

Cool Metal Roofing

By: Cool Metal Roofing Coalition *

INTRODUCTION

Metal roofing has been a preferred roofing material for centuries. Metal roofing is available in a wide variety of substrates, colors, textures and profiles. Though diverse in appearance, metal roofing has many common attributes such as durability, recycled content, recyclability, fire resistance, low weight, low life cycle cost and sustainability.



Depending upon the surface finish, Cool Metal Roofing can provide enhanced energy efficiency with its solar reflectance and infrared emittance properties. In fact the solar reflectance and infrared emittance of a metal roof can be engineered to meet the climate requirements of the building. Cool metal roofing can provide the desired high reflectance and low emittance in climates where heating loads prevail. Cool metal roofing can also provide the desired high reflectance and high emittance where cooling loads dominate. Cool metal roofing easily meets the requirements of the EPA's Energy Star® program.

DESCRIPTION

A. What is Metal Roofing ?

Metal roofing is represented by a variety of metal-based roof coverings designed to provide buildings with protection from the elements, allow for positive drainage of water from the roof surface and to keep contents and occupants dry and comfortable. Metal roofing products are available in a range of metals including steel, aluminum, copper, zinc, stainless steel and titanium.

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The predominant metal roofing substrate is metallic-coated steel sheet. The metallic coatings include zinc (galvanized), 55% aluminum-zinc alloy (Galvalume® sheet), 5% aluminum-zinc alloy (Galfan®), aluminum and lead-tin alloy (terne).

With its expected long life, metal roofing is a highly desirable and sustainable building component. Additionally, many of the metals used in roofing will have recycled content varying from 25% to 95%, often with much of that recycled content being in the post-consumer category.

B. What is Cool Metal Roofing ?

With proper design, metal roofing systems save energy by reducing a building's cooling and/or heating load. Many metal roof systems are reflective, easily vented and also lend themselves well to insulated roof systems to help reduce heat gain into a building. Many products are also formed in ways that stop heat transfer through conduction by allowing only minimal contact between the metal and the underlying structure.

Mill-finish metal roof systems have very high solar reflectance, providing further reductions in heat gain. Metal roofs with oven-cured prepainted organic coatings that incorporate new "cool pigment" technology offer high total solar reflectance and high infrared emittance even with darker colors. Such prepainted metal roofing products meet the reflectance requirements of all major energy code initiatives. Finally, unlike many roofing materials, metal's low thermal mass will not store heat and radiate it into a building in the evening hours.



C. Types of Metal Roofing

There are two basic classifications of metal roofing; Structural and Non-Structural (also known as Architectural). Structural metal roofing attaches directly to purlins or lathe boards and does not require any sort of solid support beneath it. Non-Structural metal roofing requires a solid substrate beneath it, typically plywood, oriented strand board, or a metal roof deck.

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Structural metal roofing is broken down into low slope and steep slope categories. Low slope products are available for roof pitches from ¼12

to 3:12 while steep slope products are designed for roof pitches greater than 3:12. Low slope structural metal roofing consists of interlocking panels, commonly called Standing Seam Roofing, that run vertically on the roof surface. These products can have a painted, mill-finish, or clear acrylic finish. To ensure watertightness on roofs of less than 3:12 pitch, some products will require machine seaming during installation. These special machines are rolled along the panels to crimp the panel seams together.



Steep slope structural metal roofing is available in both vertical and horizontal profiles. The vertical panels include standing seam systems that are fastened to underlying purlins with hidden clips or fastening flanges. A wide variety of corrugated or tile facsimile metal roofs that are attached with exposed fasteners directly through the metal roofing panels are also available. These products overlap or interlock on their side and end laps for watertightness. Special seaming machines are typically not required.

Most non-structural metal roof panels are designed for roof pitches of 3:12 or greater. Rather than transmit gravity loads through to purlins or lathe boards beneath them, non-structural systems transfer gravity loads to the roofdeck beneath them. Non-structural systems are available in a variety of styles including vertical standing seam, corrugated, and tile profiles as well as a wide variety of horizontal panels. The horizontal panels simulate the look of standard shingles, wood shake, slate and tile. Most non-structural metal roofing will have a coating for aesthetics and durability. Coatings include various paint finishes as well as aggregate (stone) finishes.

D. Characteristics of Metal Roofing

The benefits of metal roofing include:

- Sustainability. Metal roofing products are not subject to the degradation experienced by organic materials when they are exposed to the weather cycle. This provides metal roofing with a long life in terms of its ability to resist the elements and also to possess a low maintenance cost.
- Low Weight. Metal roof systems typically vary from 40 to 135 pounds per 100 square feet, making them among the lowest weight roofing products available. Low weight places fewer demands on a building's structure making metal roofing an excellent choice for retrofit projects. The light weight is also a benefit in locations prone to seismic activity.



- Fire Resistance. Many metal roof systems have been tested to meet Class A, B, and C fire ratings.
- Aesthetics. Due to its ability to accept coatings of various colors and patterns and its ability to be formed into a wide variety of functional profiles, metal roofing products can be found to fit and enhance the aesthetic design of virtually any building.
- Wind Resistance. The interlocking or active fastening of most metal roofing panels allows them to pass very severe wind and uplift tests including ASTM E1592, UL 580 and UL 1897. Many products carry approval for use in Dade County, Florida.

E. Useful Life of Metal Roofing

Metal roofing has a very long history, with roofs dating back to the 1800s still in service. The sustainability of metal roofing provides property owners with a very low “per year” cost option in roofing. Metal roofing products being manufactured today carry manufacturers’ warranties lasting from 20 to 50 years. However, most products have been designed so that they can be refurbished on site for additional life once their original finish reaches its useful life. Metal roofing materials are 100% recyclable in the event that they are ever removed.

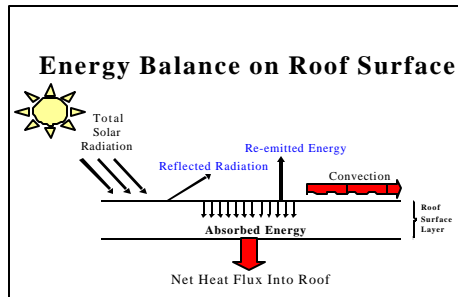
The high-quality oven-cured paint systems used on prepainted metal roofing are formulated to resist chalking and fading of their colors. In addition, these paint systems shed dirt and do not support the growth of algae or fungal matter.

F. Economics of Metal Roofing

The long life and low maintenance of metal roofing, combined with the savings from energy efficiency, give it a very attractive life-cycle cost.

APPLICATION

Cool metal roofing is used for reducing cooling/heating loads on new construction and on retrofit roofing applications in the commercial, industrial, architectural, institutional and residential construction markets. This family



of roofing products has attractive solar reflectance and infrared emittance properties, depending on the choice of finishes and colors, making it ideal for lowering cooling and heating energy usage, lowering peak energy demand in buildings, and mitigating the urban heat island effect.

Cool metal roofing products are included on the EPA's Energy Star Roof Products directory. The EPA estimates that reflective roofs can save up to 40% cooling energy on homes and buildings. Florida Power and Light (FPL) has also recognized the sustainable energy-efficiency of metal roofing in a cooperative program involving Florida Solar Energy Center and Habitat for Humanity. FPL found that a painted metal roof could save a homeowner about 23% annually in cooling costs compared to a dark colored traditional shingle roof. (www.fpl.com , February 5, 2001 press release)

Low Slope

Cool metal roofs as large as 1 million square feet are common in industrial and commercial construction. Weathertight standing seam roof systems are designed with special clips and fastener systems to allow for thermal expansion and contraction.



Retrofit

Leaky flat non-metallic roofs can be replaced with sloped metal roofs by adding an engineered light weight secondary structural system to the existing building. Metal roofing is also an excellent choice for steep slope retrofit roofing projects. In many cases it can be applied directly over worn out asphalt shingles eliminating the need to landfill the old roofing materials.



RELEVANT CODES AND STANDARDS

The relevant codes and standards have been broken down into the following categories:

- Building Codes and Regulations that invoke energy standards that include cool roofs
- Energy Standards that have minimum properties associated with cool roof designations
- Rating Programs for independent certification and labeling of roof products

Building Codes and Regulations

International Building Code (2003) – [link to <http://www.iccsafe.org>]
Section 1301.1 – Buildings shall be designed and constructed in accordance with the International Energy Conservation Code.

International Energy Conservation Code (2003) [link to <http://www.iccsafe.org>]
Section 701.1 - Commercial buildings shall meet the requirements of ASHRAE 90.1, or meet the deemed to comply acceptable practice for commercial buildings (which does not address cool roof requirements). Cool roofs are not addressed for residential buildings.

National Fire Protection Association (NFPA) 5000 Building Construction and Safety Code (2003) [link to <http://www.nfpa.org>] Section 51.2 – All commercial buildings, except storage and industrial occupancies, shall meet the requirements of ASHRAE 90.1. Cool roofs are not addressed for residential buildings.

California Title 24 Energy Efficiency Standards for Residential and Nonresidential Buildings (2005)
[link to <http://www.energy.ca.gov/title24/index.html>] - The cool roof performance criteria only apply to low slope (2:12 or less) roofs on nonresidential buildings. A cool roof is defined as one with a solar reflectance of at least 0.70 and an infrared emittance of at least 0.75. There is also an allowance for a cool roof that has a very high reflectance, but a lower emittance. While cool roofs are not *required* on nonresidential buildings in California when the new Title 24 Standard becomes effective in 2005, other parts of the building envelope (ex. A/C or lighting) must be upgraded to achieve the same overall energy consumption of a building with a cool roof. Title 24 also requires cool roof properties to be verified through CRRC ratings (described below), or low default values for reflectance and emittance must be substituted in energy calculations.

Energy Standards

ANSI/ASHRAE/IESNA Standard 90.1 *Energy Standard for Buildings Except Low-Rise Residential Buildings (2001)* [link to <http://www.ashrae.org>] Section 5.3.1.1 – The roof insulation requirement (U Factor) can be reduced by as much as 23 percent if the roof qualifies as a cool roof. The reduction is based on the number of heating degree days, with the largest reduction in milder climates with fewer heating degree days. ASHRAE 90.1 defines a cool roof as having a minimum solar reflectance of 0.70 and a minimum infrared emittance of 0.75. Reflectance is measured using ASTM E903, E1175, or E1918. Emittance is measured using ASTM C835, C1371, or E408. [link to <http://www.astm.org>]

Rating Programs

Environmental Protection Agency (EPA) Energy Star Program Requirements for Roof Products

[link to http://www.energystar.gov/ia/partners/product_specs/eligibility/roofs_elig.pdf]

This federal program designates roof products that comply with the EPA requirements to assist consumers in making informed decisions with respect to energy conservation. The guidelines for energy star designation are different for low slope (2:12 or less) and steep slope roofs. The EPA Energy Star guidelines include initial solar reflectance (≥ 0.25 for steep slope and ≥ 0.65 for low slope), weathered solar reflectance (≥ 0.15 for steep slope and ≥ 0.50 for low slope, after three years of normal exposure) and a comparable warranty to non-reflective roof products.

Cool Roof Rating Council (CRRC) Product Rating Program

[link to <http://www.coolroofs.org/productratingprogram.html>] The CRRC administers a Rating Program under which manufacturers can label various roof surface products with radiative property values. Tests must be carried out in CRRC accredited laboratories. Solar reflectance is measured using ASTM E903, E1918, or C1549. Emittance is measured using ASTM C1371 or E408. [link to <http://www.astm.org>].

Leadership in Energy and Environmental Design (LEED)

[link to http://www.usgbc.org/leed/leed_main.asp] The LEED rating system is a national consensus-based program to accelerate the development and implementation of green building practices. The program awards “points” for different green building design measures, including cool roofs. LEED is designed for rating new and existing commercial, institutional, and high-rise residential buildings. To qualify as cool, LEED requires roofs to meet EPA Energy Star requirements for solar reflectance as well as a requirement for an emittance of 0.90.

ADDITIONAL RESOURCES

State and Federal Agencies Involved in Cool Roofing

California Energy Commission – www.energy.ca.gov

U.S. DOE Energy Efficiency and Renewable Energy – www.eren.doe.gov

EPA Energy Star – Roof Products Program – www.energystar.gov

Florida Solar Energy Center – www.fsec.ucf.edu

Lawrence Berkeley National Laboratory – www.lbl.gov/heatiland

National Association of Home Builders Research Center– www.nahbrc.org

Oak Ridge National Laboratory – www.ornl.gov/roofs+walls

Sustainable Buildings Industry Council – www.sbicouncil.org

United States Green Building Council – www.usgbc.org

Trade Associations and Organizations

Aluminum Association - www.aluminum.org

American Iron & Steel Institute - www.steel.org

Bob Vila EnergyWise Home Projects – www.bobvila.com

Cool Metal Roofing Coalition - www.coolmetalroofing.com

Copper Development Association - www.copper.org

Galvalume Sheet Producers of North America - www.steelroofing.com

Light Gauge Steel Engineers Association - www.lgsea.com

Metal Building Manufacturers Association - www.mbma.com

Metal Construction Association - www.metalconstruction.org

Metal Roofing Alliance - www.metalroofing.com

National Coil Coating Association - www.coilcoating.org

National Roofing Contractors Association - www.nrca.net

North American Steel Framing Alliance - www.steel framingalliance.com

Specialty Steel Industry of North America - www.ssina.com

Steel Framing Alliance - www.steel framingalliance.com

Steel Recycling Institute - www.recycle-steel.org