Product Rating Manual

Technical Committee

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HISTORY OF CHANGES

Version	Date	Changes
2nd version	Feb. 2016	The phrase "or to alloy/s commonly used in Europe such as 3005, 5005 or H12 / H14" has been added in section 4.1.1, paragraph (D) substrate. This was added as the initially suggested standard aluminum panel is not commonly used in Europe.
2nd version	Feb. 2016	The phrase "Manufacturers or Sellers that have already rated their products with the CRRC, should submit a copy of the Test Results Report (form CRRC F-2) as it has been submitted to the CRRC as well as a copy of the valid CRRC Product label. " has been added in Section 3.3, Step 4 in the list, to clarify the procedure to be followed by Manufacturers and Sellers who have their products already rated with the CRRC
2nd version	Feb. 2016	The following clarification has been added in Section 4.1.1 paragraph (C)Specimen labelling: The batch number should also be indicated on the sample. For example: FA00000003_1 ↓ ↓ ECRC ID Number Specimen serial number (from 1 to 9) Batch #: xxxxxxx
2nd version	Feb. 2016	Correction of problems identified in the form ECRC-F-1 (listed below): 1.Point B.12 the input value for temperature automatically turns to the input value for humidity. 2.Point B.13d when the value of SRI is completed, the value of thermal emmitance changes. 3.1point B.18 you cannot choose which point to check, since all of the points are automatically checked 4.Point A.6 no possibility is given to enter a phone number different from that of the fax number 5. Point 18: The field after "tests conducted" is deleted 6. Point 18: The ASTM E1980 – 11 for the calculation of SRI was added in the list of standards
2nd version	Feb. 2016	Correction of problems identified in the form ECRC-F-2 (listed below): 1. Point 6: Telephone number automatically copied to fax number 2. Pont 16: Fields address and title not active
2nd version	Feb. 2016	Correction of problems identified in the form ECRC- L-1(listed below): In the signatures part the content in the "name" field is automatically copied in the "Title

		field”
2nd version	Feb. 2016	Correction of problems identified in the form ECRC- L-2(listed below): The form ECRC-L-2 is not active, data cannot be entered
2nd version	Feb. 2016	A template document for the statement of independence has been developed and has been linked to the ECRC Product Rating Manual
2nd version	May 2016	The date has been removed from the standards mentioned in the document. Current standards are used unless specified otherwise.
2nd version	Dec. 2016	According to Dec. 2016 ECRC Board decision the solar spectrum used for the calculation of solar reflectance is ASTME891 air mass 1.5 beam normal
2nd version	Dec. 2016	CRRC 1 Standard was replaced by ANSI/CRRC S100 Standard

1. GENERAL

1.1 Scope

The European Cool Roof Council ("**ECRC**") operates a rating program for the radiative properties of roofing products. The purpose of this ECRC product rating program is to provide a uniform and credible system for rating and reporting the Radiative Properties of Roofing Products by granting them an ECRC Label, indicating one or more radiative property ratings reported by ECRC Accredited/Approved Testing Laboratory reports. In the framework of this program, Manufacturers and Sellers have the opportunity to label roofing products with the measured values of their Initial Radiative Properties. These properties are determined and verified through testing by Accredited/Approved Testing Laboratories and a process of random testing of rated products. Any roofing product can be tested as long as it is in compliance with the specifications and requirements defined in Manual.

ECRC plans to include in its Product Rating Program the rating of the radiative properties of aged products. This will be done at a second stage and it will be obligatory for all those who participate in the ECRC Product rating program.

The ECRC product rating program does not specify minimum or target values for any radiative property.

1.2 Liability

The ECRC product rating program or the ECRC Labels does not constitute a warranty by the ECRC regarding any properties of the Roofing Product. Any rating or ECRC Label resulting from ECRC product rating program shall not constitute an endorsement of, or recommendation for neither a guarantee regarding any properties of the respective Roofing Product. The ECRC is not a merchant in the business of selling Roofing Products, and therefore, cannot warrant products as to their merchantability or fitness for a particular use. The ECRC 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 ECRC Accredited/Approved Laboratory, any Seller or Manufacturer having rated products by the ECRC;
2. reliance on any ECRC product description, specification, rating or test, whether appearing in a report, in a printed or electronic directory, or on a label; or
3. the sale or use of any ECRC Rated Roofing Products.

1.3 Roof product definition

A roof product is defined as a material designed, manufactured and constructed as the outer most part of the roof assembly that is in direct contact with solar radiation. Roofing products include: tiles, coatings, membranes, shingles and metal products.

1.3.1 ECRC classification of Roofing Products

The following Roofing Product categories are included in the ECRC Rated Products database:

- **Built-up Roofing**: Built-up Roofing (BUR) consists of built-up layers of coated asphalt and insulation applied on site and can be covered with a capsheet (or surfacing material). The products rated by the ECRC in this category refer to the properties of the cap sheet. This is categorised as a field applied system.
- **Foam Roof Systems**: Foam systems can be divided into field-applied and factory-applied categories. Field-applied foam systems are similar to field-applied coatings, as they are sprayed on in liquid form and harden as they set on top of the roof. Factory-applied foam systems are formed into rigid panels and coated with a coating. The foam usually gives the roof system additional insulation properties.
- **Prepainted Metal Roofs**: Prepainted metal refers to a metal sheet on which a coating material has been applied by coil coating in a factory prior to rolling and profiling to its final shape. Prepainted metal roofing products can be rolled and formed to produce a variety of profiles; from a basic trapezoidal one to one that appears like pantiles and also a typical “standing seam” configuration. They come in a variety of textures and colours, including some “cool” colours, specially formulated to achieve significantly greater Solar Reflectance than conventional metal roofing coatings having the same visual appearance (EN 13523-0).
- **Reinforced Bitumen Sheet made of Modified Bitumen:** It is a factory produced flexible layer of bitumen with internal or external incorporation of one or more carriers, supplied in roll form ready for use. It is topped with a surfacing material. Like BURs, the Radiative Properties of modified bitumen are determined by the surfacing material (EN 13707). There are two basic categories:
  - **Elastomeric Bitumen** that consists of petroleum bitumen and/or oxidized bitumen modified by the addition of thermo-plastic rubbers which is field applied (EN 13707).
  - **Plastomeric Bitumen** which is petroleum bitumen modified by polyolefins (EN 13707).
- **Field Applied Coatings**: Field-applied coatings are applied directly onto the roof surface, either on a new roof assembly or over an existing roof surface and can be applied on top of almost every surface, as long as the right coating is selected. These are supplied in a range of different qualities and are all air-drying.
- **Tiles and Slates**: These all overlap and fit together to give the final weather-tight outer most layer of the roof. Concrete and clay tiles come in a wide variety of colours, shapes and sizes, some with reflective coatings. Their high infrared mass and loose laid nature (allowing air to easily pass between and behind the tiles) provide additional thermal benefits giving energy savings beyond their reflectance and emittance properties (EN490, EN1304).
- **Asphalt or Bituminous Shingles:** A type of roof covering consisting of a felt mat saturated with bitumen. Small rock granules are added to one side of the shingle in order to protect against natural elements such as sun and rain. Depending on whether the shingle base is organic (paper felt) or fiberglass, the granules are composed of asphalt cement, a mineral stabilizer like limestone and sand-sized

mineral granules. This can be coloured and can be formulated to improve Solar Reflectance. Typically, these are factory applied coated Roofing Products (EN 544).

- **Single-Ply**: Single-ply roofing is a pre-fabricated sheet of rubber polymers. Single-ply roofing is laid down in a single layer over a low or steep-sloped roof. The single-ply membrane can be loose-laid and weighted down with ballast or pavers or firmly set on the roof and attached with mechanical fasteners or adhesives. There are two main types of single-ply materials:
  - **Single-Ply Thermoset** (includes EPDM, Hypalon): Thermosets are materials that cannot be hot-air welded because it changes their physical characteristics. Instead, tape or contact cement must be used to seal the seams.
  - **Single-Ply Thermoplastic** (includes TPO, PVC, EVA, etc.): Single-Ply Thermoplastic is a flexible sheet membrane which consists of compounded plastic polymers. When heat is applied onto the surface, the single-ply thermoplastic seams are welded together making the material seamless and effective. Most thermoplastics are manufactured to include a reinforcement layer (usually polyester or fiberglass) for extra durability and strength. There are various types of single-ply thermoplastic such as PVC & TPO.PVC (polyvinyl chloride) is a synthetic polymer prepared from vinyl chloride. It tends to be more expensive than TPO, but is well known for long-term performance and is naturally fire-retardant. TPO (thermoplastic polyolefin) is a blend of polymers that can contain flame-retardants or UV absorbers. EVA single-ply is also known for its long-term performances and can contain flame retardants.
- **Other**: This category includes products that do not fit in the above mentioned categories.

For additional information please refer to the document: "An introduction guide for Cool Roofing materials".

The above ECRC Rated Products categories and database is only indicative and is subject to any modification whatsoever by ECRC at its sole discretion, without any notification.

1.4 Glossary of terms

Accreditation Organization: organizations external to the ECRC, complying with ISO/IEC 17011, which audit the testing laboratories on the ECRC accepted measurement methods and standards, perform regular re-audits and grant the ISO 17025 certification to testing laboratories.

Accredited Independent Testing Laboratories (AITL): A testing laboratory that is accredited by an Accreditation Organization to test the Radiative Properties of Roofing Products and is completely independent from any Manufacturer or Seller. This laboratory is accredited to operate according to ISO 17025 complying with the requirements described in this Manual.

Accredited Manufacturer Testing Laboratories (AMTL): A testing laboratory affiliated with a Seller or Manufacturer that is accredited by an Accreditation Organization to test the Radiative Properties of Roofing Products. This laboratory is accredited to operate according to ISO17025 complying with the requirements of described in this Manual.

Accredited Testing Laboratory: An AITL or AMTL complying with the requirements of this Manual.

Approved Independent Testing Laboratory: An independent testing laboratory, having initiated the procedures for ISO17025 (2005) accreditation for the measurement of at least one of the radiative properties of roofing materials, that has received formal recognition by the ECRC for having demonstrated technical competency to perform specific types of tests, in accordance with the specifications and requirements described in this Manual. Only applicable for the first year of operation of the ECRC Product Rating Program and only if at national level there is no other Accredited Laboratory to perform the specific type of measurement.

Coating Thickness: The dry thickness of a coating when applied to a substrate, measured in accordance with ASTM D1005, ASTM D7091 or ISO 2178 or ISO 2360 or EN ISO 2808.

Cool Roof Rating Council U.S. (CRRC): The CRRC is an independent, non-profit organization that maintains a third-party rating system for Radiative Properties of roof surfacing materials operating in the U.S.

CRRC Label: The distinctive informational label that contains the CRRC Logo and other pertinent radiative property information specific to a Roofing Product granted by the U.S. Cool Roof Rating Council (CRRC-1 Program Manual)

ECRC Label: The distinctive informational label that contains the ECRC Logo and information about the radiative properties and other information specific to a Roofing Product granted by the European Cool Roofs Council, as set out in ECRC Rated Product Label.

ECRC Logo: the ECRC accreditation or approval logo in color or black and white, as set out in ECRC Rated Product Label.

ECRC Quality Assurance Procedures: set out in Section 5 of this Manual.

Formula Change: A formula change is considered any change in resin, pigment, pigment grind, materials ratios, or anything which in total results in a change of the Solar Reflectance or Infrared Emittance by 0.05 units or more.

Infrared Emittance: The ratio of the radiant heat flux emitted by a sample to that emitted by a blackbody radiator at the same temperature. It refers to a material's ability to release absorbed heat. It is expressed by a unit less number between 0 and 1 (or 0% and 100%).

Initial Radiative Properties: The Solar Reflectance and Infrared Emittance of a Roofing Product determined from an unexposed specimen which is prepared for the specific purpose of testing its Radiative Properties.

Low slope roof: A Roof that has a surface with a maximum slope of 5 cm rise for 30 cm run, corresponding to less than a 10-degree inclination (ASTME1918).

Manufacturers and Sellers:
a) Sellers: natural persons or legal entities commercializing Roofing Products under their own name to end customers.

b) Manufacturers: legal entities producing Roofing Products or product components and selling these to Sellers.

Manual: this document and its annexes, if any, to be modified by ECRC any time upon its sole discretion without notification and which is available any time at ECRC Product Rating Program Manual.

Profiled Roofing Products: Roofing Products that vary in rise over a given width, viewed in cross section.

Random Testing of Rated Products: An ECRC rating program Quality Assurance Procedure consisting of the periodic and random selection of ECRC Rated Roofing Products and their testing by an Accredited or Approved Testing Laboratory.

Radiative Properties: The Solar Reflectance and Infrared Emittance of a roofing product**.**

Rated Radiative Properties: The Solar Reflectance and Infrared Emittance of a roofing product, which are reported on the ECRC Label and published in the ECRC Rated Products database.

Rated Roofing Product: A Roofing Product that is permitted to bear the ECRC Label and is published in the ECRC Rated Products database.

Product Rating Application: definition to be provided?

Roofing Product: a material designed, manufactured and constructed as the outer most part of the roof assembly that is in direct contact with solar radiation, including without limitation tiles, coatings, membranes, shingles and metal products.

Roofing Product Label: see ECRC label

Solar Reflectance: The ratio of the solar energy that is reflected by a surface to the incident solar energy. It is expressed with a number between 0 and 1 (or 0% and 100%).

Solar Reflectance Index (SRI): An indicator of how "cool" a material is. SRI combines both the Solar Reflectance and the Infrared Emittance in a single value. It quantifies how hot a flat surface would get relative to a standard black (reflectivity 5%, emittance 90%) and a standard white surface (reflectivity 80%, emittance 90%).This is specified under moderate convective coefficient of 12 $W \cdot m^{-2} \cdot K^{-1}$ or 2-6 $m \cdot sec^{-1}$.

Specimen Mean: The arithmetic mean of the property values (e.g., solar reflectances) measured for all members of a specimen set.

Specimen Mean Standard Error: The population standard deviation divided by the square root of the number of specimens.

Specimen Standard Deviation: The square root of the ratio of the sum of the squares of the deviation from the specimen mean to a number one less than the number of specimens.

Steep slope roof: A Roofing Product with a surface with a minimum slope of 5cm rise for 30cm run, corresponding to more than a 10 degree inclination (ASTME1918).

Thermal Emittance: see above **Infrared Emittance**

Variegated Roofing Product: A material with a varied surface colour or which has discrete markings of different colours, requiring a larger sample measurement of Solar Reflectance.

2. ACCREDITED ANDAPPROVEDTESTINGLABORATORIES ("ATLS")

The ECRC will accept in its Product Rating Program three types of European testing laboratories:

a) Accredited Independent testing laboratories (AITLs)

b) Accredited Manufacturer testing laboratories and (AMTLs)

c) Approved Independent testing laboratories

In this section the requirements for the above mentioned types of laboratories are further described. All Roofing Products must be tested by an ATL.

2.1 Overview of the laboratory accreditation/approval process

The ECRC will only give accreditation to testing laboratories upon the condition that they fulfill a set of conditions described in detail in Section 2of this Manual. The process of such accreditation is the following:

1. Any European testing laboratory that wishes to become accredited with the ECRC should either be already accredited to ISO 17025 or having started the process of seeking ISO17025 accreditation for at least one of the ECRC accepted measurement methods as defined by the ECRC in Section 4 of this Manual.

2. The laboratory must verify it fulfills the conditions described in Section 2 of this Manual, fill in the necessary forms, sign the appropriate agreements and submit its application to the ECRC Secretariat.

3. Within a week of sending the accreditation application to the ECRC Secretariat, the applicant will receive confirmation whether or not the application has been duly received.

4. The ECRC will check that the applications submitted by the laboratories fulfill the ECRC accreditation requirements, then review them and decide upon its sole discretion on granting the respective laboratory the required ECRC Logo. If the laboratory receives the ECRC accreditation it will be added in the list of ECRC Accredited Laboratories on the ECRC website. It will also receive a unique ECRC ID number. Processing of the testing laboratories application by the ECRC may take between 1-2 months.

5. The ECRC Secretariat will notify the laboratory of the ECRC decision.

6. ECRC Accredited Laboratories will remain in the ECRC Accredited Laboratories list for a period of one year. In order to remain in the ECRC Accredited Laboratories list and use the ECRC Accredited laboratory logo they must reapply following the procedures described in this Section. ECRC Approved testing laboratories must achieve the ISO17025 accreditation during the first year and thus reapply to enter in the ECRC Accredited Laboratories list.

2.2 Requirements for Accredited Independent Testing Laboratories

An ECRC AITL is defined as a European testing laboratory that is ISO17025 accredited to test the Radiative Properties of Roofing Products as defined in this Manual and is completely independent from any Manufacturer or Seller. The Accredited Independent Testing Laboratories can perform Radiative Properties measurements according to the procedures and specifications defined by the ECRC in this Manual. They receive the ECRC AITL logo. They

may charge their clients for making the measurements required for the latter's products to be included in the ECRC database and report the results to them. They have to participate at the ECRC's quality assurance procedures.

In order to become an ECRC Accredited Independent Testing Laboratory a company must complete the following steps:

- Fill in and sign the ECRC Accredited/Approved Laboratory participation application form (ECRC-F-4).
- Sign the Accredited/Approved Testing Laboratory Agreement (ECRC-L-1)
- Sign a statement of independence (sample statement ECRC-H-5)
- Pay the ECRC the agreed fee(ECRC-H-3)
- Demonstrate certification under ISO-17025 by providing:
  - Copy of accreditation certificate
  - Evidence of certification by an ECRC Approved Accreditation Organization, complying with ISO17011
  - A listing of standards and test methods that the laboratory is accredited to perform

2.3 Requirements for Accredited Manufacturer Testing Laboratories

An ECRC AMTL is defined as a European testing laboratory that is ISO17025 accredited to test the Radiative Properties of Roofing Products as defined in this Manual and is affiliated to a roofing manufacturer. An ECRC AMTL can perform Radiative Properties measurements according to the procedures and specifications defined by the ECRC for roof product Sellers or Manufacturers and also for the Roofing Product Manufacturer or Seller with whom they are affiliated. They receive the ECRC AMTL logo. They may charge their clients for making the measurements required for their products to be included in the ECRC database and report the results to them. They have to participate at the ECRC's quality assurance procedures.

In order to be considered as an ECRC Accredited Manufacturer Testing Laboratory a company must complete the following steps:

- Fill in and sign the ECRC Accredited/Approved Laboratory Participation Application Form (ECRC-F-4).
- Sign the Accredited/Approved Testing Laboratory Agreement (ECRC-L-1)
- Pay the ECRC the agreed fee(ECRC-H-3)
- Demonstrate certification under ISO-17025 by providing:
  - Copy of Accreditation Certificate or Schedule of Accreditation.
  - Evidence of certification by an ECRC Approved Accreditation Organization, complying with ISO17011

- A listing of standards and test methods that the laboratory is accredited to perform

2.4 Requirement for Approved Testing Laboratories (under ISO17025 accreditation)

An ECRC Approved Testing Laboratory is an independent testing laboratory, that has initiated the procedures for ISO17025accreditation for at least one of the measurement methods for determining the radiative properties of roofing materials, that has received formal recognition by the ECRC for having demonstrated technical competency to perform specific types of tests, in accordance with the specifications and requirements described in this Manual. Only applicable for the first year of operation of the ECRC Product Rating Program and only if at national level there is no other Accredited Laboratory to perform the specific type of measurement. ECRC will include such labs in ECRC Approved laboratories list and will grant them the ECRC Approved Laboratory Logo. In order to be considered as an Approved Testing Laboratory for a period of 1 year, the laboratories shall comply with all the following conditions and complete the following steps:

- Pass an ECRC ILC test in communication with the ECRC Secretariat and provide an attestation thereof in its successful completion.
- Sign a statement and provide documentation to indicate that it has started the ISO 17025 certification procedure and provide timescales for accreditation within that year
- Sign a statement of independence (sample statement ECRC-H-5).
- Fill in and sign the ECRC Accredited/Approved Laboratory Participation Application Form (ECRC-F-4).
- Sign the Accredited/Approved Testing Laboratory Agreement (ECRC-L-1).
- Pay the ECRC the agreed fee (ECRC-H-3).

3. PRODUCT RATING PROCESS

The following sections describe the process for the initial rating of Roofing Products by the ECRC. In order to obtain and/or maintain an ECRC Rated Roofing Product status an applicant Seller or Manufacturer shall comply with all of the conditions and criteria of this section and all applicable requirements of the ECRC's Roofing Product rating program.

3.1 Product rating process

In order to have a Roofing Product rated by the ECRC, applying Manufacturer or Seller must comply with the conditions described below:

1. Select an ECRC Accredited or Approved Testing Laboratory from the ECRC web site.
2. Send the ECRC Secretariat by email (ecrc@coolroofcouncil.eu) the completed form (ECRC-F-0) to obtain a unique ID number for the Roofing Product to be rated and a unique ID number for the applying Manufacturer or Seller).

3. Prepare the Roofing Product specimens according to the instructions given in section 4.1 of this Manual. Label each Roofing Product specimen using the ID provided by the ECRC Secretariat according to the specifications described in section 4.1.
4. Complete the appropriate sections of the Initial Test Results Report (ECRC-F-1).
5. Send the following to the selected ECRC Accredited/Approved test laboratory:
    a. Test Results Report (appropriate sections completed)(ECRC-F-1)
    b. Labeled Roofing Product specimens
6. Once the Test Results Report has been received from the appointed ATL, submit a completed Initial Product Rating Application (ECRC-F-2) to the ECRC Secretariat according to Section 3.3.
7. Sign and comply with a legal agreement with the ECRC (ECRC-L-2)
8. Pay the ECRC appropriate fee
9. Upon acceptance and approval of the Product Rating Application by the ECRC upon its sole discretion (processing may take up from 1-3 months), the Roofing Product will be added to the online ECRC Rated Products database (which is updated a every 30 days, which is a mere indication) with initial ratings. Upon posting to the online ECRC Rated Products database, Manufacturer or Sellers are authorized to print the ECRC Roofing Product Label with initial rating information.

3.1.1 Special conditions for CRRC rated Roofing Products

Manufacturers or Sellers that have their products already rated by the U.S. CRRC and also want to receive the ECRC label should submit the Product Rating Application as described in section 3.3, and also provide proof that:

- Manufacturers or Sellers Roofing Products are sold/ distributed in Europe
- Roofing Products have a current and valid CRRC label
- They are members of the ECRC and will remain as members for a period of at least three consecutive years as of the Product Rating Application date.

3.2 Quality Control

Manufacturers or Sellers shall have an appropriate quality control plan in place that ensures its Roofing Product(s) maintain their Radiative Properties at or above their certified Radiative Properties. Ideally the Manufacturers or Sellers should operate to an accredited quality management system such as ISO9001. A Manufacturer or Seller shall designate at least one employee as quality control manager at each of its manufacturing plants, and shall provide the ECRC with the name and contact information of that personin the Product Rating Application. If the Manufacturer' or Seller' quality management system is ISO9001 accredited, a copy of its valid schedule / certificate should be supplied upon ECRC's first request. If a Manufacturer or Seller is not ISO9001 accredited then all quality control records and the quality control plan shall be made available to the ECRC upon ECRC's first request.

3.3 Roofing Product rating application checklist

An applicant, Manufacturer or Seller, shall submit the following information to the ECRC for each Roofing Product for which it wishes to obtain ECRC ratings:

1. A completed ECRC Initial Product Rating Application form(ECRC-F-2).
2. The appropriate application fee (ECRC-H-3).
3. The name and contact information of the quality control manager(s) (to be filled in, in the initial product rating application) and, if available, a copy of current and valid ISO9001 Quality management certificate
4. An ATL test report for the Roofing Product to be ECRC accredited (ECRC-F-1). Manufacturers or Sellers that have already rated their products with the CRRC, should submit a copy of the Test Results Report (form CRRC F-2) as it has been submitted to the CRRC as well as a copy of the valid CRRC Product label.
5. One page instruction sheet on how to collect and/or prepare a sample in case the Rated Roofing Product is selected for random testing.
6. List with names and contact details of at least three contractors, customers or distributors from which ECRC can obtain random marketplace samples (ECRC-F-3).
7. A copy of the letter sent to the designated contractors, customers or distributors notifying them that they may be contacted by the ECRC for the collection of random samples for testing (ECRC-F-5).
8. Signed legal agreement with the ECRC (ECRC-L-2).
9. Any other pertinent information relevant to the submission required by the ECRC Roofing Product Rating Program.

When a Roofing Product rating is approved by the ECRC, the Roofing Product will be added to the online ECRC Rated Roofing Products database along with its initial ratings and relevant information, which shall exclusively be subject to ECRC's qualification, such as:

- ECRC Rated Roofing Product ID
- Roofing Product name
- Roofing Product type
- Initial & aged* values for Solar Reflectance
- Initial & aged* values for Infrared Emittance
- Initial & aged* values for Solar Reflectance Index
- climate type where the weathering test has been conducted for the Rated Roofing Product
- Roofing Product's intended roof slope (low and/or steep slope)
- The colour that best describes the Roofing Product
- More information on the Roofing Product(e.g. company website, contact person, test methods used)

ECRC shall use best efforts to update the ECRC Rated Roofing Product database at least once every month.

*At a second stage the ECRC Product Rating Program will include the rating of aged values of the Radiative Properties of Roofing Products. Until this is established the indication "pending" will appear on the ECRC Label and the ECRC Rated Products database under the field "aged solar reflectance", "aged infrared emittance" and "aged SRI" for each product.

Please note that the placement of a Roofing Product in the ECRC Rated Products database does not mean that the Roofing Product is "solar reflective" or "cool" as defined by any particular code body or program.

3.4 ECRC Label

When a Product Rating is approved by the ECRC and the Roofing Product is added to the online ECRC Rated Roofing Products database, the Manufacturer or Seller is authorized to print the ECRC product Label with the initial rating information, to be determined upon ECRC's sole discretion, such as:

- Initial & aged* values for Solar Reflectance,
- Initial & aged* values for Infrared Emittance
- Initial & aged* values for SRI
- climate type where the weathering test has been conducted for the Rated Roofing Product
- Manufacturers and/or Seller's name
- Rated Roofing Product ID number,
- Date of measurement at the ATL

The conditions for using the ECRC product Label are detailed in section 6 below.

*At a second stage the ECRC Product Rating Program will include the rating of aged values of the Radiative Properties of Roofing Products. Until this is established the indication "pending" will appear on the ECRC Label and the ECRC Rated Products database under the field "aged solar reflectance" and "aged infrared emittance" for each product.

3.5 Random testing of Rated Roofing Products

As part of its quality assurance program, the ECRC will periodically select Rated Roofing Products and have them tested by an ATL in order to assurance its compliance with the radiative properties as displayed on the ECRC Label. These Rated Roofing Products will be obtained either directly from the marketplace or from the point of manufacture. A number of Roofing Products from the list of Rated Roofing Products will be selected by the ECRC for testing each year. The percentage of Rated Roofing Products to be tested each year will be established by the ECRC Secretariat in consultation with the ECRC Board at its sole discretion. Products are considered to fail periodic testing if the measured Radiative Properties from the ATL are by ±0.05 different from the certified Radiative Properties displayed on the ECRC label and the ECRC Rated Roofing Products database. The process for random testing of Rated Roofing Products is detailed in section 5.2.

Manufacturers and Sellers shall provide information to the ECRC to enable the ECRC to obtain samples of their Roofing Product for periodic testing upon ECRC's request. Each Manufacturer or Seller shall provide a list of distributors, customers or contractors, in Europe, and this information shall be provided with each application for Roofing Product rating. The information will be updated every three years at the time of application for product renewal, pursuant to section 3.7 below, and shall be communicated immediately to

ECRC. Parties listed by the Manufacturer or Seller shall agree to provide samples to the ECRC at no cost and at ECRC's first request. Requests for samples shall be made no more frequently than once a year, unless a Roofing Product fails the first test and must be retested. In certain cases, the Manufacturer or Seller shall also agree to have samples collected from their point of manufacture subsequent to routine quality control inspections.

Manufacturers shall provide a one-page instruction sheet on how to collect or prepare the sample for random testing as described above. This instruction sheet shall be included with the application for Roofing Product Rating as indicated in section 3.3 above.

3.6 Product renewal

A Rated Roofing Product will remain in the ECRC Rated Roofing Products database for a period of three years. In order to keep a Rated Roofing Product in the ECRC Rated Roofing Product database after this three-year period, a Manufacturer or Seller must contact the ECRC Secretariat and pay the renewal fee for the subsequent three years. Any changes in the information submitted to the ECRC in the framework of the original Product Rating Application must be reported.

3.7 Retesting of Rated Roofing Products

If an ECRC Rated Roofing Product undergoes any change in code, description, resin, pigment, pigment grind, material ratios, or anything else which in total results in a change of the Solar Reflectance or Infrared Emittance that is equal to or higher than 0.05 then it is considered that the Rated Roofing Product has undergone a significant Formula Change, the ECRC Label expires as well as the inclusion in the ECRC Rated Products database and a new ECRC Roofing Product rating pursuant to section 3 of this Manual shall be required. The Manufacturer or Seller shall discontinue labeling the old Rated Roofing Product with the ECRC Label.

If a Rated Roofing Product undergoes formulation changes resulting in a change in Solar Reflectance and Infrared Emittance of less than 0.05, and therefore does not fall into the definition of a Formula Change, as indicated in the previous paragraph, the ECRC Label does not expire and it can remain in the ECRC Rated Products database. The Manufacturer or Seller does not need to make a new product rating submission unless the Manufacturer or Seller chooses to rerate the Roofing Product.

In any case, in order to rerate an ECRC Rated Product, the Manufacturer or Seller shall submit a new Application including a new test results report, all other required fees and documentation, a Product Rating Application indicating that it concerns "Formula Change or Retesting Application" and stating if the change refers to formulation or ID of the Roofing Product.

Such rerated Roofing Product shall receive an ECRC product ID number that consists of the ID number of the original Rated Product followed by a suffix. When the application for the new Product is accepted by the ECRC, it will replace the old product in the ECRC Rated Products database and the information, Radiative Properties etc. of the rerated product will appear replacing the old ones in the Rated Roofing Products database and on the ECRC

Label. The ECRC will keep a record of all old replaced Rated Products. The Manufacturer shall discontinue labeling the old Product with the ECRC Label.

3.8 Rated Roofing Product removal

An ECRC Rated Roofing Product shall be removed from the ECRC Rated Roofing Products database for any of the following reasons:

1. The Rated Roofing Product is no longer in production by the Manufacturer or the Manufacturer no longer wishes to maintain the ECRC Roofing Product rating
2. The Rated Roofing Product has been reformulated or retested by the manufacturer resulting in a different Solar Reflectance or Infrared Emittance value from the initial rating and a new product has been rated
3. The Roofing Product Rating has been terminated by the ECRC for any reason, including failure of Random Testing of Rated Roofing Products or failure to comply with the ECRC Roofing Product rating program requirements in any way.

ECRC will keep records of all Roofing Products removed from the ECRC Rated Roofing Products database.

4. TESTING PROCEDURES

All candidate specimens used for the purposes of testing initial Radiative Properties shall be chosen and provided by the Manufacturers or Sellers. The Manufacturer or Seller shall be responsible for identifying each separate Roofing Product. Specimen preparation and testing shall be performed in accordance with the following sections.

4.1 Test specimens' preparation procedures

The following sections describe the specimen preparation procedures, including specimen selection, specimen size and labeling for all the different types of roofing materials.

4.1.1 All Roofing Products (except tiles and variegated products)

This section describes the specimen selection and preparation procedures for all Roofing Products except for variegated products and tiles, which are described in sections 4.1.2 and 4.1.3 respectively.

(A) Specimen selection

For the testing of Radiative Properties by ATLs, nine (9) specimens of Roofing Products shall be randomly selected from routine production. These should be selected at random from 2 independent batches. This results in a total of four specimens from one batch and five from the other.

(B) Specimen size

Each specimen shall be 150cm^2 (10cmx15cm) in size.

(C)Specimen labeling

Each Roofing Product to be rated with the ECRC shall receive a unique identifier by the ECRC Secretariat. The Manufacturer/Seller should use this ID number to label each of the Roofing

Product specimens to be tested by the ATL, adding a suffix to indicate the number of the specimen. The batch number should also be indicated on the sample.

For example:
FA00000003_1
↓ ↓
ECRC ID Number Specimen serial number (from 1 to 9)

Batch #: xxxxxxx

ECRC Labels shall be designed by the Manufacturer to be durable for a period of four (4) years, during which specimens will be exposed to the environment. The following labeling processes are given as examples:

-small weatherproof laminated plastic labels which are engraved with the specimen ID and then attached to the back of the specimen.

- Waterproof, indelible, paint pens to write the specimen ID on the back of the specimen.

(D) Substrate:

Only the following Roofing Products need to be applied to a substrate:

1. Liquid field-applied Roofing Products: Shall be applied to the substrate(s) intended for end use or to a standard aluminium panel. The standard substrate shall conform to 3003 H14 uncoated aluminium alloy in accordance with ASTM D1730 or to alloy/s commonly used in Europe such as 3005, 5005 or H12 / H14 , or shall be chosen by the manufacturer so as to be representative of end use. Liquid field-applied Roofing Product specimens shall be applied at the minimum dry micron thickness or coverage recommended by the Manufacturer for use in the field. The dry micron thickness shall be within 20% of the Manufacturer's recommended minimum thickness and shall be verified upon initial testing by an ATL in accordance with the procedures set forth in section 4.

2. Factory-applied Roofing Products: Shall be applied to the substrate(s) intended for end use or to a standard aluminum panel. The standard aluminium panel shall conform to 3003 H14 uncoated aluminium alloy in accordance with ASTM D1730.

(E)Radiative Properties Reporting:

The Initial Radiative Properties of the Roofing Product specimens shall be calculated as the arithmetic average of the initial test results of the 9specimens from the two batches.

(F)Packaging:

Manufacturers and Sellers are responsible for ensuring that the packaging of the test specimens for shipment is done in such a way that the radiative properties of the specimens are not altered. As an example, enclosing the specimens in plastic envelopes and using bubble envelopes for shipment could be a good practice that prevents the specimens' surface from being damaged and their radiative properties from being altered.

4.1.2 Variegated Roofing Products

(A) Specimen selection

The specimen selection procedure for variegated Roofing Products is the same as for standard Roofing Products described in section 4.1.1(A).

(B) Specimen size:

The area of each specimen must be at least 150cm^2(10cmx15cm).

For shingle or modified bitumen products the specimens to be tested shall have an area of at least 2275cm^2(25cmx91cm).

(C)Specimen labeling

Specimens shall be labeled according to section 4.1.1 (C).

(D) Radiative Properties Reporting:

The Initial Radiative Properties reported shall be determined as the average of the initial test results of the specimens of the Roofing Product from batches A and B.

(E)Packaging:

Manufacturers and Sellers are responsible for ensuring that the packaging of the test specimens for shipment is done in such a way that the radiative properties of the specimens are not altered. As an example, enclosing the specimens in plastic envelopes and using bubble envelopes for shipment could be a good practice that prevents the specimens' surface from being damaged and their radiative properties from being altered.

4.1.3 Tiles

(A) Specimen preparation

Tile Roofing Products, both mono-color and variegated, shall be rated using nine (9) individual tiles chosen randomly. Tiles shall be flat, unless only profiled Roofing Products are available. Flat and S-shape tiles shall be cut down by the tile of the Roofing Product Manufacturer to a smaller size of not less than 15cm by 15cm, allowing any unreadable areas to be removed, as long as a representative specimen remains intact in order to be tested. All other profiled tiles must be sent as full, uncut tiles.

(B)Specimen labeling

Specimens shall be labeled according to section 4.1.1 (C).

(C) Radiative Properties Reporting:

Initial Rated Radiative Properties reported shall be determined by the average of the initial test results of the 9 tested specimens.

(D)Packaging:

Manufacturers and Sellers are responsible for ensuring that the packaging of the test specimens for shipment is done in such a way that the radiative properties of the specimens are not altered.

4.1.4 Special processes

The ECRC may approve other methods of specimen selection on a case by case basis for special processes or circumstances upon its sole discretionary.

4.2 Solar Reflectance tests

(A)Solar Reflectance tests shall be conducted based upon one of the following test methods, unless the Roofing Products is listed in section 4.2 (B) or 4.2 (C). An air mass of 1.5 shall be used for E903, C1549 and CRRC-1 Test Method #1:

1. ASTM E903- in conjunction with ASTM E891 air mass 1.5 beam normal spectrum.

2. ASTM C1549 for ASTM E891 air mass 1.5 beam normal.

3. CRRC-1 Test Method #1 (ANSI/CRRC S100).

Note: The test procedure for CRRC-1 Test Method #1: Standard Practice for Measuring Solar Reflectance of a flat, opaque, and heterogeneous surface using a portable solar reflectometer is contained in section 4 of the ANSI/CRRC S100 as attached as APPENDIX A.

(B)Variegated Roofing Products. Test specimens of Variegated Roofing Products shall be tested for Solar Reflectance in accordance with CRRC-1 Test Method #1: Standard Practice for measuring Solar Reflectance of a flat, opaque, and heterogeneous surface using a portable solar reflectometer.

(C)Presumed Non-Variegated Modified Bitumen Cap sheets. Modified bitumen cap sheets with non-continuous (particle) top coatings that are represented as non-variegated products shall be tested in accordance with the following requirements:

Test methodsASTME903 or ASTMC1549 are used to conduct initial testing. The ATL shall first test the specimen as described below to confirm that the specimen is not a Variegated Roofing Product:

The ATL shall take a series of five (5) Solar Reflectance measurements approximately equidistant along a diagonal axis of the specimen. If any of the five Solar Reflectance measurements varies by more than 0.05 from the arithmetic average of all five measurements, then the product will be deemed to be a Variegated Product. The ATL shall reject these specimens and new specimens of Roofing Product shall be submitted under the terms according to the specifications described in section 4.1.2.

(D)Tile products. Tile products shall be tested in accordance with CRRC-1 Test Method 1 or the Template Method as described below. The ATL performing the measurements shall mark the arrangement of the tiles and record the locations of the measurements in the report developed.

- CRRC-1 Test Method 1 (for tiles) Tests shall be conducted in accordance with CRRC-1 Test Method# 1, and conform to the following requirements:

1. Six measurements shall be taken on randomly chosen and non-repeated test cells on each of nine tiles selected. A test cell is an element of a grid of contiguous 2.5 cm by 2.5cm squares projected on the surface of each tile. The aperture of the measurement device shall be centered within the cell.

2. After measuring all specimens, compute the estimate of specimen mean standard error of the measurements.

3. If the estimate of Specimen Mean Standard Error is 0.02 or less the test is complete, and the measured property is permitted to be reported.

4. If the estimate of specimen mean standard error is greater than 0.02 the test is incomplete, and an additional test shall be performed at a 7th location on each tile. Following the 7th test on each tile, compute the estimate of specimen mean standard error. If the estimate of specimen mean standard error is 0.02 or less the test is complete and the measured property is permitted to be reported. If the estimate of specimen mean standard error is greater than 0.02 then repeat this step 4 at an additional randomly selected and non-repeated location on each tile until either:

a. the estimate of specimen mean standard deviation is 0.02 or less is achieved or

b. every test cell on every tile has been measured.

If either condition (a) or (b) has been satisfied, the test is complete and both the specimen mean and the specimen mean standard deviation shall be reported. If condition (b) has been satisfied it shall be reported that all test cells have been measured.

- Template method. The measurements shall be taken in the locations indicated by the template, in accordance with Figure 1 below. Position the template to include the maximum color variegation on the specimens.

1. The measurements shall be taken on each of nine tiles selected.

2. Following the measurements of all specimens, compute the estimate of specimen mean standard error of the measurements.

3. If the estimate of specimen mean standard error is 0.02 or less the test is complete, and the measured property is permitted to be reported.

4. If the estimate of specimen mean standard error is greater than 0.02 the test is incomplete and the specimens will be tested in accordance with the CRRC-1 Test Method 1 above

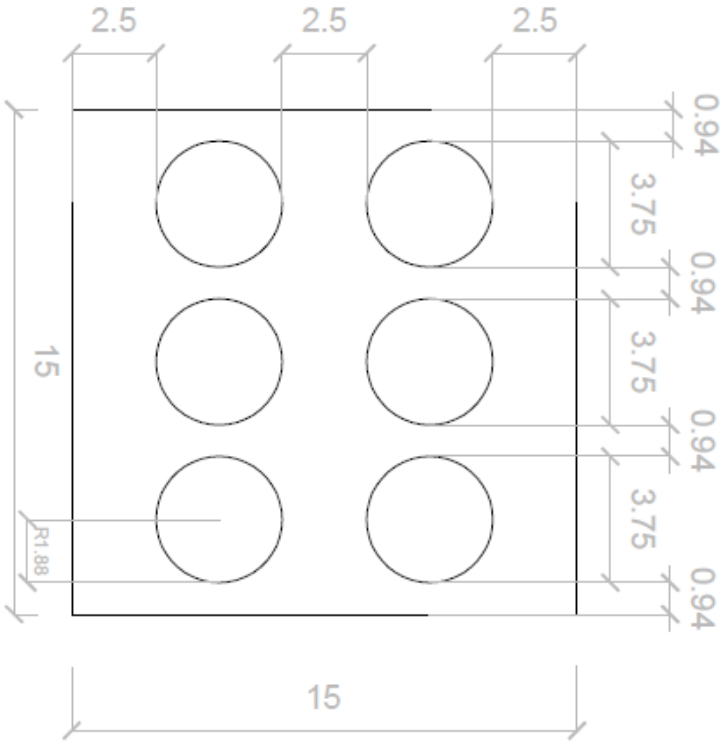

Figure 1: Dimensions (in cm) of the template used for the tile template measurement method

4.3 Infrared emittance tests

(A) Infrared Emittance tests shall be conducted using equipment and procedures in accordance with ASTMC1371 or EN 15976unless the Roofing Product is listed in section 4.3(B) or 4.3 (C).

(B) Low conductivity materials: any product not on an uninsulated metal substrate shall be tested using the Slide Method as described in the Devices &Services Technical Note TN 11-2 or TN 04-01 andTN10-2.

(C) Profiled products: Measurement of products having cylindrical surfaces products shall be done according to the method described in the Devices &Services Technical Note TN 11-3

4.4 Solar Reflectance Index (SRI)

Based on the measurements of Solar Reflectance and Infrared Emittance the Solar Reflectance Index (SRI) shall be calculated according to ASTM E1980-11. For the calculation of the SRI, medium wind conditions corresponding to a convection coefficient equal to 12 $W \cdot m^{-2} \cdot K^{-1}$ or 2-6 $m \cdot sec^{-1}$, shall be considered.

4.5 Thickness tests

(A) Field-applied roof coatings thickness tests shall be conducted in accordance with ASTM D1005, ASTM D7091or ISO 2178or ENISO2808.

(B) Single ply Roofing Products shall be tested for overall thickness using ASTM D751 or EN 1849-1.More specifically, a thickness measurement shall be taken at five evenly spaced points on each of the nine Roofing Product specimens. The average of the five measurements shall be used to determine the overall thickness of each specimen. The average thickness for a given specimen shall be within 20% of the Manufacturer's stated thickness. A specimen which is not within this range shall not be used for ECRC ratings. The ATL shall contact the Manufacturer or Seller to supply new Roofing Product specimens.

4.6 Reporting

4.6.1Radiative Properties Reporting:

The rated Radiative Properties of the Roofing Product specimens shall be determined by the average of the initial test results of the specimens from batches A and B as described in the above sections.

4.6.2 Test Report Contents

ATLs shall submit a report of measured Radiative Properties, both initial, to the Manufacturer or Seller for use in compiling a Roofing Product rating application. The report shall contain information as required by the appropriate test method or standard, and shall include the following information:

(A) Name and address of the Manufacturer.

(B) Name and identification of Roofing Product.

(C) Identification of the type and model of instrument used.

(D) Identification of any calibration standards used and their calibration status.

(E) Date of testing.

(F) Name and address of the testing agency, and name of person in charge of the test.

(G) Test method(s) employed (including method revision date).

(H) Thickness of top coating or material tested, if applicable.

(I) Summary of data.

5. QUALITY ASSURANCE PROCEDURES

The following sections describe in detail the current ECRC Quality Assurance Procedures.

5.1 ILC test for laboratories

All laboratories that want to participate in the ECRC Roofing Product rating programwill have to take part in periodic interlaboratory comparison testing that will be organized by the ECRC once a year. The purpose is to ensure consistency and competence of the laboratory by evaluating the test results against the other laboratory values and/orpre-determined test results of the same samples. The ECRC will provide the respective laboratories with test samples and the ATLs will have to measure and report the solar reflectance, the infrared

emittance and the thickness of the samples (if required), according to the procedures and specifications described in sections 4.2, 4.3 and 4.5 of the Manual. The ECRC will notify the laboratories about the results and of any corrective actions if necessary. If the laboratories do not comply with those corrective actions within the imposed timeframe, they will be excluded from the ECRC roofing Product rating program.

In addition, as specified in section 2.4 laboratories that that want to participate the ECRC Roofing Product rating program and are under ISO 17025 accreditation for an ECRC approved test method will have to pass first the ECRC ILC test. The procedure for this is the following:

- Laboratories under ISO17025 accreditation shall contact the ECRC Secretariat and ask to receive the ECRC ILC samples.
- The samples will be sent to the laboratory by the ECRC Secretariat.
- The measurement results will be returned to the ECRC Secretariat and will be compared to the round robin test results to ensure that applicant's test procedures are consistent with ECRC's procedures and its equipment are properly calibrated.
- Results are considered to fail the ECRC ILC test if the measured Radiative Properties from the laboratory are more than ±0.05 different than the corresponding ECRC ILC results for the same samples.
- If a laboratory fails to pass the test, it can re-apply to be ECRC accredited or approved after demonstrating personnel training records and/or instrumentation calibration records by an appropriate company/organization.

5.2 Random testing of Rated Roofing Products

As part of its quality assurance procedures, the ECRC will periodically select Rated Roofing Products, obtain them from the marketplace or from the point of manufacturing, and have them tested by an ATL. A number of products from the Rated Roofing Products database will be selected for testing each year at ECRC's sole discretion. The percentage of products to be tested each year will be established by the ECRC Secretariat in consultation with the ECRC board. Rated Roofing Products are considered to fail periodic testing if the measured Radiative Properties from the AITL are by ±0.05 different than the Rated Radiative Properties as displayed in the ECRC Rated Products database and ECRC Rated Product Label. The process for random testing of Rated Roofing Products is described below:

(i) Manufacturers called to participate in the random testing procedure shall provide information to the ECRC regarding the places where the ECRC can obtain samples of their Rated Roofing Product for random testing by providing a list of three cooperating distributors, contractors or customers with each application for Roofing Product rating. This information will be updated, if necessary, at the time of application for Product renewal pursuant to section 3.7. The Manufacturer warrants and guarantees that the entities listed by the Manufacturer shall agree to provide samples to the ECRC at no cost and upon ECRC's first request. The ECRC will not bear any cost in this respect, including, without limitation the costs for shipment, preparing or providing the samples. Requests for samples shall be made by ECRC no

more frequently than once a year, unless a Rated Roofing Product fails the first test and must be retested.

(ii) Manufacturers shall provide instructions to ECRC on how to collect or prepare the sample according to ECRC procedures and product specifications. This instruction sheet shall be included with the application for product rating and will be reviewed by the ECRC and forwarded to the contractor, distributor or customer indicated to provide the ECRC with samples.

(iii) The sample to be collected for the random testing will depend on the type of Roofing Product (shingle, coating, tile etc.). The Roofing Product sample might consist of a shingle, a roofing tile, single ply roofing, a clipping from a metal roofing panel, or in the case of field-applied coatings, a prepared sample.

- In the case of field-applied coatings, the instructions will describe how to apply the coating to standard aluminium “panels”.
- The instructions for collecting samples of other Roofing Product types will address issues such as how to take a sample without damaging the Roofing Product and how to obtain a representative sample. In the case of sheet goods, metal roofing products, shingles and tiles, the instructions will describe how to select a representative sample of the Roofing Product and package it for safe transport.
- Samples should be labeled before being sent to the ECRC according to the Manufacturer instructions.

(iv)The ECRC Secretariat will contact ATLs regarding their availability and agree with one of them to perform the testing. The ECRC Secretariat will ship the received samples to the respective ATL for testing.

(v) The results of the test will be compared to the data reported on the ECRC Label of the product and listed in the ECRC Rated Products database. If the randomly tested results are no more than ±0.05 at variance with the Rated Roofing Product values, then the Rated Roofing Product is considered to have passed the random test, and a note will be placed in the file for the Rated Roofing Product documenting the events by the ECRC Secretariat.

(vi) If the results from random testing differ by ±0.05 from the Initial Solar Reflectance or Infrared Emittance values, then the ECRC will follow the below procedure for retesting of random samples.

-If there are no errors, then the sample is tested at another ATL (sent within a month of original testing). If the Rated Roofing Product differs by less than ±0.05 at variance with the Rated Roofing Products values, when tested at another ATL, then the Rated Roofing Product is considered to pass the random test and the section 5.2 (v) shall apply.

-If the results from the second ATL still differ by ±0.05 from the Rated Roofing Product values, then another sample will be collected from another

participating contractor, distributor or customer and the second sample will be tested at an ATL at the sole expense of the Manufacturer.

-If the second sample of the Rated Roofing Product differs not more than ±0.05 at variance with the Rated Roofing Products values, when tested at another ATL, then the Rated Roofing Product will be considered to pass the random test and the section 5.2 (v) shall apply.

-If the second sample of the Rated Roofing Product differs more than ±0.05 at variance with the Rated Roofing Products values, when tested at another ATL, then the Roofing Product is considered to have failed the random test.

-If a Roofing Product fails the random testing program, the Manufacturer or Seller will be notified by the ECRC Secretariat in due course in writing. The Manufacturer or Seller shall be given a 20 business-day period as of the date of the foregoing notification to respond to the random testing failure in which period the use of the ECRC Label can be suspended at the ECRC board sole discretion as set out below.

-If no appeal is made within that timeframe by the Manufacturer or Seller of the respective Roofing Product, the Roofing Product shall be removed from the ECRC Rated Products database and its rating is revoked. The Manufacturer or Seller shall be obliged to immediately cease and discontinue use of the ECRC Label for the respective Roofing product in any way whatsoever.

-Manufacturers may choose to re-rate a Roofing Product that failed the random-testing as set out in this section. Re-rated Roofing Products shall be treated as a new Roofing Product according to the specifications described in the Manual. The re-rated Roofing Product shall automatically be selected for random testing pursuant to this section in the following year.

-A random testing failure of Rated Product of a Manufacturer or Seller may incur further action at the discretion of the ECRC board, including complete removal of the Manufacturer’s or Seller’s other Rated Productfrom the ECRC Rated Products database and use of the ECRC Label.

-If a Manufacturer or Seller has reason to believe that a random testing failure is in error and elects to dispute the results, he shall follow the appeals procedure detailed in section 9. The Manufacturer’s or Seller’s appeal shall take place within 20 days of the ECRC’s written notification to the Manufacturer or Seller regarding Roofing Product failure. During this 20-day period, the Roofing Product will remain active in the ECRC Rated Roofing Products database. If the Manufacturer files an appeal pursuant to section 9 below, the Roofing Product will remain on the database until the appeal is resolved.

6. ECRC RATED PRODUCT LABEL USE

6.1 After the ECRC has explicitly granted the ECRC Label to the Seller or Manufacturer for particular Roofing Products, the Seller or Manufacturer shall only be entitled to apply this ECRC Label on the Roofing Product for which the ECRC Label is granted by the ECRC in accordance with this Manual and for a period of three year or until the Roofing Product does not comply with the Roofing Product in accordance with this Manual, whichever occurring the earliest. The Seller or Manufacturer shall not be entitled to alter, delete, amend or modify in any way whatsoever the ECRC Label except with respect to size and colour subject to the following: (i) The ECRC Label should be of such size as to permit legibility of the wording. (ii) The colours set by the ECRC or may use black or shades of gray. (iii) Only use of the entire ECRC Label is allowed; in particular one may not display or use the design portion of ECRC Label without the words “RATED PRODUCT.”

More information can be found in the Guide: Using ECRC Labels WRITING AND TALKING ABOUT ECRC.

6.2 After the ECRC has explicitly granted the ECRC Logo to the laboratory concerned, the laboratory shall only be entitled to apply this ECRC Logo in accordance with this Manual and for a period of three year or until the laboratory does not comply with the with the approval or accreditation requirements in this Manual, whichever occurring the earliest. The laboratory shall not be entitled to alter, delete, amend or modify in any way whatsoever the ECRC Logo except with respect to size and colour subject to the following: (i) The ECRC Logos hould be of such size as to permit legibility of the wording. (ii) The colours set by the ECRC or may use black or shades of gray. (iii) Only use of the entire ECRC Logo is allowed.

More information can be found in the Guide: Using ECRC Labels WRITING AND TALKING ABOUT ECRC.

7. REVOCATION OR CLOSING FILES

The ECRC shall have the authority to revoke or modify the ECRC Label and inclusion of a Product in the ECRC Rated Products database or the ECRC Logo at its sole discretion in case of:

(A) Failure of the material to conform to its ECRC Label and information included in the ECRC Rated Products database.

(B) Failure of the material, and/or method of manufacturing, to remain consistent with the ECRC Label and information included in the ECRC Rated Products database.

(C) Failure to comply with any condition or rule of this Manual.

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

(E) Failure to comply with any provision related with the ECRC Roofing Product rating program or any other agreement between ECRC on the one hand and Seller and/or Manufacturer respectively the laboratory on the other hand.

(F) Any other ground considered as adequate cause in the sole judgment upon ECRC's sole discretion whether of the same or a different type than listed above.

7.1 Reinstatement

A Manufacturer or Seller respectively laboratory may seek reinstatement to the ECRC after a period of three months. The submission for reinstatement shall be in accordance with the requirements for Roofing Product submission as described in section 3 or laboratory qualification as described in section 2. The decision to reinstate a delisted Manufacturer or Seller's Roofing Product or the approval or accreditation of a laboratory will be determined by the ECRC certification board.

7.2 Consultation

Prior to the ECRC acting on the closing of files, the Manufacturer or Seller holding of the ECRC Label or the laboratory holding the ECRC Logos hall be given reasonable notice and an opportunity to be heard in its request for reinstatement in accordance with section 8.

8. COMPLAINTS

This section 8 describes the procedures for complaints regarding ECRC Labels and Roofing Product ratings on the one hand and the ECRC Logo on the other hand.
Only the Manufacturer or Seller, applicant for an ECRC rating of the respective Roofing Productor the laboratory, applicant for the ECRC Logo, shall have the opportunity to discuss, clarify, and resolve disagreements with respect to the ratings by the ECRC or investigations by the laboratories participating in this ECRC Product rating program by submitting a complaint in accordance with the following proceedings:

1. Complaints shall be directed to the ECRC Secretariat, and shall include the following information:
    a. The name(s) and address(s) of the filer of the claim, telephone, facsimile, and e-mail contact numbers,
    b. A detailed description of the complaint,
    c. Relevant information to support the complaint
2. The ECRC may ask any further information or action take any action as it deems appropriate, in its sole discretion, to address the complaint.

9. APPEALS

A Manufacturer or Seller, the "Appellant," aggrieved by any determination pursuant to section7 "Revocation or Closing Flies" by the ECRC can lodge an appeal within 20 days of the date of as indicated on the ECRC's determination in accordance with the following proceedings

1. Appeals shall be submitted in writing, directed to the ECRC Secretariat, and shall include the following information:
    (A) The name and address of the Appellant, telephone, facsimile, and email contact numbers, and the name and address of legal counsel if the appellant desires to have representation,

(B) A detailed description of the Roofing Product under appeal,
(C) A detailed description of the issue being appealed,
(D) A detailed statement of reasons for appeal,
(E) Relevant evidence and supporting data or information.

The ECRC 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 ECRC, the content of the additional information or written clarification is of substance to warrant additional time.

2. Upon receipt of the Appeal, the ECRC shall assign a file number. All future correspondence to and from the ECRC shall reference the file number. The ECRC may ask any further information or action take any action as it deems appropriate, in its sole discretion, to address the Appeal.

10. INTELLECTUAL PROPERTY

1. The ECRC grants a worldwide right to:
   - every user of the Manual, who accepts, a non-exclusive, non-transferable right to use this Manual privately and internally in order to participate in the ECRC Roofing Product rating program as described therein;
   - the Manufacturer or Seller to use the ECRC Label to apply on the Roofing Product for which the ECRC Label is granted by the ECRC and for a period of three year or until the Roofing Product does not comply with the Roofing Product in accordance with this Manual or the agreement (to be) entered into with the ECRC, whichever occurring the earliest. The Seller or Manufacturer shall not be entitled to alter, delete, amend or modify in any way whatsoever the ECRC Label except with respect to size and colour subject to the following: (i) The ECRC Label should be of such size as to permit legibility of the wording. (ii) The colours set by the ECRC or may use black or shades of gray. (iii) Only use of the entire ECRC Label is allowed; in particular, one may not display or use the design portion of ECRC Label without the words “RATED PRODUCT.” In case of misuse of the ECRC Label by the Manufacturer or Seller or not complying with this Manual or another agreement (to be) entered to with the ECRC by the Manufacturer or Seller, the ECRC can have the ECRC Label withdrawn and the Manufacturer or Seller should immediately cease any use of the ECRC Label. Moreover, the Manufacturer or Seller can then be excluded from the Product Rating Program as well as the Roofing product concerned.
   - the laboratory to use the ECRC Logo for a period of three year or until the laboratory does not comply with this Manual or the agreement (to be) entered into with the ECRC, whichever occurring the earliest. The laboratory shall not be entitled to alter, delete, amend or modify in any

way whatsoever the ECRC Logo except with respect to size and colour subject to the following: (i) The ECRC Logo should be of such size as to permit legibility of the wording. (ii) The colours set by the ECRC or may use black or shades of gray. (iii) Only use of the entire ECRC Logo is allowed. In case of misuse of the ECRC Logo by the laboratory or not complying with this Manual or another agreement (to be) entered to with the ECRC by the laboratory, the ECRC can have the ECRC Logo withdrawn and the laboratory should immediately cease any use of the ECRC Logo. Moreover, the laboratory can then be excluded from the Product Rating Program.

2. No other rights are granted. For the sake of clarity, and without limitation, no user of the Manual, (including but not limited to the Manufacturer or Seller) is allowed (except to the extent expressly permitted by applicable compelling law or by terms and conditions regarding open source components in the software):

    - to distribute, reproduce rent, lease, lend, sell, transfer, sublicense, assign or make any (other) commercial use of the Manual or ECRC Label, except the latter applied on the respective Roofing Products;
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REFERENCES

ASTM C1371: Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers

ASTM C1549: Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer

ASTM D1005: Standard Test Method for Measurement of Dry-Film Thickness of Organic Coatings Using Micrometers

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

ASTM D1730: Standard Practices for Preparation of Aluminium and Aluminium-Alloy Surfaces for Painting

ASTM E903: Standard Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres

ASTM E 1918: Standard Test Method for Measuring Solar Reflectance of Horizontal or Low-Sloped Surfaces in the Field

ASTM E1980: Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces

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

CRRC-1 Program ManualCool Roof Rating Council, Inc., October 4, 2012 Version Available on line at: http://www.coolroofs.org/productratingprogram.html

ANSI/CRRC S100 Standard Test Methods for Determining Radiative Properties of Materials © 2016 Cool Roof Rating Council, Inc. All Rights Reserved. Cool Roof Rating Council Available on line at: http://coolroofs.org/product-rating/ansi-crrc-s100

CRRC-1 Test Method #1: Standard Practice for Measuring Solar Reflectance of a Flat, Opaque, and Heterogeneous Surface Using a Portable Solar Reflectometer Available on line at: http://www.coolroofs.org/productratingprogram.html

Devices & Services Technical Note 11-2 : Model AE1 Emittance Measurements using a Port Adapter, Model AE-ADP, Available online at: http://www.devicesandservices.com/TechNotes/TN11-2.pdf

Devices & Services Technical Note 04-01: EMISSOMETER MODEL AE – Slide Method for AE Measurements, Available on line at: http://www.devicesandservices.com/TechNotes/TN04-1.pdf

Devices & Services Technical Note 10-2: EMISSOMETER MODEL AE1 – Slide Method for High Emittance Materials with Low Thermal Conductivity, Available on line at: http://www.devicesandservices.com/TechNotes/TN10-2.pdf

EN 490: Concrete roofing tiles and fittings for roof covering and wall cladding. Product specifications

EN 544: Bitumen singles with mineral and/or synthetic reinforcements. Product specification and test methods

EN 15976: Flexible sheets for waterproofing. Determination of emissivity

EN1304: Clay roofing tiles and fittings. Product definitions and specifications

EN 13707: Flexible sheets for waterproofing. Reinforced bitumen sheets for roof waterproofing. Definitions and characteristics

EN 1849-1: Flexible sheets for waterproofing. Determination of thickness and mass per unit area. Bitumen sheets for roof waterproofing

EN 13523-0 : Coil coated metals - test methods - part 0: general introduction and list of test methods

ISO 2178 : Non-magnetic coatings on magnetic substrates -- Measurement of coating thickness -- Magnetic method

ISO/IEC 17025: General requirements for the competence of testing and calibration laboratories

ISO/IEC 17011: Conformity assessment -- General requirements for accreditation bodies accrediting conformity assessment bodies.

APPENDIX A:

CRRC test method #1: Standard Practice for Measuring Solar Reflectance of a Flat, Opaque, and Heterogeneous Surface Using a Portable Solar Reflectometer (CRRC 1 Standard)

1. Scope

This Appendix A covers a technique for estimating the mean solar reflectance of a flat, opaque, and heterogeneous test surface at standard conditions, such as a variegated, granule-covered asphalt roofing shingle. The mean solar reflectance of the test surface is determined by averaging the solar reflectances of randomly located spots (small regions) measured with a commercial portable solar reflectometer in accordance with ASTM C1549.

This standard practice shall be used in conjunction with ASTM C1549.

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

2. Reference Documents

ASTM STANDARDS

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

TERMINOLOGY

Estimate of Sample Mean Standard Error. The sample (rather than population) standard deviation divided by the square root of the number of samples.

Heterogeneous. Consisting of dissimilar or diverse ingredients or constituents.

Population. The group of sample values about which conclusions are to be drawn, such as a set of solar reflectance values determined from non-overlapping spots (small regions) that cover an entire test surface.

Population Mean. The arithmetic mean of the property values (e.g., solar reflectances) 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.

Reflectometer. A device that measures reflectance.

Sample Mean. The arithmetic mean of the property values (e.g., solar reflectances) measured for all members of a sample set.

Sample Mean Standard Error. The population standard deviation divided by the square root of the number of samples.

Sample Set. A subset of the population, such as a set of non-overlapping spots (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.

Spot. A small region of a test surface, such as a 1 inch by 1 inch square or a 1 inch-diameter circle, whose solar reflectance can be measured.

Test Surface. A flat, opaque, and heterogeneous surface, such as that of a variegated, granule-covered asphalt shingle.

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

Variegated. Having discrete markings of different colors.

SUMMARY OF STANDARD PRACTICE

For a flat, opaque, and heterogeneous test surface, solar reflectances are measured in accordance with ASTM C1549 at a series of randomly located, non-overlapping spots (small areas) until the specimen mean standard error is small enough to use the specimen mean as an estimate of the mean solar reflectance of the test surface.

3. Significance and Use

This standard practice provides a method for determining the mean solar reflectance of a flat, opaque, and heterogeneous surface, from multiple, random and non-duplicative spot measurements of solar reflectance.

4. Procedure

(A) Set-up

1. Obtain a representative test specimen.
2. Let w and h represent the width and height of the test surface in units of centimeters.

Place a pair of marked rulers at a right angle on two sides of the test surface to establish a grid of w×h square cells, each 2.5 cm by 2.5 cm (1 inch by 1 inch) and centered on integer coordinates. If the area of the test surface does not exceed 194square centimeters (30 square inches), apply Procedure A. If the area is 194 square centimeters (30 square inches) in area or greater, apply Procedure B.

(B) Procedure A (for test surfaces not exceeding 30 square inches in area)

1. Measure the solar reflectance at the center of each cell with a solar spectrum reflectometer in accordance with ASTM C1549, centered over each cell.
2. Report the mean value of cell solar reflectance as the mean solar reflectance of the test surface.

(C) Procedure B (for test surfaces exceeding 30 square inches in area)

1. Measure the solar reflectance at the centers of a minimum of 30 different and randomly selected cells with a solar spectrum reflectometer centered over each cell in accordance with ASTM C1549.
2. Compute the mean, standard deviation, and estimate of standard mean standard error of the solar reflectance of the specimen set. These quantities are defined in Eqs. (3), (4) and (6) of the Appendix, respectively.
3. If the estimate of specimen mean standard error exceeds 0.005, increase the number of specimens by measuring solar reflectance of additional, different, and randomly selected cells.
4. Repeats steps 2 and 3 until the estimate of specimen mean standard error of the specimen set does not exceed 0.005.

5. Report the specimen mean plus or minus twice the estimate of specimen mean standard error as the mean solar reflectance to within 95% confidence.

5. Report

Include in the report, in addition to the requirements stated in ASTM C1549, the following:

(A) Data Requirements

1. The width, height, and area of the test surface.
2. The solar reflectance measurement procedure followed (A or B).
3. The central coordinates and solar reflectance of each cell measured.
4. For Procedure A (applied to test surfaces not exceeding 30 square inches in area), the mean solar reflectance of the test surface, equal to the mean value of cell solar reflectance.
5. For Procedure B (applied to test surfaces exceeding 30 square inches in area), the mean solar reflectance of the test surface to within 95% confidence, expressed as the specimen mean plus or minus twice the estimate of specimen mean standard error.

(B) Test Specimen

1. Manufacturer of the product
2. Manufacturer-designated product name and color.

(C) Date

Date specimen was tested.

6. Precision and Bias

Procedure B was evaluated in a round robin test for six products (solar reflectance 0.04 - 0.20) by five laboratories (Table 1). For five of the six products, the spread in reported values (maximum – minimum) did not exceed 0.01. For the sixth product, the spread was 0.03.

Table 1 Precision and Bias

Specimen Number	Specimen	A	B	C	D	E	**Mean**
#2	Black 3 Tab	0.038	0.036	0.04	0.034	0.04	0.04
#3	Lt. Gray 3 Tab	0.201	0.19	0.20	0.174	0.19	0.19
#4	Contrast 3 Tab	0.070	0.068	0.07	0.064	0.073	0.07
#5	Brown Laminate	0.067	0.06	0.06	0.058	0.062	0.06
#6	Green Slate	0.060	0.055	0.06	0.049	0.059	0.06
#1	Brown Shake	0.060	0.061	0.06	0.053	0.069	0.06

7. Appendix (Non Mandatory)

All reflectances in the following discussion are solar reflectances.

The mean reflectance:

$$R \equiv A^{-1} \int_A r \, dA \tag{1}$$

of a test surface of area A is equal to the mean reflectance of the entire population of N = A/a surface "spots,"

$$\mu \equiv \frac{1}{N} \sum_{i=1}^{N} r_i \, . \tag{2}$$

Each spot i is a sub region of reflectance i r and area a that is small enough to be measured with a reflectometer, and does not overlap any of its neighbors. If N is large, it is convenient to estimate the population means spot reflectance, and hence the test surface means reflectance R, of a large surface by randomly sampling a population subset. Consider a specimen set of different, non-overlapping, and randomly located spots that have mean reflectance

$$\bar{r} \equiv \frac{1}{n} \sum_{i=1}^{n} r_i \tag{3}$$

with standard deviation

$$s \equiv \sqrt{\frac{1}{n-1} \sum_{i=1}^{n} \left(r_i - \bar{r}_n \right)^2} \tag{4}$$

By the Central Limit theorem, the specimen mean r has a standard error

$$\sigma_{\bar{r}} = \sigma / \sqrt{n} \tag{5}$$

where σ is the standard deviation of the spot reflectances of the entire population (Crow et al.,1960). The population mean spot reflectance □ (which is also the mean solar reflectance of the test surface, R) is equal to $\bar{r} \pm 2\sigma_{\bar{r}}$ (95% confidence). If the specimen size n is sufficientlylarge (say, n ≥ 30), the population standard deviation σis well approximated by the specimen standard deviation s, and the estimate of the specimen mean standard error is

$$\sigma_{\bar{r}} \approx s / \sqrt{n} \tag{6}$$

The instrument used to measure spot reflectance in accordance with C1549 has a circular aperture. Hence, the test surface formed by a matrix of contiguous, non-overlapping circular measurement spots will cover a fraction π/4≈ 79% of the rectangular region bounding the matrix of circles. The remaining 21% of the rectangular region will not be sampled. This should be acceptable if the optical properties of the area between each measurement circle and its bounding square are expected to be the same as those of the surface within each measurement circle.

Bibliography

Crow, E.L., F.A. Davis, and M.W. Maxfield. 1960. Statistics Manual: With Examples TakenFrom Ordnance Development. New York: Dover Publications.