“DURA COOL”

COOL ROOF TECHNOLOGY
“COOL ROOF” TERMINOLOGY

- **SOLAR REFLECTANCE**
  - The fraction of the solar energy that is reflected by a roof.

- **EMITTANCE**
  - The amount of absorbed heat that is radiated from a roof. The higher the value, the better the roof radiates.

- **EMISSIVITY**
  - Indicates the roof’s ability to reject solar heat.

- **HEAT ISLAND**
  - Summer warming trends occurring in urban areas.
Solar Reflectance

The fraction of the solar energy that is reflected by a roof, expressed as a number between zero and one. The higher the value, the better the roof reflects solar energy.

For example, white reflective coating or membrane has a reflectance value of 0.85 (reflects 85% of solar energy hitting it and absorbs the remaining 15%), while asphalt has a value of 0.09 (reflects 9%).
Emittance

The amount of absorbed heat that is radiated from a roof, expressed as a number between zero and one. The higher the value, the better the roof radiates heat.
EMISSIONITY

Indicates the roof’s ability to reject solar heat, and is the combined value of reflectivity and emittance. It is defined so that a standard black is zero (reflectance 0.05, emittance 0.90) and a standard white is 100 (reflectance 0.80, emittance 0.90).

Because of the way SRI is defined, very hot materials can have slightly negative SRI values, and very cool materials can have SRI values exceeding 100.
“HEAT ISLAND”

Research that is conducted to find, analyze, and implement solutions to the summer warming trends occurring in urban areas, the so-called “Heat Island” effect.

We currently concentrate on the study and development of more reflective surfaces for roadways and building.
EFFICIENCY BENEFITS

“Energy Star” Approval

The most efficient roofing materials are those that are ENERGY STAR qualified. In order to qualify for the ENERGY STAR label, roofing products must meet the following specifications:
EFFICIENCY BENEFITS
“Energy Star” Approval

SPECIFICATION #1

For low-slope roofs (surfaces with a slope of 2:12 inches or less), the initial solar reflectance must be at least 0.65. The material must maintain a level of at least 0.50 after three years of instillation under normal conditions.
SPECIFICATION #2

For high-slope roofs (surfaces with a slope of 2:12 inches or greater), the initial solar reflectance must be at least 0.25. The material must maintain a level of at least 0.15 after three years of installation under normal conditions.
Why Cool Roofs?

- Energy Savings
- 60% Solar Energy Gain Via Roof
- Mitigate Urban Heat Island Effect
- Environmental Impact
- Reduce Peak Energy Demand
  - Even in northern cool climates
  - Incentive for utility companies
The Roofing Market

- 80 million buildings in USA
- Roofing market: 23 billion square feet
- Metal roofing market share:
  - Residential: As high as 8%
  - Commercial: As high as 33%
- Cool roofing volume is growing

Sources: DOE, NRCA, Ducker Worldwide, F.W. Dodge
Cool Metal Roofing

• Can save up to 40% cooling energy
  (especially homes with cooling ducts in attics)

• Save $ and energy during peak cooling demand
Energy Balance on Roof Surface

- Total Solar Radiation
- Reflected Radiation
- Re-Emitted Energy
- Convection
- Absorbed Energy
- Net Heat Flux Into Roof
## Roofing Material Thermal Properties

<table>
<thead>
<tr>
<th>Material</th>
<th>Initial Solar Reflectance</th>
<th>Infrared Emittance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal (unpainted)</td>
<td>0.60-0.80</td>
<td>0.04-0.10</td>
</tr>
<tr>
<td>Metal (painted and granular coated)</td>
<td>0.10-0.75 *</td>
<td>0.75 +</td>
</tr>
<tr>
<td>Comp Asphalt Shingles</td>
<td>0.05-0.25</td>
<td>0.90</td>
</tr>
<tr>
<td>Modified Bitumen</td>
<td>0.05-0.25</td>
<td>0.90</td>
</tr>
<tr>
<td>Built Up Roofing</td>
<td>0.05-0.80</td>
<td>0.90</td>
</tr>
<tr>
<td>Concrete/Clay Tile</td>
<td>0.20-0.70</td>
<td>0.90</td>
</tr>
<tr>
<td>White Single Ply Membrane</td>
<td>0.70-0.80</td>
<td>0.85 +</td>
</tr>
</tbody>
</table>

* depending on color

Source: ORNL and LBNL

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**Emissivity** is generally high in coatings and paint films, but very low in unpainted metallic surfaces.
# Roof Surface Temperature

## Infrared Emittance Has Less Impact Than Solar Reflectance

(Example for Air Temperature of 98° F)

Source: LBNL, ASTM D1980

<table>
<thead>
<tr>
<th>solar reflectance</th>
<th>emittance</th>
<th>temperature (F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.70</td>
<td>0.75</td>
<td>124</td>
</tr>
<tr>
<td>0.70</td>
<td>0.90</td>
<td>122</td>
</tr>
<tr>
<td>0.55</td>
<td>0.75</td>
<td>139</td>
</tr>
<tr>
<td>0.70</td>
<td>0.75</td>
<td>125</td>
</tr>
<tr>
<td>0.80</td>
<td>0.75</td>
<td>115</td>
</tr>
</tbody>
</table>
Urban Heat Island Effect

- Urban areas 6-8 °F warmer than suburbs
  (Dark pavements, dark roofing and less vegetation)
- Roof surface temperatures have effect
  (lower temperatures = less smog, less pollution, lower peak energy demand)
- High reflectance/emittance = low surface temperatures
Smog Formation

Heat is a catalyst for smog

Like Los Angeles, many cities exceed ambient air quality standards for ozone (smog).

The air in Los Angeles is noticeably cleaner during winter, yet the number of cars on the road is approximately the same as in summer.
Comparing Solar Reflectance of Pigments

Regal White
Standard SR .67
Cool SR .72

Rawhide
Standard SR .47
Cool SR .56

Slate Blue
Standard SR .21
Cool SR .33

Brick Red
Standard SR .25
Cool SR .30

Charcoal Gray
Standard SR .14
Cool SR .28

Hartford Green
Standard SR .11
Cool SR .28

Slate Bronze
Standard SR .08
Cool SR .26
## Cool Roof Policies

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Star</td>
<td>low slope (&lt; 2:12)</td>
<td>N/A</td>
<td>0.65</td>
<td>0.50</td>
</tr>
<tr>
<td></td>
<td>steep slope (&gt; 2:12)</td>
<td>N/A</td>
<td>0.25</td>
<td>0.15</td>
</tr>
<tr>
<td>California Energy Code (Title 24)</td>
<td>Required</td>
<td>0.70</td>
<td>none</td>
<td>0.75</td>
</tr>
<tr>
<td>Florida State Energy Code</td>
<td>Commercial</td>
<td>Required</td>
<td>0.65</td>
<td>none</td>
</tr>
<tr>
<td></td>
<td>Residential</td>
<td>Credit</td>
<td>0.65</td>
<td>none</td>
</tr>
<tr>
<td>Georgia Energy Code</td>
<td>Credit</td>
<td>0.70</td>
<td>0.75</td>
<td>none</td>
</tr>
<tr>
<td>Chicago Energy Conservation Code</td>
<td>low slope (&lt; 2:12)</td>
<td>Mandatory</td>
<td>0.25</td>
<td>0.25</td>
</tr>
<tr>
<td></td>
<td>mod slope (2:12 - 5:12)</td>
<td>Mandatory</td>
<td>0.15</td>
<td>0.15</td>
</tr>
<tr>
<td>LEED</td>
<td>Credit</td>
<td>0.65</td>
<td>0.50</td>
<td>0.90</td>
</tr>
<tr>
<td>ASHRAE</td>
<td>90.1 Commercial</td>
<td>Credit</td>
<td>0.70</td>
<td>none</td>
</tr>
<tr>
<td></td>
<td>90.2 Residential</td>
<td>0.65</td>
<td>none</td>
<td>0.75</td>
</tr>
<tr>
<td>IECC</td>
<td>Credit</td>
<td>0.70</td>
<td>none</td>
<td>0.75</td>
</tr>
<tr>
<td>Canadian Energy Code</td>
<td>Credit</td>
<td>none</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>California State/Utility Cool Roof</td>
<td>Mandatory</td>
<td>0.65</td>
<td>0.50</td>
<td>none</td>
</tr>
<tr>
<td>Rebate Programs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Eley Associates, 2003
## Energy Star Criteria

<table>
<thead>
<tr>
<th>Roof Slope</th>
<th>Initial Solar Reflectance</th>
<th>Aged Solar Reflectance *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Slope (≤ 2:12)</td>
<td>0.65</td>
<td>0.50</td>
</tr>
<tr>
<td>Steep Slope (&gt;2:12)</td>
<td>0.25</td>
<td>0.15</td>
</tr>
</tbody>
</table>

* Aged values reported after three years exposure using one of three protocols:
  1) Field measurements on roofs in 3 metro areas (ASTM E1918, C1549)
  2) Samples from roofs in 3 metro areas tested in lab (ASTM E903, C1549)
  3) Exposure panels from weathering farms measured in lab (ASTM E-903 and C-1549)

[www.energystar.gov](www.energystar.gov)
Sustainable Sites - Credit 7.2

Use Energy Star® compliant (highly reflective) and high EMISSIVITY roofing (EMISSIVITY of at least 0.90 when tested in accordance with ASTM E408) for a minimum of 75% of roof surface.

<table>
<thead>
<tr>
<th>Roof Slope</th>
<th>Initial Solar Reflectance</th>
<th>Aged Solar Reflectance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Slope (&lt; 2:12)</td>
<td>0.65</td>
<td>0.50</td>
</tr>
<tr>
<td>Steep Slope (&gt;2:12)</td>
<td>0.25</td>
<td>0.15</td>
</tr>
</tbody>
</table>
INCENTIVES & REBATES

- FEDERAL INCENTIVE PROGRAMS
- STATE/MUNICIPAL REBATES
- UTILITY REBATES/CREDITS
- TAX CREDITS
- ENERGY CREDITS
- HIGHER RE-SALE VALUES
- CODES & STANDARDS
- ENERGY STAR
- COOL ROOF RATING COUNCIL
- USGBC LEED™ RATING PROGRAM
- ENERGY & ENVIRONMENTAL SAVINGS
U.S. GREEN BUILDING COUNCIL

MEMBERSHIP 1999: 250
     2003: 4800

BUDGET 1999: $400,000
     2003: $17,000,000
Pigments in the Value Chain

Pigments are colored powders

Incorporated into paint, plastics, concrete, ceramics...

Applied on or formed into various materials

Imparting a wide range of colored effects
How do Pigments work?

**Colored Pigments** selectively absorb visible light

The rest of the light is reflected and appears as color to the human eye
Of the sunlight that reaches the Earth...

...only 46% is visible to the human eye.
Leadership in Energy & Environmental Design®

A leading-edge system for designing, constructing, operating and certifying the world’s greenest buildings.

USGBC’s flagship rating system is LEED for New Construction and Major Renovations (LEED-NC)
LEED-NC® Point Distribution

Five LEED credit categories
LEED and Metal Roofing

ONE point each for:

• Post-consumer recycled content +
• 1/2 post-industrial recycled content =
• 5% of value of all materials in project
• 20% of all materials manufactured locally
• 50% of all materials torn off in old-building teardown are recycled
• Roof with high reflectance and high emittance
You Have Resources!

- Coalition: www.coolmetalroofing.org
  Cool Facts, Cool Brochure, FAQ’s, Research
- Coalition Executive Director
  Greg Crawford: 412-922-2772, ext 206
  fax: 412-922-3213
- USGBC website for LEED: www.usgbc.org
- Energy Star: www.energystar.gov
- Cool Roof Rating Council (CRRC): www.coolroofs.org
- Oak Ridge National Laboratory:
  www.ornl.gov/roofs+walls/index.html
LEED & Metal Roofing

- Remember: *Buildings are LEED certified, products are not.*
- Metal gets credit for its recycled content and recyclability
- Roofing & siding are part of a scoring system
The Problem - Heat

- Dark materials **ABSORB HEAT** from the sun
- When those dark surfaces are roofs, some of the heat is **TRANSFERRED INSIDE**
Cool Coating Benefits

- Heat is **REFLECTED** away from buildings
- All the advantages of greater reflectivity can be had **WITHOUT SACRIFICING COLOR CHOICE**
- Dramatically increases the reflectivity of medium to dark colors to such a degree that the product will meet the **ENERGY STAR** specifications for **STEEP SLOPE** Cool Roofs
- Smog is **REDUCED** when environmental temperatures are reduced
Solar Reflectance

• Solar reflectance describes an object's ability to reflect solar radiation away from its surface.

• It is measured in the UV, IR, and visible light wavelengths and therefore should not be confused with gloss/sheen, which is based solely on visible light reflection.

• Don’t confuse reflectivity with glare!
Impact on Temperature and Energy Consumption

• Rule of Thumb:
  – FOR EVERY 1% INCREASE IN ROOF REFLECTANCE, TEMPERATURE DECREASES 1°F
    • example: Improving reflectance from 10% to 50% lowers surface temperature 40°F
  – FOR EVERY 10% INCREASE IN ROOF REFLECTANCE, COOLING/HEATING ENERGY COSTS DROP 2¢/ft² (warm climates)

Per LBNL: based on DOE 2 model, LBNL models, ORNL calculator, EnergyPlus model
This is to certify that the metal roofing product purchased contains either a Dura Coat Products, Inc. Durapon 70 Dura-Cool, XT-20SMP – Dura-Cool, XT40SMP – Dura-Cool coating that:

a) Has appropriate pigmented coatings that are specifically and primarily designed to reduce the heat gain of a dwelling unit when installed on the dwelling unit; and,

b) Meets or exceeds ENERGY STAR program requirements for steep-slope roofs (as in effect at the time of installation),

In accordance with IRS Notice 2006-26. Furthermore, the roof coating is an “eligible building envelope component that qualifies for the credit allowed under § 25C”.

Dura Coat Products, Inc.
26655 Peoples Road
Huntsville, AL  35756

Dura Coat Products, Inc.
5361 Via Ricardo
Riverside, CA  92509

Declaration Statement:
Under penalties of perjury, I declare that I have examined this certification statement, and to the best of my knowledge and belief, the facts presented are true, correct, and complete.

Lenny J. Greenhall – Corporate Vice President
THANK YOU

Advanced Coating Technology

"Providing Tomorrow's Coating Technology Today"