

Overview

The CRRC is proposing a revision of the ANSI/CRRC S100 (2021), *Standard Test Methods for Determining Radiative Properties of Materials* (CRRC S100). The largest change is the introduction of radiative property testing and weathering requirements for exterior wall materials, which were vetted by the CRRC Wall Rating Program Committee (technical body) and CRRC Board of Directors. A new section for wall materials (W.S.2) is added to the draft standard and all subsections start with the letter “W.” The existing sections of the standard that only apply to roofing materials are appended with the letter “R.” Section headings that do not include an R or W apply to both roofing and exterior walls.

In addition, the CRRC is proposing various revisions to the draft standard that apply to multiple roofing product types, which were vetted by the CRRC Technical Committee and adopted into the CRRC-1 Roof Product Rating Program by the CRRC Board of Directors.

A summary of the key proposed revisions to the CRRC S100 standard can be found below and does not include administrative edits, such as formatting changes or minor clarifications that do not substantively modify the nature of the provisions.

The redline version of the draft standard can be found on pages 6 through 58 of this document.

Summary of Key Proposed Revisions

S.1.1 Scope

- A. Added exterior walls to the scope of the standard.

Section 1.5 Glossary of Terms

- A. Removed the reference to Section S.2.5 in the definition of Coating Thickness because it is not necessary and is inconsistent with the other definitions.
- B. Removed “Hunter” from the Color Family definition to accommodate the addition of CIELAB color scale for architectural coatings in the CRRC S100 standard.
- C. Revised the definition of Color Family Element because it is duplicative of the Color Family Group definition.
- D. Added a new definition for Incorrectly Exposed specimens developed by the CRRC Technical Committee and approved by the CRRC Board of Directors for the inclusion in the CRRC Product Rating Programs.
- E. Revised L, a, b Color Coordinates definition to state “either the Hunter L, a, b or CIELAB scales” to accommodate the addition of architectural coatings in the CRRC S100 standard.
- F. Revised the definition of Low-Sloped Roofing Product to align with the industry’s definition (i.e. what is defined in most building codes) and the CRRC-1 Roof Program.

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https://coolroofs.org/documents/CRRC-S100-Public-Comment-Form_2024-01-05.pdf

- G. Changed “Fluid-Applied” to “Liquid-Applied” Roofing Product to align with the term used in the CRRC-1 Roof Program and the industry-preferred term.
- H. Added a new definition for Polymer/Composite Molded Shake/Slate/Tile Shaped Products that was developed by the CRRC Technical Committee and approved by the CRRC Board of Directors for the inclusion in the CRRC-1 Roof Program. The new term is proposed in the standard and should be defined in the glossary of the CRRC S100 standard.
- I. Added a new definition for Multi-Shade Polymer/Composite Roofing Product that was developed by the CRRC Technical Committee and approved by the CRRC Board of Directors for the inclusion in the CRRC-1 Roof Program. The new term is used in the standard but was not defined in the glossary of the CRRC S100 standard.
- J. Added a new definition for Single-Ply Membrane roofing product that was developed by the CRRC Technical Committee and approved by the CRRC Board of Directors for the inclusion in the CRRC-1 Roof Program. The term is used in the standard but was not defined in the glossary of the CRRC S100 standard.
- K. Revised the definition of Tile Roofing Product to align with the definition developed by the CRRC Technical Committee and approved by the CRRC Board of Directors for the inclusion in the CRRC-1 Roof Program.
- L. Revised definition of Spot to include thermal emittance and to remove the specified dimensions because Thermal emittance cannot be measured in a 1” x 1” area.
- M. Added new definitions for Roof and Wall Standard Substrates because the terms are used in the standard but were not defined in the glossary of the CRRC S100 standard.
- N. Revised the definition of Steep-Sloped Roofing Product to align with the industry’s definition (i.e. what is defined in most building codes) and the CRRC-1 Roof Program.
- O. Added “authorized” and replaced “ratings” with “Radiative Properties” to the definition of Test Farm Site to clarify the requirements for weathering locations and aged testing that are specified in the CRRC S100 standard.
- P. Added new definitions for the following exterior wall product types:
 - Wall Product, Architectural Coating
 - Wall Product, Factory-Coated Metal
 - Wall Product, Insulated Vinyl Siding
 - Wall Product, Polypropylene Siding
 - Wall Product, Vinyl Siding

Section 1.6 References

- A. Updated the editions of referenced standards.
- B. Removed ASTM D1669 because it is not used in the CRRC-1 Roof Program.

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- C. Added various ASTM standards for exterior wall products.
- D. Removed ASTM E1980 because SRI is not part of the CRRC S100 standard.

Section R.S.2.1 [Roofing] Product Specimens

- A. Revised last paragraph to clarify that new specimens must meet the size requirements.

Section R.S.2.2(F) [Roofing] Solar Reflectance Tests

- A. Added a provision for Polymer/Composite Roofing Products that are sold in a set containing multiple shades that was vetted by the CRRC Technical Committee and approved by the CRRC Board of Directors for adoption into the CRRC-1 Roof Program.

Section R.S.2.3 [Roofing] Thermal Emittance Tests

- A. Revised this section to clarify that all products, unless they are uninsulated metal or a Factory-Applied coating on an uninsulated metal substrate, shall be tested using the Slide Method. Products on an uninsulated metal substrate may be tested using the Slide Method or ASTM C1371. The current order of the list places testing with ASTM C1371 before the Slide Method though only a very limited number of products may be tested with C1371.

Section R.S.2.5 [Roofing] Thickness Tests

- A. Removed ASTM D1669 thickness test standard because it is not used in the CRRC-1 Roof Program.
- B. Added detailed procedures for measuring thickness of liquid-applied coatings using ASTM D1005 that align with the CRRC-1 Roof Program.
- C. Added detailed procedures for measuring thickness of single-ply membranes that align with the CRRC-1 Roof Program.

Section R.S.2.6(B) [Roofing] Requirements for Field Exposure of Roofing Products

- A. Updated the number of annual heating and cooling degree days for each test farm site based on the 2021 edition of ASHRAE Standard 169.
- B. Removed Chicago, IL and Youngstown, OH from list of qualified locations based on ASHRAE 169-2021.

Section R.S.2.7(E) [Roofing] Requirements for Laboratory Soiling and Weathering of Roofing Materials

- A. Added information for liquid-applied coatings on rough substrates.

Section R.S.3.2(B–D) [Roofing] Standard Production Line Roofing Product Specimen

- A. Added clarification that identified information shall be placed on the *back* of the specimen.
- B. Removed clause “during which Specimens will be exposed to the environment” to reduce confusion between the required timeframe for weathering (three years) and the label durability timeframe (four years). Four years is necessary since the identification label must be legible during aged testing. Per the CRRC-1 Roof Program requirements, the laboratory must retain aged tested specimens for 90 calendar days or until the aged ratings are approved by the CRRC before releasing the specimens to the manufacturer.
- C. Added specimen preparation provisions for liquid-applied coatings on rough substrates.
- D. Clarified that the number of specimens required for reporting the average initial test results is nine specimens. The nine specimens are divided into three sets that each go to an authorized test farm in each of the climates designated in the CRRC S100 standard.
- E. Added the new term “incorrectly exposed” to the provisions for discarding unusable specimens from the reporting of aged radiative properties.

Section R.S.3.3(B–D) [Roofing] Factory-Applied Coating Products

- A. Added clarification that identified information shall be placed on the *back* of the specimen.
- B. Removed clause “during which Specimens will be exposed to the environment” to reduce confusion between the required timeframe for weathering (three years) and the label durability timeframe (four years). Four years is necessary since the identification label must be legible during aged testing. Per the CRRC-1 Roof Program requirements, the laboratory must retain aged tested specimens for 90 calendar days or until the aged ratings are approved by the CRRC before releasing the specimens to the manufacturer.
- C. Added the new term “incorrectly exposed” to the provisions for discarding unusable specimens from the reporting of aged radiative properties.

Section R.S.3.4(A–C) [Roofing] Variegated Products

- A. Revised the section to clarify that it is an array (set) of specimens and not a single specimen that comprise a batch of shingles.
- B. Added clarification that identified information shall be placed on the *back* of the specimen.
- C. Removed clause “during which Specimens will be exposed to the environment” to reduce confusion between the required timeframe for weathering (three years) and the label durability timeframe (four years). Four years is necessary since the identification label

must be legible during aged testing. Per the CRRC-1 Roof Program requirements, the laboratory must retain aged tested specimens for 90 calendar days or until the aged ratings are approved by the CRRC before releasing the specimens to the manufacturer.

- D. Added the new term “incorrectly exposed” to the provisions for discarding unusable specimens from the reporting of aged radiative properties.

Exterior Wall Section W.S.2 – Conduct of Tests

- A. Added new Sections W.S.2.1 through W.S.3.4 for exterior wall materials.

Appendix A (Roofing) – Tile Method Template

- A. Added guidance about noting the placement of the template on the back or sides of each specimen to ensure the template is placed in the same location for aged testing.

Appendix B(F, G) (Roofing) – Procedure for Variegated Shingles Undergoing Laboratory Soiling and Weathering

- A. Inserted the word “Laboratory” before “Aged Solar Reflectance and “Aged Thermal Emittance” for clarification.

Appendix C (Roofing) – Protocol for Liquid-Applied Coatings Applied to a Rough Substrate

- A. Added new section that describes the process for coating products applied to a rough substrate. The protocol is in addition to the existing coatings test procedure, which tests coatings on a smooth aluminum substrate or another smooth substrate specified by the Seller or OM. The protocol aligns with the CRRC-1 Roof Program, and was developed by the CRRC Technical Committee with input from the Roof Coatings Manufacturers Association and approved by the CRRC Board of Directors for adoption into the CRRC-1 Roof Program.

Redline Version of Draft CRRC S100 Standard*

Proposed changes shown in strikeout and
underline

* The title page of the CRRC S100 standard has been omitted
from this draft version.

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Section S.1 - General

S.1.1 Scope

~~This~~ ~~The CRRC S100 S~~ ~~standard~~ ~~(Standard)~~ covers specimen preparation and test methods for determining the Initial and Aged Radiative Properties of roofing ~~and exterior wall~~ products.

S.1.2 Significance and Use

This standard provides a practice and method for testing and reporting the Radiative Properties of roofing ~~and exterior wall~~ products before and after a specified test exposure. ~~Roofing Product~~ Specimens are exposed to specific tests and to the exterior environment throughout a specified time period. The tests provide a relative measure of the ~~roofing-product's~~ response to the test conditions. The standard does not purport to be representative of all conditions that ~~installed~~ roofing ~~and exterior wall~~ products experience ~~in the field~~. Variations of the test conditions or ~~Specimen specimen~~ construction also affect the ~~Specimen specimen~~ response.

S.1.3 Units

The values are stated in the International System of Units (SI units), which is regarded as the norm for this standard. All other values shall be shown in parenthesis and are provided for informational purposes only.

S.1.4 Advisory Notes

The text of ~~the this S~~ ~~standard~~ contains references to advisory notes that are provided as explanatory material. These advisory notes shall not be considered part of ~~the this S~~ ~~standard~~.

S.1.5 Glossary of Terms

Unless otherwise expressly stated, the following words and terms shall have the meanings as indicated in this document.

Accredited Independent Testing Laboratory (AITL) - A testing laboratory that is accredited for compliance with ISO/IEC Standard 17025 to test roofing ~~and/or exterior wall~~ products and is completely independent from any ~~roofing or exterior wall roofing-product~~ manufacturer or ~~roofing-product~~ seller. Accredited shall be defined as achieving third-party evaluation accreditation by an organization accredited to ISO 17011.

Accredited Manufacturer Testing Laboratory (AMTL) - A testing laboratory affiliated with a roofing or exterior wall product manufacturer or roofing or exterior wall product seller that is accredited to test the Radiative Properties of roofing these products. Accredited shall be defined as achieving third-party evaluation by a nationally recognized organization, such as the Cool Roof Rating Council, of the compliance with testing requirements in of this Sstandard, competence of testing, and proper calibration of equipment.

Batch - A single quantity of product processed at one time as a mixture or combination of raw materials.

Coating Thickness – The dry film thickness of a coating when applied to a substrate, measured in accordance with section S.2.5 of this standard.

Color Family - A pre-defined range of absolute Hunter “L,” “a,” and “b” color coordinates that establishes the color space for a pre-defined set (group) of colors.

Color Family Additional Element - A Color Family Element that is not the Color Family Representative Element.

Color Family Binder/Resin Technology - General class of Factory-Appplied coatings used in metal roofing and exterior wall products which are defined by the family of related binder/resin chemicals used to formulate such coatings.

Color Family Element - A uniquely formulated roofing or exterior wall product that is a member of a Color Family Group and that is either a factory applied roof product component that serves as the top coating on a factory coated metal roofing product or a metal roofing product that has a Factory Applied Roof Product Component as its top coating.

Color Family Group - One or more Production Line Factory-Appplied metal coatings or or factory-coated metal roofing or exterior wall product s that have the same binder/resin technology, or Architectural Coating Wall Product from the same Product Line, and that have color properties and Radiative Properties that fall within the ranges established for the respective Color Family.

Color Family Representative Element - A Color Family Element that is used to initially establish a Color Family Group.

Cooling Degree Day (CDD) - For any one day when the mean temperature is more than 10 °C or 50 °F, there are as many degree-days as degrees Celsius or Fahrenheit temperature difference between the mean temperature for the day and 10 °C or 50 °F. Annual cooling degree-days (CDDs) are the sum or the degree-days over a calendar year. (Source: ASHRAE Standard 169).

Directionally Reflective Material - A roofing product material with Solar Reflectance that varies with solar incidence angle.

Emittance, Thermal - The ratio of the radiant heat flux emitted by a Specimen to that emitted by a blackbody radiator at the same temperature.

Estimate of Specimen Mean Standard Error - The Specimen (rather than population) standard deviation divided by the square root of the number of Specimens.

Factory-Applied Roof or Exterior Wall Product Component - A material or component made by an Other Manufacturer (OM) which is applied to a substrate in a factory or coating facility (i.e., not in the field).

Heating Degree Day (HDD) - For any one day, when the mean temperature is less than 18 °C or 65 °F, there are as many degree-days as degrees Celsius or Fahrenheit temperature difference between the mean temperature for the day and 18 °C or 65 °F. Annual heating degree-days (HDDs) are the sum of the degree-days over the calendar year. (Source: ASHRAE Standard 169)

Heterogeneous - Consisting of dissimilar or diverse ingredients or constituents.

Incorrectly Exposed – A Specimen that is unusable after weathering exposure due to improper exposure placement by the Test Farm. Incorrectly Exposed Specimens shall include, but not be limited to, Specimens that are placed face down (e.g., with the test surface facing the test fence), Specimens that are mounted at the incorrect tilt, or any other exposure practice that does not comply with the requirements of this Standard.

Hunter-L, a, b Color Coordinates - A set of three numbers characterizing the lightness (L), redness/greenness (a) and yellowness/blueness (b) of a color, on either the Hunter L, a, b or CIELAB scales.

Laboratory Exposure of Roofing Products - A laboratory standard practice that replicates the effects of three years of natural exposure, including soiling and weathering, on the Solar Reflectance and Thermal Emittance of roofing products.

Low-Sloped Roofing Product – A roof product intended for installation on a roof surface with a slope (rise to run) ratio of less than 2:12 (9.5 degrees from the horizontal). Roofing products designed for installation with a slope of 2:12 or less.

Other Manufacturer (OM) - A manufacturer that supplies a roofing or exterior wall product, component or raw material to a Seller, either directly or indirectly. Manufacturers that supply roofing or exterior wall products to others for private label sales are also within the scope of this definition.

Population - A group of Specimen values in which conclusions are to be drawn, such as a set of Solar Reflectance values determined from non-overlapping Spots (small regions) that cover an entire Test Surface.

Population Mean - The arithmetic mean of the property values (e.g., Solar Reflectance) measured for all members of a Population.

Population Standard Deviation - The square root of the arithmetic mean of the squares of the deviation from the *Population* mean.

Product Line, Architectural Coating – A set of Architectural Coating products sold under the same brand name. Product Lines may include multiple gloss levels (e.g., Semi-Gloss, Eggshell).

Roofing Products, Standard Product - Production line of roofing or exterior wall products, excluding Color Family Elements.

Roofing Product, Variegated - A roofing or exterior wall product with a varied surface color or which has discrete markings of different colors.

Profiled Roofing Products - Roofing products that vary in rise over a given width as can be seen in a cross-sectional view.

Radiative Properties - The Solar Reflectance and Thermal Emittance of a roofing or exterior wall product.

Radiative Properties, Aged - The Radiative Properties of a roofing or exterior wall product tested after completing field exposure, or a roofing product tested after Laboratory Exposure if the product has begun but not yet completed field exposure.

Radiative Properties, Field-Exposed - The Solar Reflectance and Thermal Emittance of a roofing or exterior wall product after three years of outdoor weathering at a Test Farm.

Radiative Properties, Initial - The Solar Reflectance and Thermal Emittance of a roofing or exterior wall product determined from a SpecimenSpecimens that is-are prepared or collected for the specific purpose of testing the Initial Radiative Properties.

Radiative Properties, Laboratory Exposed - The Solar Reflectance and Thermal Emittance of a roofing product following application of the practice for laboratory soiling and weathering of roofing products.

Radiative Properties, Tested - The reported Solar Reflectance and Thermal Emittance of a roofing or exterior wall product as determined by an AITL.

Reflectance, Solar - The ratio of the reflected solar flux to the incident solar flux.

Reflectometer - A device that measures the solar reflectance of an object's surface.

Relative Humidity (RH) - The ratio of the partial pressure or density of water vapor to the saturation pressure or density, respectively, at the same dry-bulb temperature, and barometric pressure of the ambient air. (*Source: ASHRAE Terminology of Heating, Ventilation, Air-Conditioning, & Refrigeration*).

Roofing Product, ~~Fluid Field~~ Liquid-Applied - A roofing product that is applied as a ~~fluid liquid in the field~~ to a roofing substrate in order to improve the Solar Reflectance and/or Thermal Emittance, among other things.

Roofing Product, Polymer/Composite Molded Shake/Slate/Tile Shaped Products – A polymer-based material formed into a shake, slate, or tile facsimile.

Roofing Product, Multi-Shade Polymer/Composite - A Polymer/Composite Molded Shake/Slate/Tile Shaped Roofing Product that is sold as a set containing a mix of multiple shades with the same surface formulation.

~~**Roofing Product, Production Line**~~ - ~~Production line of roofing products are standard color offerings by the manufacturer and are promoted in general product information and in marketing materials.~~

~~**Roofing Products, Standard**~~ - ~~Production line of roofing products, excluding Color Family Elements.~~

Roofing Product, Single-Ply Membrane - A flexible synthetic polymer-based sheet applied to the roof in a single layer, whose primary function is the exclusion of water.

Roofing Product, Tile - ~~A tile made of clay or concrete that is intended as a roof covering. Roofing tiles are available in a variety of profiles, surface textures, and colors.~~ **A rigid cladding, typically clay or concrete, that is installed in overlapping pieces to cover a roof.**

Roofing Product, Variegated - A material with a varied surface color or which has discrete markings of different colors.

Roofing Product, Wood - ~~Roofing products manufactured from various trees, including but not limited to western red cedar, cypress, pine and redwood.~~

Single-Ply Thickness - The overall thickness of a Single-Ply Membrane, excluding any fabric backing.

Specimen - A portion of a product used for Radiative Property testing and weathering.

~~**Specimen Sample Mean**~~ - The arithmetic mean of the property values (e.g., Solar Reflectance) measured for all members of a ~~Specimen~~ set.

~~**Specimen Sample Mean Standard Error**~~ - The Population Standard Deviation divided by the square root of the ~~number of specimens~~ **sample size.**

~~**Specimen Sample Set**~~ - A subset of the Population, such as a set of non-overlapping Spots (i.e., small regions) on a Test Surface.

Specimen Standard Deviation - The square root of the ratio of the sum of the squares of the deviation from the ~~Specimen~~ mean to a number one less than the number of ~~Specimens~~.

Seller - A roofing ~~ore exterior wall~~ product seller. Sellers are limited to business entities that package, label and bring the ~~roofing~~ product to market.

Spot - A small region of a Test Surface, ~~such as a 2.54 centimeter by 2.54 centimeter (1 inch by 1 inch) square or a 2.54 centimeter (1 inch) diameter circle,~~ in which Solar Reflectance ~~or Thermal Emittance~~ can be measured.

Standard Substrate, Roof - A metal panel that conforms to 3003 H14 uncoated aluminum alloy.

Standard Substrate, Wall - A panel with a Solar Reflectance less than 0.20 that can withstand three years of field exposure.

Steep-Sloped Roofing Product - A roof product intended for installation on a roof surface with a slope (rise to run) ratio greater than or equal to 2:12 (9.5 degrees from the horizontal).

Roof products designed to be installed with a slope greater than 2:12.

Test Farm Site - One of three authorized locations where a product is placed for weathering exposure before the measurement of Aged Radiative Properties.ratings.

Test Surface - Outer surface of a product Sspecimen.

Test Surface Mean Solar Reflectance - The ratio of solar energy reflected from a Test Surface to the solar energy incident on a Test Surface, equal to the ratio of area-integrated Solar Reflectance to area.

Uncharacteristically Damaged - A Sspecimen that is unusable after weathering exposure through no fault of Sspecimen preparation by the Seller or Other Manufacturer. Unusable refers to the inability to accurately measure the Aged Radiative Properties of the product Sspecimen. Uncharacteristically Damaged shall include, but not be limited to, the following: damage during transit of the product by improper handling; animal excrement that stained the Sspecimen; irreparable damage or destruction due to a natural disaster, such as a hurricane, tornado, flooding, or other disaster; or any other unforeseen event that might harm the Sspecimen beyond normal weather exposure.

Variegated - Having discrete markings of different colors.

Wall Product, Architectural Coating – A paint that is applied directly to an exterior wall.

Wall Product, Factory-Coated Metal – A paint or coating that is applied to a metal substrate in a factory or coating facility.

Wall Product, Insulated Vinyl Siding – A Vinyl Siding Wall Product containing an additional insulative layer with an R-value no less than 2.0.

Wall Product, Polypropylene Siding – An exterior wall product that is manufactured from polypropylene resin.

Wall Product, Vinyl Siding – A dual layer coextruded wall product manufactured from plastic, typically Polyvinyl Chloride (PVC).

S.1.6 References

American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

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180 Technology Parkway, NW

Peachtree, GA 30092

1791 Tullie Circle, NE

Atlanta, GA 30329-2305

www.ashrae.org

ANSI/ASHRAE Standard 169-2021~~13~~– Climatic Data for Building Design Standards.

ASHRAE Terminology of Heating, Ventilation, Air Conditioning, & Refrigeration, 1991.

ASTM International (ASTM)

100 Barr Harbor Drive

West ~~Conshohocken~~Conshohocken, PA 19428-2959

www.astm.org

ASTM C1549-16(2022), Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer.

ASTM C1371-15(2022), Standard Test Method for Determination of Emittance of Materials Near Room Temperature using Portable Emissometers.

ASTM C1864-17(2022), Standard Test Method for Determination of Solar Reflectance of Directionally Reflective Material Using Portable Solar Reflectometer.

ASTM D751-~~1906~~(2014), Standard Test Methods for Coated Fabrics.

ASTM D1005-95(2020~~13~~), Standard Test Method for Measurement of Dry-Film Thickness of Organic Coatings Using Micrometers.

ASTM D1730-09(2020~~14~~), Standard Practices for Preparation of Aluminum and Aluminum-Alloy Surfaces for Painting.

~~ASTM D1669-07 (2013), Standard Practice for Preparation of Test Panels for Accelerated and Outdoor Weathering of Bituminous Coatings.~~

ASTM D3679-21 (2021), Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Siding

ASTM D7091-22~~13~~, Standard Practice for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals.

ASTM D7254-21 (2021), Standard Specification for Polypropylene (PP) Siding.

ASTM D7793-21 (2021), Standard Specification for Insulated Vinyl Siding.

ASTM D7897-18, Standard Practice for Laboratory Soiling and Weathering of Roofing Materials to Simulate Effects of Natural Exposure on Solar Reflectance and Thermal Emittance.

ASTM E805-~~22~~~~12a~~(2017), Standard Practice for Identification of Instrumental Methods of Color or Color-Difference Measurement of Materials.

ASTM E891-87(1992), Tables for Terrestrial Direct Normal Solar Spectral Irradiance Tables for Air Mass 1.5. Note: Currently a withdrawn standard.

ASTM E903-~~4~~~~20~~, Standard Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres.

ASTM E1918-~~21~~~~16~~, Standard Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field.

~~ASTM E1980-11, Standard Practice for Calculating Solar Reflectance Index (SRI) of Horizontal and Low-Sloped Opaque Surfaces.~~

ASTM G7/~~G7M-2~~~~13~~, Standard Practice for Atmospheric Environmental Exposure Testing of Nonmetallic Materials.

ASTM G147-17, Standard Practice for Conditioning and Handling of Nonmetallic Materials for Natural and Artificial Weathering Tests.

ASTM G197-14 (2021), Standard Table for Reference Solar Spectral Distributions: Direct and Diffuse on 20° Tilted and Vertical Surfaces.

The International Organization for Standardization (ISO)

1, ch. de la Voie-Creuse, Case Postale 56

CH-1211 Geneva 20, Switzerland

www.iso.org

ISO/IEC Standard 17025-2017, General requirements for the competence of testing and calibration laboratories.

ISO/IEC Standard 17011-2017, Conformity assessment -- General requirements for accreditation bodies accrediting conformity assessment bodies.

National Oceanic and Atmospheric Administration (NOAA)

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SUBMIT COMMENTS BY 11:59 PM PACIFIC ON FEBRUARY 19, 2024
CRRC Public Comment Form is Required for Comment Submissions:
https://coolroofs.org/documents/CRRC-S100-Public-Comment-Form_2024-01-05.pdf

www.noaa.gov

NOAA, Comparative Climatic Data – Average Relative Humidity, [CCD-2018](#).

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Roofing Section R.S.2 - Conduct of Tests

R.S.2.1 Product Specimens

All candidate Specimens used for the purposes of testing Initial Radiative Properties and Aged Radiative Properties shall be chosen by the Seller or Other Manufacturer (OM). The Seller or OM shall be responsible for identifying each separate roofing product, material or component. Testing shall be in accordance with this section.

An Accredited Independent Testing Laboratory (AITL) shall measure the dimensions of each test Specimen. Specimen measurements shall be within 2.54 centimeters (1 inch) of the minimum required Specimen size, and Specimens shall be measured to an accuracy of 0.64 centimeters (0.25 inches).

The AITLs shall note in the initial test results if Specimens meet the size requirements. If the Specimens do not meet the size requirements, the AITL will notify the Seller or OM and obtain new Specimens that meet the Specimen size requirements.

R.S.2.2 Solar Reflectance Tests

- (A) Solar Reflectance tests shall be conducted based upon one of the following test methods. See sections S.2.2(B–F) below for more information.
1. ASTM E903 in conjunction with the beam-normal solar spectral irradiance reported in ASTM E891.
 2. ASTM E1918
 3. ASTM C1549, using instrument output 1.5E for Solar Spectrum Reflectometer version 6 or 1.5 Solar Spectrum Reflectometer version 5.
 4. ASTM C1864, using instrument output 1.5E for Solar Spectrum Reflectometer version 6 or 1.5 Solar Spectrum Reflectometer version 5.
 5. CRRC-1 Test Method #1, using instrument output 1.5E for Solar Spectrum Reflectometer version 6 or 1.5 Solar Spectrum Reflectometer version 5. CRRC-1 Test Method #1 is contained in Appendix X1 of ASTM C1549. There are three variants of CRRC-1 Test Method #1:
 - a. Variegated Roofing Product
 - b. Tile Roofing Product
 - c. Wood Roofing Product
 6. Tile Template Method, located in Appendix A (Roofing) of this Standard.

- (B) Variegated Roofing Products. Test specimens of Variegated roofing products shall be tested for Solar Reflectance in accordance with ASTM E1918 or CRRC-1 Test Method #1.
- (C) Presumed Non-Variegated Modified Bitumen Capsheets. Modified bitumen capsheets with non-continuous (particle) top coatings that are represented as non-Variegated products shall be tested in accordance with the following requirements:
1. No confirmation of non-Variegated status is required when test method E1918 is used to conduct initial testing.
 2. When test method E903 or C1549 is used to conduct initial testing, the AITL shall first test the Sspecimen as described below to confirm that the Sspecimen is not a Variegated roofing product, as follows:
 - a. The AITL shall take a series of five (5) Solar Reflectance measurements approximately equidistant along a diagonal axis of the specimen. When any of the five (5) Solar Reflectance measurements varies by more than 0.05 from the arithmetic average of all five (5) measurements, then the product will be deemed to be a Variegated product and shall be tested in accordance with Section R.S.2.2(B) of this Standard.
- (D) Tile Products. Tile Roofing Products shall be tested in accordance with (D)1 or (D)2 below. The AITL performing the measurements shall mark the arrangement of the tiles and record the locations of the measurements in the report developed in accordance with Section S.2.8 of this Standard.
1. Tile Test Method (Variant of CRRC-1 Test Method #1). Tests shall be conducted in accordance with CRRC-1 Test Method #1, and the following requirements:
 - a. Six (6) measurements shall be taken on randomly-chosen Sspots across the Test Surface and non-repeated test cells on each of the nine (9) selected tiles. A test cell is an element of a grid of contiguous 2.54 centimeter by 2.54 centimeter (1 inch by 1 inch) squares projected on the surface of each tile. The aperture of the measurement device shall be centered within the cell.
 - b. Following the measurements of all Sspecimens, compute the Estimate of Specimen Mean Standard Error of the measurements.
 - c. If the Estimate of Specimen Mean Standard Error is 0.02 or less, the test is complete and the measured property is permitted to be reported.

d. If the Estimate of Specimen Mean Standard Error is greater than 0.02, the test is incomplete and an additional test shall be performed at a seventh location on each tile.

e. Following the seventh test on each tile, compute the Estimate of Specimen Mean Standard Error. If the Estimate of Specimen Mean Standard Error is 0.02 or less, the test is complete and the measured property is permitted to be reported. If the Estimate of Specimen Mean Standard Error is greater than 0.02, then repeat ~~s~~Specimen testing at an additional randomly selected and non-repeated location on each tile until either:

e.

- the Estimate of Specimen Mean Standard Error is 0.02 or less is achieved, or
- every test cell on every tile has been measured.

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If either of these two conditions have been satisfied, the test is complete and both the specimen mean and the Specimen Mean Standard Error shall be reported. If only the second condition has been satisfied, report that all test cells have been measured.

2. Tile Template Method. The measurements shall be taken in the locations indicated by the tile template, in accordance with Appendix A (Roofing) of this Standard. Position the template to include the maximum color variegation on each ~~S~~specimen. When ~~S~~specimens are tested for both initial and aged results, the measurement locations shall be the same for both tests.

- a. The measurements shall be taken on each of the nine (9) selected tiles.
- b. Following the measurements of all ~~S~~specimens, compute the Estimate of Specimen Mean Standard Error of the measurements.
- c. If the Estimate of Specimen Mean Standard Error is 0.02 or less, the test is complete and the measured property is permitted to be reported.
- d. If the Estimate of Specimen Mean Standard Error is greater than 0.02, the test is incomplete and the ~~S~~specimens will need to be tested in accordance with Section S.2.2 (D)1 above (~~CRRC-1~~Tile Test Method ~~#1~~).

(E) Directionally Reflective Roofing Products. Directionally reflective roofing products shall be tested in accordance with ASTM C1864.

(F) Polymer/Composite Roofing Products. Polymer/Composite products that are sold as a set containing multiple shades with the same surface formulation (e.g., an equal mix of light, medium, and dark panels) shall be tested using the CRRC-1 Test Method #1 variant for wood products. Specimens shall be organized into arrays of three (3) panels to capture the widest range of natural color variation. Each array shall contain one light-colored panel, one medium-colored panel, and one dark-colored panel. Measurements on the array shall be taken at randomly generated locations until a standard error of equal to or less than 0.02 is achieved with a minimum of 30 sample points.

(F)(G) Wood Products. Wood products shall be tested using the CRRC-1 Test Method #1 variant for wood products. ~~Wood product~~ Specimens shall be organized into arrays of three (3) panels to capture the widest range of natural color variation. Each array shall contain one light-colored panel, one medium-colored panel, and one dark-colored panel. Measurements on the array shall be taken at randomly generated locations until a standard error of equal to or less than 0.02 is achieved with a minimum of 30 sample points.

(G)(H) Roofing Aggregate. Roofing ~~A~~aggregate shall be tested in accordance with ASTM E1918.

(H)(I) For all product categories not identified in items (B) through (HG), any method in section S.2.2 (A) may be used, except for ASTM C1864, which applies only to directionally reflective materials.

Advisory Note: Lawrence Berkeley National Laboratory provides Excel tools for the use of CRRC-1 Test Method #1 (Variegated Products, Tile, and Wood) that calculate the standard error and records the locations of the measurements. Visit <https://heatisland.lbl.gov/resources/technical-resources> to download copies of these tools.

R.S.2.3 Thermal Emittance Tests

Thermal Emittance tests shall comply with the following:

- (A)** Be conducted in accordance with ~~ASTM C1371~~ the Slide Method. The emissometer head shall be moved without creating a gap between the specimen and the emissometer every 15 seconds during the testing procedure.
- (B)** Have three (3) measurements taken on each ~~specimen~~ Specimen.
- (C)** ~~Any roofing product other than u~~ Uninsulated metal or a Ffactory-~~A~~applied coating on an uninsulated metal substrate may be tested using the Slide Method or ASTM C1371. ~~shall be tested using the Slide Method. In the Slide Method, the emissometer head~~

~~shall be moved, without creating a gap between the specimen and the emissometer, every 15 seconds during the testing procedure.~~

Advisory note: The Slide Method can be found in Devices and Services (D&S) Technical Note 11-2 at <http://devicesandservices.com>. Moore, Charles. Model AE1 Emittance Measurements using a Port Adapter, Model AE-ADP. D&S Technical Note 11-2. Dallas, TX: Devices & Services Co., 2011.

R.S.2.4 Color Family Elements – Instrumentally-Measured Color Tests

For Color Family Elements, only, Color Family Element product ~~S~~specimens shall be tested for L, a, and b coordinates on the Hunter color scale. Color measurement equipment specification: 0°/45° (illuminant/observer) geometry with 10° standard observer, D65 illuminant. (Informative Note: See ASTM E805, Section 9 for reference only.)

The color ~~S~~specimen shall be conditioned to room temperature (24±3 °C) for at least 30 minutes prior to measurement. The color ~~S~~specimen shall be placed on the instrument according to manufacturer instructions. L, a, and b coordinates shall be measured at three locations on the ~~S~~specimen surface and the average of each color coordinate shall be reported. Measurements shall be performed according to instrument manufacturer instructions. Results shall be reported in a way that identifies each number with its respective coordinate (L, a, b) and ~~S~~specimen.

R.S.2.5 Thickness Tests

~~(A) Fluid-Liquid-Applied Coatings:~~ Thickness tests shall be conducted in accordance with ~~ASTM D1669~~, ASTM D1005 or ASTM D7091.

~~1. If ASTM D1005 is followed, the following additional requirements shall be observed:~~

- ~~a. If the AITL prepares the test Specimens, Procedure A of ASTM D1005 shall be followed using the alternate approach described in ASTM D1005 Section 6.1.5 to measure the substrate Thickness.~~
- ~~b. If the Seller or OM has prepared the test Specimens, the AITL shall measure the Thickness of the unprepared Standard Substrate that is provided by the Seller or OM.~~

~~1.—~~A ~~T~~thickness measurement shall be taken at five (5) evenly spaced points on each of the nine (9) ~~S~~specimens. The average of the five (5) measurements shall be used to determine the ~~T~~thickness of the coating on each ~~S~~specimen. The average ~~T~~thickness of the measured coating for a given ~~S~~specimen shall be within 20% of the manufacturer's recommended minimum ~~T~~thickness. A

Sspecimen which is not within this range shall not be used for ratings. The AITL shall notify the Seller or OM to supply a new product sample.

2.

~~(A)~~(B) Single-pPly membranes: Thickness tests shall be conducted in accordance with ASTM D751. A Thickness measurement shall be taken at five (5) evenly spaced points on each of the nine (9) Sspecimens. The average of the five (5) measurements shall be used to determine the overall Thickness of each Sspecimen. A Specimen's measured average Thickness shall comply with the Thickness tolerance specified by the relevant ASTM standard for the sample material. If no ASTM standard exists for the material or the relevant ASTM standard does not specify a Thickness tolerance, the measured average Thickness must be greater than or equal to the manufacturer's published minimum Thickness. ~~The average thickness for a given specimen shall be within 20% of the manufacturer's stated thickness.~~ A Sspecimen which is not within this range shall not be used for ratings. The AITL shall notify the Seller or OM to supply a new product sample.

R.S.2.6 Requirements for Field Exposure of Roofing Products

The following criteria shall be met to determine aged ratings:

- (A) Test Farm Qualifications: A weathering farm shall be accredited for compliance with ISO/IEC Standard 17025 to weather and test roofing products, and shall be independent from any AITL, OM or Seller.
- (B) Test Farm Sites: Roofing product Sspecimens shall be exposed in the following three (3) locations representing three (3) climate zones:
1. Hot/Humid climate with:
 - a. Annual Heating Degree-Day (HDD) @ 18 °C of ~~7,280~~ (Annual HDD @ 65 °F of ~~13,014~~), and
 - b. Annual Cooling Degree-Day (CDD) @ 10 °C of ~~5,447~~ 5,334 (Annual CDD @ 50 °F of ~~9,602~~ 805), and
 - c. An average yearly relative humidity of ~~82~~ 83% in the A.M. and 61% in the P.M.
 2. Cold/Temperate climate with:
 - a. Annual Heating Degree-Day (HDD) @ 18 °C of ~~2,978~~ 3,280 (Annual HDD @ 65 °F of ~~5,904~~ 361), and
 - b. Annual Cooling Degree-Day (CDD) @ 10 °C of ~~1,662~~ 917 (Annual CDD @ 50 °F of ~~2,992~~ 3,451), and

c. An average yearly relative humidity of ~~79~~~~80~~% in the A.M. and 62% in the P.M.

3. Hot/Dry climate with:

- a. Annual Heating Degree-Day (HDD) @ 18 °C of ~~523~~~~486~~ (Annual HDD @ 65 °F of ~~944~~~~874~~), and
- b. Annual Cooling Degree-Day (CDD) @ 10 °C of 5,~~182~~~~067~~ (Annual CDD @ 50 °F of 9,~~328~~~~120~~), and
- c. An average yearly relative humidity of ~~46~~~~50~~% in the A.M. and 23% in the P.M.

The heating degree-day and cooling degree-day shall be determined in accordance with ANSI/ASHRAE Standard 169. The average yearly relative humidity shall be determined in accordance with NOAA comparative climate data. Test farm location climate values shall be within plus or minus 10% of those values shown above.

Advisory note: Examples of regions of the United States that comply with Section S.2.6 are, but are not limited to, the following:

Hot/Humid climate: Miami, Florida.

Cold/Dry climate: ~~Chicago, Illinois;~~ Cleveland, Ohio; ~~Youngstown, Ohio;~~ Pittsburgh, Pennsylvania.

Hot/Dry climate: Phoenix, AZ.

- (C) Specimen Exposure Period: -Specimens of each product shall be exposed for a minimum of three (3) continuous years at the locations specified in Section S.2.6(B) in accordance with ~~S~~specimen preparations described in Section S.3. Specimens shall remain untouched for that minimum period, except for removal and reinstallation within the Test Farm as result of weather conditions that have the potential for damaging the test specimens. Said removal and reinstallation shall be in accordance with the policy and procedures of the ~~test farm~~Test Farm responsible for the safe-keeping of the ~~s~~Specimens.
- (D) Specimen Mounting: Exposure for both metallic and nonmetallic materials shall be in accordance with ASTM G7. Specimens shall be mounted for exposure on plywood in such a way that there is no run off from one panel to another. Products designated for only Steep-Sloped applications shall be exposed on plywood backing at a 45° tilt angle. Low-~~S~~slope products shall be exposed on plywood backing at a 5° tilt angle. Products designated as both ~~L~~ow- and ~~S~~teep-~~S~~sloped are to be exposed at ~~L~~ow-~~S~~slope only (5° tilt angle).

- (E) Exposure Removal: After three-year exposure, the Sspecimens are permitted to be removed for purposes of testing and reporting Aged Solar Reflectance and Thermal Emittance results.

To ensure the proper handling of Sspecimens, AITLs and Test Farms shall adhere to the procedures in ASTM G147, **except** sections 14.3 through 14.4 involving the washing of Sspecimens. The Test Surface of each Specimen **shall not** be washed, cleaned, or wiped in any fashion. Loose dirt, embedded dirt, environmental stains, mold, mildew and any other material that rests on—or has become incorporated into—the surface of the material shall not be altered.

- (F) Testing of Exposed Specimens: The Specimens shall be tested in accordance with Section R.S.2 of this Standard.
- (G) Exposure Notification: The Test Farm shall be responsible for notifying the Seller or OM of exposure start and end dates and any other pertinent information about Specimen damage or unusual appearance. The Test Farm is also responsible for accurately labeling exposed Specimens to match the exposure location (i.e., Test Farm Site).

R.S.2.7 Requirements for Laboratory Soiling and Weathering of Roofing Materials

The following criteria shall be used to determine Laboratory-Exposed Radiative Properties:

- (A) Specimen qualifications:
1. Each product Specimen shall comply with the requirements of ASTM D7897.
 2. The exposed area of each Specimen shall be 10 centimeters by 10 centimeters (3.94 inches by 3.94 inches).
- (B) Specimen quantity: Three (3) Specimens of each roofing product randomly selected from the routine production for purposes of testing.
- (C) Laboratory soiling and weathering: The laboratory soiling and weathering shall be conducted in accordance with ASTM D7897, using the soiling mixture for average U.S. conditions in accordance with Section 6.1 of ASTM D7897.
- (D) Variegated Shingle Products: Variegated shingles undergoing laboratory soiling and weathering shall adhere to the requirements in Appendix B of this Standard.
- (E) Liquid-Applied Coatings on Rough Substrates: Coated rough substrates shall adhere to the Specimen preparation requirements in Appendix C of this Standard.

(D)—

~~(E)~~(F) Reporting: The report for laboratory soiling and weathering of roofing materials shall include:

1. Information as required by Section 10 of ASTM D7897.
2. The Solar Reflectance and Thermal Emittance of each Specimen measured in accordance with Sections R.S.2 of this Standard, before and after laboratory soiling and weathering. The laboratory-exposed Solar Reflectance value and Laboratory-Exposed Thermal Emittance value of the product shall be determined by calculating the arithmetic means of the corresponding values of the three Specimens measured after laboratory soiling and weathering.

R.S.2.8 Report of Results

Accredited Independent Testing Laboratories (AITL) shall submit a report of Tested Radiative Properties, both initial and aged, to the Seller or OM for use in compiling a product rating application. The report shall contain the following information:

- (A) The AITL shall report as Tested Aged Radiative Properties the Field-Exposed Radiative Properties of any product that has completed field exposure in accordance with Section R.S.2.6 of this Standard.
- (B) If a product has begun, but not yet completed, field exposure in accordance with Sections R.S.2.6 and R.S.2.3 of this Standard, the AITL shall report as Tested Aged Radiative Properties the Laboratory-Exposed Radiative Properties obtained in accordance with Section R.S.2.7 of this Standard, or report that Aged Radiative Properties have not been tested.
- (C) The AITL shall note in its report whether the Tested Aged Radiative Properties are Field-Exposed Radiative Properties or Laboratory-Exposed Radiative Properties.
- (D) The report shall contain information as required by the appropriate test method and shall also include the following information:
 1. Name and address of the OM or Seller.
 2. Name and identification for the roofing product.
 3. Name and address of the AITL and name of the person overseeing testing and the technician who performed the testing.
 4. Test method(s) employed.
 5. Thickness of top coating or material tested, if applicable.
 6. Summary of data (i.e., test results).

Roofing Section S.3 - Test Specimen Selection

R.S.3.1 General

Roof product Specimen selection shall be determined in accordance with one of the following:

- (A) Section R.S.3.2 for Standard Roofing Products, when the roof product is not part of a Color Family Group, a Color Family Additional Element, or a Variegated roofing product.
- (B) Section R.S.3.3 for Factory-Appplied coatings and factory-coated metal products.
- (C) Section R.S.3.4 for Variegated roofing products.
- (D) Section R.S.2.7 for laboratory-soiled and weathered products.

R.S.3.2 Standard Production Line Roofing Product Specimen

(A) Specimen Selection:

Nine (9) Specimens shall be randomly selected from routine production and sent to an AITL for testing. These Specimens shall be grouped into three (3) sets:

- 1. Three (3) Specimens from Batch A,
- 2. Three (3) Specimens from a Batch B, and
- 3. Three (3) Specimens for which each of the two (2) Batches shall be represented.

This results in a total of four (4) Specimens from one Batch and five (5) from the other.

For Tile Roofing Products, both mono-color and Variegated, shall be tested using nine (9) individual tiles. For tile blend assemblies that are made up of two (2) or more colors, each color must be tested as an individual product.

(B) Specimen Preparation (including size, batch, number of Specimens, identification, substrate and Thickness):

- 1. Each Specimen shall be a minimum of 10.2 centimeters by 15.2 centimeters (4 inches by 6 inches) in size.
- 2. Each Specimen shall be identified with the following on the backs of the Specimens testing surface:
 - a. manufacturer's name and address;
 - b. product name and/or model number; and
 - c. Batch number and individual Specimen number.

The label adhered to each Specimen shall be durable, and the information on the label legible, for a minimum period of four (4) years, ~~during which Specimens will be exposed to the environment.~~

For Tile Roofing Products, flat and S-shape tiles shall be permitted to be cut down by the tile manufacturer to a smaller size of not less than 15.24 centimeters by 15.24 centimeters (6 inches by 6 inches), allowing any unreadable areas to be removed as long as a representative Specimen remains intact in order to be tested. All other curved tiles must be sent as full, uncut tiles.

(C) Substrate:

The Seller or OM shall be responsible for ensuring that product Specimens are prepared on the appropriate substrate(s) according to the following provisions:

1. Non-Variegated Roofing Products: With the exception of ~~fluid field-applied~~Liquid-Applied Coatings and Factory-Applied Roof Product Components, non-Variegated roofing product Specimens need not be applied to a substrate.

Advisory note: *Non-Variegated Products may include, for example, single-ply membrane, factory-coated metal, non-variegated asphalt shingles, and capsheets.*

- ~~2. Fluid Field-Applied~~Liquid-Applied Roofing ProductsCoating on Smooth Substrates: Shall be applied to the substrate(s) intended for end use, to a standard aluminum panel or to a substrate approved by the certifying agency. The standard substrate shall conform to 3003 H14 uncoated aluminum alloy in accordance with ASTM D1730. Alternative substrates shall be as recommended by the manufacturer for field installation. ~~Fluid field-applied~~Liquid-Applied roofing productCoating specimens shall be applied at the minimum dry film Thickness or coverage recommended by the manufacturer for use ~~in the field~~on site. The dry film Thickness shall be within 20% of the manufacturer's recommended minimum Thickness and shall be verified upon initial testing by an AITL in accordance with the procedures set forth in Section R.S.2.5 of this ~~document~~Standard.

2.

3. Liquid-Applied Coatings on Rough Substrates: Shall adhere to the protocol in Appendix C of this standard. Liquid-Applied coating Specimens shall be applied at the minimum dry film Thickness or coverage recommended by the manufacturer. The dry film Thickness shall be within 20% of the manufacturer's recommended minimum. Thickness and shall be verified upon initial testing by an AITL in accordance with the procedures set forth in Appendix C of this Standard.

3.4. Factory-Applied Roof Product Components: -Factory-Applied Roof Product Component Specimens shall be applied to the substrate(s) intended for end use or to a standard aluminum panel. The standard aluminum panel shall conform to 3003 H14 uncoated aluminum alloy in accordance with ASTM D1730.

(D) Radiative Properties Reporting:

The Tested Radiative Properties of the product Specimens shall be reported according to the following provisions:

1. Initial Tested Radiative Properties shall be reported as the average of each of the nine (9) the initial test results of the Specimens from Batches A and B.
2. Field-Exposed Tested Radiative Properties shall be reported as the arithmetic average of the field-exposed test results of each of the nine (9) product Specimens that undergo three-year field exposure.
3. In the event that a Specimen is Uncharacteristically Damaged or Incorrectly Exposed during field exposure, the Specimen shall be removed from the calculation of the Aged Radiative Properties. As a result of such an occurrence, the Aged Radiative Properties that are reported shall be no higher than the arithmetic average of the averaged results from each Test Farm Site.

Up to two (2) product Specimens per Test Farm Site shall be permitted to be discarded if Uncharacteristically Damaged or Incorrectly Exposed. Should all three (3) Specimens from one Test Farm Site be Uncharacteristically Damaged or Incorrectly Exposed, the Seller or OM shall have their products re-tested. For asphalt shingle products, see Section R.S.3.4(C)3 of this Standard.

R.S.3.3 Factory-Colored Applied Coating Products

This section refers to both Factory-Applied coatings and factory-coated metal panels.

A Seller or OM shall establish a standard color or a Color Family Group. A Color Family Group shall consist of the same Color Family binder/resin technology. In establishing a standard color or Color Family Group, the standard color or a representative of the group shall be tested for Radiative Properties by an AITL and aged according to Section R.S.2.6 of this Standard.

Color for an individual product or Color Family Group shall be established using Hunter L, a, and b measurements, which are conducted on product Specimens from two (2) distinct Batches A and B. The reported values shall establish the color of the product.

Advisory note: Colorimetry measurements may be made by an AITL, AMTL, test farm, Seller, or OM.

(A) Specimen Selection:

1. Standard Color or Color Group: Nine (9) Specimens shall be randomly selected from routine production and sent to an AITL for testing. These Specimens shall be grouped into three (3) sets: a) three (3) Specimens from one Batch, b) three (3) Specimens from a second Batch, and c) another set of three (3) Specimens for which each of the two Batches must be represented. This results in a total of four (4) Specimens from one Batch and five (5) from the other.
2. Color Family Additional Element: For each Color Family Additional Element to be added to an existing Color Family Group, six (6) Specimens shall be randomly selected and sent to an AITL for testing. The Specimens shall be grouped into two (2) sets: a) three (3) Specimens from one Batch, and b) three (3) Specimens from a second Batch.

(B) Specimen Preparation:

1. Each Specimen shall be at least 155 square centimeters (24 square inches) in size.
2. Each Specimen shall be identified with the following on the backs of the Specimens testing surface:
 - a. manufacturer's name and address;
 - b. product name and/or model number;
 - c. Batch number and individual Specimen number.

The label adhered to each Specimen shall be durable, and the information on the label legible, for a minimum period of four (4) years, during which Specimens will be exposed to the environment.

(C) Substrate:

The Seller or OM shall be responsible for ensuring that product Specimens are prepared on the appropriate substrate(s) according to the following provisions:

1. Factory-Coated Metal Products: -Factory-coated metal product Specimens need not be applied to thea Standard sSubstrate.
2. Factory-Applied Coatings: -Factory-Applied Rroof Pproduct eComponent Specimens shall be applied to a substrate(s) intended for commercial use or to a standard aluminum panel. The Sstandard sSubstrate shall conform to 3003 H14 uncoated aluminum alloy in accordance with ASTM D1730.

(D) Radiative Properties Reporting:

The Tested Radiative Properties of the product Specimens shall be reported according to the following provisions:

1. Initial Tested Radiative Properties shall be reported as the average of the tests conducted on Specimens from Batches A and B.
2. Field-Exposed Tested Radiative Properties shall be reported as the arithmetic average of the Field-Exposed test results of each of the nine (9) product Specimens that undergo field exposure.
3. In the event that a Specimen is Uncharacteristically Damaged or Incorrectly Exposed during field exposure, the Specimen shall be removed from the calculation of the Field-Exposed Radiative Properties. As a result of such an occurrence, the Field-Exposed Tested Radiative Properties that are reported shall be no higher than the arithmetic average of the averaged results from each Test Farm Site.
4. Up to two (2) product Specimens per Test Farm Site shall be permitted to be discarded if Uncharacteristically Damaged or Incorrectly Exposed. Should all three (3) Specimens from one Test Farm Site be Uncharacteristically Damaged or Incorrectly Exposed, the Seller or OM shall have their products re-tested.

Color Family Additional Elements are not subject to Aged Radiative Properties Testing. The Aged Tested Radiative Properties reported on the Color Family Additional Element and in the test results shall be identical to what is reported for the Representative Element of the Color Family Group. Either the initial Color Family Group default value or the actual aged value of the Representative Element, whichever is lower, shall be used.

R.S.3.4 Variegated Products

Variegated roofing products shall either be tested using ASTM E1918 or CRRC-1 Test Method #1. When products are tested in accordance with CRRC-1 Test Method #1 the following provisions must be followed:

(A) Specimen Selection:

1. Specimens of Variegated roofing shingle products with non-continuous top surfaces (e.g., granules, particles) that are tested under CRRC-1 Test Method #1 shall be randomly selected from routine production and sent to an AITL for testing. These Specimens shall be grouped into three (3) sets of arrays:
 - a. One Specimen array composed of at least two (2) shingles from Batch A;

- b. One ~~Specimen array~~ ~~composed~~ ~~is~~ ~~ed~~ of at least two (2) shingles from Batch B; and
- c. One ~~Specimen array~~ for which each of the two (2) Batches shall be represented, including at least one shingle from Batch A and one shingle from Batch B.

Advisory note: ~~specimens~~ ~~Arrays~~ may be ~~comprised~~ ~~composed~~ of multiple pieces. Top surfaces may be particles, or other materials creating a Variegated surface.

- 2. For Variegated tile, non-shingle, or modified bitumen products that are tested under CRRC-1 Test Method #1, Specimens shall be randomly selected from routine production and sent to an AITL for testing. These Specimens shall be grouped into three (3) sets:
 - a. Three (3) Specimens from Batch A;
 - b. Three (3) Specimens from Batch B;
 - c. Three (3) Specimens for which each of the two Batches shall be represented.

Advisory Note: Tile is tested with either the tile variant of CRRC-1 Test Method #1 or the Tile Template Method, which specifies Specimen size requirements.

(B) Specimen Preparation:

Advisory note: The ~~manufacturer~~ ~~Seller or OM~~ may opt to work with an AITL to prepare Specimens in accordance with the following provisions.

- 1. ~~Specimens~~ ~~Arrays~~ to be tested under CRRC-1 Test Method #1:
 - a. Variegated shingle products shall have a minimum dimension of 25.4 centimeters by 91.4 centimeters (10 inches by 36 inches) of exposure surface. ~~Shingle Specimens~~ ~~Arrays~~ shall include at least two (2) full courses of exposure surface in height. ~~Specimens~~ ~~Arrays~~, including individual ~~pieces~~ ~~Specimens~~ that comprise the ~~Specimen~~ ~~array~~, shall be labeled with the necessary information for identification by Batch and Specimen. The labels must be designed to be durable for a period of four (4) years, with the information legible, ~~during which time Specimens will be exposed to the environment.~~
 - b. For Variegated tile roofing products, Specimens may be full uncut tiles or cut by the tile manufacturer to a smaller size not less than 15.24 centimeters by 15.24 centimeters (6 inches by 6 inches). Unreadable areas may be removed as long as a representative Specimen remains

intact for testing. ~~Specimens~~ Each Specimen shall be labeled on the backs of the Specimens testing surface with the necessary information for identification by Batch and Specimen. The labels must be designed to be durable for a period of four (4) years, with the information legible, ~~during which time Specimens will be exposed to the environment.~~

- c. For Variegated products that are neither shingles nor modified bitumen, the area of each Specimen shall be at least 10.2 by 25.4 centimeters (4 inches by 10 inches). Each ~~Specimens~~ shall be labeled Specimens testing surface with the necessary information for identification by Batch and Specimen. The labels must be designed to be durable for a period of four (4) years, with the information legible, ~~during which time Specimens will be exposed to the environment.~~

2. The Seller or OM shall be responsible for ensuring that Specimens of Variegated roofing products that are tested in accordance with ASTM E1918 are prepared on the appropriate substrate(s) in accordance with the recommendations of the manufacturer, and meet the minimum size requirements for testing under ASTM E1918.

(C) Radiative Properties Reporting:

1. Initial Tested Radiative Properties shall be reported as the arithmetic average of the average radiative property values determined in accordance with CRRC-1 Test Method #1.

For Variegated shingle products, in the event that two (2) ~~Specimens-arrays~~ yield Radiative Property values that differ by more than 0.05 from each other, both ~~Specimens-arrays~~ shall be deemed to be non-compliant with the requirements stated in ~~this section~~ (Section R.S.3 of this Standard). The Seller or OM shall then be required to prepare three (3) additional Specimens arrays of sufficiently larger dimensions to ensure that the difference in the Radiative Property values between each of the two (2) new measured Specimens-arrays is equal to or less than 0.05.

2. Field-Exposed Tested Radiative Properties shall be reported as the arithmetic average of the average radiative values for each of the three (3) Test Farm Sites, as determined in accordance with CRRC-1 Test Method #1.
3. In the event that a Specimen is Uncharacteristically Damaged or Incorrectly Exposed during field exposure, the Specimen shall be removed from the calculation of the Field-Exposed Radiative Properties. As a result of such an occurrence, the Field-Exposed Testing Radiative Properties that are reported

shall be no higher than the arithmetic average of the averaged results from each Test Farm Site.

Up to two (2) product Specimens per Test Farm Site shall be permitted to be discarded if Uncharacteristically Damaged or Incorrectly Exposed. Should all three (3) Specimens from one Test Farm Site be Uncharacteristically Damaged or Incorrectly Exposed, the Seller or OM shall have the product re-tested.

For Variegated shingle Specimens, if the test Specimen from one Test Farm Site is Uncharacteristically Damaged or Incorrectly Exposed, the Seller or OM shall have the product re-tested.

Exterior Wall Section W.S.2 – Conduct of Tests

W.S.2.1 Product Specimens

All product Specimens used for Initial and Aged Radiative Property testing shall be chosen by the wall product Seller or OM.

An Accredited Independent Testing Laboratory (AITL) or Accredited Manufacturing Testing Laboratory (AMTL), if applicable, shall measure the dimensions of each test Specimen. Specimen measurements shall be within 2.54 centimeters (1 inch) of the minimum required Specimen size, and Specimens shall be measured to an accuracy of 0.64 centimeters (0.25 inches).

The accredited test lab shall note in the initial test results that the Specimens meet the size requirements. If the Specimens do not meet the size requirements, the laboratory will notify the Seller or OM to obtain new Specimens.

W.S.2.2 Solar Reflectance Tests

(A) Solar Reflectance tests shall be conducted based upon one of the following test methods using the air-mass 1.5 global vertical (AM1.5GV) Solar Reflectance of a sun-facing, 90° (vertical) tilted surface, except for Variegated wall products, which must be tested using CRRC-1 Test Method #1.

1. ASTM E903, in conjunction with the global solar-spectral irradiance at air mass 1.5 incident on a sun-facing, 90° (vertical) tilted surface, specified as "Global 90°" in ASTM G197.
2. ASTM C1549, using the global Solar Reflectance at air-mass 1.5 for a sun-facing, 90° (vertical) tilted surface, specified as output "1.590" (air mass 1.5; tilt 90°) on of the Solar Spectrum Reflectometer version 6.
3. CRRC-1 Test Method #1, using the variant of ASTM C1549 specified in item (2).

Advisory note: The CRRC-1 Test Method #1 can be found in the appendix of ASTM C1549.

(B) For Architectural Coating Wall Products applied to a Standard Substrate, the bare Standard Substrate must also be tested for Solar Reflectance using the same test method that is used for the prepared Specimens. The Solar Reflectance of the Standard Substrate must meet the requirements of Section W.S.3.2 of this Standard.

W.S.2.3 Thermal Emittance Tests

Thermal Emittance tests shall comply with the following:

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- (A) Be conducted in accordance with the Slide Method. The emissometer head shall be moved without creating a gap between the specimen and the emissometer every 15 seconds during the testing procedure.
- (B) There shall be three (3) measurements taken on each Specimen.
- (C) Uninsulated metal or a Factory-Applied coating on an uninsulated metal substrate may be tested using the Slide Method or ASTM C1371.

Advisory note: The Slide Method can be found in Devices and Services (D&S) Technical Note 11-2 at <http://devicesandservices.com>. Moore, Charles. Model AE1 Emittance Measurements using a Port Adapter, Model AE-ADP. D&S Technical Note 11-2. Dallas, TX: Devices & Services Co., 2011.

W.S.2.4 Color Family Elements – Instrumentally Measured Color Tests

Color Family Elements shall be tested for L, a, and b coordinates on the Hunter color scale for Factory-Applied coatings or CIE color scale for Architectural Coating Wall Product, respectively. Color measurement equipment specification: 0°/45° (illuminant/observer) geometry with 10° standard observer, D65 illuminant. (Informative Note: See ASTM E805, Section 9 for reference only.)

Color measurements shall be taken on one Specimen from Batch A and one Specimen from Batch B in accordance with Section S.3.3. The color Specimen shall be conditioned to room temperature (24 ± 3 °C) for at least 30 minutes prior to measurement. The color Specimen shall be placed on the instrument and measurements conducted according to the instrument manufacturer's instructions. The L, a, and b coordinates shall be measured at three (3) locations on the Specimen Test Surface and the average of each color coordinate shall be reported. The test results shall be reported in a manner that identifies the specific Specimen, the color coordinates (L, a, b) at each location, and the average of the three readings for each coordinate.

W.S.2.5 Thickness Tests

- (A) Architectural Coatings: Thickness tests shall be conducted in accordance with ASTM D1005 or ASTM D7091. A Thickness measurement shall be taken at five (5) evenly spaced points on each of the Specimens. The average of the five (5) measurements shall be used to determine the Thickness of the coating on each Specimen. The average Thickness of the measured coating for a given Specimen shall be within 20% of the manufacturer's recommended minimum dry film Thickness. Any Specimen that is not within this range shall not be used for ratings. The accredited testing laboratory shall notify the Seller or OM to request a new Specimen.

(B) If ASTM D1005 is followed, the following additional requirements shall be observed:

- 1. If the laboratory prepares the test Specimens, Procedure A of ASTM D1005 shall be followed using the alternate approach described in ASTM D1005 Section 6.1.5 to measure the substrate Thickness.**
- 2. If the Seller or OM has prepared the test Specimens:**
 - a. For products applied to a Standard Substrate, the laboratory shall measure the Thickness of the bare Standard Substrate that is provided in accordance with section W.S.3.2 (C) and W.S.3.3 (C) of this standard. ASTM D1005 Sections 6.1.3 or 6.1.5 shall not be used to measure the substrate Thickness.**
 - b. For products applied to a Leneta Chart, the laboratory shall measure the Thickness of the exposed portion of the Leneta Chart. ASTM D1005 Sections 6.1.3 or 6.1.5 shall not be used to measure the substrate Thickness.**

W.S.2.6 Requirements for Field Exposure of Wall Products

The following criteria shall be met to determine aged ratings:

- (A) Test Farm Qualifications: A Test Farm shall be accredited to ISO/IEC Standard 17025 for the weathering and colorimetry testing of wall products, and shall be independent from any AITL or Seller or OM.**
- (B) Test Farm Sites: Specimens shall be exposed in the following three (3) locations representing three (3) climate zones:**
 - 1. Hot/Humid climate with:**
 - a. Annual Heating Degree-Day (HDD) @ 18 °C of 80 (Annual HDD @ 65 °F of 144), and**
 - b. Annual Cooling Degree-Day (CDD) @ 10 °C of 5,334 (Annual CDD @ 50 °F of 9,602), and**
 - c. An average yearly Relative Humidity of 82% in the A.M. and 61% in the P.M.**
 - 2. Cold/Temperate climate with:**
 - a. Annual Heating Degree-Day (HDD) @ 18 °C of 2,978 (Annual HDD @ 65 °F of 5,631), and**
 - b. Annual Cooling Degree-Day (CDD) @ 10 °C of 1,917 (Annual CDD @ 50 °F of 3,451), and**
 - c. An average yearly Relative Humidity of 79% in the A.M. and 62% in the P.M.**

3. Hot/Dry climate with:

- a. Annual Heating Degree-Day (HDD) @ 18 °C of 486 (Annual HDD @ 65 °F of 874), and
- b. Annual Cooling Degree-Day (CDD) @ 10 °C of 5,182 (Annual CDD @ 50 °F of 9,328), and
- c. An average yearly Relative Humidity of 46% in the A.M. and 23% in the P.M.

The heating degree-day and cooling degree-day shall be determined in accordance with ANSI/ASHRAE Standard 169. The average yearly relative humidity shall be determined in accordance with NOAA comparative climate data. Test Farm location climate values shall be within plus or minus 10% of those values shown above.

Advisory note: Examples of regions of the United States that comply with Section S.2.6 are, but are not limited to, the following:

Hot/Humid climate: Miami, Florida.

Cold/Temperate climate: Cleveland, Ohio; Pittsburgh, Pennsylvania.

Hot/Dry climate: Phoenix, AZ.

- (C) Specimen Exposure Period: Specimens shall be exposed for a minimum of three (3) continuous years at the locations specified in Section W.S.2.6(B) of this standard in accordance with Specimen preparations described in Section W.S.3 of this standard. Specimens shall remain untouched for that minimum period, except for removal and reinstallation at the Test Farm Site as a result of weather conditions that have the potential for damaging the Specimens. Said removal and reinstallation shall be in accordance with the Test Farm's policy and procedures for the safe-keeping of Specimens.
- (D) Specimen Mounting: Exposure shall be in accordance with ASTM G7. Specimens shall be exposed on wood backing at 90° South either in an offset rack that horizontally staggers Specimens or on the top row of a non-offset rack to minimize cross-contamination induced by dripping.
- (E) Exposure Removal: After three years of exposure, the Specimens are removed for the purposes of testing and reporting the Aged Solar Reflectance and Thermal Emittance results.

To ensure the proper handling of Specimens, AITLs and Test Farms shall adhere to the procedures in ASTM G147, **except** sections 14.3 through 14.4 involving the washing of Specimens. The Test Surface of each Specimen **shall not** be washed, cleaned, or wiped in any fashion. Loose dirt, embedded dirt, environmental stains, mold, mildew, and any other material that rests on—or has become incorporated into—the surface of the material shall not be altered.

- (F) Testing of Exposed Specimens: The Specimens shall be tested in accordance with Section W.S.2 of this standard.
- (G) Exposure Notification: The Test Farm shall be responsible for notifying the Seller or OM of exposure start and end dates and any other pertinent information about Specimen damage or unusual appearance. The Test Farm is also responsible for accurately labeling the exposed Specimens to coincide with the exposure location (i.e., Test Farm Site).

Exterior Wall Section W.S.3 - Test Specimen Selection

W.S.3.1 General

Wall product Specimen selection shall be determined in accordance with one of the following:

- (A) Section W.S.3.2 of this standard for standard wall products, when the product is not a Color Family Representative Element, a Color Family Additional Element, or a Variegated wall product.
- (B) Section W.S.3.3 of this standard for products that are part of a Color Family Group.
- (C) Section W.S.3.4 below for Variegated wall products.

W.S.3.2 Standard Wall Products

(A) Specimen Selection:

The Seller or OM shall randomly select nine (9) Specimens from routine production to send to an AITL for testing. These Specimens shall be grouped into three (3) sets:

1. Three (3) Specimens from Batch A,
2. Three (3) Specimens from a Batch B, and
3. Three (3) Specimens for which each of the two (2) Batches shall be represented.

This results in a total of four (4) Specimens from one Batch and five (5) from the other.

For Polypropylene Siding Wall Products, all shapes with the same formulation must be measured to determine the lowest Solar Reflectance. The profile with the lowest Solar Reflectance will be reported and will be sent to the Test Farm for three-year weathering.

Profiled metal wall products shall be tested using flat Specimens of the same color and material.

(B) Specimen Preparation (including size, Batch, number of Specimens, identification, substrate, and Thickness):

1. Each Specimen shall be a minimum of 10.2 centimeters by 15.2 centimeters (4 inches by 6 inches) or 7.6 centimeters by 25.4 centimeters (3 inches by 10 inches) in size.
2. Each Specimen shall be identified with the following on the back of the Specimen:
 - a. Seller or OM name;
 - b. product name and/or model number; and
 - c. Batch number and individual Specimen number.

Labels shall be adhered to the back of each Specimen and be durable, and the information on the label legible, for a minimum of four (4) years.

(C) Substrate:

Where applicable, the Seller or OM shall be responsible for ensuring that product Specimens are prepared on the appropriate substrate(s) according to the following provisions:

1. Architectural Coating Wall Products:
 - a. Architectural Coating Wall Products shall be applied to a Standard Substrate with a Solar Reflectance less than 0.20 that can withstand three years of field exposure. Specimens shall be applied at the minimum dry film Thickness or coverage recommended by the Seller or OM. The dry film Thickness shall be within 20% of the manufacturer's recommended minimum Thickness and shall be verified upon initial testing by an AITL in accordance with the procedures set forth in Section W.S.2.5 of this standard.
 - b. -The Seller or OM shall either supply prepared Specimens or supply the substrate to the AITL along with instructions on how to properly apply the coating to the substrate. If the Specimens are prepared on a Standard Substrate by the Seller or OM prior to being provided to the AITL, the Seller or OM shall also send one unprepared Standard Substrate to allow the AITL to measure the substrate thickness in accordance with Section W.S.2.5 of this standard and substrate Solar Reflectance in accordance with Section W.S.2.2 of this standard.

Advisory note: To meet the Standard Substrate Solar Reflectance requirement, the Cool Roof Rating Council (CRRC) has tested and verified

that 6000 series aluminum alloy panels (e.g., Q-lab ASX-310) anodized using AnoBlack EC meet the Solar Reflectance requirements. If coating adhesion issues occur, panels can be de-glossed by scrubbing with an abrasive pad. To maintain corrosion protection, the back side should not be de-glossed. The Seller or OM is responsible for verifying coating adhesion. The Seller or OM may choose the exact material size, chemistry, and supplier of the panels, as long as they meet the size and Solar Reflectance requirements of this standard.

2. Vinyl Siding Wall Products, Polypropylene Siding Wall Products, and Insulated Vinyl Siding Wall Products: The Seller or OM shall be responsible for ensuring that Specimens are prepared on the appropriate substrate(s) based on solid or Variegated capstock.

(D) Radiative Properties Reporting:

The Tested Radiative Properties of the Specimens shall be reported according to the following provisions:

1. Initial Tested Radiative Properties shall be reported as the arithmetic mean of the initial test results of the Specimens from Batches A and B.
2. Aged Tested Radiative Properties shall be reported as the arithmetic mean of the aged test results for each of the nine (9) Specimens that completed three-year weathering.
3. In the event that a Specimen is Uncharacteristically Damaged or Incorrectly Exposed during weathering, the Specimen shall be removed from the calculation of the Aged Radiative Properties. As a result of such an occurrence, the Aged Radiative Properties that are reported shall be the arithmetic mean of the measurements made on the remaining Specimens from each Test Farm Site.

Up to two (2) Specimens per Test Farm Site shall be permitted to be discarded if Uncharacteristically Damaged or Incorrectly Exposed. Should all three (3) Specimens from one Test Farm Site be Uncharacteristically Damaged or Incorrectly Exposed, the Seller or OM shall have the product re-tested by the accredited test lab.

W.S.3.3 Color Family Group Products

All elements of a Color Family Group must belong to the same Product Line. In establishing a Color Family Group, the Seller or OM will submit data for all products included in the group. The Representative Element of the group shall undergo Radiative Property testing by an AITL and aged according to section W.S.2.6 in this standard. Color Family Additional Elements may be tested by an AITL or an AMTL.

Color shall be established using the average Hunter L, a, b color scale for Factory-Applied coatings or CIELAB for Architectural Coating Wall Products measurements taken on one Specimen from Batch A and one Specimen from Batch B. The reported values shall establish the color of the product. The measured color coordinates shall fall within the defined color coordinate ranges for the selected Color Family.

Advisory note: *Colorimetry measurements may be made by an AITL, AMTL, or Test Farm.*

(A) Specimen Selection:

1. Color Family Representative Element: The Seller or OM shall randomly select nine (9) Specimens from routine production to send to an AITL for testing. The Specimens shall be grouped into three (3) sets: a) three (3) Specimens from one Batch, b) three (3) Specimens from a second Batch, and c) another set of three (3) specimens for which each of the two Batches must be represented. This results in a total of four (4) Specimen from one Batch and five (5) from the other.
2. Color Family Additional Element: For each Color Family Additional Element to be added to an existing Color Family Group, six (6) Specimens shall be randomly selected and tested by an AITL or AMTL. The Specimen shall be grouped into two (2) sets: a) three (3) Specimens from one Batch and b) three (3) Specimens from a second Batch.

(B) Specimen Preparation:

1. Each Specimen shall be at least 155 square centimeters (24 square inches) in size.
2. Each Specimen shall be identified with the following on the back of the Specimen:
 - a. Seller or OM name;
 - b. product name and/or model number; and
 - c. Batch number and individual Specimen number.

Specimens shall be legibly labeled on the back of each panel. In the case of Representative Elements, the labeling shall be durable, and the information on the label legible, for a minimum period of four (4) years.

(C) Substrate:

Where applicable, the Seller or OM shall be responsible for ensuring that product Specimens are prepared on the appropriate substrate(s) according to the following provisions:

1. Architectural Coating Wall Products:

- a. Color Family Representative Element products shall be applied to a Standard Substrate with a Solar Reflectance less than 0.20. Color Family Additional Element Products shall be applied to the Standard Substrate or a Leneta BK chart or the black portion of a Leneta 2C chart.
- b. Specimens shall be applied at the minimum dry film Thickness or coverage recommended by the Seller or OM. The dry film Thickness shall be within 20% of the manufacturer's recommended minimum Thickness and shall be verified upon initial testing by an AITL in accordance with the procedures set forth in Section W.S.2.5 of this standard. The Thickness of Color Family Additional Elements may be verified by an AITL or an AMTL.
- c. The Seller or OM shall either supply prepared Specimens or supply the substrate to the AITL, or an AMTL for Color Family Additional Elements, along with instructions on how to properly apply the coating to the substrate. If the Specimens are prepared on a Standard Substrate by the Seller or OM prior to being provided to the AITL or AMTL, the Seller or OM shall also send one unprepared Standard Substrate to allow the AITL or AMTL to measure the substrate thickness in accordance with Section W.S.2.5 of this standard and substrate Solar Reflectance in accordance with Section W.S.2.2 of this standard. If the Specimens are prepared on a Leneta chart by the Seller or OM prior to being provided to the AITL or AMTL, the Seller or OM shall ensure that sufficient space is left bare to allow the AITL or AMTL to measure the substrate thickness, while still meeting the Specimen size requirement in Section W.S.3.32 (B) of this standard.

Advisory note: To meet the Standard Substrate Solar Reflectance requirement, the Cool Roof Rating Council has tested and verified that 6000 series aluminum alloy panels (e.g., Q-lab ASX-310) anodized using AnoBlack EC meet the Solar Reflectance requirements. If coating adhesion issues occur, panels can be de-glossed by scrubbing with an abrasive pad. To maintain corrosion protection, the back side should not be de-glossed. The Seller or OM is responsible for verifying coating adhesion. The Seller or OM may choose the exact size, chemistry, and supplier of the panels, as long as they meet the size and Solar Reflectance requirements of this Standard.

(D) Radiative Properties Reporting:

The Tested Radiative Properties of the Specimens shall be reported as described in Section W.S.3.2 (D) in this standard with the following exception: Color Family Additional Elements are not subject to Aged Radiative Properties testing. The Aged Tested Radiative Properties reported for the Color Family Additional Element and in the test results shall be identical to what is reported for the Representative Element of the Color Family Group.

W.S.3.4 Variegated Products

A product is considered Variegated if a series of five (5) Solar Reflectance measurements taken approximately equidistant along a diagonal axis of the Specimen varies by more than 0.05 from the arithmetic mean of all five measurements.

Variegated wall products shall be tested using CRRC-1 Test Method #1. When products are tested in accordance with CRRC-1 Test Method #1, the following provisions must be followed:

(A) Specimen Selection:

1. The Seller or OM shall randomly select Specimens from routine production to send to an AITL for testing. These Specimens shall be grouped into three (3) sets:
 - a. Three (3) Specimens from Batch A;
 - b. Three (3) Specimens from Batch B;
 - c. Three (3) Specimens for which each of the two Batches shall be represented.

(B) Specimen Preparation:

1. The area of each Specimen shall be at least 10.2 by 25.4 centimeters (4 inches by 10 inches).
2. Each Specimen shall be labeled on the back of the Specimen with the necessary information for identification by Batch and Specimen.
 - a. Labels shall be adhered to the back of each Specimen and be durable, and the information on the label legible for a minimum period of four (4) years.

(C) Radiative Properties Reporting:

1. Initial Tested Radiative Properties shall be reported as the arithmetic mean of the average Radiative Property values determined in accordance with CRRC-1 Test Method #1.

In the event that two (2) Specimens yield Radiative Property values that differ by more than 0.05 from each other, both Specimens shall be deemed to be non-compliant with the requirements stated in Section W.S.3.4 of this standard. The Seller or OM shall then be required to prepare three (3) additional Specimens of sufficiently larger dimensions to ensure that the difference in the Radiative Property values between each of the two (2) new measured Specimens is equal to or less than 0.05.

2. Aged Tested Radiative Properties shall be reported as the arithmetic mean of the average Radiative Values for each of the three (3) Test Farm Sites, as determined in accordance with CRRC-1 Test Method #1.
3. In the event that a Specimen is Uncharacteristically Damaged or Incorrectly Exposed during weathering, the Specimen shall be removed from the calculation of the Aged Radiative Properties. As a result of such an occurrence, the Aged Radiative Properties that are reported shall be no higher than the arithmetic mean of the averaged results from each Test Farm Site. Up to two (2) Specimens per Test Farm Site shall be permitted to be discarded if Uncharacteristically Damaged or Incorrectly Exposed. Should all three (3) Specimens from one Test Farm Site be Uncharacteristically Damaged or Incorrectly Exposed, the Seller or OM shall have the product re-tested.

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CRRC Public Comment Period
January 5, 2024 – February 19, 2024
SUBMIT COMMENTS BY 11:59 PM PACIFIC ON FEBRUARY 19, 2024
CRRC Public Comment Form is Required for Comment Submissions:
https://coolroofs.org/documents/CRRC-S100-Public-Comment-Form_2024-01-05.pdf

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Appendix **B (Roofing)** - Procedure for Variegated Shingles Undergoing Laboratory Soiling and Weathering

The following criteria shall be used to determine the Laboratory-Exposed Radiative Properties of Variegated **roofing** shingles. The procedure is limited to products with a designed exposure height of not less than 10.16 centimeters (4 inches) and not greater than 30.48 centimeters (12 inches).

- (A) **Specimen Selection:** A minimum of nine (9) Specimens shall be randomly selected from a minimum of three (3) full shingle boards. Specimens shall be selected from the portion of the shingle designed for exposure and weathering, which shall be separated from the full shingle board. Discard the “unexposed shingle area” portion ~~(s- Shown in ee~~ Figures 1 and 2 below-).
- (B) **Specimen Size:** Starting from left to right, cut nine (9) Specimens 10.16 centimeters (4 inches) wide by full height of the exposed area as shown in Figure 3 below. If needed, adjust the location where the 10.16-centimeter-wide Specimens are obtained in order to have a continuous, flat piece of material without gaps or raised edges (i.e., typical of three tab and laminated shingles). Once the shingles boards have been cut into nine (9) Specimens that are 10.16 centimeters wide, discard the remaining material.
- (C) **Testing locations:** For each cut piece that is 10.16 centimeters (4 inches) wide by no more than 30.48 centimeters (12 inches) high, apply a random procedure to determine the location (e.g., top, middle or bottom) where each 10.16-centimeter by 10.16-centimeter Specimen will be obtained (see Figures 4 – 6 below).
- (D) **Identification:** The manufacturer shall assign a unique number for each of the 10.16 centimeter by 10.16-centimeter (4 inch by 4 inch) pieces obtained from the three (3) shingle boards and mark the numbers on the back of each Specimen.
- (E) **Pre-test Preparation:** Before proceeding, measure the average Initial Solar Reflectance of each un-aged Specimen. Ensure that the average Initial Solar Reflectance is +/-0.02 of the value determined by Section **R.S.2.2(B)** if Variegated or **R.S.2.2(C)** if non-Variegated. If the value is not +/- 0.02, then other test Specimens that were previously cut shall be used as replacements for testing. Recalculate the Initial Solar Reflectance of the new set of nine (9) Specimens. If necessary, repeat this substitution process until the average Initial **Solar** Reflectance of the nine (9) Specimens is +/- 0.02 of the initial reflectance values as measured using Section **R.S.2.2 in this Standard**.

- (F) **Solar Reflectance Soiling, Testing A and Reporting:** Randomly select nine (9) of the numbered 10.16 centimeter by 10.16-centimeter (4 inch by 4 inch) Specimens assigned for soiling and weathering. Conduct laboratory soiling and weathering on each the nine (9) test Specimens in accordance with ASTM D7897. Upon completion of the laboratory soiling and weathering procedure, record the nine (9) Solar Reflectance measurements for each of the nine (9) Specimens in the locations shown in Figure 7 below. Calculate each Specimen's Laboratory Aged Solar Reflectance as the average of the nine (9) measurements for each Specimen. Calculate the overall average Laboratory Aged Solar Reflectance based on all nine (9) Specimens. Report the Laboratory Aged Solar Reflectance of each Specimen with the test results. If Initial Solar Reflectance values were determined using the optional process described above then report those values.
- (G) **Thermal emittance testing and reporting:** Measure the Laboratory Aged Thermal Emittance of each of the nine (9) aged Specimens in accordance with Section R.S.2.3(C) in this standard. Calculate the overall average Thermal Emittance for all nine (9) Specimens. Report the Thermal Emittance of each Specimen with the test results.

Figure 1. Full Shingle Board as Received from Manufacturer



Figure 2. -Unexposed and Exposed Areas of Separated Shingle Board



Figure 3.- Diagram of Full Shingle as Cut into 10-Centimeter Pieces

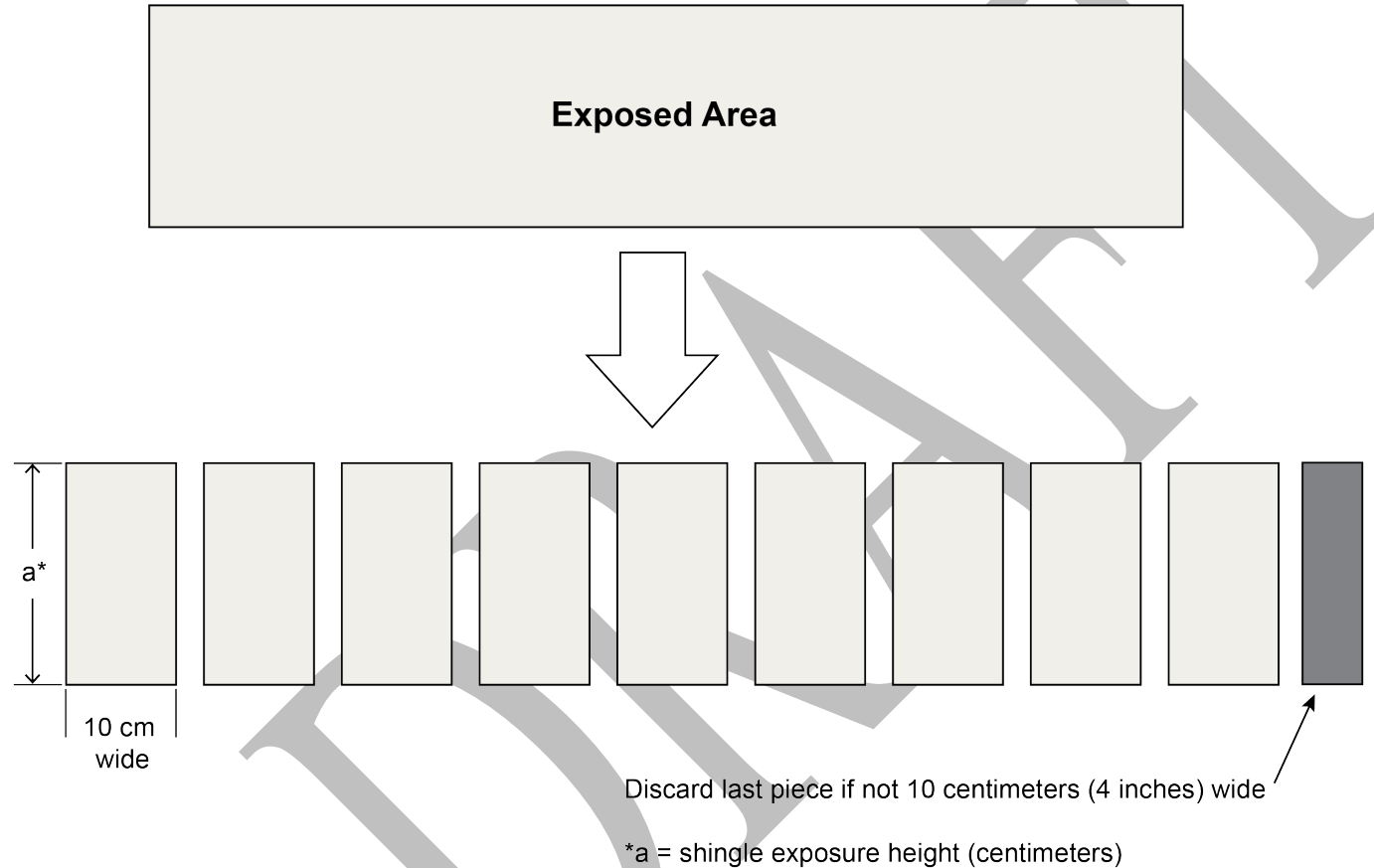


Figure 4. -Test Specimen Obtained from Bottom Portion of Exposed Area

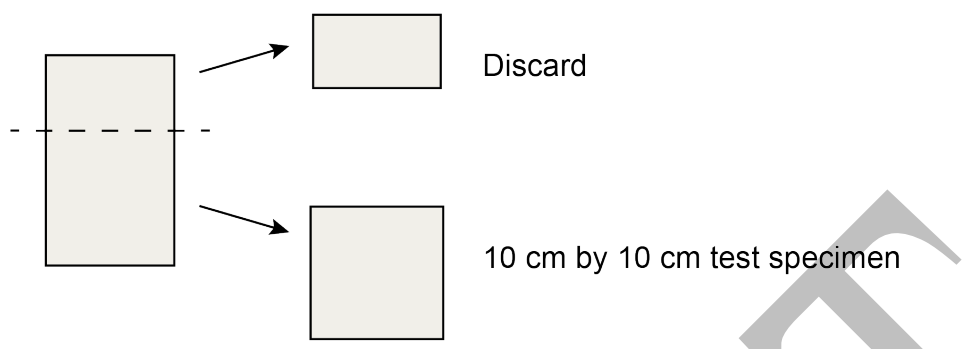


Figure 5. -Test Specimen Obtained from Middle Portion of Exposed Area

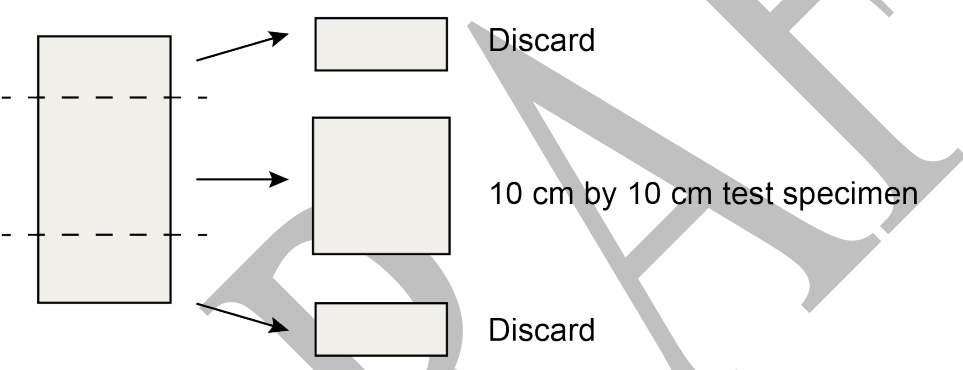


Figure 6. -Test Specimen Obtained from Top Portion of Exposed Area

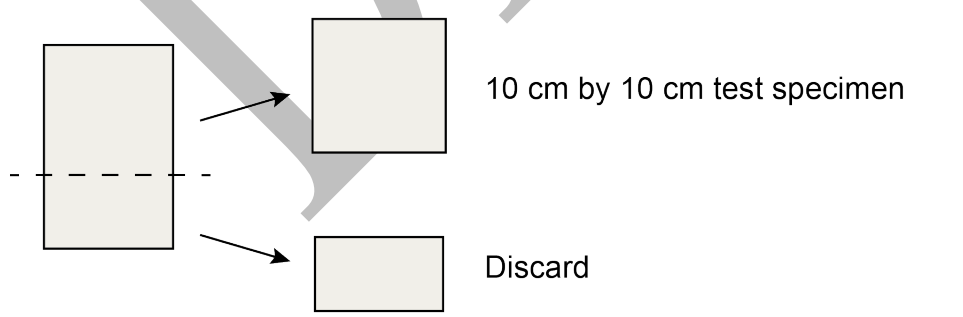
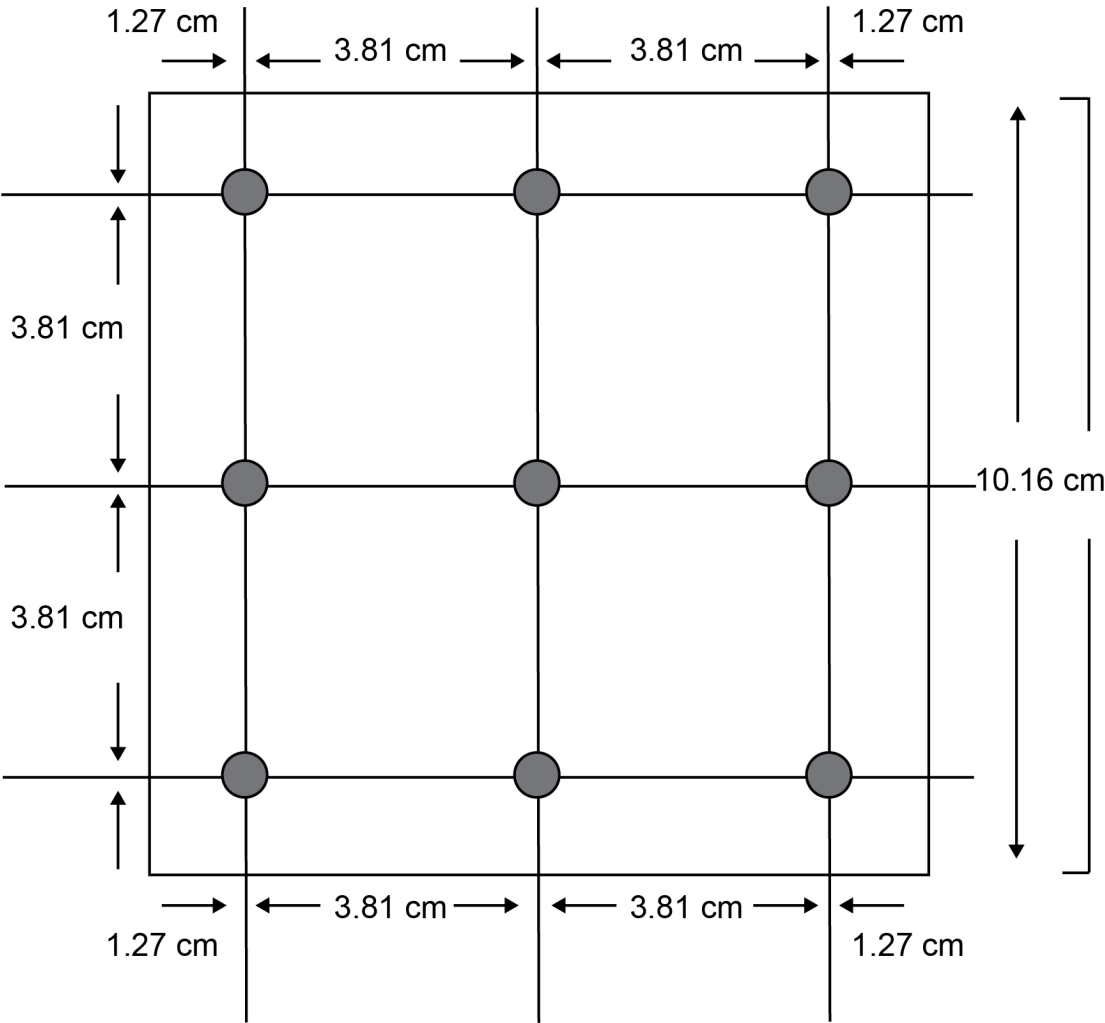


Figure 7. Variegated Shingle Measurement Template



Appendix C (Roofing) – Protocol for Liquid-Applied Coatings Applied to a Rough Substrate

INTRODUCTION

The following procedure describes the process for coating products applied to a rough substrate. The protocol is in addition to the existing coatings test procedure, which tests coatings on a smooth aluminum substrate or another smooth substrate specified by the Seller or OM.

ELIGIBILITY

This method pertains to Liquid-Applied Roof Coating products, including but not limited to acrylic, silicone, polyurethane, and aluminum-based products, which can be applied over a rough surface (defined as an application surface that is equally coarse or coarser than a new #11 granulated modified bitumen sheet).

INITIAL TESTING

Initial testing shall adhere to the R.S.2 of this Standard with the following exceptions.

Specimen Preparation

The Seller or OM shall either provide nine (9) prepared Specimens and a copy of the coating product technical data sheet to the AITL or the AITL may prepare the coating Specimens as described below. Specimen selection and preparation shall be in accordance with R.S.3.2 of this standard.

Materials needed

- Nine (9), standard aluminum panels, each at least 155 square centimeters (24 square inches) in size. For Specimens undergoing laboratory soiling and weathering, only three (3) panels are required, each 10 centimeters by 10 centimeters (3.94 inches by 3.94 inches).
- Black #11 sieve size granules, sufficient to cover nine (9) product Specimens
- Coating product to be tested
- Brush to apply coating
- Coating product technical data sheet
- Weight conversion calculation / calculator

Advisory Note: *The Cool Roof Rating Council provides a Coatings on Rough Substrates Excel Reporting Tool to assist with the specimen preparation process for coatings applied to rough substrates. The tool calculates the topcoat mass and determines whether it is within tolerance of the manufacturer's recommended topcoat weight. To request the Coatings on Rough Substrates Excel Reporting Tool, email info@coolroofs.org.*

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Procedure for Single-Coat Application

1. Apply a foundation coat of the coating that will be tested on a standard clean aluminum panel. The coating shall be applied at a Thickness of at least 20 mils (dry film Thickness) and sufficient to adequately adhere to a granule layer.
2. While the foundation coat is still wet, broadcast standard black #11 sieve size granules across the panel until the granules are rejected from the panel.
3. Allow the Specimen to dry. Drying time will vary based on product composition.
4. Confirm that the Specimen is completely dry by taking a weight measurement, then waiting 24 hours. If the weight has not changed by more than 0.1 grams, proceed to the next step. If the weight changes by more than 0.1 grams during this 24 hour period, wait an additional 24 hours before proceeding.
5. After the Specimen is dry, gently shake off any excess granules. Record the weight of the combined foundation coat, granule layer, and panel in grams, to two decimal places.
6. Apply the coating that will be tested at the coverage rate specified in the application instructions- provided by the manufacturer (for multiple coats, see the Procedure for Multiple-Coat application below).
7. Immediately after applying the top, record the total Specimen weight (panel, foundation coat, granule, and wet top coat) in grams, to two decimal places.
8. Calculate the weight of the top coat. This must fall within $\pm 20\%$ of the expected top coat weight. If the top coat weight falls outside of the 20% tolerance, new Specimens must be prepared. Record the final top coat weight for each Specimen.
9. Repeat steps 1 through 7 to create a total of nine (9) Specimens.

Procedure for Multiple-Coat Application

1. Apply a foundation coat of the coating that will be tested for a CRRC rating to a standard clean aluminum panel. The coating shall be applied at a Thickness of at least 20 mils (dry film Thickness) and sufficient to adequately adhere to a granule layer.
2. While the foundation coat is still wet, broadcast standard black #11 sieve size granules across the panel until the granules are rejected from the panel.
3. Allow the Specimen to dry. Drying time will vary based on product composition.
4. Confirm that the Specimen is completely dry by taking a weight measurement, then waiting 24 hours. If the weight has not changed by more than 0.1 grams, proceed to the next step. If the weight changes by more than 0.1 grams during this 24 hour period, wait an additional 24 hours before proceeding.
5. After the Specimen is dry, gently shake off any excess granules. Record the weight of the combined foundation coat, granule layer, and panel in grams, to two decimal places. Report this value in the Excel reporting tool.
6. Apply the first coat of the coating that will be tested for a CRRC product rating at the coverage rate specified in the application instructions provided by the Manufacturer.
7. Immediately after applying the first coat, record the total Specimen weight (panel, foundation coat, granule, and wet first coat) in grams, to two decimal places. Report this

value in the Excel Reporting Tool. The Excel Reporting Tool will calculate the weight of the first coat.

8. Allow the Specimen to dry for the length of time specified by the application instructions. Immediately before applying the next coat, record the total Specimen weight (panel, foundation coat, granule, and first coat) in grams, to two decimal places.
9. Apply the next coat at the coverage rate specified in the application instructions provided by the Manufacturer.
10. Immediately after applying the next coat, record the total Specimen weight (panel, foundation coat, granule, first coat, and wet top coat) in grams, to two decimal places. Report this value in the Excel Reporting Tool. The Excel Reporting Tool will calculate the weight of the top coat.
11. If more than two coats are required, repeat steps 8, 9, and 10 for each subsequent coat.
12. The Excel Reporting Tool will calculate the cumulative weight as shown in the Excel Reporting Tool. If the cumulative weight falls outside of the 20% tolerance, new Specimens must be prepared. Report the final Cumulative Weight for each Specimen in the Initial Test Results Report on the Online Rating Portal and upload a copy of the Excel Reporting Tool.
13. Repeat steps 1 through 12 to create a total of 9 Specimens.

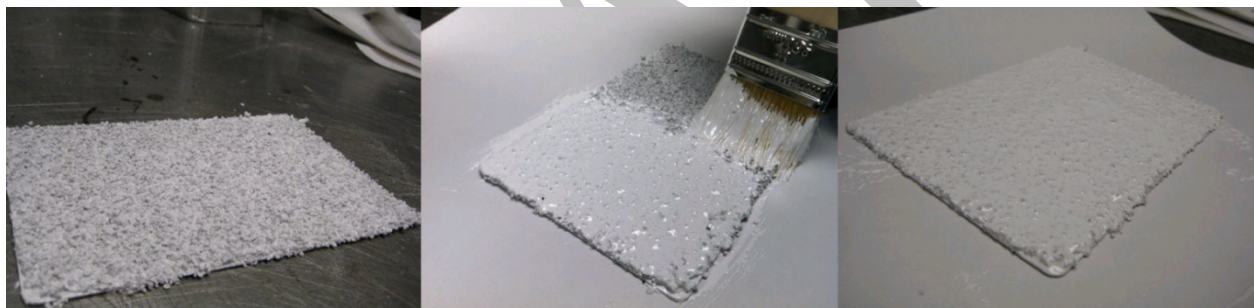


Figure 1. Example of specimen preparation

Initial Testing

The AITL shall measure Solar Reflectance and Thermal Emittance in accordance with tests specified in Sections R.S.2.2 and R.S.2.3 of this standard.

WEATHERING AND AGED TESTING

Product weathering and aged testing shall follow the requirements set forth in Section R.S.2.2, R.S.2.3, and R.S.2.6 of this standard. Laboratory soiling and weathering shall follow the requirements set forth in Section R.S.2.7 of this standard.