

The cool roofing movement
CRRC rates roofing materials for energy efficiency

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During the past decade, designers, contractors, consultants and building owners have shown rising awareness of the radiative-energy properties of roof systems as key contributors to buildings' thermal performances and energy efficiency. Thanks to this growing market awareness, "cool roofing" has become a center of interest in the roofing marketplace.

Building codes are beginning to reflect the cool roofing trend by including cool roofing requirements. For instance, on Nov. 5, 2003, California adopted language for the state's 2005 Title 24 Energy Efficiency Standards that requires cool roof systems for new construction (and most reroofing) for commercial buildings; the state also effectively requires roofing materials to be rated by the Cool Roof Rating Council (CRRC).

In such a market, reliable radiative-energy performance ratings are the bedrock of effective specifications. This article will explain why professionals throughout the building industry are increasingly turning to CRRC to provide fair ratings of roofing products. CRRC is focused on implementing and communicating a fair, accurate, credible radiative-energy performance rating system for roof surfaces. A clear, fair rating system is important for strengthening markets for roofing products that save energy and reduce a building's negative effects on the environment. CRRC's approach complements other programs that set minimum performance thresholds, such as the U.S. Environmental Protection Agency's ENERGY STAR® program.

What are cool roofs?

Traditionally, dark-colored roofs have been used on buildings throughout the world. As common experience has shown, dark surfaces heat up when exposed to sunlight. If a roof heats up, some heat is transferred inside a building, especially if the roof is poorly insulated. Maintaining comfort inside such a building often requires higher energy use and air-conditioning bills.

Figure courtesy of Lawrence Berkeley National Laboratory, Berkeley, Calif.

How cities compare with rural areas in terms of excess heating caused by buildings and pavement made of dark materials

In contrast, lighter-colored, or cooler, roofing materials can help alleviate these problems. Two primary properties determine a roofing product's coolness: how much of the sun's heat is reflected away from the roof instead of absorbed (solar reflectance) and how effectively the absorbed heat is released from the roof (thermal emittance). In general, lighter-colored roofs have higher reflectance properties and can be 70 degrees Fahrenheit (21 degrees Celsius) cooler on a hot day than a typical dark-colored roof according to Lawrence Berkeley National Laboratory (LBNL), Berkeley, Calif. This is good news not only for the work environment inside a building but also for the work environment on a roof.

The effectiveness of a cool roof depends on the climate in which it is situated. Buildings located in warmer climates that require significant air-conditioning most obviously will benefit from cool roofs. Cool roof system installations in Alabama, Arizona, California, Florida and most states south of the 36th parallel generally make sense. Cool roofs especially are beneficial in these climates because they can reduce cooling energy by lowering roof temperatures during times of highest energy demand.

Consideration for the seasonal energy trade-offs of cool roofs also is necessary in northern states because in winter cool roofs may lead to modest increases in a building's heating load, especially where insulation levels

are low. It is important to note, however, that the amount of energy reflected off a roof during winter is less than that which is reflected in summer because winter days are shorter and the sun is lower in the sky. Therefore, for these climates, the savings in summer are relatively greater than the increase of heating costs in winter.

Studies of buildings by LBNL and Florida Solar Energy Center show cool roofs result in up to 40 percent cooling energy savings. LBNL estimates that about \$750 million in utility bills could be saved nationwide each year using cool roofs.

Another benefit of cool roofing is reduction of the heat island effect. Heat islands result when buildings and pavement made of dark materials absorb the sun's rays instead of reflect them, causing the temperature of the surfaces and the air around them to rise and resulting in the excess heating of urban areas compared with their surroundings.

The heat island effect can lead to elevated air-conditioning use; increased air pollution (as a result of more consumption of fossil fuels to meet this increased energy demand); and formulation of smog, which increases with higher temperatures. According to LBNL, high reflectivity and emissivity of cool roofs can reduce the heat island phenomenon and its detrimental consequences.

Cool roofs have an additional benefit aside from saving energy and money and reducing the heat island effect: increased roof system life span. Light-colored cool roofs can be expected to last longer than darker roofs because they do not go through as extreme heating and cooling cycles that cause roofing components to expand and contract.

CRRC

In response to the rising awareness of the benefits of cool roofs and the need for reliable data about their performances, CRRC was created in 1998 to develop accurate and credible methods for evaluating and labeling the solar reflectances and thermal emittances of roofing products and disseminate the information to all interested parties.

A sample CRRC product rating label

Paul Beemer, legal and technical director with Henry Co., Huntington Park, Calif., and a member of CRRC's board of directors, explains these savings: "CRRC is dedicated to cost-effective cool roofing. More end-users are finding that our impartial ratings cut through the marketing hype, and more manufacturers are realizing the best way to show off their products is through CRRC ratings."

CRRC is a nonprofit educational organization with the following mission:

- To implement and communicate fair, accurate and credible radiative-energy performance rating systems for roof surfaces
- To support research into energy-related radiative properties of roof surfaces, including durability of those properties
- To provide education and objective support to parties interested in understanding and comparing roofing options

Although CRRC provides roofing professionals and consumers with reliable radiative-energy performance information about roofing materials, CRRC does not establish or enforce performance thresholds. Therefore, CRRC, which is funded by membership dues and licensing fees, is positioned to serve as a technical foundation for programs and codes that require minimum standards for solar reflectance and/or thermal emittance.

The centerpiece of CRRC is its third-party testing and rating program that provides fair, credible reflectance and emissivity data for roof surfaces. Through its Product Rating Program, CRRC standardizes and ensures the quality of the rating of products submitted by roofing manufacturers and sellers.

The CRRC program is strengthened by its recognition of roofing product radiative-energy property tests performed only by properly trained and accredited independent laboratories. Any roofing manufacturer or seller that completes the appropriate applications, forms and fees to become licensed by CRRC is eligible to submit products for CRRC rating on a nondiscriminatory basis.

The Product Rating Program was launched in September 2002. During its first year, the program has proved to be successful. The number of products listed in the online Rated Products Directory nearly doubled during the first six months of 2003 only to increase another 30 percent during the following two-month span. Currently, more than 130 products are listed in the directory. CRRC also has incorporated an annual random testing process, which calls for testing products in the field to verify the products used in applications are indeed the products originally submitted for ratings.

The Product Rating Program is designed to provide unbiased initial and aged performance ratings for roofing products. Exposure to the environment can affect a roofing material's radiative-energy performance. In the age-testing component of the rating program, product samples are aged (weathered) for three years at CRRC-accredited test farms in three U.S. locations representing different climates: hot/dry, hot/humid and cold/temperate. In this way, all samples are environmentally exposed in the same natural climates and under unbiased field laboratory conditions. As of press time, the complete Aged Testing Protocol was expected to be released in December 2003. As a result, CRRC-rated products soon will be required to begin their three-year exposure.

After a CRRC-accredited testing laboratory has measured a product's initial radiative-energy properties, the product and its ratings are listed in the Rated Products Directory, which is free for anyone to view online. This ratings information also can be obtained by telephone.

A manufacturer or seller may affix to a product the CRRC label displaying the applicable rating information. A sample CRRC label is shown on this page.

When a product's aged reflectance and emittance values are measured after completion of weathering at a test farm, the aged ratings subsequently are added to the directory and the product's CRRC label. Code officials and customers can refer to either the online directory or product label to obtain clear and accurate information about the roofing products they are considering and make informed decisions for selecting cool roof products.

CRRC membership, which is open to any interested party, is separate from but complementary to being a licensee who submits products for ratings, a function limited to roofing product manufacturers and sellers.

CRRC members include roofing manufacturers, suppliers and distributors, as well as roofing contractors, consultants, nonprofit groups, government agencies, educational institutions, air-quality boards, code bodies, energy service companies and other interested individuals. Currently, there are more than 115 participants in CRRC, including members, licensed sellers, other manufacturers and accredited testing laboratories.

"During the past year, our membership has expanded to include representatives from many different sectors in the roofing industry, which, in turn, has strengthened our program," explains David Cocuzzi, manager of coil coatings with Columbus, Ohio-based AZKO Nobel; vice chairman of CRRC's board of directors; and chairman of CRRC's Membership and Outreach Committee.

The effects

"Arguably, the most significant nontechnical development for cool roofing is its introduction into building codes, most notably in California," says Peter Turnbull, senior program manager with Pacific Gas & Electric, San Francisco, and chairman of CRRC's board of directors. "Code changes in that state for 2005 make cool roofing a *requirement* for low-slope commercial buildings. The requirement affects not only new construction but also applies to most reroofing jobs."

With an eye toward increasing the energy efficiency of buildings, code bodies increasingly are requiring better radiative-energy performances of roof systems. California has taken the lead. The California Energy Commission has selected CRRC as the sole supervisory entity for the purpose of maintaining a rating system for radiative-energy properties of roofing materials. The recently adopted language of the state's building energy-efficiency standard requires a cool roof and defines one as having an initial solar reflectance of 0.70 and thermal emittance of 0.75 for low-slope roof systems on commercial buildings as rated and documented under the CRRC system.

During the past two years, more than 55 million square feet (5 million m²) of cool roofing materials were installed in California because of a statewide rebate program, and California utilities are continuing that success with new incentive programs. The California investor-owned utilities' cool roofs incentive program is expected to reference CRRC this year. Between \$7 million to \$10 million in rebates are expected to be distributed for the installation of low-slope commercial roof systems over air-conditioned spaces.

Cool roof system construction also qualifies for a point in The U.S. Green Building Council's Leadership in Energy & Environmental Design (LEED) Green Building Rating System™ either as a Heat Island credit or an Energy and Atmosphere credit. (For more information about LEED, refer to "[Green buildings standard](#)," September 2003 issue, page 30.)

As in California, a growing number of jurisdictions and programs are expected to cite the CRRC rating system as a means of verifying roof product radiative-energy performance. Cool roofing technologies increasingly are included in energy-efficiency standards, and specifiers are turning to CRRC's product rating database to help make purchasing decisions.

Public projects in cities such as Atlanta and Salt Lake City have proved that thousands of dollars can be saved on energy bills. States such as Florida, California and Virginia also have chosen cool roofing for new school construction and found their energy bills significantly were reduced.

In addition, the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Inc. is considering proposals to reference CRRC's rating system in ASHRAE 90.1, "Energy Standard for Buildings Except Low-Rise Residential Buildings," and ASHRAE 90.2, "Energy Code for New Low-Rise Residential Buildings." The current ASHRAE standards require a minimum total solar reflectance of 0.7 and minimum thermal emittance of 0.75 when tested according to ASHRAE's listed test methods. ASHRAE 90.1 and 90.2 are referenced by 37 state energy codes and included in the 2003 version of the *International Energy Conservation Code*.

The proposals are slated to be adopted into the two ASHRAE standards by June, and the expected recognition of CRRC within ASHRAE standards likely will lead to references to CRRC in other state building codes.

CRRC also is integrated into the ENERGY STAR roofing program. Manufacturers with products rated in the CRRC program can submit their CRRC test results for ENERGY STAR documentation.

The industry and CRRC

Cool roofing rapidly is becoming recognized for the benefits it provides to all players in the roofing and construction industries. Research by national laboratories and other institutions points to the importance of cool roofs in lowering the energy demand of buildings and mitigating urban heat islands. Owners of commercial and

residential buildings are beginning to demand cool roofs—regardless of code measures requiring them—and want to find contractors who will install them. More important, the adoption of the Title 24 language will require all newly constructed and renovated low-slope commercial roof systems in California to be cool, a move that likely will be followed by other state code bodies.

As the cool roofing industry continues to gain momentum, roofing manufacturers and sellers who participate in CRRC will be best positioned to benefit from future cool roofing requirements that will be instituted by code bodies and voluntary programs.

Robyn Beavers is administrative manager for CRRC.