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PRODUCT PERFORMANCE ASSESSMENT

Version: **13 May 2013 Amd 1**

Material	**Rock(stone)wool** by ROCKWOOL®
Type	**Granulate**
Product	**EnergySaver** (Masonry)
Application	***Cavity* masonry walls**

This document: Describes how EnergySaver Cavity Wall Insulation (EnergySaver) achieves:

- **Compliant performance – *required* by the National Construction Code (NCC) Volume One and Two – Building Code of Australia (BCA), and**
- **Expected performance – attributes that contribute to building design-life.**

Associated documents: EnergySaver compliance set [1].

COMPLIANT PERFORMANCE

Relevant *DTS Provisions*

The BCA defined building classifications and wall types that apply for this assessment are shown in Table 1.

Table 1	Building Classification	Wall type	Construction
BCA Volume One	Class 2, 3, 9 Buildings	External, Common & Fire walls	Unreinforced *cavity* masonry
BCA Volume Two	Class 1 & 10a Buildings	External, Common & Separating walls	

Performance that is *required* [2] for the nominated building classifications, wall types and construction type has been determined in **EnergySaver (Masonry) – NCC**. A summary of *required* performance is shown in Table 2.

Table 2	Damp and weatherproof	Fire resisting	Sound insulation	Thermal insulation
External walls	*Required*	Can be *required*	Can be *required*	Can be *required*
Common walls	Can be *required*			
Separating walls		*Required*	*Required*	
Fire walls			Can be *required*	

Satisfying the Performance Requirements

[1] EnergySaver compliance
Product technical statement
Product data sheet
Product performance assessment
Construction code review

BCA A0.5/1.0.5 Meeting the Performance Requirements states that compliance can be demonstrated by:

(a) Complying with *Deemed-to-Satisfy* (DTS) *Provisions*, or

(b) Formulating an *Alternative Solution* which complies with the *Performance Requirements* or is at least *equivalent* to the *DTS Provisions*, or

(c) By using a combination of (a) and (b).

[2] BCA defined terms
In keeping with NCC protocol, BCA defined terms are shown in italics.

This assessment uses:

- For **damp and weatherproofing, fire resistance, and sound insulation** – option (b): to show that there is no greater risk associated with *cavity* masonry when the product is installed than that associated with the *DTS Provisions*.
- For **thermal insulation** – option (a): to verify material performance complies with the *DTS Provisions*.

The assessment methodology described in **BCA A0.9/1.0.9 Assessment Methods** has then been used to describe how compliant performance has been determined.

Damp and weatherproofing

DTS Provisions

BCA Volume One and **Two** *DTS Provisions* describe *cavity* masonry design and construction that is deemed-to-satisfy the *Performance Requirements* for damp and weatherproofing.

For the placement of insulation in the *cavity* Acceptable Construction Manual (ACM):

AS 3700
Masonry structures

AS 4773 Parts 1 & 2
Masonry for small buildings

- **AS 3700** states that..."Where insulating material is placed in a cavity, appropriate measures shall be taken to ensure that the moisture resistance of the wall is maintained".
- **AS 4773** states that..."The minimum cavity width shall be 35 mm and shall be measured clear from any conduit, insulation or service placed within the cavity".

Therefore the *DTS Provisions* both *require* a *cavity* to be maintained between the insulation and the outer leaf **and** allow the *cavity* to be filled with insulation where it can be shown that moisture resistance is maintained.

Performance Requirement FP1.4/P2.2.2 Weatherproofing
A roof and *external* wall must prevent the penetration of water that could cause unhealthy or dangerous conditions, or loss of amenity for the occupants: and undue dampness or deterioration of building elements.

In neither case does the BCA (**AS 3700** or **AS 4773**) prescribe a test or provide assessment criteria for assessing the acceptable water and moisture penetration resistance of *cavity* masonry construction.

When a *cavity* masonry wall is subject to wind-driven rain it is likely that there will be migration of water through the outer leaf. When water does penetrate through the outer leaf, it must flow down the inside face of the outer leaf and be drained out of the building fabric at flashings and/or weepholes without breaching the cavity space.

FP1.5/P2.2.3 Dampness
Moisture from the ground must be prevented from causing undue dampness or deterioration of building elements; and unhealthy or dangerous conditions, or loss of amenity for occupants.

When masonry is subject to ground moisture it is likely that there will be capillary migration of moisture up the wall. When moisture is present, it must be prevented from rising up, or bridging across the cavity, to the inner leaf of masonry.

The above provide reasonable measures for determining damp and weatherproofing performance when a material is installed in the *cavity*. If it can be determined that there is no greater risk of water or moisture being transferred across the *cavity* than for *DTS cavity* masonry, then *cavity* masonry damp and weatherproofing performance is achieved.

Material properties

[3] Interstitial (building)
An air space or gap between building materials.

Table 3 describes the relevant material properties. Water and capillary resistant performance is intrinsic to damp and weatherproofing performance, water vapour permeability ensures there is no increased risk of interstitial [3] condensation, and being chemically inert, the material will not affect or be affected by masonry accessories (wire ties, flashings, damp-proof courses etc).

Table 3	Material properties description
Water resistant	A discontinuous, random, short fibre material impregnated with a water repellent agent during manufacture, making the fibre surface hydrophobic (repels water molecules). When installed, the product forms a homogenous fibrous mass with consistent performance. When liquid water meets the surface of the material the hydrophobic fibre surface resists cohesive bonding between the water and fibre molecules. This allows the adhesive forces in the water molecule to dominate, with the result that water beads into droplets and flows at the surface rather than penetrating into the material. Therefore, under normal atmospheric pressures, the material will not absorb water. Whilst water can be forced into the material under pressure, once the pressure is removed the water will leave the material because there is no cohesive bond to retain the water molecules. Moisture will exit the material by evaporating and then diffusing through the material (see Vapour permeability).
Resistant to capillary action	Whilst the fibres cluster together to create randomly connected air pockets that would otherwise promote capillary action, the hydrophobic fibre surface does not allow the cohesive bond between water and fibrous molecules required for adsorption that leads to capillary moisture movement.
Water vapour permeable	Airborne water vapour driven by convective forces will diffuse through the material. Water molecules size in vapour form is small enough to pass through the material structure. The hydrophobic nature of the fibre surface does not allow for sorption so the product only retains very low levels of internal moisture. This combined with the open fibrous structure of the material that allows the material to "breath", means the material has a mathematical water vapour resistance factor comparable to still air. Therefore the material has little effect on *cavity* water vapour diffusion.

Appropriate test or accepted assessment criteria

For *cavity* masonry walls, interstitial insulation performance will be affected by the material properties of the insulation and the work practices used to position the material.

Therefore the most rigorous demonstration of weatherproofing compliance is when both material performance and installation practice are tested.

ASTM E514–11
Standard test method for water penetration and leakage through masonry

There is no Australian criterion for determining *cavity* masonry weatherproofing performance.

BS 4315.2
Methods of test for resistance to air and water penetration. Permeable walling constructions (water penetration)

A review of international standards discovered **ASTM E514–11**, **BS 4315.2 1970**, and **BBA – Water resistance of cavity walls filled with thermal insulation materials**.

ASTM E514 and **BS 4315.2** provide methods for determining water penetration through masonry. Both use a similar test, but neither is specifically designed to test *cavity* masonry or the as-installed performance of *cavity* masonry when interstitial insulation is installed.

BBA
British Board of Agrément

BBA – Water resistance of cavity walls filled with thermal insulation materials is a purpose designed to determine the water resistance of *cavity* masonry filled with insulation, and the adequacy of fill using the specified installation machinery and drilling pattern.

Each of the above use a similar method where a sample wall is subject to simulated wind-driven rain conditions. However as shown in Table 4, the BBA test is significantly more stringent: both in the duration and intent to sustain an inner face water flow.

Table 4	Wall size	Number tested	Duration	Wind-driven rain		Cavity water flow
				Spray rate	Pressure	
ASTM E514	1.08m^2 (1.2 x 0.9m) single leaf wall	3	4 hours	138 litres/hr/m^2	500 Pa	Test measures if and how much water flow
BS 4315.2						
BBA	3 x 3m cavity wall	2	Day 1-5	Adjusted from 60-600 l/hr to sustain nominated cavity water flow rates	0 Pa	0.3 l/min
			Day 6-10		250 Pa	0.8 l/min
			Day 11-15		500 Pa	1.4 l/min

Therefore it is reasonable to use the **BBA** test to determine if *cavity* masonry with insulation installed presents a greater risk of water being transferred across the *cavity* than *DTS* (unfilled) *cavity* masonry.

BBA testing

BCA A2.2/1.2.2 Evidence of suitability, sub-clause (a)(i) recognises test evidence from a *Registered Testing Authority*. **BCA A1.1/1.1.1 Definitions** states that a *Registered Testing Authority* can be an organisation outside Australia registered by an authority recognised by the National Association of Testing Authorities (NATA) through a mutual recognition agreement.

The British Board of Agrément (BBA) is accredited to test the **Water resistance of cavity walls filled with thermal insulation materials** by the United Kingdom Accreditation Service (UKAS) who is in turn recognised by NATA through a Mutual Recognition Agreement. The BBA is therefore recognised by the BCA as being a *Registered Testing Authority*.

BS EN 14064.1
Thermal insulation products for buildings – In-situ formed loose-fill mineral wool (MW) products. Part 1: Specification for the loose-fill products before installation

The BBA test is evidence that, when installed, the product does not present a greater risk of water being transferred across the *cavity* and therefore does not affect the weatherproofing performance of unfilled *DTS cavity* masonry.

Material performance

BS EN 1609
Thermal insulating products for building applications – Determination of short term water absorption by partial immersion

For the BBA *cavity* wall test, water absorption is deemed to be the material performance attribute that determines the water resistance of *cavity* masonry when filled with insulation. Product water absorption performance has been determined by the BBA in accordance with **BS EN 14064.1** using the test method described in **BS EN 1609**. BBA is accredited to test the water absorption of thermal insulation using **BS EN 1609** by UKAS.

ISO 9001
Quality management systems

The Rockwool Limited **ISO 9001** Quality Assurance program includes regular as-manufactured testing to ensure product performance achieves the water absorption performance nominated as being required for the BBA *cavity* wall test.

Installation practice

For the BBA *cavity* wall test, adequacy of fill is deemed to be the installation outcome that determines the water resistance of *cavity* masonry when filled with insulation. Adequacy of fill is achieved when the installation machinery, drilling pattern and work practice are those specified for the BBA *cavity* wall test and described in Table 5.

Table 5		Installed outcome	
	Cavity width	Nominal – 50mm wide	Tolerance – not less than 40mm
	Density	Nominal – 40 kg/m^3	Tolerance – local area density variation of ±10kg/m^3 in any 0.5m^2 area
Work practice	Installer	Undertaken by AIS Home Insulation (AIS) trained and approved technicians	
	Installation	Work practices as described in the Cavity Wall Insulation Technician's Manual	
	Equipment	BBA approved blowing machine complete with hoses, nozzles, connectors and remote control lead	
Wall height (building geometry)	Qualification	AS 4773.1 (see 1.2.3 Limitations on building geometry) only applies for buildings where the *external wall* height, measured from ground level to the underside of the eave, does not exceed 6.0m. AS 3700 does not place any limitation *external wall* height.	
	Generally	Installation in walls up to 9m in height.	
	Limitation	Installation in walls over 9m in height requires a location specific *cavity* assessment.	
R-Value	Generally	BCA Volume One Specification J1.5 Wall construction, Figure 2(b) and BCA Volume Two Part 3.12.1, Figure 3.12.1.3 Explanatory Information 1 show the unfilled *cavity* air space as having an *R-Value* of R0.17. Therefore, when the *cavity* is filled R0.17 must be deducted from the *Total R-Value* of the wall construction (BCA Volume Two Figure 3.12.1.3(e): cavity masonry R0.69 less filled air space (cavity) 0.17 = R0.52 + added insulation *R-Value*).	

BBA Agrément Certificate

[4] Certificate of Conformity
Whilst the BBA Certificate is not recognised by the BCA, A1.1/1.1.1 Definitions recognises a "Certificate" as...a product...system certification stating that the properties and performance of a building material or method of construction or design fulfil specific requirements of the applicable national code.

A BBA Agrément Certificate [4] proves the fitness for the purpose of a construction product and its compliance or contribution to compliance with United Kingdom (UK – British, Scottish, Welsh and Irish) building regulations.

BBA Agrément Certificate No. 0086-CPD-461281 (Fourth issue to Rockwool Limited) is evidence of product compliance with UK building regulations for liquid water penetration (damp and waterproofing) and water vapour penetration (condensation).

The Agrément Certificate was first issued on the basis of test evidence, nominated work practices and the examination of the manufacturing process. Once issued, the Certificate holder is subject to production and installed product surveillance throughout the life of the Certificate, and ongoing (typically every three years) certification reviews.

The continued renewal of the Agrément Certificate since 1989 provides as-installed evidence of *cavity* masonry damp and weatherproofing performance.

Fire resistance

DTS Provisions

For an insulation material located in the *cavity* of a masonry wall, **BCA Volume One** and **Two** determine fire resisting performance in terms of *non-combustibility* and affect on any *required fire-resistance level* (FRL).

Non-combustibility is determined:

AS 1530.1
Methods for fire tests on building materials, components and structures – Combustibility test for materials.

- For a material, either by testing in accordance with **AS 1530.1** or satisfying the provisions of **C1.12/3.7.1.2 Non-combustible materials**.
- For a construction or part of building (*cavity* masonry wall), by being constructed wholly of materials that are not deemed *combustible*.

Material properties

Table 6 describes the relevant material properties.

Table 6	Material properties description
Non-combustible	The product is an inert vitreous silicate mineral wool with a small amount of Bakelite (a synthetic thermosetting resin binder) and up to 0.3% mineral oil or up to 0.5% silicone oil or emulsion, giving it a low organic matter content and a low calorific value. Mineral wool as being *fire-resisting* in BCA Volume Two 3.7.1.8 (c)(i), (d)(ii), (g)(ii)(C) and (h)(ii)(B).

European reaction to fire classification

BS EN 13501.1
Fire classification of construction products and building elements.

Classification using test data from reaction to fire tests

The product has been tested by the British Standards Institution (BSI) in accordance with the harmonised European classification procedure given in **BS EN 13501.1** and has achieved an A1 (best) Classification. BSI is accredited to test the fire resistance of materials using **BS EN 13501.1** by UKAS and is therefore recognised by the BCA as a *Registered Testing Authority*.

Expert judgement has determined that, for rock(stone)wool material, an A1 Classification means that the product can be considered as *non-combustible* in terms of clause **C1.12/3.7.1.2** (and would be classified as a Group 1 material in terms of **Specification C1.10 Fire Hazard Properties**).

For the affect on any *required FRL, expert judgement* has also determined that, when *cavity* masonry is *required* to achieve an FRL, installing the product into the cavity will not diminish the *fire resisting* performance of the wall, and may improve FRL performance.

The above is evidence that the product complies with the *DTS Provisions* and therefore satisfies the *Performance Requirements* relevant to fire resistance.

Fire – Heating appliances, fireplaces, chimneys and flues

DTS Provisions

For insulation located against, adjacent to or abutting a heating appliance or component, **BCA Volume One** and **Two** determine *required* performance in terms of heat resistance.

AS/NZS 2918, sub-clause **2.1 Material service temperature** *requires* insulation associated with a heating appliance to have a service temperature classification of heat resistant (>600^{0}C) or heat tolerant (150-600^{0}C).

Material properties

Table 7 describes the relevant material properties.

Table 7	Material properties description
Service temperature	The melting point of the material is above 1000°C and a general purpose service temperature has been determined to be above 600°C. However temperature can affect the performance of the water resisting additive, therefore for *cavity* installation the service temperature of the additive is the limiting factor.

ASTM C411 Hot service performance – Pipe insulation

Testing according to ASTM C411 determined that the service temperature can be considered as greater than 600^0C, and therefore the material could be considered as heat resisting. However, the service temperature of the water resisting additive is lower than 600^0C and a heat tolerant classification applies.

This is evidence that the product complies with the *DTS Provisions* and the like and therefore satisfies the *Performance Requirements* for heating appliances, fireplaces, chimneys and flues.

Fire – Bushfire areas

DTS Provisions

For construction in bushfire prone areas, **BCA Volume One** and **Two** determine *required* performance for insulation materials used in wall construction in terms of *non-combustibility* up to BAL 40, and FRL performance for BAL FZ.

Material properties

Table 6 (above) describes the relevant material properties.

European reaction to fire classification

As described above, *expert judgement* has determined that the European A1 classification means that the product can be considered *non-combustible* and will not degrade the FRL performance of a masonry wall.

This is evidence that the product complies with the *DTS Provisions* for BAL FZ *cavity* masonry wall construction and therefore satisfies the *Performance Requirements* relevant to fire resistance in bushfire areas.

Sound insulation

DTS Provisions

For *cavity* masonry *separating wall* sound insulation performance, **BCA Volume One** and **Two** determine performance in terms of the weighted sound reduction index with spectrum adaption term (Rw+Crt) and discontinuous construction.

Material properties

Table 8 describes the relevant material properties.

Table 8	Material properties description
Sound absorbing	When installed the material forms a homogenous fibrous mass with consistent performance. The randomly orientated short fibre open cell structure absorbs sound waves incident to the surface, but the "blown" method of installation and installed density tends to promote sound transmission across the fibre structure, resulting in a performance neutral outcome across the cavity. At a blown density of 40kg/m3 the product provides an airflow resistivity of 11kNs/m^4 in accordance with ISO 9053. This acts to reduce sound transmission along the cavity.

Airborne sound insulation and impact sound transmission testing

ISO 9053
Materials for acoustical applications – Determination of airflow resistance.

AS 1191
Acoustics – Method for laboratory measurement of airborne sound insulation of building elements.

Testing had been undertaken by Acoustic Laboratories Australia Pty Ltd in accordance with **AS 1191** to determine the airborne sound insulation and impact sound transmission affect when the product is installed into discontinuous construction (no wire ties) *cavity* masonry.

Acoustic Laboratories Australia Pty Ltd is recognised as providing *expert judgement* on acoustic performance and testing material performance.

Outcomes show that for **BCA Volume One** and **Two**, when the product is installed into *DTS* cavity masonry (two leaves of 110mm clay brick, discontinuous – no wire ties, minimum 50mm cavity, 13mm cement render on each outside face), the *required* Rw+Crt of 50 is achieved.

Outcomes also show that when the product is installed into the Boral "Acoustic Maxi" 90/70/90mm *cavity* wall *Alternative Solution* (two leaves of 90mm Acoustic Maxi clay brick, discontinuous – no wire ties, minimum 70mm cavity), performance is also no less than the *required* Rw + Crt 50.

The above is evidence that when the product is installed, the sound insulating performances of the nominated wall types comply with the *DTS Provisions* and therefore satisfy the *Performance Requirement* for sound insulation.

Thermal insulation

DTS Provisions

AS/NZS 4859.1
Materials for the thermal insulation of buildings – General criteria and technical provisions

For an insulation material used to improve building fabric thermal performance, **BCA Volume One** and **Two** determine performance in terms of compliance with **AS/NZS 4859.1**.

Material properties

Table 9 describes the relevant material properties.

Table 9	**Material properties description**
Thermal conductivity	The material forms a complex matrix of fibres that entraps air and restricts heat flow. The high fibre and low "shot" (unprocessed solid material) content creates a high proportion of evenly distributed void spaces that trap air and minimise air-borne conduction, and the material properties provide low fibre conductivity. The low temperatures associated with building operation together with the diffuse fibre structure and installed density of the *cavity* installed product act to reduce radiant energy transmission between fibres. Free convection across the installed fibre is reduced by the airflow resistance of the fibrous structure.
Dimensional stability	Whilst compressed for transport and storage, the mechanised installation "blowing" process re-lofts the fibre without any reduction in compressive strength. The non-directional interlocking fibrous structure gives good transverse elasticity, and when installed to the nominal density, will fit tightly and without settlement.
Resistant to air movement	The denser fibrous structure acts to resist forced (wind driven) convection. When installed in the *cavity*, air movement through the cavity is impeded, reducing the flow of air borne moisture and energy loss or gain.

Thermal conductivity testing

ASTM C 687
Standard practice for determination of thermal resistance of loose fill building insulation

AS/NZS 4859.1 describes the product as a "loose fill", nominates **ASTM C 687** as the standard method for determination of thermal properties, and states that material thermal resistance is to be determined at a standard mean temperature of 23 ±1^{0}C (or by extrapolation of measurements performed at a minimum of two other mean temperatures).

ASTM C 687 then nominates **ASTM C 518** as a test method.

ASTM C 518
Standard test method for steady-state thermal transmission properties by means of a heat flow meter apparatus

Compliance with AS/NZS 4859.1 is achieved when a product sample is tested to determine the laboratory thermal conductivity, and manufacturing Quality Assurance program is in place to ensure as-manufactured product is consistent with the laboratory performance.

The product has been tested by the BBA in accordance **ASTM C 518**. BBA is accredited to test the thermal performance of materials using **ASTM C 518** by UKAS and is therefore recognised by the BCA as a *Registered Testing Authority*. The BBA test reported a thermal conductivity of 0.036 W/m.K at a mean temperature of 10 ±1^{0}C and must be adjusted by calculation to determine material performance at 23 ±1^{0}C.

Declared thermal conductivity

[5] Declared thermal conductivity
Testing to ISO 8301: 1991 and BS EN 12667:2001.

Uncertainty evaluation in accordance with ISO/IEC 17025:2005 – range 0.036 – 0.38 W/m.K providing a level of confidence of 95% that the achieved thermal conductivity will be 0.037W/m.K.

The declared [5] thermal conductivity that is to be used for design calculations is 0.038 W/m.K (see sidebar) has been calculated for a mean temperature of 23 ±1^{0}C using regression analysis based on thermal conductivity outcomes for a range of mean temperatures.

This evidence verifies that the product complies with the *DTS Provisions* and therefore satisfies the *Performance Requirement* for building thermal performance.

EXPECTED PERFORMANCE

Chemical

Compatibility

The product is manufactured from diabase (volcanic rock) and is inert and will not react with, or be affected by building materials or chemicals.

Biological

The product is inorganic and rot-proof. It will not support vermin, rodent or insect life, nor will it encourage the growth of fungi, moulds or bacteria.

Mechanical

Dimensional stability

The nominal installation density and random fibrous structure ensures the product provides a continuous, tight fitting, insulation layer when adjacent materials expand and contract.

The very low thermal expansion coefficient ensures that, when installed, the product is dimensionally stable and will not shrink or expand; ensuring the continuity of insulation is retained over the life of the building.

The tight fitting installation also ensures that insulation remains “in place” at penetrations and when construction changes or remedial work is undertaken.

Durability

The product has been used in cavity wall construction since the 1960’s and has a demonstrated performance life.

The very high melting temperature allows for on-site welding and the like without damage to the insulation.

Environment

Every year the earth’s volcanoes and plate tectonics produce 30-40,000 times more rock material that is used to make the product.

Product manufacture does not use ozone depleting CFC, HCFC or any other type of foaming agents. Life cycle assessments show that product manufacturing, service life and thermal performance combine to deliver a low energy and CO_2 footprint.

Health and safety

Over 60 years of health research has now concluded that there are no long-term health problems from using rock(stone)wool.

In March 1995 the UK Health and Safety Executive concluded that rock(stone)wool should not be classified as a potential carcinogen. Under the World Health Organisation (WHO) and its Monographs Programme of the International Agency for Research on Cancer (IARC) rock(stone)wool is classified as Group 3 (not classifiable as to its carcinogenicity in humans [6]).

[6] IRAC working group in Man-Made Vitreous Fibres, Volume 81 of the AIRC Monographs, Lyon, 9-16 October 2001.

It is recommended that for the handling and installation of rock(stone)wool the internationally recognised Safety Data Sheet (SDS) be followed [7].

[7] Safety data sheet (SDS) Contact AIS or download the datasheet from the AIS website.

Notices

National Construction Code 2013

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1	13 May 2013	Editorial changes to improve clarity.