

Cool Roofs and Title 24, the California Energy Code Changes for Non-Residential Buildings in the 2005 Update

Title 24, the code regulating the energy efficiency of California buildings, is currently being updated. The current standard went into effect in June of 2001. An updated standard was approved in November of 2003 and is scheduled to go into effect on October 1, 2005. Development of this update was mandated by the California Assembly Bill 970 and Senate Bill 5X, bills passed by the California legislature in response to the energy crisis of the year 2000.

The 2005 updates include very important changes regarding the use of cool roofing on non-residential buildings. The three major revisions to Title 24 affecting cool roofs are:

- Definition of cool roofing is expanded and strengthened,
- Cool roofing becomes the standard roofing material for use on all low-slope roofs,
- Re-roofs of existing buildings must conform to cool roof requirements.

These revisions and their ramifications are discussed in depth below.

Cool Roof Definition [Title 24 Section 118 (i)]

The concept of cool roofing was first introduced in the 2001 version of Title 24, and the basic definition does not change in the 2005 update. In order to be cool, a roofing material must have high solar reflectance and high thermal emittance:

- solar reflectance of 0.70 or higher and thermal emittance of 0.75 or higher,
- unless the roof material is a clay or concrete tile, in which case it must have solar reflectance of 0.40 or higher and thermal emittance of 0.75 or higher.

The 2005 standard expands this definition by adding an option for materials with low thermal emittance to qualify as cool if they have “very high” solar reflectance.

- if thermal emittance is less than 0.75, solar reflectance must be greater than or equal to $0.70 + 0.34 \times (0.75 - \text{thermal emittance})$

Metallic surfaced roofing products, such as galvanized roofing, aluminum coatings and modified bitumen products tend to have lower values of thermal emittance. This new provision allows a few metallic roofing products to qualify as cool under the 2005 standard.

The 2005 update also contains a few changes for liquid coatings. In 2001, any liquid coated roof was required to be at least 20 mils thick after drying, but the 2005 standard requires higher thicknesses for cement-based coatings. The 2001 standard required all coatings to meet ASTM D6083, the “Standard Specification for Liquid Applied Acrylic Coating Used in Roofing. The 2005 standard no longer requires meeting ASTM D6083, instead requiring coatings to meet the specifications listed in Table 118-C. From Section 118 (i) of the 2005 update:

- liquid coatings must be applied at minimum 20 mil dry thickness across the entire roof surface, and must meet the standards laid out in Table 118-C,
 - Exception 1 - Aluminum pigmented coatings must meet ASTM D2824 (Standard Specification for Aluminum-Pigmented Asphalt Roof Coatings, Nonfibered, Asbestos Fibered, and Fibered without Asbestos) or ASTM D6848 (Standard Specification for Aluminum-Pigmented Emulsified Asphalt Used as a Protective Coating for Roofing) and be installed as specified in ASTM D3805 (Standard Guide for Application of Aluminum-Pigmented Asphalt Roof Coatings),
 - Exception 2 - Cement-based coatings must contain a minimum of 20% cement and meet ASTM D822 (Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings), plus have at least 30 mil dry thickness when installed over capsheet, at least 40 mil dry thickness over metal, and at least 200 mil dry thickness over gravel or rock.

TABLE 118-C Minimum Performance Requirements for Liquid Applied Roof Coatings

Physical Property	ASTM Test Procedure	Requirement
Initial percent elongation (break)	D 2370	Minimum 60% 0 °F (-18°C) Minimum 200% 73 °F (23 °C)
Initial tensile strength (maximum stress)	D 2370	Minimum 100 psi (1.38 Mpa) 73°F (23°C) Minimum 200 psi (2.76 Mpa) 0°F (-18°C)
Final percent elongation (break) after accelerated weathering 1000 h	D 2370	Minimum 40% 0°F (-18°C) Minimum 100% 73°F (23°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.		

The ASTM D6083 requirement was dropped because manufacturers objected to being held to a standard specifically for acrylic coatings. For 2005, Table 118-C keeps those parts of D6083 that pertain to the elasticity and longevity of a variety of roof coatings, not just acrylic coatings.

Some coatings would have trouble meeting the requirements in Table 118-C, so exceptions are allowed for aluminum and cement-based coatings. Aluminum coatings must meet their own set of ASTM standards for product quality and application. Cement-based coatings do not yet have any ASTM standards that cover their quality or application. Instead, Title 24 requires these coatings to contain at least 20% cement, and to be applied more thickly than other coatings. Cement-based coatings are also expected to meet ASTM D822, a test to measure the effects of exposure to sunlight.

In 2001, the Cool Roof Rating Council (CRRC) was still laying out its program for ensuring the accurate measurement, reporting and certification of cool roof products. The 2001 version of Title 24 designated CRRC's authority to begin to certify roof products on January 1, 2003. CRRC has been successful at running this certification program, and is still in charge under the 2005 version of Title 24. Solar reflectance and thermal emittance of roofing materials must be tested and certified according to the CRRC's Product Rating Program in order to receive cool roof credit. (More information about this program can be found at www.coolroofs.org).

Cool Roofing Becomes Standard [Title 24, Sections 140 through 143]

To understand cool roofing requirements, it helps to first understand how Title 24 compliance works. There are three ways for buildings to comply with Title 24, (1) the prescriptive envelope component approach, (2) the prescriptive overall envelope approach and (3) the performance approach. Under (1) the prescriptive envelope component approach, each component in the building envelope (i.e, walls, windows, roof/ceiling, floors) must meet specified efficiency requirements. Following this approach is usually the easiest way to comply with Title 24. Under (2) the prescriptive overall envelope approach, the building's entire envelope must stay within heat loss and heat gain limits. Heat loss & gain calculations must be made for the proposed building and compared to a standard building described by the prescriptive envelope components. Under (3) the performance approach, the entire building must stay within a total energy budget for space conditioning, lighting and water heating. The performance approach requires more extensive building energy modeling, again comparing the proposed building to a standard building design.

Under 2001 Title 24 requirements, cool roofing is not one of the components specified in approach (1) or part of the standard building design used for comparison in approaches (2) or (3). Credit can be taken for cool roofing under approaches (2) and (3) if extra calculations are made to show cool roofing's effects on the proposed building.

Under the 2005 update, cool roofing becomes one of the prescribed envelope components in approach (1), and part of the definition of a standard building used under approaches (2) and (3). If cool roofing is not used, another building component must compensate for the lack, and calculations must prove that the envelope heat gain and loss or the overall building's energy budgets do not exceed those of a standard building with cool roofing.

Under the 2001 version of Title 24 cool roofing is strictly optional. Taking credit for cool roofing is more complicated, and this credit is traded for the use of other, less efficient building components. The 2005 changes don't make cool roofing completely mandatory, but they do make it the standard or default material to use. The 2005 update strongly encourages the use of cool roofing, and raises the overall efficiency level of buildings.

Re-Roofing with Cool Roofs [Title 24, Section 149]

The 2005 update to Title 24 requires that cool roofing be used not just on new construction, but also on existing non-residential buildings. A cool roof must be used if more than half the roof or more than 2,000 square feet of an existing roof is being replaced, recovered or recoated. If cool roofing is not used for re-roofing, the building envelope must be improved in some other way to compensate for the lost efficiency opportunity, and calculations must be made to justify the effectiveness of these measures.

There is one exception where cool roofing is not required. Roofs ballasted with rock or gravel can forego the use of cool roofing if all of the following requirements can be met:

1. The existing roof has a rock or gravel surface, and
2. The new roof has a rock or gravel surface, and
3. There is no removal of existing layers of roof coverings of more than fifty percent of the roof or more than 2,000 square feet of roof, whichever is less; and
4. There is no recoating with a liquid applied coating; and
5. There is no installation of a recover board, rigid insulation or other rigid, smooth substrate to separate and protect the new roof recovering from the existing roof.

Re-roofing using cool materials is not strictly mandatory under the updated version of Title 24. But it is probably easier to comply with Title 24 by installing a cool roof than to install other efficiency measures and document their effectiveness.

The re-roofing provision demonstrates the intention of the California Energy Commission to realize the energy savings potential of cool roofing. Cool roofing has proven to be a cost-effective alternative to traditional roofing materials. It not only reduces a building's energy use, but also tends to reduce cooling electricity use on summer afternoons – during the periods of peak electricity demand that stress California's electrical grid. By requiring non-residential buildings to re-roof with cool roofing, the majority of these buildings will be saving energy and reducing peak electrical demand within the next 15 to 20 years.

This provision is a major change for the roofing industry. Cool roof installations still account for less than 25% of all California re-roofing work, despite three years of cool roof incentives given by the state and public and private utilities. The most commonly installed roof in California today is not a cool roof, it is a built-up roof surfaced with asphalt capsheet or gravel. Every roofer in California knows how to install a built-up roof, but not all are experienced at installing different types of cool roofing.

These changes are also significant for building owners, who tend to be even less familiar with cool roofing materials than roofers. Roof maintenance is often driven by the installation cost of the roof materials. Built-up roofs tend to have lower initial installation costs than some types of cool roofing materials. However, built-up roofs usually cost more over their entire life cycle, due to the need for more frequent and expensive maintenance, and the extra costs of cooling the building.

Summary

The 2005 update expands the definition of cool roofing and strengthens its requirements for quality and application, and helps to ensure that the cool roofs being installed are reliable. By making cool roofing part of the standard definition of an energy efficient building, and by requiring re-roofing of existing roofs with cool roofing, the 2005 updates to Title 24 promise to rapidly increase the amount of cool roofing being installed on California's non-residential buildings.

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