

## **THERMAL INSULATION EVALUATION BY CALCULATION**

### **FLAT CONCRETE ROOF, 50MM REFLECTIVE CAVITY, 65MM REFLECTIVE SL GRADE POLYSTYRENE, UNVENTILATED 70-600MM REFLECTIVE CAVITY ABOVE SUSPENDED CEILING**

**Calculation: 223.28w**

Evaluation for Winter, 12.0°C ambient air temperature, 18.0°C inside air temperature.

| Roof Element                                | m <sup>2</sup> .K/W | °C out              | °C in        | °C avg | Δt   | Assumed Cavity Properties |             |    |           |  | Note |
|---|---------------------|---------------------|--------------|--------|------|---------------------------|-------------|----|-----------|--|------|
|   |                     |                     |              |        |      | e1                        | e2          | mm | Heat Flow |  |      |
| Outside air film:                           | 0.040               | <b>12.00</b>        | 12.07        | 12.04  | 0.07 |                           |             |    |           |  | 1    |
| Roof membrane:                              | 0.061               | 12.07               | 12.19        | 12.13  | 0.11 |                           |             |    |           |  | 4    |
| 150mm concrete slab:                        | 0.104               | 12.19               | 12.38        | 12.28  | 0.19 |                           |             |    |           |  | 4    |
| Sealed reflective 50mm air space:           | <b>0.585</b>        | 12.38               | 13.47        | 12.93  | 1.09 | 0.87                      | <b>0.03</b> | 50 | Up        |  | 5,6  |
| <b>SL Grade EPS, 65mm, with RFL:</b>        | <b>1.647</b>        | 13.47               | 16.54        | 15.01  | 3.07 |                           |             | 65 |           |  | 7    |
| Unventilated reflective 70-600mm air space: | <b>0.613</b>        | 16.54               | 17.68        | 17.11  | 1.14 | <b>0.03</b>               | 0.87        | 70 | Up        |  | 5,6  |
| Suspended 10mm plasterboard ceiling:        | 0.059               | 17.68               | 17.79        | 17.74  | 0.11 |                           |             |    |           |  | 3    |
| Indoor air film (unreflective surface):     | 0.110               | 17.79               | <b>18.00</b> | 17.90  | 0.21 |                           |             |    |           |  | 2    |
| <b>R<sub>Ti</sub> = 3.22</b>                |                     | m <sup>2</sup> .K/W |              | 6.00   |      |                           |             |    |           |  |      |

**Corresponding Total Conductance (k<sub>Ti</sub>): 0.31 W/(m<sup>2</sup>.K)**

**NOTES:**

- Calculated 2/7/08 22:30 Ref: 223\_E.xls
- Determinations based upon AS/NZS 4859.1:2002/Amdt 1 2006, Materials for the thermal insulation of buildings**
- 1 AS/NZS 4859.1:2002/Amdt 1 2006, Clause K5(a)
  - 2 AS/NZS 4859.1:2002/Amdt 1, Table K1 and Clause K4.2 (a) (iv)
  - 3 AS/NZS 4859.1:2002/Amdt 1 2006, Clause K8.1(a) 'RFL'=Reflective Foil Laminate
  - 4 AIRAH 2000 Handbook, page 617
  - 5 Cavity air space insulation values (shown in italics) were estimated using Reflect3 software.  
These are iterative calculations per the USA Division of Housing Research Paper 32, applicable for roof pitch 18°-35° to ±0.05 m<sup>2</sup>.K/W.  
The cavity R calculation assumes an air cavity of the gap shown with uniform parallel surfaces.  
Although the air space may be more than 70mm, calculation is for 70mm as R&P extrapolation is prohibited by AS/NZS 4859.1:2002/Amdt 1 2006, Clause K3.1
  - 6 The calculations incorporate the dust assumptions of AS/NZS 4859.1:2002/Amdt 1 2006, Clauses K3.2 & K4.2 (e+0.0)
  - 7 Assumes k=0.0407 W/m.K for 23°C; e=0.10 and 0.03. R adjusted 0.39%/K in line with AS/NZS 4859.1:2002/Amdt 1 2006, Clause K3.1
  - 8 Indoor & outdoor air temperatures per AS/NZS 4859.1:2002/Amdt 1 2006, Clause K3.1
  - 9 Thermal short-circuiting by frames is not considered here as evaluation is for the insulation path only.
  - 10 This report may not be reproduced except in full. Results may not be quoted without reference to the assumptions.
  - 11 Calculated by James Fricker, M.AIRAH, M.IEAust, CPEng.

**CONCLUSION:**

For the above roof having SL Grade EPS and Double Sided Antiglare Foil infrared emittances of 0.10 and 0.03, the WINTER Total R-value per AS4859.1:2002/Amdt 1 2006 Clause K3.1 is:

**R3.22 m<sup>2</sup>.K/W** for an air temperature difference of 18°-12° = 6K

Application results for various EPS grades  
(65mm, 15.0°C mean and 6K Δt)

| EPS Grade       | k at 23°C     | EPS R        | Total R             | Added R value |
|-----------------|---------------|--------------|---------------------|---------------|
| Class L         | 0.0427        | 1.571        | 3.14                | 2.59          |
| <b>Class SL</b> | <b>0.0407</b> | <b>1.647</b> | <b>3.22</b>         | 2.67          |
| Class S         | 0.0394        | 1.702        | 3.27                | 2.72          |
| Class M         | 0.0380        | 1.764        | 3.34                | 2.78          |
| Class H         | 0.0365        | 1.836        | 3.41                | 2.85          |
| Class VH        | 0.0349        | 1.919        | 3.49                | 2.94          |
|                 | (W/m.K)       | \            | m <sup>2</sup> .K/W | /             |

Signed:

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