WALL PRODUCT RATING PROGRAM MANUAL
CRRC-2

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PREFACE

The CRRC Wall Rating Program has been developed under the direction of the Cool Roof Rating Council. The Cool Roof Rating Council is a nonprofit organization whose mission is:

To bring objective, scientific information related to cool surfaces to critical discussions and informed decisions about the impacts of heat islands, extreme heat, and energy use in the built environment.

By pursuing this mission, the CRRC will become the recognized informational resource for reducing the urban heat island effect, increasing building energy efficiency, improving occupant comfort, and mitigating the global climate effects of greenhouse gas emissions.

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ADVISORY NOTE: ALL REFERENCED DOCUMENTS SUCH AS CRRC AGREEMENTS, APPLICATIONS, FORMS, PROCEDURES OR OTHER ITEMS MAY BE FOUND AT

https://coolroofs.org/programs/wall-rating-program/all-forms-2

CHAPTER 1.0 FOREWORD

1.1 Scope

The Cool Roof Rating Council, Inc. (CRRC) operates a uniform rating system for the Radiative Properties of exterior Wall Products ("Wall Rating Program"). The system is supported by a rating program under which manufacturers and sellers ("Wall Licensees") have the opportunity to label exterior Wall Products with measured Initial and Aged Radiative Properties. These properties are determined through testing by CRRC Accredited Independent Testing Laboratories (AITLs) and, in some cases, Approved Manufacturer Testing Laboratories (AMTLs). The properties are periodically verified through Validation Testing conducted by AITLs. The Wall Rating Program references ANSI/CRRC S100 - *Standard Test Methods for Determining Radiative Properties of Materials*.

Advisory Note: *The CRRC does not specify minimum threshold values for Radiative Properties. The Wall Rating Program is not intended to be used as a primary law or regulation, but rather as an authoritative resource that complements adopted laws or regulations. If the CRRC Wall Rating Program is referenced by a law or regulation, the provisions of that law or regulation may dictate specific requirements that are in addition to or conflict with the CRRC Wall Rating Program. It is therefore the responsibility of the user to comply with applicable laws and regulations.*

1.2 Liability

1.2.1 Disclaimer

The CRRC is the copyright owner of the CRRC Wall Product Label, which bears one or more radiative property values reported by AITLs. The AITLs act independently from the CRRC.

A product Rating Authorization does not constitute a warranty by the CRRC regarding the Radiative Properties of an exterior Wall Product. A rating is not an endorsement of, or recommendation for, any exterior Wall Product. The CRRC is not a merchant in the business of selling exterior Wall Products, and therefore, cannot warrant products as to their merchantability or fitness for a particular use.

The CRRC therefore disclaims any and all liability, including but not limited to, damages for personal or other injury, lost profits, lost savings or other consequential or incidental damages that may arise from or in connection with:

1. services provided by, decisions made by, or reports issued or granted by any AITL or Wall Licensee;
2. reliance on any CRRC product description, specification, rating or test, whether appearing in a report, product Rating Authorization, printed or electronic directory or on a product label; or
3. the sale or use of any CRRC rated exterior Wall Product.

1.2.2 Indemnification

Wall Licensees are required to enter into a license agreement with the CRRC, which contains, among other provisions, an indemnification of the CRRC, its Board of Directors (CRRC Board), officers, and agents from and against liability.

1.3 Membership and License Applications

The use of official CRRC forms is required when applying for CRRC membership, CRRC licenses, and to become an approved CRRC testing laboratory or test farm. Official CRRC forms can be found online at www.coolroofs.org.

1.3.3 Limitations

Product rating applications shall be limited to the holder of the rights of materials and products for which the Rating Authorization is sought. For applications that reference another rated product, the application shall include documentation that the applicant has authorization from the manufacturer to use the test report data.

1.4 Glossary of Terms

1.4.1 Scope

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

1.4.2 Definitions

Approved Testing Laboratory – A laboratory that has received formal recognition by the CRRC as having demonstrated technical competency to perform specific types of tests in accordance with Chapter 2.0 of this manual.

Accredited Independent Testing Laboratory – An Accredited Testing Laboratory that is approved by

the CRRC to test exterior Wall Products and is completely independent from any manufacturing company.

Approved Manufacturer Testing Laboratory – An Approved Testing Laboratory affiliated with a Wall Licensee that is approved by the CRRC to test the Radiative Properties of Wall Products.

Agreement, Approved Laboratory – A written agreement that is entered into between the CRRC and a CRRC-approved testing laboratory.

Agreement, Wall Licensee – A written agreement that is entered into between the CRRC and a Wall Licensee.

Agreement, Approved Test Farm – A written agreement that is entered into between the CRRC and a CRRC Approved Test Farm.

Approved Test Farm – A company that the CRRC has approved to conduct exposure activities for products that are undergoing the process to obtain aged ratings.

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

Challenge Testing – Validation Testing that is triggered by concerns raised by a CRRC Licensee, the CRRC, or another entity about Product Ratings that are listed on the CRRC Rated Wall Products Directory.

Coating Thickness – The Dry Film Thickness of a coating when applied to a substrate.

Color Family – A predefined range of Hunter or CIE "L," "a," and "b" Color Coordinates that establishes the color space for a CRRC-predefined set of colors.

Color Family Additional Element – A uniquely formulated Architectural Coating Wall Product or Factory-Coated Metal Wall Product intended for application to an exterior wall that is CRRC-rated as a member of a Color Family Group and is not a Representative Element.

Color Family Group – One or more Architectural Coating or Factory-Coated Metal products rated by a Wall Licensee that are part of the same Product Line and that have color properties that fall within the ranges established for the respective CRRC Color Family.

Color Family Representative Element – A uniquely formulated Architectural Coating or Factory Coated Metal intended for application to an exterior wall that is used to initially establish a Wall Licensee's 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 of the degree-days over a calendar year. *(Source: ASHRAE Standard 169)*.

Compound Product Rating – A compound product rating applies to two or more products that have the same surface formulation and same Radiative Properties that are listed together as one product entry on the CRRC Rated Wall Products Directory and CRRC Label. Products of any type may be eligible for a Compound Product Rating.

Embossed Panel – A three-dimensional grain pattern that is transferred to the extruded panel.

Estimate of Sample Mean Standard Error – The Sample (rather than Population) Standard Deviation divided by the square root of the number of Specimens.

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

Formula Change – Individual or accumulated changes in a product (e.g., pigment or resin) that changes the Solar Reflectance or Thermal Emittance by ±0.05 or more.

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*)

Heavily Textured Panel – An uneven surface that contains a grain texture and defining shadow lines transferred to the injection molded panel.

Heterogeneous – Consisting of dissimilar or diverse ingredients or constituents.

Hunter/CIE "L," "a," "b" Color Coordinates – Numeric measurements of a color's lightness (L), redness/greenness (a) and yellowness/blueness (b) in accordance with ASTM E805, Section 9. Color Measurement Equipment Specification: 0°/45° or

45°/0° (illuminant angle/viewing angle) geometry with 10° standard observer, D65 illuminant.

Inactive or Inactivated Product Rating – Any product rating that is removed from the CRRC Wall Rated Products Directory due to a Wall Licensee's request or non-payment of fees.

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 program manual.

Label, CRRC – The distinctive informational mark that contains the CRRC Wall Rating Program logo and other pertinent radiative property information specific to a Wall Product.

Licensed Party – An entity that is a Wall Licensee or approved testing Laboratory.

Light Reflectance Value (LRV) – The percentage of visible and usable light that is reflected by a surface.

Logo, CRRC – The distinctive registered service mark of the CRRC.

Manufacturer, Wall Product – A company that produces Wall Products.

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

Population Mean – The arithmetic mean of the Radiative Property values 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).

Production Line – A Wall Licensee's standard color offerings that are promoted in general product information and in marketing materials.

Radiative Properties – The Solar Reflectance and Thermal Emittance of a Wall Product.

Radiative Properties, Rated – The Solar Reflectance and Thermal Emittance of a Wall Product reported on a CRRC Label and published on the CRRC Rated Wall Products Directory.

Radiative Properties, Aged – The Solar Reflectance and Thermal Emittance of a Wall Product weathered and tested in accordance with Section 4.5 of this manual and Section W.S.2 of ANSI/CRRC S100.

Radiative Properties, Initial – The Solar Reflectance and Thermal Emittance of a Wall Product that tested in accordance with Section 4.5 of this manual.

Radiative Properties, Tested – The measured Solar Reflectance and Thermal Emittance of a Wall Product as reported by a CRRC-approved test lab.

Rating Authorization – An official notification from the CRRC to a Wall Licensee regarding the approval of a CRRC product rating.

Reactivated Product – An Inactive Product Rating that is reactivated by the CRRC upon request by the Wall Licensee.

Reference Rating – a product rating application that relies on the rated values from a different application for an identical product (e.g., private labeling)

Reflectance, Solar – The fraction of solar energy that is reflected by an exterior Wall Product.

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

Responsible Person – An individual employee of a CRRC-approved test lab who has participated in a CRRC laboratory training workshop and who will supervise or perform all CRRC-related testing at that laboratory.

Retested Product – A CRRC-rated product that replaces an original product rating due to Validation Testing failure, test method change, or discontinuation for any other reason.

Sample – A set of test Specimens.

Sample Mean – The arithmetic mean of the Radiative Property values measured for all members of a Sample set.

Sample Mean Standard Error – The Population Standard Deviation divided by the square root of the sample size.

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

Sample Standard Deviation – The square root of the ratio of the sum of the squares of the deviation from the Sample Mean to a number one less than the number of Samples.

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

Smooth Panel – A panel that contains no visual pattern, embossment, or texture.

Solar Reflectometer – A device that measures Solar Reflectance.

Spot – A small region of a Test Surface in which *Solar Reflectance* can be measured.

Standard Substrate – A panel with a Solar Reflectance less than 0.20 that can Withstand Field Exposure for at least three years.

Test Farm Site – An authorized location where product Specimens are placed for three-year weathering exposure before aged testing is conducted.

Test Surface – Outer surface of a product test Specimen.

Test Surface Mean Solar Reflectance – The ratio of solar energy reflected from a Test Surface to the solar energy incident on a Test Surface.

Thickness, Dry Film – The thickness of liquid-applied a paint or coating, when dried, as applied to a substrate.

Terminated Product Rating – Any product rating permanently removed from the CRRC Rated Wall Products Directory due to a Validation Testing failure or retesting requirements. Terminated products are not eligible for reactivation.

Uncharacteristically Damaged – A Specimen that is unusable for weathering exposure placement or unusable after weathering exposure through no fault of Specimen preparation by the Wall Licensee or Specimen preparer. “Unusable” refers to the inability to accurately measure the Aged Radiative Properties of the product Specimen. 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 Specimen; 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 Specimen beyond normal weather exposure.

Validation Testing - A quality assurance mechanism used by the CRRC Product Rating Programs that periodically tests actively rated products to verify that the radiative data published on the CRRC Rated Products Directories remain accurate and reliable.

Wall Licensee – A manufacturer and/or seller of exterior Wall Products that has met and maintains compliance with the Wall Rating Program requirements and has signed the CRRC Wall Rating Program License Agreement. Wall Licensees may manufacture their products, purchase them from another manufacturer, or both.

Wall Product – A material designed, manufactured and constructed as the outermost part of the wall assembly that is in direct contact with solar radiation.

Wall Product, Architectural Coating – A coating recommended for field application to stationary structures and their appurtenances, and to portable buildings. This definition excludes adhesives and coatings recommended by the manufacturer or importer solely for shop applications or solely for application to non-stationary structures, such as airplanes, ships, boats, and railcars.

Wall Product, CRRC Rated – An exterior Wall Product that has received a CRRC Rating Authorization and is published on the CRRC Rated Wall Products Directory.

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 a thermal insulance (R-value) not less than 0.35 $m^2 \cdot K/W$ (2 $h \cdot ft^2 \cdot °F/BTU$).

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

Wall Product, Privately-Labeled – A Wall Product manufactured by an entity other than the Wall Licensee that is bringing it to market.

Wall Product, Standard – A CRRC-rated Production Line Wall Product that is not part of a Color Family Group or rated under a Compound Rating.

Wall Product, Variegated – A Wall Product with a varied surface color or discrete markings of different colors.

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

Withstand Field Exposure – To undergo exposure to the natural elements for a specified length of time without loss of function as a substrate for Aged Radiative Property testing of the product applied to it.

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ISO/IEC 17025 (2017), *General Requirements for the Competence of Testing and Calibration Laboratories*, International Organization for Standardization, Geneva, Switzerland, https://www.iso.org/standard/66912.html.

CHAPTER 2.0 LABORATORY AND TEST FARM REQUIREMENTS

2.1 General

This chapter contains the requirements for Accredited Independent Testing Laboratories (AITL), Approved Manufacturer Testing Laboratories (AMTL), and Approved Test Farms. AITLs and Approved Test Farms are to remain separate and unaffiliated entities.

2.2 Requirements for All Approved Testing Laboratories

Product testing for a CRRC product rating must be conducted by CRRC-approved testing laboratories. The requirements for testing laboratory approval are:

(A) The laboratory must submit a completed application to the CRRC for consideration as a recognized CRRC Approved Testing Laboratory, and pay the required fee. AITLs that have been approved to participate in the CRRC Roof Rating Program do not need to reapply or pay a separate fee to participate in the Wall Rating Program. However, they will need to provide evidence that they have the proper test equipment to perform the measurements in accordance with this manual.

(B) At least one employee of the Approved Testing Laboratory must participate in a CRRC laboratory training workshop. This employee shall be designated as a Responsible Person for CRRC testing. All testing for CRRC product ratings shall be performed or supervised by the Responsible Person, who shall ensure that test results are reported in accordance with section 3.9 of this manual. The laboratory shall notify the CRRC within 10 business days of any personnel changes as they pertain to the Responsible Person(s). A CRRC-approved laboratory must retain at least one Responsible Person to perform testing and ensure the accurate reporting of test results to the CRRC.

(C) After participating in a CRRC laboratory training workshop, the laboratory must demonstrate competency prior to CRRC approval by completing testing on a set of Specimens provided by the CRRC. The CRRC's evaluation of the laboratory's test results shall adhere to the same criteria used to evaluate product rating data.

(D) The laboratory must demonstrate ongoing competency by participating in the CRRC's Interlaboratory Comparison Study (ILC) in accordance with section 2.2.1 of this manual.

(E) The laboratory must not be a CRRC Approved Test Farm or an affiliate of a CRRC Approved Test Farm.

2.2.1 Interlaboratory Comparison Study

As part of ongoing compliance with CRRC approval, AITLs, AMTLs, and Approved Test Farms are required to participate in the biennial ILC. The purpose of the ILC is to conduct a periodic evaluation to ensure consistency and competency of the testing laboratory by evaluating the test results against the test results of the other participants.

Participants shall report the Solar Reflectance, Thermal Emittance, and Thickness (where applicable) for a Sample set of products provided by the CRRC in accordance with Chapter 3.0 of this manual and W.S.2 of ANSI/CRRC S100. Test Farms and laboratories that test colorimetry must also report color measurements, where applicable.

The CRRC will notify participants of the results at the completion of the ILC, and shall notify the participants of any corrective actions that may be necessary.

2.3 Special Requirements for Approved Manufacturer Testing Laboratories

All AMTLs shall be subject to the provisions contained in Sections 2.2, 2.6, Appendix 1 of this manual, and the following:

(A) All AMTLs shall participate in the ILC in accordance with Section 2.2.1 of this manual. Approved Manufacturer Testing Laboratories will be responsible for testing only their respective product type from the ILC Sample set.

(B) All AMTLs shall submit proof to the CRRC that the following procedures are in place:

1. Written procedures for the operation of any CRRC-approved test methods.
2. Written training records of laboratory personnel who can perform testing and reporting of the test results to the CRRC.
3. System for documenting and retaining testing records.
4. System for calibrating any and all equipment used for product testing.

2.4 Special Requirements for Accredited Independent Testing Laboratories

An AITL shall demonstrate that it meets the CRRC's requirements through submission of the following information at the time of application to become an AITL, or at the request of the CRRC:

(A) Evidence of accreditation by an official accreditation body as complying with the International Standard ISO 17025.

(B) A list of test methods on their current ISO 17025 scopes of accreditation that the AITL will perform for the CRRC Wall Product Rating Program.

(C) Maintain at all times all tests on the current ISO 17025 scope of accreditation that the Accredited Independent Testing Laboratory will perform for the CRRC Wall Rating Program.

(D) Notify the CRRC immediately if the Accredited Independent Testing Laboratory's ISO 17025 scope of accreditation changes.

(E) A statement of independence that shows the laboratory has no significant ownership or commercial interest in a supplier, roofing and/or Wall Product company, and is also not owned by such a company.

2.5 Requirements for Test Farms

2.5.1 Test Farm Application Requirements

A test farm shall demonstrate that it meets the CRRC's requirements through submission of the following information at the time of application to become an Approved Test Farm, or at the request of the CRRC:

(A) Evidence of accreditation by an official accreditation body as complying with ISO 17025.

(B) A list of test methods on their current ISO 17025 scopes of accreditation that the test farm will perform for the CRRC Wall Product Rating Program.

(C) Maintain at all times all tests on the current ISO 17025 scope of accreditation that the test farm will perform for the CRRC Wall Rating Program.

(D) Exposure locations as specified in Section W.S.2.6 of ANSI/CRRC S100 .

(E) A listing of exposure methods that an accrediting body has found the test farm capable of performing for the CRRC.

(F) A statement that shows the test farm has no significant ownership or commercial interest in a supplier, roofing and/or Wall Product company, and is also not owned by such a company.

(G) A statement that the test farm is not an AITL or an affiliate of an AITL.

(H) Participation in the ILC upon CRRC request, in accordance with Section 2.2.1of this manual, if the test farm measures colorimetry. The test farm will only be responsible for testing colorimetry of applicable products in the Sample set.

2.6 Renewal Requirements for Laboratories and Test Farms

Approved Test Farms, AITLs, and AMTLs must renew participation with the CRRC on an annual basis by paying the annual renewal fees.

To renew annual participation with the CRRC, Approved Test Farms and Accredited Independent

Testing Laboratories shall provide a copy of their current ISO 17025 scopes of accreditation. The scopes must list the CRRC-approved test methods the accredited laboratory or test farm performs for the CRRC Wall Rating Program.

To renew annual participation with the CRRC, Approved Manufacturer Testing Laboratories shall confirm that the procedures submitted to the CRRC in accordance with Section 2.3(B) of this manual are up-to-date or submit the most current versions of the procedures if applicable. The procedures must cover the CRRC-approved test methods the Approved Manufacturer Testing Laboratory performs for the Wall Rating Program.

CHAPTER 3.0 PRODUCT TESTING, WEATHERING & REPORTING REQUIREMENTS

3.1 General

This chapter, and the requirements in Section W.S.2 of ANSI/CRRC S100, contain the product testing, weathering, and reporting requirements for the Wall Rating Program.

3.2 Test Specimen Measurements

(A) The AITL shall verify that the test Specimens meet the required dimensions for that product type in accordance with Section W.S.3 of ANSI/CRRC S100. If the Specimen(s) do not meet the size requirements, the AITL will notify the Wall Licensee to obtain new test Specimens that meet the stated size requirements for that product type.

(B) The AITL shall conduct one measurement per Specimen width and length.

3.3 Solar Reflectance Tests

Solar Reflectance tests shall be conducted in accordance with W.S.2.2 of ANSI/CRRC S100 or Appendix 2 of this manual. Results shall be reported to three decimal places.

If The Standard Test Method for Determining the Directional Hemispherical Solar Reflectance of Materials Using a Directional-Hemispherical Portable Reflectometer, using the global Solar Reflectance at air-mass 1.5 for a sun-facing, 90° (vertical) tilted surface, specified as output “G197GT90” on the Surface Optics 410-Solar or 410-Solar-i.

If ASTM E903 is used to measure Solar Reflectance, the following requirements apply.

(A) The integrating sphere shall be fitted with a wall mount. A center mount shall not be used.

(B) ASTM E903 may only be used to measure the Solar Reflectance of Specimens with surfaces that are flat and uniform in color. ASTM E903 shall not be used to measure surfaces that are profiled, textured, or variegated in color.

(C) ASTM E903 shall not be used for aged testing.

3.4 Thermal Emittance Tests

Thermal Emittance tests shall be conducted in accordance with Section W.S.2.3 of ANSI/CRRC S100. Results shall be reported to two decimal places.

3.5 Thickness Tests

Thickness tests shall be conducted for Architectural Coating Wall Products in accordance with Section W.S.2.5 of ANSI/CRRC S100.

3.6 Colorimetry

Color measurements shall be conducted for Architectural Coating Wall Products and Factory-Coated Metal Wall Products in accordance with Section W.S.2.4 of ANSI/CRRC S100and Appendix 1 of this manual.

3.7 Weathering

After initial testing, the AITL shall forward the test Specimens with the Test Farm Notification Form (WF-3) directly to an Approved Test Farm for weathering exposure.

The AITL must ship the test Specimens to the Approved Test Farm within 30 calendar days of the initial testing date. If shipment cannot occur within the 30-calendar day window, the AITL must retest the Specimens prior to shipping the Specimens to the Test Farm so that the shipment date complies with the 30-day Shipment Policy. The AITL must update the Portal application with the updated test results prior to submitting the initial test data to the CRRC.

Specimens shall be placed for three-year exposure within two (2) placement cycles of the initial test date. If Specimens are not placed within two (2)

placement cycles of the initial test date, new Specimens and retesting are required (unless otherwise arranged with the CRRC). Upon CRRC approval, retested data will replace existing data in the CRRC Rated Wall Products Directory.

Exposures will begin on the first day of every other month throughout the year beginning with January 1. The test farm will conduct weathering of the Specimens in accordance with ASTM G7.

Product weathering exposure and removal requirements, which shall include Specimen mounting, exposure, and removal, shall be in accordance with W.S.2.6 of ANSI/CRRC S100. After the Specimens are placed on the exposure racks, the test farm takes initial placement photos of the Specimens and enters the photos and exposure placement details into the CRRC Online Rating Portal.

The test farm shall notify the CRRC within 30 calendar days if Specimens have been pulled before the official three-year exposure completion date.

Approved Test Farms are required to photograph Specimens during three-year weathering at each exposure site. The photographs shall be taken when placed for exposure and every year over the course of three-year weathering (i.e., at the time of placement and after 12, 24, and 36 months of exposure) and sent to the CRRC. Photographs must adhere to the following requirements:

(A) During three-year exposure, the Approved Test Farm shall submit photos to the CRRC using the following file nomenclature template:

Wall_FL/AZ/OH_Initial/12m/24m/36m_YYYY-MM-DD_[Specimen]#

1. The date in the file name shall be the date that the photo was taken.
2. Specimen numbers:

    i. If the label is on the back of the Specimen, a photo of the front and back of the Specimen must be taken.

    ii. If the label is placed next to the front of the Specimen, only the front of the Specimen must be photographed.

(B) Multiple Specimens can be grouped together in a single photograph (front and back, depending on label placement) as long as the entire surface of each Specimen is clearly visible in the photograph.

(C) Proper lighting and high-resolution image quality are required.

After three-year weathering is complete, the test farm shall ship the weathered Specimens, along with a completed version of the Test Farm Notification Form including the exposure removal information, directly to the AITL specified by the Wall Licensee.

The AITL must submit test results to the CRRC within three (3) months (90 calendar days) of removal from the test farm. If aged data are not received within 90 calendar days, the product enters a 30-calendar day “under review” period and the Licensee will be notified. If the CRRC does not receive the aged data by the end of the “under review” period, the product will be suspended and removed from the CRRC Rated Wall Products Directory unless otherwise arranged with the CRRC.

After conducting aged testing of the weathered Specimens, the AITL shall retain the Specimens for a period of 90 calendar days or until the rated Radiative Properties are approved by the CRRC. The AITL must use the current CRRC-approved test methods applicable to the Wall Product type for the Radiative Property tests of the aged products regardless of the test methods used for initial testing. The AITL will send the Test Farm Notification Form (WF-3) provided by the test farm to the Wall Licensee.

All AITLs, AMTLs, and Approved Test Farms shall adhere to select sections of ASTM G147 for the proper handling of weathered product Samples, in accordance with Section 2.5.2 of this manual and Section W.S.2.6 of ANSI/CRRC S100.

3.7.1 Damaged and Incorrectly Exposed Test Specimens

In the event that a test Specimen is Uncharacteristically Damaged in transit to the test farm or during weathering exposure to a degree that its Radiative Properties cannot be accurately measured or a Specimen is Incorrectly Exposed, it shall be removed from the calculation of the Aged Radiative Properties. As a result of such an occurrence, the Aged Radiative Properties shall be reported as the arithmetic mean of the remaining Specimens from each Test Farm Site.

Up to two Specimens per Test Farm Site are permitted to be discarded if Uncharacteristically

Damaged or Incorrectly Exposed. Should all three Specimens from one Test Farm Site be Uncharacteristically Damaged or Incorrectly Exposed, the Wall Licensee shall submit new Specimens and start the rating process over, which shall include initial testing, exposure at all three Test Farm Sites, and aged testing.

In the event that all three Specimens from one Test Farm Site are Uncharacteristically Damaged or Incorrectly Exposed and retesting is required, the product is permitted to be listed on the CRRC Rated Wall Products Directory until retesting is completed by the AITL. Retesting includes taking new initial measurements as well as going through the three-year exposure process to obtain the Aged Radiative Properties. If the new initial ratings differ from the original initial ratings by no more than ±0.05, then the initial ratings on the CRRC Rated Wall Products Directory will be updated to reflect the new initial ratings. The Wall Licensee shall be responsible for ensuring that the CRRC Wall Product Label and any reference to the original initial ratings are appropriately updated based on the new initial ratings. If the CRRC has not received a retesting submission within six (6) months of being notified that the original Specimens are unusable, the product will be removed from the CRRC Rated Products Directory, and the Wall Licensee will be notified.

All other conditions of damage will be assumed to be outside of the intent and application of Uncharacteristically Damaged or Incorrectly Exposed. Should all three Specimens from one test farm be rendered unusable from damage outside of what is defined as Uncharacteristically Damaged or Incorrectly Exposed, the Wall Rating Program Committee shall review the case and provide a recommendation to the CRRC Board on whether the product needs to go through the rating process again. The CRRC Board shall take appropriate actions that may include removal of the product from the CRRC Rated Wall Products Directory, in which case, the Wall Licensee would be required to start the rating process over if a rating is desired. Alternatively, the Wall Licensee may elect to start the product rating process over again by having a new product Sample tested in advance or in place of the CRRC Board's evaluation.

3.8 Specific Testing Considerations for Certain Product Types

See Section W.S.3.2 of ANSI/CRRC S100, and the following provisions:

(A) Architectural Coating Wall Products shall be applied to a Standard Substrate at the minimum dry film Thickness or coverage recommended by the Manufacturer for use on-site. For products that will undergo weathering (Standard Products and Color Family Representative Elements), the Standard Substrate shall be a panel with a Solar Reflectance less than 0.20 that can Withstand Field Exposure for at least three years. For paints that are designed for application to a specific substrate, the Manufacturer can choose to use an alternative substrate to the default substrate, so long as the Solar Reflectance of the substrate is less than 0.20. For products not undergoing weathering (Color Family Additional Elements), the product shall be applied to the Standard Substrate, a Leneta Form BK plain black chart, or the black portion of a Leneta Form 2C opacity chart. The Manufacturer shall either supply prepared panels, or supply the substrate to the AITL along with instructions on how to properly apply the coating to the substrate.

1. If Architectural Coating Specimens are prepared on a Standard Substrate by the Licensee prior to shipment to the laboratory, the following requirements apply:
    - i If no primer is used in the preparation of the Specimens, the Licensee shall send one unprepared (i.e., bare) Standard Substrate to the laboratory in addition to the prepared Specimens to allow the laboratory to measure the substrate Thickness in accordance with Section W.S.2.5 of and substrate Solar Reflectance in accordance with Section W.S.2.2 (B) of ANSI/CRRC S100.
    - ii If a primer is used in the preparation of the Specimens, the Licensee shall send one unprepared (i.e., bare) Standard Substrate to the laboratory in addition to the prepared Specimens to allow the

laboratory to measure the substrate Solar Reflectance in accordance with Section W.S.2.2 (B) of ANSI/CRRC S100. In addition, the Licensee shall send one Standard Substrate prepared with only the primer, applied at the same thickness as the primer used for the prepared Specimens, to allow the laboratory to measure the thickness of the primed substrate in accordance with Section W.S.2.5 (B) of ANSI/CRRC S100.

2. If Architectural Coating Specimens are prepared on a Leneta Form by the Licensee prior to shipment to the laboratory, the following requirements apply:
    i If no primer is used in the preparation of the Specimens, the Licensee shall ensure that sufficient space on the Lenata Form is left bare to allow the laboratory to measure the substrate thickness, while still meeting the Specimen size requirements of Section W.S.3.3 (B) of this manual.
    ii If a primer is used in the preparation of the Specimens, the Licensee shall apply primer to the Leneta Form, followed by the Architectural Coating being tested. The Licensee shall ensure that sufficient space on the primed Leneta Form is left uncoated to allow the laboratory to measure the primed substrate thickness, while still meeting the Specimen size requirements of Section W.S.3.3 (B) of ANSI/CRRC S100.

(B) Polypropylene Siding Wall Products with multiple product shapes that share the same surface formulation are eligible for a Compound Rating. The Licensee will submit nine (9) Specimens of each shape for the initial rating in accordance with Section W.S.3.2 (A) of ANSI/CRRC S100. All shapes must be initially measured by an AITL to determine the lowest Solar Reflectance. The shape with the lowest Solar Reflectance will be used for reporting the CRRC initial and aged values and sent to the test farm for weathering.

3.9 Reporting

Reporting of Tested Radiative Properties shall be in accordance with the following provisions:

(A) Initial Radiative Properties shall be the arithmetic mean of the initial test results of the Specimens from Batches A and B.

(B) Aged Radiative Properties shall be the arithmetic mean of the aged test results of each of the nine (9) product Specimens that undergo aging exposure.

(C) The AITL shall photograph Specimens during initial and aged testing of all products undergoing the process of obtaining a CRRC product rating. The photographs shall be submitted with the initial test results and the aged test results. The AITL must include the following information in the file name of each digital photo:

- Initial or Aged
- Date photo was taken
- Specimen numbers

Example: Initial_YYYY-MM-DD_[Specimen #] Multiple Specimens can be grouped together in a single photograph as long as the entire surface of each Specimen is clearly visible in the photograph. Proper lighting and high resolution image quality are required.

Advisory Note*: Photos are not required for Color Family Additional Elements, but if they are taken and submitted to the CRRC, the following file nomenclature should be used: CF_YYYY-MM-DD_(Specimen #)*

3.10 Validation Testing of Rated Products

The purpose of the Validation Testing Program is to verify the accuracy of actively rated product ratings and to maintain the credibility of the CRRC Rated Wall Products Directory, in accordance with the CRRC Validation Testing Procedures (see Appendix 3 of this program manual).

Products with an active CRRC rating are required to have passed Validation Testing in order to remain active on the CRRC Rated Wall Products Directory, with the exception of Reference products. Reference products are excluded from Validation Testing because they are subjected to Validation Testing through the parent product.

Actively rated products are due for Validation Testing seven (7) years after initial approval of the ratings and every seven (7) years thereafter. Products may be tested before seven (7) years if Challenge Testing is invoked (see Challenge Testing, Appendix 3).

When a product is due for Validation Testing, Licensees must submit a decision on how to proceed at the beginning of that year. Licensees must indicate if a product will proceed with testing, voluntarily terminate, or proceed with a Formula Change or Retesting application to replace the existing product.

For products proceeding with Validation Testing, the CRRC will inform the Licensees which AITL will be conducting testing. The Licensee shall send product Samples (test specimens) undergoing Validation Testing directly to the selected AITL.

Licensees must provide information to the CRRC detailing how the Samples were produced. Samples should be uniquely identifiable, whether through the Sample Tag or labeling of the individual Sample(s).

If applicable, Licensees must provide a brief instruction document outlining how to prepare the Sample(s). This instruction document must be supplied to the AITL.

Products are considered to have failed a Validation Test if:

1. The measured Solar Reflectance as reported by the AITL for the Validation Testing Program differs by more than ±0.05 from the initial rated Solar Reflectance, or
2. The measured Thermal Emittance as reported by the AITL for the Validation Testing Program differs by more than ±0.05 from the initial rated Thermal Emittance for products with an initial emittance of less than or equal to 0.30 or differs more than ±0.10 for products with an initial emittance greater than 0.30.

If the product fails two (2) separate Validation Tests, the product is deemed out of compliance with the requirements of the CRRC Wall Product Rating Program, and the Product Rating will be removed from the CRRC Rated Wall Products Directory on December 31st of the year that the product was selected for Validation Testing.

Licensees are responsible for shipping product Samples to the AITL, giving the AITL enough time to test and submit Validation Test results to the CRRC by the end of the year, including enough time for second tests if necessary. Failure to pass Validation Testing by December 31 can result in the product being permanently removed from the CRRC Rated Wall Products Directory.

See Appendix 3 of this program manual for more detailed information regarding Validation Testing.

CHAPTER 4.0 CRITERIA FOR EXTERIOR WALL PRODUCT LICENSEES

4.1 General

To obtain or maintain an active status as a Wall Licensee with rated Wall Products, the Wall Licensee shall comply with all the conditions and criteria of this chapter and all applicable requirements of the CRRC Wall Rating Program.

A Wall Licensee, as governed by the CRRC Wall Rating Program License Agreement, shall make no representation that it is “approved” or “certified” by the CRRC or that the rated product is approved or certified by the CRRC. The CRRC does not certify or approve products as a part of the Wall Rating Program.

4.2 Compliance with Criteria and Conditions

Compliance by a Wall Licensee with all the criteria and conditions of the CRRC Wall Rating Program shall be subject to review by the CRRC at any time.

4.3 Licensee’s Representative

A Wall Licensee shall designate one or more individuals to be responsible for the proper labeling of CRRC rated products and serve as the primary point of contact for the Wall Rating Program. The Licensee shall notify the CRRC if there are changes to the responsible individual(s).

4.4 Quality Control

The Wall Licensee shall have an appropriate quality control plan in place to ensure its product(s) maintain their Radiative Properties within ±0.05 of those listed for that product(s) on the CRRC Rated Wall Products Directory (i.e., values obtained through testing). A Wall Licensee shall designate at least one employee as the quality control manager at each plant. All quality control records and the quality control plan shall be made available to the CRRC upon written request.

4.5 Initial and Aged Testing Requirements

All products, with the exception of Color Family Additional Elements and Reference Ratings, shall be submitted to an AITL for Initial Radiative Properties testing.

Upon completion of initial testing by the AITL, the product Specimens, along with a Test Farm Notification Form (WF-3), shall be shipped by the AITL to an Approved Test Farm within 30 calendar days of the initial test date where they shall undergo weathering exposure for three (3) years, after which they shall be retested by an AITL in order to determine the Aged Radiative Properties. Color Family Additional Elements may be tested by either an AITL or AMTL and do not undergo three-year weathering. For Compound Ratings, only the product with the lowest Solar Reflectance undergoes weathering.

Testing and weathering exposure shall be performed at the expense of the Wall Licensee.

The Wall Licensee shall be responsible for the selection, sampling, and labeling of products that go through testing for a CRRC product rating according to the provisions set forth in Chapter 3.0 of this manual and Section W.S.2 of ANSI/CRRC S100.

4.6 Product Rating Applications

With the exception of Color Family Additional Elements and Reference Ratings, each Wall Licensee shall have its products' Radiative Properties measured by a CRRC-approved Accredited Independent Testing Laboratory as described in Section 4.5 of this manual. The Wall Licensee shall complete the following steps for each product for which it wishes to obtain a CRRC product rating:

1. Submit a product rating application.
2. Submit payment of the application fee.
3. Submit a Safety Data Sheet, product specification sheet, field application instructions, or other supporting documentation, as applicable.
4. Assign a public contact for the CRRC Rated Wall Products Directory.
5. Denote the Approved Testing Laboratory and Approved Test Farm that will handle testing and Sample exposure for the product, respectively.
6. Provide any other pertinent information relevant to the submission, as applicable or as requested by the CRRC.

4.7 Product Rating Authorization Procedures

(A) Product Rating Authorization: After receiving the required items listed in Section 4.6 above and conducting a review and approval of the test results, the CRRC will notify the Wall Licensee by email regarding the approval of the Rating Authorization. A Notification of Product Rating certificate will be provided by email. Any copy of the Notification of Product Rating certificate shall be reproduced in its entirety.

(B) Reference Ratings (Private-Labeling): A Wall Licensee may apply for a Reference Rating if they are bringing a product to market that contains an existing CRRC-rated component.

For example, the original Manufacturer of an exterior Wall Product, such as a paint producer, may obtain a CRRC product rating for the product, even if they are not the company bringing the product to market. A Wall Licensee that manufactures a final exterior Wall Product using that CRRC-rated component (e.g., paint formulation) may use the original Manufacturer's CRRC rated values for their own CRRC product rating.

Reference Ratings can also be obtained for private labeled products. If one Manufacturer sells a CRRC-rated product to another company to be marketed under a different brand name, the marketer of the private labeled product may use the original Manufacturer's CRRC rated values for their own CRRC product rating.

Any scenario wherein one product's ratings rely on another product's ratings through a Reference Rating application, identical rating values must be used for both the rated products on the CRRC Rated Wall Products Directory and the CRRC Wall Product Label. If the original

Manufacturer's product rating is terminated, all product ratings referencing that rating will also be terminated.

(C) Rating Acquisitions Procedures: When a Wall Licensee (e.g., Company A) acquires another Wall Licensee (e.g., Company B) or its products and wishes to retain the product ratings under Company A's name, Company A must submit a new Product Rating Application for each of Company B's actively rated products in accordance with the procedures in Section 4.6 of this manual. Under normal circumstances, Company A will be able to use the existing Test Results Reports originally obtained by Company B. However, the CRRC reserves the right to require Company A to resubmit products for initial testing, weathering, and aged testing, if warranted, such as in the case where the test method originally used to measure the product is no longer current.

The CRRC will work with the Wall Licensee to ensure that the rated values for the new product listings are correct.

4.8 Formula Change

A Formula Change is defined as a change in the Radiative Properties of a rated product by more than ±0.05 of the Initial Radiative Properties. Any CRRC rated product that undergoes a Formula Change shall obtain a new CRRC product rating and new CRRC Rating Authorization in accordance with the procedures as set forth in Chapter 3.0 and Section 4.6 of this manual. See Appendix 3 of this program for more information about retesting as a result of Validation Testing failure.

To rate a new formulation of a rated product, the Wall Licensee shall have an AITL (or AMTL, as applicable) submit new test results and complete the requirements described in Section 4.6 of this manual. The replacement product shall receive a CRRC product ID number that consists of the ID number for the original formulation followed by a letter suffix. When the test results of the reformulated product are approved by the CRRC, the Radiative Properties of the product shall be listed on the CRRC Rated Wall Products Directory and on the CRRC Wall Product Label. The rating for the previous formulation will remain on the CRRC Rated Wall Products Directory until the Wall Licensee chooses to have it inactivated. The Wall Licensee shall discontinue the use of the CRRC label for any inactivated product.

(A) Reference Ratings: A Wall Licensee with a Reference Rating for a product that undergoes reformulation will be asked to confirm if they wish to transition the Reference Rating to the reformulated product. If the Reference Rating is transitioned to the reformulated product, the Radiative Properties of the Reference Rating displayed on the CRRC Rated Wall Products Directory will be updated to align with the retested values. The Wall Licensee must also transition to using a new CRRC Wall Product Label that displays the retested values.

4.9 Product Retesting Due to Test Method Changes

The CRRC reserves the right to adopt new test methods or substantively revise existing test methods. When the CRRC Board approves a new or revised test method, the previous test method is withdrawn from the Wall Rating Program, which may require some products with existing CRRC ratings to be retested using new product Specimens in accordance with the new or revised test method. The specific retesting requirements will vary depending on the test method adoption or change.

4.10 CRRC Label Requirements

The Wall Licensee shall only use the CRRC Wall Product Label for CRRC rated products in accordance with Chapter 5.0 of this manual.

4.11 Confidentiality

CRRC product rating applications and test results shall be considered confidential and shall not be disclosed by the CRRC except as set forth in this manual, pursuant to legal proceedings or in the context of appeals.

4.12 Inactive and Terminated Product Ratings

The following requirements shall apply to inactivated and terminated products:

(A) A CRRC rated product shall be removed from the CRRC Rated Wall Products Directory for any of the following reasons:

1. Product has been discontinued by the Manufacturer, meaning it is no longer in production or available for purchase.

2. The Manufacturer no longer wishes to maintain a CRRC product rating.
3. The Manufacturer fails to pay renewals fees for the product.
4. The product rating has been terminated by the CRRC for any reason, including Validation Testing failure or failure to comply with CRRC requirements.

(B) Once a product rating is no longer active and listed on the CRRC Rated Wall Products Directory, the Wall Licensee must discontinue use of the CRRC Wall Product Label and CRRC Rated Wall Product Logo in all product packaging, marketing materials, product data sheets, and any and all other digital and print materials containing the CRRC Wall Product Label and/or CRRC Rated Wall Products Logo.

(C) The Wall Licensee must reapply for a reinstatement of an inactivated product. The Wall Licensee must provide a statement that the product formula has not changed or must have the reformulated product retested in accordance with Chapter 3.0 and Section 4.8 of this manual. Any outstanding fees must be paid to the CRRC before the product will be reinstated.

For inactivated products that have not undergone a Formula Change, previous test data may only be used if the previous testing was conducted in accordance with current CRRC testing and weathering requirements, otherwise the product must restart the rating process.

(D) Terminated products are not eligible for reinstatement.

CHAPTER 5.0 CRRC LABEL USE

5.1 General

Use of the CRRC Wall Product Label, as governed by the CRRC Wall Rating Program License Agreement, is permitted solely for products that meet the CRRC Wall Rating Program requirements and for which a CRRC Rating Authorization has been issued.

5.2 Licensed Use of the CRRC Wall Product Label

The following requirements shall be met when using the CRRC Wall Product Label:

(A) The graphic format shall be as shown in the Wall Rating Program License Agreement.

(B) The CRRC Wall Product Label shall be used only for Wall Products that have been determined by the CRRC to meet the CRRC Wall Rating Program requirements.

(C) The CRRC Wall Product Label shall be clearly visible when placed on one or more of the following:

1. The rated Wall Product.
2. The packaging, wrapping or container for the rated Wall Product.
3. The bill of lading or other documentation that accompanies the delivery of the Wall Product to the user.
4. Marketing materials for the Wall Product.

(D) When used in product marketing or informational materials for multiple products, the CRRC Wall Product Label shall be placed adjacent to the specific Wall Product that received the CRRC Rating Authorization.

5.3 Reproduction of Label

The CRRC will provide the CRRC Wall Product Label to the Wall Licensee upon request. The label is available in color and in grayscale. Reproduction of the label shall meet the following requirements:

(A) Not be smaller than the CRRC Wall Product Label provided to the Wall Licensee.

(B) Meet the same proportions of the CRRC Wall Product Label provided to the Wall Licensee, if the Wall Licensee wishes to increase the size of the CRRC Wall Product Label.

(C) Include the Radiative Properties as issued by the CRRC.

(D) Not be altered or modified in any way.

CHAPTER 6.0 REVOCATION OR CLOSING FILES

6.1 Scope

The CRRC shall have the authority to revoke or modify for cause (including but not limited to imposition of further conditions) any license and/or product rating granted under the CRRC Wall Rating Program. “Cause” shall include:

(A) Failure of the material to conform to the rating upon which the Rating Authorization was based.

(B) Failure of the material, and/or method of manufacturing, to remain consistent.

(C) Failure to comply with any condition or rule of the CRRC Wall Rating Program.

(D) Any intentional misstatement in the application or any inaccurate data knowingly submitted in support thereof.

(E) Failure to comply with any provision in the Rating Authorization, Wall Rating Program License Agreement, and/or Approved Manufacturing Testing Laboratory License Agreement.

(F) Any other ground considered as adequate cause in the judgment of the CRRC whether of the same or a different type than listed above.

Upon revocation of the license, the terminated Licensed Party must discontinue use of the CRRC Wall Product Label, CRRC Rated Wall Product Logo, CRRC Accredited Laboratory Logo, or CRRC Test Farm Logo, where applicable.

6.2 Reinstatement

(A) Licensed parties that are terminated as a result of nonpayment of annual CRRC renewal fees may be reinstated if the necessary fees are paid within the same calendar year. At the end of the calendar year, reinstatement is subject to item (B).

(B) The submission for license reinstatement shall be in accordance with the requirements stipulated in Chapter 4.0 (Licensees) or Chapter 2.0 (approved test labs) of this manual.

(C) Reinstatement of a product rating is subject to the provisions in Section 4.12 of this manual; terminated products are not eligible for reinstatement. The decision to reinstate an inactivated product may be subject to review by the CRRC Board.

6.3 Consultation

Prior to the CRRC acting on the closing of files, the holder of the CRRC license shall be given reasonable notice and an opportunity to be heard in accordance with Section 7.2 of this manual.

CHAPTER 7.0 COMPLAINTS

7.1 Purpose

These rules establish procedures for complaints regarding CRRC licenses and Wall Product ratings.

7.2 Pre-Action Procedures

Any party shall be afforded the opportunity to discuss, clarify, and resolve disagreements with respect to cited disputes concerning actions by the CRRC or by a Licensed Party regarding licensure and labeling policies and procedures prior to that party submitting a complaint.

7.3 Submission

Any person may submit a written complaint to the CRRC. Complaints shall be directed to CRRC headquarters, and shall include the following information:

(A) The name(s) and address(es) of the submitter(s), telephone, and email contact information;

(B) description of the complaint;

(C) relevant information to support the complaint; and

(D) a filing fee to be determined by the CRRC Board. In the event of a complaint regarding inaccuracy of a product rating, the complainant shall pay a filling fee that includes the cost of obtaining and testing the product Sample.

The CRRC reserves the right to request further information or written clarification.

7.3.1 Notification

Upon receipt of the complaint, the CRRC shall forward a notice indicating receipt of the submission,

an action plan that further identifies cost and timeline for resolving the complaint, and shall assign the submission a file number. Any Licensed Party who is the subject of the complaint shall be provided with a copy of the notice.

7.3.2 Review

The CRRC may take such action as it deems appropriate, in its sole discretion, to address complaints pertaining to the CRRC Wall Product Rating Program and participation thereof. In the event of a complaint regarding inaccuracy of a Wall Licensee's product rating, the CRRC will obtain a product Sample and shall perform testing in accordance with the Validation Testing procedures (see Challenge Testing, Appendix 3 of this program manual). In the event the product rating was inaccurate, the Wall Licensee shall pay the CRRC the amount of the filing fee and the complainant shall have its filing fee refunded.

The CRRC shall notify the complainant of the CRRC's decision by certified mail, return receipt requested, or other method, which provides evidence of, and a receipt for, delivery.

7.3.3 Responsibility of Licensed Parties and Complainants

The Licensed Party and complainant shall keep a record of all complaints made known to it relating to compliance with rating requirements and makes these records available to the CRRC when requested and:

(A) Takes appropriate action with respect to such complaints and any deficiencies found in products that affect compliance with the requirements for CRRC rating;

(B) Documents the actions taken; and

(C) Informs the CRRC, without delay, of changes that may affect its ability to conform with the CRRC's requirements.

CHAPTER 8.0 APPEALS

8.1 General

Any Licensed Party (appellant) aggrieved by any determination by the CRRC pursuant to Chapter 6.0 of this manual who chooses to appeal shall do so within 20 business days of the date of receipt of said written determination or order.

8.2 Submission

Appeals shall be submitted in writing, directed to the CRRC Board Chairperson, addressed to the CRRC headquarters, and shall include the following information:

(A) The name and address of the appellant, telephone, and email contact information, and the name and address of legal counsel if the appellant desires to have representation;

(B) description of the product under appeal,

(C) description of the issue being appealed;

(D) statement of reasons for appeal; and

(E) relevant evidence and supporting data or information.

The CRRC reserves the right to request further information or a written clarification from the appellant, and shall extend the appeal review if, in the opinion of the CRRC, the content of the additional information or written clarification is of substance to warrant additional time.

8.3 Notification

Upon receipt of the appeal, the CRRC shall assign a file number. All future correspondence to and from the CRRC shall reference the file number. The appellant shall be notified of any associated hearings convened by the CRRC Board.

8.4 Appeal Review

The CRRC shall, upon receipt of a completed submission, evaluate the appeal and render a decision of the matters in dispute within 20 business days of receipt of the completed submission or within 20 business days of a hearing if one is convened. The decision to hold a hearing shall be at the discretion of the CRRC Board. The CRRC reserves the right to extend the time of review if the CRRC determines that there is sufficient cause. The CRRC shall notify the appellant of its decision by certified mail, return receipt requested, or other method, which provides evidence of, and a receipt for, delivery.

CHAPTER 9.0 ARBITRATION

9.1 General

If the appellant disputes the decision of the CRRC under Chapter 8.0 of this manual, the appellant has the right to appeal solely through arbitration. The appellant shall notify the CRRC of a request for arbitration in writing within 20 business days of receipt of the written appeal review decision. The request shall include the following information:

(A) The name(s) and address(es) of the appellant(s), telephone, and email contact information, and name and address of legal counsel if the appellant desires to have said representation;

(B) description of the product subject to the arbitration,

(C) description of the issue being arbitrated;

(D) statement of reason for the arbitration;

(E) relevant evidence and supporting data or information; and

(F) concise statement of its rebuttal position(s).

9.2 Arbitration Method

The arbitration shall consist of one of the following methods:

(A) A single arbitrator selected jointly by the appellant and the CRRC to investigate and resolve the matter, or

(B) The CRRC and the appellant shall use the American Arbitration Association's procedures for the selection of a single arbitrator from a list of seven candidates, with each party having the right to strike three.

9.3 Cost

The appellant shall be responsible for all time and expense costs incidental to the arbitration proceedings.

9.4 Hearing

The hearing may be conducted under the American Arbitration Association procedures for arbitration if requested by either party. Unless otherwise agreed upon by all parties, the arbitrator(s) shall issue a written decision within 15 business days of the hearing or of the final written submission.

APPENDIX 1: COLOR FAMILY POLICIES AND PROCEDURES

1.0 Scope

These procedures describe the process to establish a Color Family Group (also see W.S.3.3 of ANSI/CRRC S100) for a given Architectural Coating Wall Product or Factory-Applied Coating Wall Product Product Line through the CRRC Color Family Program and the subsequent inclusion of Color Family Additional Elements to a Color Family Group. This procedure is limited to Architectural Coating Wall Products and Factory-Applied Coating Wall Products, which have thousands of color options available to consumers, making it cost-prohibitive for Wall Licensees to seek Standard Product Ratings on every available color.

A Wall Licensee that manufactures or sells Architectural Coating Wall Products or Factory-Applied Coating Wall Products may also rate products using the Standard Wall Product rating at any time; the Color Family procedures are an optional pathway to streamline the rating process for hundreds or thousands of colors.

2.0 Approved Manufacturer Test Laboratories

The test results for Color Family Additional Elements may be submitted to the CRRC by an Approved Manufacturer Testing Laboratory (AMTL) or an Accredited Independent Testing Laboratory (AITL).

All AMTLs are subject to the requirements described in Chapter 2.0 of this manual. The CRRC will not accept test results for Color Family Representative Elements or for Standard Products from an AMTL, only an AITL.

3.0 Establishing a Color Family Group

Multiple Color Families are defined within the L,a,b color space, using Hunter coordinates for Factory-Applied Coating Wall Products or CIE coordinates for Architectural Coating Wall Products. The Color Families are defined in Table 1 and Table 2, below. A Wall Licensee may elect to establish one or more Color Family Groups within a Color Family. All members of a Color Family Group must be a part of the same Product Line and fall within the same Color Family parameters shown in Table 1 or Table 2. If a product falls outside the L,a,b ranges provided in Table 1 and Table 2, the product must be rated as a Standard Wall Product. Only one gloss level needs to be submitted for testing for products that are available in multiple gloss levels.

3.1 Rating Process for Establishing a Color Family Group

1. The Wall Licensee will submit product testing data for all products in the Color Family Group, whether tested by an AITL or AMTL. The CRRC will review the product data and select the product that will act as the Color Family Representative Element for the establishment of a Color Family Group. The Color Family Representative Element must have the lowest Solar Reflectance of all of the products that will be included in the Color Family Group. If more than one product has the lowest Solar Reflectance, the product that has the lowest Thermal Emittance will be the Representative Element. If more than one product has the lowest Solar Reflectance and Thermal Emittance, the product with the lowest L value will be the Representative Element.
    a. Note: The product with the lowest Solar Reflectance typically correlates to the product with the lowest Light Reflectance Value (LRV) and highest pigment loading in that Color Family.
2. The Wall Licensee shall prepare the appropriate number of Specimens of the Representative Element, following the requirements described in Section W.S.3.3 of ANSI/CRRC S100 and submit the Specimens to an AITL for testing.

3. The AITL shall conduct Solar Reflectance, Thermal Emittance, and colorimetry testing and report the results in accordance with Section W.S.2 of ANSI/CRRC S100.
4. The CRRC will review the initial test results. As soon as the initial test results are approved by the CRRC, a unique CRRC ID number will be assigned to the product and the product rating will be appear on the Directory. If Color Family Additional Element applications were submitted at the same time as establishing the Color Family Group, the CRRC will review and approve those applications at this time. The Wall Licensee is also eligible to submit additional Color Family Additional Element ratings, as described below.
5. After the AITL submits the test results to the CRRC, the AITL shall send the Specimens to an Approved Test Farm for three-year natural exposure in accordance with Chapter 3.0 of this manual and Section W.S.2 of ANSI/CRRC S100.
6. The remainder of the rating process shall follow the process for a Standard Product rating.

4.0 Submitting Color Family Additional Elements

A Wall Licensee may submit Color Family Additional Elements to an established Color Family Group after the CRRC has approved the initial test results for the Color Family Representative Element that has established that Color Family Group.

4.1 Rating Process for Adding Additional Elements to a Color Family Group

1. The Wall Licensee shall prepare the appropriate number of Additional Element Specimens in accordance with Section W.S.3.3 of ANSI/CRRC S100 of this manual.
2. Either an AMTL or AITL shall conduct colorimetry testing as described in Section W.S.3.3 of ANSI/CRRC S100. If the product does not fall within the Color Family L,a,b ranges for the established Color Family Group, the product is not eligible for a Color Family rating; it will need to be rated as a Standard Product.
3. Either the AMTL or AITL shall conduct initial Solar Reflectance and Thermal Emittance testing and report the results in accordance with Chapter 3.0 of this manual and Section W.S.2 of ANSI/CRRC S100. For Architectural Coating products, Thickness testing must also be conducted in accordance with
   Chapter 3.0 of this Manual and Section W.S.2 of ANSI/CRRC S100. The initial tested Solar Reflectance of the Color Family Additional Element shall be equal to or greater than the initial Solar Reflectance of the Color Family Representative Element.
   a. Note: If the Solar Reflectance of the Color Family Additional Element does not meet or exceed the initial Solar Reflectance of the Color Family Representative Element, the Additional Element is not eligible for inclusion in the Color Family Group.
4. If all requirements are met, the Additional Element will be added to the Color Family Group on the Directory. Once approved by the CRRC, the measured initial Solar Reflectance and Thermal Emittance values of the Additional Element will be published on the Directory. The Additional Element will inherit the aged Solar Reflectance and Thermal Emittance values of the Representative Element.

Table 1. Wall Rating Program Color Families for Architectural Coating Wall Products

Color Family Name	Typical LRV Ranges*	CIE L range	CIE a range	CIE b range
Muted Dark Colors	0 to 14.99	0 to 45	-14.99 to 19.99	-15.99 to 24.99
Muted Medium Colors	15 to 35	45.1 to 65	-14.99 to 19.99	-15.99 to 24.99
Blues	4 to 35	25 to 65	-50 to 19.99	-100 to -16
Muted Yellows & Greens	15 to 45	25 to 65	-14.99 to 19.99	25 to 49.99
Bright Yellows & Oranges	25 to 85	55 to 100	-50 to 50	50 to 100
Greens	5 to 35	25 to 65	-100 to -15	-15.99 to 49.99
Reds & Purples	5 to 35	25 to 65	20 to 100	-40 to 50
Pastels (Medium)	33 to 60	65.01 to 79.99	-50 to 49.99	-35 to 49.99
Pastels (Light) and Whites	54 to 100	80 to 100	-35 to 35	-35 to 49.99

*** For Reference Only**

Table 2. Wall Rating Program Color Families for Factory-Applied Coating Wall Products

Color Family Name	Hunter L range	Hunter a range	Hunter b range
Red	17 to 29	7 to 36	0 to 15
Terra Cotta	20 to 38	15 to 30	6 to 16
Bright Red	23 to 38	35 to 49	10 to 48
Beige / Off-White	59 to 86	-5 to 5	-3 to 23
Tan	51 to 65	-2 to 7	6 to 21
Dark Blue	13 to 35	-7 to 6	-25 to -2
Medium To Light Blue	34 to 55	-12 to -3	-25 to -8
Dark Brown	17 to 30	-1 to 9	0 to 10
Medium To Light Brown	25 to 58	-2 to 17	2 to 26
Dark Green	18 to 45	-20 to -3	-25 to 11
Medium To Light Green	24 to 70	-20 to 0	-25 to 11
White	76 to 89	-3 to 2	-3 to 10
Bright White	>85	-3 to 1	-3 to 6
Black	<26	-1.5 to 1.5	-1.5 to 1.5
Dark Grey	24 to 42	-4 to 2	-8 to 4
Medium To Light Grey	40 to 77	-4 to 3	-3 to 8
Pearlescent Colors	25 to 75	-15 to 17	-15 to 24

APPENDIX 2: STANDARD TEST METHOD FOR DETERMINING THE DIRECTIONAL-HEMISPHERICAL SOLAR REFLECTANCE OF MATERIALS USING A DIRECTIONAL-HEMISPHERICAL PORTABLE REFLECTOMETER

1. Scope

1.1. This test method covers a technique for determining the directional-hemispherical Solar Reflectance of materials in a laboratory or on-site using a commercial portable Reflectometer. The purpose of the test method is to evaluate the reflectance properties of surfaces exposed to solar radiation.

1.2. This test method is applicable to Specimens of materials having both specular and diffuse optical properties.

1.3. This technique is supported by comparing Reflectometer measurements with those using ASTM E903-12 test method for Solar Reflectance using integrating spheres.

1.4. This test method refers to applications using standard solar spectral irradiance functions but may be applied using alternative weighting functions if the source and details are reported.

1.5. *This standard does not purport to address the safety concerns, if any, associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and determine the applicability of regulatory limitations.*

2. Referenced Documents

2.1. ASTM Standards:

2.1.1. C1549-16 Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer

2.1.2. C1864-17e1 Standard Test Method for Determination of Solar Reflectance of Directionally Reflective Material Using Portable Solar Reflectometer

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

2.1.4. E490-00a (2019) Standard Solar Constant and Zero Air Mass Solar Spectral Irradiance Tables

2.1.5. E891-92 Tables for Terrestrial Direct Normal Solar Spectral Irradiance Tables for Air Mass 1.5

2.1.6. G173-03 (2020) Standard Tables for Reference Solar Spectral Irradiances: Direct Normal and Hemispherical on 37° Tilted Surface

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

2.2. Additional References:

2.2.1. Levinson, R.; Akbari, H.; Berdahl, P.; “Measuring Solar Reflectance-Part I: Defining a metric that accurately predicts solar heat gain,” *Solar Energy* **84**, 1717-1744 (2010).

2.2.2. Gueymard, C.; “Simple Model of the Atmospheric Radiative Transfer of Sunshine (SMARTS) 2.9.5.” <http://www.nrel.gov/grid/solar-resource/smarts.html>.

3. Terminology

3.1. Definitions – The definitions in ASTM C1549-16, ASTM E903-12, and Levinson *et al.* (2010) are applicable to this method.

3.2. Definitions of terms specific to this standard:

3.2.1. Directional-hemispherical reflectance – ratio of the total energy reflected into the subtending hemisphere to the energy incident on the surface from a given direction.

3.2.2. Directional-hemispherical in-band reflectance – directional-hemispherical reflectance for a given wavelength band (i.e., measured by a given detector).

3.2.3. Solar spectral irradiance – power of electromagnetic radiation received from the Sun per unit area as a function of wavelength.

3.3. Symbols:

3.3.1. λ – Wavelength of light, nm.

3.3.2. R_{solar} – Directional-hemispherical Solar Reflectance, dimensionless.

3.3.3. $R_{in\text{-}band,j}$ – Directional-hemispherical in-band reflectance measured by detector *j*, dimensionless.

3.3.4. $\rho(\lambda)$ – Directional-hemispherical spectral reflectance, dimensionless.

3.3.5. $\imath(\lambda)$ – Solar spectral irradiance, $W/m^2 \cdot nm$.

4. Summary of Test Method

4.1. This test method uses a commercial portable Reflectometer to characterize the directional hemispherical Solar Reflectance of a material. The test Specimen is illuminated at 20° from normal and the directional-hemispherical reflectance is measured in seven wavelength bands from approximately 335 to 2,500 nm utilizing an integrating sphere equipped with an array of detectors and filters.

4.2. The instrument's software calculates the directional-hemispherical Solar Reflectance or absorptance by taking a weighted average of the directional-hemispherical in-band reflectances using a standard or custom solar spectral irradiance as the weighting function.

5. Significance and Use

5.1. Exposure to solar radiation is primary concern for construction materials, aerospace vehicles, solar power devices, and any application where a surface is exposed to solar radiation. The property called "Solar Reflectance" is defined as the fraction of incident solar radiation reflected by a surface.

5.2. This test method is designed to provide reproducible data on-site or in the lab. Use this method to compare results among laboratory or on-site facilities, compare results from different times by the same facility, or compare data obtained on different materials. This method can be used to monitor changes in directional-hemispherical Solar Reflectance due to aging, exposure, or other dynamic processes.

5.2. Directional-hemispherical Solar Reflectance affects the heat balance of the building envelope and the performance of solar energy systems, including photovoltaic devices and solar thermal energy collectors.

5.3. Directional-hemispherical Solar Reflectance is critical for the thermal control of spacecraft and the solar power of extraterrestrial systems.

5.4. This test method provides a means for determining directional-hemispherical Solar Reflectance for both terrestrial and extraterrestrial conditions using either standard solar spectral irradiance or alternative weighting functions.

5.6. This test method is appropriate for smooth and rough materials having both specular and diffuse optical properties. Some structured anisotropic materials may require special consideration because of the azimuthal angular dependence of the reflectance. For such cases, an average directionalhemispherical Solar Reflectance can be determined by making measurements at several orientations (refer to ASTM C1864-17).

6. Apparatus

6.1. This test method applies to directional-hemispherical Solar Reflectance determination with a commercial portable Reflectometer. The instrument utilizes the principles of an integrating sphere for performing optical reflectance measurements in the spectral region of 335 to 2,500 nm. The instrument consists of two units, the Measurement Head and the Command Module (Fig. 1).

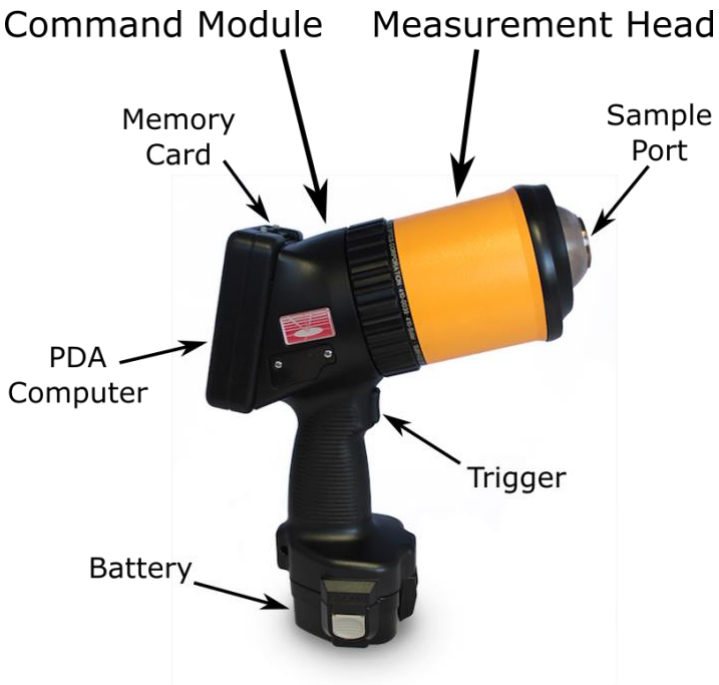

Figure 1. 410-Solar-i Reflectometer by Surface Optics Corporation

6.1.1. Measurement Head – The Measurement Head is constructed around an integrating sphere for measurements of directional-hemispherical reflectance. Light from a tungsten halogen lamp enters the integrating sphere through an internal beam port and illuminates the test Specimen at the sample port at a 20° angle of incidence. The test Specimen scatters light back into the integrating sphere where it is uniformly diffused. A portion of the light reaches the detector arrays which are used to measure the directional-hemispherical in-band reflectance. Optical filters and detector arrays cover seven spectral bands in the wavelength range of 335 to 2,500 nm (335-380, 400-540, 480-600, 590-720, 700-1,100, 1,000-1,700, and 1,700-2,500 nm). A rubber ring protects the measured surface from contact with the metal surface of the integrating sphere and provides a non-skid surface to press against the sample surface.

6.1.2. Command Module – The Command Module provides computer processing, electrical power, and structural support for the Measurement Head. The Command Module housing contains the Trigger, Battery Cartridge, a small Personal Digital Assistant (PDA) type computer, Light Emitting Diode (LED) & Vibrator Motor indicators, Secure Digital (SD) card port, Measurement Head mechanical and electrical

connections, Input/Output port, and safety strap. The computer is located at the top of the handle with a touch screen display that faces the user during operation. The user controls the unit by selecting various software functions from the touch screen interface and pressing the trigger when a measurement is to be made.

6.2. Calibration Coupons – Calibration of the Reflectometer is accomplished with a manufacturer-supplied calibration coupon. The reflectance values of the provided coupon are stored on the supplied SD card. Zero reflectance is measured with no sample present at the sample port of the integrating sphere. The Measurement Head must be pointed away from artificial light sources, such as fluorescent lighting, during the Zero measurement.[i] During the calibration process (and during each sample measurement cycle), the instrument automatically makes an additional measurement of the light beam reflected off a specific location on the wall of the integrating sphere. A ratio of the electrical signal generated by the detector when the beam illuminates the sample to that when the beam illuminates the reference point on the integrating sphere is used in the calculation of sample reflectance values. This normalization process eliminates most of instrument drift that might be caused by thermal or electrical system instabilities.

6.3. Test Specimens – Specimens to be tested can be flat, concave (inner diameter larger than 15 cm), or convex (outer diameter larger than 8 cm), and may have specular or diffuse characteristics. The sample is illuminated with an elliptical spot of about 12 mm at the major axis and 6 mm at the minor axis. The sample port of the integrating sphere is pressed flush against the measured surface, which must have a minimum dimension of 13 mm.

7. Procedure

7.1. Setup – The instrument is powered from a 12 volt battery. The battery must be charged in the manufacturer-supplied battery charger prior to first use. The battery is inserted in the bottom of the Command Module by the user. The instrument is powered up by pressing the trigger located at internal top of the handle. The instrument boots to the Main Operation menu displayed on the computer screen. The user can adjust various parameters through the **Setup** menu. The instrument shall be calibrated after at least 5 min. of warm-up time.

7.1.1. Calibration Setup – The **Calibration Setup** menu contains the known reflectance values of the calibration coupon. These values are provided by the manufacturer and must match the supplied calibration coupon.

7.1.2. Device Setup – The **Device Setup** menu contains various device parameters which alter the performance conditions of the instrument. The factory settings are appropriate for most measurements. Most commonly, the user might adjust Points (number of readings averaged during one measurement), Cal X (number of repetitions during calibration procedure), and Sample X (number of measurements used to generate statistics).

7.2. Calibration – From the main menu, press **Calibration** to display the Calibration screen. The computer screen guides the user through the calibration process using the calibration coupon. The coupon requires a set of calibration values, which are entered under the Calibration Setup menu and are stored in a file on the SD card. The name of the current calibration file is displayed at the top of the calibration screen. To select a different calibration file, press the button with the calibration name, make selection. Remove the sample port cap from the integrating sphere and hold the calibration coupon flat against the sample port and press the trigger. Continue to hold the coupon over the sample port during the measurement. The LED and vibrator motor will indicate that the measurement step is complete. Remove the calibration coupon from in front of the sample port and press the trigger with nothing blocking the sample port (do not aim at fluorescent lights). The LED and vibrator motor will indicate that the calibration is complete. Press the back arrow at the bottom of the screen to return to the Main Menu. Repeat the calibration procedure every time the instrument is turned on and after extreme changes in the environment (e.g. temperature, humidity).

7.3. Measurement – Press the **Measurement** button on the Main Menu screen. All data taken with the 410-Solar-i are saved into a data file (*.ems) and stored on the SD card. The file name is displayed on the grey button under the screen title. The sample name is indicated on the second button. To change the file name and/or the sample name press the appropriate button. The software keeps a list of the data files on the card. Take the unit to the surface to be tested. Press the sample port tight against the measured object and press the trigger. Continue to hold the sample port against the measured surface while the measurement is taken and the hourglass indicator is shown. To indicate that the measurement is finished, the hourglass will disappear, the LED in the upper left-hand corner of the PDA housing will light, and the handle will vibrate. The measurement results are saved and displayed in a column on the PDA screen. The graphical representation of the data can be viewed by pressing the Graph button. Each reflectance value is plotted at the measured value across the entire spectral band. The instrument can be pre-set to display either directional-hemispherical Solar Reflectance or absorptance, this setting is done in the Device Setup. To view the directional-hemispherical Solar Reflectance value, press the ρ (rho) button at the bottom of the screen. Under that screen the solar spectral irradiance can be selected.

7.4. Calculation – Before a test is performed, press the small button marked "[n]x" to enter the number of readings to be performed and averaged. Upon completion of the first reading, the color of the [n]x button changes from black to red, the number of measurements is lowered by 1, and the reflectance values and directional-hemispherical Solar Reflectance are displayed. Continue taking measurements until the color of the button changes back to black. The screen will then display a column of averaged reflectance values and the standard deviation for each of those values. The averaged directional-hemispherical Solar Reflectance and its standard deviation are also displayed. All values are automatically stored on the SD card.

7.5. Directional-Hemispherical Solar Reflectance – The instrument measures the directionalhemispherical reflectance of a test Specimen in each of the seven spectral bands listed in Section 6.1.1. Directional-hemispherical spectral reflectance ρ(λ) is estimated as a simple step function from the seven directional-hemispherical in-band reflectances. Directional-hemispherical Solar Reflectance R_{solar} is computed as the weighted average of the directional-hemispherical spectral reflectance, where the solar spectral irradiance ı(λ) is the weighting function. That is,

$$R_{solar} = \frac{\int_{\lambda_1}^{\lambda_2} \rho(\lambda) \times i(\lambda)\, d\lambda}{\int_{\lambda_1}^{\lambda_2} i(\lambda)\, d\lambda} \quad (1)$$

where the limits 1 and 2 are 250 and 2,500 nm. Note, the reflectance from 335 nm is linearly extrapolated out to 250 nm for this calculation.

7.5.1. Solar Spectral Irradiance – The user can select one of the standard solar spectral irradiances provided with the instrument or their own custom weighting function via the **Solar Irradiance** drop-down menu located in the **Directional-Hemispherical Solar Reflectance** screen. Standard solar spectral irradiances are denoted using the same initialism as Levinson *et al.* (2010). For terrestrial applications use E891BN (ASTM E891-92), AM1GH (Gueymard, 2006), G173GT (ASTM G173-12), G197GT20 (ASTM G197-14), G197GT90 (ASTM G197-14), or AM1.5GH (Gueymard, 2006). For extraterrestrial applications use AM0 (ASTM E490-14). Custom weighting functions are added as a *.jfn file to the **Program** directory on the SD card.

7.6. Evaluation of a Surface – Quantify the variability of the directional-hemispherical Solar Reflectance with position on a test Specimen by measuring three or more locations on the surface.

8. Report

8.1. Reporting requirements shall be in accordance with ASTM C1549.

9. Precision and Bias

9.1. Precision – Precision statistics were determined for SOC 410-Solar-i portable Reflectometer measurements of the 26 materials shown in Table 1. The samples include roofing materials and paints. Here, “panel” refers to a smooth rectangular metal sheet as the base material and “shingle” refers to a rough rectangular felt mat as the base material. Based on the standard deviation of those measurements, the precision was found to be within 0.02 reflectance units (scale of 0 to 1).

9.2. Bias – Directional-hemispherical Solar Reflectance values calculated using the air mass 1.5 global tilt solar spectral irradiance specified by ASTM G173-12 were obtained for 26 materials using ASTM E903-12. These measurements were used to assess the bias of the SOC 410-Solar-i from ASTM E90312 which is shown in Table 1. The 410-Solar-i test method yields directional-hemispherical Solar Reflectance results that are 0.004 higher than those obtained with ASTM E903-12.

Table 1. Comparison of directional-hemispherical Solar Reflectance measurements on 26 samples using the SOC 410-Solar-i portable Reflectometer and a spectrophotometer operated according to E903-12. Directional-hemispherical Solar Reflectance values are calculated using the air mass 1.5 global tilt solar spectral irradiance specified by ASTM G173-12.

Coating	Cary 5000i	410-Solar-i
White Knight Plus on Panel	0.82	0.82
White Knight Plus on Shingle	0.80	0.80
Pyramic on Panel	0.82	0.80
Pyramic on Shingle	0.82	0.81
White Coating	0.84	0.84
TPO	0.77	0.76
Beige Acrylic	0.69	0.70
Aluminized Shingle	0.64	0.64
EPDM	0.16	0.15
Shingle	0.17	0.17
Silver Shadow	0.27	0.28
Red Metallic	0.45	0.46
Duke Blue	0.30	0.31
Saffron Metallic	0.49	0.50
Ultra Cool Pewter	0.41	0.43
Russet Metallic	0.29	0.30
Nike Orange	0.51	0.53
Sandstone	0.58	0.58
Copper	0.43	0.44
Aged Copper	0.29	0.30

Zinc Yellow	0.66	0.68
Matte Black	0.09	0.09
Decisive Yellow	0.71	0.73
Seekonk Purple	0.24	0.23
Regal White	0.73	0.73
Weathered Zinc	0.29	0.30

10. Keywords

10.1. portable; handheld; Reflectometer; solar; spectral; reflectance; directional; hemispherical; ultraviolet; visible; near infrared;

11. Suitable Practices

11.1. Do not overreach. Always keep proper footing and balance.

11.2. Be sure that no one is below when using the unit in high locations.

11.3. Use of the lanyard is encouraged but do not carry the unit using only the lanyard.

11.4. Do not drop, shake, or strike the unit.

11.5. Do not remove the two screws in the factory diagnostics port cover. Removal of the screws or cover or accessing the port will void the warranty.

11.6. Be careful not to scratch or physically damage the screen.

11.7. Protect against electrostatic discharge.

11.8. Do not store at temperatures below -25 °C (-13 °F) or above 70 °C (158 °F).

11.9. Warm unit to at least 0 °C (32 °F) for two hours before using if stored below 0 °C (32 °F).

11.10. Do not operate at ambient temperatures below 0 °C (32 °F) or above 50 °C (122 °F).

11.11. The integrating sphere is a critical component of the instrument. Care should be taken to avoid contaminating the integrating sphere. When possible, make measurements pointing the Reflectometer downwards.

11.12. Replace the sampling port cap when not taking measurements to minimize contamination of the integrating sphere.

11.13. Use the storage container or another airtight barrier when not in use.

11.14. Avoid working in heavy fog, snow, or rain, or under conditions of blowing dust.

11.15. Avoid placing the 410 on any surface covered with movable dust or dirt, such as the ground or floor.

11.16. Do not put any objects or solvents inside the integrating sphere. Do not blow air into the integrating sphere including electronics cleaning products.

11.17. The surface of the calibration coupon should be protected from scratches and contamination. Do not touch the surface of the calibration coupon.

11.18. Always cover the calibration coupons and put away immediately after calibration is complete. Replace the calibration coupon if it becomes damaged or contaminated.

[i] A chopper modulates the light source at ~100 Hz. The electrical signals generated by the detector are filtered via lock-in amplification such that the only signals extracted are those modulating at the reference frequency (100 Hz). Artificial light sources, such as fluorescent lighting, can flicker close to this frequency and contribute to the measurement.

APPENDIX 3: VALIDATION TESTING PROCEDURES

Purpose

Section 3.10 of the CRRC-2 Wall Product Rating Program Manual calls for validation testing of actively rated products in order to verify the values and retain the credibility of the CRRC Rated Wall Products Directory. This document describes the policy and procedures of the CRRC Validation Testing Program.

Validation Testing Policy

This section describes the requirements for Licensees with active product ratings on the CRRC Rated Wall Products Directory whose products are due for Validation Testing.

1. The Validation Testing Program is conducted on a calendar-year schedule and is expected to be completed by the end of the calendar year.
2. At the start of each Validation Testing Program cycle, the Licensee must submit their decision through the CRRC Online Rating Portal (Portal) for each product due for Validation Testing to determine if a product will proceed with testing, voluntarily terminate, or proceed with a Formula Change or Retesting application to replace the existing product.
3. For products proceeding with Validation Testing, the CRRC will designate the AITL that will receive the test specimens (Specimens) for Validation Testing. The Licensee is required to ship the Specimens to the AITL within 10 to 15 business days of CRRC assignment.
4. It is the responsibility of the Licensee to initiate Validation Testing at the beginning of each year, providing adequate time for the AITL to submit Validation Testing test results to the CRRC prior to the end of the year, including second tests, if required. Failure to have passing Validation Testing results can result in the product's permanent removal from the CRRC Rated Wall Products Directory at the end of the year (December 31).

Validation Testing Procedures

Selection of Rated Wall Products for Validation Testing

Products with active CRRC ratings will be due every seven (7) years for Validation Testing with the exception of Reference products. Reference products are excluded from Validation Testing because they are indirectly subjected to Validation Testing through the parent product. The CRRC will terminate any product listed on the CRRC Rated Wall Products Directory that has not completed and passed Validation Testing every seven (7) years.

Products shall undergo Validation Testing by a CRRC-designated AITL approved to conduct testing for the Wall Program.

Products may also be manually selected for Validation Testing through Challenge Testing to address a specific need, or in response to a concern or formal complaint as outlined in Chapter 7 of the CRRC-2 Wall Product Rating Program Manual.

The Licensee has the option to re-rate a product that is due for Validation Testing without going through the Validation Testing process. If the Licensee chooses to re-rate the product without going through Validation Testing, the Reformulated or Retested Product Rating Procedure shall be followed in accordance with section 4.8 of this manual. The existing rating may be retained until the new rating is published or until the December 31 of the Validation Testing year, whichever is sooner.

Laboratory Selection and Testing Process

1. Each year, the CRRC will send all AITLs an invitation to participate in the Validation Testing Program; AITLs may opt out of participating.
2. For AITLs that confirm their participation, they:
    a. Are approved to test products for the Wall Program,
    b. Agree to test products for the Validation Testing Program for a predefined, negotiated price per product that may vary by product type, and
    c. Will be assigned products by the CRRC based on laboratory availability on a rotating basis. To increase efficiency and prevent delays, the CRRC will refrain from assigning new products to the same AITL if the AITL has not submitted Validation Testing results for previously assigned products.
3. The CRRC will inform the AITL when a product has been assigned to be shipped to them.
    a. The AITL should expect to receive the Validation Testing product from the Licensee within approximately 15 days of being notified.
    b. If the AITL has not received the Validation Testing product within approximately 15 days of being notified, they should contact the CRRC.
4. The AITL shall inspect the Validation Testing package upon receipt to ensure that the Validation Testing samples were not damaged during shipping, Validation Testing samples are properly labeled, and confirm that a copy of the Sample Tag and brief preparation instructions are enclosed.
    a. If the Validation Testing samples have been damaged during shipping, incorrectly or not labeled, or the package does not contain a copy of the Sample Tag or brief preparation instructions, the AITL shall notify the CRRC immediately.
5. The AITL is required to photograph Specimens of all products undergoing Validation Testing. The photographs shall be uploaded to the CRRC Online Rating Portal, along with the test results.
6. CRRC-designated AITLs must conduct testing of the Validation Testing specimens according to the most current CRRC approved test methods and report the test results via the CRRC Online Rating Portal within four (4) weeks of receipt of the Specimens.
7. The AITL will directly invoice the CRRC at the predetermined negotiated amount per product.
8. The CRRC will review the Validation Test Results prior to paying the AITL invoice.
9. The AITL is required to hold the Specimens for at least one month (30 calendar days) following completion of testing.

If a product fails to meet the Validation Testing Program requirements in the first Validation Test, the CRRC will assign a second AITL to perform a second test following steps 2 through 9.

Shipping Samples of Rated Products for Validation Testing

When a rated product participates in Validation Testing, the CRRC will inform the Licensee which AITL they will need to ship the Validation Testing Specimens to. The Licensee must ship the Validation Testing specimens directly to the CRRC-designated AITL within 15 calendar days of the AITL designation.

1. When preparing the Validation Testing package before shipping it to the AITL, the Licensee shall:

a. Label the untested side (back) of each Validation Testing Specimen with the CRRC Product ID.
b. Package Validation Testing Specimens appropriately to ensure that the Specimens are not damaged during shipping.
c. Include a copy of the Sample Tag from the CRRC Online Rating Portal in the package; and
d. Include a copy of a Safety Data Sheet and a Technical Data Sheet containing application instructions in the package, where applicable.

Licensees are responsible for shipping the Sample directly to the CRRC-designated AITL. Samples can be provided by a routine production batch, a one-time/single-run batch, a retain sample, a separate party (e.g., fabricator or private label producer), or a lab batch, as long as traceability is provided.

The Sample size that Licensees ship to AITLs for Validation Testing will vary by product type. Standard product specimens 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 following the requirements outlined in Section W.S.3.2 of ANSI/CRRC S100. For all product types except Variegated products, one (1) Specimen from one (1) lot/batch must be shipped, but two (2) Specimens from one (1) lot/batch is recommended.

Variegated products shall have and area of at least 10.2 by 25.4 centimeters (4 inches by 10 inches) and shall include at least two (2) Specimens from one (1) lot/batch that properly represents the variation of the product following the requirements outlined in Section R.S.3.4 of ANSI/CRRC S100.

Validation Testing of Certain Products

Validation Testing for Paint / Architectural Coatings

For Validation Testing, all Paint / Architectural Coatings may be tested using a Leneta Form BK plain black chart, or the black portion of a Leneta Form 2C opacity chart. If not tested using a Leneta chart, the Standard Substrate shall be a panel with a Solar Reflectance of less than 0.20.

The Manufacturer shall either supply prepared panels, or supply the substrate to the AITL along with instructions on how to properly apply the coating to the substrate. In either case, the AITL must conduct a Coating Thickness test in accordance with Chapter 3.5 of the CRRC-2 Wall Product Rating Program Manual. The average Thickness of the measured coating for each Specimen must be within 20% of the Manufacturer's recommended minimum Thickness.

If a primer is used in the preparation of Architectural Coating Wall Product specimens, test in accordance with section 3.8 of the CRRC-2 Wall Product Rating Program Manual.

Validation Testing for Color Family Product Ratings

The Validation Testing Program will verify that the Hunter L, a, b coordinates for Factory-Applied Coating Wall Products or the CIELAB color coordinates for Architectural Coating Wall Products to ensure the products are placed in the appropriate Color Family. The Radiative Properties of the product measured through Validation Testing must meet the requirements set forth in the "Evaluating Validation Testing Results" section below.

Validation Testing for Color Family Representative Elements

If a Color Family Representative Element fails Validation Testing, the entire Color Family Group, including Additional Elements, are considered out of compliance with the requirements in the CRRC Wall Product Rating Program. To keep the Color Family active, the Licensee must:

1. Submit a Formula Change or Retesting application for the Representative Element and the Additional Elements will be moved to reference the new Representative Element. Once the reformulated application has approved Initial Test Results, the failed Representative Element will be Replaced or will Terminate at the end of the year (December 31), whichever is sooner, or
2. The Licensee may convert an Additional Element to become the Representative for that Color Family by submitting a new Representative Element application and proceeding with the Initial and Aged Testing Requirements located in Section 3.5 of the CRRC-2 Wall Product Rating Program Manual. The other Additional Elements will be moved to reference the new Representative Element and the failed Representative Element will Terminate at the end of the year (December 31).

If the Licensee does not proceed with either of the above options, then all of the product ratings included in the Color Family Group shall be Terminated and removed from the Rated Products Directory at the end of the year (December 31).

Validation Testing for Color Family Additional Elements

If a Color Family Additional Element fails Validation Testing, it is removed from the CRRC Rated Wall Products Directory without influencing the rest of the Color Family Group. The Additional Element will Terminate at the end of the year (December 31).

Evaluating Validation Testing Results

The objective of Validation Testing is for the CRRC to evaluate the product that was originally submitted for CRRC Rating. In the case of Compound Ratings, where multiple products are listed under one CRRC Product ID, the manufacturer should submit the same specimen profile that was originally tested. If the original profile is not available, the submitted specimen will still be evaluated under the below criteria. The results of Validation Testing will be compared to the data reported in the Portal. The product is deemed to have passed the Validation Test if:

- The Solar Reflectance test results are no more than ±0.05 from the listed initial product rating, and
- The Thermal Emittance test results
    - are no more than ±0.05 for products with an initial emittance of 0.30 or less from the listed initial product rating, or
    - no more than ±0.10 for products with an initial emittance greater than 0.30 from the listed initial product rating.

For example, if the listed initial Solar Reflectance is 0.50, then any test result that is between 0.45 and 0.55 (inclusive) is considered passing.

If the Validation Test results meet the threshold above, the product is considered to have passed Validation Testing for the year and the product's rating will remain active for an additional seven (7) years. If the results from the Validation Test differ from the listed initial product ratings beyond the threshold described above, the CRRC will follow the procedure below for retesting the Samples.

Retesting of Validation Testing Samples

When a product fails to meet the requirements of Validation Testing with passing results, the CRRC will first contact the AITL that performed the Validation Testing to confirm there are no typographical or other errors in the reported results.

If there are no errors, the CRRC will notify the Licensee and request that new samples from a different batch or production source from the first Validation Testing be shipped to a second CRRC-designated AITL for validation testing following the Validation Testing Procedures outlined in this appendix.

If the product meets the requirements of Validation Testing in the second test, then the product is considered to have passed Validation Testing, and the product's rating remains active for an additional seven (7) years.

If the results from the second test do not meet the requirements set forth in the “Evaluating Validation Testing Results” section above, the product is considered out of compliance with the requirements of the CRRC Wall Product Rating Program, and the product shall be Terminated and removed from the Rated Wall Products Directory at the end of the year (December 31). Terminated products are not eligible for reactivation.

The Licensee shall cease and discontinue the use of the CRRC Rated Product Logo or CRRC Product Label from any product packaging, marketing materials (digital or print), product specification sheets, and anywhere else that the logo and label are being used upon termination on December 31.

If a product that is being Privately-Labeled is Terminated due to a Validation Testing failure, all corresponding product ratings (i.e. Reference ratings) that rely on the original Manufacturer’s rating will also be Terminated.

If any of the products listed under a Compound Rating fails Validation Testing, including the representative, the complete product listing shall be Terminated.

AMTL Testing Violations

If an Additional Element that was tested by an AMTL fails VT, the CRRC will note the failure as a violation of the Wall Rating Program requirements. If any Additional Elements from a Color Family Group are selected and fail VT, the AMTL will be placed in an “Under Review” period, during which no new product ratings can be submitted until the laboratory conducts testing on a set of Specimens supplied by the CRRC. The test results submitted by the AMTL will be compared with other known test values to ensure the AMTL’s results align with the results provided by other testing entities.

If an additional five (5) products are subsequently selected and fail VT and the Wall Licensee cannot provide sufficient data to support that they should pass VT, the AMTL will be suspended from the CRRC Wall Rating Program and will not be eligible to submit any new product ratings for a period of twelve (12) months. Reinstatement will be subject to the discretion of the CRRC Board. The AMTL may be subject to a reinstatement fee.