"TOTAL R"

THERMAL PERFORMANCE CALCULATIONS

TO AS/NZS 4859.1:2002/Amdt 1 (Dec 2006)

The following calculations are based upon:

a) AS/NZS 4859.1:2002/Amdt 1 (Dec 2006) "Materials for the thermal insulation of buildings. Part 1: General criteria and technical provisions",

b) the Australian Institute of Refrigeration Air-conditioning & Heating (AIRAH) Handbook (2007 Edition), and (if necessary) the ASHRAE Fundamentals Handbook.

Results reported are for the **insulation path** only per the original AS/NZS 4859.1:2002 Clause 1.5.3.3 – *"Total thermal resistance - A total resistance associated with a material or a system or construction of materials, specified as a Total R, including surface film resistances"* to be in alignment with the BCA2009 Specification J1.3 examples.

R-values for parallel-faced air cavities were calculated using the Reflect-3 computer software that is based on Robinson and Powell data and validated by Oakridge National Laboratory, USA. These calculations are iterative and only the converged results are shown. (Note that Reflect-3 calculations are limited to a maximum 100mm air gap.) Where parallel-faced air gaps exceed 100mm, calculation is done per ISO 6946:2007 Building components and building elements — Thermal resistance and thermal transmittance — Calculation method.

Total R-values are based on product in-service conditions in accordance with AS/NZS 4859.1:2002/Amdt 1 (Dec 2006) including the alteration of insulation material R for temperature, and derations of reflective foil emittances due to dust.

The calculations are independently endorsed per requirements of AS/NZS 4859.1:2002/Amdt 1.

Each calculation result is subject to the notes and assumptions listed on the calculation.

Please note that if a construction differs from the described system, the thermal resistance may alter.

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SUMMARY OF RESULTS

JMF Calc.	ROOFS	Total R "s" Summer	Total R "w" Winter	Added R "s" Summer	Added R "w" Winter
324.01v	TILED ROOF, VENTILATED REFLECTIVE ATTIC, SOLAVIS "RADIANTSHIELD" INSULATION ON JOISTS, 90MM UNVENTILATED REFLECTIVE AIR SPACE, 10MM PLASTERBOARD	**R3.06**	**R1.10**	**R2.31**	**R0.87**
324.02	PITCHED METAL ROOF, UNVENTILATED REFLECTIVE ATTIC, SOLAVIS "RADIANTSHIELD" INSULATION ON JOISTS, 90MM UNVENTILATED REFLECTIVE AIR SPACE, 10MM PLASTERBOARD	**R3.01**	**R1.41**	**R2.47**	**R1.02**

NOTES: The above shows Total R determinations based upon AS/NZS 4859.1:2002/Amdt 1 2006, Materials for the thermal insulation of buildings. The insulation thermal resistance is calculated for the Australian air temperature differences (winter: 18°-12°C = 6K, summer: 36°-24°C = 12K) per AS/NZS 4859.1:2002/Amdt 1 2006.

"Added R" is the additional Total R solely due to the presence of SOLAVIS "RADIANTSHIELD" , applicable for the specific case.

Results current as at 9/12/2009

THERMAL INSULATION EVALUATION BY CALCULATION

TILED ROOF, VENTILATED REFLECTIVE ATTIC, SOLAVIS "RADIANTSHIELD" INSULATION ON JOISTS, 90MM UNVENTILATED REFLECTIVE AIR SPACE, 10MM PLASTERBOARD

Calculation: 324.01vs

Evaluation for Summer, 36.0°C ambient air temperature, 24.0°C inside air temperature.

						Assumed Cavity Properties				
Roof Element	m².K/W	°C out	°C in	°C avg	Δt	e1	e2	mm	Heat Flow	Note
Outside air film:	0.040	**36.00**	35.84	35.92	0.16					1
Tiled roof:	0.023	35.84	35.75	35.80	0.09					3
Ventilated reflective attic:	1.070	35.75	31.55	33.65	4.20	0.87	**0.29**		Down	4,6,6a
SOLAVIS "RADIANTSHIELD"	0.110	31.55	31.12	31.33	0.43		(bright both sides)			7
90mm reflective airspace:	***1.593***	31.12	24.86	27.99	6.26	**0.04**	0.87	90	Down	5,6
10mm plasterboard:	0.059	24.86	24.63	24.74	0.23					3,3a
Indoor still air film (unreflective surface):	0.160	24.63	**24.00**	24.31	0.63	0.87	0.87			2
Total Thermal Resistance, R_{Ti} =	**3.06**	m².K/W			12.00					

Corresponding Total Conductance (k_{Ti}): 0.33 W/(m².K)

NOTES:

Calculated 9/12/09 23:37 Ref: 324_A.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 2006, Table K1, still air film.
3 2007 AIRAH Technical Handbook pages 164-177 3a For 13mm plasterboard, add 0.018m²·K/W to the Total R.
4 R interpolated from Table K2 R1.36 (for e=0.87&0.05). If attic highly ventilated by fan, the result would be Total R1.89
5 Cavity air space insulation value (shown in italics) was estimated using Reflect3 software.
This is an iterative calculation per the USA Division of Housing Research Paper 32.
The cavity R calculation assumes an air cavity of the gap shown with uniform parallel surfaces.
6 The calculations incorporate the dust assumptions of AS/NZS 4859.1:2002/Amdt 1 2006:
6a Under tiles, attic assumed ventilated per Clause K4.2a(iii); emittance per Clause K3.2d&a(iii) (e+0.25)
7 **SOLAVIS "RADIANTSHIELD" has tested infrared emittances of 0.04 both sides and Material R0.11m²·K/W.**
8 **For this case, the presence of the SOLAVIS "RADIANTSHIELD" causes Total R to increase by R2.31 m².K/W**
9 Indoor & outdoor air temperatures per AS/NZS 4859.1:2002/Amdt 1 2006, Clause K3.1
10 Thermal short-circuiting by frames is not considered here as evaluation is for the insulation path only.
11 This computation is not compliant for labelling of insulation products to AS/NZS 4859.1:2002 without an independent endorsement from a recognised laboratory per Section 4.3 of the standard.
12 This report may not be reproduced except in full. Results may not be quoted without reference to the assumptions.
13 Calculated by James Fricker, F.AIRAH, M.Eng.Aust, CPEng.

CONCLUSION:

For the above roof arrangement and SUMMER air temperature difference of 36°-24° = 12K,
the Total R-value per AS4859.1:2002/Amdt 1, 2006 Clause K3.1 is:

R3.06 m².K/W

Similarly calculated, if Solavis Radiant Shield" had emittances of 0.03 both sides, the result would be

R3.24 m².K/W

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THERMAL INSULATION EVALUATION BY CALCULATION

TILED ROOF, VENTILATED REFLECTIVE ATTIC, SOLAVIS "RADIANTSHIELD" INSULATION ON JOISTS, 90MM UNVENTILATED REFLECTIVE AIR SPACE, 10MM PLASTERBOARD

Calculation: 324.01vw

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

						Assumed Cavity Properties				
Roof Element	m².K/W	°C out	°C in	°C avg	Δt	e1	e2	mm	Heat Flow	Note
Outside air film:	0.040	**12.00**	12.22	12.11	0.22					1
Tiled roof:	0.023	12.22	12.34	12.28	0.12					3
Ventilated reflective attic:	0.230	12.34	13.59	12.97	1.25	0.87	**0.29**		Up	4,6,6a
SOLAVIS "RADIANTSHIELD"	0.110	13.59	14.19	13.89	0.60		(bright both sides)			7
90mm reflective airspace:	***0.533***	14.19	17.08	15.64	2.89	**0.04**	0.87	90	Up	5,6
10mm plasterboard:	0.059	17.08	17.40	17.24	0.32					3,3a
Indoor still air film (unreflective surface):	0.110	17.40	**18.00**	17.70	0.60	0.87	0.87			2
Total Thermal Resistance, R_{Ti} =	**1.10**	m².K/W			6.00					

Corresponding Total Conductance (k_{Ti}): 0.91 W/(m².K)

NOTES:

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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 2006, Table K1, still air film.
3 2007 AIRAH Technical Handbook pages 164-177 3a For 13mm plasterboard, add 0.018m²·K/W to the Total R.
4 R interpolated from Table K2 R0.34 (for e=0.87&0.05). If attic highly ventilated by fan, the result would be Total R0.78
5 Cavity air space insulation value (shown in italics) was estimated using Reflect3 software.
This is an iterative calculation per the USA Division of Housing Research Paper 32.
The cavity R calculation assumes an air cavity of the gap shown with uniform parallel surfaces.
6 The calculations incorporate the dust assumptions of AS/NZS 4859.1:2002/Amdt 1 2006:
6a Under tiles, attic assumed ventilated per Clause K4.2a(iii); emittance per Clause K3.2d&a(iii) (e+0.25)
7 **SOLAVIS "RADIANTSHIELD" has tested infrared emittances of 0.04 both sides and Material R0.11m²·K/W.**
8 **For this case, the presence of the SOLAVIS "RADIANTSHIELD" causes Total R to increase by R0.87 m².K/W**
9 Indoor & outdoor air temperatures per AS/NZS 4859.1:2002/Amdt 1 2006, Clause K3.1
10 Thermal short-circuiting by frames is not considered here as evaluation is for the insulation path only.
11 This computation is not compliant for labelling of insulation products to AS/NZS 4859.1:2002 without an independent endorsement from a recognised laboratory per Section 4.3 of the standard.
12 This report may not be reproduced except in full. Results may not be quoted without reference to the assumptions.
13 Calculated by James Fricker, F.AIRAH, M.Eng.Aust, CPEng.

CONCLUSION:

For the above roof arrangement and WINTER air temperature difference of 18°-12° = 6K,
the Total R-value per AS4859.1:2002/Amdt 1, 2006 Clause K3.1 is:

R1.10 m².K/W

Similarly calculated, if Solavis Radiant Shield" had emittances of 0.03 both sides, the result would be

R1.13 m².K/W

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THERMAL INSULATION EVALUATION BY CALCULATION

PITCHED METAL ROOF, UNVENTILATED REFLECTIVE ATTIC, SOLAVIS "RADIANTSHIELD" INSULATION ON JOISTS, 90MM UNVENTILATED REFLECTIVE AIR SPACE, 10MM PLASTERBOARD

Calculation: 324.02s

Evaluation for Summer, 36.0°C ambient air temperature, 24.0°C inside air temperature.

						Assumed Cavity Properties				
Roof Element	m².K/W	°C out	°C in	°C avg	Δt	e1	e2	mm	Heat Flow	Note
Outside air film:	0.040	**36.00**	35.84	35.92	0.16					1
Metal roof:	0.000	35.84	35.84	35.84	0.00					3
Unventilated reflective attic:	1.050	35.84	31.65	33.75	4.19	0.87	**0.09**		Down	4
SOLAVIS "RADIANTSHIELD"	0.110	31.65	31.22	31.44	0.44		(bright both sides)			7
90mm reflective airspace:	***1.591***	31.22	24.87	28.04	6.34	**0.04**	0.87	90	Down	5,6
10mm plasterboard:	0.059	24.87	24.64	24.76	0.24					3,3a
Indoor still air film (unreflective surface):	0.160	24.64	**24.00**	24.32	0.64	0.87	0.87			2
Total Thermal Resistance, R_{Ti} =	**3.01**	m².K/W			12.00					

Corresponding Total Conductance (k_{Ti}): 0.33 W/(m².K)

NOTES:

Calculated 9/12/09 23:37 Ref: 324_A.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 2006, Table K1, still air film.
3 2007 AIRAH Technical Handbook pages 164-177 3a. For 13mm plasterboard, add 0.018m²·K/W to the Total R.
4 R interpolated from Table K2 R1.09 (for e=0.87&0.05). If attic highly ventilated by fan, the result would be Total R1.89
5 Cavity air space insulation value (shown in italics) was estimated using Reflect3 software.
This is an iterative calculation per the USA Division of Housing Research Paper 32.
The cavity R calculation assumes an air cavity of the gap shown with uniform parallel surfaces.
6 The calculations incorporate the dust assumptions of AS/NZS 4859.1:2002/Amdt 1 2006:
Unvented under metal roof, Clause K4.2a(i), Clause K3.2c&a(ii) (e+0.05)
7 **SOLAVIS "RADIANTSHIELD" has tested infrared emittances of 0.04 both sides and Material R0.11m²·K/W.**
8 **For this case, the presence of the SOLAVIS "RADIANTSHIELD" causes Total R to increase by R2.47 m².K/W**
9 Indoor & outdoor air temperatures per AS/NZS 4859.1:2002/Amdt 1 2006, Clause K3.1
10 Thermal short-circuiting by frames is not considered here as evaluation is for the insulation path only.
11 This computation is not compliant for labelling of insulation products to AS/NZS 4859.1:2002 without an independent endorsement from a recognised laboratory per Section 4.3 of the standard.
12 This report may not be reproduced except in full. Results may not be quoted without reference to the assumptions.
13 Calculated by James Fricker, F.AIRAH, M.Eng.Aust, CPEng.

CONCLUSION:

For the above roof arrangement and SUMMER air temperature difference of 36°-24° = 12K,
the Total R-value per AS4859.1:2002/Amdt 1, 2006 Clause K3.1 is:

R3.01 m².K/W

Similarly calculated, if Solavis Radiant Shield" had emittances of 0.03 both sides, the result would be

R3.19 m².K/W

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PITCHED METAL ROOF, UNVENTILATED REFLECTIVE ATTIC, SOLAVIS "RADIANTSHIELD" INSULATION ON JOISTS, 90MM UNVENTILATED REFLECTIVE AIR SPACE, 10MM PLASTERBOARD

Calculation: 324.02w

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

						Assumed Cavity Properties				
Roof Element	m².K/W	°C out	°C in	°C avg	Δt	e1	e2	mm	Heat Flow	Note
Outside air film:	0.040	**12.00**	12.17	12.09	0.17					1
Metal roof:	0.000	12.17	12.17	12.17	0.00					3
Unventilated reflective attic:	0.540	12.17	14.47	13.32	2.30	0.87	**0.09**		Up	4
SOLAVIS "RADIANTSHIELD"	0.110	14.47	14.94	14.71	0.47		(bright both sides)			7
90mm reflective airspace:	***0.548***	14.94	17.28	16.11	2.34	**0.04**	0.87	90	Up	5,6
10mm plasterboard:	0.059	17.28	17.53	17.41	0.25					3,3a
Indoor still air film (unreflective surface):	0.110	17.53	**18.00**	17.77	0.47	0.87	0.87			2
Total Thermal Resistance, R_{Ti} =	**1.41**	m².K/W			6.00					

Corresponding Total Conductance (k_{Ti}): 0.71 W/(m².K)

NOTES:

Calculated 9/12/09 23:37 Ref: 324_A.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 2006, Table K1, still air film.
3 2007 AIRAH Technical Handbook pages 164-177 3a. For 13mm plasterboard, add 0.018m²·K/W to the Total R.
4 R interpolated from Table K2 R0.56 (for e=0.87&0.05). If attic highly ventilated by fan, the result would be Total R0.80
5 Cavity air space insulation value (shown in italics) was estimated using Reflect3 software.
This is an iterative calculation per the USA Division of Housing Research Paper 32.
The cavity R calculation assumes an air cavity of the gap shown with uniform parallel surfaces.
6 The calculations incorporate the dust assumptions of AS/NZS 4859.1:2002/Amdt 1 2006:
Unvented under metal roof, Clause K4.2a(i), Clause K3.2c&a(ii) (e+0.05)
7 **SOLAVIS "RADIANTSHIELD" has tested infrared emittances of 0.04 both sides and Material R0.11m²·K/W.**
8 **For this case, the presence of the SOLAVIS "RADIANTSHIELD" causes Total R to increase by R1.02 m².K/W**
9 Indoor & outdoor air temperatures per AS/NZS 4859.1:2002/Amdt 1 2006, Clause K3.1
10 Thermal short-circuiting by frames is not considered here as evaluation is for the insulation path only.
11 This computation is not compliant for labelling of insulation products to AS/NZS 4859.1:2002 without an independent endorsement from a recognised laboratory per Section 4.3 of the standard.
12 This report may not be reproduced except in full. Results may not be quoted without reference to the assumptions.
13 Calculated by James Fricker, F.AIRAH, M.Eng.Aust, CPEng.

CONCLUSION:

For the above roof arrangement and WINTER air temperature difference of 18°-12° = 6K,
the Total R-value per AS4859.1:2002/Amdt 1, 2006 Clause K3.1 is:

R1.41 m².K/W

Similarly calculated, if Solavis Radiant Shield" had emittances of 0.03 both sides, the result would be

R1.42 m².K/W

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