



ENERGY STAR® Program Requirements Product Specification for Roof Products

Eligibility Criteria FINAL DRAFT Version 3.0

Following is the ENERGY STAR **Version 3.0** product specification for roof products. A product shall meet all of the identified criteria if it is to earn the ENERGY STAR.

1. Definitions

1.1 General

- A. Roof surface: The uppermost part of the roof system that is in direct contact with solar radiation.
- B. Low-Slope Roofs: Surfaces with a slope of 2:12 or less.¹
- C. Steep-Slope Roofs: Surfaces with a slope greater than 2:12.
- D. Low-Slope Roof Products: Products that are typically installed on low-slope surfaces such as single-ply membranes, built-up-roofs (BUR), modified bitumen, spray polyurethane foam, roof coatings, metal panels, and standing-seam profiled metal. Some products that are typically installed on low-slope roofs may also be installed on steep-slope roofs (e.g., single-ply membranes and roof coatings). For the purposes of this specification, the roof product will constitute the roof surface.
- E. Steep-Slope Roof Products: Products that are typically installed on steep-slope surfaces such as composite shingles, clay, concrete, or fiber-cement tile, slate, metal panels, and metal shingles. Some products that are typically installed on low-slope roofs may also be installed on steep-slope roofs (e.g., single-ply membranes and roof coatings). For the purposes of this specification, the roof product will constitute the roof surface.

1.2 Roof Products

- F. Built-Up-Roof (BUR): Traditional hot asphalt or coal tar built-up roofing membrane assembly consists of alternating layers of felts, fabrics, or mats saturated with bitumen during manufacture, assembled in place, and adhered with applied layers of hot bitumen. Surfacing for the hot BUR can be aggregate embedded in hot asphalt; mineral-surface cap sheets; modified bitumen cap sheets; or smooth-surface applications or coatings.²
- G. Asphalt Shingle: Composed of a base material, either organic felt or glass fiber mat; asphalt; and surfacing material, generally in the form of mineral granules.³
- H. Metal Roof Component: Metal roof product designed to resemble a traditional steep-slope residential product such as shingle, tile, shake, or slate.
- I. Metal Roof Panel: Roofing systems using metal panels are divided into two categories: architectural and structural. Architectural metal roofs are applied over a substrate while structural metal roofs span between structural supports without the need for a substrate to carry the applied

¹ As defined in ASTM Standard E 1918-06.

² National Roofing Contractors Association Commercial Low-Slope Roofing Materials Guide 1998.

³ Ibid.

loads. Standing seam roofs can be used on roofs with slopes as low as ¼:12. Steel and aluminum sheets are commonly used to fabricate metal roof panels. Steel requires a corrosion resistant metal coating such as zinc, aluminum, alloys of zinc-aluminum, or tin. Metallic coated steel includes galvanized steel, aluminized steel, zinc-aluminum-coated steel and terne-coated steel. Metallic coated steels may also be painted to provide additional corrosion protection, as well as color.

- J. Modified Bitumen: Roll roofing products consisting of asphalt, reinforcing layers, and in some cases, surfacing. During manufacture, a polymer (APP, or atactic polypropylene, and SBS, or styrene butadiene styrene, are the most common) is added to the bitumen while heating, which "modifies," or changes, its properties.⁴
- K. Roof Coating: A material typically applied in the liquid state to the roof surface at the time of construction or at a later time as a retrofit measure. Roof coatings may be bituminous, polymeric, polymer modified, epoxy based, or other formulations. Bituminous roof coatings are formulated using bitumen. Polymeric roof coatings are formulated using a variety of synthetic resins such as acrylic, neoprene, styrene butadiene, urethane, polyvinyl acetate, and others. Polymer modified roof coatings are manufactured by combining a portion of the polymeric technology with bitumen technology.
- L. Roof Tile: May be composed of clay, concrete, fiber-cement, or synthetic materials. A variety of tile profiles, styles, finishes, and colors are available.
- M. Single-Ply Membrane: A term applied to a sheet membrane which is a membrane fabricated in a controlled factory environment. It is waterproof and weather resistant. It may be a laminate of one or more materials and may or may not contain reinforcing fabrics.⁵
- N. Spray Polyurethane Foam Roof System: A fully adhered system that consists of a rigid closed-cell sprayed-in-place polyurethane foam insulation and a protective roof coating. Typical coatings include acrylic, silicone, or urethane elastomers.
- O. Variegated Roof Products: A material with a varied surface color, requiring a larger sample for measurement of Solar Reflectance.⁶
- P. Factory-Applied Roof Product Component: A material or component made by a licensed Original Manufacturer (OM) which is applied to a substrate in a factory or coating facility (i.e. not in the field).

1.3 Roof Product Performance

- Q. Solar Flux: The direct and diffuse radiation from the sun received at ground level over the solar spectrum expressed in watts per square meter.
- R. Solar Reflectance: The fraction of solar flux reflected by a surface expressed as a percent or within the range of 0.00 and 1.00.
- S. Solar Spectrum: Radiation originating from the sun, including ultraviolet, visible, and near-infrared radiation. Approximately 99 percent of solar energy lies between wavelengths of 0.3 to 3.5 micrometers (Fm).
- T. Thermal Emittance: The ratio of the radiant heat flux emitted by a sample to that emitted by a blackbody radiator at the same temperature (Total Thermal Emittance).⁷

⁴ National Roofing Contractors Association Commercial Low-Slope Roofing Materials Guide 1998.

⁵ As found in Single Ply Roofing Industry's Publication, Flexible Membrane Roofing: Professional's Guide to Specifications, 2003.

⁶ As defined in Cool Roof Rating Council, Product Rating Program, CRRC-1.

⁷ Ibid.

1.4 Color Families

- U. Color Family Binder/Resin Technology: General class of factory-applied coatings used in metal roofing products which are defined by the family of related binder/resin chemicals used to formulate such coatings.
- V. Hunter “L,” “a,” “b” Color Values: A numeric measurement of a color’s lightness (L), redness/greenness (a) and yellowness/blueness (b).
- W. Color Family: A CRRC pre-defined range of Hunter “L”, “a”, and “b” color values that establishes the color space for a CRRC predefined set of seventeen colors.
- X. Color Family Group: One or more production line of factory coated metal roofing products that have the same binder/resin technology, color properties, solar reflectance, and thermal emittance values that fall within the ranges established for the respective CRRC Color Family.
- Y. Color Family Element: A uniquely formulated roofing product that is a member of a Color Family Group and is either: (1) a factory-applied roof product component that serves as the top coating on a factory coated metal roofing product or (2) a metal roofing product that has a factory-applied roof product component as its top coating.
- Z. Color Family Representative Element: A Color Family Element that is used to initially establish a Color Family Group.
- AA. Color Family Additional Element: A Color Family Element that is not the Color Family Representative Element.⁸

1.5 Climate Zones

- BB. Hot/Humid Climate: A region with Annual Heating Degree-Day (HDD) at 65⁰ F of 200, Annual Cooling Degree-Day (CDD) at 50⁰ F of 9,474 and an average yearly relative humidity of 83% in the A.M. and 61% in the P.M. Example regions include but are not limited to: Miami, Florida⁹
- CC. Hot/Dry Climate: A region with Annual HDD at 65⁰ F of 1,350, Annual CDD at 50⁰ F of 8,245 and an average yearly relative humidity of 50% in the A.M. and 23% in the P.M. Example regions include but are not limited to: Phoenix, Arizona⁹
- DD. Cold/Temperate Climate: A region with Annual HDD at 65⁰ F of 6,201, Annual CDD @ 50⁰ F of 2,755 and an average yearly relative humidity of 80% in the A.M. and 62% in the P.M. Example regions include but are not limited to: Cleveland, Ohio⁹

2. Scope

- 2.1. **Included Products**: Products that meet the definition of a Roofing Product as specified herein are eligible for ENERGY STAR qualification, with the exception of products listed in Section 2.2. To qualify for ENERGY STAR, roof products shall be:
 - 2.1.1. Tested through the Cool Roof Rating Council (CRRC) Product Rating Program, including Color Family Groups and Compound Product Ratings, or¹⁰
 - 2.1.2. Evaluated using the test methods referenced in Table 3 in Section 4, below.

⁸ As defined in Cool Roof Rating Council, Product Rating Program, CRRC-1.

⁹ As defined in Cool Roof Rating Council, Product Rating Program, ANSI/CRRC-1-2010, ANSI Approved 11.16.2010.

¹⁰ Information on the Cool Roof Rating Council Product Rating Program can be found at www.coolroofs.org

2.2. Excluded Products: Roof products intended for use on siding or walls, are not eligible for ENERGY STAR under this product specification.

3. Qualification Criteria

3.1 Significant Digits and Rounding

- 3.1.1. All calculations shall be carried out with actual measured or observed values. Only the final result of a calculation shall be rounded.
- 3.1.2. Unless otherwise specified, compliance with specification limits shall be evaluated using exact values without any benefit from rounding.
- 3.1.3. Directly measured or calculated values that are submitted for reporting on the ENERGY STAR website shall be rounded to the nearest significant digit as expressed in the corresponding specification limit.

3.2 Solar Reflectance and Reliability

- 3.2.1 The average of all solar reflectance values obtained during testing shall be used to meet the Initial Solar Reflectance limits provided in Table 1 (low-slope) or Table 2 (steep-slope), below.
- 3.2.2. To meet the Maintenance of Solar Reflectance limits provided in Table 1 (low-slope) or Table 2 (steep-slope), below, roof products shall qualify by obtaining the average of solar reflectance values obtained during testing for products weathered in three different climate zones as defined in Section 1.5, above. Note that the three climate zone values used to determine qualification under this option represent averaged values within each individual climate zone.
- 3.2.3 The hot/humid, hot/dry, and cold/temperate climates Heating Degree-Day (HDD) and Cooling Degree-Day (CDD) shall be determined in accordance with ANSI/ASHRAE Standard 169-2006. Average yearly relative humidity shall be determined in accordance with NOAA comparative climate data. Test farm location climate values shall be within plus or minus ten-percent of those values presented in the climate zone definitions in Section 1.5, above.
- 3.2.4 Roof products that may be applied to either low-slope or steep-slope roofs, such as roof coatings and single-ply membranes, shall meet the Table 1 requirements, below.

Table 1 – Specifications for Low-Slope Roof Products	
Characteristic	Performance Specification
Solar Reflectance	
Initial Solar Reflectance	Greater than or equal to 0.65.
Maintenance of Solar Reflectance	Greater than or equal to 0.50 three years after installation under normal conditions.
Reliability	
Manufacturer warranty for defects in materials and manufacturing	Each company's warranty for ENERGY STAR qualified roof products shall be equal in all material respects to the product warranty offered by the same company for comparable non-ENERGY STAR qualified roof products. A company that sells only ENERGY STAR qualified roof products shall offer a warranty that is equal in all material respects to the standard industry warranty for comparable non-ENERGY STAR qualified roof products.

Table 2 – Specifications for Steep-Slope Roof Products	
Characteristic	Performance Specification
Energy Efficiency Levels	
Initial Solar Reflectance	Greater than or equal to 0.25.
Maintenance of Solar Reflectance	Greater than or equal to 0.15 three years after installation under normal conditions.
Reliability	
Manufacturer warranty for defects in materials and manufacturing	Each company's warranty for ENERGY STAR qualified roof products shall be equal in all material respects to the product warranty offered by the same company for comparable non-ENERGY STAR qualified roof membrane products. A company that sells only ENERGY STAR qualified roof products shall offer a warranty that is equal in all material respects to the standard industry warranty for comparable non-ENERGY STAR qualified roof products.

4. Test Requirements

4.1 Representative Models shall be selected for testing per the following requirements:

- 4.1.1 For qualification of an individual product model, the representative product shall be equivalent to that which is intended to be marketed and labeled as ENERGY STAR.
- 4.1.2 For qualification of a product family, one product shall be designated as the Color Family Representative Element. The Color Family Representative Element shall be tested for initial *and* aged solar reflectance and thermal emittance. Tested initial solar reflectance shall meet or exceed the Color Family Group default solar reflectance value and default thermal emittance value. Additional products to be submitted into an already established Color Family Group are called Color Family Additional Elements. Color Family Additional Elements shall also be tested for initial solar reflectance and thermal emittance, but aged testing is not required. All Color Family Elements shall be tested for Hunter “L”, “a”, “b” values. Color families are defined in *Table 1: CRRC Color Families and Characteristics*.¹¹
- 4.1.3 For Color Family Representative Elements, aged reflectance values are subsequently established for the Color Family Group as *either* the measured aged values of the Color Family Representative Element *or* the initial Color Family default values, whichever is lower.
- 4.1.4 After a Color Family Group is established by rating a Color Family Representative Element, additional products of the same binder/resin technology that fall within the specified Hunter “L”, “a”, “b” color range can then be added to the Color Family Group as “Color Family Additional Elements” by testing each Additional Element’s initial solar reflectance and thermal emittance. Reported values shall be no higher than the default values of the Color Family Program as defined for that color group.

Note 1: No aged testing is required for Color Family Additional Elements. The Color Family Additional Element shall qualify using the default solar reflectance value and default thermal emittance value of the Color Family Group and the aged solar reflectance value of the Representative Element of the Color Family Group; either the initial Color Family Group default value or the actual aged rated value of the Representative Element, whichever is lower.¹²

Note 2: Variegated roof products using binder/resin technologies encompassing multiple Color Family Groups shall not qualify as Color Family Additional Elements.

¹¹ As found in Cool Roof Rating Council’s [Product Rating Program Manual CRRC-1](#).

¹² As found in Cool Roof Rating Council’s [Product Rating Program Manual CRRC-1](#).

Note: EPA has added the following two tables to clarify Color Family certification. The tables are intended to provide a more readable format for assessing Color Family Representative Elements and Color Family Additional Elements based on the information in section 4.1.2 through 4.1.4 Note 1.

Table 3 – Color Family Representative Elements Testing and Reporting Requirements	
Initial Solar Reflectance	Testing: Required Performance requirement: Tested initial solar reflectance shall meet or exceed the Color Family default solar reflectance value
Maintenance of Solar Reflectance	Testing: Required Performance requirement: Measured aged values of the Color Family Representative Element <i>or</i> the Color Family default solar reflectance values, whichever is lower
Emissivity	Testing: Required Performance requirement: Tested emissivity shall meet or exceed the Color Family default thermal emittance value
Hunter “L” “a” “b” Values	Testing: Required Performance requirement: Hunter “L” “a” “b” values must fall within the appropriate Color Family range

Table 4 – Color Family Additional Elements Testing and Reporting Requirements	
Initial Solar Reflectance	Testing: Required Performance requirement: Tested initial solar reflectance shall meet or exceed the Color Family default solar reflectance value Reporting requirement: Color Family default solar reflectance value
Maintenance of Solar Reflectance	Testing: N/A Performance requirement: N/A Reporting requirement: The lower of the measured aged values of the Color Family Representative Element <i>or</i> the Color Family default solar reflectance values
Emissivity	Testing: Required Performance requirement: Tested emissivity shall meet or exceed the Color Family default thermal emittance value Reporting requirement: Color Family default thermal emittance value
Hunter “L” “a” “b” Values	Testing: Required Performance requirement: Hunter “L” “a” “b” values must fall within the appropriate Color Family range

4.1.5 When testing roof products, the following test methods shall be used to determine ENERGY STAR qualification:

Table 5 – Test Methods for ENERGY STAR Qualification	
ENERGY STAR Requirement	Test Method Reference
Initial Solar Reflectance	ASTM E 903-96 - <i>Standard Test Method for Solar Absorptance, Reflectance, and Transmission of Materials Using Integrating Spheres</i> (solar reflectance only, values for solar absorptance and transmission need not be obtained), or ASTM E 1918-06: <i>Standard Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field</i> , or

	ASTM C 1549-09 - <i>Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer</i>
Initial Solar Reflectance: Variegated Roof Products (optional)	CRRC-1 Test Method #1 - <i>Standard Practice for Measuring Solar Reflectance of a Flat, Opaque, and Heterogeneous Surface Using a Portable Solar Reflectometer</i>
Initial Solar Reflectance: Tile Products (optional)	CRRC-1 Program Manual, Section 2.2.4.A
Initial Solar Reflectance: Wood Products (optional)	CRRC-1 Program Manual, Section 2.2.4.B
Maintenance of Solar Reflectance*	ENERGY STAR Test Method for Roof Products: Maintenance of Solar Reflectance, July 2016 (relevant ASTM standard references are included in this document)
Emissivity	ASTM C1371-04a(2010)e1 - <i>Standard Test Method for Determination of Emittance of Materials Near Room Temperature using Portable Emissometers</i>
Emissivity: Slide Test Method (optional)	CRRC-1 Program Manual, Section 2.2.5

Note: EPA remains interested in an accelerated aging method and will continue to closely monitor efforts by the U.S. Department of Energy (DOE) in pursuing its Advanced Surfaces (Accelerated Aging) Project. EPA encourages partners to stay engaged in this process and provide feedback on this alternative test that could help to address the length of time required for qualification. Once EPA has reviewed and is satisfied with the integrity of the test method, EPA will adopt this method as an accepted alternative to the proposed weathering farm test procedure and could potentially be available before the effective date of Version 3.0. EPA will also continue to accept products tested in accordance with the climate zone weathering requirement detailed in the Version 3.0 specification.

***Note:** Maintenance of Solar Reflectance can also be established using the CRRC Color Family Program as defined in the Product Rating Program Manual (CRRC-1). This program addresses the fact that, with a given binder/resin material technology, the performance of a product will vary little between products of similar, but not identical, color. This program establishes a representative product (i.e., Color Family Representative Element), which will represent a group of similar products throughout the testing process. Please refer to the Color Family Group Requirements and Color Family Additional Element Requirements sections above for additional information.

4.2 Initial Solar Reflectance: Each exposure panel shall be at least 24 square inches in size, e.g. 4" x 6" or 3" x 8" and shall be sized in accordance with applicable test method requirements e.g. for CRRC-1 Test Method #1 each exposure panel shall be 40 square inches per sample and for E1918-06 each exposure panel shall be 172 square feet per sample. For field applied coatings, the sample shall be prepared according to manufacturer recommendation for thickness used in the field over a black substrate.

Note: In response to stakeholder request to clarify sample size requirements, EPA has provided further explanation in 4.2 above that sample size shall follow that which is outlined within the applicable test method used for initial solar reflectance measurements.

4.3 Changes to Product Formulation: If a fundamental element of product formulation occurs, such as the base latex, the product shall be retested for the solar reflectance of both initially and

according to the Maintenance of Solar Reflectance Test Method. In addition, to ensure other product formulation changes will not affect the solar reflectance of the product, evidence shall be provided that shows product formulation or recipe has not changed since the solar reflectance testing was performed.

- 4.4 Color Family Element Testing:** All Color Family Elements shall be tested for Hunter “L”, “a”, “b” values. Color families are defined in *Table 1: CRRC Color Families and Characteristics* found in the CRRC Product Rating Program Manual (CRRC-1).
- 4.5 Emissivity:** Initial emissivity results shall be tested according to the test methods listed in Table 3 of this specification. Roof products are not required to meet minimum emissivity requirements for ENERGY STAR qualification at this time unless the roof product is qualifying using Color Family Groups.
- 4.6** As required in the *ENERGY STAR Test Method for Roof Products: Maintenance of Solar Reflectance*, the test surface of each sample shall not be washed, cleaned, or wiped in any fashion prior to testing aged solar reflectance. Loose dirt, embedded dirt, environmental stains, mold, mildew, and any other material that rests on – or has become incorporated into – the surface of the material shall not be altered.

5. Effective Date

The ENERGY STAR Roof Products Specification shall take effect on **July 1, 2017**. To qualify for ENERGY STAR, a product model shall meet the ENERGY STAR specification in effect on the model’s date of manufacture. The date of manufacture is specific to each unit and is the date on which a unit is considered to be completely assembled.

Note: Some stakeholders continue to express concern that given third-party certification processes, and the length of time needed to test aged reflectivity, the effective date as proposed in the previous draft (i.e., 3 years 6 months after Version 3.0 finalization) would be too challenging. EPA continues to believe that this transition period allows manufacturers enough time to test aged reflectivity, if needed, and transition to the new specification.

6. Future Specification Revisions

EPA reserves the right to change the specification should technological and/or market changes affect its usefulness to consumers, industry, or the environment. In keeping with current policy, revisions to the specification are arrived at through industry discussions. In the event of a specification revision, please note that the ENERGY STAR qualification is not automatically granted for the life of a product model.