

California's Title 24 For Low-Slope Roofs

**Building Energy
Efficiency Standards**



Effective July 1st, 2014

California's Title 24 for Low-Slope Roofs

Meeting the Code... Avoiding Hassles

About GAF

Founded in 1886, GAF has become North America's largest manufacturer of commercial and residential roofing. Our success in growing the company to nearly \$3 billion in sales has been based on our unique philosophy of:

- Helping property owners & architects to make their best and safest roofing choices
- Helping support distributors and roofing contractors build their businesses and avoid hassles

GAF is your best and safest choice! For more information, visit www.gaf.com.

About Title 24

The California Energy Commission (CEC) was created in 1974 through the Warren-Alquist State Energy Resources Conservation and Development Act to construct and periodically modify energy efficiency standards for residential and non-residential buildings. In 1978, all building codes and standards were combined under one umbrella called Title 24 Building Standards Code and Part 6 of this standard code has the requirements for energy efficiency while Part 1 has the administrative requirements. For more information or to download a copy of Title 24, visit www.energy.ca.gov/title24/

Why Title 24 Now?

- California has over 35 million people and from 1960 to 1974 when the CEC was created, they saw their energy consumption rise over 50% per capita, which means that not only as their population was increasing, the amount of energy each person was using was also increasing dramatically.
- California's building efficiency standards (along with those for energy efficient appliances) have saved more than \$56 billion in electricity and natural gas costs since 1978. It is estimated the standards will save an additional \$23 billion by 2013.
- The CEC's forecast data shows that 1/3 of the energy (natural gas and electricity) consumed in California is consumed by buildings.
- Strengthening the requirements of Title 24 has been a very key element in the state's climate change initiative.

Why Cool Roofs?

- Roof surface temperatures and attic temperatures can be reduced significantly.
- By lowering attic temperatures, air conditioning costs can be reduced by as much as 10-15% according to the Department of Energy's ENERGY STAR program.
- Reductions in air conditioning use help to reduce the "peak energy demand" on the power grid, reducing the need for new power plant construction.
- Cool roofs can reduce the effects of "Urban Heat Islands", where data shows that urban areas have higher ambient temperatures than surrounding rural areas because of their concentration of dark surfaces and the sparseness of vegetation (dark surfaces can be up to 70F hotter on a warm summer day than reflective, "cool" surfaces).

Do All Roofs Have “Cool Roof” Requirements in Title 24?

No. While Title 24 applies to all residential and non-residential buildings in the state, the specific requirements for roofs are dependent on geographic location, building use (residential, non-residential), type of construction (new construction, addition, or re-roofing), building type (low rise/high rise, low slope/high slope), etc. As this manual outlines, there are many instances where a “cool” roof is not required, and the CEC has been diligent in their requirements for “cool roofing” where it makes sense for property owners in the state. This is because in cooler climates, there can actually be a “penalty” for installing a roof with high reflectance.

When Does the 2013 Version of Title 24 Go Into Effect?

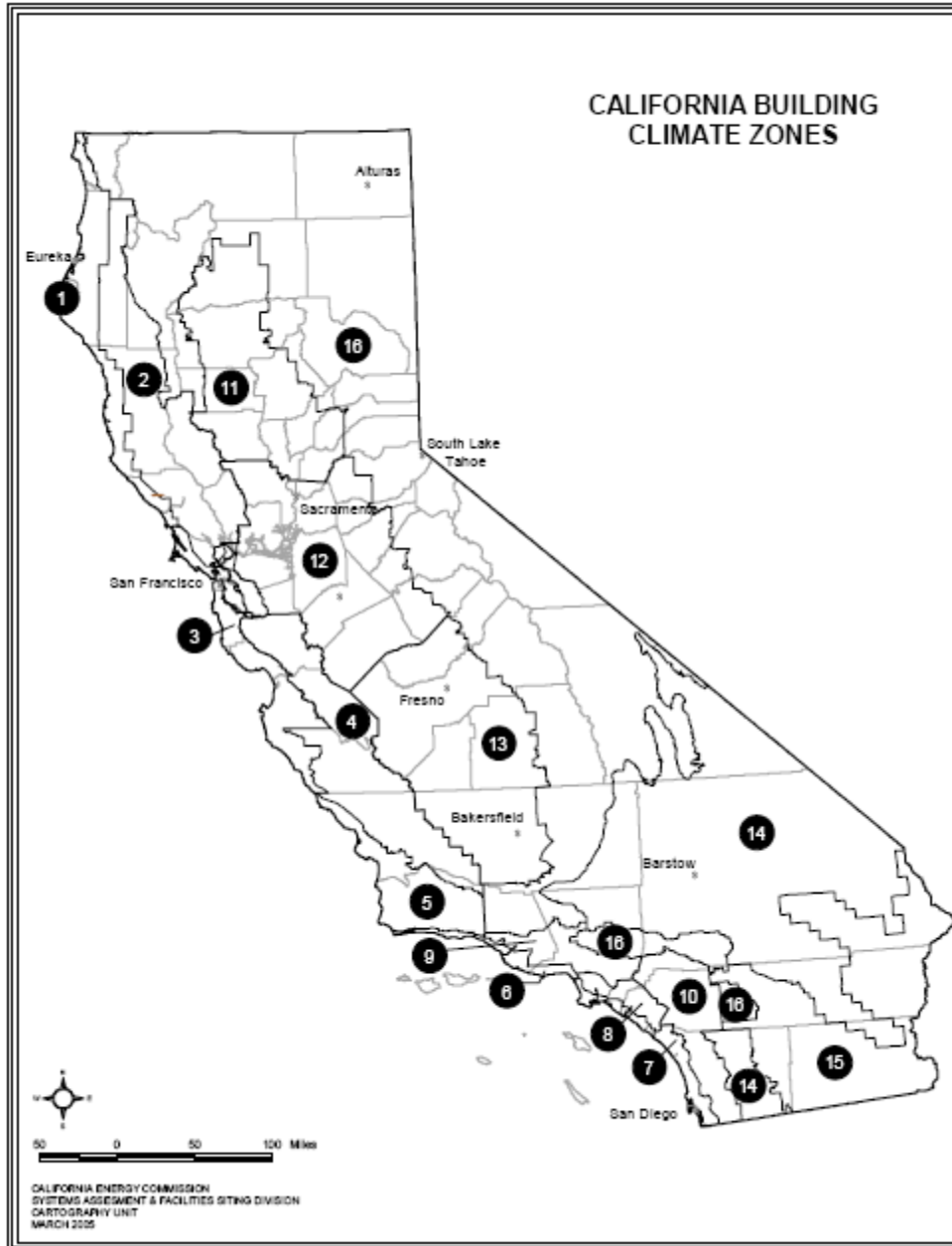
California's Building Energy Efficiency Standards are updated on an approximately three-year cycle. The 2013 Standards will continue to improve upon the current 2008 Standards for new construction of, and additions and alterations to, residential and nonresidential buildings. The 2013 Standards will go into effect on July 1, 2014, following approval of the California Building Standards Commission.

Glossary of Cool Roofing Terms

Term	Explanation
CRRC	Cool Roof Rating Council The CRRC does not set requirements for solar reflectance (reflectivity) or thermal emittance; instead, they set the requirements for how to measure these properties and how to label products that have been measured. They also provide independent certification of a product's reflectance and emittance.
ENERGY STAR	ENERGY STAR is a joint federal program of the U.S. Environmental Protection Agency and the U.S. Department of Energy that provides choices for energy efficient products and practices.
Low Slope	Slopes up to and including 2:12
Solar Reflectance	The part of solar energy that is reflected by a surface, expressed as a percentage, e.g. a material with a 0.25 solar reflectance reflects 25% of solar energy. In Title 24, the term “aged reflectance” is used and refers to the reflectance of a material after 3 years of aging in the field.
SRI	Solar Reflectance Index SRI combines reflectivity and emittance to measure a roof's overall ability to reject solar heat. The calculation of this index is defined by ASTM E 1980-01 and is based on a mathematical formula that includes values for solar absorptance, solar flux, thermal emissivity, and various other coefficients. Title 24 provides SRI alternatives to the solar reflectance and thermal emittance requirements.
Steep Slope	Slopes greater than 2:12
Thermal Emittance	The relative ability of a material to release absorbed heat gained from solar energy.

California's 16 Climate Zones

California has very distinct and differing climates which have been broken into 16 different "climate zones". These zones recognize that different climates have different energy demands and costs. The following map shows the 16 climate zones for the state:



Complying With Title 24

There are 3 different ways to comply with the requirements for energy efficiency in Title 24

Prescriptive Approach

This is the simplest approach to meeting the requirements of Title 24, particularly for re-roofing because it defaults to installing a “cool roof” or other options (for re-roofing only). When the “cool roof” is installed, the prescribed requirements are met.

Overall Envelope Approach

This approach allows non-cool roofing to be installed if enough attic insulation is installed. While this trade-off makes sense, it must be accompanied by documentation that the amount of insulation used was adequate and meets the energy performance requirements for the building.

Performance Approach

The approach to meeting Title 24 requires detailed calculations using CEC software where the energy efficiency of the entire building is calculated and compared to a prescribed energy “budget”. Using this method allows for trade-offs between different building envelope components and provides flexibility for designers; however, it is very difficult to comply with the standard when only making alterations to an existing building. Typically, an energy consultant is used when this approach is taken for compliance.

Understanding How Title 24 Classifies Buildings

In addition to knowing where the building is located so you can know what is required, you need to know how Title 24 classifies “buildings”.

“Low Rise Residential”... describes:

- All single family homes of any number of stories
- All duplexes of any number of stories
- All multi-family buildings up to 3 stories in height
- Garden apartments and other housing types up to 3 stories in height

“Nonresidential”... describes:

- Offices, retail and wholesale stores
- Grocery stores, restaurants, theaters
- Hotels and motels
- Industrial work buildings
- Commercial or industrial storage units
- Schools and churches
- Apartment and multi-family buildings with four or more stories
- Long-term care facilities
- Dormitories
- Private garages, carports, sheds and agricultural buildings

“High Rise Residential”... describes:

- All multi-family residential buildings with 4 or more habitable stories
- Garden apartments and other housing types with 4 or more habitable stories

For more information on building classifications, please refer to the actual Title 24, Part 6 standard.

Minimum Performance Requirements for Liquid Applied Roof Coatings on Low-Sloped Roofs

Table 110.8-C

Physical Property	ASTM Test Procedure	Requirement
Initial percent elongation (break)	D 2370	Minimum 200% 73°F (23°C)
Initial percent elongation (break) <u>OR</u> Initial Flexibility	D 2370 D522, Test B	Minimum 60% 0°F (-18°C) Minimum pass 1" mandrel 0°F (-18°C)
Initial tensile strength (max stress)	D 2370	Minimum 100 psi (1.38 Mpa) 76°F (23°C)
Initial tensile strength (max stress) <u>OR</u> Initial Flexibility	D 2370 D522, Test B	Minimum 200 psi (2.76 Mpa) 0°F (-18°C) Minimum pass 1" mandrel 0°F (-18°C)
Final percent elongation (break) after accelerated weathering 1000 h	D 2370	Minimum 100% 73°F (23°C)
Final percent elongation (break) after accelerated weathering 1000 h <u>OR</u> Flexibility after accelerated weathering 1000 h	D 2370	Minimum 40% 0°F (-18°C) Minimum pass 1" mandrel 0°F (-18°C)
Permeance	D 1653	Maximum 50 perms
Accelerated weathering 1000 h	D 4798	No cracking or checking*
* Any cracking or checking visible to the eye fails the test procedure		

Liquid applied roof coatings applied to low-sloped roofs in the field as the top surface of a roof covering shall:

- A. Be applied across the entire roof surface to meet the dry mil thickness or coverage recommended by the coating manufacturer, taking into consideration the substrate the substrate is applied, and
- B. Meet the minimum performance requirements listed above or the minimum performance requirements of ASTM C836, D3468, D6083, or D6694, whichever are appropriate to the coating material.

Note: *Qualifying coatings include elastomeric coatings and white acrylic coatings*

EXCEPTION 1: Aluminum-pigmented asphalt roof coatings shall meet the requirements of ASTM D2824 or ASTM D6848 and be installed as specified by ASTM D3805.

EXCEPTION 2: Cement-based roof coatings shall contain a minimum of 20 percent cement and shall meet requirements of ASTM C1583, ASTM D822, and ASTM D5870.

Note: *Requirements do not apply to industrial coatings that are factory-applied, such as metal roof panels.*

Mandatory Requirements¹ for Solar Ready Buildings

Low-rise and High-rise Multi-family Buildings, Hotel/ Motel Occupancies, and Nonresidential Buildings shall comply with the requirements of Section 110.10(b) through 110.10(d).

(b). Solar Zone.

1. Minimum Area. The solar zone shall be located on the roof or overhang of the building or on the roof or overhang of another structure located within 250 feet of the building or on covered parking installed with the building project and have a total area no less than 15 percent of the total roof area of the building excluding any skylight area.

EXCEPTION 1: Buildings with a permanently installed solar electric system having a nameplate DC power rating, measured under Standard Test Conditions, of no less than one watt per square foot of roof area.

EXCEPTION 2: Buildings with a permanently installed domestic solar water heating system complying with Section 150.1(c)8Ciii.

EXCEPTION 3: Buildings with designated solar zone area that is no less than 50 percent of the potential solar zone area. The potential solar zone area is the total area of any low-sloped roofs where the annual solar access is 70 percent or greater and any steep-sloped roofs oriented between 110 degrees and 270 degrees of true north where the annual solar access is 70 percent or greater. Solar access is the ratio of solar insolation including shade to the solar insolation without shade. Shading from obstructions located on the roof or any other part of the building shall not be included in the determination of annual solar access.

EXCEPTION 4: Low-rise and high-rise multi-family buildings meeting the following conditions: Refer to Section 110.10(b)1B Exception 4 for further requirements.

EXCEPTION 5: Buildings where the roof is designed and approved to be used for vehicular traffic or for a heliport.

2. Orientation. All sections of the solar zone located on steep-sloped roofs shall be oriented between 110 degrees and 270 degrees of true north.

3. Shading.

- A. No obstructions, including but not limited to, vents, chimneys, architectural features, and roof mounted equipment, shall be located in the same zone.
- B. Any obstruction, located on the roof or any other part of the building that projects above the solar zone shall be located at least twice the distance, measure in the horizontal plane, of the height difference between the highest point of the obstruction and the horizontal projection of the nearest point of the solar zone, measured in the vertical plane.

EXCEPTION 1: Any obstruction, located on the roof or any other part of the building that is oriented north of all points of the solar zone.

4. Structural Design Loads² on Construction Documents.

- a. For areas of the roof designated as solar zone, the structural design loads for roof dead load and roof live load shall be clearly indicated on the construction documents.

Notes:

1. For further Solar Ready Building requirements, refer to Section 110.10(C) through 110.10(d).
2. Section 110.10(b)4 does not require the inclusion of any collateral load for future solar energy systems.

Insulation Requirements for Roof Additions, Alterations, and Repairs to Existing Buildings

Table 141.0-C

Climate Zone	Nonresidential		High-rise Residential and Guest Rooms of Hotel/ Motel Buildings	
	Continuous Insulation R-value	U-factor	Continuous Insulation R-value	U-factor
1	R-8	0.082	R-14	0.055
2	R-14	0.055	R-14	0.055
3-9	R-8	0.082	R-14	0.055
10-16	R-14	0.055	R-14	0.055

EXCEPTION 1: The existing roof is insulated with at least R-7 insulation or it has a U-factor lower than 0.089.

EXCEPTION 2: If mechanical equipment is located on the roof and it will not be disconnected and lifted as part of the roof replacement, insulation added may be limited to the maximum insulation thickness that will allow a height of 8 inches (203 mm) from the roof membrane surface to the top of the base flashing.

EXCEPTION 3: If adding the required insulation will reduce the base flashing height to less than 8 inches (203 mm) at penthouse or parapet walls, the insulation added may be limited to the maximum insulation thickness that will allow a height of 8 inches (203 mm) from the roof membrane surface to the top of the base flashing

- A. The penthouse or parapet walls are finished with an exterior cladding material other than the roof covering membrane material; and
- B. The penthouse or parapet walls have exterior cladding that must be removed to install the new roof covering membrane to maintain the flashing height of 8 inches (203 mm); and
- C. For nonresidential buildings, the ratio of the replaced roof area to the linear dimension of the affects penthouse or parapet walls shall be less than 25 square feet per linear foot for Climate Zones 2, and 10 through 16, and less the 100 square feet per linear foot for Climate Zones 1, and 3 through 9.

EXCEPTION 4: For high-rise residential buildings, hotels or motels, the ratio of the replaced roof area to the linear dimension of affected penthouse or parapet walls shall be less than 25 square feet per linear foot for all Climate Zones.

EXCEPTION 5: Tapered insulation may be used which has a thermal resistance less than that prescribed in the Table 141.0-C at the drains and other low points, provided that the thickness of insulation is increased at the high points of the roof so that the average thermal resistance equals or exceeds the value that is specified in Table 141.0-C.

Prescriptive Envelope Requirements

Non-Residential (including relocatable public schools)

Type of Construction	Climate Zones	Minimum Requirements
New Construction	1-16 (See map on page 3)	Install Cool Roofing: 1. Aged Reflectance: ≥ 0.63 Initial Thermal Emittance: ≥ 0.75 Or 2. Aged SRI ≥ 75
Re-roofing*	1-16 (See map on page 3)	Install Cool Roofing: 1. Aged Reflectance: ≥ 0.63 Initial Thermal Emittance: ≥ 0.75 Or 2. Aged SRI ≥ 75

* Re-roofing requirements must be met when more than 50% of the roof is recovered or replaced or the roof area is greater than 20 squares (2,000 sq.ft.)

EXCEPTION 1: Wood framed roof assemblies in climate zones 3 and 5 are exempt if the roof assembly has a U-factor of .039 or lower.

EXCEPTION 2: Metal framed roof s in climate zones 3 and 5 if the roof assembly has a U-factor of .048 or lower.

EXCEPTION 3: Roof constructions that have thermal mass over the roof membrane with a weight of at least 25lb/ft² are exempt from the requirements.

EXCEPTION 4: An aged solar reflectance less than 0.63 is allowed provided the maximum roof/ceiling U-factor in Table 140.3 is not exceeded.

Note: 1. Air barriers are required in Climate Zones 11-16.
2. There are **no** alternatives to using a cool roofing product for re-roofing.

Prescriptive Envelope Requirements

High-Rise Residential & Hotels & Motels

Type of Construction	Climate Zones	Minimum Requirements
New Construction	9-11 & 13-15 (See map on page 3)	Install Cool Roofing: 1. Aged Reflectance: ≥ 0.55 Initial Thermal Emittance: ≥ 0.75 Or 2. Aged SRI ≥ 64
Re-roofing*	9-11 & 13-15 (See map on page 3)	Install Cool Roofing: 1. Aged Reflectance: ≥ 0.55 Initial Thermal Emittance: ≥ 0.75 Or 2. Aged SRI ≥ 64

* Re-roofing requirements must be met when more than 50% of the roof is recovered or replaced or the roof area is greater than 20 squares (2,000 sq.ft.)

EXCEPTION 1: Roof constructions that have thermal mass over the roof membrane with a weight of at least 25lb/ft².

EXCEPTION 2: Roof area covered by building integrated photovoltaic panels and building integrated solar thermal panels are not required to meet the cool roof requirements for solar reflectance, thermal emittance, or SRI.

Note: 1. There are **no** alternatives to using a cool roofing product for re-roofing.



Prescriptive Envelope Requirements

Low-Rise Residential (typical single family home)

Type of Construction	Climate Zones	Minimum Requirements
New Construction	13 & 15 (See map on page 3)	Install Cool Roofing: 1. Aged Reflectance: ≥ 0.63 Initial Thermal Emittance: ≥ 0.75 Or 2. Aged SRI ≥ 75
Re-roofing*	13 & 15 (See map on page 3)	Install Cool Roofing (or see alternatives below): 1. Aged Reflectance: ≥ 0.63 Initial Thermal Emittance: ≥ 0.75 Or 2. Aged SRI ≥ 0.75

* Re-roofing requirements must be met when more than 50% of the roof is recovered or replaced or the roof area is greater than 10 squares (1,000 sq.ft.)

EXCEPTION 1: Buildings with no ducts in the attics

EXCEPTION 2: The aged solar reflectance can be meet by using insulation at roof deck specified in Table 150.2-A.

GAF Eligible Products

Product	Aged Reflectivity (≥0.63)	Initial Emissivity (≥0.75)	Aged SRI* (Title 24) (≥75)
Cap Sheets			
Ruberoid® EnergyCap™ 30 FR SBS Membrane (white)	0.63	0.84	75
GAFGLAS® EnergyCap™ BUR Mineral Surfaced Cap Sheet (white)	0.63	0.90	76
Ruberoid® EnergyCap™ Torch Granule FR (white)	0.70	0.81	84
Single-Ply Membranes			
EverGuard® TPO FB Ultra (white)	0.68	0.90	83
EverGuard® TPO (white)	0.68	0.90	83
EverGuard® Freedom™ TPO (white)	0.68	0.90	83
EverGuard® Steep Slope TPO (white)	0.68	0.90	83
EverGuard® Energy Gray TPO	0.67	0.87	81
EverGuard® Energy Tan TPO	0.66	0.89	80
EverGuard Extreme® TPO (white)	0.72	0.84	87
EverGuard Extreme® TPO FB Ultra (white)	0.72	0.84	87
EverGuard Extreme® Freedom™ TPO HW (white)	0.72	0.84	87
EverGuard® PVC (white)	0.61	0.95	75
EverGuard® PVC Smooth (white)	0.76	0.87	94
EverGuard® PVC XK (white)	0.76	0.87	94
EverGuard® PVC XK Fleeceback (white)	0.76	0.87	94
Coatings			
TOPCOAT® Membrane (white)	0.68	0.90	83
TOPCOAT® EnergyCote™ Elastomeric Coating (white)	0.78	0.87	97
TOPCOAT® EPDM Coating (white)	0.70	0.88	85

* Aged SRI is based on Aged Reflectivity and Initial Emissivity per Title 24 requirements.

GAF Alternatives to a Cool Roof






GAF offers a fully array of garden roofing products in our hassle-free **GardenScapes™** product line.

Remember, although garden roofs are not cool roofs by their reflectance properties, will they be allowed under the 2013 standards. The California Energy commission considers a garden roof as a roof with thermal mass on it.

Our **GardenScapes™** systems feature a simple, effective design featuring our exclusive **DuroGro™** 4-in-1 drainage foundation system and **Start-Rite™** growing medium. Fewer components mean less chance of installation problems. No other manufacturer offers you more waterproofing choices for your garden roof as well as a single-source guarantee that covers your complete garden roof.

Please go to www.gaf.com for more information on all of our garden roofing products.

Common Questions & Answers...To Avoid Hassles

Question	Avoiding Hassles																						
<p>Are there labeling requirements to meet Title 24?</p>	<ul style="list-style-type: none"> Yes! If you are going to meet the prescriptive requirements and use a cool roofing product, it must not only meet the requirements of Title 24, but it must have a CRRC label that shows its solar reflectance and emittance. <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td rowspan="2" style="text-align: center; vertical-align: middle;">  </td> <td style="text-align: center;"><u>Initial</u></td> <td style="text-align: center;"><u>Weathered</u></td> </tr> <tr> <td style="text-align: center;">Solar Reflectance</td> <td style="text-align: center;">0.00</td> <td style="text-align: center;">Pending</td> </tr> <tr> <td></td> <td style="text-align: center;">Thermal Emittance</td> <td style="text-align: center;">0.00</td> <td style="text-align: center;">Pending</td> </tr> <tr> <td colspan="3">Rated Product ID Number</td> <td style="text-align: center;">-----</td> </tr> <tr> <td colspan="3">Licensed Seller ID Number</td> <td style="text-align: center;">-----</td> </tr> <tr> <td colspan="2">Classification</td> <td colspan="2">Production Line</td> </tr> </table> <p style="font-size: small; margin-top: 5px;">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 style="font-size: x-small; margin-top: 5px;">Manufacturer of product stipulates that these ratings were determined in accordance with the applicable Cool Roof Rating Council procedures.</p> </div>		<u>Initial</u>	<u>Weathered</u>	Solar Reflectance	0.00	Pending		Thermal Emittance	0.00	Pending	Rated Product ID Number			-----	Licensed Seller ID Number			-----	Classification		Production Line	
	<u>Initial</u>		<u>Weathered</u>																				
	Solar Reflectance	0.00	Pending																				
	Thermal Emittance	0.00	Pending																				
Rated Product ID Number			-----																				
Licensed Seller ID Number			-----																				
Classification		Production Line																					
<p>We've heard a lot about tax credits/ exemptions... does installing cool roofing that meets Title 24 qualify for a tax credit?</p>	<ul style="list-style-type: none"> Not necessarily! In order to qualify under the 2009 American Recovery and Stimulus Plan, homeowners have to have products that meet ENERGY STAR requirements installed on their home. The requirements for ENERGY STAR are different than Title 24 and only those products labeled to meet ENERGY STAR currently qualify for tax credits. For further information about potential tax credits, go to www.energystar.gov 																						
<p>If a product has an Energy Star rating mark, can it be used in California?</p>	<ul style="list-style-type: none"> Maybe... but if you have to use "cool roofing" to meet Title 24, then the product you use must also have a CRRC label. 																						
<p>If the CRRC label only has "as manufactured" values, can it be used under Title 24?</p>	<ul style="list-style-type: none"> Yes! Because Title 24 allows for a "calculation" of the 3 year aged value. 																						
<p>If a zone is not listed in the Prescriptive Requirements Tables, what do I have to do?</p>	<ul style="list-style-type: none"> You do NOT have to use a cool roofing product to be in compliance with Title 24. If a zone is not listed, there is not a requirement for cool roofing in that geographic area. 																						
<p>Although garden roofs are not cool roofs by their reflectance properties, will they be allowed under the 2013</p>	<ul style="list-style-type: none"> Yes! The California Energy commission considers a garden roof as a roof with thermal mass on it. 																						

standards?	
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Common Questions & Answers (continued)

Question	Avoiding Hassles
<p>Who will enforce Title 24? Is there a permitting process?</p>	<ul style="list-style-type: none"> <p>Enforcement to the Energy Efficiency Standards rests with your local building code official(s) ... typically a city or county building code department. If you are in an area that will require “cool roofing”, you should contact the building code office in your city or county (whichever is applicable) and make sure that you understand what will be required to pull a building permit. California law requires building permits for both new construction and alterations and renovations, and your local office may adopt a “Certificate of Compliance” that will be used to verify compliance to Title 24.</p>

Want to Learn More?

GAF Technical Services... can provide detail and answer questions on project specific conditions.

Contact Telephone... 1-800-766-3411.

For more information... about GAF’s commitment to green manufacturing processes and our full line of energy saving products, visit “Green Roof Central” at www.gaf/green.com.

Helpful Links...

www.gaf.com

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www.energy.ca.gov/title24/

California’s Title 24 Home Page

title24@energy.stat.ca.us

California’s Title 24 E-mail Hotline

www.coolroofs.org

Cool Roof Rating Council’s Home Page

www.energystar.gov

Energy Star’s Home Page

<http://gaf.ecoscorecard.com>

GAF’s ecoScorecard

www.coolroofs.org

Cool Roof Rating Council (CRRC)

www.energystar.gov

Federal Tax Credits

www.DSIREusa.org

State Incentives for Renewables & Efficiency

<http://cool.gaf.com>

Cool Roof Energy Savings Tool (CREST)

