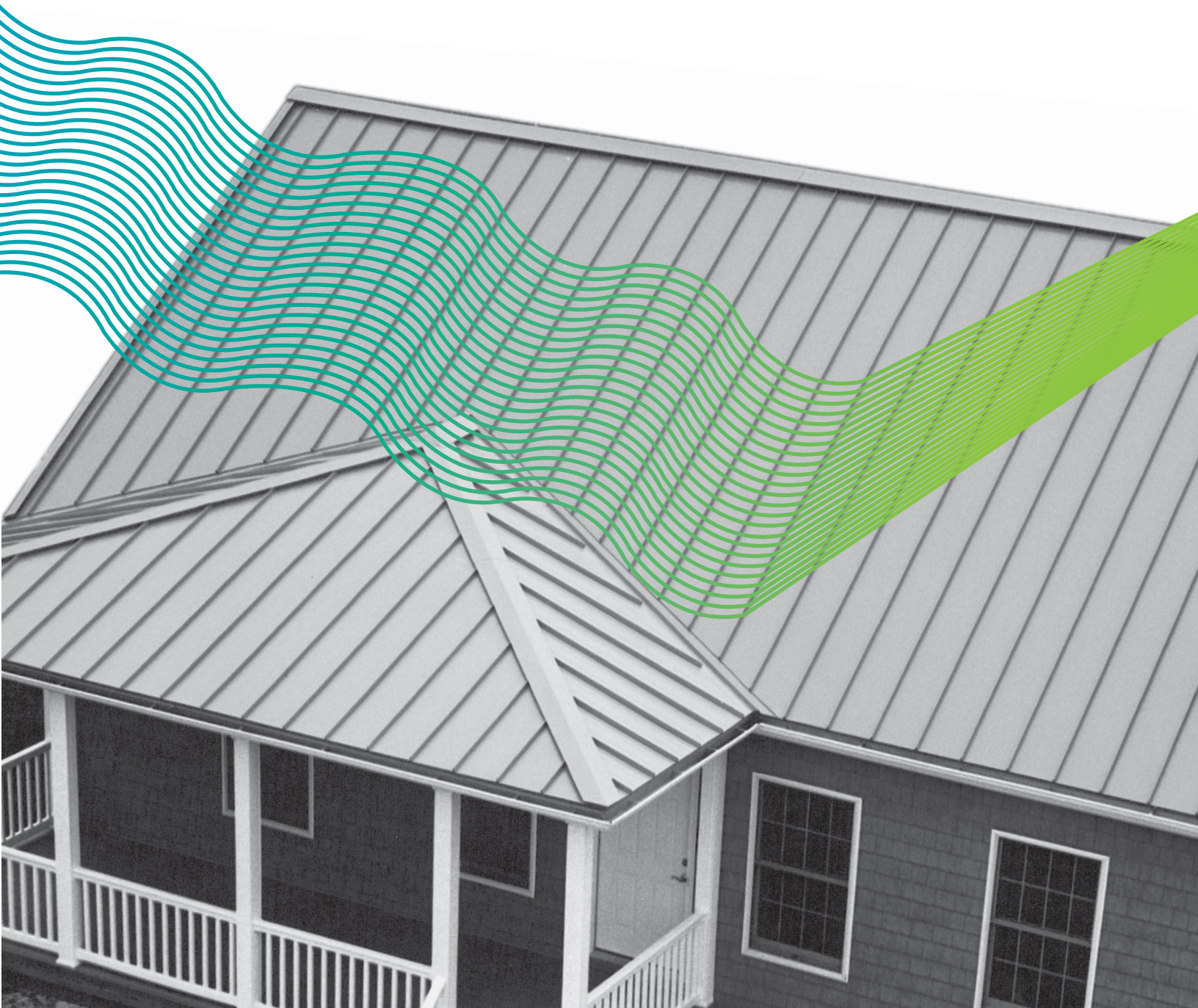


# COOL CHEMISTRY<sup>®</sup> Series

Improved energy efficiency with superior performance

**AkzoNobel**



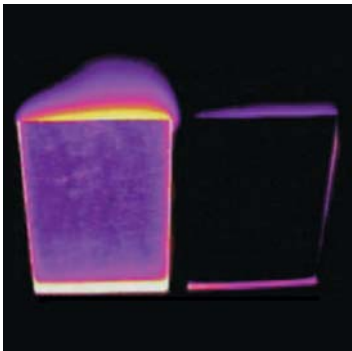
# Painted metal outshines them all

## IR camera - laboratory demonstration

In the laboratory, the effect of infrared light can be demonstrated on various materials through a simple arrangement. New materials can be tested, and the amount of heat generated directly observed, under controlled conditions, without the need to construct test buildings.



A bank of infrared lamps is arranged to shine on test materials mounted at an angle approximating a roof exposure.



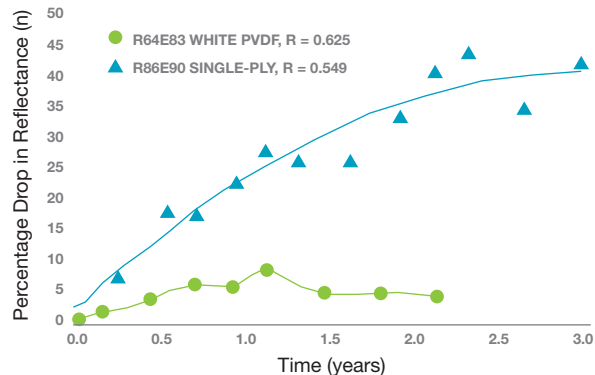
Through the use of a thermal imaging camera, a visual record is made of the temperature of the test materials. The panel on the left uses traditional pigments, while the panel on the right uses COOL CHEMISTRY® pigmentation.

## Research into the benefits of cool metal roofing

Studies conducted by several independent and government sponsored research organizations have demonstrated the improved energy efficiency attributable to the use of more solar reflective materials on roofs. More recently, these organizations have concluded, based on additional studies, that pre-painted metal outperforms other construction materials for reducing energy costs when used on roofs.

## Oak Ridge National Labs

In a three-year study conducted with the cooperation of several industry groups, various metal roofing systems were compared for energy efficiency and service life. "Early data suggests both, that metal panels maintain high reflectance, even after continuous exposure to the elements and also that painted and unpainted metal panels maintain their energy efficiency better over time than other roofing materials under test."



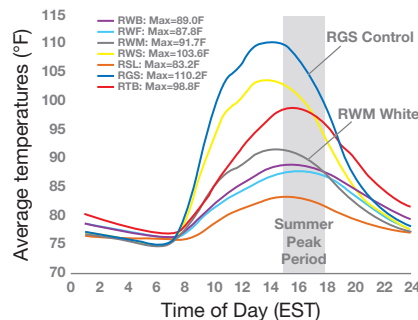
SOURCE: OAK RIDGE NATIONAL LABORATORY

## Florida Solar Energy Center

Results of tests conducted by Florida Solar Energy Center for FPL showed that white painted galvanized metal roof saved the most energy. Other materials included dark gray shingles, white shingles, white flat tile, white tile, terra-cotta S-shaped tile. The results are being used to develop a program that will promote selection of white or light colored roofs for energy conservation.

The maximum attic temperature during the peak summer hours is 40°F higher than the ambient air temperature in the control home, but no higher than ambient with highly reflective roofing systems. Light colored shingles and terra cotta roofs show temperatures in between.

## Average attic air temperatures over unoccupied period



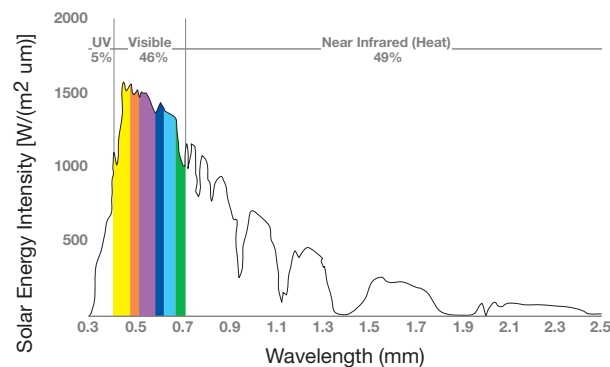
SOURCE: FLORIDA SOLAR ENERGY CENTER

# It starts with the sun - cause and effects

## Components of solar energy

Energy from the sun that strikes the earth has three components, most of which we cannot see. The energy that determines the color of an object, the visible spectrum, represents only 46% of the sun's energy. Ultraviolet light (UV) is about 5% of the spectrum and is the energy that can cause damage to our bodies and skin, as well as degrade paints and polymers. Infrared light, the invisible portion, represents about 49% of the spectrum.

## Spectrum of solar radiance



## Invisible spectrum

Infrared light contributes to heat build-up. Products containing infrared-absorbing pigments will heat up faster and to a greater degree than products colored with infrared-reflecting pigments. The benefits of reducing temperature are well known. Heat accelerates the degradation of color, gloss, elasticity, and other physical properties of roofing materials. Thermal expansion and contraction may shorten the life of roofing.

## Energy efficiency

Various scientific studies document that the energy efficiency of a building is dependent upon many factors, including the building age, occupancy and the design and selection of construction materials. One study, of more than 200 homes in central Florida, reports that air conditioning accounts for 33% of electrical consumption. The report notes that higher levels of ceiling insulation and lower attic temperatures produced by reflective roofs are major factors in reducing air conditioning use and demand.

## Important Definitions

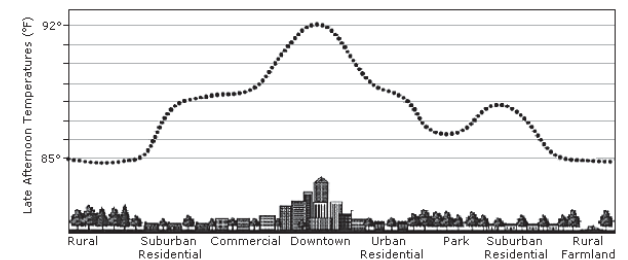
**Total Solar Reflectance (TSR)** - Amount of infrared radiation reflected from a surface, expressed in terms of % or decimal (i.e., 68% or 0.68).

**Thermal Emittance (TE)** - Percentage of radiation emitted from a heated body, compared to a perfect black body, expressed in terms of % or decimal (i.e., 68% or 0.68).

## Heat island effect

Growth in urban areas has produced "Urban Heat Islands." These urban heat islands may be as much as 12 degrees warmer than surrounding, less developed areas. Surface temperatures of roads, sidewalks, and building roofs may be 70 degrees higher than the ambient air temperature. These higher temperatures result in high air conditioning costs and the need for greater electrical production. The excess heat and increased energy production leads to increased levels of ozone and pollution/smog. Reducing temperature by as little as one half degree can reduce smog by 5%. Using highly reflective roofing materials can reduce cooling costs by as much as 23%.

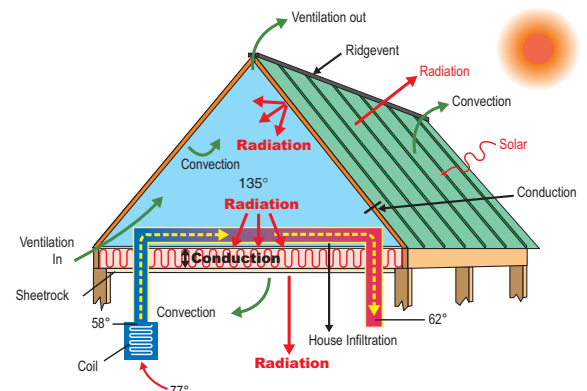
## Sketch of an urban heat island profile



SOURCE: NASA/GHCC PROJECT ATLANTA

## Vented attic thermal processes

Roof and attic thermal performance exerts a powerful influence on cooling energy use in Florida homes. Unshaded residential roofs are heated by solar radiation causing high afternoon attic air temperatures. The large influence on cooling is due to increased ceiling heat transfer as well as heat gains to the duct systems which are typically located in the attic space.



SOURCE: FLORIDA SOLAR ENERGY CENTER



# Creating the right cool chemistry

## Components of coatings

All coatings contain two primary ingredients – resin and pigment. The long-term performance of exterior coatings is dictated by resin strength and the correct choice of pigmentation. You simply cannot have one without the other. The right combination will insure a superdurable coating.

The resin's primary functions are to provide adhesion, flexibility, hardness, moisture and chemical resistance, and resistance to UV light. The pigment provides the color of the coating. The right pigment is critical in formulating a coating that resists fading, another important property of the pigment.



## Differences in pigment types

Pigments used in exterior metal coatings fall into three classifications:

**organic pigments:** comprising a class of pigments that may have good — but usually not ultimate — durability. Just as the curtains in your living room can be expected to fade with time, so can the organic pigments used in coatings. It generally costs less to use organic pigments.

**inorganic pigments:** pigments that are synthetic or naturally occurring which do not contain carbon compounds. The majority of these colorants provide excellent long-term performance. The exception is carbon black, which can sometimes be considered an inorganic pigment. Their higher performance usually comes at a higher cost than organic colorants.

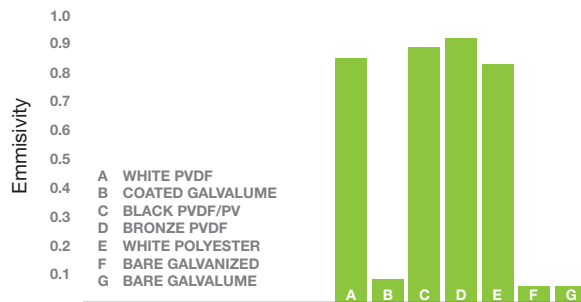
**ceramic pigments:** named after their original use in ceramic products, these complex inorganic pigments are made from mixed metal oxides synthesized at molten metal temperatures. The most color stable pigments available today, they offer unparalleled resistance to heat, light and chemical attack. These attributes make them ideal for use in the highest quality exterior coatings to assure long-term color retention even after decades of weathering. Higher cost is usually associated with their higher performance.

## Greater reflectivity achieved through pigmentation

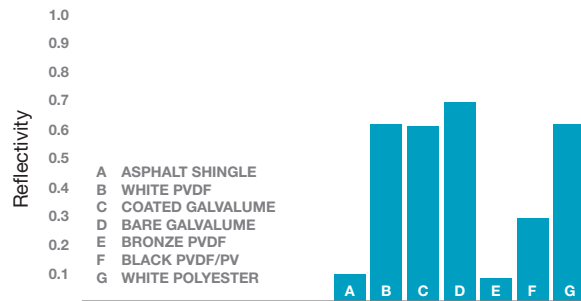
These pigments take solar reflectance a step higher than previously possible. Solar Reflective Pigments (SRP) have been altered, physically and chemically, to reflect infrared radiation while still absorbing the same amount of visible light, thus appearing as the same color as lesser reflecting pigments, yet staying much cooler.

It should be no secret – higher solar reflective coatings are possible through the use of select ceramic pigments and new SRP's.

## Emmissivity is influenced by the coating



## Reflectivity is influenced by pigmentation



# We are leaders in cool roof coatings

## The proof is in the performance

Long term durability needs to go hand-in-hand with solar reflectance. Many of the SRP's are mixed metal oxides (inorganic/ceramic) that have been around for years, and are typically used in high performance coatings such as TRINAR® and our CERAM-A-STAR® family of products.

The truly new SRP's now appearing in the marketplace are represented by a handful of colors, chemistries, and suppliers, for which only limited actual South Florida testing data is available.

Examples of "improved solar reflectance" appearing in the marketplace are quite often nothing more than the comparison between low-cost, organic pigmentation and the ceramic and select inorganic pigments which have been used for years in our TRINAR and CERAM-A-STAR product lines.

Many existing TRINAR and CERAM-A-STAR colors are, and have always been, formulated with SRP's because both systems use high quality pigmentation. The most notable exceptions are those colors using considerable amounts of black or brown traditional ceramic pigments. For these colors, improvements in TSR may be realized by using AkzoNobel's COOL CHEMISTRY Series of coatings with ceramic pigments that have the highest level of infrared reflectance.

For years AkzoNobel has served its customers worldwide by creating the right chemistry with products such as TRINAR and our CERAM-A-STAR product lines. With our COOL CHEMISTRY Series of coatings, we continue to offer the unparalleled durability of TRINAR and CERAM-A-STAR in formulations which reduce energy consumption in buildings, thus lowering costs while protecting natural resources and help reduce pollution.

"The selection of reflective roofing systems represents one of the most significant energy-saving options available to home owners and builders."

– Florida Solar Energy Center

## Coil Coatings

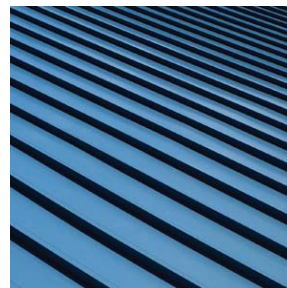
Our 70% PVDF coating TRINAR, along with our industry leading silicone-modified polyester, CERAM-A-STAR 1050, are available in COOL CHEMISTRY formulations that contain ceramic infrared reflective pigments. When COOL CHEMISTRY Series paints are used on metal roofing, the result is a sustainable building material that can lower air conditioning costs, reduce peak energy demand, and help to mitigate urban heat island effects.

## Extrusion Coatings

We also have a full line of extrusion coatings that are available as COOL CHEMISTRY colors, and also contain infrared reflective pigments. Our TRINAR *ULTRA* coatings offer other eco-friendly characteristics, such as a lower volume of VOC's, and lower amounts of hazardous air pollutants. TRINAR coatings also are ideally suited for application on louvers and other sun screens, which can be used to create shaded areas either inside or outside a building.

## Increased efficiency, reliable performance

All of our products that utilize infrared reflective pigments in our COOL CHEMISTRY Series of coil and extrusion coatings have the same exceptional performance as the standard versions. For example, COOL CHEMISTRY versions of our TRINAR spray and coil coatings will meet or exceed the superior performance AAMA 2605 specification



# Cool Roof Rating Programs: Energy Star, LEED and CRRC

## List of web sites for more information

- Energy Star  
[www.energystar.gov](http://www.energystar.gov)
- LEED / U.S. Green Building Council  
[www.usgbc.org](http://www.usgbc.org)
- Cool Metal Roofing Coalition  
[www.coolmetalroofing.org](http://www.coolmetalroofing.org)
- Metal Roofing Alliance  
[www.metalroofing.com](http://www.metalroofing.com)
- Metal Construction Association  
[www.metalconstruction.org](http://www.metalconstruction.org)
- California Energy Commission  
Consumer Energy Center  
[www.consumerenergycenter.org](http://www.consumerenergycenter.org)
- Cool Roof Rating Council  
[www.coolroofs.org](http://www.coolroofs.org)
- Metal Building Manufacturers Association  
[www.mbma.com](http://www.mbma.com)
- National Coil Coating Association  
[www.coilcoating.org](http://www.coilcoating.org)
- Lawrence Berkeley National Lab  
<http://eetd.lbl.gov/HeatIsland/CoolRoofs>
- Oak Ridge National Lab  
[www.ornl.gov/roofs+walls/index.html](http://www.ornl.gov/roofs+walls/index.html)
- Florida Solar Energy Center  
[www.fsec.ucf.edu](http://www.fsec.ucf.edu)

### Introduction to Energy Star

Introduced in 1992, Energy Star is a joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy, which is designed to identify and promote energy efficient products. The first products that were Energy Star labeled were computers and monitors, but since then the program has been expanded to now include a wide range of products from appliances to building products.

Through 2011, nearly 20,000 organizations have partnered with Energy Star to encourage energy efficiency, and realize significant financial and environmental benefits. Energy Star provides the technical information and tools that organizations and consumers need to choose energy-efficient solutions and best management practices. It is also a well recognized brand, with more than 80% of the American public recognizing the Energy Star label.

### Energy Star and Cool Metal Roofing

Energy Star has a labeling program for reflective roofing products, which includes cool metal roofs. This allows manufacturers to use the Energy Star label on reflective roof products that meet the U.S. EPA's specifications for solar reflectance and reliability.

A roofing manufacturer must first apply to become an Energy Star Partner, and then once they are approved they can submit products for certification. Energy Star Partners wishing to list new products are required to have an EPA-approved Accredited Lab perform the appropriate testing, which is submitted to a Certification Body (CB) for review. The CB is responsible for verifying the data and will certify or reject the product(s) for the EPA. Once a product is certified, it is listed on the Energy Star web site.

### Energy Star specifications

ROOF SLOPE	INITIAL SOLAR REFLECTANCE	3RD YEAR SOLAR REFLECTANCE
Low Slope ( $\leq$ 2:12 inches)	$\geq$ 0.65	$\geq$ 0.50
Steep Slope ( $>$ 2:12 inches)	$\geq$ 0.25	$\geq$ 0.15

NOTE: THERMAL EMITTANCE VALUES MUST BE REPORTED AS REQUIRED BY ENERGY STAR, BUT THEY ARE NOT A CONDITION OF CERTIFICATION.

### Introduction to LEED

The LEED® Green Building Rating System™ was developed by the U.S. Green Building Council (USGBC) to identify and certify buildings that are designed, constructed and operated sustainably. The LEED Rating System is intended to provide a framework for rating new and existing commercial, institutional and residential buildings in regards to energy efficiency. LEED is based on a 100 point scale, where points are awarded for certain aspects of a building's design and construction. Points are awarded in credits within five different categories: Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, and Indoor Environmental Quality.

The current version of this program is LEED 2009, which will remain active until June 2015. The new version is LEED v4, introduced in 2013 and running concurrently with LEED 2009. Cool metal roofing can help a building project qualify for points in LEED, outlined by the requirements spelled out on the following pages.

### Introduction to the Cool Roof Rating Council

The Cool Roof Rating Council was created in 1998 to develop accurate and credible methods for evaluating and labeling the solar reflectance and thermal emittance of roofing products, and to disseminate this information to the industry.

At the core of the CRRC is its Product Rating Program, in which roofing manufacturers can label various roof products with values of radiative properties evaluated under a strict program administered by the CRRC. Code bodies, architects, building owners and specifiers can rely on the rating information provided in the CRRC Rated Products Directory

The CRRC does not set a minimum definition for "cool", the CRRC simply lists the measured radiative property values on their Directory. This data serves as an impartial source of information and is referenced by other programs, such as LEED.

# Prepainted metal roofing compliance: LEED 2009

## Sustainable Sites (SS Credit 7.2)

### SS Credit 7.2: Heat Island Effect - Roof (1 Point)

#### Intent:

Reduce heat islands (ambient thermal gradient differences between developed and undeveloped areas) to minimize impact on microclimate and human and wildlife habitats.

#### Requirements:

##### OPTION 1

Use roofing materials having a Solar Reflectance Index<sup>1</sup> (SRI) equal to or greater than the values in the table below for a minimum of 75% of the roof surface.

Roofing materials having a lower SRI value than those listed below may be used if the weighted rooftop SRI average meets the following criteria:

$(\text{Area SRI roof} / \text{Total roof area}) \times (\text{SRI of installed roof} / \text{Required SRI}) \geq 75\%$

ROOF TYPE	SLOPE	SRI
Low-Sloped Roof	≤ 2:12	78
Steep-Sloped Roof	> 2:12	29

##### OPTION 2

Install a vegetated roof for at least 50% of the roof area.

##### OPTION 3

Install high albedo and vegetated roof surfaces that, in combination, meet the following criteria:

$(\text{Area of SRI Roof} / 0.75) + (\text{Area of vegetated roof} / 0.5) \geq \text{Total Roof Area}$

ROOF TYPE	SLOPE	SRI
Low-Sloped Roof	≤ 2:12	78
Steep-Sloped Roof	> 2:12	29

#### Potential Technologies & Strategies

Consider installing high-albedo and vegetated roofs to reduce heat absorption. SRI is calculated according to ASTM E 1980. Reflectance is measured according to ASTM E 903, ASTM E 1918, or ASTM C 1549. Emittance is measured according to ASTM E 408 or ASTM C 1371. Default values are available in the LEED 2009 Reference Guides. Product information is available from the Cool Roof Rating Council web site, at [www.coolroofs.org](http://www.coolroofs.org) and the ENERGY STAR web site, at [www.energystar.gov](http://www.energystar.gov).

### To comply with Credit 7.2 in LEED 2009, the following steps must be taken:

- Building owner and design team registers the building project in advance with the USGBC, which provides LEED document templates for subsequent submission of the project details to USGBC for certification.
  - Information on materials, building practice, systems used, etc. included on the letter templates.
  - Specific information with respect to LEED SS-credit 7.2 includes roof surface SRI values.
- Metal roof manufacturer must verify to owner/architect/specifier that roof material and design complies with criteria in Credit 7.2.
- Paint supplier provides to metal roofing manufacturer a certified laboratory test report of measured TSR, TE and calculated SRI on the specified type of paint system and color requested.
- Building owner/architect/spec writer must take into account the percentage of the roof surface area to be covered by metal roofing. Note that Credit 7.2 calls for at least 75% of the area to be covered with a cool roof. If more than 75% of the area is covered (excluding parapets, sky lights, and equipment) a lower effective SRI is permitted by using the calculator in Credit 7.2.

<sup>1</sup>The Solar Reflectance Index (SRI) is a measure of the constructed surface's ability to reflect solar heat, as shown by a small temperature rise. It is defined so that a standard black (reflectance 0.05, emittance 0.90) is 0 and a standard white (reflectance 0.80, emittance 0.90) is 100. To calculate the SRI for a given material, obtain the reflectance value and emittance value for the material. SRI is calculated according to ASTM E 1980. Reflectance is measured according to ASTM E 903, ASTM E 1918, or ASTM C 1549. Emittance is measured according to ASTM E 408 or ASTM C 1371.

For more information, please contact:

**Akzo Nobel Coatings Inc.**  
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614.294.3361



[www.akzonobel.com/ccna](http://www.akzonobel.com/ccna)

AkzoNobel is a leading global paints and coatings company and a major producer of specialty chemicals. We supply industries and consumers worldwide with innovative products and are passionate about developing sustainable answers for our customers. Our portfolio includes well-known brands such as Dulux, Sikkens, International and Eka. Headquartered in Amsterdam, the Netherlands, we are consistently ranked as one of the leaders in the area of sustainability. With operations in more than 80 countries, our 50,000 people around the world are committed to delivering leading products and technologies to meet the growing demands of our fast-changing world.

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