

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

Title 24, Part 6 Building Energy Efficiency Standards:

- [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-ALT-01-E](#): Certificate of Compliance – Residential Alterations
- [CF1R-ENV-04-E](#): Certificate of Compliance – Solar Reflectance Index Calculation Worksheet
- [CF2R-ENV-04-E](#): Installation Certificate for Roofing

Code Triggers

The Title 24, Part 6 Building Energy Efficiency Standards (Energy Standards) call for a cool roof when:

- The residential project is in an affected climate zone. This varies by roof style. (See Table 1)
- Replacing, recovering or recoating the exterior surface of existing residential roofs when >50% of the roof is replaced



Solar Reflectance Index

The SRI provides an alternative to meeting solar reflectance and thermal emittance requirements for cool roofs. SRI values are set to a normalized scale that incorporates the effects of both reflectance and thermal emittance.

Generally the higher the SRI, the better the roofing material's ability to reduce heat transfer into the building.

The SRI value is calculated based on:

- The aged solar reflectance and the thermal emittance of the roofing material
- The SRI worksheet also takes inputs for the roof slope

The SRI alternative is useful when a particular product exceeds the Energy Standards requirement for either the aged solar reflectance or the thermal emittance, but does not meet both requirements. In this case the combination of the aged solar reflectance and the thermal emittance for the product may be sufficient to comply with the SRI requirement.

Qualifying as a Cool Roof

To qualify as a cool roof under the Energy Standards, 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 Standards (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 Standards.

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:

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

ρ_{initial} = Initial Solar Reflectance

β = 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

$$\begin{aligned} \text{3-yr Aged Solar Reflectance} &= [0.2 + 0.65 (0.8 - 0.2)] \\ &= 0.2 + 0.39 \\ &= 0.59 \end{aligned}$$

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): for asphalt shingles - 0.08/0.75; for all other roofing products - 0.10/0.75.



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

Requirements

Roof Style	Climate zone	Either these reflectance and emittance values		Or this SRI value
		Min. 3-yr Aged Solar Reflectance	Min. Thermal Emittance	Min. SRI
Low-slope ¹	13 & 15	0.63	0.75	75
Steep-slope ¹	10 thru 15	0.20	0.75	16

¹ Low-slope = Rise-to-run ratio of 2:12 or less (9.5 degrees or fewer from horizontal).
Steep-slope = Rise-to-run ratio greater than 2:12 (more than 9.5 degrees from horizontal).

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/ft ²
Any slope	Roof is on addition ≤300 ft ²
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) This includes green roofs (roofs that are covered with vegetation) weighing at least 25 lb/ft ² , though any portion of the roof not covered with vegetation will need to comply with cool roof requirements if not otherwise exempt.
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: Values 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-ALT-01-E:** Certificate of Compliance - Residential Alterations
 - 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 home owner

Why?: To show compliance with 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 the home owner

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

Why?: To verify the field installation meets or exceeds code

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

Product Labeling:

- 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 Standards.
- Product labeling must be available for final inspection by building department.

		Initial	Weathered
	Solar Reflectance	0.00	Pending
	Thermal Emittance	0.00	Pending
	Rated Product ID Number	-----	
Licensed Seller ID Number	-----		
Classification	Production Line		
<small>Cool Roof Rating Council ratings are determined for a fixed set of conditions, and may not be appropriate for determining seasonal energy performance. The actual effect of solar reflectance and thermal emittance on building performance may vary.</small>			
<small>Manufacturer of product stipulates that these ratings were determined in accordance with the applicable Cool Roof Rating Council procedures.</small>			



For More Information

Primary Documents

- Energy Standards Section 110.8(i) - Mandatory Requirements - Roofing Products Solar Reflectance and Thermal Emittance:
energycodeace.com/site/custom/public/reference-ace-2016/Documents/section1108mandatoryrequirementsforinsulationroofingproductsandr.htm#sec110_8i4
- Energy Standards Section 150.1(c)11 – Prescriptive Standards/Component Package for Low-Rise Residential Buildings, Roof Products:
energycodeace.com/site/custom/public/reference-ace-2016/Documents/section1501performanceandprescriptivecomplianceapproachesforlowr.htm#sec150_1_c11
- Energy Standards Section 150.2(b)1H – Energy Efficiency Standards for Alterations to Existing Low-Rise Residential Buildings, Prescriptive Approach, Roofs:
energycodeace.com/site/custom/public/reference-ace-2016/Documents/section1502energyefficiencystandardsforadditionsandalterationsto.htm#sec150_2_b1H
- Energy Standards Section 150.2(b)2 - Energy Efficiency Standards for Alterations to Existing Low-Rise Residential Buildings, Performance Approach:
energycodeace.com/site/custom/public/reference-ace-2016/Documents/section1502energyefficiencystandardsforadditionsandalterationsto.htm#sec150_2_b2

Cool Roof Products and Specifications

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

California Energy Commission Information & Services

- Energy Standards Hotline: 1-800-772-3300 (Free) or Title24@energy.ca.gov
- Online Resource Center:
energy.ca.gov/title24/orc/
 - The Energy Commission’s main web portal for Energy Standards, 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!



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