

# New Fire Test Method for Alternative Ignition Barriers for Attic and Crawlspace

## **Jesse Beitel**

Fire Test Consultant,  
Hughes Associates

## **Rick Duncan**

Technical Director  
SPFA

## **Mac Sheldon**

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

## **Si Favardin**

Senior Specialist  
ICC-Evaluation  
Services

[www.icc-es.org](http://www.icc-es.org)



# 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 Crawlspace 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*



# End-Use Fire Testing

- Special Approval for Foam In Attics and Crawlspace
  - 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



## Industry Association Sponsors



Center for the Polyurethanes Industry

## Tier II – Supplier Sponsors



# 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

# Project Timeline



2008								
JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
<b>TASK FORCE FORMED</b> Discussed attic and crawlspace testing issues  Agreed to address as an industry under SPFA leadership	<b>COLLECTION AND REVIEW OF EXISTING TEST DATA</b> Individual suppliers with ESRs reviewed SwRI 99-02 data  Statistical evaluation to develop 3/12 criteria  Average flame out door + 3 SD = 3 mins  Average burn through floor + 3SD = 12 minutes	<b>INTERIM SOLUTION DEVELOPMENT</b> Proposed interim '3/12' criteria for AC-377 Appendix B Valid from June 1, 2008 to June 1, 2009  Submitted as comments during June 2008 hearing process  Accepted by ICC-ES on May 28, 2008.	<b>LONG-TERM SOLUTION DISCUSSED</b> Small-scale test (cone-calorimeter) to qualify IBs  Large-scale test to demonstrate performance  Medium-scale room corner tests most repeatable	<b>TEST METHOD PROPOSED</b> Repeatable test protocol similar to existing test methods  Room corner burn test was determined to be best approach  Selected NFPA 286 as a starting point	<b>LAB EVALUATION</b> Evaluated several fire test labs  Selected SwRI			



2008			2009							
OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN		
<b>INDUSTRY MEMBER FUNDING</b> Solicited support from SPFA supplier members  \$150k goal met by 16 supplier members, SPFA and CPI	<b>PHASE I RANGE-FINDING</b> Phase I – Exploratory Studies: Tested four modules with prescriptive IB (¼" plywood) and alternative IB (intumescent coating) on SPF to determine optimal burner regime. Burner mapping study completed.	<b>PHASE II REFINEMENT</b> Phase II – Refinement Studies; Repeated testing on four modules using selected burner regime	<b>PHASE III VALIDATION</b> Phase III – Validation Studies: Tested four modules to develop plywood baseline. Agreed on 4:18 criteria	<b>PROPOSAL DEVELOPMENT</b> Test procedure written and AC-377 updated  Approved by 14-1 majority  CPI review  Submitted to ICC-ES	<b>PROPOSAL REFINEMENT</b> Responded to questions from ICC-ES  Reviewed program with other members of foamed plastics 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**
  - *Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth.*
- **With minor modifications**
  - Determine modifications required for this application

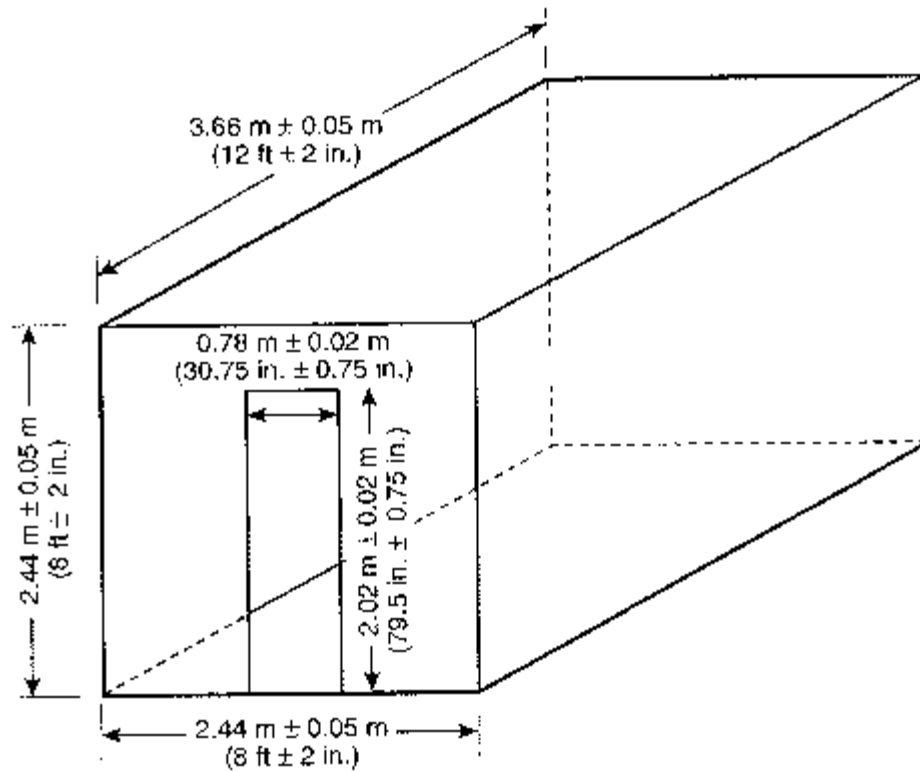
# Rationale For Selecting NFPA 286

- **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

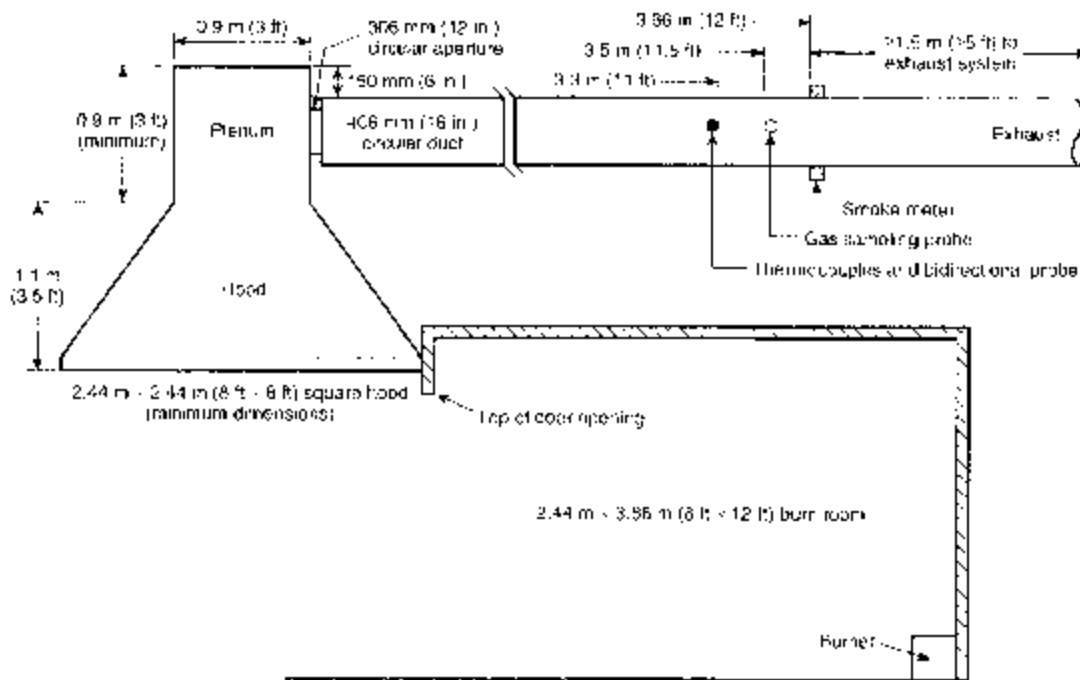
# NFPA 286 Procedures Used

- **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



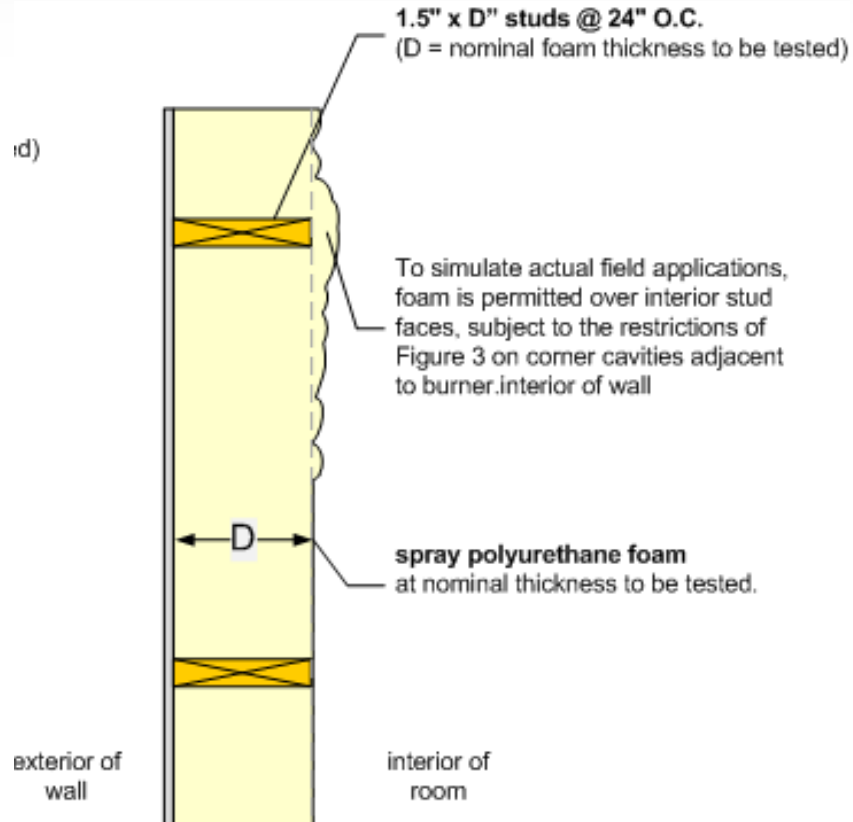
# Room/Hood Arrangement



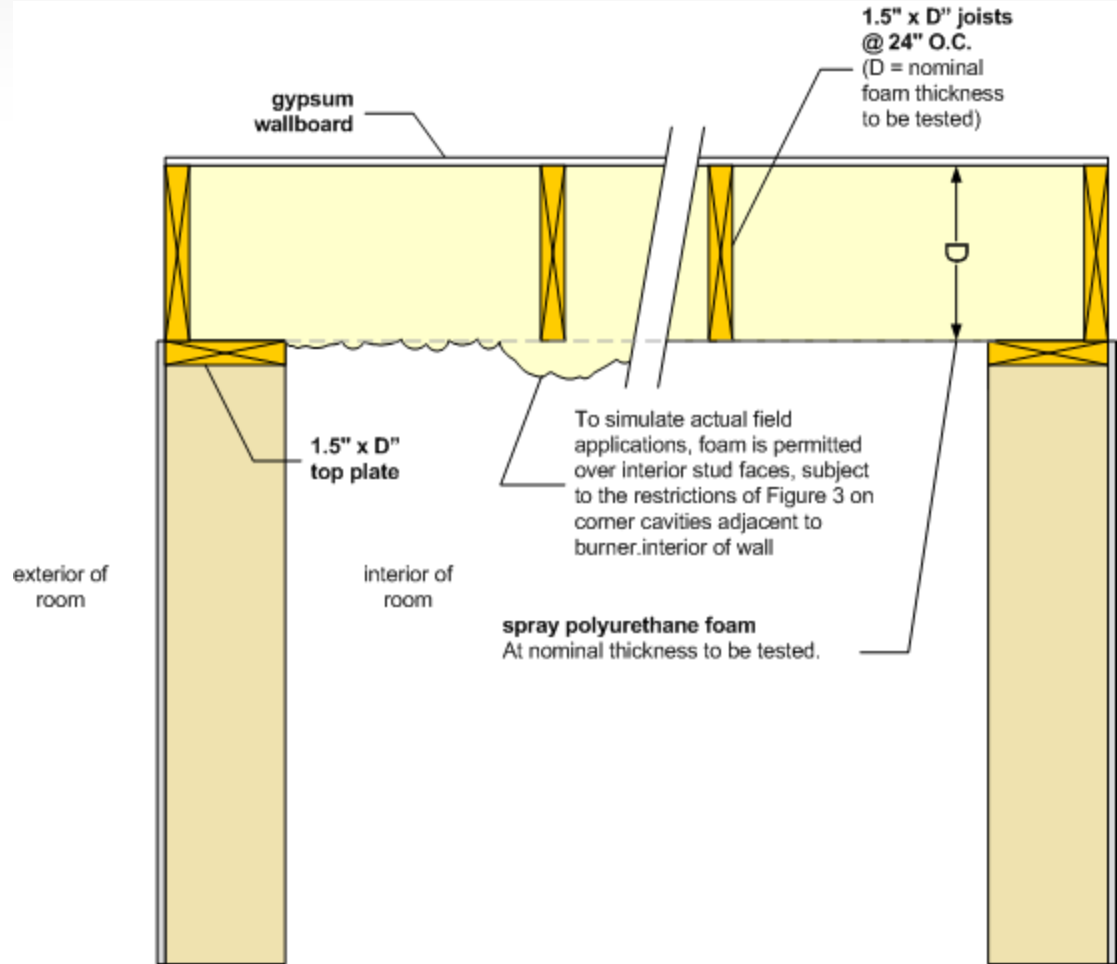
# Deviations from NFPA 286

- **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



# Elevation View of Ceiling

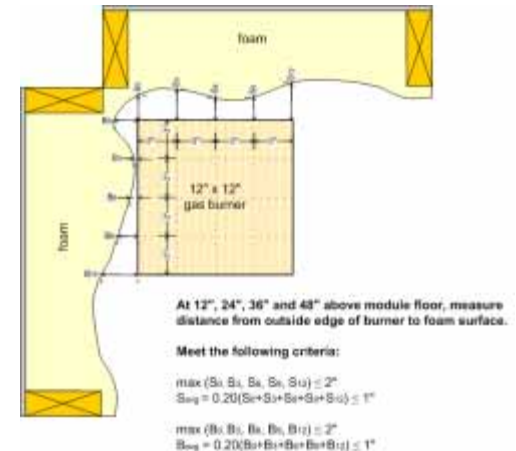


# Determination of Flashover

- Five parameters to determine flashover
  - Flames exit doorway
  - Auto-ignition of paper targets on floor
  - Avg. upper layer temp exceeds 1112<sup>o</sup>F
  - Heat Release Rate exceeds 1MW
  - Heat flux on floor exceeds 25 kW/m<sup>2</sup>
- 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

Phase			Module Description				Burner Regime	
			SwRI Module Label	Foam Type	Foam Class	Ignition Barrier Type	Fire Offset (in)	Initial Fire Size (kW)
I	Initial	18-Nov	A	LD	I	1/4" plywood	0	40
			B	LD	I	intumescent	0	40
		19-Nov	C1	MD	I	intumescent	1	25
			C2	MD	I	intumescent	1	30
			D1	MD	II	1/4" plywood	2	25
			D2	MD	II	1/4" plywood	1	25
II	Explore	16-Dec	E	MD	I	intumescent	0	40
			F	LD	I	intumescent	0	40
			AA	LD	I	1/4" plywood	2	40
		17-Dec	DD	MD	II	1/4" plywood	0	40
III	Validate	12-Jan	G	LD	I	1/4" plywood	0	40
			H	MD	I	1/4" plywood	0	40
			AAA	LD	I	1/4" plywood	0	40
			DDD	MD	II	1/4" plywood	0	40

# Fire Test Results



Shortly after ignition

# Fire Test Results



Impinging on ceiling

# Fire Test Results



Flames out doorway

# Results – ¼ in Plywood + Foam

Test No.	Foam Type	Time to Attain						Avg. of All 6	Avg. w/o Paper Targets
		Flames Out Door	1 MW HRR	20 Kw-Floor	600C	Ignition Paper - back	Ignition Paper front		
G	LD	4:01	4:17	4:12	3:52	4:03	4:10	4:05	4:05
AAA	LD	4:15	4:23	4:48	3:57	4:29	4:50	4:27	4:20
H	MD	4:25	4:23	4:23	3:58	4:33	5:03	4:27	4:17
DDD	MD	4:35	4:37	4:42	4:17	4:51	5:00	4:40	4:32
<b>Avg.</b>		<b>4:19</b>	<b>4:25</b>	<b>4:31</b>	<b>4:01</b>	<b>4:29</b>	<b>4:45</b>	<b>4:25</b>	<b>4:19</b>
DD	MD	5:03	5:02	5:02	4:32	6:13	6:10		4:54
A	LD	3:46	3:45	3:40	3:18	N/A	N/A	--	3:37
<b>Avg.</b>		<b>4:24</b>	<b>4:23</b>	<b>4:21</b>	<b>3:55</b>				<b>4:16</b>
<b>1/4 plywood AVERAGE</b>		<b>4:20</b>	<b>4:24</b>	<b>4:27</b>	<b>3:59</b>				<b>4:18</b>

# 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

Approval Option	ICC-ES AC377 Section	Attics	Crawl Spaces	Effective Date	Deadline for Test Data Submission	ESR End-of-Life	NOTES
Prescriptive Ignition Barrier	3.4.4 and Appx A 1.1	X		N/A	N/A	N/A	[4]
	3.4.5 and Appx A 2.1		X	N/A	N/A	N/A	[4]
SwRI 99-02 Crawl Space Test Kraft Faced Fiberglass Baseline	ICBO-ES Letter	X	X	April 2000	June 1, 2008	June 1, 2009	
SwRI 99-02 Crawl Space Test Interim 3/12 Criteria	Appendix B	X	X	June 1, 2008	June 1, 2009	January 1, 2010	[2], [3]
Generic Comparative Room Corner (Plywood Baseline)	Appendix A 1.2.2	X		June 1, 2009	June 1, 2010	January 1, 2011	[1]
Room Corner Thermal Barrier Test	Appendix A 1.2.1	X		June 1, 2009	N/A	N/A	[5]
	Appendix A 2.2.1		X	June 1, 2009	N/A	N/A	[5]
SwRI 99-02 Crawl Space Test Plywood Baseline	Appendix A 2.2.2 and Appendix C		X	June 1, 2008	N/A	N/A	
Modified NFPA 286 Room Corner Test Specified Pass/Fail Time 4:18	Appendix X	X	X	June 3, 2009	N/A	N/A	

[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

