Thermoshield Insulating Value

Radiant Barrier

A radiation control coating is analogous to a radiant barrier. Its resistance to heat flow or **"R"** value increased tremendously with the increase in the reflectivity of the surface. This ultra-thin barrier and its ability to reflect the heat from its surface was later known as **"Radiant Barrier"**.

ASHRAE is aware of the unique property of the thin film of still air on the surface of a radiant barrier, where as the radiant barrier itself could be metallic and a heat conductor. But as long as there is no physical contact or "conduction" the radiant barrier can increase the insulating value **"R"** of the still air against it. Most ceiling and wall insulations are now sold with radiant barrier surfaces to take advantage of this phenomenon.

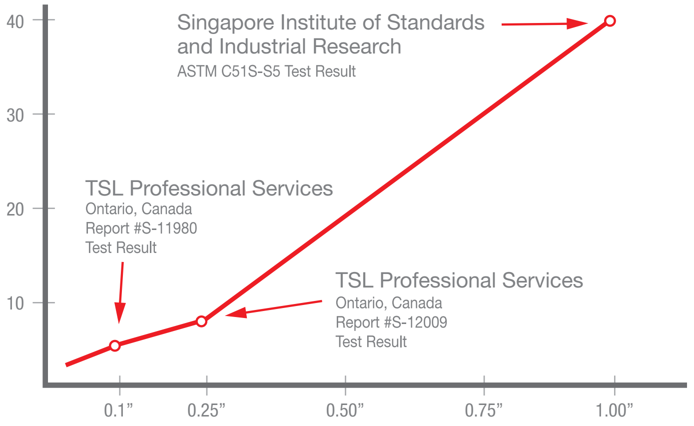
> ***Highly reflective surface like a bright aluminium foil can increase thermal resistance or "R" value in an enclosed space up to four (4) times as compared to a non-reflective substrate.***
>
> ***Thickness is not a factor in the increase of the insulating value.***
>
> Ashrae handbook of Fundamental (1972)
>
> *Chapter 20, P. 357 - "Surface Conductances and Resistances for Air"*

These "R" values were derived from controlled ideal laboratory conditions utilising ASTM Standard C236, Guarded hot box or the ASTM Standard C976, Calibrated hot box procedures.

Whereas ***Radiant Barrier*** is used in enclosed ceiling space and walls to improve its overall insulation value, a ***Radiation Control Coating*** is used on the surface to re-radiate or reflect and dissipate radiant heat.

A Radiation Control Coating must have the following re-radiation properties to be effective as an exterior radiant barrier:

1. Low solar absorbance (will absorb less solar energy)
2. High emittance value (will radiate more heat away from surface)
3. High convection coefficient (will convect more heat to the ambient air as surface temperature increases)
4. Very low thermal conductivity ("R" value reciprocal)



Insulation Value Equivalent

Material Testing facilities, TRW and Singapore's SISIR are both world renown in their standard of performance. We have relied heavily on their test results in evaluating the thermo physical properties of ceramic coatings.

The Department of the US Air force performed an independent test of their own for their interest in using the coating in lieu of insulation on expansive aircraft hangar buildings. Lowering down the surface skin temperature of the metal roofing will drastically reduce thermal expansion at peak afternoon temperature. Reducing thermal shock or roof movement will reduce water leaks and corrosion.

This is evident in large metal roofs coated with ceramic coating where water leaks had stopped and a much cooler inside temperature is experienced.

The Christian Testing Lab is the closest test in determining the actual R-value equivalent of the ceramic coating. SISIR K-value will give us an R-value of 40 per 2.54cm. But our coating does not function as an insulation alone as exhibited in the TRW tests. Having a similar property as a radiant barrier, the thickness is of minor consequence.

The surface thermo physical characteristic plays a major role in its ability to provide high reflectivity and drastically reduces inward radiation of exterior heat. The unique property of ceramic coatings has proved in an actual controlled test that it is equivalent to 10.15cm thick of Styrofoam (extruded) insulation of R-20 value. ($\frac{ft^2.°F}{Btu}$)

Ceramic Coating True R-Value

Acting as Pure Insulation = R-40 per inch (see figure 1)

Incorporating three independent test results produced an almost linear line proving that this generated curve will give us an accurate R-value of the ***Ceramic Coating***.

However, we must remember that if we use this product as a ***Radiation Control Coating***, its other thermo physical properties will come into play and will give a much higher R-value equivalent.

Metric conversions: For R-values $\frac{ft^2.°F}{Btu}$ to metric format of R-value, multiply as per following example.

$$\text{R-value } 40\ \frac{ft^2.°F}{Btu} \times 0.1761 = \text{R-value } 7.044\ \frac{m^2.°C}{w}$$

Referring to the above R-value of 40 per inch as per test ASTM C518-85 of the Singapore institute of Standards and Industrial Research, one must take into consideration that this value reflects only a comparison of pure insulation and is not truly representative of the coating's ability as referred to in the Results Summary under point number 3 in this document.

Our ceramic coating's effective efficient capability to re-radiate, i.e. reflect solar spectrum energy, e.g. UV, Visible, Near infra-red and Far Infra-red wave lengths will increase the usable R-value with which to calculate heat loads for all buildings to R-20 $\frac{ft^2.°F}{Btu}$

Thermoshield Insulating Value contued

Radiation Control Thermal Test I

TRW Space and Technology

Engineering and Test Division
One Space Park, Redondo Beach CA, 90278

Test Performed

Solar Absorbance And Emittance Radiation Control Ceramic coating samples. July 1986

Result Summary

Low solar absorbance as (0 .18 - 0.20)
comparable to spacecraft coating.

High emittance value eb (0 .90 - 0.97).

High convection coefficient h
(1.2 @ 32°C ambient air)
(1.26 @ 44°C ambient air)

Radiation Control Thermal Test II

Department of the Airforce

15th Air Base Wing (PACAF)
Hickam Air Force Base Hawaii, 96853-5000

Test Radiation Control

Ceramic coating of Bldg. 1209
Hickham AFB, Hawaii 96853 April 1997

Result Summary

Warehouse temp. before ceramic coating = 38°C average peak
Inside skin temp. of metal roof surface = 46°C

Warehouse temp. after ceramic coating = 30°C (decrease of 8°C)

Inside skin temp. of metal roof surface = 34°C (decrease of 12°C)

The conclusion of the test proved that the ceramic coating provides a highly heat reflective insulation that decreases the inward radiation of exterior heat. The coating is unquestionably an effective and cost efficient way to insulate buildings.

Radiation Control Thermal Test III

Christina Test Laboratories Inc

2625 Lower Wetumpka Road
Montgomery, Alabama, 36110

Thermal Performance Tests

of Two Similar Structures
(Similar to ASTM C236) July 1978

Result Summary

Two test buildings of 183m x 2.44m x 2.35m high were constructed with all walls fully insulated. After determining that both buildings have the same thermal characteristic, one was coated with ceramic coating on the bare metal roof. Hourly temperatures were taken on both buildings and underside Styrofoam roof insulation was added to the non-coated roof until the hourly inside room temperature equalised.

It required a total of 10.16cm thickness of the (extruded) Styrofoam insulation extruded before the room temperature was brought down to equal the building with the ceramic coating.

Therefore, with Styrofoam R-Value of 5, $\left(\frac{ft^2.°F}{Btu}\right)$ the equivalent value of 20 equals the thermal insulating performance of two coats of ceramic coating @ approx. 381 micron DFT.

Radiation Control Thermal Test VI

Singapore Institute of Standards & Industrial Research

Ref. No. GC/12/3/1713SISIR/FP
July, 1990

ASTM C518-85 Thermal

Conductivity Test on Radiation
Control ceramic coating.

Result Summary

Two pieces of concrete slabs, each on nominal size of 300 x 300 x 30mm thick, one with a thin coat of (approx. 0.5mm) of ceramic coating on the surface of the slab.

The ASTM C518-85 “Steady-State Thermal Transmission Properties by means of the heat Flow Meter” was performed on both specimen.

Using standard fibreglass insulation for flow meter calibration thermal conductivity reading on 25.4mm thickness was 0.03556@/m Deg K at mean temperature of 31°C.

The K-value of the 0.5mm ceramic coating was 0.00345W/m Deg K or theoretically (10) ten times better than fibreglass.

Combining the very low thermal conductivity of the ceramic coat, and its low solar absorbance, complemented by its high emittance value and high convection coefficient has made Radiation Control Coatings a very simple, efficient and cost effective way to insulate buildings.

Thermoshield Insulating Value contued

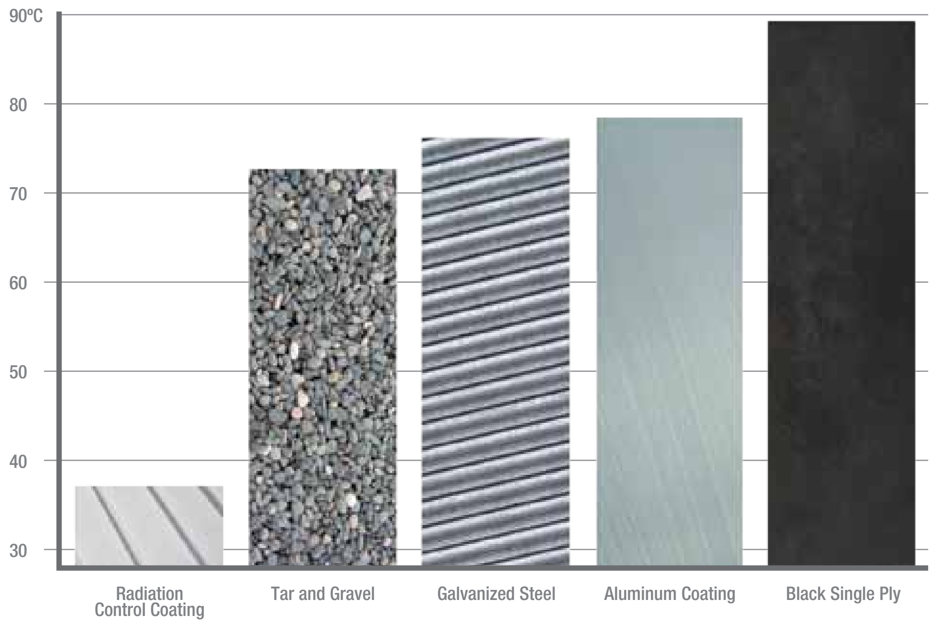
The Effects of Colour on Temperature

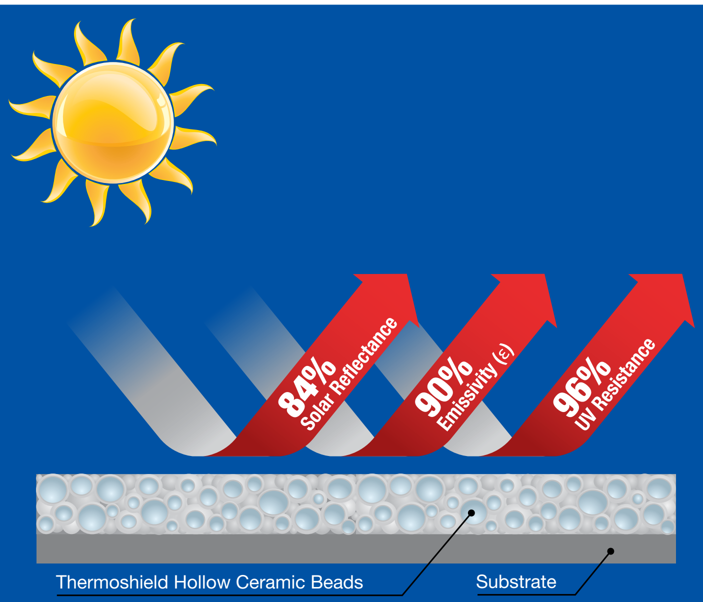
Tests were conducted to determine the effect of colours on the temperature of a roof system. Coatings were applied over 2" of polyurethane foam. Small thermo probes were embedded in or under the coating material. The following graph shows the difference between coloured coatings and other roofing materials when exposed to sunlight.

Temperatures of Coatings and Other Materials in Sunlight

These numbers were measured in north central Texas with an ambient temperature of 32°C. Higher altitudes or ambient temperatures above 32°C will result in even hotter surface temperatures than those measured. From the graph it may be seen that even light coloured coatings raise the temperature somewhat. Radiation control coatings reflect sunlight very well. Unfortunately, aluminium filled coatings by contrast are good absorbers of solar energy.

Aluminium coatings and galvanised steel both exceed 77°C while black single ply exceeds 88°C. Radiation control coatings are obviously more productive in repelling extreme heat.





Thermoshield re-radiates heat off a substrate and reflects damaging ultraviolet light.

The ceramic thermal barrier properties of Thermoshield are due to millions of hollow micro-ceramic beads that cluster together and create dead air space. The success of Thermoshield is due to its ability to counter 'radiant heat' transfer. Thermoshield remains effective when it becomes tarnished and addresses the full solar spectrum.

Thermoshield is unique as it has the ability to offer year round energy savings due to its high insulation properties.

A University of Melbourne study proved that Thermoshield has an additional benefit unseen in other products. This benefit is the ability of the product to improve the retention of heat within a building during colder weather.