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February 11, 2010

TO: PARTIES INTERESTED IN EVALUATION REPORTS ON BUILDING-INTEGRATED PHOTOVOLTAIC (BIPV) ROOF MODULES AND PANELS

SUBJECT: Revisions to the Acceptance Criteria for Building-integrated Photovoltaic (BIPV) Roof Modules and Panels, Subject AC365-0210-R2 (YM/CA)

Dear Madam or Sir:

Enclosed is a copy of the subject revised acceptance criteria approved by the ICC-ES Evaluation Committee on February 2, 2010, effective March 1, 2010.

This acceptance criteria was revised to expand the scope of recognition to include BIPV roof modules that are self-adhered to a new roof covering system composed of either single-ply membrane, built-up roof or metal roof panels. The BIPV roof modules are the top layer of a complete roof covering system.

The approved revisions, as shown in Section 3.2 of the criteria, were to include guidelines to evaluate BIPV roof modules that are self-adhered to either a single-ply membrane, built-up roof, or metal roof panels roof covering system

Evaluation reports issued on or after the effective date noted above, and falling within the scope of this criteria, will be required to comply with the enclosed edition of the criteria. Evaluation reports issued prior to the effective date may be in compliance either with the enclosed acceptance criteria or with the previous edition. Evaluation reports based on a superseded version of an acceptance criteria must be brought into compliance with the most recent edition at the time the reports are reissued. Therefore, applicants should submit data verifying compliance at the time they apply for re-examination.

If you have any questions, please contact Yamil Moya, staff engineer, at (800) 423-6587, extension 3289. You may also reach us by e-mail at es@icc-es.org.

Yours very truly,

A handwritten signature in black ink that reads 'Gary G. Nichols'.

Gary G. Nichols, P.E., SECB
Vice President

GN/md

Enclosure

cc: Evaluation Committee

ACCEPTANCE CRITERIA FOR BUILDING-INTEGRATED PHOTOVOLTAIC (BIPV) ROOF MODULES AND PANELS

AC365

Approved February 2010

Effective March 1, 2010

Previously approved October 2009, October 2006

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.

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

ACCEPTANCE CRITERIA FOR BUILDING-INTEGRATED PHOTOVOLTAIC (BIPV) ROOF MODULES AND PANELS (AC365)

1.0 INTRODUCTION

1.1 Purpose: The purpose of this acceptance criteria is to establish requirements for recognition of building-integrated photovoltaic (BIPV) roof modules and panels in an ICC Evaluation Service, Inc. (ICC-ES), evaluation report under the 2006 and 2009 *International Building Code*[®] (IBC), the 2006 and 2009 *International Residential Code*[®] (IRC), and the 1997 *Uniform Building Code*[™] (UBC). The bases of recognition are IBC Section 104.11, IRC Section R104.11, and UBC Section 104.2.8. The reason for the development of this criteria is to provide guidelines for the evaluation of BIPV roof modules and panels, which are not addressed in the codes.

1.2 Scope: This criteria is applicable to BIPV roof modules and panels used in roof covering systems. The BIPV roof panels are installed with an underlayment above a solid-sheathed wood roof deck with a slope greater than or equal to 2:12 (16.7 percent) when used with asphalt shingles, or 2¹/₂:12 (20.8 percent) when used with clay or concrete tiles. When installed as part of a roof covering system, the BIPV roof panels are installed with an underlayment and flashing, as determined by testing under this criteria and the installation instructions. Under this criteria, the BIPV roof panels are limited to use in conjunction with asphalt shingles and clay or concrete tiles. The BIPV roof modules are a component of a roof covering system where the module is self-adhered to the top layer of single-ply membranes or to built-up roofs or to metal roof panels. The roof covering system incorporating the BIPV roof module must be installed at no less than the minimum roof slope specified by the code for single-ply membrane roof coverings, built-up roofs or metal roof panels roof coverings, as applicable. The electrical safety requirements and solar energy performance of the BIPV roof modules and panels are outside the scope of this criteria.

1.3 Codes and Referenced Standards:

1.3.1 2009 *International Building Code*[®] (2009 IBC), International Code Council.

1.3.2 2009 *International Residential Code*[®] (2009 IRC), International Code Council.

1.3.3 2006 *International Building Code*[®] (2006 IBC), International Code Council.

1.3.4 2006 *International Residential Code*[®] (2006 IRC), International Code Council.

1.3.5 1997 *Uniform Building Code*[™] (UBC).

1.3.6 ASTM E 108-07a, Test Methods for Fire Tests of Roof Coverings, ASTM International.

1.3.7 ASTM D 638-01, Standard Test Method for Tensile Properties of Plastics, ASTM International.

1.3.8 ASTM D 882-02, Standard Test Method for Tensile Properties of Thin Plastic Sheeting, ASTM International.

1.3.9 ASTM D 903-98(2004), Test Method for Peel or Stripping Strength of Adhesive Bond ASTM International.

1.3.10 ASTM D 3746-85(2002), Test Method for Impact Resistance of Bituminous Roofing Systems, ASTM International.

1.3.11 ASTM D 4272-03, Test Method for Total Energy Impact of Plastic Films by Dart Drop, ASTM International.

1.3.12 ASTM G 152-06, Practice for Operating Light-Exposure Apparatus (Carbon Arc-Type) with and without Water for Exposure of Nonmetallic Materials, ASTM International.

1.3.13 ASTM G 155-05a, Practice for Operating Light Exposure Apparatus (Xenon Arc-Type) with and without Water for Exposure of Nonmetallic Materials, ASTM International.

1.3.14 UL 580-2006, Test Method for Uplift Resistance of Roof Assemblies, Underwriters Laboratories Inc.

1.3.15 UL 746C-2004 (6th edition), Polymeric Materials—Use in Electrical Equipment Evaluations—with Revisions Through February 20, 2006, Underwriters Laboratories, Inc.

1.3.16 UL 790-04, Standard Test Methods for Fire Tests of Roof Covering Materials, Underwriters Laboratories Inc.

1.3.17 UL 1703 Third Edition (2002), Flat Plate Photovoltaic Panels, Underwriters Laboratories Inc.

1.3.18 UL 1897-04, Uplift Tests for Roof Covering Systems, Underwriters Laboratories.

1.3.19 FM 4470 (1992), Approval Standard for Class 1 Roof Covers, Factory Mutual Global Research.

1.3.20 FM 4474 (2004), Evaluating the Simulated Wind Uplift Resistance of Roof Assemblies Using Static Positive and/or Negative Differential Pressures, Factory Mutual Global Research.

1.3.21 CGSB 37-GP-52M (1984), Roofing and Waterproofing Membrane, Sheet Applied, Elastomeric, Canadian General Standards Board.

1.3.22 ANSI Z97.1– 84(R1994), Safety Glazing Materials Used in Buildings—Safety Performance Specifications and Methods of Test (Reaffirmed 1994).

1.3.23 CPSC 16 CFR Part 1201 (1977), Safety Standard for Architectural Glazing Material.

1.3.24 SBCCI SSTD 11-97, Test Standard for Determining Wind Resistance of Concrete or Clay Roof Tiles.

1.3.25 TAS No. 100-95, Test Procedure for Wind and Wind Driven Rain Resistance of Discontinuous Roofing Systems, 2001 Florida Building Code—Test Protocol HVHZ.

1.3.26 ICC-ES Acceptance Criteria for Special Roofing Systems (AC07), dated April 2007 (corrected February 2009).

1.3.27 IEC 61646 Edition 2.0, 2008-05, IEC International Standard, Thin-film Terrestrial Photovoltaic (PV) modules-Design qualification and type approval.

ACCEPTANCE CRITERIA FOR BUILDING-INTEGRATED PHOTOVOLTAIC (BIPV) ROOF MODULES AND PANELS (AC365)

1.4 Definitions

1.4.1 Photovoltaic Laminate: A photovoltaic laminate consists of a transparent superstrate which forms the top (weather-exposed) surface of the BIPV roof panel; photovoltaic cells and electrical interconnects; a substrate which forms the back surface of the module; protective layers of encapsulant material as required between the superstrate cells; and other components.

1.4.2 Building-integrated Photovoltaic (BIPV) Roof Panel: An integrated, manufactured assembly consisting of the photovoltaic laminate and other factory-assembled components, such as the support structure, with interlocking or overlapping edges. The BIPV roof panel is mechanically attached or optionally supplementary adhered to the roof deck, and is installed with other roof covering system components.

1.4.3 BIPV Roof Module: A photovoltaic module consisting of superstrate; photovoltaic cells and electrical interconnects; insulated and protective layers of encapsulant material as required between the superstrate cells; and other components. The BIPV roof module is self-adhered to the top layer of single-ply membranes or to built-up roofs or to metal roof panels.

1.4.4 Roof Covering System Components: Components installed in the field in conjunction with the BIPV roof modules and panels include:

1.4.4.1. BIPV roof panels: Underlayment, mechanical fasteners, flashing, and either asphalt shingles, concrete roof tiles or clay roof tiles.

1.4.4.2. BIPV roof modules: Flashing and either single-ply membranes, built-up roofing or metal roof panels.

1.4.5 BIPV Roof Covering System:

1.4.5.1. A complete roof covering system consisting of BIPV roof panels and the components specified in Section 1.4.4.1.

1.4.5.2. A complete roof covering system consisting of BIPV roof modules and the components specified in Section 1.4.4.2.

2.0 BASIC INFORMATION AND REPORT OF TESTS

The following basic information shall be submitted:

2.1 Product Description: Complete information, as applicable, concerning materials, dimensions, coatings, manufacturing process, and installation procedures for the BIPV roof module or panel.

2.2 Installation Instructions: Scale drawings; size and location of fasteners; and installation details, including BIPV module or panel replacement details, flashing and roof slope limitations.

2.3 Packaging and Identification: The method of packaging and identifying the BIPV roof modules or panels shall be specified. Identification shall include the ICC-ES evaluation report number and notice of any product installation limitations.

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 Procedure for Evaluation Reports.

2.5 Test Reports: Test reports shall comply with AC85.

2.6 Product Sampling: Sampling of products shall be in accordance with Section 3.1 of AC85.

3.0 TEST AND PERFORMANCE REQUIREMENTS

3.1 BIPV Roof Panel Roof Covering System (Mechanically Attached to Roof Deck):

3.1.1 Fire Classification Test: Fire-classification roof tests conducted in accordance with ASTM E 108 or UL 790 (IBC, IRC) or UBC Standard 15-2 (UBC) are required. The minimum fire classification shall be Class C. The testing laboratory shall establish the most critical test assembly based on the roof covering assemblies for which recognition is desired. Roof underlayment and any other roof covering system component necessary for obtaining the classification in the tests shall be manufactured under the listing program of an inspection agency accredited by the International Accreditation Service or otherwise acceptable to ICC-ES.

3.1.2 Wind Resistance:

3.1.2.1. General: The BIPV roof panels shall be tested in accordance with UL 1897. As an alternative, tests may be conducted in accordance with Section 800 of SBCCI SSTDD 11-99, or an alternate static pressure or wind tunnel test procedure, provided the test procedures used are accepted by ICC-ES staff prior to testing. The panels shall be tested over solid sheathing, as applicable to the recognition sought. Connections to framing or to sheathing shall be based on minimum conditions. Connection density shall be evaluated for both interior and perimeter corner zones. At least one roof deck shall be tested for each condition. The roof deck shall be representative of a roof deck used in the installation of the BIPV roof panels. Allowable loading will be based on a minimum safety factor of 2.0, applied to the ultimate load. Positive loads will be based on the adequacy of the structural framing and sheathing.

3.1.2.2. Allowable loads shall not exceed the established values for mechanical connectors, such as nails and screws. Fasteners used to attach BIPV roof panels to roof deck shall be corrosion-resistant and be made of similar materials to prevent a galvanic reaction.

3.1.3 Wind-driven Rain: Wind-driven rain tests shall be conducted in accordance with Florida Building Code TAS 100-95. All roof system variants intended for use with various roof types shall be tested. Roofing system components shall be installed as required by the BIPV manufacturer's instructions for the configuration under test. The BIPV roof system test assembly shall be installed in accordance with the manufacturer's published installation instructions on a 10-foot-by-10-foot (3.05 by 3.05 m) flat deck at the prescribed minimum slope. The test area is defined as an 8-foot-wide (2.44 m) section of this deck centered on the centerline of the wind generator nozzle. The BIPV roof system shall consist of at least four adjacent courses of BIPV panels, and roof system components as required by the installation instructions. One test shall be conducted for each approved roof covering type (asphalt shingles, and clay and concrete tiles) for which recognition is sought. The selected roof covering shall cover the remainder of the test deck. There must be at least one course of roofing material or 12

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inches (305 mm), whichever is greater, below the BIPV roofing panels. One test must include vertical joints between the BIPV panels in the test area on at least three courses, and one test must include vertical joints between the BIPV roof panels and other roof covering in the test area of at least three courses. The same specimens may be used for both tests. Any openings on the perimeter of the test assembly may be sealed. Roof covering materials not immediately adjacent to the BIPV roof panels may be secured with additional fasteners or adhesives if required to prevent tear-off and impingement on the BIPV roofing system. If tear-off of nonadjacent roof covering results in a failure of the test, the test may be repeated.

3.1.4 Durability:

3.1.4.1. Photovoltaic Laminate:

3.1.4.1.1. Superstrate: Reports of tests shall be submitted showing compliance with at least one of the following:

a. The requirements in the Performance Specifications and Methods of Test for Safety Glazing Material Used In Buildings, ANSI Z97.1-1984; or

b. The requirements in the Code of Federal Regulations, Title 16 CPSC Part 1201– Safety Standard for Architectural Glazing Materials; or

c. Reports of impact tests in accordance with Section 30 of UL 1703 or Section 10.17 of IEC 61646 [using a 1.5-inch-diameter (35 mm) hailstone]. The condition of acceptance is that the superstrate of the photovoltaic laminate shall not crack.

3.1.4.1.2. Temperature Cycling Test: Testing shall be conducted on the photovoltaic laminate in accordance with UL 1703, Section 35.

Conditions of Acceptance: Testing of the photovoltaic laminate shall not result in delamination, cracking or separation of materials.

3.1.4.1.3. Humidity Test: Testing shall be conducted on the photovoltaic laminate in accordance with UL 1703, Section 36.

Conditions of Acceptance: Testing of the photovoltaic laminate shall not result in delamination, cracking or separation of materials.

3.1.4.2. BIPV Roof Panel Materials: With the exception of the photovoltaic laminate, the materials used to fabricate the BIPV roof panel shall comply with one of the following:

3.1.4.2.1. Exposed Metal Components: Reports of tests showing compliance with the material requirements of Tables 1507.4.3(1) and (2) of the IBC, Tables R905.10.3(1) and (2) of the IRC, or Section 1507.8 of the UBC, as applicable. For materials other than those listed in the above noted tables, the material shall be shown to be equivalent to those listed.

3.1.4.2.2. Polymeric or Elastomeric Materials of BIPV Roof Panel Tiles Used as Roof Covering: The following tests are required for all weather-exposed polymeric or elastomeric materials used in the BIPV roof panels:

1. Uplift bend tests in accordance with Section 3.2.3 of AC07 are required for recognition of roof

slopes exceeding 60 degrees (173 percent) from the horizontal.

2. Data in accordance with Section 3.2.5.2 of AC07 shall be submitted.

3. Temperature-cycling test data in accordance with Section 3.2.6 of AC07 shall be submitted.

4. Weathering tests in accordance with Section 4.1 are required for all weather-exposed polymeric or elastomeric materials used in the BIPV roof panels. After the 2000-hour exposure, both exposed and control specimens shall be tested in accordance with ASTM D 638. A minimum of five specimens shall be tested for both control and exposed condition.

Conditions of Acceptance: The average loss in tensile strength and elongation after the weatherometer test shall be evaluated on a case-by-case basis. Failure for exposed samples is also defined as surface changes, as viewed by minimum 5x magnification, such as cracking, checking, crazing, erosion, or chalking that might affect performance.

3.1.4.2.3. Durability of Adhesive Components:

When BIPV roof panels are supplementarily adhered to each other or other approved roof covering, as demonstrated in the qualifying tests described in Section 3.1.2 and 3.1.3 of this criteria, testing to determine the durability of the adhesive used shall be conducted in accordance with Section 4.3 of this criteria, except that the test samples shall be representative of the adhered substrate components (BIPV roof panel components and approved roof covering) for which recognition is sought.

3.1.5 Penetration Test: Penetration tests shall be conducted in accordance with Section 4.2.

Conditions of Acceptance: There shall be no shattering or cracking of the superstrate, causing exposure of the plastic or other compressible materials; or excessive permanent deformation under the applied load, resulting in unsatisfactory performance of the test panel.

3.2 BIPV Roof Module Roof Covering Systems (Self-adhered):

3.2.1 General: The systems and system components must be qualified in accordance with the requirements of this criteria and comply with the applicable provisions of the code.

3.2.2 Fire Classification Testing: Fire classification testing of representative BIPV roof module roof covering systems, conducted in accordance with ASTM E 108 or UL 790 (IBC or IRC) or UBC Standard 15-2 (UBC), is required. The testing laboratory shall establish the most critical assembly for which recognition is desired. Roof covering assemblies shall be manufactured under the listing program of an inspection agency accredited by the International Accreditation Service or otherwise acceptable to ICC-ES.

3.2.3 Wind Uplift Resistance: The BIPV roof module roof covering systems shall be tested in accordance with either UL 580, FM 4474 (2009 IBC), or FM 4470 (2006 IBC) . The systems shall be tested for adhesion of the modules and for the ultimate uplift load capacity of each system. The systems tested, including the roof deck, shall be representative of the systems for which recognition is sought. Allowable loading will be

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based on a minimum safety factor of 2.0, applied to the ultimate uplift load of the system or the load where delamination of the module occurs, whichever is less.

3.2.4 Impact Resistance: BIPV roof modules installed on low slope roofs (roof slope < 2:12) shall be tested for impact resistance in accordance with ASTM D 3746, ASTM D 4272, CGSB 37-GP-52M or the "Resistance to Foot Traffic Test" in Section 5.5 of FM 4470.

3.2.5 Durability:

3.2.5.1. Superstrate: Except as noted in Exception No. 1 of Section 17 of UL 1703, reports of tests shall be submitted showing compliance with at least one of the following:

a. The requirements in the Performance Specifications and Methods of Test for Safety Glazing Material Used In Buildings, ANSI Z97.1-1984.

b. The requirements in the Code of Federal Regulations, Title 16 CPSC Part 1201– Safety Standard for Architectural Glazing Materials.

c. Reports of impact tests in accordance with Section 30 of UL 1703 or Section 10.17 of IEC 61646 [using a 1.5-inch-diameter (38 mm) hailstone]. The condition of acceptance is that the superstrate of the photovoltaic laminate shall not crack.

3.2.5.2. Temperature Cycling Test: Testing shall be conducted on the BIPV roof module in accordance with UL 1703, Section 35.

Conditions of Acceptance: Testing shall not result in specimen delamination, cracking or separation of materials.

3.2.5.3. Humidity Test: Testing shall be conducted on the BIPV roof module in accordance with Section 36 of UL 1703.

Conditions of Acceptance: Testing shall not result in specimen delamination, cracking or separation of materials.

3.2.5.4. Ultraviolet Exposure:

Ultraviolet light exposure testing and conditions of acceptance for the BIPV roof module shall comply with the requirements found in Section 25 of UL 746C, when installation is limited to roof slopes equal to or greater than 2:12.

When installation of the roof covering system will include roof slopes of less than 2:12, the durability provisions found in Section 1504.6 of the IBC, and as indicated in this section, shall be followed. Weathering tests shall be conducted in accordance with Section 4.1 of this criteria. After the 2000-hour exposure, both exposed and control specimens shall be tested in accordance with ASTM D 638 or ASTM D 882, as applicable. A minimum of five specimens shall be tested for both control and exposed condition. The average loss in tensile strength and elongation after the weatherometer test shall be evaluated on a case-by-case basis. Failure for exposed specimens is also defined as surface changes, as viewed by minimum 5X magnification, such as cracking, checking,

cracking, erosion, or chalking that might affect performance.

3.2.5.5 Retention of Adhesion after Temperature Cycling: The durability of the self-adhered BIPV roof module shall be determined through testing in accordance with Section 4.3 of this criteria. Testing shall be conducted of the BIPV roof module adhered to representative substrates for which recognition is sought.

4.0 TEST METHODS

4.1 Weatherometer Test:

4.1.1 Sample: Ten representative samples of the elastomeric or polymeric material shall be prepared in accordance with ASTM D 638 or ASTM D 882, as applicable, of which five shall be held as controls. The same sample preparation and method of loading shall be used for all specimens.

4.1.2 Apparatus: See ASTM G 152, Cycle 1 of Appendix Table X1, or ASTM G 155, Cycle 1 of Appendix X3.1.

4.1.3 Procedure: The test shall be conducted for a period of 2000 hours. Specimen condition, examined under 5x magnification, may be reported at the end of 500, 1000, and 1500 hours of exposure, and a report is required after 2000 hours.

4.2 Penetration Test:

4.2.1 Test Panel Assembly: A BIPV roof panel shall be installed in an assembly that will be the most critical to the BIPV roof panel and to other non-BIPV roof tiles or panels, as demonstrated in the BIPV manufacturer's installation instructions.

4.2.2 Apparatus: A 3-inch-diameter (76 mm) steel plate with rounded corners. A device capable of imposing a 200-pound (890 N) load.

4.2.3 Procedure: The test panel assembly shall be continuously supported by a rigid backing. A 200-pound (890 N) load, imposed on the steel plate, shall be applied at the most critical location of the test panel, as determined by the testing agency. The superimposed load shall be reduced to zero and there shall be reloading a minimum of four additional times. The test panel and other roof panels are to be inspected after the test and the condition at the steel plate interface noted.

4.3 Retention of Adhesion after Temperature Cycling:

4.3.1 Samples: Samples shall be prepared in accordance with ASTM D 903, except as modified in this section (Section 4.3.1). Specimens shall be assembled individually, since cutting specimens to size after assembly may influence the test results.

4.3.1.1. Each sample shall consist of the following:

1. Five control specimens of the module or module material adhered to each substrate for which recognition is sought. The specimens are to be conditioned at 75±2°F (23.9±1.1°C) and at a relative humidity of 50±2 percent, for not less than one hour prior to peel strength testing in accordance with Section 4.3.2 of this criteria. See Section 4.3.1.4 for length of conditioning materials before and after specimen assembly.

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2. Five specimens consisting of the module or module material adhered to each substrate for which recognition is sought. The specimens are to be subjected to temperature-cycling exposure in accordance with Section 3.2.6 of AC07. After the temperature-cycling exposure, the specimens are conditioned at $75\pm 2^{\circ}\text{F}$ ($23.9\pm 1.1^{\circ}\text{C}$) and at a relative humidity of 50 ± 2 percent, for not less than one hour prior to peel strength testing in accordance with Section 4.3.2 of this criteria.

4.3.1.2. For module or module material adhesion to substrate, the test specimen shall consist of one piece of module or module material, 3 by 8 ± 0.125 inches (76 by 203 ± 2 mm), adhered to a 3-by-5-inch (76 by 127 mm) section of the substrate that measures 3 by 6 inches (76 by 152 mm). The substrate is to be securely bonded and/or nailed to a piece of minimum $\frac{1}{4}$ -inch-thick (6 mm), Exposure 1 plywood complying with Department of Commerce PS-1 or PS-2, and measuring 3 by 6 inches (76 by 152 mm).

4.3.1.3. The test specimen shall be rolled three times back and forth with a roller having a mass of 26 pounds (11.8 kg) ± 0.5 percent, a diameter of 5 inches (127 mm) ± 5 percent, and a width of 5 inches (127 mm) ± 5 percent, at an approximate rate of two to three seconds per rolling cycle.

4.3.1.4. Materials used to construct the control specimens and test specimens, and the roller described in Section 3.2.6.1.3, shall be conditioned for not less than four hours prior to the assembly.

4.3.2 Peel-strength Test Procedure: Samples shall be tested and results reported in accordance with ASTM D 903, except as modified in this section (Section 4.3.2).

4.3.2.1. A constant rate-of-jaw-separation type tester shall be used for testing and results reported in accordance with ASTM D 903, except as modified in this section (Section 4.3.2).

4.3.2.2. At last five specimens shall be tested for each test temperature. The test temperature is the condition temperature.

4.3.2.3. The free end of the adhered module or module material shall be separated from the substrate by hand for an approximate distance of 2 inches (51 mm), leaving a bonded area of approximately 3 by 3 inches (76 by 76 mm). The specimen shall be placed in the testing machine by clamping the free end of the substrate material in the lower grip, turning back the free end of the test module or module 180 degrees, and clamping it in the upper grip. The specimen shall be maintained in the approximate plane of the clamps during the test. Not less than three quarters of the bonded area shall be peeled to establish the peel curve.

4.3.2.4. The peel strength shall be determined by drawing on the autographic chart the average load line that will accommodate the recorded curve. The load shall be recorded, eliminating any peaks associated with module or module material tear. The result shall be converted to a lbf/ft width (kg/30.5 cm width) value.

4.3.2.5. For each series of tests, the following shall be reported: the type of substrate (single-ply membrane or metal roof panel), the individual measurements, the average, and the standard deviation of all the test values in lb/ft (kg/mm) width.

Conditions of Acceptance: Specimens exposed to temperature-cycling shall display no statistically significant or a maximum 5 percent absolute loss in adhesion performance when compared to the control specimens.

5.0 QUALITY CONTROL

5.1 The BIPV roof modules and panels 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.

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

6.0 EVALUATION REPORT RECOGNITION

The evaluation report shall include the following statements or information:

6.1 General:

1. Recognition of the BIPV roof module or the BIPV roof panel is limited to use as part of a complete roof covering system; the electrical safety requirements and solar energy performance of this product are outside the scope of this report.

2. The roof classification (A, B or C) as determined in accordance with Section 3.1.1 or 3.2.2 of this criteria.

3. The wind resistance or wind uplift resistance capacities as determined in accordance with Section 3.1.2 or 3.2.3 of this criteria.

6.2 BIPV Roof Panel Systems:

1. BIPV roof panel roof covering systems shall be installed on roofs with a slope equal to or greater than 2:12 (16.7 percent slope) when used with asphalt shingles, or $2\frac{1}{2}$:12 (20.8 percent slope) when used with clay or concrete roof tiles.

2. The BIPV roof panels must be installed with underlayment and flashing in accordance with the applicable code.

3. The BIPV roof panel roof covering systems shall be limited to use in conjunction with asphalt shingles, clay roof tiles or concrete roof tiles.

6.3 BIPV Roof Module Systems

1. BIPV roof module roof covering systems shall be installed on roofs with a minimum roof slope as specified in the applicable code for the type of roof covering qualified with the module.

2. The BIPV roof module roof covering systems are limited to use as components of new single-ply membrane, built-up roof or metal roof panel roof coverings.