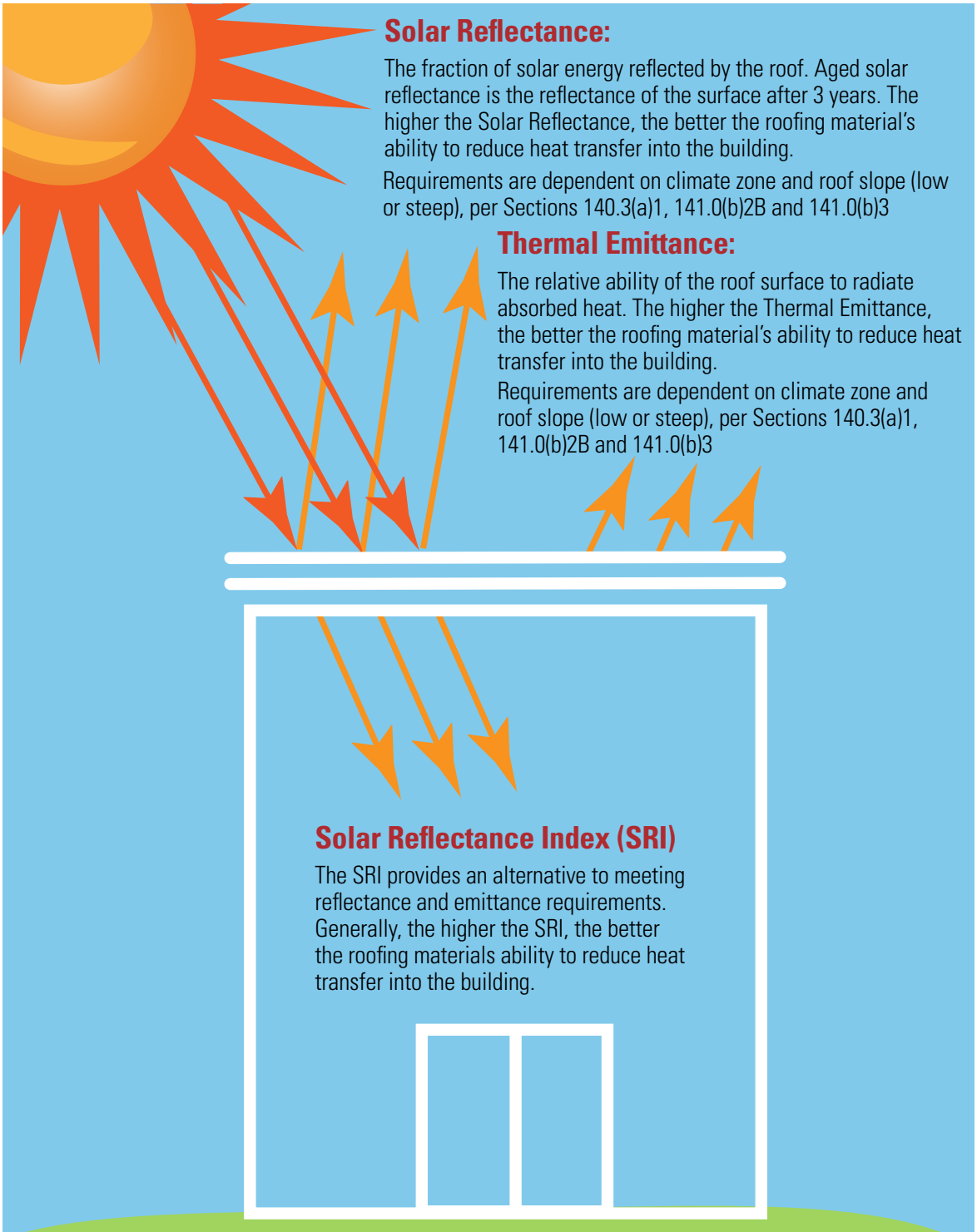
Nonresidential

# Cool Roofs and Reroofing



## Solar Reflectance:

The fraction of solar energy reflected by the roof. Aged solar reflectance is the reflectance of the surface after 3 years. The higher the Solar Reflectance, the better the roofing material's ability to reduce heat transfer into the building.

Requirements are dependent on climate zone and roof slope (low or steep), per Sections 140.3(a)1, 141.0(b)2B and 141.0(b)3

## Thermal Emittance:

The relative ability of the roof surface to radiate absorbed heat. The higher the Thermal Emittance, the better the roofing material's ability to reduce heat transfer into the building.

Requirements are dependent on climate zone and roof slope (low or steep), per Sections 140.3(a)1, 141.0(b)2B and 141.0(b)3

## 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 (CRCC) rating and meet specified values for reflectance and emittance (or specified SRI values.)

Projects with roofs not CRRC certified must use the Performance approach (see Section 141.0(b)3).

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, 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 |
|---|
| California's Title 24, Part 6 Building Energy Efficiency Standards (Energy Code):<br>• Section 110.8(i) – Mandatory Requirements Roofing Products Solar Reflectance and Thermal Emittance<br>• Section 140.1 – Performance Approach: Energy Budgets<br>• Section 140.2 – Prescriptive Compliance Approaches<br>• Section 140.3(a)1 – Prescriptive Requirements for Exterior Roofs and Ceilings<br>• Section 141.0(b)2B – Alterations to Existing Buildings, Outdoor Lighting, and Internally and Externally Illuminated Signs – Prescriptive Approach<br>• Section 141.0(b)3 – Alterations to Existing Buildings, Outdoor Lighting, and Internally and Externally Illuminated Signs – Performance Approach |
| **Relevant Compliance Forms** |
| NRCC-ENV-E: Envelope Component Approach<br>NRCI-ENV-01-E: Certificate of Installation for Envelope |

# Code Triggers

The Energy Code calls 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 ft$^2$ 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 (depending on climate zone) with the performance approach.

# Solar Reflectance Index

The SRI provides an alternative to meeting solar reflectance and thermal emittance Prescriptive 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
- Calculating the SRI value using the NRCC-ENV-E 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 Code 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 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 Solar Reflectance Index (SRI) – values specified in the Energy Code (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 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). The higher the solar reflectance, the roof surface is able to reduce heat transfer into the building (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(ρinitial – 0.2) ]**

ρinitial = Initial Solar Reflectance

β = Soiling Resistance by product type:

- Field-Applied Coating β = 0.65
- Other β = 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 quantifies how much of the absorbed heat is rejected for a given material. The higher the thermal emittance value, the better the roofing material is at reducing cooling loads.

## 2019 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 Code Section 140.3(a)1A.

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

For guidance regarding Cool Roofs and the Performance approach for alterations, see Energy Code 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 Residential, 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 for Cool Roof Requirements:

| | |
|---|---|
| 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 constructions with a weight of at least 25 lb/ft² over the roof membrane.<br>*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.* |
| Low-sloped alterations | Aged solar reflectance <0.63 is allowed provided the maximum roof / ceiling U-factor indicated in Table 141.0-B (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. See Table 140.3. | 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 Code, 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 $ft^2$ per linear foot
    - Climate zones 1, 3 - 9: less than 100 $ft^2$ per linear foot

    **For high-rise residential buildings, hotels or motels:**

    - All climate zones: less than 25 $ft^2$ 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 Code – 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.

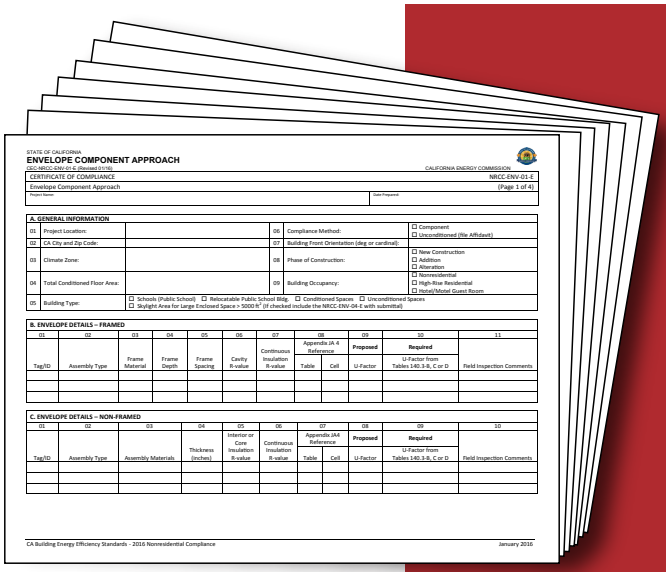
# Forms – Which & When

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

## During Design:

- NRCC-ENV-E: Certificate of Compliance for Envelope Component Approach
  - Table F. Roof Assembly Schedule - documentation author lists details of roof reflectance properties and certifies that the roof assembly meets Prescriptive requirements
  - Table G. Rated Roofing Material (Cool Roof) - engineer or contractor lists roof slope and material reflectance, emittance and SRI values to determine roof materials meet Prescriptive requirements
  - Signed by the engineer of record, architect or authority
  - Submitted to the building department by the permit applicant

**Why?:** To ensure the proposed roofing material meets the Prescriptive requirements, or indicate an exception has been applied.



STATE OF CALIFORNIA
**ENVELOPE COMPONENT APPROACH**
CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF COMPLIANCE — NRCC-ENV-01-E
Envelope Component Approach — (Page 1 of 4)

**A. GENERAL INFORMATION**

| | | | | | |
|---|---|---|---|---|---|
| 01 | Project Location: | | 06 | Compliance Method: | ☐ Component ☐ Unconditioned (file Affidavit) |
| 02 | CA City and Zip Code: | | 07 | Building Front Orientation (deg or cardinal): | |
| 03 | Climate Zone: | | 08 | Phase of Construction: | ☐ New Construction ☐ Addition ☐ Alteration |
| 04 | Total Conditioned Floor Area: | | 09 | Building Occupancy: | ☐ Nonresidential ☐ High-Rise Residential ☐ Hotel/Motel Guest Room |
| 05 | Building Type: | ☐ Schools (Public School) ☐ Relocatable Public School Bldg. ☐ Conditioned Spaces ☐ Unconditioned Spaces ☐ Skylight Area for Large Enclosed Space > 5000 ft² (if checked include the NRCC-ENV-04-E with submittal) | | | |

**B. ENVELOPE DETAILS – FRAMED**

| 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | | 09 | 10 | | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Appendix JA 4 Reference | | Proposed | Required | | |
| Tag/ID | Assembly Type | Frame Material | Frame Depth | Frame Spacing | Cavity R-value | Continuous Insulation R-value | Table | Cell | U-Factor | U-Factor from Tables 140.3-B, C or D | | Field Inspection Comments |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |

**C. ENVELOPE DETAILS – NON-FRAMED**

| 01 | 02 | 03 | 04 | 05 | 06 | 07 | | 08 | 09 | | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Appendix JA4 Reference | | Proposed | Required | | |
| Tag/ID | Assembly Type | Assembly Materials | Thickness (inches) | Interior or Core Insulation R-value | Continuous Insulation R-value | Table | Cell | U-Factor | U-Factor from Tables 140.3-B, C or D | | Field Inspection Comments |
| | | | | | | | | | | | |
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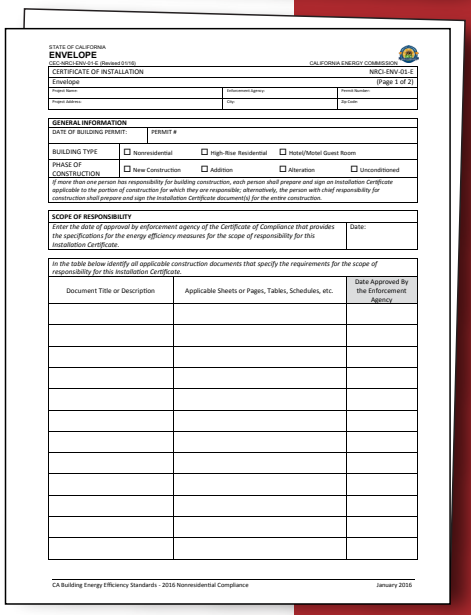
| | | | | | | | | | | | |

CA Building Energy Efficiency Standards - 2016 Nonresidential Compliance — January 2016



STATE OF CALIFORNIA
**ENVELOPE**
CALIFORNIA ENERGY COMMISSION
CERTIFICATE OF INSTALLATION — NRCI-ENV-01-E
Envelope — (Page 1 of 2)

Project Name: | Enforcement Agency: | Permit Number:
Project Address: | City: | Zip Code:

**GENERAL INFORMATION**

| | | | | |
|---|---|---|---|---|
| DATE OF BUILDING PERMIT: | PERMIT # | | | |
| BUILDING TYPE | ☐ Nonresidential | ☐ High-Rise Residential | ☐ Hotel/Motel Guest Room | |
| PHASE OF CONSTRUCTION | ☐ New Construction | ☐ Addition | ☐ Alteration | ☐ Unconditioned |

*If more than one person has responsibility for building construction, each person shall prepare and sign an Installation Certificate applicable to the portion of construction for which they are responsible; alternatively, the person with chief responsibility for construction shall prepare and sign the Installation Certificate document(s) for the entire construction.*

**SCOPE OF RESPONSIBILITY**

*Enter the date of approval by enforcement agency of the Certificate of Compliance that provides the specifications for the energy efficiency measures for the scope of responsibility for this Installation Certificate.* — Date:

*In the table below identify all applicable construction documents that specify the requirements for the scope of responsibility for this Installation Certificate.*

| Document Title or Description | Applicable Sheets or Pages, Tables, Schedules, etc. | Date Approved By the Enforcement Agency |
|---|---|---|
| | | |
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CA Building Energy Efficiency Standards - 2016 Nonresidential Compliance — January 2016

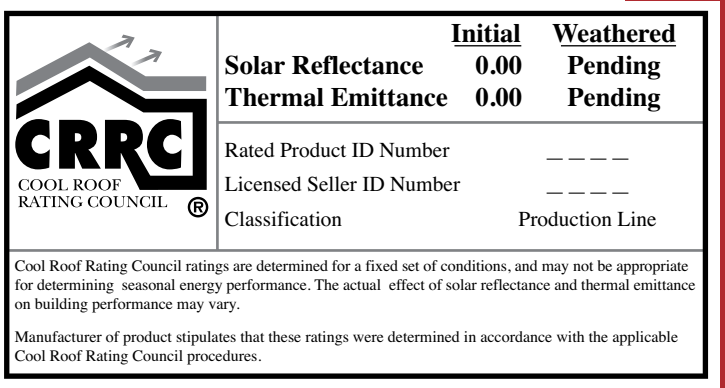
## During Construction:

- 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 Code.
- 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



CRRC
COOL ROOF RATING COUNCIL ®

| | Initial | Weathered |
|---|---|---|
| Solar Reflectance | 0.00 | Pending |
| Thermal Emittance | 0.00 | Pending |

Rated Product ID Number _ _ _ _
Licensed Seller ID Number _ _ _ _
Classification Production Line

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.

Manufacturer of product stipulates that these ratings were determined in accordance with the applicable Cool Roof Rating Council procedures.

# For More Information

## Primary Documents

- Energy Code 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 Code Section 140.1 - Performance Approach: Energy Budgets:
  energycodeace.com/site/custom/public/reference-ace-2016/index.html#!Documents/section1401performanceapproachenergybudgets.htm
- Energy Code Section 140.2 - Prescriptive Compliance Approaches:
  energycodeace.com/site/custom/public/reference-ace-2016/index.html#!Documents/section1402prescriptiveapproach.htm
- Energy Code 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 Code 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 Code 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

## Compliance Forms

- Nonresidential Compliance Forms
  energycodeace.com/NonresidentialForms/2019

## Cool Roof Products and Specifications

- CRRC Rated Products Directory:
  coolroofs.org/products/search.php
  – Search for rated roofing products

## California Energy Commission Information & Services

- Energy Code Hotline: 1-800-772-3300 (Free) or Title24@energy.ca.gov
- Online Resource Center:
  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!

This program is funded by California utility customers and administered by Pacific Gas and Electric Company (PG&E), San Diego Gas & Electric Company (SDG&E®), Southern California Edison Company (SCE), and Southern California Gas Company (SoCalGas®) under the auspices of the California Public Utilities Commission.