NFPA 285:
Fire Testing of Exterior Wall Assemblies Containing Combustible Components

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DuPont Building Innovations
Learning Objectives

1. Understand fire performance requirements in International Building Code (IBC)
2. Learn about fire related tests referenced by IBC
3. Understand NFPA 285 wall assembly testing
4. Understand which assembly components trigger NFPA 285 testing
5. Understand how to determine if your assembly requires NFPA 285 testing
6. Learn about potential alternative options to address compliance with NFPA 285
Section 1:
Understand International Building Code Requirements for Fire Performance
Construction Types (IBC Ch. 5, 6)

(Table 601 lists the fire resistant rating requirements for building elements, in hours)

Combustible Type V: Combustible Construction

Type IV: Non-Combustible Exterior Walls/Combustible interior structural frames

Type III: Non-Combustible Exterior Walls/Combustible interior structural frames

Type II: Non-Combustible Structure

Type I: Non-Combustible Structure

Each Type has an “A” and a “B” sub-category; “A” has increased fire protection requirements (see example below):

Type I-A: 3-hr rated structural frame
Type I-B: 2-hr rated structural frame
Type II-A: 1-hr rated structural frame
Type II-B: unprotected structural frame
3.3.2 Combustible (Material).
A material that, in the form in which it is used and under the conditions anticipated, will ignite and burn; a material that does not meet the definition of noncombustible or limited-combustible. [5000, 2012]

3.3.5 Noncombustible Material.
A material that, in the form in which it is used and under the conditions anticipated, will not ignite, burn, support combustion, or release flammable vapors when subjected to fire or heat. Materials that are reported as passing ASTM E 136, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 °C*, shall be considered noncombustible materials.

3.3.4 Limited-Combustible (Material). Refers to a building construction material not complying with the definition of noncombustible material that, in the form in which it is used, has a potential heat value not exceeding 3500 Btu/lb (8141 kJ/kg), when tested in accordance with NFPA 259, *Standard Test Method for Potential Heat of Building Materials*,............etc........
Construction Types Examples

Type V: Combustible
Type IV: Type III
Type I: Non-Combustible
Type II
### Maximum Building Height (IBC Table 503)

Including 1-story sprinkler system increase*

<table>
<thead>
<tr>
<th>Building Use</th>
<th>Type V Combustible</th>
<th>Type IV Heavy Timber</th>
<th>Type III Non-Combustible Exterior</th>
<th>Type II Non-Combustible Components</th>
<th>Type I Fire-Rated Structure</th>
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</thead>
<tbody>
<tr>
<td>Assembly***</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>Unlimited</td>
</tr>
<tr>
<td>Education</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>Unlimited</td>
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<tr>
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</tr>
<tr>
<td>Factory/Ind</td>
<td>4</td>
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<td>5</td>
<td>6</td>
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<tr>
<td>High Hazard</td>
<td>4</td>
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<tr>
<td>Institutional</td>
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<tr>
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<tr>
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<td>3</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>Unlimited</td>
</tr>
</tbody>
</table>

* Where a building is equipped with an approved automatic sprinkler system the maximum number of stories is increased by one.

Source: 2012 International Building Code
IBC Fire Related Tests and Reports

**Product Properties**

- ✔ **ASTM E84** Surface Burning Characteristics
- ✔ **ASTM E1354** Cone Calorimeter Test
- ✔ **ICC ES Reports** (*compliance aid, not a test method*)

**Assembly Properties**

- ✔ **ASTM E 119 or UL 263** Fire Rated Walls
- ✔ **NFPA 268** Radiant Ignitibility of Assemblies
- ✔ **NFPA 285** Walls With Combustible Components
What is NFPA 285?

- Test of the actual wall assembly is generally required when “noncombustible” walls contain “combustible” materials

- Is not new, but awareness has increased due to code changes

- In high-rise buildings: Assembly fire performance is critical for evacuation and life safety.
History of NFPA 285

Energy Crisis:
Leads to increased exterior insulation applications

1970’s
Late 70’s:
SPI develops full-scale test

1980’s
1988:
Uniform Building Code adopts UBC 17-6

Full-scale Fire Test
UBC 17-6 / UBC 26-4

1990’s
1997:
Uniform Building Code adopts UBC 26-9

1998:
NFPA adopts UBC 26-9 as NFPA 285

Reduced-scale Fire Test
UBC 26-9 / NFPA 285

2000’s
2000:
IBC begins requiring NFPA 285 testing

2010’s
2012:
IBC expands NFPA 285 testing to WRB

Source: “NFPA 285: What you Need to Know” by Jesse J. Beitel – JBED Summer 2012 issue
IBC NFPA 285 Testing - Material Triggers

- **Foam Plastic Insulation (Ch. 26)**
  - Applies to Type I – IV construction (~1988)
  - Applies to buildings of any height

- **Combustible Exterior Cladding (Ch. 14)**
  - EIFS - (~2000 IBC)
  - MCMs - (~2003 IBC)
  - FRPs - (~2009 IBC)
  - HPLs - (~2012 IBC)

- **Water-Resistive Barriers (Ch. 14)**
  - Applies to Type I, II, III, IV buildings over 40 ft
  - Applies to combustible WRB’s - (2012 IBC)
Section 1:
Understand International Building Code Requirements for Fire Performance

Questions?
Section 2: Wall Configuration and Performance Parameters for NFPA 285 Assembly Testing
NFPA 285 Multi-Story Test

2 Story Test with Interior & Exterior Burners

17.5 ft high × 13.3 ft wide (5.3 m high × 4.1 m wide)
NFPA 285 Fire Test - Components

- Test Wall Assembly
  - 18’0” Tall Min
  - 13’4” Wide Min

- 6” Concrete Slab
- CMU Walls
- 8” Concrete Slab
- 1st Floor Room
- 2nd Floor Room
- Room Burner
- 78” Wide Window Opening

- Window Burner
10.2.5. Flames in Second-Story Test Room.
Flames shall not occur in the second-story test room.
 NFPA 285 Fire Test – Parameters (Flame Spread)

Externally, Flames shall not reach 10 ft. above the window’s top

Externally, Flames shall not reach 5 ft. laterally from the window’s centerline
Thermocouples inside wall assembly shall not exceed 1000 °F during the test.
Section 2:
Successful NFPA 285 Assembly Performance: Test Configuration and Required Parameters

Questions?
Section 3:
Combustible Components in an Exterior Wall intended for Noncombustible Construction
Building Envelope Assembly Components

Interior Drywall
Vapor Barrier*
Cavity Insulation
Base Wall Structure

Exterior Sheathing
Air & Water Barrier
Exterior Insulation
Exterior Cladding

* Vapor Barrier’s use and location in the wall is climate specific
IBC NFPA 285 Requirements -- Triggers

a) COMBUSTIBLE COMPONENTS

- Foam Plastic Insulation
- Combustible Claddings (EIFS, MCM, FRP, HPL)
- Air & Water Barriers (WRBs)

b) DESIGN CONDITIONS REQUIRING NFPA 285

- Installations over 40’ (Type I, II, III, or IV)
- “Foam Plastic” and “Foam Plastic” core materials
IBC Combustible Component Requirements

Combustible Claddings

- EIFS - § 1408.2 (2000)
- MCM - § 1407.10 (2003)
- FRP - § 2612.5 (2009)
- HPL - § 1409.10 (2012)

Air & Water Barriers (WRBs)
- § 1403.5 (2012)

Foam Plastic Insulation – § 2603.5.5
IBC NFPA 285 Testing Requirements

Non-Combustible Construction Types I, II, III, or IV? (Per Commercial Building Code, IBC)

Is FOAM PLASTIC Insulation in the exterior wall assembly?

Is EXTERIOR CLADDING Combustible? AND Installed greater than 40’ above grade

Is WRB* Combustible? AND Installed greater than 40’ above grade

*PER 2012 IBC REVISION, EXCEPTIONS APPROVED FOR 2015 IBC RELEASE

NFPA 285 Compliance NOT REQUIRED
IBC Combustible Component Requirements

- Foam Plastic Insulation
- Combustible Claddings (EIFS, MCM, FRP, HPL)
- Air & Water Barriers

Material Requirements, IBC Type I-IV Taller than 40’

- Products are Labeled and Identified by manufacturer
- Flame Spread Index ≤25 (ASTM E84)
- Smoke Development Index ≤450 (ASTM E84)
- Maintain assembly fire rating (ASTM E119 or UL 263)
- Separated from interior by a Thermal Barrier (gyp. board)
NFPA 285 Wall Assembly: **Exterior Insulation**

**Combustible Claddings**
- EIFS - § 1408.2
- MCM - § 1407.10
- FRP - § 2612.5
- HPL - § 1409.10

**Air & Water Barriers** – § 1403.5

**FOAM PLASTIC INSULATION** – § 2603.5.5
Increasing Mandatory use of Continuous Insulation (ci) in EVERY climate zone
### Impact of Thermal Bridging on Effective Installed R-Value for Steel-Framed Walls

<table>
<thead>
<tr>
<th>Actual Cavity Depth, inch</th>
<th>Rated R-Value</th>
<th>Effective R-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5 in. depth</td>
<td>R-11</td>
<td>R-5.5</td>
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<tr>
<td></td>
<td>R-13</td>
<td>R-6.0</td>
</tr>
<tr>
<td></td>
<td>R-15</td>
<td>R-6.4</td>
</tr>
<tr>
<td>6.0 in. depth</td>
<td>R-19</td>
<td>R-7.1</td>
</tr>
<tr>
<td></td>
<td>R-21</td>
<td>R-7.4</td>
</tr>
<tr>
<td>24&quot; o.c.</td>
<td>R-11</td>
<td>R-6.6</td>
</tr>
<tr>
<td>3.5 in. depth</td>
<td>R-13</td>
<td>R-7.2</td>
</tr>
<tr>
<td></td>
<td>R-15</td>
<td>R-7.8</td>
</tr>
<tr>
<td>6.0 in. depth</td>
<td>R-19</td>
<td>R-8.6</td>
</tr>
<tr>
<td></td>
<td>R-21</td>
<td>R-9.0</td>
</tr>
</tbody>
</table>

Source: TABLE A3.3 Assembly U-Factors for Steel-Frame Walls, ASHRAE 90.1-2007
Common Insulation Types

- **Glass Fiber Batt**
  - R-value: ~3.3 R/in
  - Permeability: 118 perm-in

- **Spray Polyurethane Foam**
  - R-value: ~6 R/in (high density)*
  - Permeability: ~1.9 perm-in

- **EPS (Expanded Polystyrene)**
  - R-value: ~4 R/in
  - Permeability: ~2.7 perm-in

- **XPS (Extruded Polystyrene)**
  - R-value: ~5 R/in
  - Permeability: ~0.8 perm-in

- **Polyisocyanurate**
  - R-value: ~6 R/in
  - Permeability: ~0.75 perm-in

- **Mineral Fiber**
  - R-value: ~4 R/in
  - Permeability: ~54 perm-in

NFPA 285 Wall Assembly: Combustible Claddings

Air & Water Barriers – § 1403.5

**COMBUSTIBLE CLADDINGS**
- EIFS - § 1408.2
- MCM - § 1407.10
- FRP - § 2612.5
- HPL - § 1409.10

Foam Plastic Insulation – § 2603.5.5
COMBUSTIBLE
- Exterior Insulation Finishing Systems (EIFS)
- Metal Composite Materials (MCMs)
- Fiber Reinforced Plastics (FRPs)
- High Pressure Laminates (HPLs)

NON-COMBUSTIBLE
- Brick / Masonry / Stone / Terracotta
- Concrete / Cementitious Stucco
- Fiber Cement Boards / Panels
NFPA 285 Wall Assembly: Exterior Cladding

- Exterior Insulation Finishing Systems (EIFS) - § 1408.2
  - IBC regulates under “Foam Plastic” Requirements
  - § 1408.2: Meet the EIFS performance requirements of ASTM E2568

- Metal Composite Materials (MCMs)
- Fiber Reinforced Plastics (FRPs)
- High Pressure Laminates (HPLs)
NFPA 285 Wall Assembly: Exterior Cladding

- Exterior Insulation Finishing Systems (EIFS)
- Metal Composite Materials (MCMs) - § 1407.10
  - Excludes “Foam Plastic” core materials
  - Different core materials have different fire performance characteristics
  - Available in Open and Closed Joint Systems
  - Approximate 4mm-12mm panel thickness
  - § 1407.10.4. Comply with NFPA 285 acceptance criteria. Full-scale tests performed with the MCM in the max. thickness intended for use

- Fiber Reinforced Plastics (FRPs)
- High Pressure Laminates (HPLs)
NFPA 285 Wall Assembly: Exterior Cladding

- Exterior Insulation Finishing Systems (EIFS)
- Metal Composite Materials (MCMs)

● Fiber Reinforced Plastics (FRPs) – § 2612.5
  - Foam cores comply with “Foam Plastic” Req’s
  - Surface Burning Characteristics: Flame Spread Index ≤75 and smoke-developed index ≤ 450 (ASTM E84)
  - Installations less than 40’ above grade
    - Limited to 10% area when separation <10’
    - Flame Spread Index ≤200 (ASTM E84)
    - Fireblocking Required

http://www.cranecomposites.com
NFPA 285 Wall Assembly: Exterior Cladding

- Exterior Insulation Finishing Systems (EIFS)
- Metal Composite Materials (MCMs)
- Fiber Reinforced Plastics (FRPs)

- High Pressure Laminates (HPLs) - § 1409.10
  - Available in Open and Closed Joint Systems
  - Approximate 4mm-12mm panel thickness
  - Different core materials have different fire performance characteristics
  - Installations less than 40’ above grade
    - Limited to 10% area when separation < 5’

http://www.trespa.com
NFPA 285 Wall Assembly: Air & Water Barrier

Combustible Claddings
- EIFS - § 1408.2
- MCM - § 1407.10
- FRP - § 2612.5
- HPL - § 1409.10

Foam Plastic Insulation – § 2603.5.5

Air & Water Barriers – § 1403.5
2015 IBC has approved WRB exceptions based on material properties and fuel load potential.
# NFPA 285 Wall Assembly: Air & Water Barrier

## IBC NFPA 285 Test Requirements for WRBs

<table>
<thead>
<tr>
<th>NFPA 285 Test Req’s</th>
<th>Pre-2012</th>
<th>2012</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installations over 40’ above grade must meet the requirements of NFPA 285 (<strong>Type I, II, III, or IV</strong>).</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Exceptions

<table>
<thead>
<tr>
<th>Exceptions</th>
<th>Pre-2012</th>
<th>2012</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>WRB is the only combustible wall component and the wall has a non-combustible covering (Table 1405.2).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Windows and doors, and window/door flashings.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. WRB is the only combustible wall component and the wall has a non-combustible covering (Table 1405.2).

2. WRB is the only combustible wall component **and:**
   - ASTM E84 Product Test: **Type A**
     - flame spread index of 25 or less
     - smoke-developed index of 450
   - ASTM E1354 (Cone Calorimeter) Product Test:
     - Incident radiant heat flux of **50 kW/m²**.
     - Effective Heat of Combustion of less than **18 MJ/kg**
     - Peak Heat Release Rate less than **150 kW/m²**
     - Total Heat Release of less than **20 MJ/m²**

3. Windows and doors, and window/door flashings.
Section 3:
Combustible Components in a Non-combustible Wall Assembly

Questions?
Section 4: NFPA 285 Compliant Assemblies
NFPA 285 Test Logistics

- Limited Testing Laboratory Availability
  - Intertek (San Antonio, TX)
  - Southwest Research (San Antonio, TX)
  - Architectural Testing (York, PA)

- Potentially High Project Costs
  - High Testing Cost
  - Long Lead Time

- Results are owned by the company paying for the test
  - No directory of listed assemblies
  - No direct method for substituting assembly components
Wall Designs with **Combustible** Components

1. **Use existing NFPA 285 tested compliant system**

   OR

2. **Test new assembly per NFPA 285**

   OR

3. **Modify an existing NFPA 285 compliant system with local Authority Having Jurisdiction (AHJ) approval, such as building officials**
NFPA 285 Compliant Assemblies are Specific

● Required for various components in all configurations

● For example, there is no one test or test assembly to qualify a WRB for use in all assemblies

● Changes in configurations (air gaps, attachment systems, etc.) can cause different results

● If a “New” combustible component is added in the wall assembly, then new testing required for all of the various configurations.
Variations in Wall Assemblies = Many Tests

WRB / Polyiso / BRICK

WRB / Polyiso / MCM

WRB / Polyiso / HPL

WRB Over / Polyiso / BRICK

WRB Over / Polyiso / MCM

WRB Over / Polyiso / HPL

WRB Over / Polyiso / Fiber Cement

WRB / XPS / BRICK

WRB / XPS / MCM

WRB / XPS / HPL

WRB Over / XPS / BRICK

WRB Over / XPS / MCM

WRB Over / XPS / HPL

WRB Over / XPS / Stucco

WRB / Mineral Fiber / BRICK

WRB / Mineral Fiber / MCM

WRB / Mineral Fiber / HPL

WRB Over / Mineral Fiber / BRICK

WRB Over / Mineral Fiber / MCM

WRB Over / Mineral Fiber / HPL

WRB Over / Mineral Fiber / EIFS

WRB / EIFS
NFPA 285 Assembly Compliance Considerations

- Substitutions of one material for another can cause different test results
- Addition of combustibles (insulation, WRBs, etc.) can cause different test results
- Wall systems made of a number of previously NFPA 285 tested materials does not ensure a successful NFPA 285 test
- Tests are required for many various claddings and other combustible wall components – insulation, WRBs
SECTION 4

Engineering Judgment Letter

● Written by a independent source,
  ➢ approved by the building official
  ➢ competent and experienced
  ➢ in engineering principles of materials, methods or system analysis

● References Specific NFPA 285 “PASS” test results (owned by manufacturer)

● Specifies all corresponding wall components evaluated (structure, insulations, WRB, Claddings etc.)

● Outlines opening details and flashing conditions evaluated
Letter Expands Assembly Test Results by 4 Products
Learning Objectives

- Understand fire performance requirements in International Building Code (IBC)
- Learn about fire related tests referenced by IBC
- Understand NFPA 285 wall assembly testing
- Understand which assembly components trigger NFPA 285 testing
- Understand how to determine if your assembly requires NFPA 285 testing
- Learn about potential alternative options to address compliance with NFPA 285
Thank You!

Questions?

This concludes the American Institute of Architects Continuing Education Systems Program

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