Solar Reflectance:
The fraction of solar energy reflected by the roof. Aged solar reflectance is the reflectance of the surface after 3 years. Requirements are dependent on climate zone and roof slope (low or steep), per Section 150.2(b)1H
The higher the Solar Reflectance, the better the roofing material’s ability to reduce heat transfer into the building.

Thermal Emittance:
The relative ability of the roof surface to radiate absorbed heat. Requirements are dependent on climate zone and roof slope (low or steep), per Section 150.2(b)1H
The higher the Thermal Emittance, the better the roofing material’s ability to reduce heat transfer into the building.

Solar Reflectance Index (SRI)
The SRI provides an alternative to meeting reflectance and emittance requirements. Generally, the higher the SRI, the better the roofing materials ability to reduce heat transfer into the building.

To qualify as a Cool Roof under the Energy Code roofing material must have a Cool Roof Rating Council (CRRC) rating and meet specified values for reflectance and emittance (or specified SRI values.) Section 10-113 discusses the cool roof designation and the state’s certification program for roofing products.
What Is a Cool Roof?

A cool roof is a roofing product with high solar reflectance and thermal emittance properties, which help reduce cooling loads by lowering roof temperatures on hot, sunny days. Solar reflectance and thermal emittance are properties of the roofing surface – not of insulation that may be used in conjunction with the roofing material.

Although often light in color, cool roofs come in a wide variety of colors ranging from white to black and including blues, grays, greens, oranges, browns, and tans. Cool roofs also are available in a variety of styles: shingle, shake, tile, membrane, and spray-on liquid coatings.

Relevant Code Sections

2019 California Building Energy Efficiency Standards, Title 24, Part 6:
• Section 10-113 – Rating and Labeling of Roofing Product Reflectance and Emittance
• Section 110.8(i) – Mandatory Requirements - Roofing Products Solar Reflectance and Thermal Emittance
• Section 150.1(c)11 – Prescriptive Standards/Component Package for Low-Rise Residential Buildings, Roof Products
• Section 150.2(b)1H – Energy Efficiency Standards for Alterations to Existing Low-Rise Residential Buildings, Prescriptive Approach, Roofs:
• Section 150.2(b)2 – Energy Efficiency Standards for Alterations to Existing Low-Rise Residential Buildings, Performance Approach:

Relevant Compliance Forms

• CF1R-ADD-01-E: Certificate of Compliance – Additions 1000 ft² or Less
• CF1R-ALT-01-E: Certificate of Compliance – Residential Alterations (when HERS is triggered)
• CF1R-ALT-05-E: Certificate of Compliance – Prescriptive Alterations (Simple projects that do not trigger HERS)
• CF1R-ENV-04-E: Certificate of Compliance – Solar Reflectance Index Calculation Worksheet
• CF1R-NCB-01-E: Certificate of Compliance – Prescriptive Newly Constructed Building
• CF2R-ADD-02-E: Certificate of Installation – Prescriptive Residential Additions That Do Not Require HERS Field Verification
• CF2R-ALT-05-E: Certificate of Installation – Prescriptive Alterations (Simple projects that do not trigger HERS)
• CF2R-ENV-04-E: Certificate of Installation – Roofing and Radiant Barrier Code Triggers

The Title 24, Part 6 Building Energy Efficiency Standards (Energy Code) call for a cool roof when:
• The residential project is in an affected climate zone, which varies by roof slope (See Table 1)
• Replacing, recovering or recoating the exterior surface of existing residential roofs when >50% of the roof is replaced in specific climate zones
Qualifying as a Cool Roof

To qualify as a cool roof under the Energy Code, the roofing material must:

- Have a Cool Roof Rating Council (CRRC) rating for reflectance and thermal emittance
- Meet the aged reflectance and thermal emittance — or Standard Reflectance Index (SRI) — values specified in the Energy Code (see below)

Roofing products must be tested and labeled by the CRRC. Being included in the ENERGY STAR® list for cool roofing materials is NOT sufficient to meet the Energy Code.

Aged Solar Reflectance & Thermal Emittance

Specific aged solar reflectance and thermal emittance values must be met or exceeded for some climate zones and roof types (See Table 1). In areas where cool roofs are required, exceeding minimum requirements for solar reflectance and emittance will reduce cooling loads and may reduce building energy use.

Solar reflectance refers to a material’s ability to reflect the sun’s energy back into the atmosphere. Aged solar reflectance is the solar reflectance of the surface after three years, which typically is lower than the initial reflectance value. If the product is new and the aged solar reflectance value is unavailable, you can calculate the aged value using this formula:

\[
3\text{-year Aged Solar Reflectance} = \left[ 0.2 + \beta (\rho_{\text{initial}} - 0.2) \right]
\]

\[
\rho_{\text{initial}} = \text{Initial Solar Reflectance}
\]

\[
\beta = \text{Soiling Resistance by product type:}
\]

- Field-Applied Coating  \( \beta = 0.65 \)
- Other  \( \beta = 0.70 \)

Example: If the initial solar reflectance value is 0.8 for a field-applied coating

\[
3\text{-yr Aged Solar Reflectance} = \left[ 0.2 + 0.65 (0.8 - 0.2) \right] \\
= 0.2 + 0.39 \\
= 0.59
\]

Thermal emittance provides a means of quantifying how much of the absorbed heat is rejected for a given material. The higher the thermal emittance value, the better (the more heat the roofing material emits back to the atmosphere).

Note: Aged solar reflectance and thermal emittance values noted in tables below must be derived from CRRC Rated Products Directory. If a roofing product is not CRRC certified, it is assumed to have the following default aged reflectance/emittance values for the Performance approach (CBECC-Res): 0.10/0.85.

The following information applies to conditioned (mechanically cooled or heated) residential buildings demonstrating compliance using the Prescriptive approach.
Requirements

<table>
<thead>
<tr>
<th>Roof Slope</th>
<th>Climate zone</th>
<th>Min. 3-yr Aged Solar Reflectance</th>
<th>Min. Thermal Emittance</th>
<th>Min. SRI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-slope¹</td>
<td>13 &amp; 15</td>
<td>0.63</td>
<td>0.75</td>
<td>75</td>
</tr>
<tr>
<td>Steep-slope¹</td>
<td>10 thru 15</td>
<td>0.20</td>
<td>0.75</td>
<td>16</td>
</tr>
</tbody>
</table>

¹ Low-slope = Rise-to-run ratio of < 2:12 (lower than 9.5 degrees)
² Steep-slope = Rise-to-run ratio ≥ 2:12 (9.5 degrees or more)

Table 1 – Residential Cool Roof Requirements

Exceptions… Cool roof is NOT required if:

New Construction and Additions

- Any slope: The roof area is covered by building-integrated photovoltaic panels or building-integrated solar thermal panels
- Any Slope: Building has no ducts in the attic
- Any slope: Roof construction has a thermal mass over the roof membrane with a weight of at least 25 lb/ft²
- Any slope: Roof is an addition ≤ 300 ft²

Alterations where >50% of the roof is replaced

- Steep slope: An air-space of 1.0 inch is provided between top of roof deck and bottom of roofing product
- Steep slope: Existing ducts in the attic are insulated and sealed according to §150.1(c)9
- Steep slope: Building has a radiant barrier in the attic meeting the requirements of §150.1(c)
- Steep slope: Building has at least R-38 ceiling insulation
- Steep slope: Roofing product profile ratio of rise to width is at least 1:5 for ≥50% of the width of the roofing product
- Steep slope: R-2 or greater insulation above the roof deck in Climate Zones 10-15
- Low slope: The aged solar reflectance can be traded off with additional insulation added at the roof deck as per Table 150.2-B (See Table 3)

Table 2 – Exceptions

Aged Solar Reflectance | Roof Deck Insulation R-value
--- | ---
0.62 - 0.60 | 2
0.59 - 0.55 | 4
0.54 - 0.50 | 6
0.49 - 0.45 | 8
0.44 - 0.40 | 12
0.39 - 0.35 | 16
0.34 - 0.30 | 20
0.29 - 0.25 | 24

Table 3 – Low-Slope Alterations Tradeoff with Insulation from Table 150.2-B
Forms – Which & When

In addition to a permit, you will need the following.

**During Design:**
- **CF1R-NCB-01-E**: Prescriptive newly constructed building form
  - Roofing Products, Cool Roof (Part G, Page 3 of 7)
  - Completed and signed by the contractor or design professional
  - Submitted to the building department by the contractor or the homeowner
- **CF1R-ADD-01-E**: Certificate of Compliance – Additions 1000 ft² or Less
  - General information (Part A, Page 1 of 7)
  - Roofing Products (Cool Roof) (Part G, page 3 of 7)
  - Declaration Statement (Page 4 of 4)
  - Completed and signed by the contractor
  - Submitted to the building department by the contractor or the homeowner
- **CF1R-ALT-01-E**: Certificate of Compliance – Residential Alterations (when HERS is triggered)
  - General information (Part A, Page 1 of 4)
  - Roofing Replacement (Part C, Page 1 of 4)
  - Declaration Statement (Page 4 of 4)
  - Completed and signed by the contractor
  - Submitted to the building department by the contractor or the homeowner
- **CF1R-ALT-05-E**: Certificate of Compliance – Prescriptive Alterations (Simple projects that do not trigger HERS)
  - Completed and signed by the designer, installing contractor or homeowner
  - Submitted to the building department during permit application

**Why?**: To show compliance with the Energy Code for Cool Roof

**Notes**: Check with your local building department to determine if they have alternate documentation options.

- (Optional) **CF1R-ENV-04-E**: Certificate of Compliance – Solar Reflectance Index Calculation Worksheet
  - Completed and signed by the contractor
  - Submitted to the building department by the contractor or homeowner

**Why?**: To show compliance with Cool Roof Prescriptive requirements, where applicable

**During Construction:**
- **CF2R-ENV-04-E**: Installation Certificate for Roofing
  - Radiant Barrier Information (page 1 of 3)
  - Description of Roofing Products (2 of 3)
  - Declaration Statement (Page 3 of 3)
  - Completed and signed by the installing contractor
  - Made available for final inspection by building department
- **CF2R-ADD-02-E**: Certificate of Installation – Prescriptive Residential Additions That Do Not Require HERS Field Verification
  - General information (Part A, Page 1 of 7)
  - Roofing Products (Cool Roof) – Additional Requirements (Part K, page 5 of 9)
  - Declaration Statement (Page 4 of 4)
  - Completed and signed by the contractor
  - Submitted to the building department by the contractor or the homeowner
- **CF2R-ALT-05-E**: Certificate of Installation – Prescriptive Residential Alterations That Do Not Require HERS Field Verification
  - General information (Part A, Page 1 of 9)
  - Roof/Ceiling Insulation (Part B, Page 2 of 9)
  - Radiant Barrier (Part G, Page 4 of 9)
  - Required Vent Area (Part H, Page 4 of 9)
  - Roofing Products (Cool Roof) Installation Information (Part I, page 4 of 9)
  - Declaration Statement (Page 9 of 9)
  - Completed and signed by the installing contractor
  - Made available for final inspection by building department

**Why?**: To verify the field installation meets or exceeds the Energy Code

**Notes**: CRRC label(s) should be attached to the CF2R-ENV-04-E form

**Product Labeling per Section 10-113**:

- For all roofs:
  - CRRC label specifying the initial and aged (“weathered”) solar reflectance and thermal emittance
- For liquid-applied roof coatings applied to low-sloped roofs:
  - CRRC label specifying the initial and aged (“weathered”) solar reflectance and thermal emittance
  - Label stating the product meets the ASTM requirements specified in Section 110.8(i)4 of the Energy Code.

*Product labeling must be available for final inspection by building department.*
For More Information

Primary Documents


Cool Roof Products and Specifications

- CRRC Rated Products Directory: coolroofs.org/products/results
  - Search for rated roofing products
- Solar Reflectance Index (SRI) calculator: www.energy.ca.gov/title24/2013standards/documents/solar_reflectance/
  - Use to determine the SRI value for a specific product

California Energy Commission Information & Services

- Energy Code Hotline: 1-800-772-3300 (Free) or Title24@energy.ca.gov
- Online Resource Center: www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/online-resource-center
  - The Energy Commission’s main web portal for the Energy Code, including information, documents and historical information

Additional Resources

- Energy Code Ace: EnergyCodeAce.com
  An online “one-stop-shop” providing free resources and training to help appliance and building industry professionals decode and comply with Title 24, Part 6 and Title 20. The site is administered by California’s investor-owned utilities. Please register with the site and select an industry role for your profile in order to receive messages about all our free offerings!