

Australian/New Zealand Standard™

Thermal insulation materials for buildings

Part 2: Design



AS/NZS 4859.2:2018

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee BD-058, Thermal Insulation. It was approved on behalf of the Council of Standards Australia on 8 October 2018 and by the New Zealand Standards Approval Board on 6 June 2018.

This Standard was published on 19 November 2018.

The following are represented on Committee BD-058:

Aluminium Foil Insulation Association
Australian Building Codes Board
Australian Cellulose Insulation Manufacturers Association
Australian Institute of Refrigeration Air Conditioning and Heating
Australian Professional Thermography Association
AWTA Product Testing
Building Research Association of New Zealand
Consumers Federation of Australia
CSIRO
Engineers Australia
Housing Industry Association
Insulation Association of New Zealand
Insulation Australasia
Insulation Council of Australia and New Zealand
Master Builders Australia
Master Plumbers Australia
National Electrical and Communications Association
New Zealand Metal Roofing Manufacturers
Pliable Membranes Association of Australia and New Zealand
Roofing Association of New Zealand
Roofing Tile Association of Australia
Thermal Insulation Contractors Association of Australia, NSW

Keeping Standards up-to-date

Standards are living documents which reflect progress in science, technology and systems. To maintain their currency, all Standards are periodically reviewed, and new editions are published. Between editions, amendments may be issued. Standards may also be withdrawn. It is important that readers assure themselves they are using a current Standard, which should include any amendments which may have been published since the Standard was purchased.

Detailed information about joint Australian/New Zealand Standards can be found by visiting the Standards Web Shop at www.saiglobal.com or Standards New Zealand web site at www.standards.govt.nz and looking up the relevant Standard in the on-line catalogue.

For more frequent listings or notification of revisions, amendments and withdrawals, Standards Australia and Standards New Zealand offer a number of update options. For information about these services, users should contact their respective national Standards organization.

We also welcome suggestions for improvement in our Standards, and especially encourage readers to notify us immediately of any apparent inaccuracies or ambiguities. Please address your comments to the Chief Executive of Standards Australia or the New Zealand Standards Executive at the address shown on the back cover.

This Standard was issued in draft form for comment as DR AS/NZS 4859.2:2017.

Australian/New Zealand Standard™

Thermal insulation materials for buildings

Part 2: Design

Originated in Australia as part of AS 2352—1980, AS 2461—1981, AS 2462—1981, AS 2463—1981, AS 2464.1—1981, AS 2464.2—1981, AS 2464.3—1983, AS 2464.4—1981, AS 2464.5—1985, AS 2464.6—1983, AS 2464.7—1990 and AS 3742—1990.

Originated in New Zealand as part of NZS 1340:1959.

Previous edition part of AS/NZS 4859.1:2002.

Jointly revised in part and redesignated as AS/NZS 4859.2:2018.

COPYRIGHT

© Standards Australia Limited

© The Crown in right of New Zealand, administered by the New Zealand Standards Executive

All rights are reserved. No part of this work may be reproduced or copied in any form or by any means, electronic or mechanical, including photocopying, without the written permission of the publisher, unless otherwise permitted under the Copyright Act 1968 (Australia) or the Copyright Act 1994 (New Zealand).

Jointly published by SAI Global Limited under licence from Standards Australia Limited, GPO Box 476, Sydney, NSW 2001 and by Standards New Zealand, PO Box 1473, Wellington 6140.

ISBN 978 1 76072 262 3

PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee BD-058, Thermal Insulation, to supersede, in part, AS/NZS 4859.1:2002 (in particular Appendix K).

The objective of this Standard is to provide clear and concise requirements for determination and reporting of total R-values and system R-values to promote greater consistency of these calculations within the Australian and New Zealand marketplaces.

This Standard covers the following:

- (a) Standard assumptions for the calculation of system and total thermal resistance of insulation products used in thermal calculations.
- (b) A prescriptive calculation methodology for determining the thermal resistance of airspaces with parallel bounding surfaces of varying emissivity.
- (c) A range of conversion coefficients for multiple insulation types.
- (d) Prescriptive reporting requirements for demonstrating total R-value and system R-value calculations.

In this Standard, notes to the main text are for information and guidance only.

Statements expressed in mandatory terms in notes to tables are deemed to be requirements of this Standard.

The terms 'normative' and 'informative' have been used in this Standard to define the application of the appendix to which they apply. A 'normative' appendix is an integral part of a Standard, whereas an 'informative' appendix is only for information and guidance.

Standards Australia thanks the Australian Institute of Refrigeration, Air Conditioning and Heating (AIRAH) for permission to reproduce content from the AIRAH Handbook 2013. This content remains the copyright of AIRAH. All rights reserved.

Standards Australia thanks the International Organization for Standardization (ISO) for permission to reproduce tables and text from ISO documents in this Standard. These tables and text are copyright of ISO, Geneva, Switzerland. All rights reserved.

CONTENTS

	Page
1 SCOPE	4
2 APPLICATION.....	4
3 NORMATIVE REFERENCES	4
4 DEFINITIONS.....	4
5 STANDARD ASSUMPTIONS	5
6 CALCULATION OF THERMAL RESISTANCE OF AIRSPACES WITH PARALLEL BOUNDING SURFACES OF VARYING EMITTANCE	11
7 AIRSPACES GREATER THAN 300 mm AND AIRSPACES THAT HAVE NON-PARALLEL BOUNDING SURFACES	14
8 AIR FILMS.....	14
9 THERMAL RESISTANCE OF FLOORS	15
10 TOTAL R-VALUE CALCULATION.....	16
11 TOTAL R-VALUE AND SYSTEM R-VALUE CALCULATION REPORTING REQUIREMENTS.....	17
 APPENDICES	
A SPREADSHEET REPRESENTATION	19
B SUMMARY OF ISO 6946:2007 REPRODUCED AND MODIFIED TEXT	21
 BIBLIOGRAPHY	 23

STANDARDS AUSTRALIA/STANDARDS NEW ZEALAND

Australian/New Zealand Standard
Thermal insulation materials for buildings

Part 2: Design

1 SCOPE

This Standard specifies the assumptions to be used in calculating the system R-values and total R-values of building constructions, which include IR reflective or IR non-reflective airspaces, for the purposes of designing building components to be used in thermal insulation systems.

2 APPLICATION

The calculations performed in accordance with this Standard shall not be used for the purposes of labelling.

Where declared material R-values are required for these calculations, they shall be determined in accordance with AS/NZS 4859.1.

NOTE: Labelling requirements are specified in AS/NZS 4859.1.

3 NORMATIVE REFERENCES

The following are the normative documents referenced in this Standard:

AS/NZS

4200 Pliable building membranes and underlays

4200.1 Part 1: Materials

4859 Materials for the thermal insulation of buildings

4859.1 Part 1: General criteria and technical provisions

NZS

4214 Methods of determining the total thermal resistance of parts of buildings

ASTM

C1371 Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers

E408 Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques

AIRAH

AIRAH Handbook, Fifth Edition (2013)

4 DEFINITIONS**4.1 Material thermal resistance (R_m)**

A resistance associated with a material, specified as a material, R . Excludes surface film resistances (see conductance, film and surface coefficient) declared in accordance with AS/NZS 4859.1. [Unit: (m².K)/W]

4.2 Slightly ventilated airspace

An airspace in which there is provision for limited air flow through it from the external environment by limited openings of area (A_v) within the following ranges:

- (a) For vertical airspaces: $>500 \text{ mm}^2$ but $<1500 \text{ mm}^2$ per metre of length (in the horizontal direction).
- (b) For horizontal airspaces: $>500 \text{ mm}^2$ but $<1500 \text{ mm}^2$ per square metre of surface area.

4.3 Total thermal resistance (R_t)

A total resistance associated with a construction of materials, computed or measured over an area sufficient to be fully representative of the element of construction, and specified as a total R-value, including surface film resistances and thermal bridging. [Unit: $(\text{m}^2 \cdot \text{K})/\text{W}$]

4.4 Unventilated airspace

An airspace—

- (a) in which there is no express provision for air flow through it; and
- (b) having no insulation between it and the external environment, but with small openings to the external environment where the openings are arranged so as not to permit air flow through the layer and such openings do not exceed—
 - (i) 500 mm^2 per metre of length (in the horizontal direction) for vertical airspaces; or
 - (ii) 500 mm^2 per square metre of surface area for horizontal airspaces.

NOTE: The term ‘unventilated’ is used to conform to ISO 6946. The AIRAH Handbook uses the term ‘non-ventilated’ which, for the purposes of this Standard, is considered the same as ‘unventilated’.

4.5 Well ventilated airspace

An airspace in which the openings between the airspace and the external environment are equal to or exceed—

- (a) 1500 mm^2 per metre of length (in the horizontal direction) for vertical airspaces; and
- (b) 1500 mm^2 per square of metre of surface area for horizontal airspaces.

NOTE: The term ‘unventilated’ is used to conform to ISO 6946. The AIRAH Handbook uses the term ‘non-ventilated’ which, for the purposes of this Standard, is considered the same as ‘unventilated’.

5 STANDARD ASSUMPTIONS

5.1 Temperatures and temperature difference

For calculations of total thermal resistance of construction, the following temperatures, temperature differences and mean temperatures shall be used.

For Australia:	Heat flow out: Indoors 18°C , outdoors 12°C , mean 15°C
	Heat flow in: Indoors 24°C , outdoors 36°C , mean 30°C
For New Zealand:	Heat flow out: Indoors 18°C , outdoors 6°C , mean 12°C
	Heat flow in: Indoors 24°C , outdoors 30°C , mean 27°C

The subfloor air temperature for heat flow in conditions shall be taken as the mean of the indoor and outdoor air temperatures.

5.2 Conversion coefficients for operating temperatures different to declared mean temperature

For insulation materials that operate outside of a mean temperature of the declared R-value in a system when boundary conditions are as per Clause 5.1, adjustment for the thermal conductivity of the insulation material shall be calculated as follows:

$$R_A = \frac{R_d}{F_T} \quad \dots 5.2(1)$$

where

R_A = R-value adjusted for operating temperature, in (m².K)/W

R_d = declared material R-value, in (m².K)/W

$$F_T = e^{f_T(T_o - T_d)} \quad \dots 5.2(2)$$

where

f_T = conversion coefficient

T_o = mean operating temperature as determined by Equation 10.3(4), in °C

T_d = mean temperature at which the material R-value has been declared (see Note), in °C

NOTE: Material R-value declared mean temperature is 23°C for Australia and 15°C for New Zealand, in accordance with AS/NZS 4859.1.

The conversion coefficients for various materials shall be as given in Tables 1 to 11.

For conductivities between those given in the tables, linear interpolation shall be used.

Unless otherwise specified the conversion coefficients shall apply to both factory-made products and loose-fill materials.

For materials that are not defined by Tables 1 to 11, conversion coefficients shall be determined by testing materials at three relevant and equally distant temperatures that are within the range of 6°C to 36°C, using linear interpolation between these data points.

NOTES:

- 1 Values of thermal conductivity in Tables 1 to 11, are given as identification parameters only and should not be intended for any other purpose. Conversion coefficients are suitable for temperatures from 0°C to 36°C.
- 2 The data for XPS and PU are valid for all blowing agents.
- 3 Tables 1 to 11 are reproduced from ISO 10456:2007 with the permission of the International Organization for Standardization, ISO. This Standard can be obtained from any ISO member and from the Website of the ISO Central Secretariat at the following address: www.iso.org. Copyright remains with ISO.

TABLE 1
MINERAL WOOL

Product type	Conductivity (<i>k</i>) W/(m K)	Conversion coefficient (<i>f_T</i>) 1/K
Batts, mats and loose fill	0.035	0.0046
	0.040	0.0056
	0.045	0.0062
	0.050	0.0069
Boards	0.032	0.0038
	0.034	0.0043
	0.036	0.0048
	0.038	0.0053
Rigid boards	0.030	0.0035
	0.033	0.0035
	0.035	0.0035

TABLE 2
EXPANDED POLYSTYRENE

Thickness <i>d</i> mm	Conductivity (<i>k</i>) W/(m K)	Conversion coefficient (<i>f_T</i>) 1/K
<i>d</i> < 20	0.032	0.0031
	0.035	0.0036
	0.040	0.0041
	0.043	0.0044
20 < <i>d</i> < 40	0.032	0.0030
	0.035	0.0034
	0.040	0.0036
40 < <i>d</i> < 100	0.032	0.0030
	0.035	0.0033
	0.040	0.0036
	0.045	0.0038
	0.050	0.0041
<i>d</i> > 100	0.032	0.0030
	0.035	0.0032
	0.040	0.0034
	0.053	0.0037