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ENVIRONMENTAL CRITERIA FOR DETERMINATION OF RADIATIVE PROPERTIES OF ROOF COVERINGS AND SOLAR REFLECTANCE OF HARDSCAPE MATERIALS

EC103

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PREFACE

ICC-ES issues Environmental Criteria (ECs) to provide interested parties with information on the requirements for obtaining an ICC-ES Verification of Attributes Report (VAR). An ICC-ES VAR provides independent verification of a manufacturer's environmental claims and product attributes. ECs address the production stage of the report subject, beginning with raw material acquisition through final manufacturing and packaging, and may also include information on projections for installation, use, reuse, and end-of-life, where specifically stated therein. This EC is effective as of the date referenced above and may be amended from time to time.

All VARs must comply with the EC in effect on the date of issuance or reissuance of the report. Any technical changes to the EC will be marked within the EC. A solid vertical line (|) shall be placed in the margin within the EC to indicate a change, addition, or deletion from the previous edition. A deletion indicator (➔) shall be placed in the margin where wording has been deleted.

ICC-ES may consider alternate approaches to those contained in this EC, provided the applicant submits valid data demonstrating that the alternate approach is at least equivalent to the requirements set forth in this EC, subject to approval by ICC-ES staff. Notwithstanding that a product, material, or type or method of construction meets the requirements set forth in this EC, or that it can be demonstrated that valid alternate ECs are equivalent to the requirements in this document, ICC-ES retains the right to refuse to issue or renew a VAR, 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 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.

The EC is limited to the scope statement in Section 1.2 and is not intended to construe a comprehensive environmental claim where considerations are given to other environmental trade-offs, impacts or full life cycle assessment.

NOTE: The Preface for ICC-ES environmental criteria was revised in February 2012 to reflect changes in policy.

Environmental criteria are developed for use solely by ICC-ES for purpose of issuing ICC-ES VARs.

ENVIRONMENTAL CRITERIA FOR DETERMINATION OF RADIATIVE PROPERTIES OF ROOF COVERINGS AND SOLAR REFLECTANCE OF HARDSCAPE MATERIALS (EC103)

1.0 INTRODUCTION

1.1 Purpose: This document provides a procedure for recognition of the *solar reflectance*, *thermal emittance*, and *solar reflective index* of *roof covering* materials and *hardscape* materials in an ICC-ES Sustainable Attributes Verification and Evaluation, Verification of Attributes Report (VAR).

1.2 Scope: VARs issued under this Environmental Criteria (EC) address raw material acquisition and production stages. Life cycle assessment considerations are outside the scope of this EC. Report users are responsible for determining compliance with applicable codes, standards and environmental regulations.

1.3 Applicability: Roof and hardscape materials shall be evaluated based on Sections 1.3.1 or 1.3.2.

1.3.1 Roof Coverings: *Radiative properties* for *roof coverings* shall be based on the criteria in the following:

1.3.1.1 IgCC Section 408.3

1.3.1.2 IECC Section C402.2.1

1.3.1.3 CALGreen Sections A4.106.5 and A5.106.11.2

1.3.1.4 ICC 700 Section 602.13

1.3.1.5 ASHRAE Standard 189.1 Sections 5.3.2.3 and 5.3.2.4

1.3.1.6 ASHRAE Standard 90.1 Section 5.5.3.1.1

1.3.1.7 ANSI/GBI 01-2010 Section 7.2.2.2

1.3.1.8 LEED Credit SS7.2

1.3.2 Hardscape: *Solar reflectance* of *hardscape* materials shall be based on criteria in the following:

1.3.2.1 IgCC Section 408.2

1.3.2.2 CALGreen Section A5.106.11

1.3.2.3 ICC 700 Section 505.2

1.3.2.4 ASHRAE Standard 189.1 Section 5.3.2.1

1.3.2.5 ANSI/GBI 01-2010 Section 7.2.2.3

1.3.2.6 LEED Credit SS7.1

1.4 Reference Documents:

1.4.1 2012 *International Green Construction Code*™ (IgCC), International Code Council.

1.4.2 2012 *International Energy Conservation Code*® (IECC), International Code Council.

1.4.3 2010 California Green Building Standards Code (CALGreen), California Building Standards Commission.

1.4.4 2008 National Green Building Standard™ (ICC 700), National Association of Homebuilders.

1.4.5 ANSI/ASHRAE/USGBC/IES Standard 189.1-2009 – Standard for the Design of High-Performance Buildings (Except Low-Rise Residential Buildings), American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

1.4.6 ANSI/ASHRAE/IESNA Standard 90.1-2010 – Energy Standard for Buildings Except Low-rise Residential Buildings, American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

1.4.7 ANSI/GBI 01-2010 Green Building Assessment Protocol, Green Building Initiative, Inc.

1.4.8 LEED® 2009 for New Construction and Major Renovations, U.S. Green Building Council, Inc.

1.4.9 LEED® for Homes Rating System, Version 2008, U.S. Green Building Council, Inc.

1.4.10 LEED® 2009 for Schools New Construction and Major Renovations, U.S. Green Building Council, Inc.

1.4.11 LEED® 2009 for Core and Shell, U.S. Green Building Council, Inc.

1.4.12 LEED® 2009 for Commercial Interiors, U.S. Green Building Council, Inc.

1.4.13 ANSI/CRRC-1 Standard – 2010, Cool Roof Rating Council, Inc.

1.4.14 ASTM C1371-04a, Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers, ASTM International.

1.4.15 ASTM C1549-04, Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflector, ASTM International.

1.4.16 ASTM E408-71 (2002), Standard Test Method for Total Normal Emittance of Surfaces using Inspection-Meter Techniques, ASTM International.

1.4.17 ASTM E903-96, Standard Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres, ASTM International.

1.4.18 ASTM E1918-97, Standard Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field, ASTM International.

1.4.19 ASTM E1980-01, Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces, ASTM International.

1.5 Terms and Definitions:

1.5.1 Hardscape: Areas of a building site covered by manmade materials. (IgCC Section 202)

1.5.2 Radiative Properties: The *solar reflectance* and *thermal emittance* of a roofing product. (CRRC® 2010)

1.5.3 Radiative Properties, Aged: The *solar reflectance* and *thermal emittance* of a roofing product after three years of exposure to the weather at a test farm. (CRRC® 2010)

1.5.4 Radiative Properties, Initial: The *solar reflectance* and *thermal emittance* of a roofing product determined from a specimen which is prepared or collected for the specific purpose of testing the Initial Radiative Properties. (CRRC® 2010)

1.5.5 Roof Covering: The covering applied to the roof deck for weathering resistance, fire classification or appearance. (IgCC Section 202)

1.5.6 Solar Reflectance: A measure of the ability of a surface material to reflect sunlight. It is the fraction of

incident sunlight reflected by a surface, expressed on a scale of 0 to 1. Solar reflectance is also referred to as "albedo" (IgCC Section 202)

1.5.7 Solar Reflective Index (SRI): A value that incorporates both *solar reflectance* and *thermal emittance* in a single measure to represent a surface relative temperature in the sun. SRI compares a surface's temperature to those of standard black and standard white surfaces. It typically ranges from 0 for standard black to 100 for standard white, but can be less than 0 or greater than 100. (IgCC Section 202)

1.5.8 Steady-state Surface Temperature (T_s): The temperature of the surface, in Kelvin (K), under the standard solar and ambient conditions.

1.5.9 Thermal Emittance: The ratio of radiative power emitted by a sample to that emitted by a blackbody radiator at the same temperature. (IgCC Section 202)

2.0 REQUIRED DATA

2.1 Product Description: Information on the product to be evaluated. The information shall include the product name, style, part or model number, physical description, and a production flowchart for the overall manufacturing process. Additionally, all relevant specifications must be provided for the product, the components and/or constituents used to manufacture the product, and the components used with the product in the final assembly. Specifications must be consistent with the products as described in the submitted test reports and quality documentation. As an example, for mixed materials (wet and dry), the following must be provided:

i. Specifications of incoming materials, or the date of the signed, controlled document that describes each constituent and its specification.

ii. Mix ratios of the constituents, or the date of the signed, controlled document that describes the mix ratio.

iii. Finished product specifications (for example, for wet products, specific gravity and viscosity; for formed products, weight, compressive strength, etc.).

When agreed to by ICC-ES, in lieu of providing the actual specifications, the applicant may identify the controlled document that describes the product specifications, provided the document is identified by a revision level and/or date.

When the product specifications are not provided to ICC-ES except through reference to a controlled document as described in the preceding paragraph, the controlled document describing the product specifications shall be made available to the inspection agency for their review and their verification, during the qualifying inspection described in Section 3.3, that the product specifications are consistent with the product described in the original qualifying data.

2.2 Packaging and Identification: A description of the packaging method and field identification of the product shall be submitted. Identification shall include the ICC-ES VAR number.

2.3 Roof Coverings: The data set forth in Sections 2.3.1, 2.3.2 and 2.3.3 shall be submitted to establish the radiative properties of roof coverings:

2.3.1 Solar Reflectance: Test reports shall be provided stating the initial and aged *radiative properties* for each roof covering material to be recognized. Solar reflectance shall be determined by testing in accordance with ASTM C1549 or the ANSI/CRRC-1 Standard (using an air mass of 1.5) or ASTM E1918 .

(**Note:** ASTM E 1918 is applicable only for roof coverings intended for use on roof decks with a slope of 2:12 or less. Additionally, testing in accordance with ASTM E 903 may be used to establish solar reflectance for recognition under the IECC only. Aged specimens shall be tested in accordance with Section S.2.6 of the ANSI/CRRC-1 Standard.

2.3.2 Thermal Emittance: Test reports shall be provided stating the initial and aged thermal emittance for each roof covering to be recognized. Thermal emittance shall be determined by testing in accordance with ASTM C1371, ASTM E408 or the ANSI/CRRC-1 Standard. Aged specimens shall be tested in accordance with the ANSI/CRRC-1 Standard.

2.3.3 Solar Reflective Index: Calculations shall be provided for the solar reflective index (SRI) value for both initial and aged specimens. The SRI shall be calculated in accordance with ASTM E1980, using previously measured values for solar reflectance and thermal emittance, based on a convection coefficient of 2.1 Btu/h • ft^2 • F (12 W/m^2 • K) (medium wind speed).

2.4 Hardscape: Test reports shall be provided stating the initial *solar reflectance* for each type and color family of *hardscape material* to be recognized. *Solar reflectance* shall be determined by testing in accordance with ASTM C1549 (using an air mass of 1.5) or ASTM E1918.

3.0 QUALITY CONTROL

3.1 Required Elements of the Quality System Documentation: Quality system documentation shall be submitted that meets the following requirements:

3.1.1 The quality system documentation shall be signed and dated by an authorized representative of the manufacturer.

3.1.2 The documentation shall clearly state the facility name of the manufacturing location, the street address and telephone number, and the name of the contact person at the facility.

3.1.3 There shall be provisions for the quality system documentation to be reviewed at least annually. A record of revisions shall be maintained.

3.1.4 The documentation shall indicate how the recognized product is to be identified in the field. This information shall be consistent with the information in the "Identification" section of the VAR, and should include a copy of the product label or a description of what is included on the label. Product labeling shall include, at a minimum, the report holder's name, the VAR number (ICC-ES VAR-XXXX), and information required by the applicable environmental criteria.

3.1.5 Based on the product labeling, the quality system shall provide a means to trace finished product

back to the production and quality control records at the manufacturing facility.

3.1.6 The documentation shall describe the manufacturing process.

3.1.7 The documentation shall include provisions for the documenting of product changes, evaluation of product changes and notification to the appropriate parties.

3.1.8 Incoming Materials: The documentation shall include procedures regarding inspections or tests that are conducted on incoming materials, or other means used to determine that the materials meet specifications (for example, mill test reports, certificates of analysis, certificates of compliance, etc.). If incoming material requiring a certificate at the time of receipt does not carry a certificate, then the documentation shall contain provisions for the material to be segregated until it has been appropriately tested or inspected, or the certificate is received.

3.1.9 In-process Quality Control: The documentation shall describe in-process quality control procedures, including how manufacturing processes are monitored to ensure that the product is consistently manufactured within the allowable tolerances.

3.1.10 Final Inspection: The documentation shall detail any final inspections and/or tests that are conducted before the product is labeled and shipped, to ensure that the finished product complies with specifications and applicable design values.

3.1.11 Nonconforming Materials: The documentation shall specify how nonconforming materials—incoming materials, materials in production, and finished materials—are segregated from production until a decision is made as to their disposition.

3.1.12 When products are manufactured at multiple locations, the report applicant shall submit quality system documentation for each of the manufacturing sites.

3.1.13 When the product is manufactured by a party other than the report holder, a form provided by ICC-ES to the applicant to cover this circumstance shall be submitted.

3.2 The following declarations shall be provided to ICC-ES in a signed and dated affidavit from the report holder:

3.2.1 The ICC-ES name, mark, or report number will only be used on products that are in compliance with the VAR and the quality system documentation.

3.2.2 The report holder will promptly investigate and respond to ICC-ES when apprised by ICC-ES of complaints concerning product performance.

3.2.3 The report holder agrees to permit ICC-ES representatives to examine, at distribution points and the manufacturing plant, any product labeled as being in conformance with the VAR.

3.2.4 ICC-ES will be notified in writing if there is a significant change in the product, manufacturing procedures or quality system documentation from what was recognized upon issuance of the VAR.

3.3 Prior to issuance of a VAR, an initial on-site inspection of the manufacturing facility shall be conducted by an ICC-ES representative or a representative of an accredited inspection agency with the proper technical disciplines.

3.4 At the time of renewal of a VAR, a third-party inspection of the manufacturing facility shall be conducted as a condition of renewal of the report. This inspection shall verify that no changes to the manufacturing process, raw materials or quality program, as they relate to the *solar reflectance index* or *thermal emittance* values of the finished product, have occurred.

4.0 VAR RECOGNITION

4.1 The VAR shall state the specific product and colors for which data was submitted.

4.2 The VAR shall state both the initial and aged values for the SRI (where such recognition is sought), *solar reflectance* and *thermal emittance* of each product. If aged values are not available, then the report shall state that the values reported are initial values only. (**Note:** Only initial values are required to be reported for *hardscape materials*.)

4.3 Where the VAR subject is regulated by the scope of the *International Building Code*® (IBC) and/or the *International Residential Code*® (IRC), and is the subject of a current ICC-ES evaluation report, the following statement shall be included:

"See ICC-ES evaluation report ESR-XXXX for compliance with IBC and/or IRC code requirements."

4.4 Where the VAR subject is regulated by the scope of the IBC and/or IRC, but is not the subject of a current ICC-ES evaluation report, the following statement shall be included:

"Evaluation of the VAR subject for compliance with the requirements of the *International Building Code* and/or the *International Residential Code* is outside the scope of this evaluation report and evidence of compliance must be submitted by the permit applicant to the Authority Having Jurisdiction for approval." ■