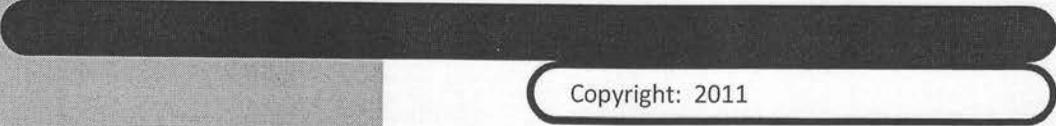


**THERMAL BARRIERS AND IGNITION
BARRIERS FOR THE SPRAY POLYURETHANE
FOAM INDUSTRY**



Copyright: 2011

SPRAY POLYURETHANE FOAM ALLIANCE
SPFA

TECHNICAL OVERSIGHT COMMITTEE

Participating Members	
Roger Morrison (Chair)* Deer Ridge Consulting	John Hatfield Penta Roofing Consultants
Eric Banks BASF Corporation	Robert Smith Invista
Jose Luna Bayer Materials Science	David Mulkey Invista
John Linnell Bayer Materials Science	John Stahl* Preferred Solutions, Inc.
Eric Machemer* Foam Run	Xuaco Pascal Honeywell
Bruce Schenke BASF Corporation	Mary Bogdan Honeywell
James Andersen BASF Corporation	Joshua Ackerman Huntsman
Chuck Skalski Gaco Western	John Evans Icynene
Mac Sheldon* Demilec	Peter Birkbeck Icynene
Chris Porter Bio-Based Insulation	Mason Knowles* Mason Knowles Consulting
Jay Zhang Convenience Products	Jason Hoerter* NCFI Polyurethanes
Tony Leonard ER Systems	Jack Moore West Roofing Systems, Inc
Stuart Hayes Evonik-Goldschmidt Corporation	Steve Crain The Dow Chemical Company
Ray Geiling Evonik-Goldschmidt Coporation	Don Lenaker

*SPFA would like to acknowledge the voluntary contributions of these individuals in the revision of this document.

NOTE: This brochure was developed to aid specifiers in choosing spray-applied polyurethane foam systems. The information provided herein, based on current customs and practices of the trade, is offered in good faith and believed to be true, but is made WITHOUT WARRANTY, EITHER EXPRESS OR IMPLIED, AS TO FITNESS, MERCHANTABILITY, OR ANY OTHER MATTER. SPFA DISCLAIMS ALL LIABILITY FOR ANY LOSS OR DAMAGE ARISING OUT OF ITS USE. Individual manufacturers and contractors should be consulted for specific information. Nominal values which may be provided herein are believed to be representative, but are not to be used as specifications nor assumed to be identical to finished products. SPFA does not endorse the proprietary products or processes of any individual manufacturer, or the services of any individual contractor.

POLICY STATEMENT

It is the policy and recommendation of the Spray Polyurethane Foam Alliance that spray polyurethane foams installed within buildings be covered with a thermal or ignition barrier as soon as possible after the initial application, except as an assembly specifically approved by a building code authority based on fire tests specific to the application.

Why Do Codes Require Thermal or Ignition Barriers?

Spray polyurethane foam (SPF), like most other organic materials, is combustible. SPFs are formulated with flame retardants to decrease the flame spread as measured by ASTM E-84 (Test for Surface Burning Characteristics for Building Materials) and other tests. However, these flame spread indices are used solely to measure and describe properties of products in response to heat and flame under controlled laboratory conditions. The numerical flame spread indexes are not intended to reflect hazards presented by SPFs or any other material under actual fire conditions.

When exposed to fire sources, such as trash fires, welding arcs, cutting torches, or red-hot metal, unprotected SPF can ignite and may result in a flash fire. Although burning SPF will form a surface layer of less flammable char, the initial burning can produce combustible gases and black smoke. In confined interiors, these combustible gases can accumulate and ignite resulting in flashover, a dangerous fire situation. Under these conditions, additional foam and/or other combustibles can become involved in the fire creating additional combustible gases and feeding the fire.

For these reasons, and to allow sufficient time for occupants to escape during a fire, model building codes require SPF to be covered by thermal barriers, ignition barriers or have the SPF assemblies meet the acceptance criteria of large-scale fire tests as described in this document.

Note 1: These fire scenarios depend on the accumulation of combustible gases. Exterior applications of SPF, such as roof systems, where combustible gases can dissipate, are less likely to become involved in flash fires and are subject to different requirements under the model building codes.

What Is A Thermal Barrier?

A thermal barrier is a material, applied between foam plastics (including spray polyurethane foam) and interior spaces designed to delay the temperature rise of the foam during a fire situation and to delay or prevent the foam's involvement in a fire. The *International Building Code*[®] (IBC) and the *International Residential Code*[®] (IRC) define an approved thermal barrier as one which is equal in fire resistance to 12.7 mm (1/2 inch) gypsum wallboard. In essence, the model building codes define ½-inch gypsum wallboard as a prescriptive thermal barrier; approved equivalents (non-prescriptive thermal barriers) must perform as well as or better than ½-inch gypsum wallboard in fire testing as described below.

Non-prescriptive thermal barriers (termed "equivalent thermal barriers") must undergo a temperature transmission fire test wherein the temperature rise of the underlying polyurethane foam is limited to not more than 121°C (250°F) after 15 minutes of fire exposure complying with the standard time temperature curve of ASTM E 119 (Test Methods for Fire Tests of Building Construction Materials). Additionally, equivalent thermal barriers must undergo a fire integrity test to establish that they will sufficiently remain in place during a fire scenario by passing a large-scale, 15-minute fire test. Equivalent thermal barriers meeting this criterion are termed a "15-minute thermal barrier" or classified as having an "index of 15."

In effect, equivalent thermal barriers (i.e., other than the prescriptive ½-inch thick gypsum wallboard) must undergo two fire tests:

- (1) A temperature transmission test (such as a modified ASTM E 119, the actual thermal barrier test apparatus being smaller than the typical large-scale wall or roof/ceiling test assemblies); and
- (2) A fire integrity test (a large-scale fire test such as NFPA 286 [with a specific acceptance criteria defined within the IBC or IRC], UL 1040, UL 1715 or FM 4880).

Since alternative assemblies must undergo the same large-scale fire test(s) as equivalent thermal barriers, many manufacturers have foregone the temperature transmission testing (e.g., ASTM E 119). Such materials are **not** classified as equivalent thermal barriers but may be used as an **alternative assembly** provided it has been approved by the code authority having jurisdiction.

NFPA 275 (Standard Method of Fire Tests for the Evaluation of Thermal Barriers Used over Foam Plastic Insulation) is an approved test standard per AC 377 for equivalent thermal barriers that incorporates both a temperature transmission fire test and a fire integrity test. Future editions of model building codes will likely include NFPA 275 as an acceptable test method.

AC 377 is the Acceptance Criteria for Spray-Applied Foam Plastic Insulation published by International Code Council Evaluation Service (ICC-ES) for the purpose of preparing evaluation reports. Copies are available at the ICC-ES website www.ICC-ES.org.

Under specific conditions, the temperature transmission test can be waived if approved by building code authorities on the

basis of large-scale fire testing representing actual end uses. Many materials which are not “15-minute thermal barriers” per ASTM E 119 or NFPA 275, or classified as equivalent thermal barriers have earned various building code acceptances as an alternate to the use of thermal barriers over spray polyurethane foam (SPF) based on large-scale fire testing. The assembly, consisting of either the exposed foam plastic or the foam plastic with a fire-retardant coating is tested using one of the following procedures:

- NFPA 286 Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth (Note: NFPA 286 does not include pass/fail criteria within it; the criteria is specifically defined within the IBC and IRC.)
- UL 1715 Fire Test of Interior Finish Material
- UL 1040 Insulated Wall Construction
- FM 4880 Building Corner Fire Test

What is an Ignition Barrier?

Model building codes allow an exception to the thermal barrier requirement in attics and crawlspaces where entry is made only for repairs or maintenance (IRC) or for the service of utilities (IBC) [see Note 3 below]. In these cases:

The foam plastic insulation is protected against ignition using one of the following ignition barrier materials:

- 1 ½-inch-thick (38 mm) mineral fiber insulation;
- 1/4-inch-thick (6.4 mm) wood structural panels;
- 3/8-inch (9.5 mm) particleboard (1/4-inch thick under the IBC)
- 1/4-inch (6.4 mm) hardboard;
- 3/8-inch (9.5 mm) gypsum board; or
- Corrosion-resistant steel having a base metal thickness of 0.016 inch (0.406 mm).

[Paraphrased from 2009 IRC Sections R316.5.3 and R316.5.4. 2009 IBC Section 2306.4.1.6 contains equivalent language.]

The materials referenced above from the IRC and IBC are termed “prescriptive ignition barriers.”

Ignition barriers do not afford as high a degree of protection from fire as thermal barriers but are considered

acceptable for attic and crawlspaces where entry is limited. Building code authorities may accept alternative ignition barrier materials and/or alternative assemblies based on large-scale tests such as outlined in ICC-ES Acceptance Criteria 377, Appendix X.

Note 2: A thermal barrier is still required between attic and crawlspace areas and interior living spaces. The ignition barrier exception is only applicable to the SPF surfaces facing attic and crawlspace areas. Typically, ceiling treatments or floor treatments provide separation from interior living spaces and serve as the thermal barrier in these cases.

Where Is A Thermal Barrier Required?

All model building codes require that SPF, with some exceptions, be separated from interior living spaces by an "approved thermal barrier." Therefore, unless an exception applies, all interior SPF applications are required to be covered with a thermal barrier, covered with an equivalent thermal barrier or be part of a tested alternative assembly.

Exceptions to the thermal barrier requirement include:

- Exterior applications as part of certain tested and classified roof assemblies;
- Certain masonry or concrete constructions;
- Certain attics and crawlspaces (see discussion under "Where Is An Ignition Barrier Permitted?");
- Sill plates and headers (limited to certain SPFs in Type V construction); and
- Others as provided by the model building codes.

Review the specific code requirements on a case-by-case basis.

Where Is An Ignition Barrier Permitted?

The IBC and IRC permit the use of an ignition barrier as an alternative to installing a thermal barrier in attics and crawlspaces where entry is made only for repairs and maintenance (IRC) or for the service of utilities (IBC) [see Note 3 below]. Therefore, in such attics or crawlspaces, SPF surfaces need not be covered with a thermal barrier provided it is (1) covered with a prescriptive ignition barrier; or (2) part of an assembly tested in accordance with AC 377, Appendix X.

Note 3: Model building codes allow an exception to the thermal barrier requirement in attics and crawlspaces where entry is made only for repairs or maintenance (IRC) or for the service of utilities (IBC). This language is often misunderstood and misinterpreted by designers, builders, SPF applicators and building officials alike.

ICC Staff and ICC-ES engineers offer the following conditions that would determine if the space is entered only for repairs, maintenance or service of utilities:

- Limited access (hatch, small door, etc)
- Utilities within space including, but not limited to, HVAC equipment, ductwork, electrical lines, plumbing, wiring of any type (telephone, internet, cable, security, etc), radiant heating, etc
- Possibility that any utility as described above may be installed in the future

Based on this interpretation of the building code, the following criteria are often applied to determine appropriate fire protection for SPF surfaces in attics and crawlspaces:

- Thermal Barrier: Whenever the attic or crawlspace is used or could be used as an auxiliary living space or for storage. Criteria for such space include ease of entry and presence of flooring. Attics and crawlspaces having access doors; pull-down or fixed stairs; or flooring (other than minimal pathways for equipment access) would fall into this category.
- Ignition Barrier: Whenever the attic or crawlspace is not or could not be used as an auxiliary

living space or for storage. Criteria include difficulty of entry (for example a hatch or opening not easily accessible) and lack of flooring.

- Neither: Whenever no access exists to the space and the space is not connected and does not communicate with other spaces. (See Note 2 regarding ceiling and floor treatments).

Selection of Thermal Barriers

Generally, SPF installers have three choices:

- (1) Prescriptive thermal barrier: The IBC and IRC specifically name ½-inch gypsum wallboard as an “approved” thermal barrier.
- (2) Equivalent thermal barriers: Materials equivalent to ½-inch gypsum wallboard can be used as thermal barriers provided they have been tested in accordance with the IBC or IRC to limit temperature rise and remain in place for 15 minutes as described above in the “What is a Thermal Barrier” section. Typical equivalent thermal barriers include:
 - a. Spray-applied cementitious materials
 - b. Spray-applied cellulose materials
 - c. Portland cement plaster
 - d. Other various proprietary materials.

Evaluation reports can assist code officials in determining the code compliance of equivalent thermal barriers. Local building code officials are permitted to allow the use of an equivalent thermal barrier which has not been issued an evaluation report provided that data satisfactory to the code official is submitted for approval.

Equivalent thermal barriers and alternative assemblies are tested as part of assemblies which include specific formulations, materials, thicknesses and densities. Unless otherwise approved by the code authority having jurisdiction, the following rules apply:

1. SPF may be installed at thicknesses and density equal to or less than tested;
2. Protective materials must be installed at thicknesses equal to or greater than tested;
3. Formulations, materials and construction must conform to that which was tested.

- (3) Alternative assemblies: SPF may be covered with other materials (such as intumescent or other coating systems) or left exposed provided the assembly has been specifically approved on the basis of large-scale fire testing representing the actual end-use configuration. Alternative assemblies may have a currently valid evaluation report. Local building code officials are permitted to allow the use of an alternate assembly which has not been issued an evaluation report provided that data satisfactory to the code official is submitted for approval. Generally accepted tests for alternative assemblies include:

- NFPA 286 Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth (with specific acceptance criteria defined within the IBC or IRC)
- UL 1715 Fire Test of Interior Finish Material
- UL 1040 Insulated Wall Construction)
- FM 4880 Building Corner Fire Test)

Alternative assemblies tested under AC 377, Appendix X are not appropriate alternative assemblies for meeting thermal barrier requirements.

Caution: Just because a material is advertised as a “thermal barrier” or an assembly is advertised as not requiring a thermal barrier does not mean that it has been approved by a code agency or a local code official. Ask for test data and code body approvals, listings, or other written indications of acceptability under the code to be sure that the product selected offers the fire protection that the code requires.

Selection of Ignition Barriers

Generally, SPF installers have three choices:

- (1) Prescriptive ignition barriers: These are specifically named in the IBC and IRC by type and thickness (for a list, see the "What is an Ignition Barrier" section above).
- (2) Alternative materials: Alternate coatings or coverings may be approved by code authorities having jurisdiction. Proof of appropriate testing in accordance with AC 377, Appendix X supported by an evaluation report may be required (additional limitations are applicable, see Note 4).
- (3) Alternative assemblies: Leaving SPF exposed in an attic or crawlspace may be permitted provided the SPF has been tested and passed in accordance with AC 377, Appendix X. An evaluation report maybe required by the code authority having jurisdiction before approving such an installation (additional limitations are applicable, see Note 4).

Alternative ignition barrier materials and alternative assemblies are tested as part of assemblies which include specific formulations, materials, thicknesses and densities. Unless otherwise approved by the code authority having jurisdiction, the following rules apply:

- 1. SPF may be installed at thicknesses and density equal to or less than tested;
- 2. Protective materials must be installed at thicknesses equal to or greater than tested;
- 3. Formulations, materials and construction must conform to that which was tested.

Note 4: AC 377, Appendix X limits alternative materials and assemblies in attic and crawlspaces as follows:

- a. Entry to the attic or crawl space is only to service utilities, and no storage is permitted.
- b. There are no interconnected attic or crawl space areas.
- c. Air in the attic or crawl space is not circulated to other parts of the building.
- d. Attic ventilation is provided when required by IBC Section 1203.2 or IRC Section R806, except when air-impermeable insulation is permitted in unvented attics in accordance with Section R806.4 of IRC, Under-floor (crawl space) ventilation is provided when required by IBC Section 1203.3 or IRC Section R408.1, as applicable.
- e. The foam plastic insulation is limited to the maximum thickness and density tested.
- f. Combustion air is provided in accordance with Sections 701 and 703 (2006 IMC) and Section 701 (2009 IMC).
- g. The installed coverage rate or thickness of coatings, if part of the insulation system, shall be equal to or greater than that which was tested.

[Cited from AC 377, effective November 1, 2010]

Caution: Just because a material is advertised as an "ignition barrier" or an assembly is advertised as not requiring an ignition barrier does not mean that it has been approved by a code agency or a local code official. Ask for test data **and** code body approvals, listings, or other written indications of acceptability under the code to be sure that the product selected offers the fire protection that the code requires.

This document was developed to assist in selecting thermal barriers or ignition barriers over spray-applied polyurethane foam and/or the use of alternative assemblies. The information provided herein, based on current model building codes, customs and practices of the trade, is offered in good faith and believed to be true, but is made WITHOUT WARRANTY, EITHER EXPRESS OR IMPLIED, AS TO FITNESS, MERCHANTABILITY, OR ANY OTHER MATTER. SPFA DISCLAIMS ALL LIABILITY FOR ANY LOSS OR DAMAGE ARISING OUT OF ITS USE. Individual manufacturers, contractors and building code authorities should be consulted for specific information. SPFA does not endorse the proprietary products or processes of any individual manufacturer or the services of any individual contractor.