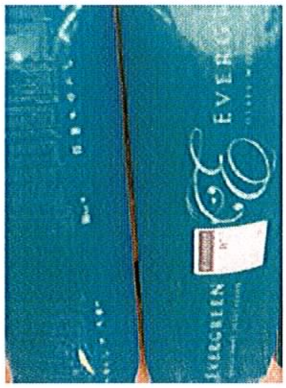
# DI0124/DU03

# Thermal Resistance of Evergreen Glass Wool Insulation R4.1





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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 Glass Wool Insulation R4.1

## 1. CLIENT

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

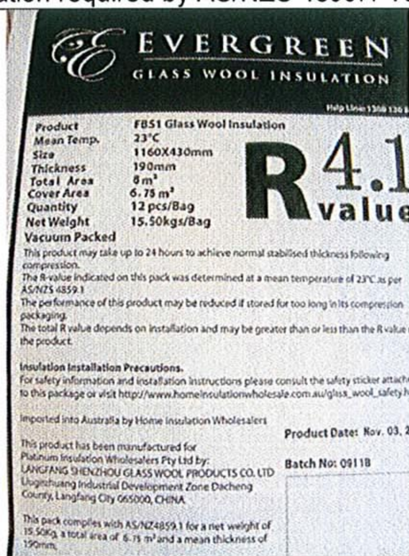
## 2. DESCRIPTION OF TEST SAMPLES

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) | 15.4, 16.3, 16.3 |

**Table 1. Product specifications**

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




| | |
|---|---|
| Product name | Glass Wool Insulation R4.1 |
| Description of contents | Glass Wool Insulation |
| Manufacturer | United Insulation Limited |
| Traceability information | |
| Manufacturing address | No. 09 United Road, E & T Zone, Langfang 065000 Hebei, China |
| Date of manufacture | Nov 03, 2009 |
| Batch number | 0911B |
| 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 |
| Number of pieces (*not required for rolls*) | 12 |
| Total area ($m^2$) | 6 |

*Table 1. continued on next page*

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| | |
|---|---|
| Length (mm or m) | 1160 |
| Width (mm or m) | 430 |
| **R-value** ($m^2K/W$) | 4.1 |
| **Net weight** (kg for pack or 'grams per sq. metre') | 15.50 |
| **Nominal thickness** (mm) | 190 |

# 3. DESCRIPTION OF TEST EQUIPMENT

The test equipment used was a LaserComp Fox 600 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%.

# 4. 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 C518-04 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.

For compliance with ASTM C518 the percentage difference between the heat flux transducer readings is required to be less than 5%. If the difference is greater than 5% then the uncertainty in the measurements of thermal resistance and conductivity are unknown and may be greater than the estimated 3% for compliant results. For one of the results in this report the difference was greater than 5% and the measurements therefore do not comply with ASTM C518. Consistency with the other results (*see* Figure 1) indicates that it has probably not affected the accuracy of measurements.

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# 5. RESULTS

**Table 2. Conditioning of five sample segments**

| BRANZ reference | D4670 | | | |
|---|---|---|---|---|
| | Thickness (mm) | | | 'grams per sq. metre' (g/m$^2$) |
| | average | max | min | |
| Initial | 167 | 179 | 160 | 2636 |
| After conditioning @ 23°C for 24 hours | 172 | 182 | 165 | 2636 |
| change | +3% | | | +0.0% |
| Std. dev. of 5 x 15 thickness measurements | 4 mm | | | |

**Table 3. Test condition set-points**

| | |
|---|---|
| Upper plate set-point temperature | 13 °C |
| Lower plate set-point temperature | 33 °C |
| Nominal difference in temperature | 20 K |
| Nominal mean temperature | 23 °C |

**Table 4. Measured results for the three test specimens**

| Calibration date | 30-Nov-09 | Calibration sample | Foamsheet x 2 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Test specimen | | Specimen 1 | | | Specimen 2 | | | Specimen 3 | | |
| BRANZ reference | | D4670A | | | D4670D | | | D4670E | | |
| 'grams per sq. metre' (of segment from which test specimen is cut) | g/m$^2$ | 2453 | | | 2757 | | | 2661 | | |
| Test date | | 1-12 | 1-12 | 1-12 | 1-12 | 1-12 | 2-12 | 2-12 | 2-12 | 2-12 |
| Test thickness | mm | 175.0 | 160.0 | 144.0 | 173.0 | 157.0 | 141.0 | 170.0 | 155.0 | 139.0 |
| Density at test thickness (of segment from which test specimen is cut) | kg/m$^3$ | 14.02 | 15.33 | 17.04 | 15.93 | 17.56 | 19.55 | 15.65 | 17.17 | 19.14 |
| Temperature difference | K | 20.00 | 20.00 | 19.99 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 |
| 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$^2$ | 5.01 | 5.27 | 5.63 | 4.79 | 5.07 | 5.44 | 4.85 | 5.13 | 5.52 |
| Thermal resistance | m$^2$K/W | 3.994 | 3.796 | 3.549 | 4.173 | 3.945 | 3.677 | 4.122 | 3.899 | 3.626 |
| Thermal conductivity | mW/mK | 43.8 | 42.1 | 40.6 | 41.5 | 39.8 | 38.3 | 41.2 | 39.8 | 38.3 |
| Difference between heat flux transducers | % | 4.9 | 4.3 | 6.1 | 5.0 | 4.1 | 3.0 | 3.1 | 5.0 | 5.0 |

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 $\rho$ is density (kg/m$^3$)

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.

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**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 | -0.0065 | +0.00104 | 0.501 | |
| Specimen 2 | 0.0049 | +0.00054 | 0.445 | |
| Specimen 3 | 0.0259 | -0.00002 | 0.243 | Standard error |
| Combined results | 0.0184 | +0.00017 | 0.322 | 0.7% |
| Uncertainty in individual thermal conductivity measurements | | | | 3% |
| Overall uncertainty in use of above equation to determine conductivity | | | | 3% |

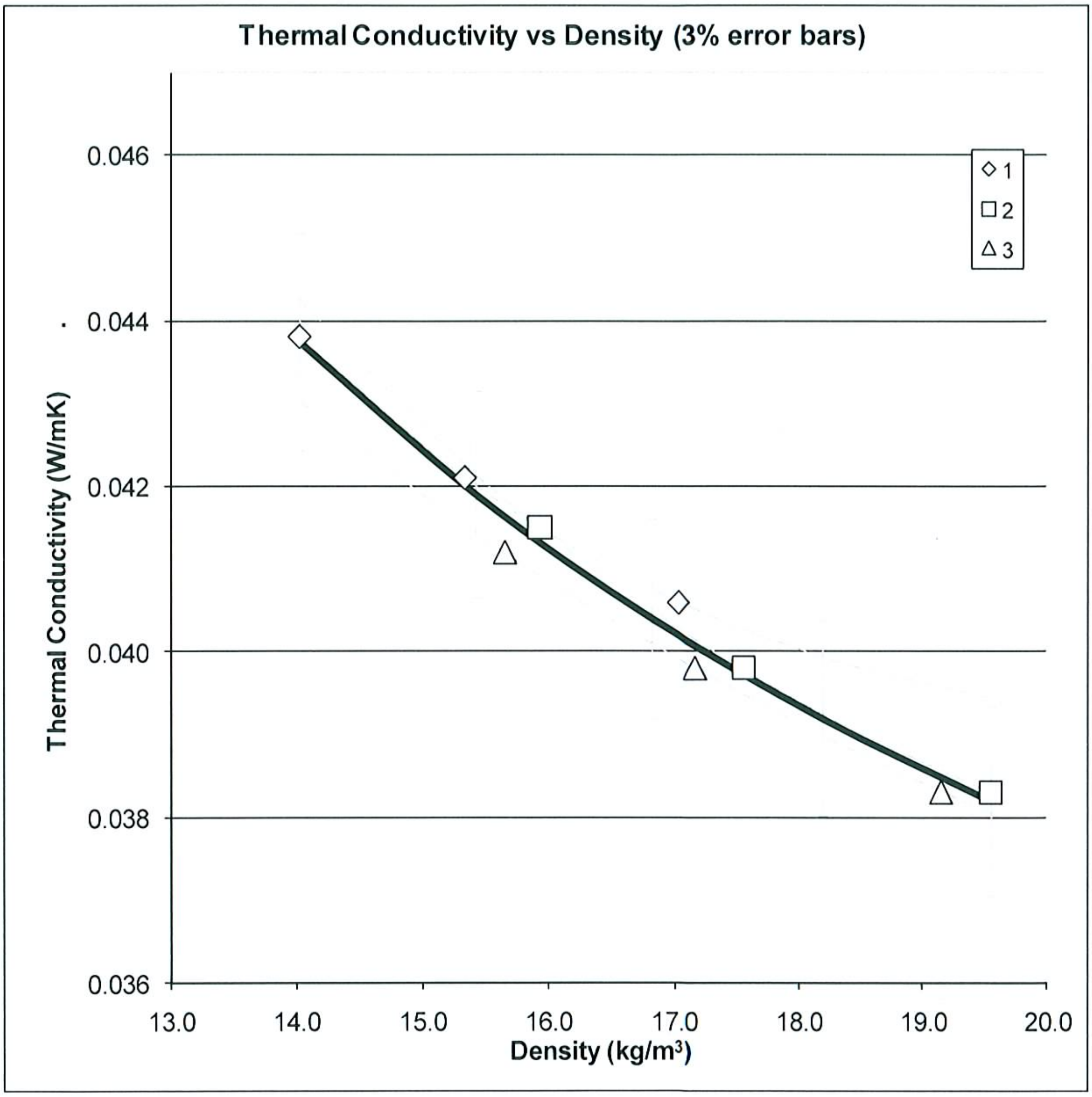


**Figure 1. Summary of thermal conductivity measurements at 23°C mean temperature**

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**Table 6. Summary and analysis of results**

| | | | | |
|---|---|---|---|---|
| *1 | *Nominal thickness* | *190* | | mm |
| 2 | Mean thickness of the five sample segments after conditioning | 172 | ± 2 | mm |
| 3 | *Nominal 'grams per square metre' of product* | *2583* | | $g/m^2$ |
| 4 | Mean 'grams per square metre' of the five sample segments (before cutting & making up to test specimen size) | 2636 | ± 32 | $g/m^2$ |
| 5,6 | Mean density of the five (un-cut) sample segments at conditioned thickness | 15.3 | ± 0.3 | $kg/m^3$ |
| 7 | Mean test temperature | 23.0 | ± 0.2 | °C |
| 9,10 | Estimated thermal conductivity of sample pack(s) at conditioned thickness | 0.0420 | | W/mK |
| 11,12 | Estimated thermal resistance of sample pack(s) at conditioned thickness | 4.10 | | $m^2K/W$ |
| 13,14 | Density at nominal weight & conditioned thickness | 15.0 | | $kg/m^3$ |
| 15,16 | Estimated thermal conductivity at nominal weight & conditioned thickness | 0.0424 | | W/mK |
| | *Nominal R-value of product* | *4.1* | | $m^2K/W$ |
| 17,18 | Estimated thermal resistance at nominal weight & conditioned thickness | 4.1 | | $m^2K/W$ |

*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** |

# 6. 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 C518-04 — *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, 2004.

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.


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# 7. LIST OF TABLES & FIGURES



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