REFLECT-TEC™
HEAT-REFLECTIVE ROOF COATING

Infrared (IR) Heat Reflective Water-Based Polyvinylidene Flouride (PVDF) Fluoropolymer Coatings

An Update for Architects

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An Update for Architects

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Course Description

Infrared (IR) heat-reflective PVDF coating systems for the tile and metal roofing surfaces of a structure are an important technological breakthrough. These water-based, field-applied coatings offer new advantages and opportunities in both residential and commercial applications. This program will provide an overview of this innovative coating technology, as well as an update on key energy-saving standards.

Learning Objectives

At the end of this program, participants will be able to:

1. **Define a "Cool Roof"**
2. **Define IR Heat-Reflective Field-Applied Roof Coatings**
3. **Define PVDF Roof Coatings**
4. **Identify Uses and Benefits of Water-Based IR Heat-Reflective Field-Applied PVDF Coating**
5. **Identify Green Building Programs That Require or Offer Credit for Cool Roof Products**

What is a "Cool Roof"?

A "cool roof" is a roof that reflects and emits heat from the sun back into the atmosphere instead of absorbing it into the building below. The amount of "cool-ness" is measured by both Total Solar Reflectance (TSR) and thermal emittance.

Arizona State University "Old Main" with IR Heat Reflective Coating and over five years exposure.

What is a "Cool Roof"?

Reflectivity and Emissivity

There are two considera-tions when looking at the energy efficiency of a surface. They include reflectivity and emissivity. Reflectivity is a measure of how well a material rejects solar energy. Emissivity refers to the degree that the material holds that energy.

Lihue International Airport - Hawaii

What is a "Cool Roof"?

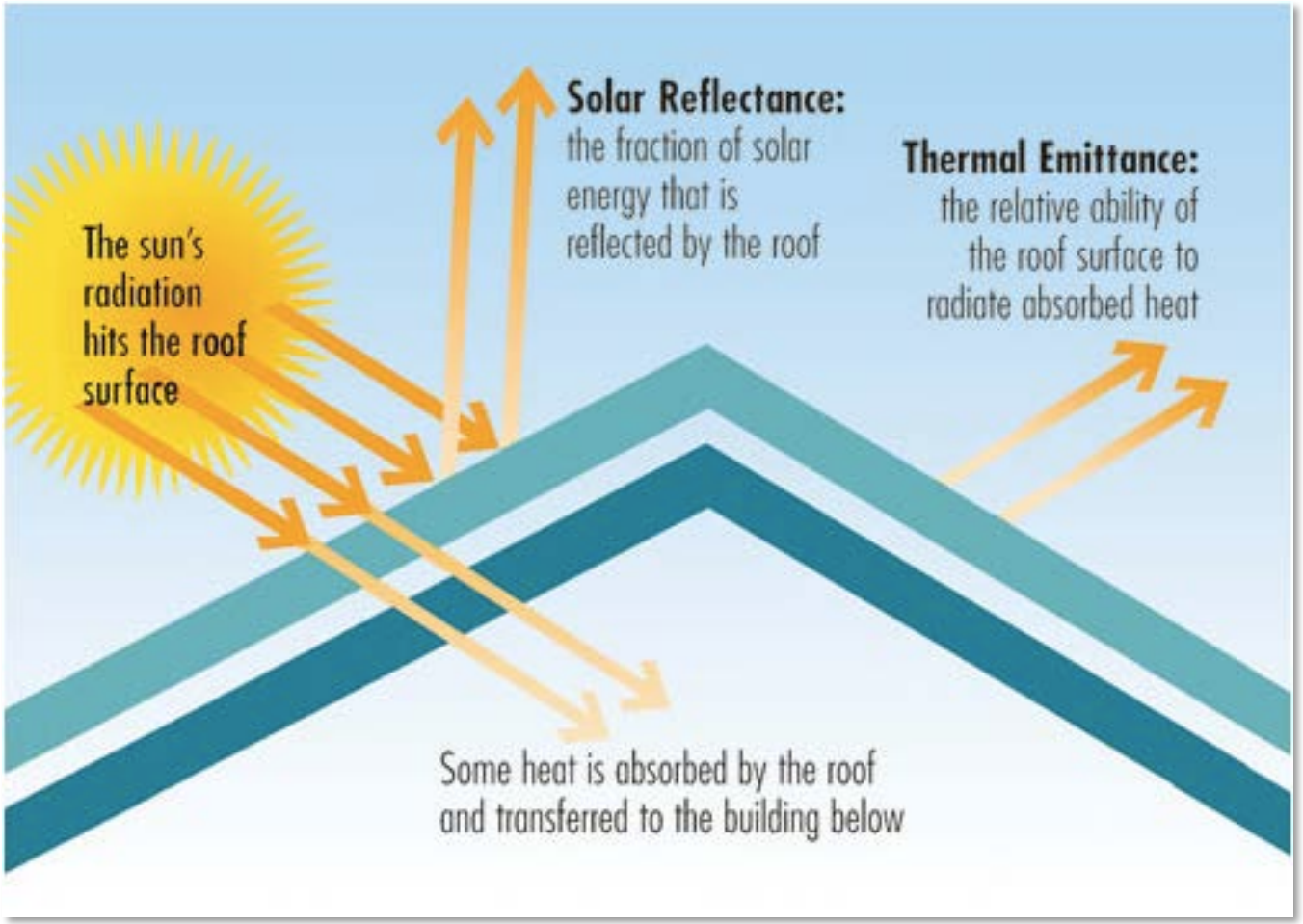


Image courtesy of Cool Roof Rating Council

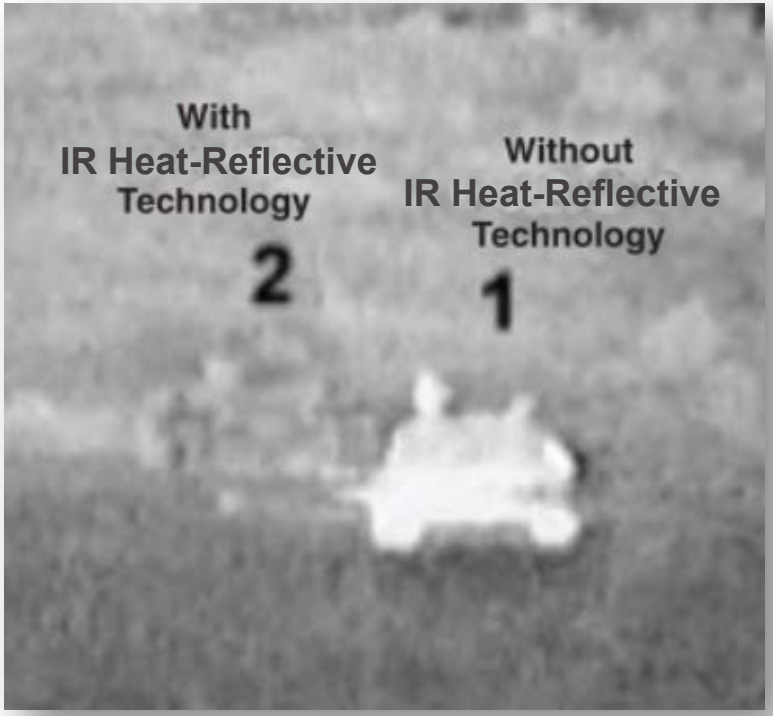
What is an "IR Heat-Reflective Roof Coating"?

Infrared (IR) Heat-Reflective Roof Coatings are revolutionary coatings formulated with a special heat-reflective finish that reflects infrared heat back into the atmosphere and can greatly increase the TSR values of new or existing metal and tile roofing structures in all colors.

IR Heat-Reflective Roof Coating - Hawaii

Origin of IR Heat- Reflective Coatings

IR Heat-Reflective coatings originated within the U.S. Military. And more recently utilized in their STEALTH program where they are used to diffuse heat to eliminate radar detection.



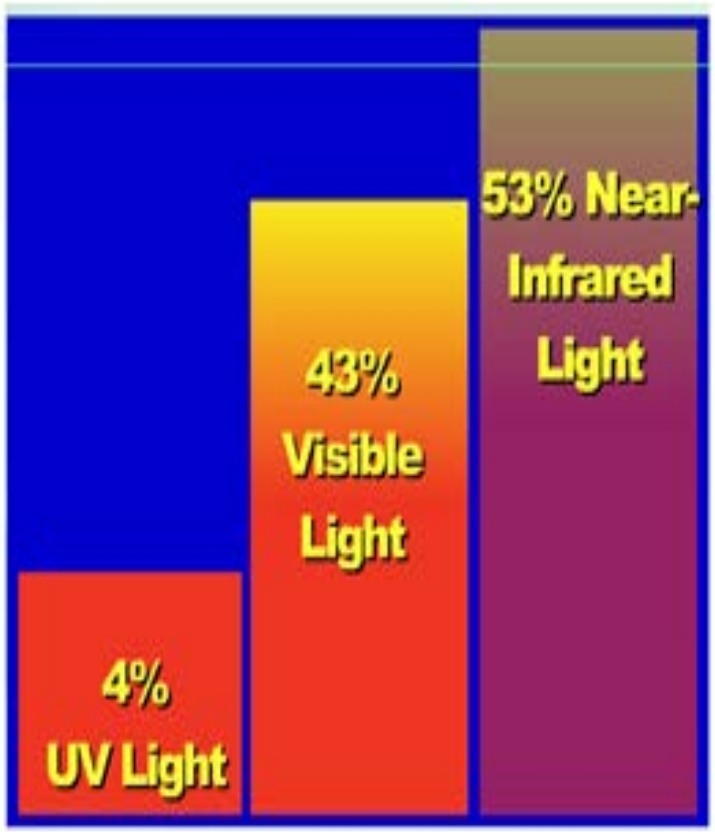
Development of IR Heat-Reflective Coatings

IR Heat-Reflective Coatings are…

- **Designed to change the infrared or invisible portion of the light spectrum, helping to reflect heat. Therefore reducing heat absorption, even in dark colors.**
- **Designed to diffuse heat evenly across the roofing surface.**
- **Works without the use of ceramic "spheres" or other non-proven technologies.**

The Light Spectrum

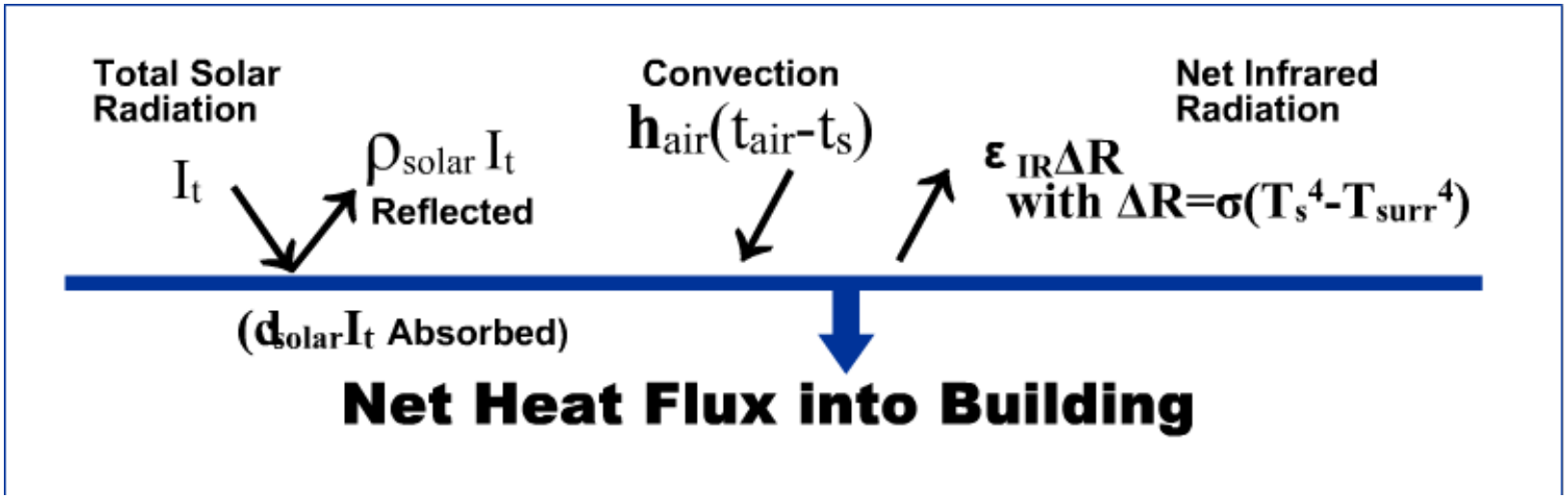
Much of the light spectrum consists of visible light – the light we can actually see. But a large portion of it is invisible to the eye – the near infrared light. IR heat reflective coatings reduce the effect of this largest portion of the light spectrum. By making this portion of the light spectrum highly reflective, darker colors can perform much like lighter colors.



Dark Colors vs. Light Colors

Anyone who has ever owned a dark colored car in the summertime knows that dark colors absorb more heat from the sun than light colors. That's because a color like black reflects less of the sun's energy than the color white. In fact, black only reflects about 5% of the sun's energy. IR heat reflective coatings allow even dark colors to act like light colors, reflecting much of the sun's radiant energy… an important advantage to designers, builders and building owners concerned about rising energy costs and global warming.

Materials and Heat Absorption



On a hot day, roof surfaces can absorb as much as 90% of the radiant energy. Even white roofs can absorb significant solar radiation. The roof's absorption of radiant energy makes the inside of the structure hotter and creates greater demand on HVAC systems, thus contributing to carbon emissions.

Tests show that advanced infrared heat reflective coatings are on average 100% more reflective than ordinary paint, even in darker colors. When less heat enters a structure, less energy is required to cool its interior.

What is a "PVDF" Fluoropolymer Roof Coating?

Water-based PVDF Fluoro-polymer Roof Coatings incorporate Polyvinylidene Flouride (PVDF) resin technology which provides several increased benefits as compared to typical acrylic roof coatings. PVDF coatings have a much harder finish, providing many benefits as compared to typical acrylic/ elastomeric roof coatings.

IR Heat-Reflective PVDF Coating applied to tile roof surface

What They Can Do

Compared to typical acrylic and/or elastomeric roof coatings and non-coated roofing surfaces, IR Heat-Reflective PVDF Roof Coatings can…

- **Greatly reduce the amount of heat that is absorbed and retained by a building's exterior roof surfaces.**
- **Lower exterior roof temperatures by over 50 degrees when compared to non-reflective coatings, paints, and uncoated surfaces in many colors.**
- **Provide a "passive" cooling technique that yields peak cooling load reductions and carbon reductions. Reduce the urban heat island effect, which contributes to urban smog and causes increased demands on power plants.**

What They Can Do (cont.)

Compared to typical acrylic and/or elastomeric roof coatings and non-coated roofing surfaces, IR Heat-Reflective PVDF Roof Coatings can…

- **Reduce building fatigue by reducing expansion and contraction due to heating and cooling cycles.**
- **Help prevent colors from fading due to UV light exposure.**
- **Prevent reduction in TSR due to dirt pick-up.**
- **Resist mold and mildew growth leading to reduced maintenance costs.**
- **Lead to longer air-conditioning unit life due to reduced use.**

Features & Benefits

- ***Aesthetic Appeal:*** **Offers greater design flexibility through use of dark colors.**
- ***Total Solar Reflectance (TSR) and Energy Savings:*** **Increased TSR, even in white color, significantly reduces roof surface temperatures while helping reduce peak cooling load.**
- ***Resistance to Dirt Pick-Up:*** **Keeps coating surface clean and prevents reduced Solar Reflectance due to dirt pick-up, especially in white!**
- ***Resistance to Mold/ Mildew Growth:*** **Prevents visual degradation, reduced TSR, and lowers maintenance costs!**

Features & Benefits (Cont.)

- ***Durability:*** **Prevents moisture penetration, reduces the effects of roofing structure fatigue caused by expansion and contraction and effectively extends the life cycle of existing building stock.**
- ***Retention of Color and Gloss:*** **Provides superior resistance to fading as compared to conventional paints – even in dark colors.**
- ***Reduced Environmental Impact:*** **Exterior coating is formulated with Low Volatile Organic Compounds (VOC) that meet requirements of "green" building rating systems such as LEED® even as an exterior applied coating.**

Aesthetic and Style Choices

IR Heat-Reflective PVDF Coatings offer a wide range of design choices…

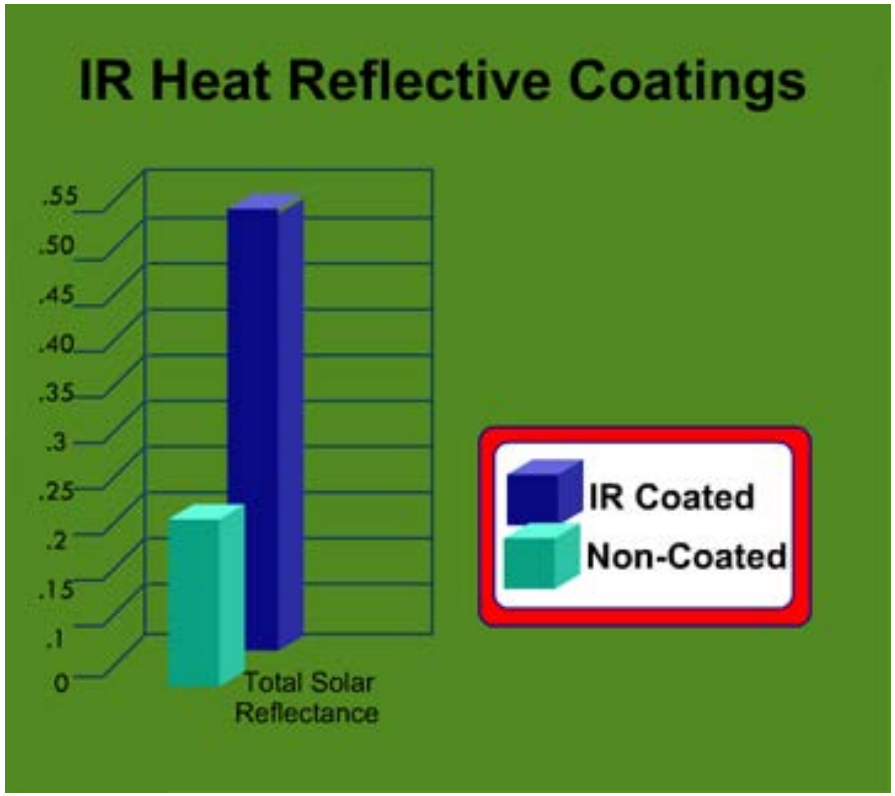
- **Exhibit heat-reflective properties, even in medium or dark colors, eliminating the necessity to have a white roof to enjoy the benefits of increased reflectivity.**
- **Ability to use various colors to match or complement wall and trim colors.**
- **Semi-gloss finish that is not only visually appealing but also contributes to resistance to dirt-pickup and self cleaning properties.**

Total Solar Reflectance (TSR)

Definition:

The ratio of total solar radiation which is reflected outward by the surface to the amount of total solar radiation falling on the surface.

Traditional paint colors provide limited heat reflective properties. IR heat reflective coatings enable high reflectance, in ALL colors, even white and dark. In fact, IR heat reflective PVDF coatings are on average 100% more reflective than traditional paints and coatings in the same color. Additionally, they resist dirt pick-up, which can accumulate and reduce TSR over time.



Solar Reflective Index (SRI)

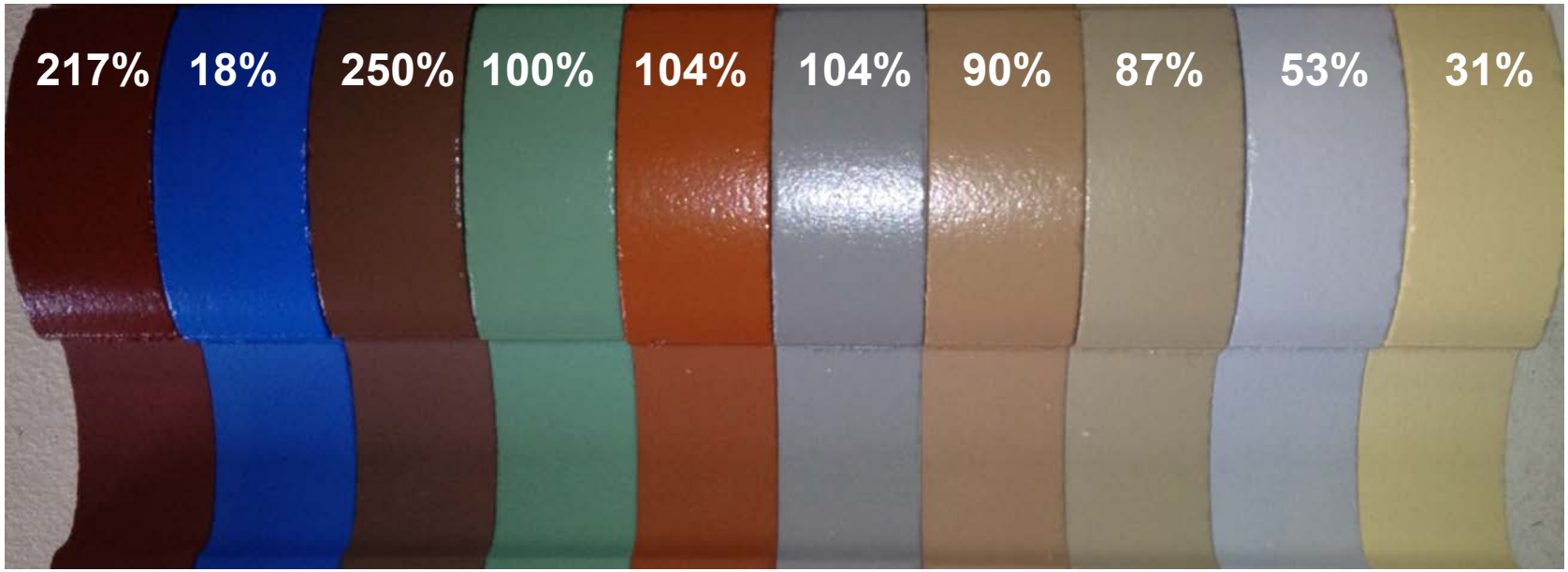
Definition:
The Solar Reflective Index (SRI) incorporates both the Total Solar Reflectance (SRI) and thermal emittance in to one value. SRI is used by many codes, standard, and programs that specify cool roofing requirements. A high SRI value is synonymous with a cool roof.

Calculating SRI:
Lawrence Berkeley National Laboratory maintains a user-friendly SRI calculator on their website. Simply input the Total Solar Reflectance and thermal emittance values and the calculator will determine the SRI. This tool is located at www.coolcolors.lbl.gov .

Increased TSR, in ALL Colors!

Total Solar Reflectance - IR Heat-Reflective PVDF Coatings
% Increase TSR vs. Conventional Paint

0.38	0.40	0.42	0.44	0.47	0.49	0.55	0.58	0.61	0.68
217%	18%	250%	100%	104%	104%	90%	87%	53%	31%



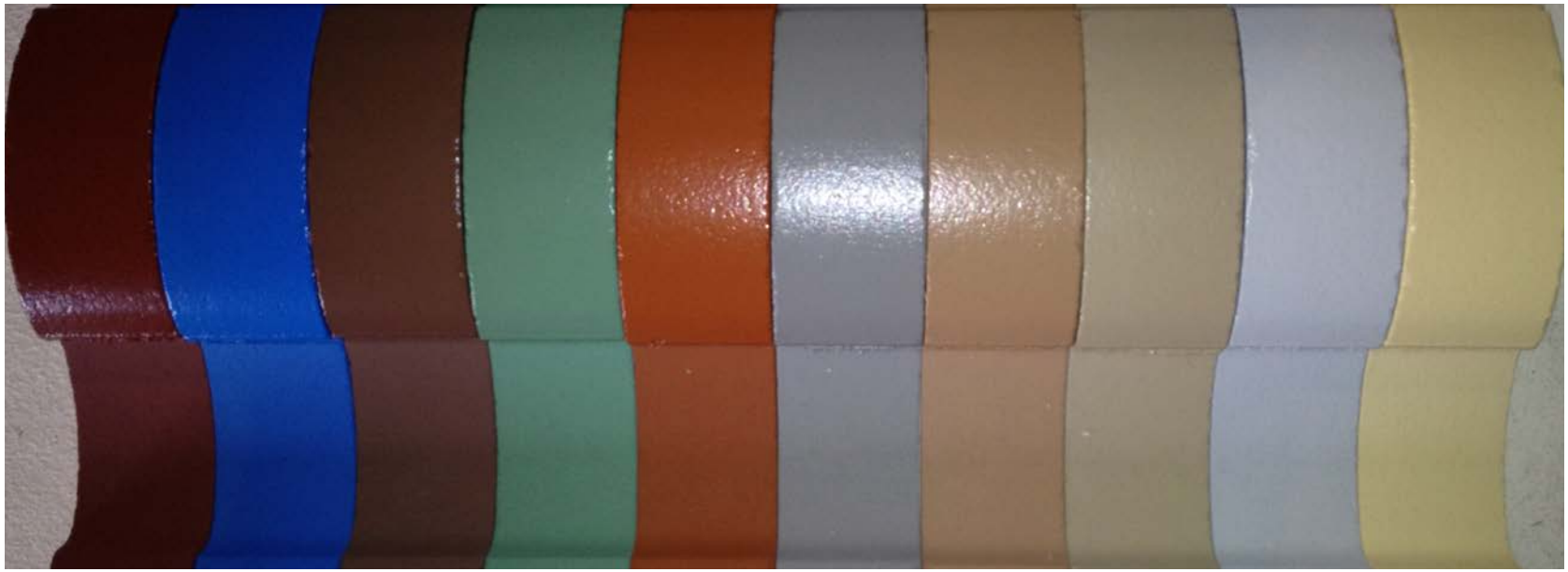
0.12	0.34	0.12	0.22	0.23	0.24	0.29	0.31	0.40	0.52

Conventional Paint TSR

Increased SRI, in ALL Colors!

Solar Reflective Index - IR Heat-Reflective PVDF Coatings

42	45	48	50	54	57	65	69	73	83



9	38	9	22	24	25	31	34	46	61

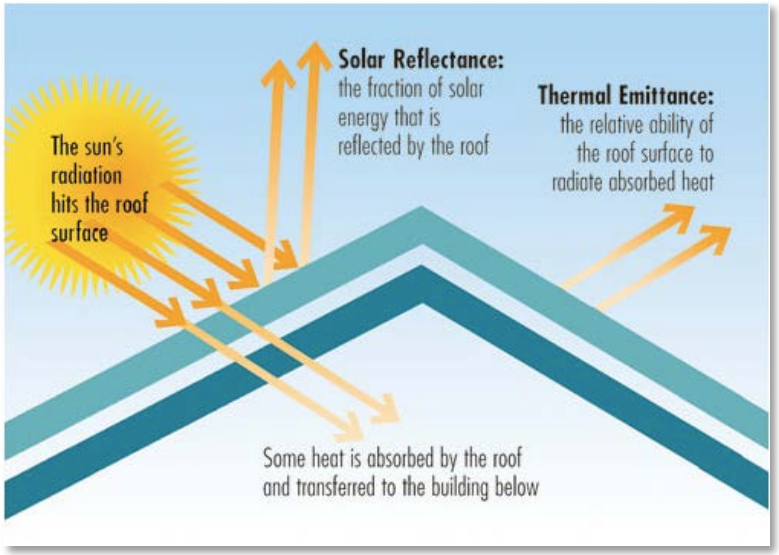
Conventional Paint SRI

Estimated Increase in TSR Total Solar Reflectance

IR Heat-Reflective PVDF Coatings Color Family	Estimated Increase in Reflectivity vs. Traditional Paint
Light	>30%
Medium	>100%
Dark	>200%

Total Solar Absorption

Definition:
The ratio of the amount of total solar radiation absorbed by the surface to the amount of total solar energy falling on the surface. Solar absorption is that portion of total solar radiation neither transmitted nor reflected.



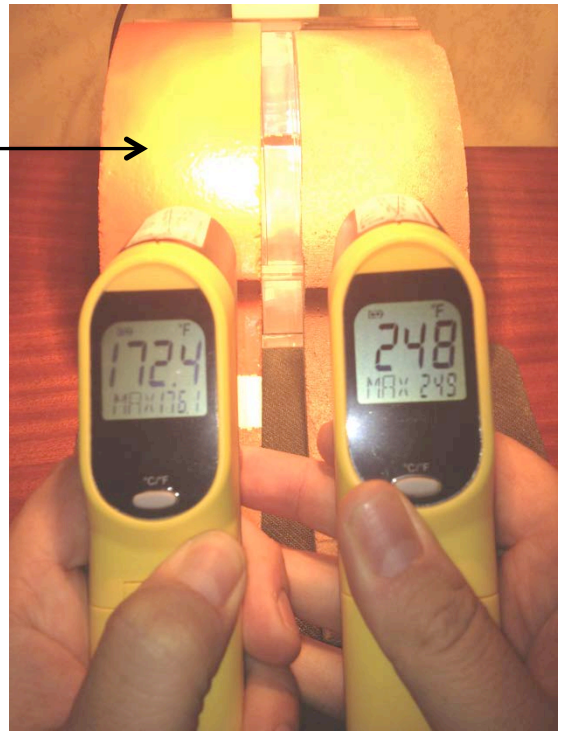
Because more solar radiation is reflected by IR heat reflective PVDF coatings, the emittance value is higher. When less energy is absorbed, the amount of heat entering the interior of a structure is reduced. This reduction in heat means a reduction in the use of HVAC systems to cool the interior, reducing peak cooling loads.

Reduced Surface Temperatures

Increased Total Solar Reflectance obtained with IR Heat-Reflective PVDF Coatings can lead to surface temperature reductions of over 50° F*.

Metal →

Tile →



Heat lamp demonstrations show surface temperature reductions of over 50° F obtained with IR Heat-Reflective PVDF Coating when compared to traditional acrylic paint in identical color on a metal surface (left) and over 70° F when compared to uncoated tile (right) – even in a darker color!

Reduced Peak Cooling Load

Depending on the climate zone, substrate & other conditions in which a building is located, heat reflective coatings can make a significant contribution to reduce peak cooling load & lower cooling costs. Heat reflective coatings can:

- **Lower roof surface temperatures by over 50 degrees when compared to traditional paints and uncoated roofing surfaces in many colors.**
- **Reduce energy costs related to peak cooling load*.**
- **Create less heat buildup around the building (heat island effect) that can raise interior temperatures.**

*Percentage of peak cooling load reductions are based on models generated from the "Roof Savings Calculator" Beta Release v 0.92 Oak Ridge and Lawrence Berkeley National Laboratories when compared to a non-cool roof . Cooling costs savings, percentage of peak cooling load and surface temperature reductions will vary based on color chosen, geographical location, climate condition, and substrate type. In some climates, there may be a heating penalty. For more information, see www.texcote.com.

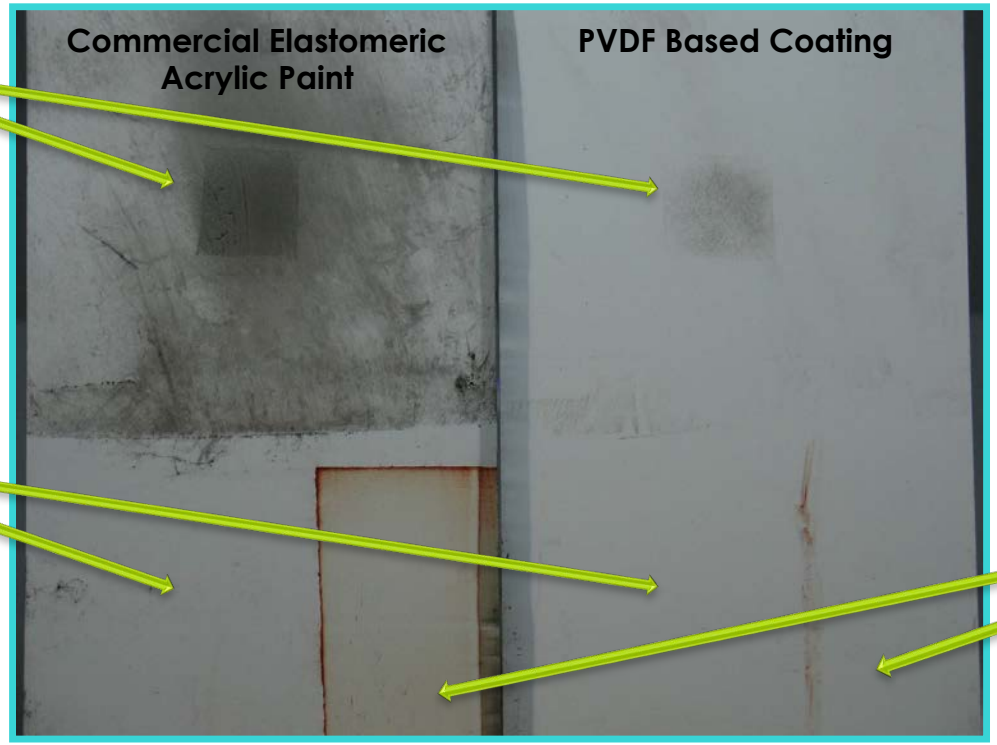
Estimated Reduction in Peak Cooling Load*

IR Heat-Reflective PVDF Coatings Color Family	Estimated Reduction in Peak Cooling Load
Light	20-30% (KWh)
Medium	15-25% (KWh)
Dark	10-20% (KWh)

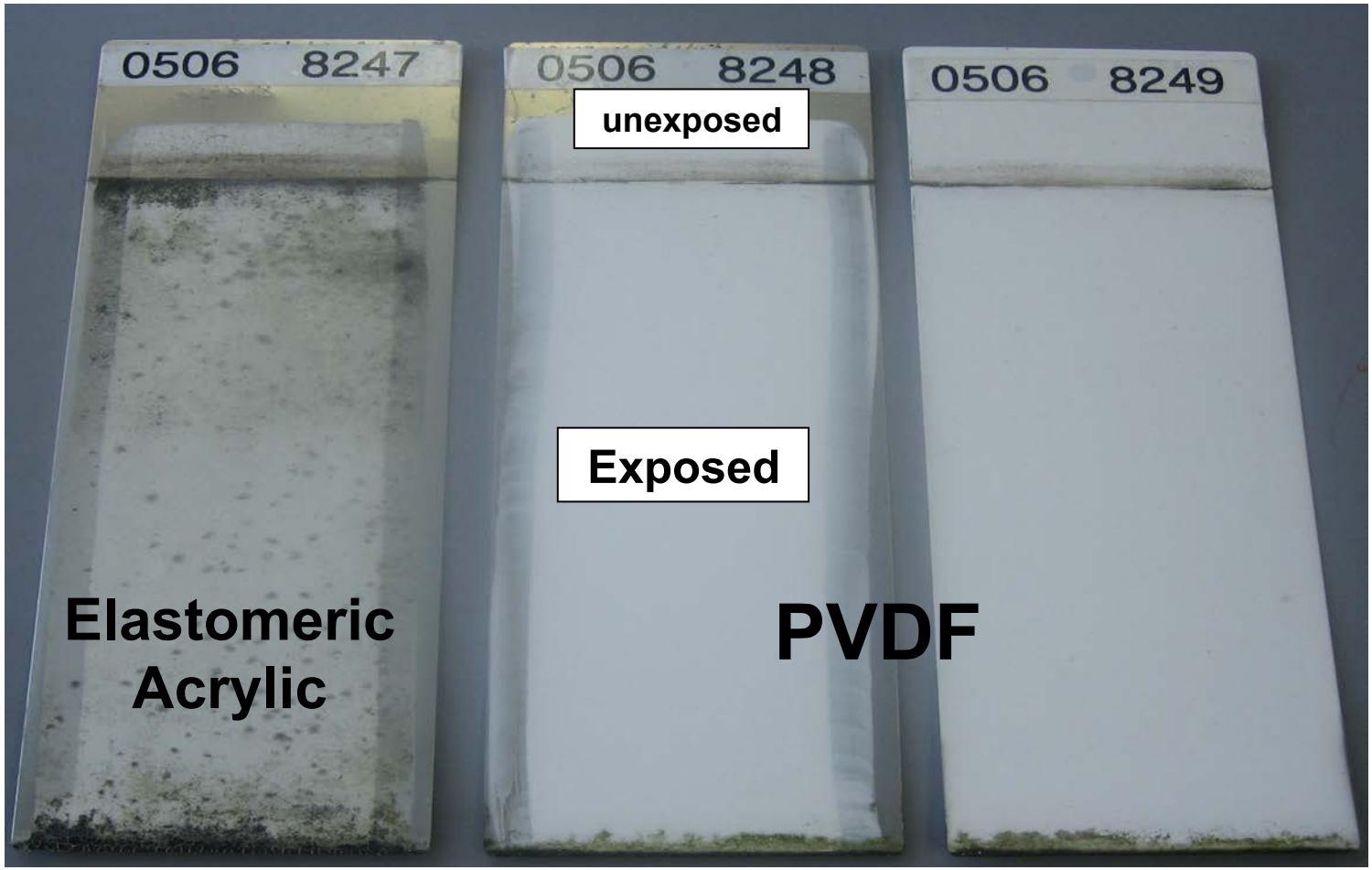
*Percentage of peak cooling load reductions are based on models generated from the “Roof Savings Calculator” Beta Release v 0.92 Oak Ridge and Lawrence Berkeley National Laboratories when compared to a non-cool roof . Cooling costs savings, percentage of peak cooling load and surface temperature reductions will vary based on color chosen, geographical location, climate condition, and substrate type. In some climates, there may be a heating penalty. For more information, see www.texcote.com.

Resistance to Dirt Pick-Up, Even in White Colors

IR heat-reflective coatings that incorporate PVDF resin technology exhibit superior resistance to dirt pick-up as compared to typical acrylic paint.



Aluminum Panels with White Coatings in FL with 10 Years Weathering



Extreme Resistance to Mold/ Mildew Growth

Water-based IR heat-reflective coatings that incorporate PVDF resin technology exhibit superior resistance to mold and mildew growth as compared to typical acrylic/ elastomeric paint and uncoated surfaces. Mold and mildew growth on a roof surface can cause a reduction in Total Solar Reflectance and increases maintenance costs.

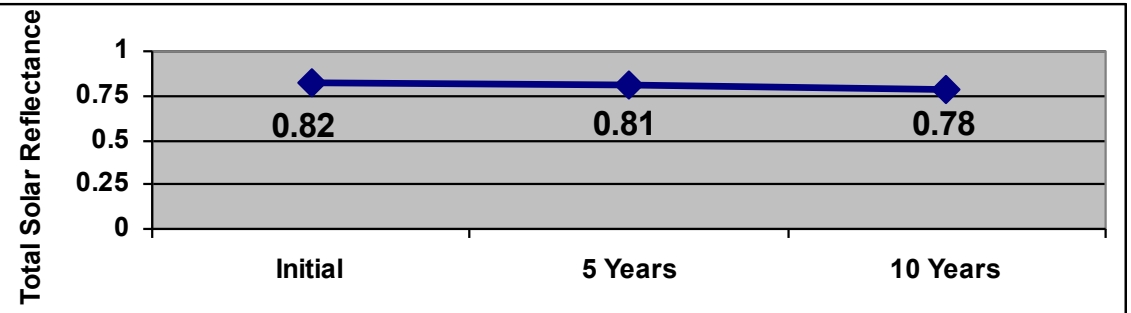
Extreme Resistance to Mold/ Mildew Growth

Before - Uncoated Tile

After

Less Dirt Pick-Up & Less Mold and Mildew Growth Prevents TSR Reductions

Typical acrylic/ elastomeric coatings experience a reduction in TSR over time as dirt and other contaminants build on the surface, even in white! Water-based IR Heat Reflective PVDF Coatings resist these contaminants and maintain a TSR of 0.78 after 10 years exposure. The TSR of typical acrylic/ elastomeric white coatings was reduced to 0.55 after only 3 years in a study done by Lawrence Berkely National Laboratory.



Maintains 0.78 TSR After 10 Years Exposure

Durability

Most building materials, including roof surfaces and substrates, are prone to expansion and contraction due to natural heating and cooling. Excessive heat absorption can exacerbate this natural expansion and contraction, placing stress on the substrate and causing building fatigue.

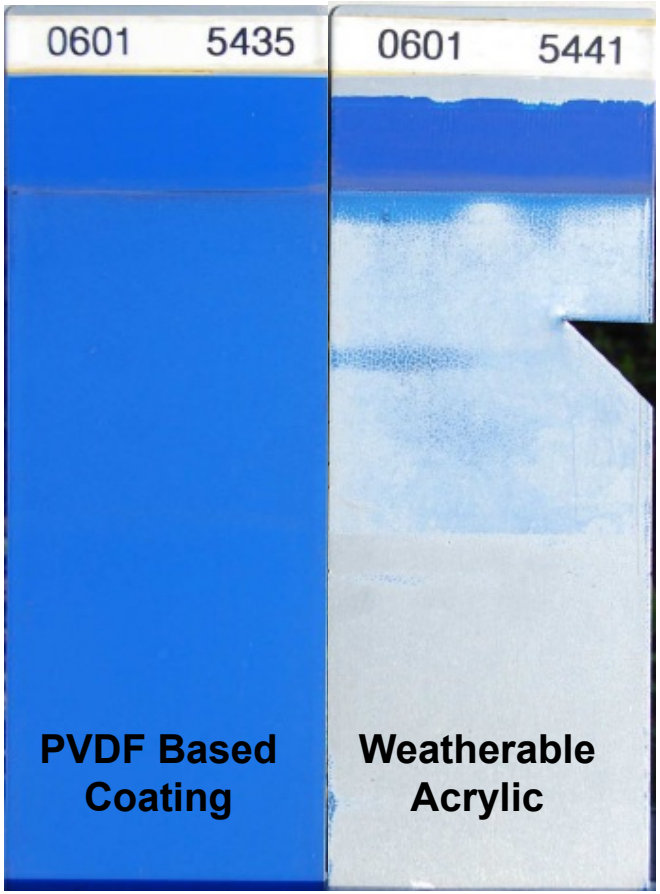
Because of the high reflectance properties of these coatings, the amount of heat absorbed by the substrate is greatly reduced. The result:

- **Less expansion and contraction.**
- **Less stress placed on the substrate.**
- **Increased life-cycle performance.**

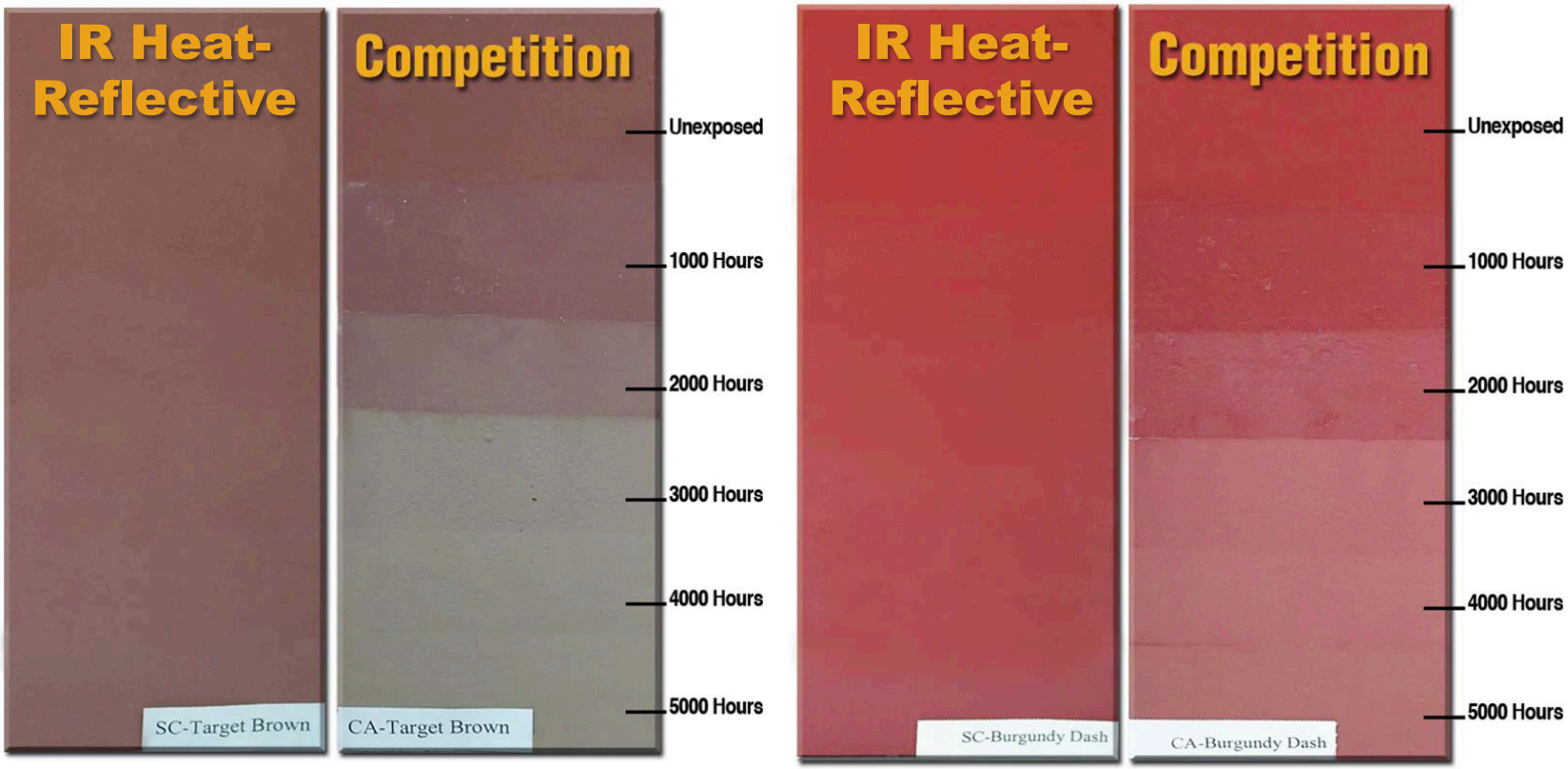
Superior Fade Resistance and Gloss Retention

The reflective qualities of these coatings lower surface temperatures and reduce fading and loss of gloss, even in darker colors. This fade resistance feature provides longer life cycle performance and is ideal for project extended life strategies.

8 ½ Years

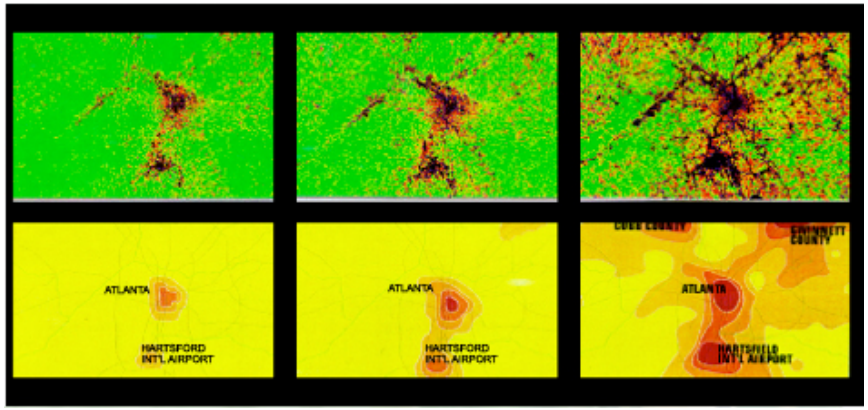


Superior Fade Resistance and Gloss Retention



Environmental Benefits

- *Energy Savings:* Heat reflective coatings reduce the amount of heat entering the interior space of a building, which means less energy is required for cooling.
- *Conservation of Resources:* No impact on landfill realized.
- *Air Quality:* The highly reflective coating systems reduce the urban heat island effect. The result is improved air quality and lower levels of urban smog – as well as decreased demand on electrical utilities' power plants, most of which burn fossil fuels to generate electricity.
- Extremely low VOC – formulated with less than 50g/L.
- This image, captured with both satellite and thermal imaging, shows the increase of the heat around the city of Atlanta over 21 years. IR heat-reflective PVDF coatings can reduce the heat island effect.



1972 1978 1992

CRRC – 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 (radiative properties) of roofing products and to disseminate the information to all interested parties. The CRRC's Rated Products Program provides a directory of various roofing surface products that have been rated under a strict program administered by the CRRC. These rated products can be found under manufacturer's name at www.coolroofs.org .

CRRC
COOL ROOF RATING COUNCIL ®
RATED PRODUCT

USGBC's LEED Program

The United States Green Building Council's Leadership in Energy and Environmental Design (LEED) provides buildling owners and operators with a framework for identifying and implementing practical and measurable green building design, construction, operations, and maintenance solutions. LEED projects are rated on a point system and can obtain silver, gold, or platinum level certifications. The LEED program includes a credit under the Sustainable Sites category for cool roofs based on their ability to reduce the urban heat island effect. A cool roof must have a minimum SRI of 78 for low sloped roofs and 29 for steep sloped roofs in order to be eligible for credit.

Thank You For Your Time!

Questions?

**Click Here to Take Short Quiz on IR Heat-Reflective PVDF Roof Coatings (Required for AIA LU Credit Registration)"

This concludes the American Institute of Architects Continuing Education Systems Program.

If you have any questions regarding this module contact:

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