

26. October 2007

**Report for Astec paints on establishing the effectiveness of their 'Energy Star' paints on the internal temperatures of buildings in BCA climate zones 1 & 2.**

**Aim:**

Astec paints wishes to ascertain an 'R' Value equivalence for a wall or roof painted with their 'Energy Star' (ES) paint for buildings in Building Code of Australia (BCA) climate zones 1 & 2.

It is understood that it is not an actual R value but an equivalence in reducing temperature in the building.

Astec have supplied absorbance figures for their paints.

**Definitions:<sup>1</sup>**

Radiation incident on an opaque surface can be partly absorbed, partly reflected, depending on the surface qualities:

Absorbance (abs) and reflectance (ref). The sum of these is always 1.

In radiant heat transfer the heat flow rate depends on the temperature difference between the emitting and receiving surfaces as well as on the surface qualities of emittance and absorbance. For a given surface the emittance and absorbances are identical for the same wavelength of radiation but both can vary with the wavelength.

For practical calculations the radiation coefficient (hr) is used:

$$hr = 5.7 \times eme \text{ (at surface temperature } 20 \text{ }^{\circ}\text{C)}$$

where eme is 'effective emittance', the mean for the emitting and receiving surfaces.

Radiant heat flow is then  $Q_{rd} = hr \times A \times dT$

Resistance R of a given body is the product of its thickness the the resistivity of its material. (m<sup>2</sup>K/W)

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<sup>1</sup> SV Szokolay, Thermal Design of Buildings, RAIA Education Division, 1987

Resistivity is the reciprocal of conductivity

Conductivity is the characteristic of a material measured as the heat flow rate through unit area, with unit temperature difference between two points unit difference apart.

	6000 °C solar radiation		At 50 °C
Material	Absorbance & Emittance	reflectance	Absorbance & Emittance
White glazed brick	0.25	0.75	0.95
Light coloured brick	0.4	0.6	0.9
Dark coloured Brick	0.8	0.2	0.9
Dark roof	0.9	0.1	0.96
White tile roof	0.4	0.6	0.5
Oxidised Aluminium roof	0.2	0.8	0.11
White paint	0.3	0.7	0.95
Matt black paint	0.96	0.04	0.96

Figures have been supplied by Astec Paints for their products in

From the Amdel Report 05MAAD12331 – Part 3– absorbance for 'white base' 0.167 and emissivity 90%

## Method

*Possible ways to proceed.*

1. *AccuRate rating of a standard building:*

*Runs with and without the paint comparing*

- a) total heating and cooling hours*
- b) internal temperatures in selected rooms*

*Given there is a decrease in the cooling hours, ascertain if a reduction in the insulation specification of the building causes a return to the cooling hours in the standard buildings.*

2. *Calculate the actual heat gain for a unit area of a specified wall construction using the solar radiation for a suitable location and specifying an ambient temperature.*

- a) Estimate the heat transferred through the wall painted with a standard paint and with ES.*

*b) Change the wall construction to increase the insulation level to make the heat transfers the same.*

*N.B. It may be possible to use Ecotect to calculate these values rather than doing them manually.*

### Method 1: AccuRate ratings

*Initially a simple house plan was chosen and the house was only simulated in one direction for two climate zones.*

*If the initial runs show some effect then further work looking at other house plans in different locations inside climate zones 1 & 2 and with the houses facing in other orientations would be required.*

A simple house plan was chosen. It has standard construction, brick veneer walls, colorbond roof, a timber floor and single glazed aluminium standard window frames with holland blind internal coverings and 600mm eaves.

The initial bulk insulation levels are R1.5 in the walls and R2.5 in the roof.

Climate zones in the BCA and in AccuRate come from different schemes. AccuRate uses weather files that change with postcode. All postcodes in Australia are mapped to one of the 69 climate zones. Factors included in the AccuRate weather files include: dry bulb temperature, wind speed, global solar irradiation, diffuse irradiation and solar altitude and azimuth.

BCA climate zone 1. Example postcode 4870 – Cairns – AccuRate climate zone 32  
BCA climate zone 2. Example postcode 4740 – Mackay – AccuRate climate zone 35.

Data entry in AccuRate allows for the solar absorbance of external walls and absorbance and emissivity of roofs to be altered.

This exploratory work involves simulating a house with values that reflect a standard roof with solar absorbance of 0.5 (**Case A**) and comparing it to one with a roof with the supplied value of 0.167 (**Case B**).

Emissivity will be held constant at 0.9.

Once figures have been established Case A simulation will be re-run to determine the level of insulation needed to match Case B (**Case C**).

All heating and cooling loads are in MJ/m<sup>2</sup>

## Results

### Cairns

	Roof Abs	Roof ins	Heat	Cooling	Latent	Total	Star
<b>A</b>	0.50	R2.5	0.2	219.0	85.5	304.6	1.4
<b>B</b>	0.17	R2.5	0.2	201.3	83.3	284.4	1.8
<b>C</b>	0.50	R4	0.1	210.3	84.9	295.1	1.6

### Mackay

	Roof Abs	Roof ins	Heat	Cool	Latent	Total	Star
<b>A</b>	0.50	R2.5	3.7	202	75.5	281.2	0.7
<b>B</b>	0.17	R2.5	3.9	185.4	73.4	262.2	1.1
<b>C</b>	0.50	R4	3.2	195.5	75.5	274.6	0.8

On the basis of this example it may be possible to say that having a roof with 'Energy Star' applied can be more effective with regard to total heating load than increasing the insulation from R2.5 to R4.0.