‘Decoding’ Thermal and Ignition Barrier Requirements for SPF

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Who is SPFA?

• **Spray Polyurethane Foam Alliance**
  – 1979: Urethane Foam Contractors Association (UFCA)
  – 1987: Polyurethane Foam Contractors Division of the Society of the Plastics Industry (SPI)
  – 1999: Affiliated with the American Chemistry Council (ACC)
  – 2003: independent trade association for contractors, manufacturers and distributors of polyurethane foam, equipment, protective coatings, inspections, surface preparations and other services.
  – Strong relationship with the ACC’s Center for Polyurethanes Industry (CPI) and Spray Foam Coalition (SFC)
What does SPFA do?

• **Education and Research**
  – Accreditation and Education Programs
  – Technical Guidelines
  – Technical Helpline (1-800-523-6154)
  – Industry Research Programs

• **Promotion and Awareness**
  – Regulatory and Legislative Activities
  – Promotional and Marketing Tools
  – Website [www.sprayfoam.org](http://www.sprayfoam.org)
  – Annual Spray Foam Conference and Exposition
  – Directory and Buyers' Guide

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Objectives

• Why Do Codes Require Thermal or Ignition Barriers?
• Fire Testing Basics
• What is a Thermal Barrier?
• What is an Ignition Barrier?
• Inspection and Verification
• Application Examples per Model Building Code
Why Do Codes Require Ignition and Thermal Barriers?

• SPF, like most organic materials, is combustible
  – Unprotected SPF will ignite when exposed to fire
  – Smoke and combustible gases can accumulate in interior spaces during fire conditions and lead to flashover
  – Flame retardants added to slow flame spread
  – Flame spread measured under controlled conditions (ASTM E84), not representative of actual fire conditions

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Why Do Codes Require Ignition and Thermal Barriers?

• Required by ICC Model Building Codes (I-codes)
  – Delays combustion and ignition of SPF
  – Provide extra time needed for worker and occupant egress
  – Requirements for Foam Plastics
    • IBC Chapter 26, Section 2603
    • IRC Chapter 3, Section R316
Fire Testing Basics

• Three categories
  • Surface Burning Characteristics (materials)
  • Room Tests (assemblies)
  • Structural Integrity Tests

• Testing standards from...
  • American Society for Testing of Materials (ASTM)
  • Underwriters Laboratories (UL)
  • National Fire Protection Association (NFPA)
  • Factory Mutual (FM)
**Fire Testing Basics: Surface Burning**

- **ASTM E84 (UL 723) Tunnel Test**
  - 25’ x 2’ x 2’ Steiner tunnel
  - Req’d for most interior building products
  - Material suspended on tunnel ceiling and ignited by gas burner at one end
    - Speed of flame front → Flame Spread Index (FSI)
    - Optical smoke density at outlet → Smoke Developed Index (SDI)
  - FSI/SDI baseline:
    - 0/0 for fiber-cement
    - 100/100 for red oak
    - 4” material thickness limitation

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Fire Testing Basics: Surface Burning

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  • Material suspended on tunnel ceiling and ignited by gas burner at one end
    • Speed of flame front → Flame Spread Index (FSI)
    • Optical smoke density at outlet → Smoke Developed Index (SDI)

Surface Burning Test results are for comparative purposes only and not related to real-world fire conditions
Fire Testing Basics: Surface Burning

- Requirements for Foam Plastics (<4”) [IBC 2603.3 / IRC R316.3]
  - Class B is a mandatory requirement
    - FSI ≤ 75 and SDI ≤ 450
  - Class A is an optional requirement (achieved by most SPF insulations) that may be mandatory in certain applications
    - FSI ≤ 25 and SDI ≤ 450
  - Different requirement on low-slope roofs
    - FSI ≤ 75 but no limit on SDI
    - Roof assembly must pass FM4450 or UL1256
Fire Testing Basics: Surface Burning

- Requirements for Foam Plastics (<4”) [IBC 2603.3 / IRC R316.3]
  - Class B is a mandatory requirement
    - FSI ≤ 75 and SDI ≤ 450
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    - FSI ≤ 25 and SDI ≤ 450
  - Different requirement on low-slope roofs
    - FSI ≤ 75 but no limit on SDI
    - Roof assembly must pass FM4450 or UL1256

NOTE: Surface Burning Test limited to 4” material thickness. Additional testing required for foam plastics to be installed >4”
Fire Testing Basics: Surface Burning

• Requirements for Foam Plastics (>4”)
  • SPF greater than 4” thick to meet certain R-values
  • ASTM E84/UL 723 limited to 4” sample thickness
  • To qualify assemblies greater than 4” thick, special approval testing is permitted [IBC 2603.9 / IRC R316.6]

• Special approval testing is performed on assembly
  • Using one of four large-scale corner fire tests
  • ½” gypsum board between foam and fire source
  • Determines maximum foam thickness intended for use
Fire Testing Basics: Surface Burning

- **ASTM E970 Critical Radiant Heat Flux Test Apparatus**
  - 1m long test panel
  - Used to qualify combustible insulations on attic floor
  - Flame should not progress more than 1 m under minimum heat flux of 0.12 W/m² from suspended gas burner
  - No material thickness limitation
Fire Testing Basics: Room-Corner

• Room Corner Test Procedure
  • Room constructed using typical wall and ceiling assemblies
  • Controlled fire source placed in corner
    • Wood crib or gas burner
  • Fire source ignited and observations recorded
    • Heat Release Rate
    • Temperatures at Ceiling
    • Heat Flux
    • Target Ignition
    • Flame-Over

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Fire Testing Basics: Room-Corner
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What is a Thermal Barrier?

• Thermal Barrier Requirement  [IBC 2603.4 / IRC R316.4]
  • Separate foam plastics from all interior spaces with approved 15-minute thermal barrier
What is a Thermal Barrier?

- Two recognized thermal barrier coverings
  - ½” gypsum board [IBC 2603.4 / IRC R316.4]
    - Prescriptive for walls and ceilings
    - >95% of thermal barrier applications
  - nominal ¾” (19/32”) plywood [IBC Table 721.6.2(1)]
    - Not prescriptive but generally accepted for floors

- Non-prescriptive (equivalent) Thermal Barriers must be approved by large-scale fire testing
What is a Thermal Barrier?

• Approved Thermal Barriers [IBC 2603.4 / IRC R316.4]
  1. Prescriptive Thermal Barrier is ½” gypsum wallboard
  2. Equivalent Thermal Barrier is a coating or covering that must pass two large-scale fire tests:
     • Average temperature rise of the unexposed surface less than 250ºF (120C) after 15 minutes of fire exposure per ASTM E 119 or UL 263
     • Remain in place 15 minutes during specified large-scale fire tests such as NFPA 286, UL 1715, UL 1040 or FM 4880
        -- OR --
     • Comply with NFPA 275 (both test above)
What is a Thermal Barrier?

• Special Approval / Alternate Assemblies [IBC 2603.9 / IRC R316.6]

3. Alternate Assemblies (e.g. Exposed SPF or SPF with a protective covering) must:
   • Remain in place 15 minutes during specified large-scale fire tests such as NFPA 286, UL 1715, UL 1040 or FM 4880
   • Does not need to comply with requirements of IBC 2603.4.
   • Product-Specific Assemblies must be tested:
     • Thermal Barrier Brand A on Foam Brand B
     • Protective coverings may include cementious, fibrous and other proprietary products
What is a Thermal Barrier?

• **No thermal barrier required:**
  - Inside masonry or concrete walls  [IBC 2603.4.1.1 / IRC R316.5.2]
  - **Cooler and freezer walls (< 400 SF floor space)***  [IBC 2603.4.1.2-3]
  - Laminated metal wall panels-one story  [IBC 2603.4.1.4]
  - **Roofing assembly*** passing UL 1256  [IBC 2603.4.1.5 / IRC R316.5.2]
  - Entry doors  [IBC 2603.4.1.7-8 / IRC R316.5.5]
  - Garage doors  [IBC 2603.4.1.9 / IRC R316.5.6]
  - Siding backer board  [IBC 2603.4.1.10 / IRC R316.5.7]

* SPF applications
What is a Thermal Barrier?

• **No thermal barrier required:**
  • Sill Plates and Headers  [IBC 2603.4.1.13 / IRC R316.5.11]
    • Limited to Type V construction
    • Max thickness 3.25”
  • Class A Foam (LD and MD)
What is a Thermal Barrier?

• **No thermal barrier required:**
  • Certain Attics and Crawl Spaces
    • Entry is made only for service of utilities [IBC 2603.4.1.6 ]
    • Entry is made for repairs and maintenance [IRC R316.5.3]
    • No storage
    • Thermal barrier required between attic/crawlspace and occupied space
  • **Ignition barrier** is required separating foam from certain attic/crawlspace

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What is an Ignition Barrier?

• **Ignition Barrier**  [IBC 2603.4.1.6 / IRC R316.5.3]
  
  – Fire protection requirements can be reduced from 15-minute thermal barrier to ignition barrier in **limited-access spaces (certain attics and crawlspaces)**
  
  – Six prescriptive ignition barriers include:
    • 1 ½” mineral fiber insulation
    • ¼” wood structural panels
    • ⅜” particleboard
    • ¼” hardboard
    • ⅜” gypsum board
    • corrosion-resistant steel having a base metal thickness of 0.016”
  
  – **Alternative Ignition Barrier Assemblies by Special Approval Testing**
What is an Ignition Barrier?

- Special Approval Tests for Alternative Ignition Barrier Assemblies  [IBC 2603.9 / IRC R316.6]

  - Same four large-scale corner burn tests as thermal barrier
    - NPFA 286, UL1715, FM4880 or UL1040

  - Special end-use fire tests per AC-377
    - Equivalent performance to ¼” plywood
    - AC-377 Appendix X Test for SPF in crawlspaces and under roof decks in unvented attics since June 2009
    - ASTM E970 Radiant Heat Flux Test for SPF on attic floors since June 2011
Ignition Barrier Performance

PASS  IB_pass.wmv
with intumescent coating

FAIL  IB_fail.wmv
without intumescent coating

AC-377 Appendix X (modified NFPA286 Room Corner) Test for Ignition Barriers
Ignition Barrier Performance

PASS  IB_pass.wmv
with intumescent coating

FAIL  IB_fail.wmv
without intumescent coating

AC-377 Appendix X (modified NFPA286 Room Corner) Test for Ignition Barriers

Even if building codes are not applicable in your jurisdiction or for a specific project, (e.g., retrofit insulation), always use the ignition barrier system recommended by the foam manufacturer.
Fire Testing: Commercial Buildings

• Additional requirements for SPF in Type I-IV Construction
  [IBC 2603.5]
  – Labelling of product
  – Thermal barrier required
  – Class A per ASTM E84 (<25 FS, <450 SD)
  – NFPA 259 test data corresponding to SPF tested per NFPA 285
  – NFPA 286 test data showing no sustained flaming
  – NFPA 285 test data for each wall assembly
  – ASTM E119 or UL 263 required for fire-resistance rated wall assemblies
Inspection and Verification

• Alternative Fire Assembly Test Results
  • Test performed by accredited 3rd-party lab
  • Sometimes difficult to interpret

• Evaluation Report
  • Test performed by accredited 3rd-party lab
  • Test results independently evaluated
  • Report defines installation
    • Product identification
    • Maximum thickness for foam
    • Alternative ignition barrier assemblies (if any)
Inspection and Verification

• Evaluation Service Reports
  • Majority of SPF insulation products have current ESRs
  • Available from manufacturer or ICC-ES websites
  • Eliminates need for contractors and inspectors to interpret test data
  • Defines product-specific requirements for thermal and ignition barriers based on fire testing
  • A sample ESR:

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Application Examples

Unvented Attic and Crawlspace

- SPF insulation under roof deck separated from attic space with approved ignition barrier prescriptive or per AC-377 Appendix X
- Limited access attic separated from interior space with approved 15-minute thermal barrier
- SPF insulation in walls separated from interior space with approved 15-minute thermal barrier
- Limited access crawlspace separated from interior space with approved 15-minute thermal barrier
- SPF insulation on walls separated from crawl space with approved ignition barrier

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Application Examples

Unvented Attic and Crawlspace – w/ Storage

- SPF insulation under roof deck separated from attic space with approved 15-minute thermal barrier
- approved 15-minute thermal barrier not required (e.g., ceiling tile)
- SPF insulation in walls separated from interior space with approved 15-minute thermal barrier
- SPF insulation on walls separated from crawlspace with approved 15-minute thermal barrier

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Application Examples

Vented Attic and Unvented Crawlspace

- SPF insulation on attic floor separated from attic space with approved ignition barrier prescriptive or per ASTM E970

- Limited access attic separated from interior space with approved 15-minute thermal barrier

- SPF insulation in walls separated from interior space with approved 15-minute thermal barrier

- Limited access crawlspace separated from interior space with approved 15-minute thermal barrier

- SPF insulation on walls separated from crawl space with approved ignition barrier

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Application Examples

Finished Room Over Garage

No ignition or thermal barrier needed if space is inaccessible (a.k.a. concealed)

All SPF insulation separated from interior space with approved 15-minute thermal barrier

½" gypsum board walls and ceilings

interior space
Application Examples

Space Under Low-Slope Roof: Tile Ceiling

- **dead** air space
- suspended tile ceiling
- interior space
- ½" gypsum board walls

SPF insulation under roof deck separated from air space with **approved 15-minute thermal barrier**

* If air space is used as an air return plenum, SPF must be covered with a 25 FSI / 50 SDI layer in addition to thermal barrier

SPF insulation in walls and ceiling separated from interior space with **approved 15-minute thermal barrier**
Application Examples

Space Under Low-Slope Roof: Gyp Board Ceiling

dead* air space

½" gypsum board ceiling

interior space

½" gypsum board walls

SPF insulation under roof deck separated from dead air space with approved ignition barrier

* If air space is used as an air return plenum, SPF must be covered with a 25 FSI / 50 SDI layer in place of ignition barrier

SPF insulation in walls and ceiling separated from interior space with approved 15-minute thermal barrier

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Final Comments

- Thermal Barriers and SPF
  - All SPF requires thermal barrier between foam and all interior spaces
  - If uncovered foam passes 15-minute thermal barrier test, or meets acceptance criteria of corner tests, no thermal barrier covering or coating is needed
Final Comments

• Ignition Barriers and SPF
  • Most closed-cell foams do not require additional ignition barrier coverings or coatings in limited access attics and crawlspaces
  • Most open-cell foams require additional ignition barrier coverings or coatings in limited access attics and crawlspaces
  • **Always consult evaluation report or third-party fire test reports to confirm ignition barrier requirements for each SPF product.**
  • **Always confirm requirements with local code official**
Summary

• Why Do Codes Require Thermal or Ignition Barriers?
• Fire Testing Methods
• What is a Thermal Barrier?
• What is an Ignition Barrier?
• Inspection and Verification
• Application Examples per Model Building Code
Key References

1. SPFA AY-126 - “Ignition and Thermal Barriers for the Spray Polyurethane Foam Industry” ©2011 SPFA


Thank You!

Questions?

SPFA Website: www.sprayfoam.org