

ACCEPTANCE CRITERIA FOR SPRAY-APPLIED FOAM PLASTIC INSULATION

AC377

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PREFACE

Evaluation reports issued by ICC Evaluation Service, LLC (ICC-ES), are based upon performance features of the International family of codes. (Some reports may also reference older code families such as the BOCA National Codes, the Standard Codes, and the Uniform 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.

This acceptance criteria has been issued to provide interested parties with guidelines for demonstrating compliance with performance features of the codes referenced in the criteria. The criteria was developed through a transparent process involving public hearings of the ICC-ES Evaluation Committee, and/or on-line postings where public comment was solicited.

New acceptance criteria will only have an “approved” date, which is the date the document was approved by the Evaluation Committee. When existing acceptance criteria are revised, the Evaluation Committee will decide whether the revised document should carry only an “approved” date, or an “approved” date combined with a “compliance” date. The compliance date is the date by which relevant evaluation reports must comply with the requirements of the criteria. See the ICC-ES web site for more information on compliance dates.

If this criteria is a revised edition, a solid vertical line (|) in the margin within the criteria indicates a technical change from the previous edition. A deletion indicator (→) is provided in the margin where wording has been deleted if the deletion involved a technical change.

ICC-ES may consider alternate criteria for report approval, provided the report applicant submits 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. ICC-ES retains the right to refuse to issue or renew any evaluation report, if the applicable product, material, 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 injury or unreasonable damage.

NOTE: The Preface for ICC-ES acceptance criteria was revised in July 2011 to reflect changes in policy.

Acceptance criteria are developed for use solely by ICC-ES for purpose of issuing ICC-ES evaluation reports.

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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, LLC (ICC-ES), evaluation report under the 2009 *International Building Code*[®] (2009 IBC), the 2009 *International Residential Code*[®] (2009 IRC), the 2009 *International Fire Code*[®] (2009 IFC), the 2009 *International Energy Conservation Code*[®] (2009 IECC), the 2006 *International Building Code*[®] (2006 IBC), the 2006 *International Residential Code*[®] (2006 IRC), the 2006 *International Fire Code*[®] (2006 IFC), the 2006 *International Energy Conservation Code* (2006 IECC), the 1997 *Uniform Building Code*[™] (UBC) and the 1997 *Uniform Fire Code*[™] (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 2009 *International Building Code*[®] (2009 IBC), International Code Council.

1.3.1.2 2009 *International Residential Code*[®] (2009 IRC), International Code Council.

1.3.1.3 2009 *International Fire Code*[®] (2009 IFC), International Code Council.

1.3.1.4 2009 *International Energy Conservation Code*[®] (2009 IECC), International Code Council.

1.3.1.5 2006 *International Building Code*[®] (2006 IBC), International Code Council.

1.3.1.6 2006 *International Residential Code*[®] (2006 IRC), International Code Council.

1.3.1.7 2006 *International Fire Code*[®] (2006 IFC), International Code Council.

1.3.1.8 2006 *International Energy Conservation Code*[®] (2006 IECC), International Code Council

1.3.1.9 1997 *Uniform Building Code*[™] (UBC).

1.3.1.10 1997 *Uniform Fire Code*[™] (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 or -04, 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 or -07, Specification for Application and Finishing of Gypsum Board.

1.3.2.1.4 ASTM C 1029-02, -05a or -08, Specification for Spray-Applied Rigid Cellular Polyurethane Thermal Insulation.

1.3.2.1.5 ASTM C 1363-05 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 D 6226-05, Standard Test Method for Open-Cell Content of Rigid Cellular Plastics.

1.3.2.1.12 ASTM E 84-04 or 07, Test Methods for Surface Burning Characteristics of Building Materials.

1.3.2.1.13 ASTM E 96-00 or E 96/E 96M-05, Test Method for Water Vapor Transmission of Materials.

1.3.2.1.14 ASTM E 119-00 or -07, Test Methods for Fire Tests of Building Construction and Materials.

1.3.2.1.15 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.

1.3.2.1.16 ASTM E 970-08, Test Method for Critical Radiant Flux of Exposed Attic Floor Insulation Using a Radiant Heat Energy Source.

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1.3.2.1.17 ASTM E 2178-03, Standard Test Method for Air Permeance of Building Materials.

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 or 2005), 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 or -07, Standard Test Method for Determining Ignitability of Exterior Wall Assemblies Using a Radiant Heat Energy Source.

1.3.2.3.3 NFPA 286-00 or -06, Standard Method of Fire Test for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth.

1.3.2.3.4 NFPA 275-09, Standard Method of Fire Tests for the Evaluation of Thermal Barriers Used over Foam Plastic Insulation.

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 or -04, 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).

1.3.2.4.6 UL 263-03, Standard for Fire Test of Building Construction and Materials.

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, 2009 IRC Sections R316.2 and N1101.4.1, 2006 IRC Sections R314.2 and N1101.4.1, 2009 IECC Sections 303.1.1 and 303.1.2, 2006 IECC Sections 102.1.1 and 102.1.11, 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

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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 (5.7×10^{-11} kg/Pa-s-m²) 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 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), 2009 IRC Sections R316.5.2, 2006 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 2009 IBC Section 803.1.2.1. or 2006 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, 2006 IRC Section R314, 2009 IRC Section R316, 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 the 2009 IBC Section 803.1.2.1. or 2006 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. 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.

3.3.3.3 Placement of the burner or wood crib shall be in accordance with the applicable standard, with the measured distance between the burner or crib and the interior surface of the assembly as described in Figure X3.

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, UL 723 or UBC Standard 8-1 in the most critical manner of installation.

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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.

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, 2009 IRC Section R316.4, 2006 IRC Section R314.4 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 Qualification of 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 or UL 263 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.

3.4.2.3 NFPA 275 is an acceptable method to establish requirements for a nonprescriptive thermal barrier.

3.4.3 Thermal Barriers for Spray-applied Foam Plastics as Nonstressed Elements in Walls and Ceilings: As an alternative to covering the foam plastic with a thermal barrier complying with IBC Section 2603.4, 2009 IRC Section R316.4, 2006 IRC Section R314.4, or UBC Section 2602.4, an assembly consisting of either the exposed foam plastic insulation or the foam plastic insulation and any coating, may be qualified by tests described in Section 3.3.3.

3.4.4 Spray-applied Foam Plastic Used in Attics: Within an attic where entry is made only for service of utilities, spray-applied foam plastics shall be protected as set forth in IBC Section 2603.4.1.6, 2009 IRC Section R316.5.3, 2006 IRC Section R314.5.3 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.

As an alternative, the prescriptive ignition barrier shall not be required when satisfactory testing is conducted with exposed foam plastic insulation or with a foam plastic insulation system, such as foam plastic insulation covered by a coating, in accordance with either Appendix A1.0 or Appendix X of this criteria.

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For assemblies where the insulation is installed on the attic floor only, the prescriptive ignition barrier shall not be required over exposed foam plastic or foam plastic insulation covered with a non-prescriptive ignition barrier when tested in accordance with ASTM E 970, where the measured critical radiant flux is not less than 0.12 watt per square centimeter. The initial sample thickness must be sufficient such that upon completion of the ASTM E 970 test, at least 0.5 inch (12.7 mm) of the foam thickness remains across the entire sample panel. To assure consistent thickness and flatness of the specimen surface, three foam thickness measurements shall be performed using a 3-inch (76 mm) disk-pin probe. The measurements shall be taken along the centerline of the specimen at $\frac{1}{4}$ L, $\frac{1}{2}$ L, and $\frac{3}{4}$ L from the end of the specimen, where L is the length of the test specimen. These three thickness measurements shall not deviate by more than 0.5 inch (12.7 mm). The maximum thickness of foam plastic recognized in the report will be the foam plastic thickness applied to the ceiling of test modules tested in accordance with Section 3.2.

3.4.5 Spray-applied Foam Plastic Used in Crawl Spaces: Within a crawl space where entry is made only for service of utilities, spray-applied foam plastic shall be protected as set forth in IBC Section 2603.4.1.6, 2009 IRC Section R316.5.4, 2006 IRC Section 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.

As an alternative, the prescriptive ignition barrier shall not be required when satisfactory testing is conducted with exposed foam plastic insulation or with a foam plastic insulation system, such as foam plastic insulation covered by a coating, in accordance with either Appendix A2.0 or Appendix X of this criteria.

3.5 Ventilation Requirements under the IRC: Unvented, attic assemblies are permitted under the conditions prescribed in IRC Section R806.4, based on testing in accordance with either ASTM E 283 or ASTM E 2178. "Air impermeable" is defined as a maximum total air leakage rate of 0.02 L/s-m² (0.004 ft³/min-ft²) when testing is at a 75 Pa pressure differential. Testing in accordance with ASTM E 283 shall be modified as follows:

1. The test frame shall be a minimum of 24 inches (610 mm) square, and a $\frac{1}{2}$ -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-m² (0.20 ft³/min-ft²).
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/ft²).
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. 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. Test specimen density must be within 10 percent of the nominal density, recognized in the evaluation report.

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. *R*-values of less than 10 shall be rounded to the nearest tenth. *R*-values of 10 or more shall be rounded to the nearest whole number.

3.6.3 Recognition of thermal-resistance (*R*-values) shall be established for the range of thicknesses and the density 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 at no less than 3.5 inches (88.9 mm). Calculated *R*-values for thicknesses between 1 inch (25.4 mm) and 3.5 inches (88.9 mm) shall be based on linear interpolation of tested *R*-values at 1-inch (25.4 mm) and 3.5-inch (88.9 mm) thicknesses. Calculated *R*-values for thicknesses greater than 3.5 inches (88.9 mm) shall be based on tested *R*-values at 3.5-inch (88.9 mm) thickness.

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

3.6.4 Sample Conditioning: Samples shall be conditioned at 73° ± 2°F (23°C ± 1°C) and 50 ± 5 percent relative humidity for 180 ± 5 days from time of manufacture, or 90 days ± 2 days at 140°F (60°C) dry heat ± 2°F (1°C) following the procedures of ASTM C 1029.

3.7 Use In Buildings of Type I, II, III and IV Construction: For purposes of this acceptance criteria, spray-applied foam plastic is a combustible material. In certain building types defined in IBC Section 602 where noncombustible materials are required, spray-applied foam plastic is permitted in exterior walls of building Types I, II, III and IV, provided appropriate testing is performed and results meet criteria according to IBC Section 2603.5, UBC Section 2602.4 (Exception 3), or UBC Section 2602.5.2, and as permitted in wall assemblies under Section 602, Exception 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 Sections 1507.14 and

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2603.6, IRC Sections R902 and 905.14 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 Except for single-component foams, the evaluation report shall state that installation shall be by professional contractors certified, accredited, authorized or approved by the report holder, or by the Spray Polyurethane Foam Alliance (SPFA).

5.3 The evaluation report shall state all of the following R-values at a mean test temperature of 75°F ± 5°F (23.8°C ± 2.8°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 Sections N1101.4 and N1101.4.1, 2009 IECC Sections 303.1.1 and 303.1.2 or 2006 IECC Sections 102.1.1 and 102.1.11, as applicable.

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 and all limitations as noted in Appendices A, X and C, as applicable.

5.8 When recognition includes installation of the spray-applied foam plastic in exterior walls of Type I through Type IV construction in accordance with Section 2603.5 of the IBC, the evaluation report shall provide details of the assemblies tested in accordance with NFPA 285, and/or NFPA 285 test results extended via third-party engineering analysis.

5.9 When a coating is used where a thermal barrier or ignition barrier is required, the thickness of the coating shall be identified both in dry film thickness and wet film thickness (in mils) and in coating application rate (in gallons per square feet) ■

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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 (nominal core density 0.5 -1.4 pcf)	Thermal Resistance at 75°F (24°C) mean temperature. One of the four test methods listed below shall be used: ASTM C 177 ASTM C 236 ASTM C 518 ASTM C 1363	As reported
	Core Density: ASTM D 1622	As reported
	Tensile Strength: ASTM D 1623	Minimum closed cell content of 90%
	Note: Closed cell content shall be determined in accordance with ASTM D 2856 or ASTM D 6226	Closed cell content less than 90%
	Dimensional Stability: ASTM D 2126	15% maximum total change
	Surface Burning Characteristics: IBC—ASTM E 84 or UL 723 UBC Standard 8-1	75 flame-spread index or less, 450 smoke-developed index or less
Medium density insulation (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: ASTM C 177 ASTM C 236 ASTM C 518 ASTM C 1363	As reported
	Core Density: ASTM D 1622	As reported
	Tensile Strength: ASTM D 1623	15 lbf/in ² , minimum
	Dimensional Stability: ASTM D 2126	15% maximum total change
	Surface Burning Characteristics: IBC—ASTM E 84 or UL 723 UBC Standard 8-1	75 flame-spread index or less, 450 smoke-developed index or less
	Compressive Strength: ASTM D 1621	15 lbf/in ² , minimum
Roofing (nominal core density 2.5 - 3.5 pcf)	Core Density: ASTM D 1622	As reported
	Tensile Strength: ASTM D 1623	40 lbf/in ² , minimum
	Dimensional Stability: ASTM D 2126	15% maximum total change
	Surface Burning Characteristics: ASTM E 84 or UL 723 UBC Standard 8-1	75 flame-spread index or less
	Compressive Strength: ASTM D 1621	40 lbf/in ² , minimum
	Thermal Resistance at 75°F (24°C) mean temperature. One of the four test methods listed below shall be used: ASTM C 177 ASTM C 236 ASTM C 518 ASTM C 1363	As reported
Sealing (nominal core density 0.5 - 2.5 pcf)	Core Density: ASTM D 1622	As reported
	Surface Burning Characteristics: IBC—ASTM E 84 or UL 723 UBC Standard 8-1	75 flame-spread index or less, 450 smoke-developed index or less
	Adhesion: ASTM D 1623	5 lbf/in ² , minimum

For **SI**: 1 pcf = 16.02 kg/m³, 1 lbf/in² = 6.89 kPa.

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

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 2006 and 2009 IBC Section 2603.4.1.6, 2009 IRC Section R316.5.3, 2006 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 As an alternative, the ignition barrier shall not be required when satisfactory testing is conducted with exposed foam plastic or with a foam plastic insulation system, such as foam plastic insulation covered by a coating in accordance with Section A1.2.1.

A1.2.1 For use on Walls or Floors of Attics or the Underside of Roof Decks of Attics: Tests shall be conducted in accordance with NFPA 286 with the conditions of acceptance specified in 2009 IBC Section 803.1.2.1 (2006 IBC Section 803.2); 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 substrates, as described in the test standard. The reported thickness shall be in accordance with Figures X1 and X2. Placement of the burner or wood crib shall be in accordance with the applicable standard, with the measured distance between the burner or crib and the interior surface of the assembly as described in Figure X3.

A1.2.1.1 Limitations: When testing is in accordance with Section A1.2.1, the evaluation report shall include the following limitations:

- a. Attic ventilation is provided when required by IBC Section 1203.2 or IRC Section R806, as applicable.
- b. Combustion air is provided in accordance with Sections 701 and 703 of the 2006 IMC and Section 701 of the 2009 IMC.
- c. The foam plastic insulation is limited to the maximum thickness and density tested.
- d. 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.

A1.2.2 Attic Floors: The maximum thickness of foam plastic applied on the ceilings for the test methods outlined in Section A1.2.1 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 ceilings, it will be required for the attic floor application also.

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 As an alternative, the ignition barrier shall not be required when satisfactory tests are conducted with exposed foam plastic or with a foam plastic insulation system, such as foam plastic insulation covered by a coating in accordance with either Section 2.2.1 or Section 2.2.2.

A2.2.1 (Option1) For Use on Walls or the Underside of Floors in a Crawl Space: Tests shall be conducted in accordance with NFPA 286 with the conditions of acceptance specified in 2009 IBC Section 803.1.2.1 (2006 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 substrates as described in the standard. The reported thickness shall be in accordance with Figures X1 and X2. Placement of the burner or wood crib shall be in accordance with the applicable standard, with the measured distance between the burner or crib and the interior surface of the assembly as described in Figure X3.

A2.2.1.1 Limitations: 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.

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- b. Combustion air is provided in accordance with Sections 701 and 703 of the 2006 IMC or Section 701 of the 2009.
- c. The foam plastic insulation is limited to the maximum thickness and density tested.
- d. 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.

A2.2.2 (Option 2) For Use on Walls or the Underside of Floors in a Crawl Space: 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 and over the foam plastic insulation (plywood is permitted by UBC Section 2602.4, Exception 4, IBC Section 2603.4.1.6, 2009 IRC Section R 316.5.3 and 2006 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.

A2.2.2.1 Limitations: 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, 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 of the 2006 IMC or Section 701 of the 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.

Appendix X

Alternate Testing for Use in Attics and Crawl Spaces without a Code-prescribed Ignition Barrier

X1.0 Scope:

X1.1 General: The objective of this testing is to evaluate the fire performance of spray-applied, polyurethane foam plastic insulation materials (SPF) when tested in a room/corner test configuration to determine if the insulation and/or the insulation system is acceptable for use in attics and crawl spaces without prescriptive ignition barriers per the IRC or IBC.

X1.2 Use in Attics: 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, 2009 IRC Section R316.5.3, 2006 IRC Section R314.5.3, or Exception 4 of UBC Section 2602.4, except as noted in Section X2.0. Utilities include, but are not limited to, mechanical equipment, electrical wiring, fans, plumbing, gas or electric hot water heaters, and gas or electric furnaces.

X1.3 Use in Crawl Spaces: 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, 2009 IRC Section R316.5.4, 2006 IRC Section R314.5.4 or Exception 4 of UBC Section 2602.4, except as noted in Section X2.0. Utilities include, but are not limited to, mechanical equipment, electrical wiring, fans, plumbing, gas or electric hot water heaters, and gas or electric furnaces.

X2.0 The ignition barrier shall not be required when satisfactory testing is conducted with exposed foam plastic insulation or with a foam plastic insulation system covered by a coating in accordance with the following:

X2.1 Test Method: The test procedure to be used is NFPA 286, "Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth," with the modifications described below.

X2.1.1 Ignition Source: The standard gas burner shall be used. The burner shall be positioned such that it is in contact with both sidewalls in the test corner of the fire test room as indicated in Figure X3.

X2.1.2 Specimen Mounting: The test specimens can be mounted in either of two configurations. Whichever configuration is used, the interior room dimensions as required by the NFPA 286 test procedure shall be maintained. The two configurations are:

a. The fire test room shall be completely lined with one layer of $\frac{5}{8}$ -inch-thick, Type X gypsum wallboard. The SPF shall be applied directly to the gypsum wallboard at the maximum thickness and density intended for use. The SPF shall be applied to both the three test walls and the test ceiling. If a covering is used over the foam, it shall be applied to both the walls and the ceiling at the same minimum thickness or coverage rate intended for use.

b. The three walls of the test room without the doorway will be constructed with wood studs sized to the same depth as the test specimen, 93 inches high, 24 inches on center with a single top and bottom plate, as shown in Figure X1. The exterior side of the walls will be covered with one layer of $\frac{5}{8}$ -inch-thick, Type X gypsum wallboard. The SPF will be sprayed to fill each stud cavity and be continuous from the bottom plate to the top plate and from stud to stud. The ceiling of the test room will be constructed as shown in Figure X2. The ceiling will consist of wood joists sized to the same depth as the test specimen at 24 inches on center. A total of five joists will be used and they will run parallel with the 12-foot length of the test room (front to back). The two outboard joists will rest on the top plates of the walls. The exterior side of the ceiling will be covered with one layer of $\frac{5}{8}$ -inch-thick, Type X gypsum wallboard. The SPF will be sprayed to fill each joist cavity and will be continuous from the front to the back and from joist to joist. If a coating (e.g., intumescent coating) is used over the foam, it shall be applied to both the walls and the ceiling at the same minimum thickness or coverage rate intended for use.

c. If a coating is used over the foam, its thickness shall be measured using the dry-film thickness technique (DFT), using one of the following methods:

Method 1 (Slit-sample method)

- i. Take two slit samples within 24 inches of the corner where the burner will be placed. The slit samples shall be approximately 0.5 inch deep, 2-3 inches long, and 0.5 inch wide. One face of the slit sample (where the measurements will be made) shall be cut perpendicular to the surface of the spray polyurethane foam.
- ii. Using an optical comparator, measure the coating thickness at four random locations on the face of each slit sample. Avoid the thinnest and the thickest spots on the samples. This will provide eight coating thickness measurements. The average of these eight measurements must be used to determine the average coating thickness.
- iii. The holes from which slit samples were taken must be filled with a nonflammable caulk or sealant.

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- iv. Weight or volume of the coating applied to the entire module area in (lb/ft² or Gallons/ft²) shall be recorded along with the measured DFT.

Method 2 (Medallion/target method)

- i. Install two metal medallions within 24 inches of the corner where the burner will be placed. The medallions shall be 2 inches by 2 inches with a ¼ inch hole in the center to allow a nail or screw to fasten the medallion to the foam surface.
- ii. Using an optical comparator or caliper, measure the coating thickness (dry mils film thickness) at four random locations of each medallion sample. Avoid the thinnest and the thickest spots on the samples. This will provide eight coating thickness measurements. The average of these eight measurements must be used to determine the average coating thickness.
- iii. The bare spots on the foam where the medallions were removed shall be coated with nonflammable caulk, coating or sealant prior to conducting the test.

X2.1.3 Test Corner Configuration: During the installation of the SPF, care shall be taken to provide as smooth a surface as possible, especially in the wall areas that will be adjacent to and above the burner. The maximum allowable deviations are described in Figure X3.

X2.1.4 Test Data: During the test, all of the following test parameters shall be determined:

- a. Time at which the Heat Release Rate exceeds 1 MW.
- b. Time at which the heat flux to the floor exceeds 20 kW/m².
- c. Time at which the average upper layer temperature exceeds 600°C.
- d. Time at which flames exit the doorway.

X2.1.5 Report: The following additional items shall be reported:

- a. Type, description, average thickness and nominal density of the SPF wall and ceiling specimens.
- b. If used as part of the insulation system, the type, description, and nominal thickness (in mils) or application rate (in gallons per 100 square feet) of coating.
- c. Time recorded for each test parameter from Section X2.1.4 above.
- d. Average of the four time values indicated in Item X2.1.5c.

X2.1.6 Conditions of Acceptance: A test shall be determined to be successful when the average time for attainment of the four measured test parameters (Item X2.1.5c, above) is 4 minutes 18 seconds or greater. This acceptance criteria is based on comparison of results for the tested assembly versus results for a code-prescribed ignition barrier applied over foam plastic insulation.

X2.2 Limitations:

X2.2.1 Attic or Crawl Space Installation:

When testing is in accordance with Appendix X, the evaluation report shall include the following limitations:

- 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).

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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.

X2.3 Attic Floors:

The maximum thickness of foam plastic applied on the walls for the test method outlined in Appendix X can be used to establish the maximum thickness of foam plastic 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.

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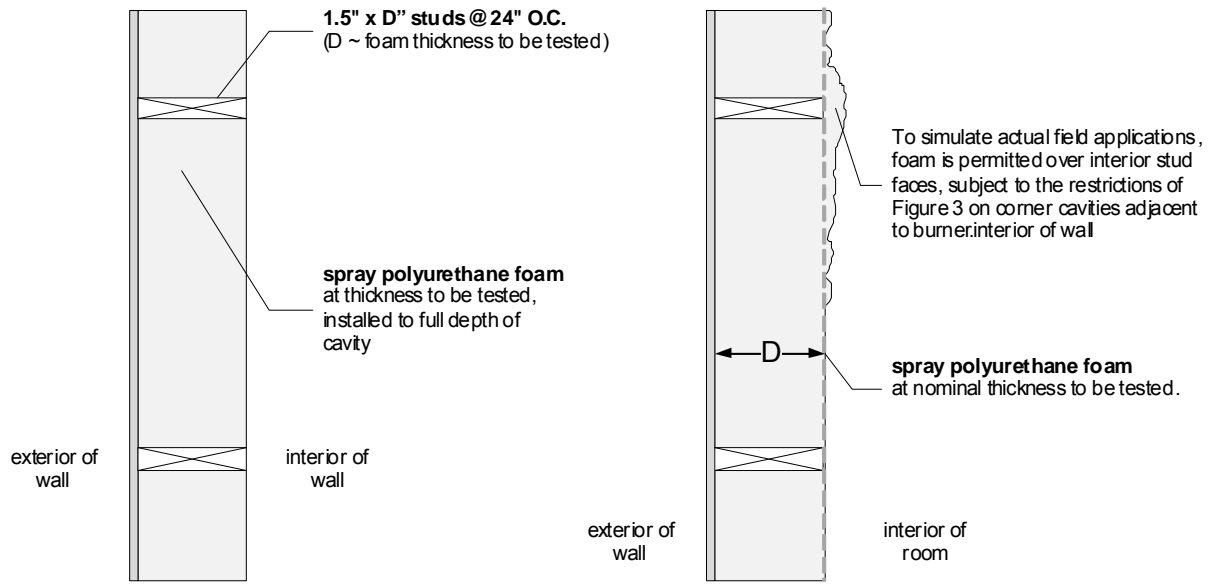


FIGURE X1—TOP VIEW OF WALL CONSTRUCTION

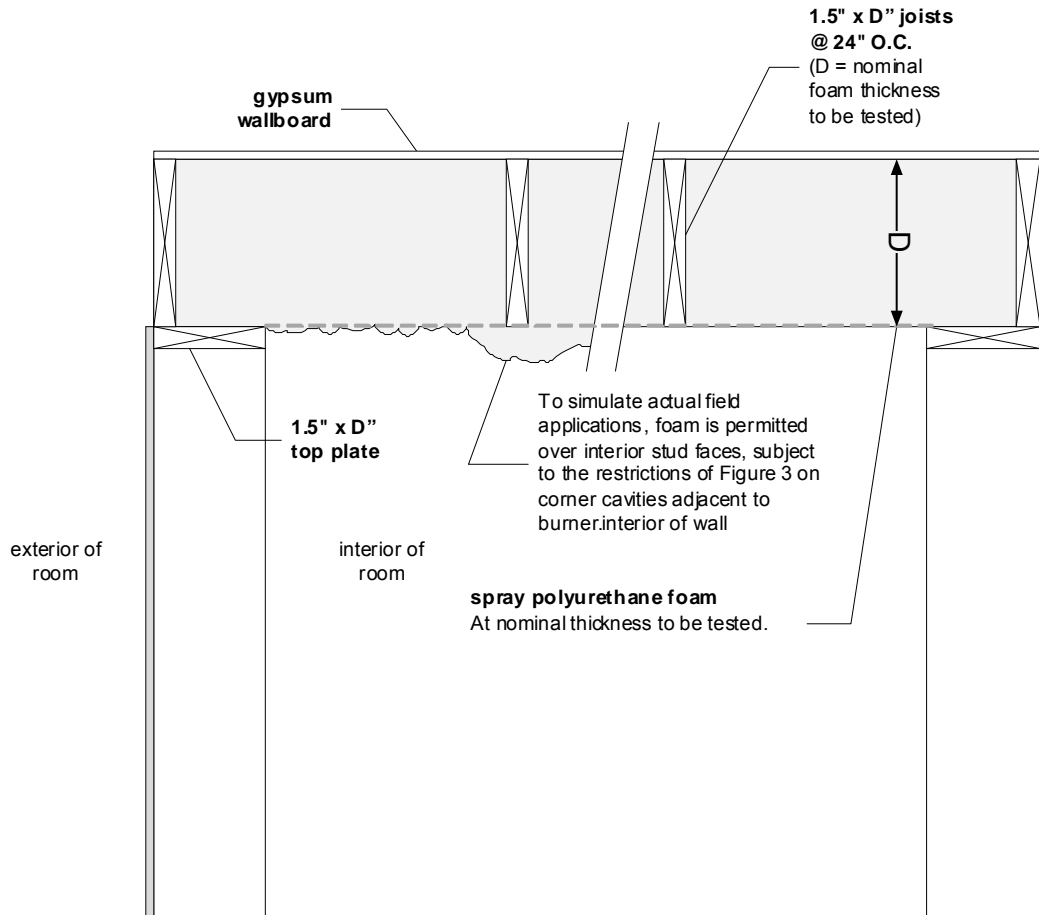
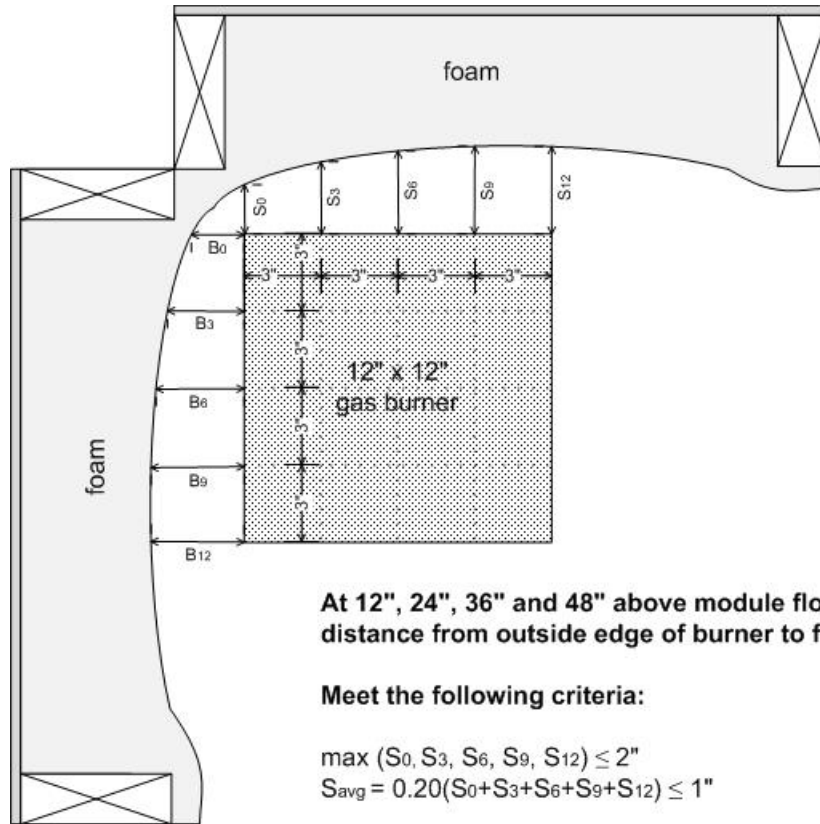


FIGURE X2—SIDE VIEW OF CEILING CONSTRUCTION

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At 12", 24", 36" and 48" above module floor, measure distance from outside edge of burner to foam surface.

Meet the following criteria:

$$\max (S_0, S_3, S_6, S_9, S_{12}) \leq 2"$$

$$S_{avg} = 0.20(S_0+S_3+S_6+S_9+S_{12}) \leq 1"$$

$$\max (B_0, B_3, B_6, B_9, B_{12}) \leq 2"$$

$$B_{avg} = 0.20(B_0+B_3+B_6+B_9+B_{12}) \leq 1"$$

FIGURE X3—MEASUREMENT POINTS FOR BURNER SPACING FROM FOAM

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 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 ± 2 in.) walls, each 48 ± 2 in. high, and built of nominal 4-in. wide by 8-in. high by 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 ± 2 in. wide and 92 ± 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 by 8-in. by 8-ft floor joists on 16-in. centers, with 2 by 8-in. joist headers, all bearing on 2 by 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 by 10 in., 2 by 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 by 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 in² placed under the crib is used for ignition.

C4.0 TEST DURATION AND END POINT COMPARISON CRITERIA

The following two criteria shall be measured and reported:

1. Time to flames emerging from the front of the crawl space.
2. Time to burn-through of the floor/deck system. If this criteria is not reached prior to laboratory personnel ending the test, the time at which the test was ended and reason for ending the test shall be reported.

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.

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- 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 control assembly.
- Signature of a representative engineer or officer of the test facility.