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W118 Infra-Red
Cool Roof Coating

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OVER 27 YEARS OF EXPERTISE

Wilcote Infra Red Cool Roof Coating

- Infra Red Technology is a new and innovative system that will transform the Coating Industry. This ground breaking Technology, was first used by the US Military, on their Aircraft to protect them and ensure that these planes, were invisible to Radar. To help explain this phenomenon, we need to understand light wavelengths that are emitted from the sun.
- Light energy emitted from the sun will reach the Earth's Surface from 295 – 2500 nano meters (nm) and is divided into three main regions: **Ultra Violet Region, Visible Region** and **Non Visible Region**.

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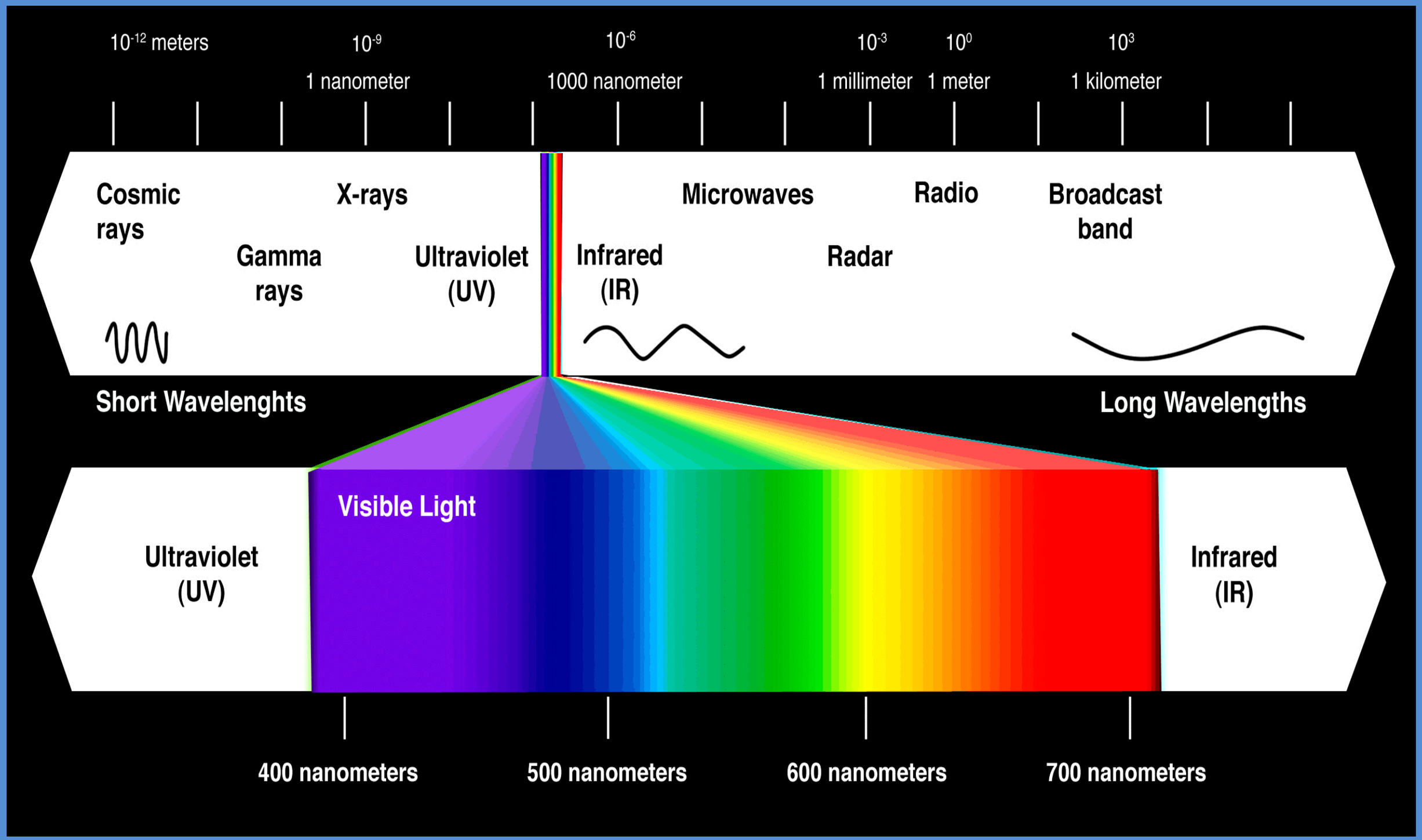

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<u>Ultra Violet Region</u> - accounts for only 5% of the sun's energy reaching the earths surface at 295nm – 400nm. UV light is responsible for sunburns and the break down of polymers in coatings.	**<u>Visible Region</u>** – accounts for 50% of the sun's energy occurs in this region and will occur at 400nm – 700nm. Pigments will selectively absorb visible light and reflect remaining light i.e ☐ White will reflect entire visible wavelength. ☐ Coloured will absorb some and reflect other e.g red will absorb all wavelengths except red. ☐ Black will absorb everything in the visible wavelength	**<u>Non Visible (Infra Red)-</u>** makes up 45% of the total solar energy and occurs at 700nm – 2500nm. Heat is a by product of Infra – Red radiation. When radiation occurs this will result in the surface heating up.

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Production of Pigments

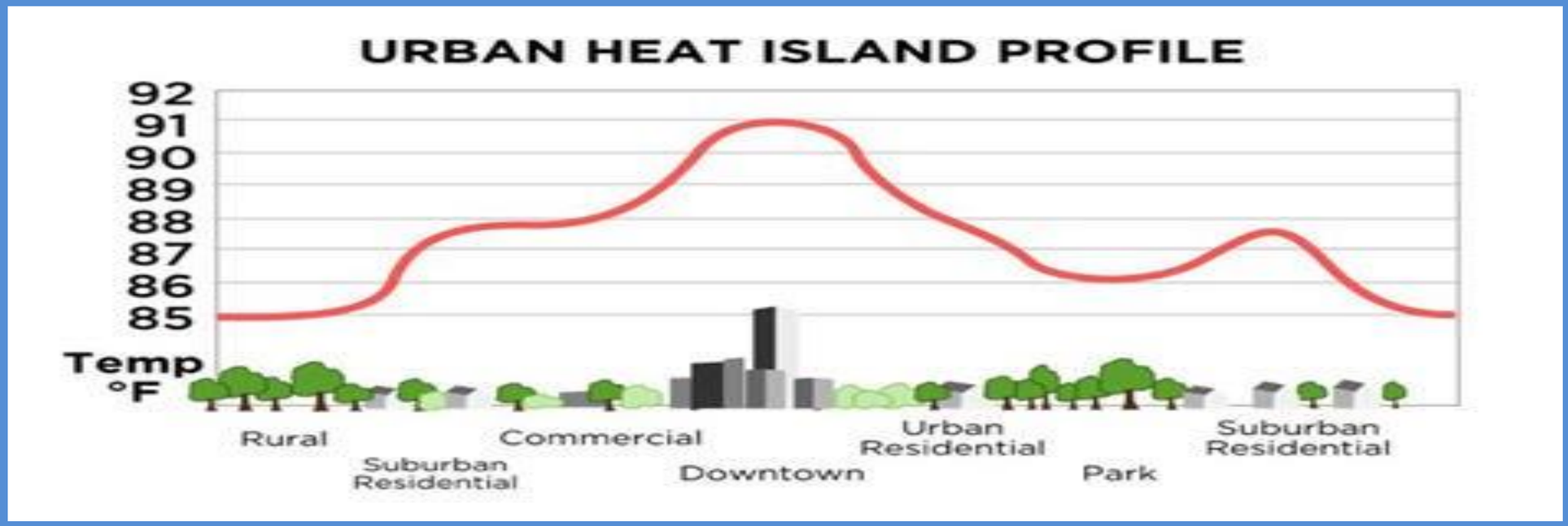
Pigments are synthesized by subjecting mixtures of metal hydroxides, nitrates, acetates or oxides to very high temperatures called calcination. Metal oxides / salts are blended together and strongly heated at temp above 1000°C. At Calcining temp the solids become reactive. The metal and oxygen ions in solids re-arrange to form new and much more stable structures.

Infra Red reflective pigments which will reflect the wavelengths as well a some visible light selectively. IR pigments may have any colour.

Need for Infra Red Technology

More people now live in “concrete jungles” or “Urban Heat Islands” where all buildings will radiate and give off heat. The amount of heat will vary and will depend on roof construction, urban heat, roof type, elevation and also the colour of coating used.

To minimise the amount of heat given off and to keep the building cooler, there is a need for cooler roofs and high rise buildings. By reflecting most of sun’s heating energy, this will minimise the amount of energy radiated by the building.



Important factor that affects Infra Red Reflectivity – Opacity

All Infra-red reflective pigments will have a high visible opacity. These pigments only transmit the infra red radiations. Thin films will not reflect all infra red radiations and may allow the radiations to pass through from the coating to the substrate. Beware that although the coating may have high visual opacity but won't be completely opaque to infra-red light. It is very important that higher coating thickness is required to be opaque to infra-red.

Benefits of IR Technology

- Can withstand chemically aggressive environments and will still retain it's colour. It won't fade in presence of ozone, acid rain, sulphur dioxide, nitrogen dioxide and other air pollutants
- Enviro friendly and will reduce heat transfer into buildings
- Low demands for temperature cooling devices
- Longer Life Cycle
- Reduction in air pollution due to low energy usage and urban air temperatures
- High Durability
- Comes in 16 different colours.

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Why the move and advance forward to Wilcote's Infra-red Cool Roof Coating

- The invisible Infra-Red wavelengths which are part of the sun's radiation, are harmful, creating heat and damage to the roof coating. Our Infra-red Cool Coating System and it's advanced Technology, is able to reflect more than 30% of these harmful rays, off the roof area, resulting in cooler surfaces.

- The reflecting of the sun's heating energy, harmlessly back into the Atmosphere and Space, results in reducing the green house effect – helping to keep our Planet cool.

- This automatically reduces the roof temperature, resulting in cooler and more pleasant interior environment. Which in turn reduces the cost of Air Condition and adds to better comfort.

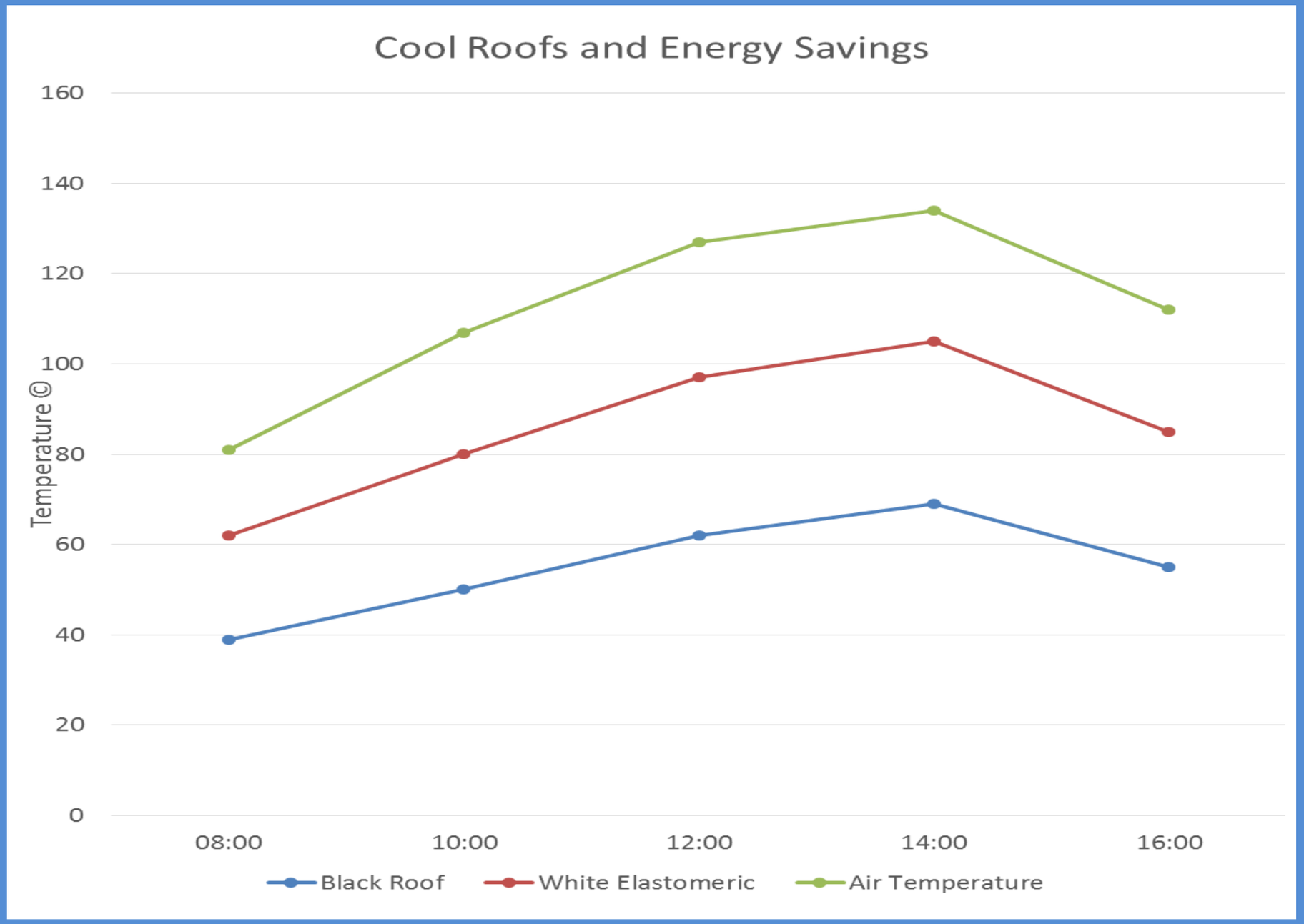
- Further positive effects, over and above energy savings, is less stress on the roof with longer lasting roof coating protection.

- This is an all round benefit to everyone, especially our Planet.

Go Green…Go Wilcote Cool.

OVER 27 YEARS OF EXPERTISE

W118 Cool Roofs and Energy Savings



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O V E R 2 7 Y E A R S O F E X P E R T I S E

Value of Cool Roof Coating

- Roof Life Extension
- Install one roof…maintain with coatings
- Lower Life Cycle Costs
- Long term, more cost effective to maintain than to re-roof !
- Reduced AC Electricity Costs pure KWh savings, smaller units
- Off peak use
- Reduced “Urban Heat Island Effects”
- ‘Cool community’
- Improved Air Quality/Reduced smog
- Reduced landfill material!

OVER 27 YEARS OF EXPERTISE

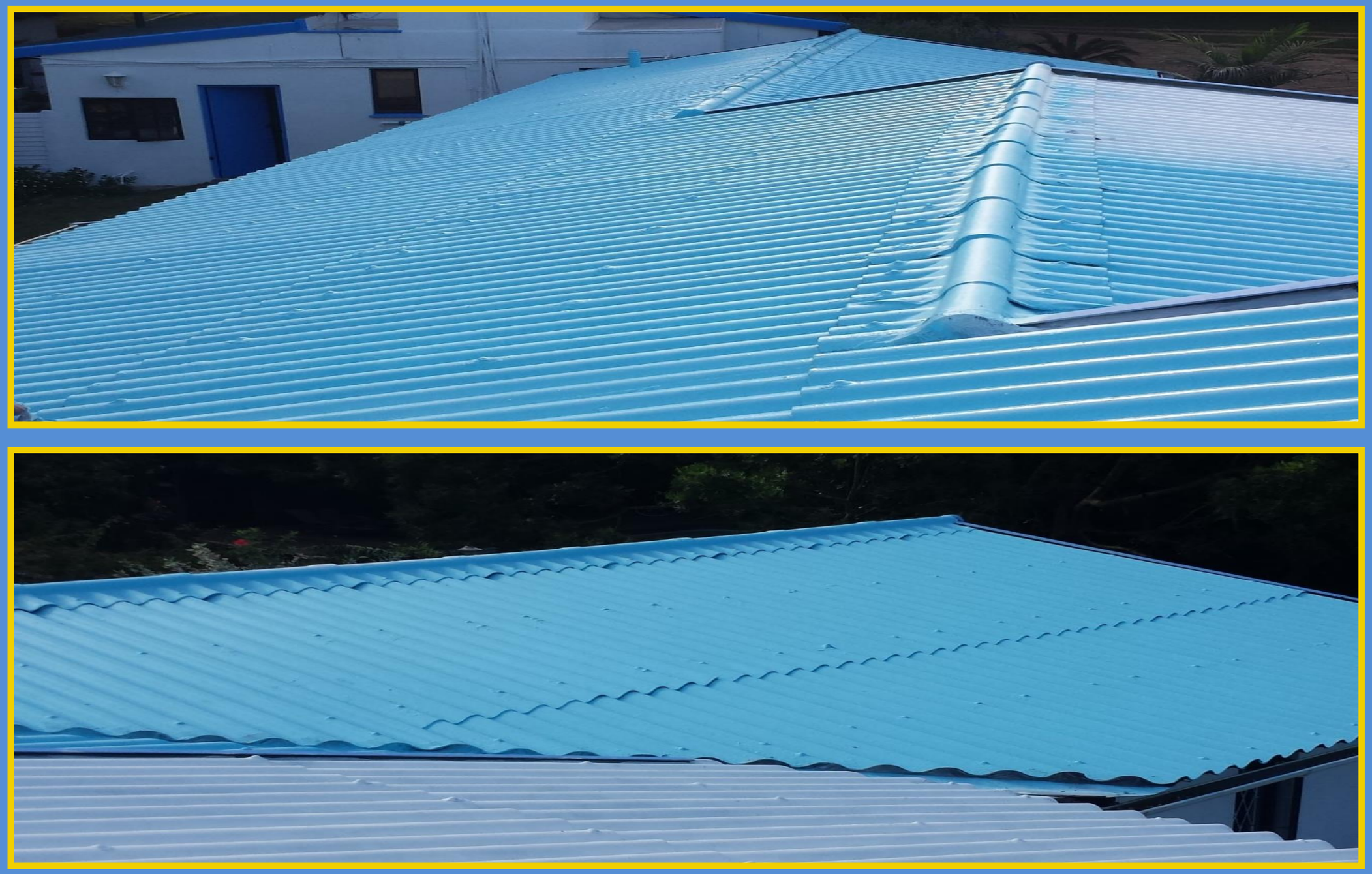
W118 Infra-Red Cool Roof Coating First Phase/

OVER 27 YEARS OF EXPERTISE

W118 Infra-Red Cool Roof Coating Primer Coat

OVER 27 YEARS OF EXPERTISE

W118 Infra-Red Cool Roof
Coating final phase/



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W118 Infra-Red Cool Roof Coating Completion

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Join us on the Green road forward…

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Construction Chemicals

CRRC Rapid Ratings Test Results for ASTM Requirements

- C1549 (ASTM Method)
  - ASTM E903
  - ASTM E891

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CRRC Certified Lab Test Results

- ASTM C1549: STM for Solar reflectance using portable Solar Reflectometer
  - Measures reflectance of incident light between 380nm and 1220nm
  - Wilcote W118 Infra Red Coating -Sandstone Beige CRRC certified lab results
    - Initial: 0.68
    - After ASTM D7897, rapid ratings for 3 year exterior aged solar reflectance: 0.67
    - Meets CRRC/ Title 24 solar reflectance: > 0.63
    - Meets Energy Star solar reflectance: >0.50

- ASTM C1371: STM for Emittance using portable emissometer
  - Measures coatings ability to emit/ transfer heat via radiation
  - Wilcote W118 Infra Red Coating -Sandstone Beige CRRC certified lab results
    - Initial: 0.91
    - After ASTM D7897, rapid ratings for 3 year exterior aged emissivity: 0.90
    - Meets CRRC/ Title 24 emissivity: > 0.75

CRRC Certified Lab Test Results

- ASTM E1980: STM for Solar Reflectance Index; SRI
  - Calculation based on solar reflectance, emissivity, and heat transfer coefficient, based on roof wind speed.
  - Wilcote W118 Infra Red Coating -Sandstone Beige CRRC certified lab results:
    - Meets CRRC / Title 24 three year rating: > 75 SRI
    - Meets Energy Star initial and 3 year rating Solar Reflectance: > 0.50

Wilcote W118 Infra Red Coating -Sandstone Beige	Solar Reflectance	Emissivity	SRI_{Low}	SRI_{Medium}	SRI_{High}
Initial Readings	0.68	0.91	82.91	83.05	83.16
CRRC Rapid Ratings: Three year Accelerated Aged ASTM D7897	0.67	0.90	81.21	81.46	81.66

- Cool Roof Rating Council/ California Energy Code Title 24 aged performance.

Building Type	Solar Reflectance	Emissivity	SRI
Non-Residential Low Slope, Climate Zone 1-16	0.63	0.75	75
High Rise Residential Low Slope, Climate Zones 1-16	0.55	0.75	64
Non-Residential Steep Slope, Climate Zones 9-11, 13-15	0.2	0.75	16
High Rise Residential Steep Slope, Climate Zones 2-15	0.2	0.75	16
Low Slope: ≤ 2ft rise :12 ft run (0.6m rise over 3.7m run)			
Steep Slope: > 2ft rise :12 ft run (0.6m rise over 3.7m run)			

http://coolroofs.org/resources/california-title-24
http://coolroofs.org/documents/Title24_2013_Update_Summary.pdf

Test Methods – Details and Examples

- ASTM C1549: STM for Solar reflectance using portable Solar Reflectometer
  - Measures % reflectance of incident light between 380nm and 1220nm
    - Example formulation based on Primal EC-4642ME w/ ZnO: 84.5%
    - Example formulation based on Primal EC-4642ME w/o ZnO: 84.2%
- ASTM C1371: STM for Emittance using portable emissometer
  - Measures coatings ability to emit/ transfer heat via radiation
    - Example formulation based on Primal EC-4642ME w/ ZnO: 90%
    - Example formulation based on Primal EC-4642ME w/o ZnO: 89%
- ASTM E-903: STM for solar absorbance, reflectance, transmittance using integrated sphere
  - See slide 4; Example formulation based on Primal EC-4642ME w/ ZnO
- ASTM E1918: STM for solar reflection for surfaces in field
  - Pyranometer/ Albedometer: Done in field on $9m^2$ section using noon day sun as light source and reference.
  - No reference data for Primal EC-4642ME
- ASTM E1980: STM for Solar Reflectance Index; SRI
  - Calculation based on solar reflectance, emissivity, and heat transfer coefficient
    - Example formulation based on Primal EC-4642ME w/ ZnO: SRI = 105.72
    - Example formulation based on Primal EC-4642ME w/o ZnO: SRI = 105.17

Test Methods – Details and Examples

- ASTM D4329/ ISO4892: Accelerated Aging/ Integrated weathering – UV/ Heat/ Moisture
  - Uses ASTM G154 for UV wavelength, intensity, light and condensation cycle time.
  - D4329, specifies panel rotation within the UV exposure cabinet (QUV).
  - Dow has this capability, but has not been used on Primal EC-4642ME
  - Dow uses Weatherometers; required for ASTM D6083.
    - Light intensity is shifted.
    - Light/ Water Cycle time change
    - Temperature of water/ condensation fixed

	ASTM D4329	ASTM D4798
Incident light Wave length	340nm	340nm
Intensity (W/m^2 nm)	0.89	0.35
UV exposure per cycle; Temperature	8h; 60°C	51m; 60°C
Water exposure, Temperature	4h; 50°C	9m; undisclosed

ASTM D4329 Conditions

7. Procedure

7.1 When the test and control specimens do not completely fill the specimen racks, fill all empty spaces with blank panels to maintain the test conditions within the chamber.

7.2 Unless otherwise specified, program the device to one of the following test cycles. Operate the device continuously.

7.2.1 *Cycle A:*

Typical Irradiance at 340 nm is 0.89 W/(m^2 · nm)
8 h UV with uninsulated black panel temperature controlled at 60°C
4 h condensation with uninsulated black panel temperature controlled at 50°C
(Used for most general applications)

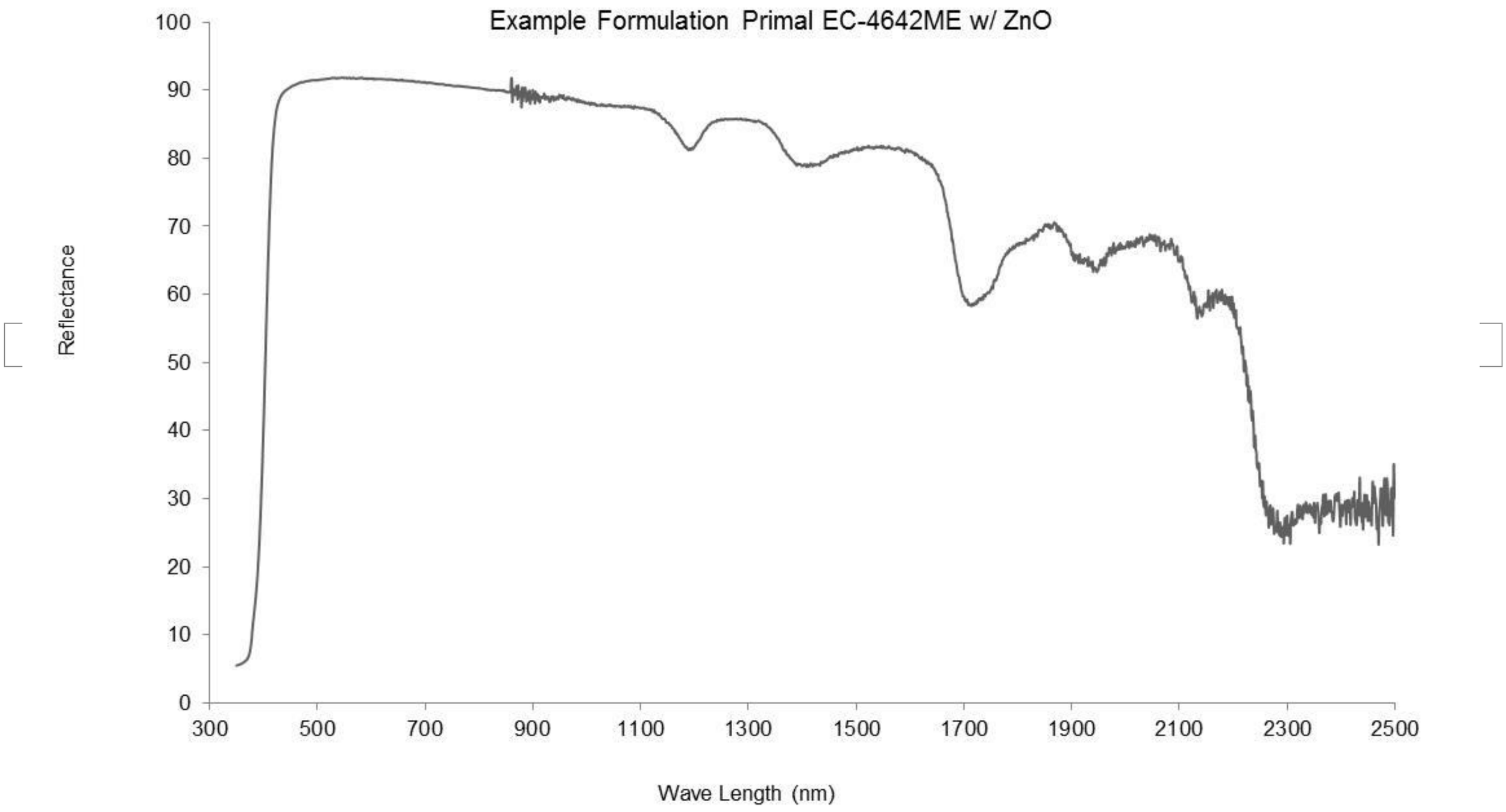
7.2.2 *Cycle B:*

Typical Irradiance at 340 nm is 0.77 W/(m^2 · nm)
8 h UV with uninsulated black panel temperature controlled at 70°C
4 h condensation with uninsulated black panel temperature controlled at 50°C
(Typically used for automotive applications) Note: Cycle B is equivalent to the exposure test cycle specified in SAE J2020.

7.2.3 *Cycle C:*

Typical Irradiance at 340 nm is 0.83 W/(m^2 · nm)
8 h UV with uninsulated black panel temperature controlled at 50°C
4 h condensation with uninsulated black panel temperature controlled at 50°C
(Typically used for some plastic building products)

ASTM E-903: Solar spectrum reflectance using integrated sphere



Solar Reflectance Index (SRI) - ASTM E1980

- Calculated value
  - Solar reflectance
  - Thermal emissivity
- SRI described three ways based on heat transfer coefficient of convection (h_c) and estimate roof wind speed
  - SRI_{Low}= Wind speed 0-2 m/s; h_c = 5
  - SRI_{Medium} = Wind speed 2-6 m/s; h_c = 12.4
  - SRI_{High} = Wind speed 6-10 m/s; h_c = 30
- SRI_{Medium} chosen for example

Formulations

http://energy.lbl.gov/coolroof/ref_01.htm/

Comparison Chart for Regulations & Standards Energy Properties

Performance Spec	ASTM Method	D6083	Title 24, Section 140.3 NR-LS / HRR-LS / NR-SS / HRR-SS* (alternate SRI value)	Energy Star
Solar Reflectivity, initial	C1549			0.65
Solar Reflectivity, 3 yrs	C1549		0.63 / 0.55 / 0.20 / 0.20 (0.75 / 0.64 / 0.16 / 0.16)	0.50
Emissivity, initial	C1471			
Emissivity, 3 yrs	C1471		0.75 / 0.75 / 0.75 / 0.75 (0.75 / 0.64 / 0.16 / 0.16)	

***NR-LS = Non-Residential Low Slope, Climate Zone 1-16**
***HRR-LS = High Rise Residential Low Slope, Climate Zones 1-16**
***NR-SS = Non-Residential Steep Slope, Climate Zones 9-11, 13-15**
***HRR-SS = High Rise Residential Steep Slope, Climate Zones 2-15**