Know the Code: Using Spray Foam Insulation In Attics and Crawl Spaces

By Centers for the Polyurethanes Industry

One of the largest growing uses of spray polyurethane foam (SPF) insulation is in residential attics and crawl spaces. As with all other foam insulation applications, this use is regulated by building codes to assure that occupants are properly protected from the risk of fire. In order to demonstrate compliance with these requirements, the spray foam supplier typically performs fire tests, the results of which are submitted to an evaluation organization, such as the International Code Council's Evaluation Services (ICC-ES), for review. A product's performance is assessed against an Acceptance Criteria meant to clarify code requirements or to provide a technical basis for products or systems that are alternates to what is specified in the code. Through a public hearing process, the ICC-ES developed the Acceptance Criteria for Spray-applied Foam Insulation (AC377).

Recent modifications to the fire testing portion of AC377 were approved by the ICC-ES Committee in June 2009. The new protocol is based on code-compliant assemblies, and creates a credible standard for flammability performance for SPF installed in attic and crawl space applications. (Note – performance in flammability tests does not necessarily predict how a material will perform in an actual fire.)

Code Requirements

According to the International Building Code (IBC 2603.4) and the International Residential Code (IRC R316.4), all foam plastic insulation must be separated from the interior of the building by an approved 15-minute thermal barrier, such as 0.5-inch (1.27cm) gypsum wall board or equivalent material. This thermal barrier may be omitted if certain conditions are met in attics and crawl spaces. Specifically, entry must be restricted to service of utilities AND the foam plastic must be protected from ignition with a code-specified material.

Section 316.5.3 of the IRC prescriptively defines the following six materials as ignition barriers:

- 1.5-inch (3.81cm) mineral fiber insulation
- 0.25-inch (0.64 cm) wood structural panels
- 0.375-inch (0.95 cm) particleboard
- 0.25-inch (0.64 cm) hardboard
- 0.375-inch (0.95 cm) gypsum wall board
- 16 mil (0.41 mm) corrosion resistant steel

Note that these materials used as ignition barriers are not necessarily as protective as thermal barriers. Unlike thermal barriers, these materials are not required to limit the average temperature rise on the unexposed surface to less than 250° F (121.11° C) after a 15-minute exposure to an ASTM E119 temperature curve, nor is there a requirement for these materials to stay in place for at least 15 minutes when subject to specific fire tests.

Special Approvals Allowed By Code

The implementation of the prescribed ignition barriers over SPF insulation in attics and crawl spaces has been awkward and inefficient. Fortunately, the building codes allow for special fire tests to prove equivalent performance of alternate assemblies. In general, these fire tests must be related to the end-use configuration, and the finished foam plastic assembly must be tested in the maximum thickness and density intended for use in the polyurethanes industry.

Options exist in the building codes to perform testing on the assembly to qualify SPF without a thermal barrier. Passing these tests, with more stringent requirements than tests for ignition barrier equivalence, would allow the assembly to be used in place of the thermal barrier. Specific testing includes NFPA 286 (with criteria from IRC R302.9.4), UL 1040, UL 1715, or FM 4880. Assemblies passing these tests can also be used as an alternate to using code-prescribed ignition barriers.

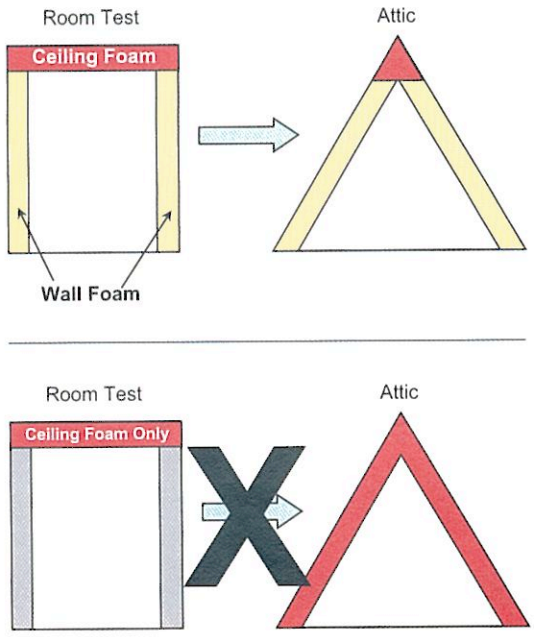
The building codes also allow code-prescriptive ignition barriers to be substituted with an assembly that can show at least equivalent performance. Again, these fire tests must be related to end-use configuration. Typically, the baseline is set based on performance of a prescribed ignition barrier over the SPF in question.

The Route to Special Approvals of Alternate Assemblies

Although the ICC-ES officially came into being on February 1, 2003, it has a history of over 70 years. The previously existing four building product evaluation services in the United States combined their operations into one: the ICC-ES. The ICC-ES evaluates building products for compliance with the code and issues reports on these products free of charge to code officials, contractors, and any others with an interest in the building industry. These reports are only advisory since it is only the code official or other authority having jurisdiction that can grant final approval for product use.

The foam plastic industry has worked with the ICC-ES to develop specific Acceptance Criteria (AC) for its products. These ACs are important because they can address products that fall under code provisions that are not sufficiently clear, such as fire testing and approval of alternate assemblies in attics and crawl spaces. These foam plastic-specific ACs are: AC12 for Foam Plastic Insulation and AC377 for Spray-Applied Foam Plastic Insulation.

Note that these ACs are intended solely for the use in development of the ICC-ES evaluation reports. The ICC-ES has not approved AC usage by other evaluation entities in publishing code-compliance reports or for product certification activities.



Complications of Comparative Testing

By definition, comparing performance of a test assembly to a baseline assembly requires two fire tests. Selection of an appropriate code-complying baseline is important to the credibility of the test. This was the case in the original AC377, where a comparative crawl space test, SwRI 99-02, developed at Southwest Research Institute, was used to eliminate the ignition barrier over foam plastic insulation altogether. In April 2000, the International Conference of Building Officials Evaluation Services (ICBO ES) allowed for testing to qualify an alternate ignition barrier material or system utilizing the comparative crawl space test, SwRI 99-02, with Kraft paper-faced fiberglass batts as an ad hoc baseline assembly [1].

As long as the foam plastic outperformed the fiberglass, the construction was approved for use in attics and crawl spaces. This policy was later adopted by ICC-ES. Although the ICBO mentioned three acceptable protocols for testing, the Kraft-faced fiberglass was chosen as the baseline by many companies. Passing performance in this test allowed for omission of the prescribed ignition barrier. One problem with the ICBO-ES, and later ICC-ES policy, was that the orientation of the Kraft paper was not specified. Leaving the Kraft paper exposed is a non-compliant construction (IRC R302.10.1 and Exception 1, IBC 719.2.1 and 719.3), and it is not a prescriptive ignition barrier.

Another complicating factor was that passing the comparative crawl space test also allowed elimination of the ignition barrier in the attic space, despite the differences in crawl space size and geometry compared to an attic space.

An Interim Solution

The ICC-ES took action in late 2007 by asking SPFA to propose a new approach for fire performance testing of attics and crawl spaces. SPFA formed an Attics and Crawl Space Task Force in early 2008 to address this request. Based on a recommendation from SPFA, ICC-ES adopted a fixed time to flame threshold for performance in SwRI 99-02 in May 2008, thereby eliminating the need for two comparative tests and providing a consistent baseline [2]. This recommendation became known as AC377 Appendix B and was seen by ICC-ES as an interim solution. It allowed SPFA time to develop a more rigorous proposal to meet the intent of the code. All new and renewed evaluation reports issued after May 2008 and before June 2009 were subject to the interim requirements. Appendix B as a fire test option expired in June 2009.

The SPFA Task Force Protocol

The SPFA, with funding from member companies and the Center for the Polyurethanes Industry, initiated a study to find a code compliant solution for testing spray foam for attic and crawl space applications. Other foam plastic insulation industries were consulted during protocol development. Recognizing that the spray foam industry would use the same test baseline, the SPFA embarked on development of a large scale fire test protocol based on a widely-accepted room corner test, a modified NFPA 286.

NFPA 286 is a room corner fire test, utilizing an 8-foot (2.44 m) high, 8-foot (2.44 m) wide by 12-foot (3.66 m) long room with a controlled sand gas burner ignition source in the corner. A code approved prescriptive ignition barrier was investigated as the comparative baseline: SPF covered with 0.25-inch (0.64 cm) plywood. Based on an average time for room flash-over from six of these tests, a Pass/Fail time threshold was assigned.

Tests were also performed on SPF without the plywood to uncover any testing issues specific to SPF. Because of the uneven surface of SPF, and based on heat-flux mapping of various ignition sources and their distance to the wall, the task force added a requirement for the SPF in the corner above the flame to be within a certain distance from the burner assembly.

Another requirement in the protocol is that the product or assembly being tested for approval must be uniform on both the walls and the ceilings. For example, there is no option to apply an intumescent coating to the wall, but not the ceiling of the attic. If a coating is used, it must be uniformly applied to both surfaces.

Attics can be made with various slopes in the ceiling. Instead of testing each possible slope for approval, this room corner test is conservative in that it evaluates the extremes of vertical wall and horizontal ceiling, eliminating the need to test each possible slope.

Currently, some manufacturers have ICC-ES reports that allow approval to cover only the vertical (wall) surface and leave the ceiling foam exposed. In the extreme case, this approval would inadvertently allow exposed foam on the ceiling of the attic to be installed on a slope all the way to the floor of the attic. The figure above uses a schematic to explain this point further. Because most attic ceilings are not 8 feet (2.44 m) from the floor at their lowest point, like the test configuration, testing only the ceiling in a room corner test does not adequately represent attic use. The requirement in the protocol that any thermally resistive coating be applied uniformly to all surfaces (vertical and horizontal) eliminates the need to limit the approval to a specific configuration. ICC-ES is allowing generic comparative room corner tests until June 2010, but will apply the SPFA test protocol requirements to any new submitted test data. In addition, testing horizontal ceilings will no longer gain approval for sloped under roof decks.

AC 377 (June 2009 Revision): Testing Options for SPF Use in Attics and Crawl Spaces

	Attics	Crawl Spaces
Thermal barrier equivalence, NFPA 286 or UL 1715, or UBC 26-3 [1]	YES Storage Allowed	YES Storage Allowed
Comparative room corner tests – plywood baseline, UBC 26-3, UL 1715 or NFPA 286 [2]	YES No Storage Permitted [testing allowed only to June 1, 2010, approvals sunset January 1, 2011]	NO
Comparative crawl space tests – plywood baseline, Appendix C [3]	NO	YES No Storage Permitted
Modified NFPA 286 [4]	YES No Storage Permitted	YES No Storage Permitted

[1] AC 377 Section 3.3.3, Appendix A 1.2.1, 2.2.1
[2] AC 377 Appendix A1.2.2
[3] AC 377 Appendix A2.2.2
[4] AC 377 Appendix X

The revised AC377 also means that Evaluation Services Reports are under review by ICC-ES. The following table can serve as a guide regarding current ESRs.

Impact of Revised AC 377 (June 2009 Revisions) on Current Evaluation Services Reports (ESRs)

Basis for ESR	Comments
NFPA 286 or UL 1715, or UBC 26-3 [1]	No need to amend/revise ESR.
Comparative room corner tests – plywood baseline, UBC 26-3, UL 1715 or NFPA 286 [2]	ESR expires January 1, 2011. Revision must be based on applicable test(s) from Testing Options Table.
Comparative crawl space tests - Kraft faced fiberglass baseline [3]	ESR expires January 1, 2010. Revision must be based on applicable test(s) from Testing Options Table.
Crawl space test Appendix B-Time threshold (prior to June 2009 Revision) [4]	ESR expires January 1, 2010. Revision must be based on applicable test(s) from Testing Options Table.
Modified NFPA 286 [5]	No need to amend/revise ESR.

[1] AC 377 (June 2009 Revisions) Section 3.3.3, Appendix A 1.2.1, 2.2.1
[2] AC 377 Appendix A1.2.2
[3] ICBO-ES April 2000 Letter
[4] Appendix B, which was deleted from AC 377 (June 2009 Revisions)
[5] AC 377 Appendix X

Generic Comparative Room Corner Test (A1.2.2) Additional Conditions and Eventual Deletion

ICC-ES decided to allow AC377 Appendix A1.2.2 to remain in place until June 2010. During this period, any new tests submitted using this generic comparative room corner test will have the following additional criteria applied (based on SPFA recommendations from their development work):

- Care shall be taken to provide as smooth a surface as possible especially in the wall areas adjacent to, as well as above, the flame source
- For testing on walls, the maximum deviations of distance between the flame source and the foam surface are as described in AC 377 Appendix X, Figure 3
- If approval is sought for the underside of roof deck only, approval will be granted only for use on horizontal surfaces at heights equal to or greater than the ceiling height tested
- If coverings are used over the foam, they shall be applied at the same thickness or minimum coverage rate to all foam surfaces

Options Available For Meeting Code

Attics

The following options are detailed in AC 377 for approved SPF use in attics:

- Use a code-prescribed ignition barrier (A1.1)
- Perform a special approval test "in lieu of thermal barrier" (A1.2.1)
- Perform a modified-NFPA 286 room corner test (Appendix X)
- Perform generic comparative room corner tests with 0.25-inch (0.64 cm) plywood baseline (A1.2.2, expires June 1, 2010)

Crawl Spaces

The following options are detailed in AC 377 for approved SPF use in crawl spaces:

- Use a code-prescribed ignition barrier (A2.1)
- Perform a special approval test "in lieu of thermal barrier" (A2.2.1)
- Perform a modified-NFPA 286 room corner test (SPFA Protocol, Appendix X)
- Perform comparative crawl space tests with 0.25-inch (0.64 cm) plywood baseline (A2.2.2 and Appendix C)

The acceptance of the SPFA Protocol by ICC-ES into the Acceptance Criteria for Spray-applied Foam Insulation (AC377, Appendix X) provides a number of credible options to demonstrate compliance with the code. Furthermore, the testing options apply to a variety of SPF products and systems, including exposed spray foam or spray foam covered by an alternate ignition barrier, such as an intumescent coating. Using the SPFA Protocol (Appendix X) allows an SPF supplier to gain acceptance of both attic and crawl space use from one test.

References

1. Gerber, B. Recognition of Use of Foam Plastic Insulation in Attics and Crawl Spaces, Subject MISC1-R2-0300 (MB/RK) (Previously MISC2-0799). International Conference of Building Officials Evaluation Services. 11 April 2000.

2. Beaton, M. Proposed Revisions to the ICC-ES Acceptance Criteria for Spray-Applied Foam Plastic insulation, Subject AC377-0508-R1. ICC-ES Evaluation Committee memo, May 19, 2008. **SF**