DI0190/DU02

Thermal Resistance of Evergreen R2.0

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All tests reported herein have been undertaken at the BRANZ Ltd laboratories located in Judgeford, Porirua, New Zealand, unless stated otherwise.

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   iii. any defects in the Products the subject of the Services; or

   iv. any changes, modifications or alterations to the Products the subject of the Services.

Thermal Resistance of Evergreen R2.0

1. CLIENT

Platinum Insulation Wholesalers P/L, 604 Terrigal Drive, Erina, NSW 2250, Australia

2. LIMITATION

The results reported here relate only to the item/s tested.

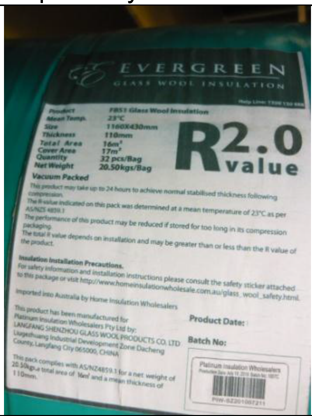
3. DESCRIPTION OF TEST SAMPLES

Five sample segments were selected from the supplied material, in accordance with ASTM C167-09 and the modifications required by AS/NZS 4859.1-02.

Net pack weights (kg) (of the test sample)	-

Table 1. Product specifications

Label information (Information required by AS/NZS 4859.1 Table 3.1 Labelling)



Product name	Evergreen Glass Wool Insulation
Description of contents	Glass Wool Insulation
Manufacturer	United Insulation Limited
Traceability information	
Manufacturing address	No.09 United Road, E & T Zone Langfang City 065000, China
Date of manufacture	July 10, 2010
Batch number	1007C
Safety instructions	Yes
Statement of compliance with AS/NZS 4859.1 including specifications consistent with this test sample nominal thickness and weight	Yes
Statement of performance dependence on storage time in compression package	Yes
Statement of R-value dependence on installation	Yes
Declaration of temperature conditions	Yes, 23°C
Time to achieve nominal thickness	Yes, 24 hrs

Table 1. continued on next page

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Table 1. continued from previous page

Number of pieces (not required for rolls)	32
Total area (m^2)	16
Length (mm or m)	1160
Width (mm or m)	430
R-value (m^2K/W)	2.0
Net weight (kg for pack or 'grams per sq. metre')	20.50
Nominal thickness (mm)	110

4. DESCRIPTION OF TEST EQUIPMENT

The test equipment used was a LaserComp Fox600 heat flow meter. The specimen for testing is placed horizontally in the apparatus, with upwards heat flows. The hot and cold plates each have a 250 mm x 250 mm heat flux transducer embedded in their surface. The edges of the specimen are insulated from the room ambient temperature. The uncertainty in individual thermal conductivity and thermal resistance measurements is estimated to be 3%.

5. PROCEDURE

Five sample segments were selected and prepared, and the thickness measured, to the requirements of ASTM C167 & AS/NZS 4859.1 Appendix D. The variations from the ASTM C167-AS/NZS 4859.1 procedure were as follows:

- Fifteen individual thickness measurements were made for each determination of thickness for a segment instead of the ten described in the standard.
- These measurements were spread in an equally spaced three by five grid instead of the particular arrangement outlined in the standard.

The five sample segments were conditioned for 24 hours at 23°C prior to the thermal performance measurements.

The three test segments were selected from the five sample segments then cut and made up to the required test specimen size of approximately 600 mm square. The 'grams per square metre' of the test specimen is assumed to be the same as the complete segment from which it is cut (approximately twice the area of the test specimen).

The specimens were tested to the requirements of ASTM C518-10 using the procedures of ASTM C653-97 including the modifications specified in AS/NZS 4859.1-02 Appendix D. See the BRANZ information sheet '*Notes on R-value measurement using ASTM C653 procedure*'. A total of nine measurements of thermal resistance were made for three values of density by testing first at an initial thickness (the lesser of the mean conditioned thickness, and, the nominal thickness plus 10%), then compressing the specimen to a thickness approximately 10% less than the initial test, and finally compressing the specimen to a thickness approximately 20% less than the initial test thickness.

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6. RESULTS

Table 2. Conditioning of five sample segments

BRANZ reference	D4933			
	Thickness (mm)			'grams per sq. metre' (g/m^2)
	average	max	min	
Initial	110	119	93	1469
After conditioning @ 23°C for 24 hours	112	121	96	1469
change	+1%			+0.0%
Std. dev. of 5 x 15 thickness measurements	7 mm			

Table 3. Test condition set-points

Upper plate set-point temperature	9.9 °C
Lower plate set-point temperature	36.1 °C
Nominal difference in temperature	26.2 K
Nominal mean temperature	23.0 °C

Table 4. Measured results for the three test specimens

Calibration date	02-Aug-10	Calibration sample	SR 06							
Test specimen		Specimen 1			Specimen 2			Specimen 3		
BRANZ reference		D4933B			D4933D			D4933E		
'grams per sq. metre' (of segment from which test specimen is cut)	g/m^2	1399			1560			1437		
Test date		5-08	5-08	5-08	6-08	6-08	6-08	9-08	9-08	9-08
Test thickness	mm	115.0	104.0	94.0	114.0	103.0	93.0	100.0	91.0	82.0
Density at test thickness (of segment from which test specimen is cut)	kg/m^3	12.16	13.45	14.88	13.68	15.14	16.77	14.37	15.79	17.53
Temperature difference	K	26.20	26.20	26.20	26.20	26.20	26.20	26.20	26.20	26.20
Mean temperature	°C	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0
Heat-flux	W/m^2	10.39	11.05	11.76	9.64	10.29	11.04	11.23	11.93	12.78
Thermal resistance	m^{2}K/W	2.521	2.372	2.227	2.719	2.547	2.374	2.334	2.197	2.050
Thermal conductivity	mW/mK	45.6	43.8	42.2	41.9	40.5	39.2	42.8	41.4	40.0
Difference between heat flux transducers	%	0.2	0.8	0.9	0.6	0.8	0.7	1.3	1.2	1.1
The results represent the average of at least 18 minutes of measurements taken after equilibrium of heat flow is achieved. Equilibrium conditions are maintained for at least 12 minutes before the averaging of results is started. Actual times are available on request.										

The analysis of the results was in accordance with the guidelines in ASTM C653-97.

The relationship between thermal conductivity and density for an insulation material can be represented by an equation of the form:

Thermal conductivity (W/mK) $\lambda = a + b.\rho + \frac{c}{\rho}$ where ρ is density (kg/m^3)

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Over the range of densities created with the test specimens, the coefficients have been determined by regression fit through the results and are listed in Table 5. The best fit equation for the results is plotted in Figure 1.

Table 5. Regression- fit for measurements at 23°C mean temperature

Thermal Conductivity	$\lambda = a + b.\rho + \frac{c}{\rho}$			
	a	b	c	
Specimen 1	0.0232	+0.00014	0.252	
Specimen 2	0.0300	-0.00009	0.180	
Specimen 3	0.0272	+0.00000	0.224	Standard error
Combined results	0.0006	+0.00086	0.419	1.9%
Uncertainty in individual thermal conductivity measurements				3%
Overall uncertainty in use of above equation to determine conductivity				4%

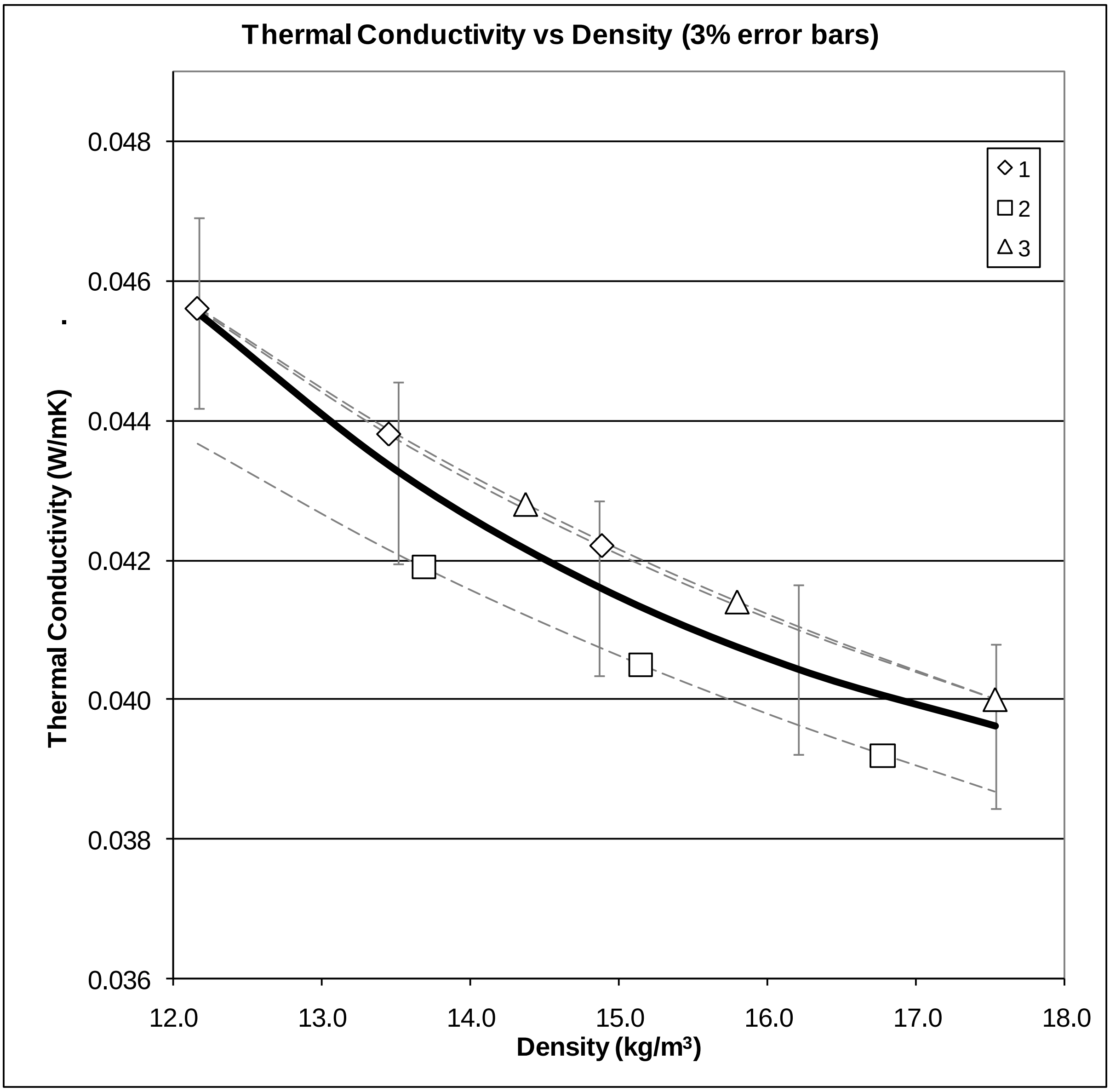

Figure 1. Summary of thermal conductivity measurements at 23°C mean temperature

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Table 6. Summary and analysis of results

Ref	Item	Value	±	Uncertainty	Unit
*1	*Nominal thickness*	*110*			mm
2	Mean thickness of the five sample segments after conditioning	112	±	2	mm
3	*Nominal 'grams per square metre' of product*	*1281*			g/m^2
4	Mean 'grams per square metre' of the five sample segments (before cutting & making up to test specimen size)	1469	±	18	g/m^2
5,6	Mean density of the five (un-cut) sample segments at nominal thickness	13.4	±	0.3	kg/m^3
7	Mean test temperature	23.0	±	0.2	°C
9,10	Estimated thermal conductivity of sample pack(s) at nominal thickness	0.0435			W/mK
11,12	Estimated thermal resistance of sample pack(s) at nominal thickness	2.53			m^2K/W
13,14	Density at nominal weight & nominal thickness	11.6			kg/m^3
15,16	Estimated thermal conductivity at nominal weight & nominal thickness	0.0466			W/mK
	Nominal R-value of product	*2.0*			m^2K/W
17,18	Estimated thermal resistance at nominal weight & nominal thickness	2.36			m^2K/W

*[1-18] *See BRANZ info sheet 'Glossary of terms used in Table 6 of Thermal Testing Reports'*

The test method was in accordance with ASTM C653 and AS/NZS 4859.1:02 Appendix D, including the alternative thickness probe diameter of 25 mm and pressure of 25 Pa allowed for in Amendment 1 (2006) of AS/NZS 4859.1

Table 7. Assessment of product compliance with labelled specifications

Compliance Requirement	Pass/Fail
Packaging & labelling compliance with AS/NZS 4859.1 Section 3*	Pass
Result compared with declared R-value (AS/NZS 4859.1 clause 2.3.3.7 prgph 1)	Pass
Combined	**Pass**

* Note – The pass requirement includes that there is a manufacturer address present but BRANZ has not necessarily checked that it is the address where the product is actually made. The results are only valid for a unique and unambiguous address of manufacture.

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7. REFERENCES

AS/NZS 4859.1:02	*Materials for the thermal insulation of buildings; Part 1: General criteria and technical provisions*. Standards Australia, Sydney, Standards New Zealand, Wellington, 2002.
Amendment 1 to AS/NZS 4859.1:02	Standards Australia, Sydney, Standards New Zealand, Wellington, 2006.
ASTM C167-09	*Standard Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations*. American Society for Testing and Materials, Philadelphia, PA, 1998.
ASTM C653-97 (07)	*Standard Guide for Determination of the Thermal Resistance of Low-Density Blanket-Type Mineral Fiber Insulation*. American Society for Testing and Materials, Philadelphia, PA, 1997.
ASTM C518-10	*Standard Test Method for Steady-State Heat Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus*. American Society for Testing and Materials, Philadelphia, PA, 2010.
BRANZ Info. sheet	*Notes on R-value measurement using ASTM C653 procedure*. BRANZ, Jul., 2008.
BRANZ Info. sheet	*Glossary of terms used in Table 6 of Thermal Test Reports*. BRANZ, Feb., 2008.

8. LIST OF TABLES & FIGURES

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