



CALIFORNIA ENERGY COMMISSION

Cool Roofs

Gary Fabian

California Energy Commission

Outreach and Education Unit

San Joaquin Valley Chapter ICC

Tulare, CA

June 30, 2015



COOL ROOFS

“Wow, that’s a very cool roof—where did you get it?”

Goals of this session:

- The **function** of a cool roof assembly
- **Changes** since last code cycle for Res and Nonres
- **New** and **alteration** impacts
- What **Plans Examiners** and **Field Inspectors** should look for



Cool Roofs

What does a “cool roof” do?

- Reduces attic temperature
 - To help the *conditioned space* stay cooler
 - To help ductwork & equipment stay cooler



Cool Roofs

Definitions:

- ***Thermal emittance***: Ratio of heat given off, relative to heat absorbed
- ***Solar reflectance***: Ratio of how much solar gets bounced away, relative to heat absorbed—given as an “aged” value

Helpful hints:

- For both, the higher the number, the better
- Yes, they can calculate & submit a *solar reflectance index* instead of TE & SR, but SRI must be calculated as “aged”
- “Cool roof” is not a type of product per se. It is a concept for saving energy. Roofing must meet TE & SR values for a given CZ and roof slope to be called “cool roof”.

Solar Reflective Index (SRI) Calculation Worksheet

SRI-WS

Computer Generated Form

Date:		Climate Zone:		Building Type:	<input type="radio"/> Residential
					<input type="radio"/> Nonresidential

Project Name: _____

Project Address: _____

Roofing Products (Cool Roof)

Roofing products with high solar reflectance and thermal emittance are referred to as "Cool Roof", which refers to an outer layer or exterior surface of a roof. As the term implies, the temperature of a cool roof is lower on hot sunny days than for a conventional roof, reducing cooling loads and energy required to provide air conditioning.

The benefit of a high reflectance surface is obvious: while dark surfaces absorb the sun's energy (visible light, invisible infrared, and ultraviolet radiation) and become hot, light-colored surfaces reflect solar energy and stay cooler. However, high emittance is also important. Emittance refers to the ability of heat to escape from the surface once it is absorbed. Surfaces with low emittance (usually shiny, metallic surfaces) contribute to the transmission of heat into the roof components under the roof surface. The heat can increase the building's air conditioning load, resulting in increased energy costs and detracting from the comfort level of the home. High-emittance roof surfaces give off absorbed heat relatively quickly through the path of least resistance: upward and out of the building.

Rating and Labeling

Roofing products that are used for compliance with the standards (prescriptive and performance approaches) are required to be tested and labeled by the Cool Roof Rating Council (CRRC). Roofing product manufacturers must have their roofing product tested for solar reflectance and thermal emittance, and be labeled according to CRRC procedures. See example of a CRRC label at right.

	Solar Reflectance	Initial 0.00	Weathered 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. Manufacturer of product stipulates that these ratings were determined in accordance with the applicable Cool Roof Rating Council procedures.</small>			

CRRC-1 Label Attached to Submittal

(Note: If no CRRC-1 label is available, this compliance method cannot be used and another method is required to meet compliance)

CRRC Product ID Number	Manufacturer	Brand	Model
-			

Roof Slope		Product Type		SRI Calculations				
≤2:12	>2:12	Field-Applied Coating	Other	Aged Reflectance Listed with CRRC?	CRRC listed Aged Solar Reflectance	Initial Solar Reflectance	Calculated Aged Solar Reflectance	Thermal Emittance
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		0	0	0	0

Solar Reflective Index	0
------------------------	----------



Cool Roofs

Is a “cool roof” a Mandatory Measure?

- No. [Sect 110.8](#) simply says that solar *reflectance* and thermal *emittance* need to be identified for particular roofing, **or** use *default values* for non-certified materials.
- [Sect 10-113](#) governs every roofing product intending to take *compliance credit*, or meet Prescriptive Requirements, to be certified by Cool Roof Rating Council.



CALIFORNIA ENERGY COMMISSION

*Nonresidential
New Construction &
Additions*



Newly Constructed Roofs

Nonres - Prescriptive - New roof

2008 – §143(a)

- Cool roof requirements depended on:
 - Roof slope
 - Climate zone
 - Product density (lb/ft²)
- Requirements in Tables 143-A through 143-C

2013 – §140.3(a)

- Cool roof requirements now depend on:
 - Roof slope
 - Steep-slope (> 2:12)
 - Low-slope (≤ 2:12)
 - Climate zone
- Requirements in Tables 140.3-B through 140.3-D

		Climate Zone																	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16		
Envelope Roofing Products Maximum U-factor Air Barrier Exterior Doors, Maximum U-factor		Roofs/ Ceilings	Metal Building	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	
			Wood Framed and Other	0.049	0.039	0.039	0.039	0.049	0.075	0.067	0.067	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
		Walls	Metal Building	0.113	0.061	0.113	0.061	0.061	0.113	0.113	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.057	0.061
			Metal-framed	0.098	0.062	0.082	0.062	0.062	0.098	0.098	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
			Mass Light ¹	0.196	0.170	0.278	0.227	0.440	0.440	0.440	0.440	0.440	0.170	0.170	0.170	0.170	0.170	0.170	0.170
			Mass Heavy ¹	0.253	0.650	0.650	0.650	0.650	0.690	0.690	0.690	0.690	0.650	0.184	0.253	0.211	0.184	0.184	0.160
			Wood-framed and Other	0.102	0.059	0.110	0.059	0.102	0.110	0.110	0.102	0.059	0.059	0.059	0.059	0.059	0.059	0.042	0.059
		Floors/ Soffits	Mass	0.092	0.092	0.269	0.269	0.269	0.269	0.269	0.269	0.269	0.269	0.092	0.092	0.092	0.092	0.092	0.058
			Other	0.048	0.039	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.039	0.071	0.071	0.039	0.039	0.039
		Low-sloped	Aged Solar Reflectance	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63
			Thermal Emittance	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
		Steep-Sloped	Aged Solar Reflectance	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
			Thermal Emittance	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
		Air Barrier		NR	REQ														
		Exterior Doors, Maximum U-factor	Non-Swinging	0.50	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	0.50
			Swinging	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70

Envelope	Fenestration	All Climate Zones				
			Fixed Window	Operable Window	Curtainwall or Storefront	Glazed Doors
Vertical	Area-Weighted Performance Rating	Max U-factor	0.36	0.46	0.41	0.45
		Max RSHGC	0.25	0.22	0.26	0.23
	Area-Weighted Performance Rating	Min VT	0.42	0.32	0.46	0.17
	Maximum WWR%	40%				
Skylights			Glass, Curb Mounted	Glass, Deck Mounted	Plastic, Curb Mounted	
	Area-Weighted Performance Rating	Max U-factor	0.58	0.46	0.88	
		Max SHGC	0.25	0.25	NR	
	Area-Weighted Performance Rating	Min VT	0.49	0.49	0.64	
	Maximum SRR%	5%				

TABLE 140.3-C – PRESCRIPTIVE ENVELOPE CRITERIA FOR HIGH-RISE RESIDENTIAL BUILDINGS AND GUEST ROOMS OF HOTEL/MOTEL BUILDINGS

				Climate Zone																
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Envelope	Maximum U-factor	Roofs/ Ceilings	Metal Building	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	
			Wood Framed and Other	0.034	0.028	0.039	0.028	0.039	0.039	0.039	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028
		Walls	Metal Building	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.057	0.057	0.057	0.057	0.057	0.057	0.057
			Metal-framed	0.105	0.105	0.105	0.105	0.105	0.105	0.105	0.105	0.105	0.105	0.105	0.105	0.105	0.105	0.105	0.105	0.105
			Mass Light ¹	0.170	0.170	0.170	0.170	0.170	0.227	0.227	0.227	0.196	0.170	0.170	0.170	0.170	0.170	0.170	0.170	0.170
			Mass Heavy ¹	0.160	0.160	0.160	0.184	0.211	0.690	0.690	0.690	0.690	0.690	0.184	0.253	0.211	0.184	0.184	0.184	0.160
			Wood-framed and Other	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.042	0.059	0.059	0.042	0.042	0.042	0.042
Roofing Products	Floors/ Soffits	Mass	0.045	0.045	0.058	0.058	0.058	0.069	0.092	0.092	0.092	0.069	0.058	0.058	0.058	0.045	0.058	0.037		
		Other	0.034	0.034	0.039	0.039	0.039	0.039	0.071	0.039	0.039	0.039	0.039	0.039	0.039	0.034	0.039	0.034		
	Low-sloped	Aged Solar Reflectance	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.55	0.55	0.55	NR	0.55	0.55	0.55	NR	
		Thermal Emittance	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.75	0.75	0.75	NR	0.75	0.75	0.75	NR	
	Steep-sloped	Aged Solar Reflectance	NR	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	NR	
		Thermal Emittance	NR	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	NR	
Exterior Doors, Maximum U-factor	Non-Swinging		0.50	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	0.50		
	Swinging		0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70		

Envelope	Fenestration	All Climate Zones					
			Fixed Window	Operable Window	Curtainwall/ Storefront	Glazed Doors	
	Vertical	Area-Weighted Performance Rating	Max U-factor	0.36	0.46	0.41	0.45
			Max RSHGC	0.25	0.22	0.26	0.23
		Area-Weighted Performance Rating	Min VT	0.42	0.32	0.46	0.17
		Maximum WWR%	40%				
	Skylights			Glass, Curb Mounted	Glass, Deck Mounted	Plastic, Curb Mounted	
		Area-Weighted Performance Rating	Max U-factor	0.58	0.46	0.88	
			Max SHGC	0.25	0.25	NR	
		Area-Weighted Performance Rating	Min VT	0.49	0.49	0.64	
Maximum SRR%	5%						

Notes:

1. Light mass walls are walls with a heat capacity of at least 7.0 Btu/h-ft² and less than 15.0 Btu/h-ft². Heavy mass walls are walls with a heat capacity of at least 15.0 Btu/h-ft².

TABLE 140.3-D PRESCRIPTIVE ENVELOPE CRITERIA FOR RELOCATABLE PUBLIC SCHOOL BUILDINGS FOR USE IN ALL CLIMATE ZONES

Roofs/Ceilings		
Roofs of Metal Buildings		Maximum U-factor 0.048
Roofs of all non-Metal Buildings		Maximum U-factor 0.039
Roofing Products – Aged Reflectance/Emittance		
Low-sloped	Low-Sloped	0.63/0.75
Steep-Sloped	Steep-Sloped	0.20/0.75
Walls		
Walls of Wood frame buildings		Maximum U-factor 0.059
Walls of Metal frame buildings		Maximum U-factor 0.062
Walls of Metal buildings		Maximum U-factor 0.057
Walls of Mass/ $7.0 \leq HC$, any building		Maximum U-factor 0.170
All Other Walls		Maximum U-factor 0.059
Floors and soffits of all buildings		Maximum U-factor 0.048
- Windows of all buildings		
U-factor		Maximum U-factor 0.47
RSHGC		Maximum RSHGC 0.26
Glazed Doors, All Buildings		
Max Average Weighted U-factor		0.45
Max Average Weighted RSHGC		0.23
Exterior Doors, all buildings		
Non-Swinging doors		Maximum U-factor 0.50
Swinging doors		Maximum U-factor 0.70
Skylights		
Glass with Curb		Maximum U-factor 0.99
Glass -without Curb		Maximum U-factor 0.57
Plastic with Curb		Maximum U-factor 0.87
Glass Skylights	0-2% SRR	Maximum SHGC 0.46
	2.1-5% SRR	Maximum SHGC 0.36
Plastic Skylights	0-2% SRR	Maximum SHGC 0.69
	2.1-5% SRR	Maximum SHGC 0.57



There are always exceptions

Nonres - New roof

- High-rise residential, guestrooms of hotels/motels
 - Mass (low-sloped) roof (“over the membrane”)
 - Roofing area with an integrated solar collector
- For other Nonres buildings
 - Insulation/solar reflectance (low-sloped) tradeoff, per [Table 140.3](#)
 - Wood-framed roofs (low-sloped) in certain CZs & improved insulation
 - *Metal building* roofs (low-sloped) in certain CZs & improved insulation
 - Mass (low-sloped) roof
 - Area covered by integrated solar collector

TABLE 140.3 ROOF/CEILING INSULATION **TRADEOFF** FOR AGED SOLAR REFLECTANCE

Nonresidential					
Aged Solar Reflectance	Metal Building Climate Zone 1-16 U-factor	Wood framed and Other Climate Zone 1 & 5 U-factor	Wood Framed and Other Climate Zone 2-4, 9-16 U-factor	Wood Framed and Other, Climate Zone 6 U-factor	Wood Framed and Other Climate Zone 7 & 8 U-factor
0.62-0.60	0.061	0.045	0.036	0.065	0.059
0.59-0.55	0.054	0.041	0.034	0.058	0.053
0.54-0.50	0.049	0.038	0.032	0.052	0.048
0.49-0.45	0.047	0.035	0.030	0.047	0.044
0.44-0.40	0.043	0.033	0.028	0.043	0.040
0.39-0.35	0.039	0.031	0.027	0.039	0.037
0.34-0.30	0.035	0.029	0.025	0.037	0.035
0.29-0.25	0.033	0.027	0.024	0.034	0.032



New Construction and the Plans Examiner - §140.3

Nonres - New roof

- **Verify characteristics** on [NRCC-ENV-01](#)
 - “Roofing Products” (*Section E on form*)
- **Match indications** on construction documents
 - Notes on drawings/spec
- Did they take an **exception**? Are they **exempt**?
- What if there are **multiple slopes**?
- What if it’s a field-applied **liquid coating**?

ENVELOPE COMPONENT APPROACH

CEC-NRCC-ENV-01-E (Revised 06/13)

CALIFORNIA ENERGY COMMISSION



CERTIFICATE OF COMPLIANCE						NRCC-ENV-01-E				
Envelope Component Approach						(Page 2 of 3)				
Project Name: 2013 CALBO Training Sample						Date Prepared: 01/01/14				

E. ROOFING PRODUCTS (COOL ROOF)													
1	2	3	4	5			6	7		8	9	10	11
Mass Roof 25 lb ft2 or greater	Roof Pitch	CRRC Product ID Number	Product Type	Proposed			Minimum Required			Comments			
				Aged Solar Reflectance	Thermal Emittance	SRI ² (Optional)	Aged Solar Reflectance	Thermal Emittance	SRI (optional)				
<input type="checkbox"/>	2 : 12	0101-2013	Single Ply	<input type="checkbox"/> ¹	0.65	0.80		0.63	0.75				
<input type="checkbox"/>				<input type="checkbox"/> ¹									
<input type="checkbox"/>				<input type="checkbox"/> ¹									
<input type="checkbox"/> An aged solar reflectance less than 0.63 is allowed provided the maximum roof / ceiling U-factor in TABLE 140.3 is not exceeded													
<input type="checkbox"/> High-rise residential buildings and Hotels and Motels with low-sloped roofs in Climate Zones 1 through 8, 12 and 16 are exempted from aged Solar Reflectance and emittance requirements.													
<input type="checkbox"/> High-rise residential buildings and Hotels and Motels with steep-sloped roofs in Climate Zones 1 and 16 are exempt from aged Solar Reflectance and emittance requirements.													
<input type="checkbox"/> The roof area covered by building integrated photovoltaic panels and building integrated solar thermal panels are exempt from aged Solar Reflectance and emittance requirements													
To apply Liquid Field Applied Coatings , the coating must be applied across the entire roof surface and meet the dry mil thickness or coverage recommended by the coatings manufacturer and meet minimum performance requirements listed in §110.8(i)4. Select the applicable coating:													
<input type="checkbox"/> Aluminum-Pigmented Asphalt Roof Coating			<input type="checkbox"/> Cement-Based Roof Coating			<input type="checkbox"/> Other _____							
NOTES:													
1. Check the box if the aged Solar reflectance was not available in the Cool Roof Rating Council's Rated Product Directory, Then use the equation in Section 110.8(i)2 where the Initial Reflectance value from the same directory and use the equation $(0.2+B(p_{initial} - 0.2))$ to obtain a calculated aged value. Where p is the Initial Solar Reflectance and B is either set to 0.65 for Field-Applied Coatings or it is set to 0.70 for all other roofing products other than Field-Applied Coating.													
2. Calculate the SRI Value by using the SRI-Worksheet at (TBD) and enter the resulting value in the SRI Column above and attach a copy for the SRI-Worksheet NRCC-ENV-03-E to the to this form.													

F. Air Barrier				
1	2	3	4	5
Tag/ID	Air Barrier Material Type	Air Barrier Assembly Type	Whole Building Air Leakage Testing	Comments

1. Tag/ID: A label (if any) from the plans, for example, A1.4 or wall.
2. Mass Type: ICF, Masonry. See JA4 for guidance.
3. Density: indicate the Density of the product being used in lb/ft³.
4. Mass Thickness: Thickness (in inches) of mass.
5. Furring Strips Thickness: If furring strips are required to meet the required wall U-factor shown in columns 10, indicate the thickness of the furring strip (in inches). See Table 4.3.14 of Joint Appendix 4.
6. Interior Insulation R-value: Enter the R-value of proposed insulation on the inside surface of the mass wall. See column 10 for the required insulation value for the wall type selected. See JA4 for guidance. Use the same descriptor (R-value or U-factor).
7. Exterior Insulation R-value: Enter the R-value of proposed insulation on the outside surface of the mass wall. See column 10 for the required insulation value for the wall type selected. See JA4 for guidance.
8. Appendix JA4 Table: Table number used to determine the U-factor (e.g., an ICF wall is 4.3.13).
9. U-factor: The U-factor for the proposed assembly. Must be less than or equal to column 9 or have an attached NRCC-ENV-06-E to show that a weighted U-factor for multiple assemblies will meet the maximum value in column 9.
10. Required U-factor: from Tables 140.3 B, C or D: Value required based on climate zone and assembly type.
11. Field Inspection: A field inspector verifies if the requirement has been met.

E. ROOFING PRODUCTS - COOL ROOF

Roofing requirements are found in Sections 110.8(i) and 140.3(i). Depending on the climate zone and roof slope, a cool roof (defined as a minimum aged solar reflectance and thermal emittance, or a minimum SRI) may be required by Tables 140.3 B, C or D.

1. Mass roof 25 lb/ft² or greater: Mass roofs are not required to have a cool roof even if the climate zone specifies minimum performance requirements.
2. Roof Pitch: Expressed as 4:12, for example, which means the roof rises 4 foot within a span of 12 feet. When roofs have multiple pitches the requirements are based on the pitch of 50% or more of the roof.
3. The CRRC Product ID Number is obtained from the Cool Roof Rating Council's Rated **Product Directory** at www.coolroofs.org/products/search.php. Products are listed by manufacturer, brand, and type of installation, roofing material, and color, as well as product performance.
4. Product type: See Cool Roof Rating Council's directory. Generally product types include single-ply roof, wood shingles, asphalt roof, metal roof, and tile roof.
5. Proposed Aged Solar Reflectance: Value is from the Cool Roof Rating Council's Rated Product Directory. If the aged value is not available, calculate the SRI using the initial solar reflectance on NRCC-ENV-03-E (Cool Roof and SRI Worksheet).
6. Proposed Thermal Emittance: From the product specifications. Skip this value if using a calculated SRI.
7. Proposed SRI: It is optional to meet either the SRI or the solar reflectance/thermal emittance. To calculate the SRI value use calculation from <http://www.energy.ca.gov/title24/>. Enter the resulting value in the SRI Column above and attach a copy of the WS-04.
8. Minimum Required Aged Solar Reflectance: Based on climate zone and roof slope.
9. Minimum Required Thermal Emittance: Based on climate zone and roof slope.
10. Minimum SRI: Based on climate zone and roof slope.



New Construction and the Field Inspector - §140.3

Nonres - New roof



- **At Framing stage verify:**
 - Roofing efficiency (TE & SR)
 - CRRC product label
 - values to match [NRCC-ENV-01](#)
 - If SR tradeoff is taken, confirm insulation assembly
 - If integrated panels exception is taken, confirm collection system



CALIFORNIA ENERGY COMMISSION

Nonresidential Roof Alteration

(Prescriptive Requirements)



Alterations/Re-roofs

Nonres - Prescriptive - Altered roof

2008 – §149(b)1B

- Threshold: When more than 50% or 2,000 ft² replaced (whichever is less), must be cool roof
- Same as prescriptive requirements for new construction, (low & steep sloped roofs)
 - Roof insulation alternative in TABLE 149-A

2013 – §141.0(b)2B

- Same threshold criteria
- Same efficiency requirements as prescriptive for new construction
- Hotels/motels & hi-rise Res have different values
- Density criteria removed
- Insulation/solar reflectance trade-off



Nonres Altered Roof

What is a *re-roof* (roofing alteration)?

- Replaced (system)
- Recovered
- Recoated

What triggers a *cool-roof* requirement when doing a re-roof?

- Greater than 50% of the existing roof area
- Greater than 2000 sq ft of area

First one triggered

Note: Any roofing not being altered is not subject to requirements



There are always exceptions

Nonres - Altered roof

- High-rise residential, guestrooms of hotels/motels
 - Roofing area with integrated solar collector
 - Mass roof
- For other Nonres buildings
 - Roofing area with integrated solar collector
 - Mass roof
 - Insulation/solar reflectance tradeoff, per [Table 141.0-B](#)

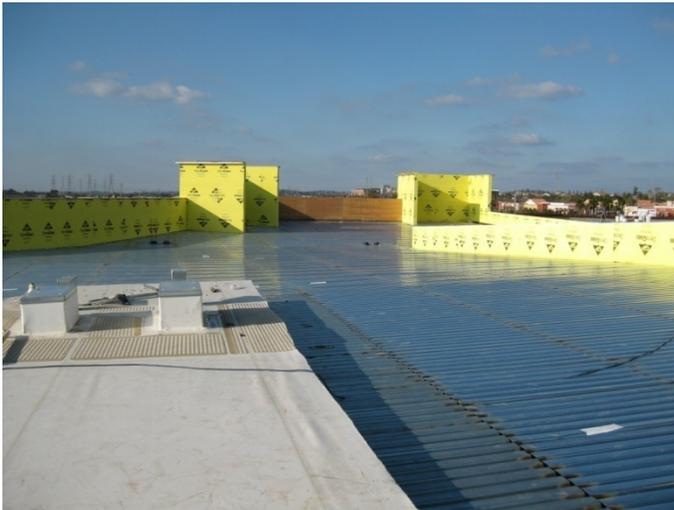
Note: When is an *exception* an *exemption*, & why?

TABLE 141.0-B Roof/Ceiling Insulation Tradeoff for Aged Solar Reflectance

Aged Solar Reflectance	Climate Zone 1, 3-9 U-factor	Climate Zone 2, 10-16 U-factor
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



Alterations & the Examiner/Inspector - §141.0(b)2B Nonres - Prescriptive - Altered roof



- **Verify at permit**
 - SR and TE values meets [NRCC-ENV-01](#)
 - Confirm if *tradeoff* or *exception* comes into play
- **Verify at Inspection**
 - Installed cool roof values meet or exceed NRCC-ENV-01 values (form shows actual & required)
 - (*CRRC product label*)
 - Verify [NRCI-ENV-01](#) from installer



CALIFORNIA ENERGY COMMISSION

QUESTIONS...

About Nonres cool roofs?





CALIFORNIA ENERGY COMMISSION

*Residential
New Construction &
Additions*



Newly Constructed Roofs

Res - Prescriptive - New Roof

2008 – §151(f)12

- Package D cool roof requirements depended on:
 - Roof slope
 - Climate zone
 - Product density (lb/ft²)
- Requirements in Table 151-B

2013 – §150.1(c)11

- Package A cool roof requirements depend on:
 - Roof slope
 - Climate zone
- Revisions to scope & application
- Requirements in [Table 150.1-A](#)

TABLE 150.1-A COMPONENT PACKAGE-A **Standard Building Design**

			Climate Zone																		
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16			
Building Envelope	Insulation ¹	Roofs /Ceilings	U 0.025 R-38	U 0.031 R-30	U 0.031 R-30	U 0.031 R-30	U 0.031 R-30	U 0.031 R-30	U 0.031 R-30	U 0.031 R-30	U 0.031 R-30	U 0.031 R-30	U 0.025 R-38								
		Walls	Above Grade	2x4 Framed ²	U 0.065 R-15+4 or R-13+5																
				Mass Wall Interior ³	U 0.070 R-13	U 0.070 R-13	U 0.059 R-17														
				Mass Wall Exterior ³	U 0.125 R-8.0	U 0.125 R-8.0	U 0.125 R-8.0														
		Below Grade	Below Grade Interior ³	U 0.070 R-13	U 0.070 R-13	U 0.070 R-13	U 0.070 R-13	U 0.070 R-13	U 0.070 R-13	U 0.070 R-13	U 0.070 R-13	U 0.070 R-13	U 0.070 R-13	U 0.070 R-13	U 0.070 R-13	U 0.070 R-13	U 0.070 R-13	U 0.070 R-13	U 0.070 R-13	U 0.066 R-15	
			Below Grade Exterior ³	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.100 R-10	U 0.100 R-10	U 0.053 R-19	
		Floors	Slab Perimeter	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	U 0.58 R-7.0	
			Raised	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	
			Concrete Raised	U 0.092 R-8.0	U 0.092 R-8.0	U 0.269 R-0	U 0.092 R-8.0	U 0.138 R4.0	U 0.092 R-8.0	U 0.092 R-8.0	U 0.138 R-4.0	U 0.092 R-8.0									
	Radiant Barrier			NR	REQ	NR															
	Roofing Products	Low-sloped	Aged Solar Reflectance	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.63	NR	0.63	NR		
			Thermal Emittance	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.75	NR	0.75	NR		
		Steep Sloped	Aged Solar Reflectance	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.20	0.20	0.20	0.20	0.20	0.20	0.20	NR	
Thermal Emittance			NR	NR	NR	NR	NR	NR	NR	NR	NR	0.75	0.75	0.75	0.75	0.75	0.75	0.75	NR		
Fenestration	Maximum U-factor ⁴		0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32			
	Maximum SHGC ⁵		NR	0.25	NR	0.25	NR	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25			
	Maximum Total Area		20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%			
	Maximum West Facing Area		NR	5%	NR	5%	NR	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%			



There are always exceptions

Res - New roof

- Mass roof
- Roofing area with an integrated solar collector



New Construction and the Plans Examiner - §150.1(c)11 Res - New Roof

- **Verify characteristics** on [CF1R-NCB-01](#)
- **Match indications** on construction documents
- Did they take an **exception**?
- Most applicants use **Performance Approach**
 - Penalized if cool roof not modeled, or if actual values are better than required



CERTIFICATE OF COMPLIANCE	CF1R-NCB-01-E
Newly Constructed Buildings	(Page 3 of 6)
Project Name: 2013 CALBO Training Sample	Date Prepared: 01/01/14

G. ROOFING PRODUCTS (COOL ROOF) (Section 150.1(c)11)										
01	02	03	04	05	06	07	08	09	10	11
Mass Roof 25 lb ft ² or greater	Roof Pitch	CRRC Product ID Number	Product Type	Proposed			Required			Comments
				Aged Solar Reflectance	Thermal Emittance	SRI	Aged Solar Reflectance	Thermal Emittance	SRI	
	4:12	0101-2013	Tile Roof	0.30	0.85		0.20	0.75	16	

NOTES:

- Any roof area covered by building integrated photovoltaic panels and solar thermal panels are exempt from the above Cool Roof requirements.
- Liquid field applied coatings must comply with installation criteria from section 110.8(i)4.

H. FENESTRATION/GLAZING AREAS ALLOWED					
01	02	03	04	05	06
Tag/ID	Orientation	Maximum Allowed	U-factor	SHGC	Comments

I. FENESTRATION PROPOSED AREAS AND EFFICIENCIES											
01	02	03	04	05	06	07	08	09	10	11	12
Tag/ID	Fenestration Type	Surface Area	Orientation N, S, W, E or Roof	# of Panels	Total Proposed Area	U-factor	Source	SHGC	Source	Exterior Shading Device	Comments
a.	Total Proposed Fenestration Area										
b.	Maximum Allowed Fenestration Area										
c.	Row a. ≤ Row b.)										
d.	If exterior shading devices are used, what is the new calculated SHGC value from CF1R-ENV-03?										



New Construction and the Field Inspector - §150.1(c)11 Res - New roof



- **Verify values at framing**
 - Roofing efficiency (TE & SR)
 - CRRC product label
 - values to match CF1R
- **Verify indications on [CF2R-ENV-04-E](#)**
 - Form shows actual & required

CERTIFICATE OF INSTALLATION		CF2R-ENV-04-E
Roofing-Radiant Barrier		(Page 2 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

F. Roofing Products (Cool Roof) Installation Information											
01	02	03	04	05	06	07	08	09	10	11	12
Tag/ ID	Roof Pitch	CRRC Product ID Number	Product Type	CRRC Listed Aged Solar Reflectance	Installed				Required		
					Initial Solar Reflectance	Aged Solar Reflectance	Thermal Emittance	SRI	Aged Solar Reflectance	Thermal Emittance	SRI

G. Roofing Products (Cool Roof) – Additional Requirements	
01	Any roof area covered by building integrated photovoltaic panels and solar thermal panels are exempt from the above Cool Roof requirements.
02	Liquid field applied coatings must comply with installation criteria from section 110.8(i)4.
03	Mass roof 25 lb/ft ² or greater: Mass roofs are not required to have a cool roof even if the climate zone specifies minimum performance requirements.
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met.	

For information and data collection only. Not valid until registered with a HERS provider

F. Roofing Products (Cool Roof) Installation Information

01. Tag/ID: A label (if any) from the plans, such as R1.
02. Roof Pitch: Indicate whether the roof pitch is $\leq 2:12$ or $> 2:12$
03. CRRC Product ID Number: If a cool roof is installed, obtain the Product ID Number from the Cool Roof Rating Council's (CRRC) product packaging label or rated products directory (<http://coolroofs.org/products/results>).
04. Product Type: Indicate the product type being used.
05. CRRC Listed Aged Solar Reflectance: State whether the 3-year aged solar reflectance value of the product used is listed on the CRRC product packaging label or rated products directory—Yes or No.
06. Installed Initial Solar Reflectance: Indicate the initial solar reflectance value of the product used; obtained from the CRRC product packaging label or rated products directory.
07. Aged Solar Reflectance: Indicate the aged solar reflectance value of the product used; obtained from the CRRC product packaging label or label or rated product directory.
 - Note: If the 3-year aged value is not available then use the equation in Section 110.8(i)2 of the Energy Standards to calculate the 3-year aged solar reflectance. One can also use the "Calculated Aged Solar Reflectance" from the Solar Reflectance Index (SRI) Calculation Worksheet" available at the California Energy Commission's website.
08. Installed Thermal Emittance: Indicate the thermal emittance value of the product used; obtained from the CRRC product packaging label or rated products directory. This can be either the initial or aged value.
09. Installed SRI: If applicable, obtain the value of the product used from the CRRC rated products directory, or the "Solar Reflectance Index (SRI) Calculation Worksheet" available at the California Energy Commission's website.
10. Proposed Aged Solar Reflectance: Report the proposed aged solar reflectance value from the CF1R.
11. Proposed Thermal Emittance: Report the proposed thermal emittance value from the CF1R..
12. Proposed SRI: Report the proposed SRI value if applicable, from the CF1R-NCB, -ADD, or -ALT-01. .

G. Roofing Products (Cool Roof) – Additional Requirements

This section contains additional requirements for Roofing Products. Other exceptions apply for additions and/or alterations.



CALIFORNIA ENERGY COMMISSION

Residential Alteration

(Prescriptive Requirements)



Res Re-roofs

Res - Prescriptive - Altered roof

2008 – §152(b)1H

- When more than 50% or 1,000 ft² replaced (whichever is less), must be cool roof
 - Steep-sloped roofs: same reqs. as prescriptive (new const.)
 - Numerous alternatives
 - Low-sloped roofs: same reqs. as prescriptive (new const.)
 - Exempt if no ducts in attic

2013 – §150.2(b)1H

- When more than 50% replaced, must be cool roof
 - Steep-sloped roofs: same as new construction/prescriptive requirement.
 - Alternatives revised/added
 - Low-sloped roofs: same as new construction/prescriptive requirement.
 - Tradeoff for reflectance/insulation



Res Altered Roof

What is a *re-roof* (roofing alteration)?

- Replaced

What triggers a *cool-roof* requirement when doing a re-roof?

- Greater than 50% of the existing roof area

Note: Any roofing not being altered is not subject to requirements



There are always exceptions

Res - Altered roof

- Low-sloped roofs
 - Attics with no ducts
 - Reflectance/insulation tradeoff, per [Table 150.2-A](#)
- Steep-sloped roofs (considered [equivalent](#))
 - Air space between roofing & roof deck
 - Profile ratio of roofing product
 - Existing ducts insulated & sealed (HERS)
 - Ceiling has at least R-38 insulation
 - Attics with radiant barrier
 - Attics with no ducts
 - Insulate above roof deck (CZ 10-15)

Note: If you are a [Blueprint](#) subscriber, you already know this

TABLE 150.2-A AGED SOLAR REFLECTANCE INSULATION TRADE OFF TABLE

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

- a. Air-space of 1.0 inch (25 mm) is provided between the top of the roof deck to the bottom of the roofing product; or
- b. The installed roofing product has a profile ratio of rise to width of 1 to 5 for 50 percent or greater of the width of the roofing product; or
- c. Existing ducts in the attic are insulated and sealed according to Section 150.1(c)9; or
- d. Buildings with at least R-38 ceiling insulation; or
- e. Buildings with a radiant barrier in the attic meeting the requirements of Section 150.1(c)2; or
- f. Buildings that have no ducts in the attic; or
- g. In Climate Zones 10-15, R-4 or greater insulation above the roof deck.



Alterations & the Examiner/Inspector - §150.2(b)1H Res - Prescriptive - Altered roof



- **Require at permit**
 - Verify SR and TE values meets [CF1R-ALT-05](#)
 - May require at Final
- **Verify at Inspection**
 - Installed cool roof values meet or exceed CF1R-ALT-05
 - Verify [CF2R-ALT-05-E](#)
 - Match CRRC product label



CERTIFICATE OF COMPLIANCE	CF1R-ALT-05-E
Prescriptive Residential Alterations That Do Not Require HERS Field Verification	(Page 3 of 8)
Project Name:	Date Prepared:

C. ROOF REPLACEMENT (Prescriptive Alteration, Section 150.2(b)1H) ←

01	02	03	04	05	06	07	08	09	10	11	12	13
Method of Compliance	Roof Pitch	Exception	CRRC Product ID Number	Product Type	R-value Deck Insulation	Proposed				Minimum Required		
						Initial Solar Reflectance	Aged Solar Reflectance	Thermal Emittance	SRI (Optional)	Aged Solar Reflectance	Thermal Emittance	SRI (Optional)

NOTES

- Roof area covered by building integrated photovoltaic panels and solar thermal panels are exempt from the above Cool Roof requirements.
- Liquid field applied coatings must comply with installation criteria from section 110.8(i)4.

D. FENESTRATION/GLAZING AREAS ALLOWED (Section 150.2(b)1)

01	02		03	04		05		06		07
Alteration Type	Maximum Allowed Fenestration Area For All Orientations (ft ²) (Windows)	Maximum Allowed Fenestration Area For All Orientations (ft ²) (Skylights)	Maximum Allowed West-Facing Fenestration Area Only (ft ²)	Existing Fenestration Area for All Orientations (ft ²)	Existing West-Facing Fenestration Area (ft ²)	Maximum Allowed U-factor (Windows)	Maximum Allowed U-factor (Skylights)	Maximum Allowed SHGC (Windows)	Maximum Allowed SHGC (Skylights)	Comments



CERTIFICATE OF INSTALLATION

CF2R-ALT-05-E

Prescriptive Residential Alterations That Do Not Require HERS Field Verification

(Page 4 of 15)

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

Roofing and Radiant Barrier

G. RADIANT BARRIER

01	Brand Name and product number	
02	Installation Type	
03	Total Attic Area (ft ²)	

H. REQUIRED VENT AREA

01	Combined NFA of installed upper and lower vents (in ²)	
02	Minimum required combined NFA of upper and lower vents (in ²)	
03	NFA of installed upper vents (in ²)	
04	Minimum required NFA of upper vents (in ²)	

I. ROOFING PRODUCTS (COOL ROOF) INSTALLATION INFORMATION

01	02	03	04	05	06	07	08
Roof Pitch	CRRC Product ID Number	Product Type	CRRC Listed Aged Solar Reflectance	Initial Solar Reflectance	Aged Solar Reflectance	Thermal Emittance	SRI



CERTIFICATE OF INSTALLATION		CF2R-ALT-05-E
Prescriptive Residential Alterations That Do Not Require HERS Field Verification		(Page 5 of 15)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City:	Zip Code:

J. RADIANT BARRIER AND ATTIC VENTILATION – ADDITIONAL REQUIREMENTS

Radiant Barrier	
01	Radiant barrier must be installed on all vertical surfaces in the attic including gable ends.
02	The emittance of the radiant barrier shall be less than or equal to 0.05 as tested with ASTM C1371, or E408.
03	The product shall meet all requirements for California certified insulation materials [radiant barriers] of the Department of Consumer Affairs, Bureau of Home Furnishings and Thermal Insulation, as specified by CCR, Title 24, Part 12, Chapter 12-13, Standards for Insulating Material
04	When determining the Total Attic Area, the area over unconditioned spaces such as the garage is included when the attic spaces are connected.
Lower Vents	
05	Lower vents are within one foot of the eave.
Upper Vents	
06	Upper vents are within three feet of the ridge
Vent Area	
07	The NFA of upper vents must be within required NFA range of upper vents Note: per Exception to R806.2 of the CBC Title 24, Part2, Vol.2.5, if the net free ventilating area is less than 1:150, then the upper ventilation must be at least 40% and no more than 50%. Part 2 contains additional requirements that must be met if the area is less than 1:150.
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met.	

K. ROOFING PRODUCTS (COOL ROOF) – ADDITIONAL REQUIREMENTS

01	Any roof area covered by building integrated photovoltaic panels and solar thermal panels are exempt from the above Cool Roof requirements.
02	Liquid field applied coatings must comply with installation criteria from section 110.8(i)4.
03	Mass roof 25 lb ft ² or greater: Mass roofs are not required to have a cool roof even if the climate zone specifies minimum performance requirements.
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met.	

H. REQUIRED VENT AREA

1. Combined NFA of installed upper and lower vents (in²): Indicate the total combined NFA of installed upper and lower vents in square inches.
2. Minimum required combined NFA of upper and lower vents (in²): Total attic area divided by 300 and multiplied by 144.
3. NFA of installed upper vents (in²): Indicate the total NFA of installed upper vents in square inches.
4. Minimum required NFA of upper vents (in²): Table H item 1 (combined NFA of installed upper and lower vents) multiplied by 0.3.

I. ROOFING PRODUCTS (COOL ROOF) **INSTALLATION INFORMATION**

1. Roof Pitch: Indicate whether the roof pitch is $\leq 2:12$ or $> 2:12$
2. CRRC Product ID Number: If a cool roof is installed, obtain the Product ID Number from the Cool Roof Rating Council's (CRRC) product packaging label or rated products directory (<http://coolroofs.org/products/results>).
3. Product Type: Indicate the product type being used.
4. CRRC Listed Aged Solar Reflectance: State whether the 3-year aged solar reflectance value of the product used is listed on the CRRC product packaging label or rated products directory—Yes or No.
5. Installed Initial Solar Reflectance: Indicate the initial solar reflectance value of the product used; obtained from the CRRC product packaging label or rated products directory.
6. Aged Solar Reflectance: Indicate the aged solar reflectance value of the product used; obtained from the CRRC product packaging label or rated product directory.
 - Note: If the 3-year aged value is not available then use the equation in Section 110.8(i)2 of the Energy Standards to calculate the 3-year aged solar reflectance. One can also use the "Calculated Aged Solar Reflectance" from the Solar Reflectance Index (SRI) Calculation Worksheet" available at the California Energy Commission's website
7. Thermal Emittance: Indicate the thermal emittance value of the product used; obtained from the CRRC product packaging label or rated products directory. This can be either the initial or aged value.
8. SRI: If applicable, obtain the value of the product used from the CRRC rated products directory, or the "Solar Reflectance Index (SRI) Calculation Worksheet" available at the California Energy Commission's website.

J. RADIANT BARRIER AND ATTIC VENTILATION – ADDITIONAL REQUIREMENTS

This section contains additional requirements for Radiant Barriers, Lower Vents, Upper Vents, and Vent Area.



Forms Exception Rule

§10-103

- For alterations that do not require HERS testing:
 - Building Department may not require CF1R form
 - OR, can create simplified version of CF1R
- Does not exempt applicant from complying with code; only from submitting forms
- Recommend including requirements on permit application for simplification (i.e. solar reflectance, thermal emittance, exception/alternative, etc.)



CALIFORNIA ENERGY COMMISSION

QUESTIONS...

About Res cool roofs?





Conclusion

- Cool roof requirements are not “*Mandatory Requirements*”
- Dependent factors include *roof slope* and *climate zone*
- There are many triggers for alternative ways of meeting intent and achieving compliance
- There are many *exceptions* and *exemptions* to help designers meet compliance economically