

Engineering Analysis of *NFPA 285* Tested Assemblies



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Introduction

Foam plastics used in buildings of Types I-IV construction require an assessment of their ability to resist vertical and lateral flame spread

IBC Section 2603.5.5:

“The exterior wall assembly shall be tested in accordance with and comply with the acceptance criteria of NFPA 285”

Introduction

- Does this mean that every possible wall assembly configuration needs to be tested to *NFPA 285* to be compliant with the code?

Introduction

- What about extension of tested assemblies through engineering analysis?
- Is actual testing required, or is engineering analysis permitted?
- Let's look at the building code requirements

Code Requirements

- First, there are exceptions to the requirement
- Code compliance of fire-rated wall assemblies

IBC Section 2603.5.5:

2603.5.5 Vertical and lateral fire propagation. The exterior wall assembly shall be tested in accordance with and comply with the acceptance criteria of NFPA 285.

Exceptions:

1. One-story buildings complying with Section 2603.4.1.4.
2. Wall assemblies where the foam plastic insulation is covered on each face by not less than 1-inch (25 mm) thickness of masonry or concrete and meeting one of the following:
 - 2.1. There is no airspace between the insulation and the concrete or masonry.
 - 2.2. The insulation has a flame spread index of not more than 25 as determined in accordance with ASTM E 84 or UL 723 and the maximum airspace between the insulation and the concrete or masonry is not more than 1 inch (25 mm).

Code Requirements - Exception #1

- One-story buildings complying with *IBC* Section 2603.4.1.4
 - Flame spread index of 25 or less
 - Smoke-developed index of 450 or less
 - Foam Plastic Insulating Sheathing (FPIS) not more than 4" thick
 - Equipped with an automatic fire sprinkler system
 - FPIS covered with 0.032"-thick aluminum or 0.0160" corrosion-resistant steel

Code Requirements - Exception #2

- FPIS covered by minimum 1" masonry or concrete AND
 - No airspace between FPIS and masonry/concrete
 - OR
 - Flame spread index less than 25 and airspace a maximum of 1"

Code Requirements

- So other than the exceptions, do all other wall assemblies need to be tested?

Code Requirements

- Alternative materials code provisions (*IBC 2015*):

104.11 Alternative materials, design and methods of construction and equipment. The provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been approved. An alternative material, design or method of construction shall be approved where the building official finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, not less than the equivalent of that prescribed in this code in quality, strength, effectiveness, fire resistance, durability and safety. Where the alternative material, design or method of construction is not approved, the building official shall respond in writing, stating the reasons why the alternative was not approved.

104.11.1 Research reports. Supporting data, where necessary to assist in the approval of materials or assemblies not specifically provided for in this code, shall consist of valid research reports from approved sources.

104.11.2 Tests. Whenever there is insufficient evidence of compliance with the provisions of this code, or evidence that a material or method does not conform to the requirements of this code, or in order to substantiate claims for alternative materials or methods, the building official shall have the authority to require tests as evidence of compliance to be made at no expense to the jurisdiction. Test methods shall be as specified in this code or by other recognized test standards. In the absence of recognized and accepted test methods, the building official shall approve the testing procedures. Tests shall be performed by an approved agency. Reports of such tests shall be retained by the building official for the period required for retention of public records.

Code Requirements

- “Shall be tested” – what does this mean?
 - Any exterior wall assembly needs to be tested to, and comply with, *NFPA 285*
- Is testing of each individual assembly required as stated, or does Section 104.11 apply?
 - Analysis may be permitted, if the requirements of Section 104.11 are met

Code Requirements – 2015 IBC Combustible Components That Can Trigger NFPA 285 Testing

- Combustible air and Water Resistive Barriers (WRB) – 1403.5
 - 2015 IBC includes two new exceptions for limited combustible WRBs
- Foam plastic insulation – 2603.5.5
- Combustible claddings
 - In buildings over 40' tall:
 - EIFS – 1408.2
 - MCM – 1407.10
 - FRP – 2612.5
 - HPL – 1409.10

NFPA 285 Testing

- When is *NFPA 285* testing of an actual wall assembly required?
 - Generally, when “noncombustible” walls contain “combustible” materials
 - Mid and High rise buildings
 - Applications where assembly fire performance is critical for evacuation and life safety

What is *NFPA 285* Testing?

- *NFPA 285* is a two-story test of a wall assembly testing flame propagation in the following areas:
 - Over the face of the wall covering
 - Vertical flame propagation within the combustible core or components
 - Over the interior surface from one floor to the next
 - Lateral flame propagation to adjacent compartments

What is *NFPA 285* Test Setup?

- Fixed gas burner in the center of the first-story test room
- The test room contains a window opening with a portable gas burner placed in it

NFPA 285 Test Procedure

- Minutes 0-5:
 - The room burner is ignited and must achieve a first-story room temperature of 1151°F
- Minutes 5-30:
 - The window burner is ignited at minute 5
 - Both continue to burn for the 25-minute period
 - Together, they must achieve an average first-story room temperature of 1648°F

NFPA 285 Pass Criteria

- For the interior:
 - No flame propagation into the second-floor room
 - No thermocouple within 1" of the interior wall surface at the second-story test room can exceed 500°F

NFPA 285 Pass Criteria

- For the exterior:
 - Flames shall not reach 10' above the top of the window opening and shall not reach 5' laterally from the window's centerline
 - Thermocouples inside the wall assembly shall not exceed 1000°F during the test

NFPA 285 Pass Criteria

- For the internal assembly (i.e., inside assembly)
 - Assemblies with:
 - Wall coverings $> \frac{1}{4}$ " thick; or wall coverings $\leq \frac{1}{4}$ " thick without an air space
 - Cannot have combustible components that exceed 750°F at thermocouples near the assembly perimeter at the second-story test room
 - Wall coverings $\leq \frac{1}{4}$ " with an air space
 - Temperatures in the air cavity must not exceed 1000°F
 - Temperatures in the insulation must not exceed 750°F at thermocouples near the assembly perimeter at the second-story test room

Alternative Material Approval Criteria

- IBC 104.11 provides the following instructions:
 1. Design is satisfactory
 2. Complies with the intent of the code
 3. Not less than that prescribed in the code in:
 - a) quality
 - b) strength
 - c) effectiveness
 - d) fire resistance
 - e) durability
 - f) safety
 4. Research report from an approved source
 5. Testing from an approved agency

Independent Evaluation by an Approved Source

- DrJ Engineering, ICC-ES, IAPMO, ATI/Intertek and NTA are all examples of approved sources that can provide evaluation of alternatives for code compliance

Alternative Material Approval Criteria

- *One example is ICC-ES AC12 – Acceptance Criteria for Foam Plastic Insulation*

AC12 Section 6.6:

When recognition includes installation of the foam plastic insulation in exterior walls of Type I through Type IV construction in accordance with Section 2603.5 of the IBC, the evaluation report shall provide details of the assemblies tested in accordance with NFPA 285, and/or NFPA 285 test results extended via a third-party engineering analysis.

- Provides specific allowance of engineering analysis to extend *NFPA 285* test results

Engineering Analysis Example

- Assembly 1 contains Product X and passes *NFPA 285* testing
 - Product X also undergoes cone calorimeter flammability testing to establish the baseline fuel load of the product
- Product Z then undergoes cone calorimeter flammability testing
 - If the results are the same or better than Product X, then Product Z is an acceptable alternative to Product X

Engineering Analysis Example

- By passing the same cone calorimeter flammability test as Product X, Product Z is proven equivalent to Product X
- Thus, Product Z can be substituted into Assembly 1 with the expectation that it would also pass *NFPA 285*

Engineering Analysis Reasoning

- Only complete assemblies are tested for compliance with *NFPA 285*
 - Therefore, the specific products used in the assemblies are the only products deemed to pass testing criteria

Engineering Analysis Reasoning

- The language regarding approval of alternative materials is very clear:
 - Alternative materials “shall be approved” if they are found to comply with Section 104.11, meet the intent of the code and are proven to be at least equivalent to material tested in the original assembly

Engineering Analysis Reasoning

- If a material that was not tested in the original assembly is brought into question as being a suitable replacement, the following language dictates the appropriate steps

IBC Section 104.11.2:

Whenever there is insufficient evidence of compliance with the provisions of this code, or evidence that a material or method does not conform to the requirements of this code, or in order to substantiate claims for alternative materials or methods, the building official shall have the authority to require tests as evidence of compliance to be made at no expense to the jurisdiction ...

Conclusion

- *2012 IBC* Commentary explains:
 - The focus of the requirement in *IBC* Section 2603.5.5 for exterior wall assemblies is flammability rather than fire resistance
- If material tests prove products are equivalent or better, assembly tests can maintain validity even after alternative material substitution

Conclusion

- For assemblies using foam plastic insulation, either option shall be permitted by the building code official:
 - Testing to *NFPA 285*, or
 - Analysis of the substitution of a different product in a tested assembly in accordance with Section 104.11

Conclusion

- Compliance report for a substituted foam plastic insulation product should:
 - Be written by an independent source:
 - Approved by the building official with the proper qualifications for the analysis of the engineering principles of materials and methods
 - Reference specific *NFPA 285* pass test results
 - Include small-scale testing, if appropriate
 - Specify all assembly components and constructions

Conclusion

- Compliance report should also:
 - Substitute only one specific component in a tested assembly in the same location with the same installation requirements (e.g., air gap, attachment method).
 - Include opening and flashing details, where required
 - Address all of the applicable concerns listed in *2015 IBC* Section 104.11