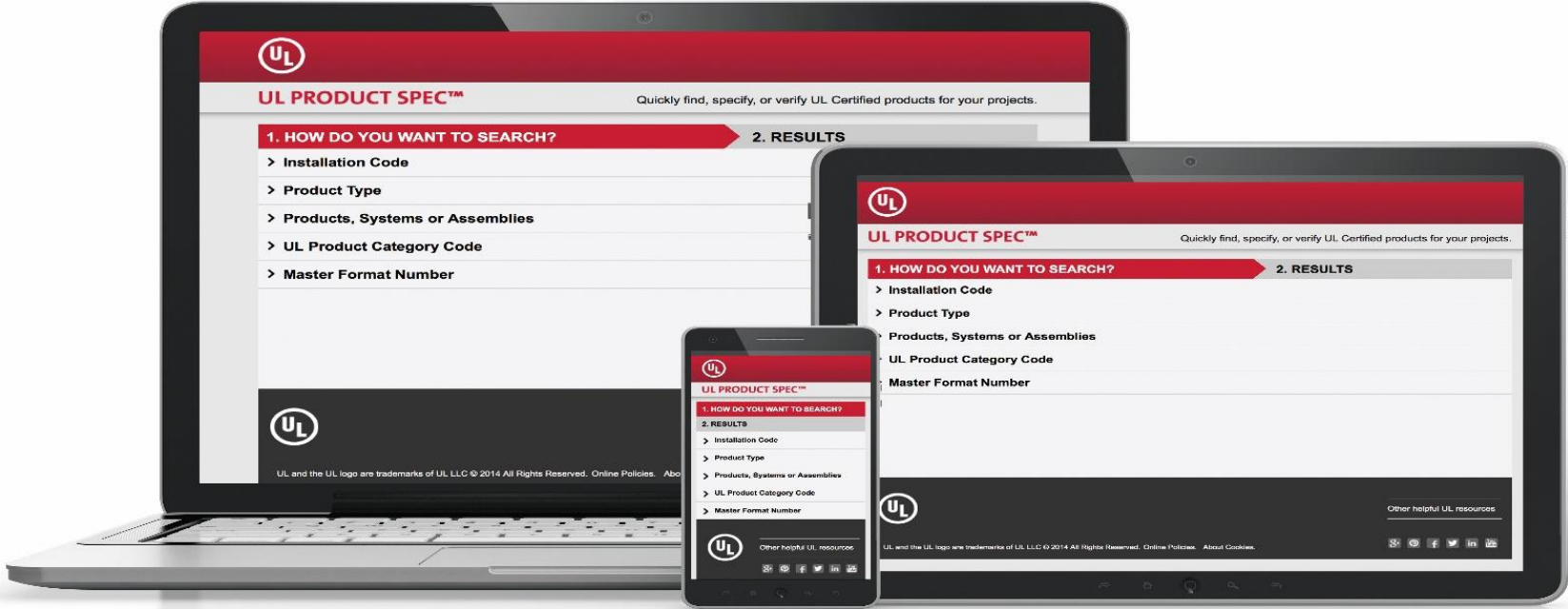
---

➤ Product Spec™

➤ Code Link



# Product Spec™



# UL Product Spec™

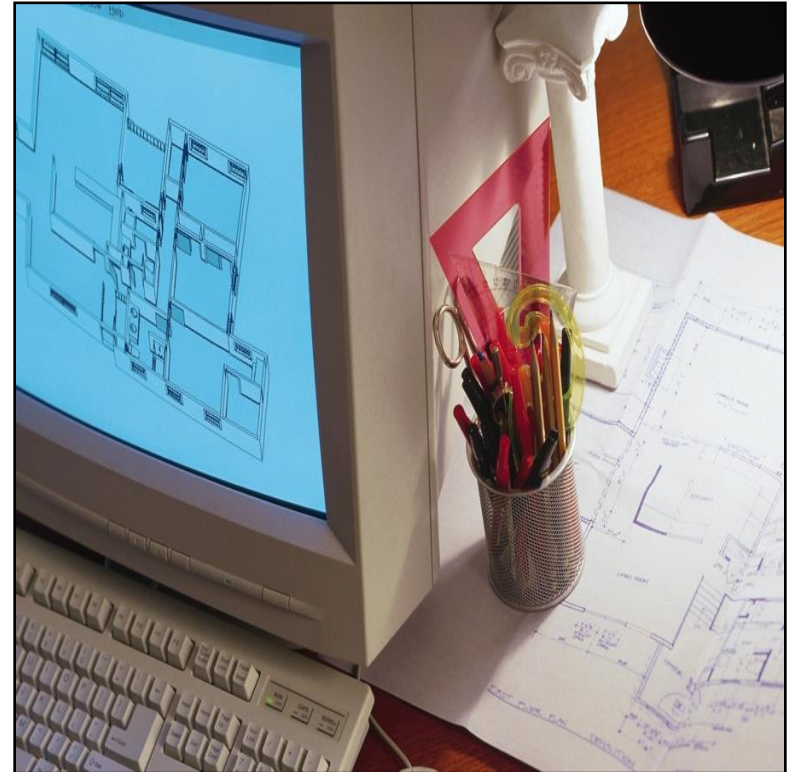
---

- Automatically formats to any device with an internet connection
- No charge to access
- Find, specify or verify UL certified building products
- Updated daily
- Easy to use
  - <http://www.ul.com/productspec>



# UL Product Spec™

Searching for  
Information  
about Building  
Envelope  
Weather  
Protection



# UL Product Spec™



## UL PRODUCT SPEC™

Quickly find, specify, or verify UL Certified products for your projects.

### 1. HOW DO YOU WANT TO SEARCH?

### 2. RESULTS

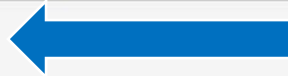
> Installation Code

> Product Type

> Products, Systems or Assemblies

> UL Product Category Code

> Master Format Number





# UL Product Spec™

**UL PRODUCT SPEC™**

Quickly find, specify, or verify UL Certified products for your projects.

**1. HOW DO YOU WANT TO SEARCH?**

**2. RESULTS**

## Building or Fire Systems

Fire Protection Systems

Commercial Cooking

Elevators

Fire Rated Walls, Floors, Beams and Columns

Firestop Systems

Passive Systems

Roofing

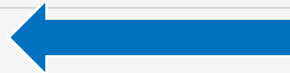
Windstorm Rated Products

Egress Equipment

Flammable Liquid Storage

Green Buildings

**Back**



# UL Product Spec™

## UL PRODUCT SPEC™

Quickly find, specify, or verify UL Certified products for your projects.

### 1. HOW DO YOU WANT TO SEARCH?

### 2. RESULTS

#### Windstorm Rated Products

Windstorm-rated Swinging Door Components (ZHCH)

Accessories for Windstorm-rated Swinging Doors (ZHCK)

Swinging Doors, Exterior (ZHCW)

Door Frames (ZHDL)

Glass Light Frames for Windstorm-rated Doors (ZHDO)

Hinges (ZHDX)

Latching Hardware (ZHEM)

Windstorm-rated Assemblies (ZHLA)

Products for Use in Windstorm-rated Assemblies (ZHLL)

Back



# Code Link

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- Correlates model code sections to UL product categories
- Covers many model codes and editions (IBC, IRC, IgCC, ICC-500, etc.)
- Flexible search capabilities
- Powerful tool to locate appropriate Listings
- [www.ul.com/codelink](http://www.ul.com/codelink)



# Code Link

## 1. HOW DO YOU WANT TO SEARCH?

## 2. RESULTS

National Electrical Code	2014	2011
International Fire Code	2015	2012
NFPA 1: Fire Code	2015	2012
NFPA 101: Life Safety Code	2012	2009
International Building Code	2015	2012
International Residential Code	2015	2012
Canadian Electrical Code, Part 1	2012	2009
ASHRAE 189.1	2011	
CAL Green	2013	
ICC 700	2012	
International Fuel Gas Code	2015	2012
International Green Construction Code	2012	



# Code Link

## UL PRODUCT SPEC™

Quickly find, specify, or verify UL Certified products for your projects.

### 1. HOW DO YOU WANT TO SEARCH?

### 2. RESULTS

National Electrical Code

2014

2011

International Fire Code

2015

2012

NFPA 1: Fire Code

2015

2012

NFPA 101: Life Safety Code

2012

2009

International Building Code

2015

2012

Enter one of the following search parameters:

Code Section Number:

1403.2

UL Product Category Code:

Example: "NITW"

Search



# Code Link

**UL PRODUCT SPEC™**

Quickly find, specify, or verify UL Certified products for your projects.

## 1. HOW DO YOU WANT TO SEARCH?

## 2. RESULTS

**Search** Code name: International Building Code; Edition: 2015; Section number: 1403.2

**Results** 1-4 of 4

### INSTALLATION CODE



### UL PRODUCT CATEGORY & CODE

IBC 2015: 1403.2

Water-resistive Barriers - Housewraps: BIDN

IBC 2015: 1403.2

Exterior Wall Systems: FWFO

IBC 2015: 1403.2

Exterior Wall System Components: FWFY

IBC 2015: 1403.2

Weather Barriers: ULEY

**Results** 1-4 of 4

**Print**

**New Search**



# Code Link

## UL PRODUCT SPEC™

Quickly find, specify, or verify UL Certified products for your projects.

1. HOW DO YOU WANT TO SEARCH?

2. RESULTS

### UL PRODUCT CATEGORY

Exterior Wall Systems, FWFO

#### GENERAL

This category covers exterior non-load-bearing wall assemblies investigated to ANSI/NFPA 285, "Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components," as required by the "International Building Code," or ANSI/NFPA 5000, "Building Construction and Safety Code."

ANSI/NFPA 285 is used to investigate the fire-propagation characteristics of exterior non-load-bearing wall assemblies and panels used as components of curtain wall assemblies that are constructed using combustible materials or that incorporate combustible components within the wall assemblies as follows:

> [Show additional information...](#)

### VIEW UL CERTIFIED PRODUCTS

[View list](#)



Print

New Search



# Code Link



## Search results

You may choose to [Refine Your Search.](#)

Company Name	Category Name	Link to File
<b>System No. EWS0001</b>	Exterior Wall Systems	<a href="#">FWFO.EWS0001</a>
<b>System No. EWS0002</b>	Exterior Wall Systems	<a href="#">FWFO.EWS0002</a>
<b>System No. EWS0003</b>	Exterior Wall Systems	<a href="#">FWFO.EWS0003</a>
<b>System No. EWS0004</b>	Exterior Wall Systems	<a href="#">FWFO.EWS0004</a>
<b>System No. EWS0005</b>	Exterior Wall Systems	<a href="#">FWFO.EWS0005</a>
<b>System No. EWS0006</b>	Exterior Wall Systems	<a href="#">FWFO.EWS0006</a>
<b>System No. EWS0007</b>	Exterior Wall Systems	<a href="#">FWFO.EWS0007</a>
<b>System No. EWS0008</b>	Exterior Wall Systems	<a href="#">FWFO.EWS0008</a>
<b>System No. EWS0009</b>	Exterior Wall Systems	<a href="#">FWFO.EWS0009</a>
<b>System No. EWS0010</b>	Exterior Wall Systems	<a href="#">FWFO.EWS0010</a>

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.





# Questions / Comments



# Thank You for Attending!!!

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