New Fire Test Method for Alternative Ignition Barriers for Attic and Crawlspaces

Jesse Beitel
Fire Test Consultant, Hughes Associates

Mac Sheldon
Attic and Crawlspace Task Force Leader
Territory Mgr. – Demilec USA

Rick Duncan
Technical Director
SPFA

Si Favardin
Senior Specialist
ICC-Evaluation Services

www.icc-es.org

June 2009 Changes to AC-377: Attic and Crawlspace Testing
Webinar Overview

• **Rick Duncan**
  – Code requirements for thermal and ignition barriers
  – Test methods for alternative ignition barriers
  – Problem definition and industry solution

• **Jess Beitel**
  – Test protocol development: objectives and approach
  – Testing details
  – Key results

• **Rick Duncan**
  – ICC-ES Hearing Results
  – Summary of attic and crawlspace test methods
  – Q&A session (ask questions on-line via webinar)
SPF and the International Codes

• **Code Sections**
  – Separate from ‘traditional’ insulations
  – IBC: Ch 26, Section 2603 Foam Plastic Insulation
  – IRC: Ch 3, R316 Foamed Plastic

• **Code Focus**
  – Fire Protection
  – Thermal Performance
  – Moisture Control
Thermal Barriers

• Thermal Barrier Requirement
  [IBC 2603.4 / IRC R316.4]
  – Separates insulation from interior of building
  – Approved 15 minute thermal barrier
    • ½” gypsum wallboard is most commonly used
    • Others to be tested per ASTM E119 and/or full-scale fire tests
  – Exception to Thermal Barrier requirement in Attics and Crawlspaces with limited access for service of utilities
Thermal Barrier Exceptions

• **Attics and Crawl Spaces** [IBC 2603.4.1.6 / IRC R316.5.3]
  
  – Entry is made for service of utilities
  – **Ignition barrier** is required separating attic/crawlspace space from foam
  – Thermal barrier required between attic/crawlspace and occupied space

*courtesy Icynene*
Ignition Barrier Requirements

• Ignition Barrier  [IBC 2603.4.1.6 / IRC R316.5.3]
  – Prescriptive ignition barriers include:
    • 1.5” mineral fiber insulation
    • 0.25” wood structural panels
    • 0.375” particleboard
    • 0.25” hardboard
    • 0.375” gypsum board
    • Corrosion-resistant steel having a base metal thickness of 0.016 “
  – Alternative Assemblies by Special Approval Testing
Alternative Assemblies

- **Special Approval Tests** [IBC 2603.9 / IRC R316.6]
  - **NFPA 286** - Contribution of Wall and Ceiling Interior Finish to Room Fire Growth (with the acceptance criteria of Section 803.2/R302.9.4)
  - **FM 4880** - Fire Rating of Insulated Wall or Wall and Roof/Ceiling Panels, Interior Finish Materials or Coatings, and Exterior Wall Systems
  - **UL 1040** - Safety Fire Test of Insulated Wall Construction
  - **UL 1715** - Fire test of interior finish material
  - *End-use fire tests*

June 2009 Changes to AC-377: Attic and Crawlspace Testing
End-Use Fire Testing

• Special Approval for Foam In Attics and Crawlspaces
  – ICC-ES has issued ESRs for this application
    • Qualifies assembly with foam alone or foam with an alternate ignition barrier
    • SwRI 99-02 test is used as a comparative test
Problem Definition

• Some tests performed using controversial baseline
  – SwRI 99-02 test performed with asphalt-kraft faced fiberglass
    • Flammable facing towards inside of test module
    • Not a prescriptive ignition barrier
    • Not a code-compliant configuration
    • Against manufacturer installation instructions
Problem Definition

- Controversial baseline brought to attention of industry
  - Meeting between ICC-ES staff and SPFA in Jan 2008
    - ICC-ES requested that industry resolve the issue
    - SPFA proposed interim ‘3/12’ solution effective 6/1/08 to 6/1/09 which was accepted by ICC-ES last year
    - During this interim period, SPFA agreed to develop new test procedure to qualify alternative ignition barrier systems for consideration at this June 2009 hearing
Industry Solution

• SPFA created an industry-wide task force to address the issue
  – Task force members
    • Open to all SPFA members
    • 43 individual members representing 24 member companies
      • 15 foam supplier companies
      • 3 coating supplier companies
      • Balance contractors, distributors, raw material suppliers and industry consultants
    • SPFA to lead development team to create a new test procedure to qualify alternative ignition barrier systems by 6/1/09
Industry Solution

$150k Sponsorship from 16 supplier companies and two industry groups

Tier I – Supplier Sponsors

- BASF The Chemical Company
- BaySystems
- BioBased Insulation
- CertainTeed
- FOAMETIX
- Dow
- Honeywell
- Huntsman
- ICYNENE
- Lapolla
- NCFI Polyurethanes
- R.T.变现
- Henry

Tier II – Supplier Sponsors

- ALD Products Company, Inc.
- Flame Control Coatings, LLC
- PSI Preferred Solutions, Inc.

June 2009 Changes to AC-377: Attic and Crawlspace Testing
Industry Solution

• Highlights of Task Force Program
  – INITIAL MEETING - January 2008
    • Discuss issue
    • Ideas collected for interim solution
  – INTERIM SOLUTION - April/May 2008
    • Proposed interim ‘3/12’ solution for AC-377 Appendix B – (Valid from June 1, 2008 to June 1, 2009)
    • Submitted as comments to Dow proposal during June 2008 hearing process and subsequently accepted by ICC-ES on May 28, 2008.
Industry Solution

• Highlights of Task Force Program (continued)
  – DISCUSSION OF LONG-TERM OPTIONS - June/July 2008
    • Task force met with SwRI Staff on June 4 and discussed types of tests practical for long-term solution including
      • small-scale: such as cone calorimeter
      • medium scale: room corner tests
      • large-scale: mock-up of unvented attic
    • Hired Mr. Jesse Beitel of Hughes Associates as fire testing consultant
    • With consultant input, task force agreed that small-scale tests not be suitable and large-scale tests would take considerable resources and time to develop and may not be repeatable.
    • Medium-scale room-corner test option was chosen
Industry Solution

• Highlights of Task Force Program (continued)
  – SELECTION OF TEST METHOD - August/September 2008
    • Proposed use of a modified room corner burn test (NFPA 286)
    • Development work to be done at SwRI
  – EVALUATION OF TEST PROCEDURE - October 2008 / January 2009
    • Phase I – Exploratory
    • Phase II – Refinement
    • Phase III – Validation (plywood baseline results)
  – DOCUMENTATION PACKAGE - February/March 2009
    • Test procedure document - Appendix X
    • Modifications to AC-377
### June 2009 Changes to AC-377: Attic and Crawlspace Testing

#### Project Timeline

<table>
<thead>
<tr>
<th>TASK FORCE FORMED</th>
<th>COLLECTION AND REVIEW OF EXISTING TEST DATA</th>
<th>INTERIM SOLUTION DEVELOPMENT</th>
<th>LONG-TERM SOLUTION DISCUSSED</th>
<th>TEST METHOD PROPOSED</th>
<th>LAB EVALUATION</th>
</tr>
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<tbody>
<tr>
<td>Discussed attic and crawlspace testing issues</td>
<td>Individual suppliers with ESRs reviewed SwRI 99-02 data</td>
<td>Proposed interim ‘3/12’ criteria for AC-377 Appendix B</td>
<td>Small-scale test (cone-calorimeter) to qualify IBs</td>
<td>Repeatable test protocol similar to existing test methods</td>
<td>Evaluated several fire test labs</td>
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<tr>
<td>Agreed to address as an industry under SPFA leadership</td>
<td>Statistical evaluation to develop 3/12 criteria</td>
<td>Valid from June 1, 2008 to June 1, 2009</td>
<td>Large-scale test to demonstrate performance</td>
<td>Room corner burn test was determined to be best approach</td>
<td>Selected SwRI</td>
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<tr>
<td></td>
<td>Average flame out door + 3 SD = 3 mins</td>
<td>Submitted as comments during June 2008 hearing process</td>
<td>Medium-scale room corner tests most repeatable</td>
<td>Selected NFPA 266 as a starting point</td>
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<td>Average burn through floor + 3SD = 12 minutes</td>
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#### 2008

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<td>FEB</td>
<td>MAR</td>
<td>APR</td>
<td>MAY</td>
<td>JUN</td>
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**INDUSTRY MEMBER FUNDING**
- Solicited support from SPFA supplier members
- $150k goal met by 16 supplier members, SPFA and CPI

**PHASE I - RANGE-FINDING**
- Phase I – Exploratory Studies: Tested four modules with prescriptive IB (k” plywood) and alternative IB (intumescent coating) on SPF to determine optimal burner regime. Burner mapping study completed.

**PHASE II - REFINEMENT**
- Phase II – Refinement Studies; Repeated testing on four modules using selected burner regime

**PHASE III - VALIDATION**
- Phase III – Validation Studies: Tested four modules to develop plywood baseline. Agreed on 4.13 criteria

**PROPOSAL DEVELOPMENT**
- Test procedure written and AC-377 updated
- Approved by 14-1 majority
- CPI review
- Submitted to ICC-ES

**PROPOSAL REFINEMENT**
- Responded to questions from ICC-ES
- Reviewed program with other members of foamed plasctics industry
- Obtained endorsement from CPI Rigid Foam Committee, PIMA, XPSA and EPSMA
Test Method Objective

Develop a testing protocol to qualify Spray Polyurethane Foam (SPF) assemblies for use in attics and crawlspaces and provide an alternative means to meet the intent of the Codes (IBC & IRC) for this application.
Approach

• **I-Code compliant method**
  – Develop a test that would meet the intent of the Codes for this application

• **Use known, proven methods**
  – If possible, use and/or modify existing test(s), to maximize robustness and repeatability

• **Simple, multipurpose test**
  – Develop a single test that could be applicable to both attics and crawlspaces

• **Establish baseline performance**
  – Pass/Fail criteria using code-approved ignition barrier
Basis For New Test

- **NFPA 286**

- **With minor modifications**
  - Determine modifications required for this application
Rationale For Selecting NFPA 286

• **Existing test**
  – for interior finish in Codes

• **Quantitative measurements**
  – performance (HRR, Temperatures, Heat Flux)

• **Applicable** to interior of attics and crawl spaces
  – Materials on walls & ceilings
  – NFPA 286 used for sloped applications
NFPA 286 Procedures Used

• Room dimensions
  – Useable for crawls and attics of all size/shape

• Gas Burner
  – controllable and consistent heat source

• Instrumentation
  – HRR / Ceiling temps / Flux on floor / Smoke

• Visual Observations
  – Flame spread / Flames out doorway / Paper targets

• Documentation
Room Dimensions

3.66 m ± 0.05 m
(12 ft ± 2 in.)

0.70 m ± 0.02 m
(27.75 in. ± 0.75 in.)

2.02 m ± 0.02 m
(79.5 in. ± 0.75 in.)

2.44 m ± 0.05 m
(8 ft ± 2 in.)

June 2009 Changes to AC-377: Attic and Crawlspace Testing
Room/Hood Arrangement
Deviations from NFPA 286

- Wall / ceiling construction
  - defined using wood framing at maximum thickness and spacing tested

- Burner regime

- Performance Criteria
  - Determination of flashover time
  - NFPA 286 does not have pass/fail criteria
Plan View Of Wall

To simulate actual field applications, foam is permitted over interior stud faces, subject to the restrictions of Figure 3 on corner cavities adjacent to burner, interior of wall.

 Spray polyurethane foam at nominal thickness to be tested.
Elevation View of Ceiling

- **gypsum wallboard**
- **1.5” x D” joists @ 24” O.C.**
  (D = nominal foam thickness to be tested)
- **1.5” x D” top plate**
- **exterior of room**
- **interior of room**
- **spray polyurethane foam**
  At nominal thickness to be tested.

To simulate actual field applications, foam is permitted over interior stud faces, subject to the restrictions of Figure 3 on corner cavities adjacent to burner. interior of wall.
Determination of Flashover

• Five parameters to determine flashover
  – Flames exit doorway
  – Auto-ignition of paper targets on floor
  – Avg. upper layer temp exceeds 1112°F
  – Heat Release Rate exceeds 1MW
  – Heat flux on floor exceeds 25 kW/m²

• NFPA 286 – Flashover occurs when any two of the parameters are attained

• Our approach – Average time for all parameters
  – Provide more precise time
Burner Regime

- **NFPA 286**
  - 40 kW – 0-5 minutes
  - 160 kW – 5-15 minutes
  - Position – Unclear – either flush or 1 in. away

- **Appendix X**
  - Discussions on HRR & placement
  - Performed Temp & Heat Flux mapping tests
  - Final determination
    - 40 kW – 0-5 minutes
    - 160 kW – 5-15 minutes
    - Placement – flush w/ walls
Test Materials

- Plywood – APA Grade A-C, ¼ inch nominal thickness, A side to fire, conditioned
- SPF – 2 types - Blinded, installed per MII
  - MD (2.0 density, Class A & Class B)
  - LD (0.5 density, Class A)
- Intumescent Coatings – Blinded, coating used was listed for the SPF, installed per MII
# Test Matrix

<table>
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<th>Phase</th>
<th>Module Description</th>
<th>Burner Regime</th>
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<td>SwRI Module Label</td>
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<tr>
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<td>A</td>
<td>LD</td>
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<td></td>
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<td>LD</td>
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<td>Initial</td>
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Fire Test Results

Shortly after ignition
Fire Test Results

Impinging on ceiling
Fire Test Results

Flames out doorway
## Results – ¼ in Plywood + Foam

<table>
<thead>
<tr>
<th>Test No.</th>
<th>Foam Type</th>
<th>Flames Out Door</th>
<th>1 MW HRR</th>
<th>20 Kw-Floor</th>
<th>600C</th>
<th>Ignition Paper - back</th>
<th>Ignition Paper front</th>
<th>Avg. of All 6</th>
<th>Avg. w/o Paper Targets</th>
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<td>LD</td>
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<td>1/4 plywood AVERAGE</td>
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<td>4:18</td>
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Test Method Conclusions

- Test Method was adopted as part of the revised AC-377, dated June 2009
- The method is described in Appendix X
- Based on proven test method
- Few variations
- Requires testing of maximum thickness and density of SPF
- Eliminates the need for running comparison tests
- Provides a standard test method to evaluate SPF in attic and crawl space applications
ICC-ES Hearing

• Held in Birmingham, AL on June 3, 2009
  – 12+ building code officials from across U.S. on Evaluation Committee
  – Reps from 15 different SPFA member companies attended

• Proponents of the proposal, led by SPFA
  – Historical overview and consensus process
  – Technical rationale for new test procedure
  – Endorsement from CPI, PIMA and XPSA

• Opposition to the proposal was also heard

• After several hours of testimony
  – Evaluation Committee unanimously voted to approve the proposal
  – Test Method is now Appx X in revised AC-377, dated June 2009

• [www.icc-es](http://www.icc-es) for more information
## Test Protocol Summary

<table>
<thead>
<tr>
<th>Approval Option</th>
<th>ICC-ES AC377 Section</th>
<th>Attics</th>
<th>Crawl Spaces</th>
<th>Effective Date</th>
<th>Deadline for Test Data Submission</th>
<th>ESR End-of-Life</th>
<th>NOTES</th>
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<td>Prescriptive Ignition Barrier</td>
<td>3.4.4 and Appx A 1.1</td>
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<td>ICBO-ES Letter</td>
<td>X</td>
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<td>April 2000</td>
<td>June 1, 2008</td>
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<td>Kraft Faced Fiberglass Baseline</td>
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<td>Interim 3/12 Criteria</td>
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<td>Generic Comparative Room Corner (Plywood Baseline)</td>
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1. Compliance with Appendix A (May 2008 ver) will be enforced as of June 1, 2009.
2. Reports issued after June 1, 2008 and before June 1, 2009 will be reviewed for compliance with conditions of acceptance in App. B. Assemblies that do not comply with Appendix B will be deleted.
3. January 1, 2010 is the date by which applicants whose evaluation reports include recognition for use in attics and crawl spaces without a code-specified ignition barrier must provide data complying with Appendix A. Data should be submitted by June 1, 2009 to ensure the reports can be revised before January 1, 2010.
4. Prescriptive ignition barriers are defined in the IRC and IBC
5. Acceptable room corner tests include NFPA 286, UL 1715 or UBC 26-3

June 2009 Changes to AC-377: Attic and Crawl Space Testing