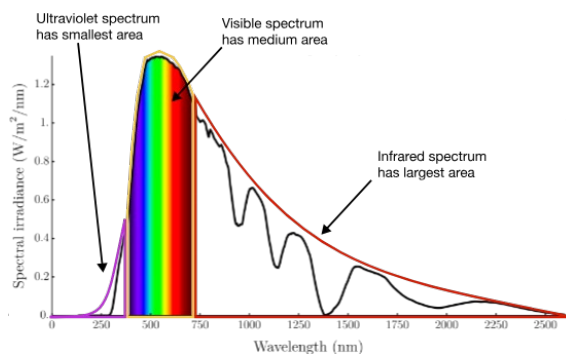


NCCA, Cool Roofing, and the CRRC Roofing and Wall Rating Programs

Over the last 20 years, the concept of “cool roofing” (i.e., high solar reflectance) has become commonplace. More states are requiring cool roofing for new buildings, and important associations such as The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) have been developing cool roof specifications. In the U.S., the Cool Roof Rating Council (CRRC) plays an important role in providing robust data to interested parties, and it has an extensive program developed, outlining all the requirements necessary to participate in its program. This tool kit is offered as an overview of the CRRC’s program. It is not meant to be used as an alternative to the substantial details offered in CRRC’s program manual. Complete details may be found at <https://coolroofs.org>.

In 1998, the California Energy Commission (CEC) decided to establish a “cool roofing” specification for any new building built in the state. The requirements were covered in the California Building Code Title 24, and included low-slope roofing, as well as steep slope roofing. Many prepainted metal roofing products are used in the latter category, which is defined as a roof having a slope >2:12 (about 10 degrees of slope). Early in the specification development stage, solar reflectance (SR) and thermal emittance (TE) were the two key properties that would be specified.

Energy coming from the sun consists of UV radiation (about 4% of total radiation from the sun), visible light (about 46%), and Infrared radiation (about 50%). Only the infrared portion provides the heating effect that we experience.



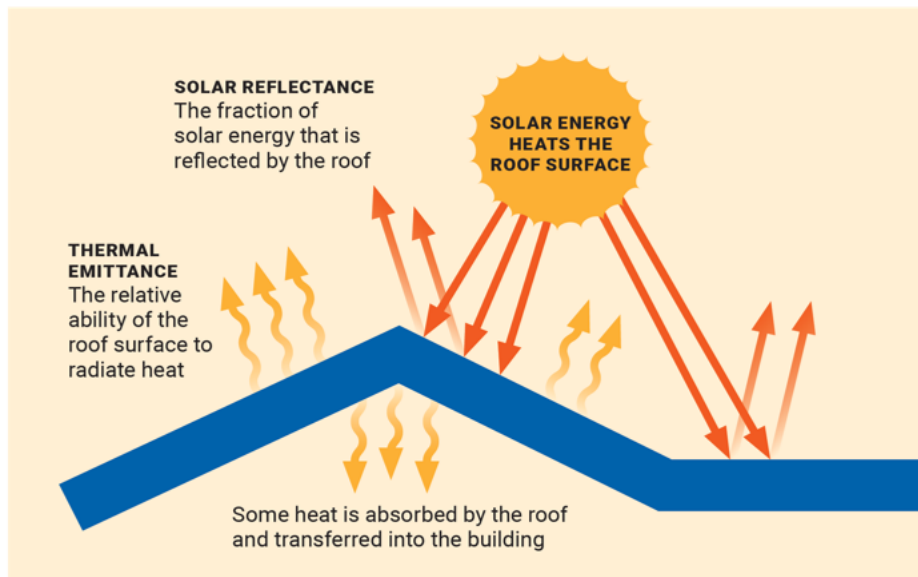
Source: Brilliant.org

As the sun strikes a building’s roof surface, the roof heats up and some of that heat is transported into the building. Particularly in warm climates, this heat transfer increases the demand for air conditioning. Maximizing the solar reflectance (SR) minimizes heat transfer, and SR is a key parameter that is specified in many building codes (not just California Title 24).

This Tool Kit is part of a series of educational aids developed by the members of the National Coil Coating Association. NCCA is a trade association of coil coaters and suppliers of raw materials and equipment used in the coil coating process. The association concentrates its efforts on providing educational resources and assisting its members in providing superior products and services to their customers. NCCA Tool Kits are information tools and should not be used as substitutes for instructions from individual manufacturers. Always consult with individual manufacturers for specific instructions regarding their products and equipment.

Thermal emittance (TE) is another key property of all materials, which is also specified in building codes where cool roofing is specified. TE measures the amount of thermal IR that an object is emitting, compared against a perfect emitter. Shiny metal, when it gets hot, stays hot because it has a very low TE. Nearly all other materials on earth, however, have a $TE > 0.75$, and this includes prepainted metal. Not only does cool roofing prepainted metal reflect a lot of solar IR, it also emits a lot of thermal IR, making it an ideal material for roofing that is designed to minimize heat transfer from the roof into the building.

The picture below shows the reflectance aspect of cool roofing (SR), along with the emittance characteristics (TE).



This illustration describes the flow of radiant energy as heat between the sun, roof surface, building interior, and surroundings. The higher the solar reflectance, the more solar energy is reflected away from the roof surface. Some of the solar energy is absorbed by the roof as heat. The higher the thermal emittance, the more of this absorbed heat is radiated away from the roof surface. IMAGE CREDIT: COOL ROOF RATING COUNCIL.

Although the CEC prefers three-year aged (i.e., weathered) values, rather than SR and TE values of new, unaged materials, it realized that only the latter would be available as the program was launched. The Commission also decided that it needed to fund the formation of a rating agency that would develop a program to collect and disseminate credible radiative data. The Cool Roof Rating Council (CRRC) became that entity.

The CRRC offers product ratings for ANY company interested in having their roofing and wall products listed and labeled with information about the product's surface radiative properties: solar reflectance and thermal emittance. In order for products to be rated, however, the company must first become a CRRC Licensee in the Roof/Wall Product Rating Program (<https://cool-roofs.org/programs/roof-rating-program/become-a-licensee>).

All radiative property testing is conducted by an CRRC Accredited Independent Testing Laboratory (AITL) in accordance with the applicable CRRC-approved test methods:

Solar reflectance

- ASTM C1549 Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer
- ASTM E1918 Standard Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field
- ASTM E903 Standard Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres
- CRRC-1 Method #1 Standard Practice for Measuring Solar Reflectance of a Flat, Opaque, and Heterogeneous Surface Using a Portable Solar Reflectometer
- CRRC Directional-Hemispherical Solar Reflectance Test Method CRRC Directional-Hemispherical Solar Reflectance Test Method (using Surface Optics 410-Solar or 410-Solar-i)

Thermal emittance

- ASTM C1371 Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers
- Slide Method (uses C1371 with materials with poor heat transfer properties; does not apply to prepainted metal, unless the sample has an insulative backing)

CRRC maintains a list of Accredited Independent Testing Laboratories that a member may choose. (<https://coolroofs.org/programs/product-testing-and-weathering/accredited-labs-and-test-farms>).

After initial testing of a product sample, the sample is sent to a CRRC Approved Test Farm where it is exposed to outdoor weathering for three years. Outdoor exposure occurs at CRRC Approved Test Farms in three designated locations in the United States that collectively represent the average U.S. climate: Arizona (hot/dry), Ohio (cold/temperate), and Florida (hot/humid). After three years of field exposure, the weathered specimens are returned to an AITL for aged testing.

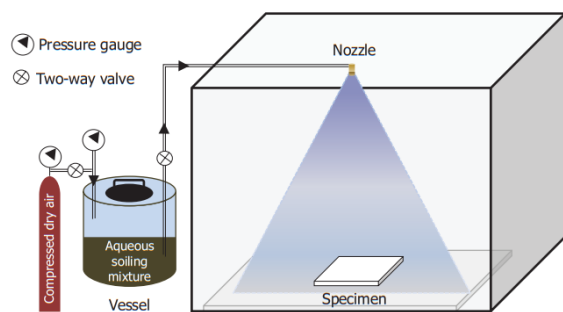
Rated roofing products are listed on the CRRC Rated Roof Products Directory (<https://coolroofs.org/directory/roof>). A product's placement in the directory does not mean that the product is "cool," as defined by any particular code, standard, or program; rather, it simply means that the product has undergone the initial testing, aging, and final testing required in the CRRC roof and wall rating programs.

Licensees are permitted to use the CRRC Product Label to display the rated values on a product's packaging. Visit the Product Label Use Guidance page on the CRRC website. The CRRC Product Label aids in quick compliance of building codes and programs that require roofing

products meet specific radiative performance levels for the reduction of energy use, greenhouse gas emissions, and/or helping mitigate the impacts of the urban heat island effect.

Rapid Ratings Program

A key part of the CRRC Product Rating Program is the three-year weathering test, which informs consumers of product performance in the field over time. In order to accelerate product development and assist manufacturers in getting products on the market sooner, the CRRC has established the Rapid Ratings Program, which is based on a laboratory-aging practice described in ASTM D7897 Standard Practice for Laboratory Soiling and Weathering of Roofing Materials to Simulate Effects of Natural Exposure on Solar Reflectance and Thermal Emittance.



Source: ASTM D7897, figure 1

CRRC Rapid Ratings is an optional product rating process that provides interim laboratory-aged values. This process allows CRRC Licensees to list the laboratory-aged radiative property. The aging simulation can be completed by an approved CRRC Rapid Ratings Lab in less than a week (<https://coolroofs.org/programs/roof-rating-program/rate-a-roofing-product#rating-types>).

The Rapid Ratings process is not a substitute for three-year weathering at a CRRC Approved Test Farm. These interim values are displayed on the Rated Roof Products Directory and on the CRRC Product Label until the product completes the required three-year weathering process and aged testing. Upon completion of three-year weathering and aged testing, the three-year aged values replace the Rapid Ratings in the directory and CRRC Product Label.

NOTE: The rapid ratings program is an accelerated *environmental staining* test, not an accelerated weathering test with which the coil coating industry is familiar. The test was developed to provide insight into the long-term performance of low-slope roofing products, such as field-applied coatings and membranes, which are inclined to stain badly during their lifetime. These soft, flexible products are formulated to accommodate expansion and contraction of a low-slope roof as it experiences significant temperature fluctuation. These softer coatings, however, are more prone to staining.

Random Testing Program

Random Testing provides quality assurance of the Rated Roof Products Directory through routine verification of a product's rated values. Each year, a percentage of products listed on the directory is randomly selected to go through the Random Testing Program. The longer a product has been listed in the Directory, or if a product was not selected in previous years, the more likely that product is to be selected for Random Testing. This program adds another level of assurance for code bodies that products in the field are performing according to the information on the CRRC Product Directory.

Color Family Program

In the prepainted metal industry, myriad colors are offered for roofing and wall products. Rating (i.e., initial testing, aging, and final testing) each product would be onerous, as well as prohibitively expensive. Since creating various colors within any coatings technology involves simply altering the selection and levels of pigments, it is reasonable to assume that the performance of a product within a similar technology (e.g., PVDF), within a narrowly defined color range, will behave similarly to other products of similar—but not identical—color. For this reason, the CRRC has adopted the concept of Color Families, Color Family Groups, and processes to qualify a limited set of products within a given resin material technology to represent the entire color line within that product.

Each color family is identified by its Hunter color values (L, a, and b). A product to be submitted as part of a color family needs to fall into the defined color space. Assuming this is the case, the submitted product is given an assigned (i.e., default) solar reflectance and thermal emittance values. For coil coated products, the following table of values is used to define the seventeen (17) color families for *both* the roofing and the wall rating programs.

Color Family	Hunter L range	Hunter a range	Hunter b range	Assigned SR	Assigned TE
Red	17 to 29	+7 to +36	0 to +15	0.25	0.83
Terra Cotta	20 to 38	+15 to +30	+6 to +16	0.35	0.83
Bright Red	23 to 38	+35 to +49	+10 to +48	0.35	0.83
Beige	59 to 86	-5 to +5	-3 to +23	0.55	0.83
Tan	51 to 65	-2 to +7	+6 to +21	0.45	0.83
Dark Blue	13 to 35	-7 to +6	-25 to -2	0.25	0.83
Med-Light Blue	34 to 55	-12 to -3	-25 to -8	0.32	0.83
Dark Brown	17 to 30	-1 to +9	0 to +10	0.25	0.83
Med-Light Brown	25 to 58	-2 to 17	+2 to +26	0.32	0.83
Dark Green	18 to 45	-20 to -3	-25 to +11	0.25	0.83
Med-Light Green	24 to 70	-20 to 0	-25 to +11	0.32	0.83
White	76 to 89	-3 to +2	-3 to +10	0.65	0.83
Bright White	>85	-3 to +1	-3 to +6	0.7	0.83
Black	<26	-1.5 to +1.5	-1.5 to +1.5	0.25	0.83
Dark Gray	24 to 42	-4 to +2	-8 to +4	0.25	0.83
Med-Light Gray	40 to 77	-4 to +3	-3 to +8	0.35	0.83
Pearlescent Colors	25 to 75	-15 to 17	-15 to 24	0.35	0.75

Measured Hunter "L," "a," and "b" color coordinates are reported in accordance with ASTM E805 Standard Practice for Identification of Instrumental Methods of Color or Color-Difference Measurement of Materials, Section 9, Colorimetry Equipment Specification: 0/45 or 45/0 (illuminant angle, viewing angle) geometry, 10 observer, D65 illuminant.

The assigned SR and TE values represent the *minimum* SR and TE for each color family—*after aging*. An abundance of weathering data was provided by NCCA members to convince CRRC that not only does the color family concept make sense, but also the default values represent realistic, aged values.

The general color family process is:

1. Submit one product for weathering that will represent the company’s color family for a particular technology. The product must fall within the color values shown above, and must have a SR and TE value greater than or equal to the values shown.
2. After three years of weathering, so long as the SR and TE of the weathered sample has remained above the SR and TE default values, that one product will represent the group.
3. Additional products (same technology as that representative formulation) that fall with the color parameter may be submitted to CRRC to be listed on the website, but still must have its SR and TE measure, but will not need to undergo three-year weathering.

NOTE: CRRC requires triplicate samples for each product read by the independent test laboratory, as well as samples being sent to a test farm. There are three locations where products need to be tested, so every submission to CRRC for weathering requires 9 samples.

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For further information regarding this toolkit, please contact the National Coil Coating Association, (216) 241-7333 or by e-mail at ncca@coilcoating.org.

January 17, 2023

The color family program has proven successful at minimizing costs within our industry while maintaining the integrity of the CRRC process, but any individual product may be listed *outside* of the color family program. This usually occurs for those few colors that do not fit neatly in the color requirements shown in the above table.

This tool kit does not attempt to describe every detail described in the CRRC rating programs. The CRRC website will direct you to all details, or you may contact NCCA headquarters at ncca@coilcoating.org.