



## ACCEPTANCE CRITERIA FOR SPRAY-APPLIED FOAM PLASTIC INSULATION

AC377

Approved May 2008

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### PREFACE

Evaluation reports issued by ICC Evaluation Service, Inc. (ICC-ES), are based upon performance features of the International family of codes and other widely adopted code families, including the Uniform Codes, the BOCA National Codes, and the SBCCI Standard Codes. Section 104.11 of the *International Building Code*® reads as follows:

The provisions of this code are not intended to prevent the installation of any materials or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been approved. An alternative material, design or method of construction shall be approved where the building official finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, at least the equivalent of that prescribed in this code in quality, strength, effectiveness, fire resistance, durability and safety.

Similar provisions are contained in the Uniform Codes, the National Codes, and the Standard Codes.

This acceptance criteria has been issued to provide all interested parties with guidelines for demonstrating compliance with performance features of the applicable code(s) referenced in the acceptance criteria. The criteria was developed and adopted following public hearings conducted by the ICC-ES Evaluation Committee, and is effective on the date shown above. All reports issued or reissued on or after the effective date must comply with this criteria, while reports issued prior to this date may be in compliance with this criteria or with the previous edition. If the criteria is an updated version from the previous edition, a solid vertical line (|) in the margin within the criteria indicates a technical change, addition, or deletion from the previous edition. A deletion indicator (→) is provided in the margin where a paragraph has been deleted if the deletion involved a technical change. This criteria may be further revised as the need dictates.

ICC-ES may consider alternate criteria, provided the report applicant submits valid data demonstrating that the alternate criteria are at least equivalent to the criteria set forth in this document, and otherwise demonstrate compliance with the performance features of the codes. Notwithstanding that a product, material, or type or method of construction meets the requirements of the criteria set forth in this document, or that it can be demonstrated that valid alternate criteria are equivalent to the criteria in this document and otherwise demonstrate compliance with the performance features of the codes, ICC-ES retains the right to refuse to issue or renew an evaluation report, if the product, material, or type or method of construction is such that either unusual care with its installation or use must be exercised for satisfactory performance, or if malfunctioning is apt to cause unreasonable property damage or personal injury or sickness relative to the benefits to be achieved by the use of the product, material, or type or method of construction.

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# ACCEPTANCE CRITERIA FOR SPRAY-APPLIED FOAM PLASTIC INSULATION (AC377)

## 1.0 INTRODUCTION

**1.1 Purpose:** The purpose of this acceptance criteria is to establish requirements for spray-applied foam plastic insulation to be recognized in an ICC Evaluation Service, Inc. (ICC-ES), evaluation report under the 2006 *International Building Code*<sup>®</sup> (IBC), the 2006 *International Fire Code*<sup>®</sup> (IFC), the 2006 *International Residential Code*<sup>®</sup> (IRC), the 2006 *International Energy Conservation Code* (IECC), the 1997 *Uniform Building Code*<sup>™</sup> (UBC) and the 1997 *Uniform Fire Code*<sup>™</sup> (UFC). The bases of recognition are IBC Section 104.11, IRC Section 104.11, IECC Section 103 and UBC Section 104.2.8.

The reason for development of this criteria is to identify applicable code requirements for spray-applied polyurethane foam plastic insulation and to clarify test methods and conditions of acceptance for diversified testing.

**1.2 Scope:** This criteria applies to single- and multiple-component, spray- and bead-applied polyurethane foam plastics for use in accordance with the applicable code. Unless otherwise noted, the term "spray-applied" refers to both spray-applied and bead-applied polyurethane foam plastic insulation used in nonstructural, air sealing and roofing applications. This criteria is limited to jobsite installations of spray-applied polyurethane foam plastics wherein during its application, the foam plastic is applied in a liquid or frothed state and permitted to free-rise and cure in situ. This criteria provides acceptable diversified test procedures for qualifying fire performance characteristics of spray-applied foam plastic insulation exceeding the maximum thickness tested in accordance with ASTM E 84 and for qualifying thermal barriers and ignition barriers. This criteria supersedes the ICC-ES Acceptance Criteria for Foam Plastic Insulation (AC12) for the above-described spray-applied foam plastic materials.

**1.3 Codes and Referenced Standards:** Where standards are referenced in this criteria, the standards shall be applied consistently with the code upon which compliance is based.

### 1.3.1 Codes:

**1.3.1.1** 2006 *International Building Code*<sup>®</sup> (IBC), International Code Council.

**1.3.1.2** 2006 *International Fire Code*<sup>®</sup> (IFC), International Code Council.

**1.3.1.3** 2006 *International Residential Code*<sup>®</sup> (IRC), International Code Council.

**1.3.1.4** 2006 *International Energy Conservation Code*<sup>®</sup> (IECC), International Code Council.

**1.3.1.5** 1997 *Uniform Building Code*<sup>™</sup> (UBC).

**1.3.1.6** 1997 *Uniform Fire Code*<sup>™</sup> (UFC).

### 1.3.2 Reference Standards:

#### 1.3.2.1 ASTM International (ASTM):

**1.3.2.1.1** ASTM C 177-99, Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus.

**1.3.2.1.2** ASTM C 518-91, Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

**1.3.2.1.3** ASTM C 840-04, Specification for Application and Finishing of Gypsum Board.

**1.3.2.1.4** ASTM C 1029-02, Specification for Spray-Applied Rigid Cellular Polyurethane Thermal Insulation.

**1.3.2.1.5** ASTM C 1363-Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus.

**1.3.2.1.6** ASTM D 1621-00, Test Method for Compressive Properties of Rigid Cellular Plastics.

**1.3.2.1.7** ASTM D 1622-98, Test Method for Determining Apparent Density of Rigid Cellular Plastics.

**1.3.2.1.8** ASTM D 1623-78 (1995), Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics (Type B Specimen).

**1.3.2.1.9** ASTM D 2126-98, Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging.

**1.3.2.1.10** ASTM D 2856-94 (1998), Standard Test Method for Open-Cell Content of Rigid Cellular Plastics by the Air Pycnometer.

**1.3.2.1.11** ASTM E 84-04, Test Methods for Surface Burning Characteristics of Building Materials.

**1.3.2.1.12** ASTM E 96-00, Test Method for Water Vapor Transmission of Materials.

**1.3.2.1.13** ASTM E 119-00, Test Methods for Fire Tests of Building Construction and Materials.

**1.3.2.1.14** ASTM E 283-04, Test Method for Determining the Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences across the Specimen.

#### 1.3.2.2 Factory Mutual (FM):

**1.3.2.2.1** FM 4450-(1989), Approval Standard for Class 1 Insulated Steel Deck Roofs—with Supplements through July 1992.

**1.3.2.2.2** FM 4880-(2001), American National Standard for Evaluating Insulated Wall or Wall and Roof/Ceiling Assemblies, Plastic Interior Finish Materials, Plastic Exterior Building Panels, Wall/Ceiling Coating Systems, Interior or Exterior Finish Systems.

#### 1.3.2.3 National Fire Protection Association (NFPA):

**1.3.2.3.1** NFPA 259-04, Test Method for Potential Heat of Building Materials.

**1.3.2.3.2** NFPA 268-01, Standard Test Method for Determining Ignitability of Exterior Wall Assemblies Using a Radiant Heat Energy Source.

**1.3.2.3.3** NFPA 286-00, Standard Method of Fire Test for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth.

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**1.3.2.4 Underwriters Laboratories (UL):**

**1.3.2.4.1** UL 723-03, Test for Surface Burning Characteristics of Building Materials, with revisions through May 2005.

**1.3.2.4.2** UL 790-98, Tests for Fire Resistance for Roof Covering Materials, with revisions through July 1998.

**1.3.2.4.3** UL 1256-02, Fire Tests of Roof Deck Construction.

**1.3.2.4.4** UL 1040-96, Fire Test of Insulated Wall Construction, with revisions through April 2001 (IBC) and June 2001 (IRC).

**1.3.2.4.5** UL 1715-97, Fire Tests of Interior Finish Material, with revisions through October 2002 (IBC) and March 2004 (IRC).

**1.4 Definitions**

**1.4.1 Free Rise:** A condition of application wherein the spray-applied foam plastic is applied to a substrate or within a cavity and allowed to expand in at least one direction without constraint.

**1.4.2 Recovered Material:** Waste material and by-products that have been recovered or diverted from solid waste. The term does not include those materials and by-products generated from, and commonly reused within, an original manufacturing process.

**1.4.3 Post-consumer Waste:** Material or product that has served its intended use and has been discarded after passing through the hands of a final user. Post-consumer waste is a part of the broader category "recycled material."

**1.4.4 Recycled Material:** Material that is utilized in place of a raw or virgin material in manufacturing a product, and consists of materials derived from post-consumer waste, industrial scrap, material derived from agricultural waste and other items.

**1.4.5 Roofing Applications:** Roofing applications are those applications wherein the spray-applied polyurethane foam plastic is applied to the exterior of a roof substrate and provided with a liquid-applied coating complying with the code.

**2.0 BASIC INFORMATION**

The following information shall be submitted:

**2.1 Product Description:** Complete information concerning material specifications, application type (low-density insulation, medium-density insulation, roofing or sealing) and density.

**2.2 Installation Instructions:** Installation details and limitations, surface preparation and equipment settings (as appropriate). Installation instructions shall specify the overall maximum thickness, the maximum thickness that can be sprayed with each pass and the maximum number of passes allowed. If more than one spray application is allowed, the report shall include any restrictions, including, but not limited to, curing time and preparation.

**2.3 Packaging and Identification:**

**2.3.1 General:** A description of the method of packaging and field identification of the spray-applied foam plastic

insulation. Identification provisions shall include the evaluation report number.

**2.3.2 Identification:** Identification shall comply with IBC Section 2603.2, IRC Sections R314.2 and N1101.4.1, or UBC Section 2602.2, as applicable.

**2.4 Testing Laboratories:** Testing laboratories shall comply with Section 2.0 of the ICC-ES Acceptance Criteria for Test Reports (AC85) and Section 4.2 of the ICC-ES Rules of Procedures for Evaluation Reports.

**2.5 Test Reports:** Test reports shall comply with AC85.

**2.6 Product Sampling:** Sampling of the spray-applied foam plastic insulation for tests under this criteria shall comply with Section 3.1 of AC85. Preparation of test assemblies shall comply with Section 3.3 of AC85. Formulation of the insulation shall be disclosed to the inspection agency. The formulation need not be disclosed to ICC-ES but shall be identified in a controlled, dated document that is available to the inspection agency. The testing submitted to ICC-ES shall be on products produced using the stated formulation. Sampling of products for tests shall verify that the components are consistent with the stated formulation.

**3.0 TEST, PERFORMANCE AND INSTALLATION REQUIREMENTS**

**3.1 Physical Properties:**

**3.1.1 Spray-applied, Rigid Cellular Polyurethane Foam (SPF):** These materials, including products into which recycled material is introduced, shall comply with the requirements in ASTM C 1029, except that only those tests identified in Table 1 need be conducted, with the conditions of acceptance as stated in Table 1. Where the number of test specimens is not specified in the applicable test methods, a minimum of five specimens shall be used.

**3.1.2 Recycled or Recovered Material Qualification:** The introduction of recycled or recovered material into ICC-ES-recognized spray-applied foam plastic materials shall be qualified to establish that finished spray-applied foam plastic insulation with recycled or recovered content meets the requirements of this acceptance criteria. The definitions in Section 1.4 apply.

**3.1.3 Vapor Retarder:** Spray-applied foam plastic insulation intended to be qualified as a vapor retarder shall be tested in accordance with ASTM E 96, Procedure A (desiccant method), and shall have a permeance rating of 1 perm ( $5.7 \times 10^{-11}$  kg/Pa-s-m<sup>2</sup>) or less at the intended thickness and density.

**3.1.4 Potential Heat Content:** Where the potential heat content of spray-applied foam plastic is required, values shall be determined in accordance with NFPA 259 or UBC Standard 26-1.

**3.1.5 Ignition:** Where ignition properties for spray-applied foam plastic are required, values shall be determined in accordance with NFPA 268 or UBC Standard 26-4 or 26-9.

**3.2 Flame-spread Characteristics:**

**3.2.1 Flame-spread Index:** The insulation shall exhibit a maximum flame-spread index of 75 when tested in

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accordance with ASTM E 84, UL 723 or UBC Standard 8-1 at the maximum thickness, or the maximum bead diameter/minimum bead spacing, and density intended for use, but no greater than 4 inches (152 mm).

**3.2.2 Smoke-developed Index:** The insulation shall exhibit a maximum smoke-developed index of 450 when tested in accordance with ASTM E 84, UL 723 or UBC Standard 8-1 at the maximum thickness, or the maximum bead diameter/minimum bead spacing, and density intended for use, but no greater than 4 inches (152 mm). Testing required to determine the smoke-developed index is waived for roofing application under IBC Section 2603.3 (Exception 3), IRC Section R314.5.2 or UBC Section 2602.5.3.

**3.2.3** For material thicknesses greater than 4 inches (152 mm) (the maximum that can be tested in the ASTM E 84 apparatus), supplemental fire testing shall be conducted in accordance with NFPA 286 (with acceptance criteria of IBC Section 803.2), FM 4880, UL 1040, UL 1715, UBC Standard 26-3 or other testing methods approved by ICC-ES prior to testing and related to the actual end-use configuration performed on the finished spray-applied foam plastic assembly in the maximum thickness and density intended for use. See Section 3.3.

**3.2.4** Other sections in the codes and this acceptance criteria may alter the maximum allowable flame-spread index.

**3.2.5** Except as specifically permitted in IBC Section 2603, IRC Section R314 or UBC Section 2602, spray-applied foam plastic recognition shall be limited to the maximum thickness and density of the test specimen.

### 3.3 Supplemental Fire Test Methods:

**3.3.1** Supplemental fire tests for spray-applied foam plastic products shall be conducted at the maximum thickness and density anticipated for use.

**3.3.2 Full-scale Corner Fire Tests:** Full-scale corner tests conducted for nonbearing wall panels, incorporating spray-applied polyurethane insulation, shall be based on Factory Mutual's building corner fire test procedure 4880 or the Underwriters Laboratories test procedure described in UL Standard 1040. These tests involve walls up to 30 feet (9144 mm) high and 50 feet (15 240 mm) long with 750- to 800-pound (340 to 365 kg) wood cribs. Assemblies justified only by full-scale corner tests are permitted to be located only in areas with a minimum clear ceiling height of 20 feet (6096 mm).

**3.3.3 Room Tests for Spray-applied Foam Plastic Insulation Used as a Nonstressed Element in Walls and Ceilings:** Testing shall be conducted in accordance with NFPA 286, UL 1715 or UBC Standard 26-3 with the following conditions:

**3.3.3.1** Testing conducted in accordance with NFPA 286 shall have conditions of acceptance as stated in IBC Section 803.2.

**3.3.3.2** Testing conducted in accordance with UL 1715 or UBC Standard 26-3 shall be modified as follows:

**3.3.3.2.1** The  $\frac{1}{2}$ -inch-thick (12.7 mm) cementitious board room liner is permitted to be replaced with other materials with equivalent or superior thermal insulation characteristics.

**3.3.3.2.2** Where the foam plastic material, in its tested thickness, has an *R* value of 25 or more, the cementitious substrate is permitted to be deleted under the following conditions:

**3.3.3.2.2.1** There is no burning completely through the foam during the test.

**3.3.3.2.2.2** Absence of the substrate does not affect the installation of thermal barriers or other coverings over the foam plastic.

**3.3.3.2.3** Conditions of acceptance shall comply with UL 1715 or UBC Standard 26-3, except for the following:

**3.3.3.2.3.1** When it can be determined that discoloration is not due to charring, the  $\frac{1}{4}$ -inch (6.4 mm) limit in Item 1 of UBC Section 26.304 is not applicable.

**3.3.3.2.3.2** Determination of excessive smoke levels shall be as set forth in Section 3.3.4 of this acceptance criteria.

### 3.3.4 Smoke Determination:

**3.3.4.1 General:** Smoke determination shall consider the following:

**3.3.4.1.1** Smoke-density measurements of the spray-applied foam plastic under ASTM E 84 or UBC Standard 8-1 in the most critical manner of installation.

**3.3.4.1.2** Visual documentation (movies, videotapes) of the smoke generated during the room test. Where an obviously high level of smoke is generated during the test, the product will be considered unacceptable. Any questionable level, as determined by ICC-ES, will be deemed unacceptable, since the present state of the art does not submit to a precise pass-fail criteria. ICC-ES reserves the right to reject visual documentation, if of poor quality. One copy of visual documentation will be retained by ICC-ES for reference purposes.

**3.3.4.2 Video Recording:** Test Protocol for Video Recording of UL 1715 or UBC Standard 26-3 tests:

**3.3.4.2.1** A 300-watt flood-type, quartz halogen lamp shall be positioned in the corner diametrically opposite the crib, near the floor level. The lamp shall be aimed at the wall corner/ceiling intersection above the crib or burner.

**3.3.4.2.2** A video camera with a mechanically adjustable iris, adjusted to prevent automatic closing of the iris opening due to brightness of the fire (at least 50 percent open), shall be used. A video monitor shall be used to determine when adjustments and compensation for the brightness of the ignition flames are needed.

The camera mount shall be adjusted so that the camera lens is approximately 3 feet (914 mm) from the floor.

The camera angle and magnification shall be adjusted until the top of the doorway and the top of the crib or burner are visible and the ceiling area directly above the fire is in full view.

**3.3.4.2.3** For each test, when the test is for wall systems only, a new section of uncoated and unpainted  $\frac{5}{8}$ -inch (15.9 mm) gypsum wallboard, 2 feet by 2 feet (610 mm by 610 mm), shall be installed in the ceiling at the wall corner intersection directly above the crib.

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**3.3.4.2.4** A clock or timer depicting “real time” shall be included in all videos. The timer may be integral to the video camera, or a clock/timer is permitted to be used, providing it can be clearly viewed throughout the test period. For the UL 1715 or UBC Standard 26-3 test, the start of the test shall be when the alcohol-soaked excelsior is ignited.

**3.3.4.2.5** Immediately prior to ignition of the crib or burner, the date and laboratory test report identification number shall be filmed.

**3.3.4.2.6** The test report shall be in sufficient detail to provide:

1. Description of the room test setup, with details.
2. Test observations, commencing with crib ignition and ending with a final description of panels after all combustion ceases.
3. Thermocouple readings.
4. Statement of passing or failing.
5. Photographic record of tests.
6. Small sample of the protective covering or panel.

### 3.4 Thermal Barrier Requirements:

**3.4.1** Spray-applied foam plastic insulation shall be separated from the interior of the building by a thermal barrier as set forth in IBC Section 2603.4, IRC Section 314.4 or UBC Section 2602.4, as applicable, except as described in Sections 3.4.3 or 3.4.4 of this criteria. For application to the exterior of metal roof decks, acceptable separation from the building interior is permitted to be determined by testing in accordance with FM 4450, UL 1256, Items 3.2 and 3.3 of UBC Section 601.3, or the ICC-ES Acceptance Criteria for Foam Plastic Insulation Applied Directly to Steel Decks (AC142) (UBC only).

**3.4.2 Index Classification for Thermal Barriers:** Thermal barriers shall have an index of 15 or greater and shall be qualified to remain in place for the time of the index classification.

**3.4.2.1 IBC and IRC:** The index classification shall be determined by exposing the thermal barrier to testing in accordance with ASTM E 119 for a minimum of 15 minutes. The condition of acceptance is that the average rise from ambient temperature at the beginning of the test is not more than 250°F (120°C).

**3.4.2.2 UBC:** The index classification shall be determined in accordance with UBC Standard 26-2. The small-scale furnace specified therein shall be recognized by ICC-ES. Recognition involves evaluating small-scale test results on a specimen that has previously been tested as a component of a full-scale fire-resistive assembly. The intent is to compare temperatures between the unexposed surface of the small-scale assembly and the full-scale assembly tested in accordance with UBC Standard 7-1. A complete report of test, including temperature readings, is required for each test. At least three additional thermocouples are necessary between the interface of gypsum wallboard and wood studs, if this type of assembly is used for calibration.

**3.4.3 Thermal Barriers for Spray-applied Foam Plastics as Nonstressed Elements in Walls and Ceilings:** As an alternative to a thermal barrier complying with IBC

Section 2603.4, IRC Section R314.4 or UBC Section 2602.4, thermal barriers may be qualified by room corner tests described in Section 3.3.3.

**3.4.4 Spray-applied Foam Plastic Used in Attic and Crawl Spaces:** Within an attic or crawl space where entry is made only for service of utilities and where there are no heat-producing appliances, spray-applied foam plastics shall be protected as set forth in IBC Section 2603.4.1.6, IRC Section R314.5.3 or R314.5.4, or Exception 4 of UBC Section 2602.4. Utilities include, but are not limited to, mechanical equipment, electrical wiring, fans, plumbing, gas or electric hot water heaters, and gas or electric furnaces

The ignition barrier shall not be required when satisfactory testing is conducted in accordance with either Appendix A or Appendix B.

**3.5 Ventilation Requirements under the IRC:** Unvented, conditioned attic assemblies are permitted under the conditions prescribed in IRC Section 806.4, provided reports of tests in accordance with ASTM E 283 are submitted, with the test procedure modified as follows:

1. The test frame shall be a minimum of 24 inches (610 mm) square, and a 1/2-inch-thick (12.7 mm), low-density fiberboard substrate complying with ASTM C 208 fastened and sealed on the panel edges. The fiberboard shall have a minimum air permeance of 1.0 L/s-m<sup>2</sup> (0.20 ft<sup>3</sup>/min-ft<sup>2</sup>).
2. The spray-applied foam plastic insulation shall be applied in the minimum thickness for which recognition is sought.
3. The test pressure difference shall be 75 Pa (1.57 lb/ft<sup>2</sup>).
4. Air flow shall be by both infiltration and exfiltration.
5. Total air leakage shall be reported as the larger result from the infiltration and exfiltration tests.
6. Air impermeable is defined as a maximum total air leakage rate of 0.02 L/s-m<sup>2</sup> (0.004 ft<sup>3</sup>/min-ft<sup>2</sup>).

Unvented crawl spaces are permitted under the conditions prescribed in IRC Section R408.3.

### 3.6 Thermal Resistance:

**3.6.1** Thermal resistance shall be determined in accordance with ASTM C 1029 except as noted herein. For sealing applications where no insulation values are claimed, determination of thermal resistance is not required.

**3.6.2** The reporting of thermal resistance shall be based on a mean-test temperature of 75°F ± 5°F (23.8°C ± 2.8°C). Supplemental thermal-resistance values at other mean temperatures may be included.

**3.6.3** Recognition of thermal-resistance values shall be established for the range of thicknesses to be recognized in the evaluation report. Tests shall be conducted at a 1-inch (25.4 mm) thickness and at the maximum thickness permitted by the test procedure, but no less than 3.5 inches (88.9 mm). Extrapolation of *R*-values beyond the tested values shall be based on the *k*-value established at the maximum thickness tested.

**Exception:** When the maximum thickness of the spray-applied foam plastic recognized in the evaluation report is less than 3.5 inches (88.9 mm), tests shall be conducted at

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a 1-inch (25.4 mm) thickness and at the maximum thickness recognized in the evaluation report.

**3.6.4 Sample Conditioning:** Tests for thermal resistance of spray-applied foam plastics utilizing expanding agents, other than air or pentane, shall be performed on samples aged or conditioned according to ASTM C 1029 or at 140°F (60°C) dry heat,  $\pm 2^\circ\text{F}$  ( $1^\circ\text{C}$ ), for 90 days.

**3.7 Noncombustible Construction:** For purposes of this acceptance criteria, spray-applied foam plastic is a combustible material. In certain instances, spray-applied foam plastic is permitted where noncombustible materials are required under IBC Section 2603.5, UBC Section 2602.4 (Exception 3), or UBC Section 2602.5.2.

**3.8 Spray-Applied Foam Plastic Insulation Used as Decorative Material:** Use of spray-applied foam plastic as a decorative material attached to the building can be considered under IFC Section 807 or UFC Section 1103.3.3.

**3.9 Spray-applied Foam Plastic Insulation Protection:** Thermal barriers and other protective components exposed to damage from moving vehicles, the handling of merchandise, or similar activities, shall be protected.

**3.10 Exterior Wall-covering Systems:** Spray-applied foam plastic insulation used with exterior wall covering systems shall comply with this criteria.

**3.11 Roof Classification:** Spray-applied foam plastic used in roofing assemblies as defined in Section 1.4.5 of this criteria shall comply with IBC Section 2603.6, IRC Section R902 or UBC Section 2602.5.3, as applicable.

**3.12** Recognition of specific products or systems may be based on end use, quantity, location and similar considerations, where testing described in Section 3 of this criteria is not applicable or practical.

### 4.0 QUALITY CONTROL

**4.1 Quality Control Program:** The products shall be manufactured under an approved quality control program with inspections by an inspection agency accredited by the International Accreditation Service (IAS) or otherwise acceptable to ICC-ES.

**4.2 Quality Documentation:** Quality documentation complying with the ICC-ES Acceptance Criteria for Quality Documentation (AC10) shall be submitted.

**4.3 Quality Control Details:** The inspection agency or testing laboratory shall provide satisfactory evidence on the spray-applied foam plastic formulation and the method of spraying and fabricating samples used for tests under this criteria. In the absence of information released by the manufacturer, the inspection agency must conduct necessary tests to make this determination. The inspection agency shall provide reasonable assurance through quality control procedures and inspections that a formulated system is the same as samples used in qualifying tests.

**4.4 Recycled and Recovered Materials:** The quality control manual shall describe the process of introducing recycled or recovered material, including cleanliness and

proportioning controls. The inspection agency shall provide reasonable assurance, through quality control procedures outlined in the manual and through inspections, that a manufactured product is the same as samples used in qualifying tests. Use of recovered or recycled material in finished spray-applied foam plastic insulation shall be addressed in the quality control procedures.

### 5.0 EVALUATION REPORT RECOGNITION

**5.1** The evaluation report shall include, at a minimum, the IBC, IRC and IECC within the evaluation scope, except when the report is limited to recognition under the IRC.

**5.2** The evaluation report shall state that installation shall be by contractors certified by the report holder.

**5.3** The evaluation report shall state all of the following *R*-values at a mean test temperature of  $75^\circ\text{F} \pm 5^\circ\text{F}$  ( $23.8^\circ\text{C} \pm 2.8^\circ\text{C}$ ) as follows:

**5.3.1** For evaluation reports recognizing spray-applied foam plastic thicknesses greater than or equal to 3.5 inches (88.9 mm):

- a. at a 1-inch (25.4 mm) thickness
- b. at the maximum thickness permitted by the applicable test procedure, but no less than 3.5 inches (88.9 mm)
- c. at other thicknesses to be recognized in the evaluation report as determined by interpolation or extrapolation permitted in Section 3.6 of this criteria.

**5.3.2** For evaluation reports recognizing spray-applied foam plastic thicknesses less than 3.5 inches (88.9 mm):

- a. at a 1-inch (25.4 mm) thickness
- b. at the maximum thickness recognized in the evaluation report
- c. at other thicknesses to be recognized in the evaluation report as determined by interpolation.

**5.3.3** *R*-values need not be reported for sealing applications where no insulation values are claimed.

**5.4** For spray-applied insulation, the evaluation report shall include a condition of use that jobsite labeling shall comply with IRC Section N1101.4.

**5.5** The evaluation report shall state the construction types for which the insulation has been evaluated.

**5.6** The evaluation report shall state whether the insulation is a vapor retarder and the minimum thickness and density to do so. When the insulation has not been tested, or does not meet the requirements for a vapor retarder, it is assumed the product is not a vapor retarder and the evaluation report shall state that a vapor retarder shall be installed as required in the applicable code.

**5.7** When recognition includes installation in attics and crawl spaces, the evaluation report shall state the requirements for ventilation. ■

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**TABLE 1—PHYSICAL PROPERTIES OF SPRAY-APPLIED POLYURETHANE FOAM PLASTIC (SPF) INSULATION BY APPLICATION**

| APPLICATION   | TESTS REQUIRED  | VALUE   |
|---|---|---|
| Low-density insulation<br>(nominal core density 0.5 - 1.0 pcf)    | Thermal Resistance at 75°F(24°C) mean temperature. One of the four test methods listed below shall be used:<br>ASTM C 177<br>ASTM C 236<br>ASTM C 518<br>ASTM C 1363  | As reported   |
|   | Core Density:<br>ASTM D 1622  | As reported   |
|   | Tensile Strength:<br>ASTM D 1623  | Minimum closed cell content of 90%                                  |
|   | Note: Closed cell content shall be determined in accordance with ASTM D 2856  | Closed cell content less than 90%                                   |
|   | Dimensional Stability:<br>ASTM D 2126   | 15% maximum total change  |
|   | Surface Burning Characteristics:<br>IBC—ASTM E 84 or UL 723<br>UBC Standard 8-1   | 75 flame-spread index or less,<br>450 smoke-developed index or less |
| Medium density insulation<br>(nominal core density 1.5 - 3.5 pcf) | Thermal Resistance at 75°F (24°C) mean temperature. One of the four test methods listed below shall be used:<br>ASTM C 177<br>ASTM C 236<br>ASTM C 518<br>ASTM C 1363 | As reported   |
|   | Core Density:<br>ASTM D 1622  | As reported   |
|   | Tensile Strength:<br>ASTM D 1623  | 15 lbf/in <sup>2</sup> , minimum                                    |
|   | Dimensional Stability:<br>ASTM D 2126   | 15% maximum total change  |
|   | Surface Burning Characteristics:<br>IBC—ASTM E 84 or UL 723<br>UBC Standard 8-1   | 75 flame-spread index or less,<br>450 smoke-developed index or less |
|   | Compressive Strength:<br>ASTM D 1621  | 15 lbf/in <sup>2</sup> , minimum                                    |
| Roofing<br>(nominal core density 2.5 - 3.5 pcf)                   | Core Density:<br>ASTM D 1622  | As reported   |
|   | Tensile Strength:<br>ASTM D 1623  | 40 lbf/in <sup>2</sup> , minimum                                    |
|   | Dimensional Stability:<br>ASTM D 2126   | 15% maximum total change  |
|   | Surface Burning Characteristics:<br>ASTM E 84 or UL 723<br>UBC Standard 8-1   | 75 flame-spread index or less                                       |
|   | Compressive Strength:<br>ASTM D 1621  | 40 lbf/in <sup>2</sup> , minimum                                    |
|   | Thermal Resistance at 75°F(24°C) mean temperature. One of the four test methods listed below shall be used:<br>ASTM C 177<br>ASTM C 236<br>ASTM C 518<br>ASTM C 1363  | As reported   |
| Sealing<br>(nominal core density 0.5 - 2.5 pcf)                   | Core Density:<br>ASTM D 1622  | As reported   |
|   | Surface Burning Characteristics:<br>IBC—ASTM E 84 or UL 723<br>UBC Standard 8-1   | 75 flame-spread index or less,<br>450 smoke-developed index or less |
|   | Adhesion:<br>ASTM D 1623  | 5 lbf/in <sup>2</sup> , minimum                                     |

For SI: 1 pcf = 16.02 kg/m<sup>3</sup>, 1 lbf/in<sup>2</sup> = 6.89 kPa.

**Appendix A**  
**Testing for use in Attics and Crawl Spaces without a Code-prescribed Ignition Barrier**

Requirements in Appendix A become effective June 1, 2009. Prior to that date, compliance is optional.

**A1.0 Use in Attics:**

**A1.1** Spray-applied polyurethane foam plastic insulation installed in attics where entry is made only for service of utilities shall be protected by an ignition barrier as set forth in IBC Section 2603.4.1.6, IRC Section R314.5.3 or Exception 4 of UBC Section 2602.4, except as noted in Section A1.2. Utilities include, but are not limited to, mechanical equipment, electrical wiring, fans, plumbing, gas or electric hot water heaters, and gas or electric furnaces.

**A1.2** The ignition barrier shall not be required when satisfactory testing is conducted in accordance with either Section A1.2.1 or Section A1.2.2.

**A1.2.1 For use on Walls or Floors of Attics or the Underside of Roof Decks of Attics with Limitations Noted in Section A1.2.3.1:** Tests shall be conducted in accordance with NFPA 286 with the conditions of acceptance specified in IBC Section 803.2; or UL 1715 or UBC Standard 26-3 with conditions of acceptance as specified in Section 3.3.3.2.3 of AC377. The tests must be conducted with the foam plastic installed at the maximum density and maximum thickness for which recognition is sought over the gypsum wallboard or glass-reinforced cement board, as described in the test standard.

**A1.2.2 For Use on Walls or Floors of Attics or the Underside of the Roof Deck of Attics with Limitations Noted in Section A1.2.3.2:** Comparative room corner fire tests shall be conducted in accordance with the test procedures of UBC Standard 26-3 or UL 1715 or NFPA 286. The foam plastic insulation shall be applied in the manner for which recognition is sought. The interior face of the control assembly shall consist of nominal 1/4-inch-thick, A-C or B-C plywood applied to the interior face of wood wall framing (plywood is permitted by UBC Section 2602.4, Exception 4, IBC Section 2603.4.1.6 and IRC Section R314.5.3 as a protective material for foam plastic located in attics.) The exterior face shall be covered with 3/8-inch-thick exterior plywood. The second test assembly shall be identical, but without plywood on the interior face of the wall. Conditions of acceptance shall consider the time-to-failure of the control test assembly, as evidenced by flashover, which is flame exiting the door opening. The second assembly with exposed foam plastic shall be tested for at least the same length of time. A successful comparison is based on no flashover of the second assembly within the time-to-failure of the control test assembly.

**A1.2.3 Limitations for Attic Installations:**

**A1.2.3.1** When testing is in accordance with Section A1.2.1, the evaluation report shall include the following limitations:

- a. Attic ventilation is provided in accordance with IBC Section 1203.2 or IRC Section R806, as applicable.
- b. Combustion air is provided in accordance with IMC Sections 701 and 703.
- c. The foam plastic insulation is limited to the maximum thickness and density tested.

**A1.2.3.2** When testing is in accordance with Section A1.2.2, the evaluation report shall include the following limitations:

- a. Entry to the attic is only to service utilities and no storage is permitted.
- b. There are no interconnected attic areas.
- c. Air in the attic is not circulated to other parts of the building.
- d. Attic ventilation is provided in accordance with IBC Section 1203.2 or IRC Section R806, as applicable.
- e. The foam plastic insulation is limited to the maximum thickness and density tested.
- f. Combustion air is provided in accordance with IMC Sections 701 and 703.

**A1.2.3.3 Attic Floors:** The maximum thickness of foam plastic applied on the walls for the test methods outlined in either Section A1.2.1 or Section A1.2.2 can be used to establish the maximum thickness of foam plastic applied without a covering in attic floors. If a proprietary ignition barrier is used on the tested walls, it will be required for the attic floor application also.



**ACCEPTANCE CRITERIA FOR SPRAY-APPLIED  
FOAM PLASTIC INSULATION (AC377)**

**A2.0 Use in Crawl Spaces:**

**A2.1** Spray-applied polyurethane foam plastic insulation installed in a crawl space where entry is made only for service of utilities shall be protected by an ignition barrier as set forth in IBC Section 2603.4.1.6, IRC Section R314.5.4 or Exception 4 of UBC Section 2602.4, except as noted in Section A2.2. Utilities include, but are not limited to, mechanical equipment, electrical wiring, fans, plumbing, gas or electric hot water heaters, and gas or electric furnaces.

**A2.2** The ignition barrier shall not be required when satisfactory tests are conducted in accordance with either Section 2.2.1 or Section 2.2.2.

**A2.2.1 For Use on Walls or the Underside of Floors in a Crawl space with Limitations as Noted in Section**

**A2.2.3.1:** Tests shall be conducted in accordance with NFPA 286 with the conditions of acceptance specified in IBC Section 803.2; or UL 1715 or UBC Standard 26-3 with conditions of acceptance as specified in Section 3.3.3.2.3 of AC377. The tests must be conducted with the foam plastic installed at the maximum density and maximum thickness for which recognition is sought, over the gypsum wallboard or glass-reinforced cement board as described in the standard.

**A2.2.2 For Use on Walls or the Underside of Floors in a Crawl Space with Limitations Noted in Section A2.2.3.2:**

Comparative crawl space fire tests shall be conducted in accordance with Appendix C where the performance of the exposed foam plastic insulation is compared under identical test conditions to that of the foam plastic insulation covered with a code-approved ignition barrier. The interior face of the control assembly shall consist of nominal 1/4-inch-thick A-C or B-C plywood applied to the interior face of wood wall framing (plywood is permitted by UBC Section 2602.4, Exception 4, IBC Section 2603.4.1.6 and IRC Section R314.5.3 as a protective material for foam plastic located in attics.) The second test assembly shall be identical, but without plywood on the interior face of the wall. The time to flashover and the time to burn through the wood-framed floor/ceiling must be equal or greater for the exposed foam plastic insulation versus the foam plastic insulation covered with the 1/4-inch-thick plywood.

**A2.2.3 Limitations for Crawl Space Applications:**

**A2.2.3.1** When testing is in accordance with Section A2.2.1, the evaluation report shall include the following limitations:

- a. Under-floor (crawl space) ventilation is provided in accordance with IBC Section 1203.3 or IRC Section R408.1, as applicable.
- b. Combustion air is provided in accordance with IMC Sections 701 and 703.
- c. The foam plastic insulation is limited to the maximum thickness and density tested.

**A2.2.3.2** When testing is in accordance with Section A2.2.2, the evaluation report shall include the following limitations:

- a. Entry to the crawl space is only to service utilities and no storage is permitted.
- b. There are no interconnected crawl space areas.
- c. Air in the crawl space is not circulated to other parts of the building.
- d. Under-floor (crawl space) ventilation is provided in accordance with 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 IMC Sections 701 and 703.

**Appendix B**  
**Alternate Qualification for Use in Attics and Crawl Spaces**

The provisions in Appendix B are valid for tests conducted, and the test reports submitted to ICC-ES, prior to June 1, 2009.

**B1.0 For Use on Walls or Floors of Attics, on the Underside of Roof Decks of Attics, on Walls in Crawl Spaces or the Underside of Floors in Crawl Spaces:**

**B1.1** Tests are conducted using the test protocol described in Appendix C of this criteria. The test assembly shall consist of the spray-applied foam plastic at the maximum thickness and maximum density for which recognition is sought.

**B1.2 Conditions of Acceptance:** The time to flashover must be greater than 3 minutes and the time to burn through the wood-framed floor/ceiling must be greater than 12 minutes.

**B1.3 Limitations:** The evaluation report shall include the following limitations:

- a. Entry to the crawl space is only to service utilities and no storage is permitted.
- b. There are no interconnected crawl space areas.
- c. Air in the crawl space is not circulated to other parts of the building.
- d. Under-floor (crawl space) ventilation is provided in accordance with 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 IMC Sections 701 and 703.

**Appendix C**  
**Test Method for Crawl Space Evaluation**

**C1.0 SCOPE**

The objective of this test is to evaluate the fire performance of foam plastic insulation materials when tested in a simulated crawl space module to determine if the insulation is acceptable for use in attic or crawl space areas without a thermal barrier. The test provides a comparison of fire performance characteristics between insulated wood sub-floor assemblies.

**C2.0 TEST CONFIGURATION**

A sub-floor assembly is mounted on top of a three-sided wall module. The simulated crawl space module consists of three 8-ft square (outside dimensions  $\pm 2$  in.) walls, each  $48 \pm 2$  in. high, and built of nominal 4-in. wide  $\times$  8-in. high  $\times$  16-in. long concrete blocks with a full open space on one side of the structure. Masonry walls or module walls constructed of wood or metal studs with two layers of  $\frac{1}{2}$  in. gypsum board are permitted provided the interior dimensions are the same as for a concrete block module, i.e.,  $88 \pm 2$  in. wide and  $92 \pm 2$  in. deep. If wood or metal stud construction is used, the studs shall be located inside the module, i.e., the width of the module is equal to the distance between the interior faces of the gypsum board attached to the side walls and the depth is equal to the distance between the front opening and the interior face of the gypsum board attached to the back wall.

The floor/ceiling above the crawl space is built using nominal 2  $\times$  8-in.  $\times$  8-ft floor joists on 16-in. centers, with 2  $\times$  8-in. joist headers, all bearing on 2  $\times$  4-in. sill plates and surfaced with  $\frac{15}{32}$ -in. thick, 4-ply, APA graded A-C plywood sub-flooring. The use of joists and headers with a larger depth, e.g., 2  $\times$  10 in., 2  $\times$  12 in., etc. is permitted at the client's request.

Note 1: The use of CDX grade plywood is considered too variable in quality for comparison purposes required for this evaluation.

Note 2: All construction lumber (joists and studs, if used) shall be of the same species and grade for all tests conducted to qualify a foam plastic insulation.

The joists are perpendicular to the camera's line-of-sight, so that they tend to dam the flame front and hold it inside the test area. The floor of the test chamber is covered with approximately 1 in. of sand. To provide additional protection, it is acceptable to cover the floor with  $\frac{1}{2}$  in. gypsum board before installing the 1 in. layer of sand.

**C3.0 IGNITION SOURCE**

The fire source is a 22-lb wood crib constructed of nominal 2  $\times$  2-in. No. 1 select grade white pine (no knots), 15-in. square in plan, spaced approximately  $1\frac{1}{2}$ -in. apart and fastened at right angles with a single nail at each end. The crib shall be conditioned to an average moisture content of  $7.5 \pm 0.5\%$ . The crib is placed in a rear corner of the crawl space 1 in. from each wall surface and supported approximately 4-in. above the floor on small sections of refractory brick. The crib sticks of the bottom layer shall be parallel to the side walls. Approximately 150 ml of ethyl alcohol in a circular or square metal pan with a surface area of 36 to 40 in<sup>2</sup> placed under the crib is used for ignition.

**C4.0 TEST DURATION AND END POINT COMPARISON CRITERIA**

One or both of the following two criteria are established for test duration and relative comparison to between tests:

1. Time to flames emerging from the front of the crawl space.
2. Time to burn-through of the floor/deck system.

**C5.0 DOCUMENTATION**

The test is recorded with photographs and video documentation positioned to view the entire front of the open side of the module. A timing reference, mechanical or electronic, is included in all photographic and video records.

**C6.0 REPORT**

The report shall include:

- Name and location of facility where test is conducted.
- A description of the tested assembly with emphasis on the insulation type (including facings), thickness, density, and attachment details.
- Photographic and video documentation: pre-test, during (including timing), and post-test.
- A summary of visual observations including time to flames exiting the module and/or burn through of the sub-floor assembly.
- Conclusions in the form of a statement of findings summarizing the fire performance of the assembly; and, as appropriate, compared to a baseline test.
- Signature of a representative engineer or officer of the test facility.