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These course materials have been prepared and reviewed by the SPFA Accreditation Committee and accepted for use in connection with the SPFA Spray Polyurethane Foam Accreditation Program on the basis of established industry criteria. The course materials are offered for educational and training purposes only and without any representation or warranty, express or implied, by SPFA as to the quality of performance of the products used or services rendered by an individual or company completing the training program. SPFA and its members specifically disclaim any and all liability for any losses, damages, injuries or damages to persons or property arising out of or resulting from the use or reliance upon these course materials by any party. SPFA neither endorses or guarantees the proprietary products or services of any particular company or individual that may be mentioned or featured in these materials.
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).

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.

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

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 crawlspace (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. For example, the building codes do list some exceptions for cooler and freezer construction and you should review the special building code requirements in these cases.

WHY DO CODES REQUIRE THERMAL BARRIERS?

Spray Polyurethane foam, like most other organic materials, is combustible. Spray polyurethane foams 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 ratings are used solely to measure and describe properties of products in response to heat and flame under controlled laboratory conditions. The numerical flame spread ratings are not intended to
reflect hazards presented by spray polyurethane foams or any other material under actual fire conditions in a real building.

When exposed to fire sources, such as welding arcs, cutting torches, or red-hot metal, unprotected spray polyurethane foam may ignite resulting in a flash fire. The burning will be brief, forming a layer of less flammable surface char. This initial burning produces combustible gases and black smoke. In confined interiors, combustible gases can accumulate and ignite resulting in flashover, a dangerous fire situation. Under these conditions, additional foam or other combustibles can become involved in the fire giving off additional combustible gases and feeding the fire. If the heat and gases are not dissipated and the temperature of the foam rises above approximately 379°C (700°F), the surface char will no longer be able to protect the foam and the foam will fuel the fire as it degrades under these extreme temperatures. Most sprayed polyurethane foam fires will involve other flammable materials, however, in a limited number of situations, when other flammable materials are not involved, sprayed polyurethane foam fires tend to be flash fires of relatively short duration.

Codes require thermal barriers for interiors to reduce the risk of a flash fire and to extend the time at which the foam would reach its auto ignition temperature should a fire originate from other sources.

All interior SPF must be protected by a code approved thermal barrier and the thermal barrier should be applied as soon as possible after polyurethane foam application. It is the polyurethane foam contractor who is responsible for insuring that a thermal barrier is applied. No written or verbal contract or disclaimer of responsibility will protect the polyurethane foam contractor from liability.

(Note 1: These fire scenarios depend on the accumulation of combustible gases. Exterior applications of spray polyurethane foam, such as roof systems, where combustible gases can dissipate, are less likely to become involved in flash fires and are treated differently under the building codes.)

**SELECTION OF THERMAL BARRIERS**

Consider the following in the selection of a thermal barrier:

1. Building code requirements.
2. Adhesion to the spray polyurethane foam (when appropriate).
3. Environment in which it is to be used.
4. Aesthetic qualities.
5. Ease of maintenance.
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.

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.
CELLULOSE THERMAL BARRIERS

Cellulose thermal barriers are composed of a dry, wood pulp based fiber, a latex adhesive and borax/boric acid fire retardants. The dry fiber is packaged in 25 to 35 lb. bags that are placed into the hopper of the blowing machine. The fiber is broken up in the hopper, metered through an air seal into the air stream created by the machine’s blower and carried through the fiber hose to the nozzle.

The adhesive concentrate is packaged in 25 to 55 gallon drums and must be diluted with water. The adhesive is pumped through a diaphragm pump and liquid line to the nozzle. At the nozzle, the adhesive is sprayed through tips onto the dry fiber as it exits. The wet fiber is sprayed onto the polyurethane foam at 1” to 1 ¼” thickness as required by building code.

The thermal barrier should have a current valid building code certification that lists a report number and date. In some cases, a local building code official will allow the use of a thermal barrier that has been tested to the satisfaction of the official but is not yet certified by a code agency.

The generally accepted tests for thermal barriers are ASTM E-119 and NFPA 286. (thermal barriers require two test, the E119 to prove the low temperature rise and NFPA 286 to prove the barrier will remain in place for 15 minutes….ref 2009 IBC 2603.4)

Caution: Just because a material is advertised as a “thermal barrier”, does not mean that a code agency or a local code official has approved it. 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 demands.

SPRAY APPLIED CEMENTITIOUS MATERIALS

Cementitious thermal barriers are made up of Portland cement, fiber fillers and dry adhesives. The material is shipped in 50 – 100 lb. bags to the job-site. The bagged dry materials are mixed with water in a mixer and pumped through a hose and gun to the surface to be sprayed.

The wet slurry is sprayed onto the spray polyurethane foam at ½” to ¾” thickness as required by applicable building codes.

GYPSUM WALLBOARD

Gypsum wallboard, sometimes referred to as sheetrock, is the most common used thermal barrier in the building envelope.

Residential homes and other buildings have been using sheetrock as interior wall
finished for many years. Sheetrock makes an attractive and versatile wall finish. Since this interior finish is consistent with building practices, is aesthetically pleasing and achieves the necessary thermal protection required over plastic insulation you will find sheetrock will be used in a large percentage of residential building envelope projects.

Gypsum wallboard must be a minimum of ½" thick and must be installed over all exposed spray polyurethane foam in compliance with good building practices. Consult your local building codes for any additional requirements.

IGNITION BARRIERS FOR THE SPRAY POLYURETHANE FOAM INDUSTRY

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 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; 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 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).

**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.

SUMMARY

- What is a thermal barrier?
  A thermal barrier is a material, applied over polyurethane foam, designed to slow the temperature rise of the foam during a fire situation, and to delay the foam’s involvement in a fire.

- Where is a thermal barrier needed?
  On the habitable side of a structure between the interior of the structure and the spray polyurethane foam.

- Why do codes require thermal barriers?
  Codes require thermal barriers for interiors to reduce the risk of a flash fire and to extend the time at which the foam would reach its auto ignition temperature should a fire originate from other sources.

- Selecting thermal barriers:
  o Cellulose - Cellulose thermal barriers are composed of a dry, wood pulp based fiber, a latex adhesive and borax/boric acid fire retardants.
  o Cementitious - Cementitious thermal barriers are made up of Portland cement, fiber fillers and dry adhesives.
  o Gypsum wallboard - Gypsum wallboard, sometimes referred to as sheetrock or drywall, is the most common used thermal barrier in the building envelope.

- Ignition Barriers- Ignition barriers are allowed in place of thermal barriers in attics and crawl spaces which are accessed for maintenance only.
SELF-QUIZ

THERMAL BARRIERS/IGNITION BARRIERS

Please circle the ONE best answer for each question.

1. A code approved thermal barrier provides _______________ for the SPF.
   a. Increases R-value
   b. A barrier against radiant heat loss
   c. Minimum fire protection in unoccupied spaces
   d. Minimum fire protection in living areas
   e. A barrier to prevent the loss of head by convection

2. A code approved thermal barrier must provide _______________ minutes or more protection to SPF during a full scale fire test.
   a. 15
   b. 25
   c. 30

3. Building codes require a thermal barrier for interiors to
   a. Reduce outgassing of spray foam
   b. Reduce the risk of flash fire
   c. Extend the life of the polyurethane foam
   d. Stop thermal losses
   e. a and d

4. Where is a 15 minute thermal barrier required?
   a. Under a roof structure
   b. Between the drywall and framing in heating climates
   c. Between shared wall multifamily housing
   d. On all doors and windows
   e. Habitable side of the structure

5. A good example of an approved thermal barrier would be:
   a. Vapor barrier paint
   b. 6 mil plastic film
   c. 0.016” sheet metal
   d. Minimum ½” gypsum board
6. A cellulose thermal barrier is composed of:
   a. Cellular plastic foam
   b. Dry wood pulp based fiber and latex adhesive
   c. Portland cement slurry
   d. Cellulose fibers embedded in a polyurethane coating

7. A cementitious thermal barrier is composed of:
   a. Cellulose embedded in a polyurethane coating
   b. Drywall joint compound
   c. Dry wood pulp based fiber and latex adhesive
   d. Portland cement slurry
   e. d and b
   f. b and c

8. The use of intumescent paints as an ignition barrier on foam requires full scale fire testing of coating and foam for the particular application in question.

   ______ TRUE    ______ FALSE

9. A good example of an approved ignition barrier would be:
   a. 1-1/2” mineral wool.
   b. Reflective insulation film.
   c. Bubble-wrap insulation.
   d. Aluminum foil.
   e. 6 mil poly sheeting.
   f. All of the above.

10. Ignition barriers are required over SPF and other foam plastics when the foam is installed in:
    a. All crawlspaces.
    b. All attics.
    c. Attics without any access.
    d. A and B.
    e. Attics and crawlspaces where access is only for maintenance of utilities.

To find out the correct answers, please turn to CHAPTER 6.