

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 140.1](#) – Performance Approach: Energy Budgets
- [Section 140.2](#) – Prescriptive Compliance Approaches
- [Section 140.3\(a\)1](#) – Prescriptive Requirements for Exterior Roofs and Ceilings
- [Section 141.0\(b\)2B](#) – Alterations to Existing Buildings, Outdoor Lighting, and Internally and Externally Illuminated Signs – Prescriptive Approach
- [Section 141.0\(b\)3](#) – Alterations to Existing Buildings, Outdoor Lighting, and Internally and Externally Illuminated Signs – Performance Approach

Relevant Compliance Forms

[NRCC-ENV-01-E](#): Certificate of Compliance for Envelope Component Approach

[NRCC-ENV-03-E](#): SRI Calculation Worksheet (if necessary)

[NRCI-ENV-01-E](#): Certificate of Installation for Envelope

Code Triggers

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

- The project is in an affected climate zone. This varies by roof slope. (See Table 1)
- Replacing, recovering or recoating the exterior surface of existing roofs, when altering:
 - 50% of the existing roof surface area OR
 - 2,000 ft² of existing roof surface whichever is less

Aged solar reflectance, thermal emittance and Solar Reflectance Index (SRI) are prescriptive, not mandatory and may be traded off or credit received with the performance approach.

Solar Reflectance Index

The SRI provides an alternative to meeting solar reflectance and thermal emittance requirements for cool roofs. SRI values range from 0 to 100. 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 (Note: the roof slope has no effect on the calculation).

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 Solar Reflectance Index (SRI) – values specified in the Energy Standards (See Table 1)

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). The higher the solar reflectance, the better (the more heat is reflected from the roofing material).

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-year Aged Solar Reflectance = [0.2 + β($\rho_{\text{initial}} - 0.2$)]	
ρ_{initial}	= Initial Solar Reflectance
β	= Soiling Resistance by product type: <ul style="list-style-type: none">• 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-yr Aged Solar Reflectance	= [0.2 + 0.65 (0.8 – 0.2)]
	= 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).

2016 Nonresidential, High-rise Residential and Hotel/Motel Guest Rooms

The requirements shown in Table 1 apply to buildings demonstrating compliance using the Prescriptive Approach: Energy Standards [Section 140.3\(a\)1A](#).

Aged solar reflectance and thermal emittance values noted in Table 1 below must be derived from the CRRC Rated Products Directory.

For guidance regarding Cool Roofs and the Performance approach for alterations, see Energy Standards [Section 141.0\(b\)3](#).



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
Nonresidential				
Low-sloped (Rise-to-run ratio of 2:12 or less; 9.5 degrees or fewer from horizontal)	1 - 16	0.63	0.75	75
Steep-sloped (Rise-to-run ratio greater than 2:12; More than 9.5 degrees from horizontal)	1 - 16	0.20	0.75	16
High-rise Res, Hotel, Motel				
Low-sloped (Rise-to-run ratio of 2:12 or less; 9.5 degrees or fewer from horizontal)	9 ^A - 11, 13 - 15	0.55	0.75	64
Steep-sloped (Rise-to-run ratio greater than 2:12; More than 9.5 degrees from horizontal)	2 - 15	0.20	0.75	16

A CZ 9 is included for new roofs but excluded for alterations.

Table 1: Nonresidential Cool Roof Requirements per Section 140.3(a)1A

Exceptions... Cool roof is NOT required if:

Any roof	The roof area is covered by building-integrated photovoltaic panels or building-integrated solar thermal panels.		
Low-sloped newly constructed and additions; all alterations	Roof construction has a thermal mass over the roof membrane with a weight of at least 25 lb/ft ² . <i>This includes green roofs (roofs that are covered with vegetation) weighing at least 25 lb/ft², though any portion of the roof not covered with vegetation will need to comply with cool roof requirements if not otherwise exempt.</i>		
Low-sloped Alterations <i>See Table 140.3 for newly constructed projects</i>	Aged solar reflectance <0.63 is allowed provided the maximum roof / ceiling U-factor below is not exceeded.		
	Aged Solar Reflectance	U-factor	
		CZ 1, 3-9	CZ 2, 10-16
	0.62 - 0.60	0.075	0.052
	0.59 - 0.55	0.066	0.048
	0.54 - 0.50	0.060	0.044
	0.49 - 0.45	0.055	0.041
	0.44 - 0.40	0.051	0.039
	0.39 - 0.35	0.047	0.037
	0.34 - 0.30	0.044	0.035
	0.29 - 0.25	0.042	0.034
Low-sloped newly constructed and additions	Wood framed roofs in CZ 3 & 5 with a roof assembly U-factor of 0.034 or lower.		

Table 2: Exceptions



Cool roof installation

Insulation Requirements for Roof Alterations (Table 141.0-C)

When roofs are exposed to the roof deck, or to the roof recover boards, the exposed area must be insulated to the values noted in Table 141.0-C of the Energy Standards, as summarized below:



Nonresidential Climate Zones 1, 3–9		Nonres in Climate Zones 2, 10–16; All High-rise Res, Hotel/Motel Buildings	
Continuous Insulation R-value	U-factor	Continuous Insulation R-value	U-factor
R-8	0.082	R-14	0.055

Table 3: Roof Alterations: Insulation Requirements

Exceptions to Roof Insulation Requirements

- If existing roof is insulated with at least R-7 insulation or it has a U-factor less than 0.089, you do not need to increase the insulation.
- If mechanical equipment on the roof will not be lifted as part of the roof replacement, you don't need to add more insulation than the maximum thickness that will allow 8 inches between the roof membrane surface and the top of the base flashing.
- You don't need to add more insulation than the maximum thickness that will allow 8 inches from the roof membrane surface to the top of the base flashing, provided that:
 - The penthouse or parapet walls are finished with an exterior cladding other than the roofing covering membrane material; AND
 - The penthouse or parapet walls have exterior cladding material that must be removed to install the new roof covering membrane to maintain a base flashing height of 8 inches (203 mm); AND
 - The ratio of the replaced roof area to the linear dimension of affected penthouse or parapet walls is:

For nonresidential:

- Climate zones 2, 10 - 16: less than 25 ft² per linear foot
- Climate zones 1, 3 - 9: less than 100 ft² per linear foot

For high-rise residential buildings, hotels or motels:

- All climate zones: less than 25 ft² per linear foot

At drains and other low points, you can use tapered insulation with a thermal resistance (R-Value) less than the value shown in Table 141.0-C of the Energy Standards – if the insulation is increased enough at the high points so the average R-Value is equal to or greater than the value in Table 141.0-C.



Forms – Which & When

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

During Design:

- **NRCC-ENV-01-E:** Certificate of Compliance for Envelope Component Approach
 - Section E, Page 2 - engineer or contractor lists details of roof reflectance properties and certifies that the roof assembly meets Prescriptive requirements
 - Completed by the engineer of record, architect or authority
- **NRCC-ENV-03-E:** SRI Calculation Worksheet (if necessary)
 - Completed by the engineer of record, architect or authority
 - Submitted to the building department by the permit applicant

Why?: To demonstrate roofing surface SRI meets minimum requirements, for cool roofs that do not meet reflectance and emittance Prescriptive requirements.

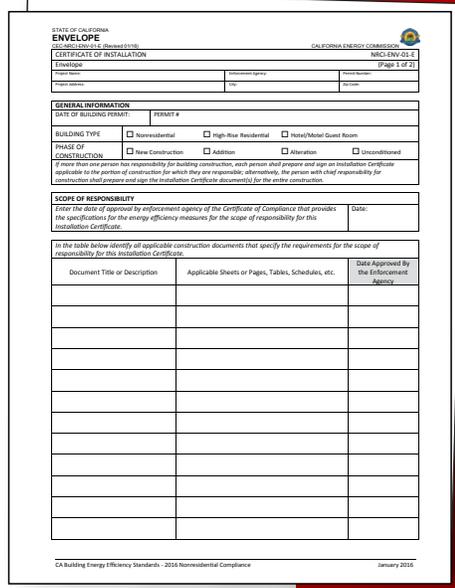
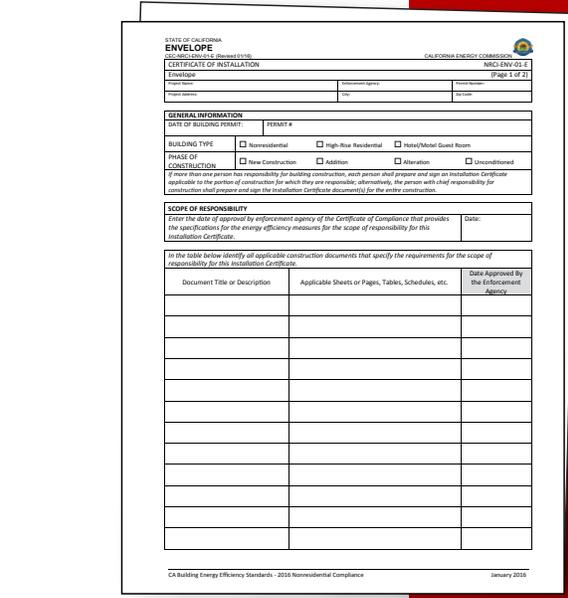
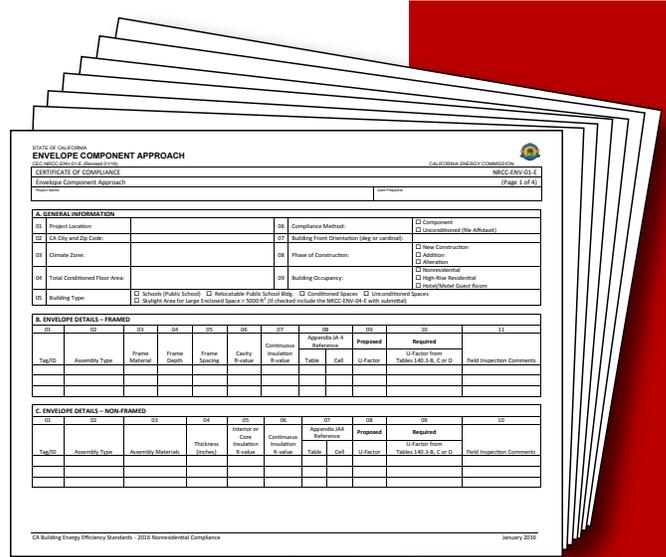
During Construction:

- **NRCI-ENV-01-E:** Certificate of Installation for Envelope
 - 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.

Product Labeling:

- For all roofs:
 - CRRC label specifying the initial and aged (“weathered”) solar reflectance and thermal emittance
- For liquid-applied roof coatings:
 - 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.
- If roofing products are not certified they shall assume the following default aged solar reflectance/thermal emittance values:
 - For asphalt shingles: 0.08/0.75
 - For all other roofing products: 0.10/0.75



	Initial	Weathered	
	Solar Reflectance	0.00	Pending
	Thermal Emittance	0.00	Pending
	Rated Product ID Number	-----	
Licensed Seller ID Number	-----		
Classification	Production Line		
<p>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.</p> <p>Manufacturer of product stipulates that these ratings were determined in accordance with the applicable Cool Roof Rating Council procedures.</p>			

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/index.html#!Documents/section1108mandatoryrequirementsforinsulationroofingproductsandr.htm#sec110_8_i
- Energy Standards Section 140.1 - Performance Approach: Energy Budgets: energycodeace.com/site/custom/public/reference-ace-2016/index.html#!Documents/section1401performanceapproachenergybudgets.htm
- Energy Standards Section 140.2 - Prescriptive Compliance Approaches: energycodeace.com/site/custom/public/reference-ace-2016/index.html#!Documents/section1402prescriptiveapproach.htm
- Energy Standards Section 140.3(a)1 - Prescriptive Requirements for Exterior Roofs and Ceilings: energycodeace.com/site/custom/public/reference-ace-2016/index.html#!Documents/section1403prescriptiverequirementsforbuildingenvelopes.htm#sec140_3_a1
- Energy Standards Section 141.0(b)2B - Alterations to Existing Buildings, Outdoor Lighting, and Internally and Externally Illuminated Signs – Prescriptive Approach energycodeace.com/site/custom/public/reference-ace-2016/index.html#!Documents/sec1410additionsalterationsrepairstoexistingbuildingsthatwillben.htm#sec141_0_b2B
- Energy Standards Section 141.0(b)3 - Alterations to Existing Buildings, Outdoor Lighting, and Internally and Externally Illuminated Signs – Performance Approach http://energycodeace.com/site/custom/public/reference-ace-2016/index.html#!Documents/sec1410additionsalterationsrepairstoexistingbuildingsthatwillben.htm#sec141_0_b3B

Cool Roof Products and Specifications

- CRRR Rated Products Directory: coolroofs.org/products/search.php
 - Search for rated roofing products
- Solar Reflectance Index (SRI) calculator: energy.ca.gov/title24/2016standards/worksheets/SRI_calculator_worksheet.pdf
 - 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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