AS/NZS 4859.1:2018

Australian/New Zealand Standard™

Thermal insulation materials for buildings

Part 1: General criteria and technical provisions

STANDARDS Australia

STANDARDS® NEW ZEALAND
PAEREWA AOTEAROA

AS/NZS 4859.1:2018

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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
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AS/NZS 4859.1:2018

Australian/New Zealand Standard™

Thermal insulation materials for buildings

Part 1: General criteria and technical provisions

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee BD-058, Thermal Insulation, to supersede, AS/NZS 4859.1:2002, *Materials for the thermal insulation of buildings*, Part 1: *General criteria and technical provisions*.

The objective of this revision is to restructure the Standard as a material properties and test methods Standard and include latest thermal insulation products testing not previously covered by the Standard.

The significant changes in this edition are as follows:

(a) The relocation of all thermal insulation system design to a separate Part of this series (i.e. AS/NZS 4859.2).

(b) The deletion of the references to the AS 1366 suite of Standards.

(c) The inclusion of a wider range of thermal insulation materials and, in particular, rigid foam products.

Emphasis has been given to the development of clear and concise requirements for determination and labelling of thermal performance, a primary performance requirement for these materials. Another consideration is the effect of ageing of materials where there is a significant change in the insulation properties of those materials over time.

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

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.

If alternative tests to those prescribed in this Standard are to be used, they would need to be considered as part of the development of a Performance Solution to demonstrate compliance with the relevant Performance Requirements of the National Construction Code (NCC) and be accepted by the relevant building authority.

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SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard provides general criteria, technical provisions and methods of test for materials that are used for thermal insulation within buildings, including materials used for thermal insulation of ductwork and pipework.

Specific requirements for individual materials or insulation types are given in Sections 4 to 9.

This Standard does not address the following:

(a) Materials for the insulation of windows or glazing.

(b) Fire performance.

(c) Installation requirements of thermal insulation.

(d) Performance requirements of systems or materials that have some primary function other than providing thermal insulation.

1.2 NORMATIVE REFERENCES

The following are the normative documents referenced in this Standard:

NOTE: Documents referenced for informative purposes are listed in the Bibliography.

AS		
1134	Wool—Determination of wool base and vegetable matter base of core samples of raw wool	
1595	Cold-rolled unalloyed, steel sheet and strip	
2001	Methods of test for textiles	
2001.6.1	Method 6.1:	Miscellaneous tests—Determination of the resistance of textiles to certain insect pests
2001.7	Method 7:	Quantitative analysis of fibre mixtures
4200	Pliable building membranes and underlays	
4200.2	Part 2:	Installation
AS/NZS		
4200	Pliable building membranes and underlays	
4200.1	Part 1:	Materials
4201	Pliable building membranes and underlays—Methods of test	
4201.1	Method 1:	Resistance to dry delamination

ISO

8301	Thermal insulation—Determination of steady-state thermal resistance and related properties; heat flow meter apparatus
8302	Thermal insulation—Determination of steady-state thermal resistance and related properties; guarded hot plate apparatus
8990	Thermal insulation—Determination of steady-state thermal transmission properties—calibrated and guarded hot box

ASTM

C167	Test methods for thickness and density of blanket or batt thermal insulations
C177	Test method for steady-state heat flux measurements and thermal transmission properties by means of the guarded-hot-plate apparatus
C335	Standard test method for steady-state heat transfer properties of horizontal pipe insulation
C518	Test method for steady-state heat flux measurements and thermal transmission properties by means of the heat flow meter apparatus
C687	Practice for the determination of thermal resistance of loose fill building insulations
C739	Standard Specification for cellulosic fibre (wood-base) loose-fill thermal insulation
C1363	Standard test method for the thermal performance of building assemblies by means of hot box apparatus
C1667	Standard test method for using heat flow meter apparatus to measure center-of-panel thermal transmission properties of vacuum insulated panels

EN

12667	Thermal performance of building materials and products—Determination of thermal resistance by means of guarded hot plate and heat flow meter methods—Products of high and medium thermal resistance
12939	Thermal performance of building materials and products—Determination of thermal resistance by means of guarded hot plate and heat flow meter methods—Thick products of high and medium thermal resistance
13164:2012 +A1:2015	Thermal insulation products for buildings—Factory made extruded polystyrene foam (XPS) products—Specification
13165:2012 +A1:2016	Thermal insulation products for buildings—Factory made rigid polyurethane foam (PU) products—Specification
13166:2012 +A1:2016	Thermal insulation products for buildings—Factory made phenolic foam (PF) products—Specification

1.3 DEFINITIONS

For the purpose of this Standard the definitions below apply.

1.3.1 Declared thermal resistance, (R_d)

Expected value of thermal resistance for a building material or product assessed from measured material thermal resistance data at reference conditions of temperature and humidity, for a stated fraction and confidence level, and corresponding to an expected service lifetime under normal conditions. [Unit: $(m^2.K)/W$]

1.3.2 Declared thermal conductivity, (λ_d)

Expected value of thermal conductivity for a building material or product assessed from measured material thermal conductivity data at reference conditions of temperature and humidity, for a stated fraction and confidence level, and corresponding to an expected service lifetime under normal conditions. [Unit: W/(m.K)]

1.3.3 Pack

A number of pieces or blankets contained as a unit, usually within plastic wrapping.

1.3.4 Pliable non-reflective insulation

A bulk insulating material that is able to be folded 180° back on itself without mechanical failure.

1.3.5 Segmented foil insulation

IR reflective insulation cut or formed into individual sections for use between or over building structural members.

NOTE: Segmented foil insulation is produced in packs, not rolls. Because it is not continuous, it cannot perform as a sarking membrane or vapour control membrane.

1.3.6 Stabilized

The value, representing the installed condition, allowing for variations of thermal insulation materials and other installation-related factors, when referring to thickness, density, thermal resistance and thermal conductivity.

1.3.7 Total thermal resistance (R_t)

A total resistance associated with a material, or a system or construction of materials, computed or measured over an area which is fully representative of the element of construction, and specified as a total-R value, including surface film resistances and thermal bridging. [Unit: $(m^2.K)/W$]

1.3.8 Wool

Wool derived from the fleece of sheep.

NOTE: The term ‘wool’ is used in this Standard as a qualifying term to describe the fibrous nature of materials such as mineral wool, rock wool, glass wool and steel wool. Where the term is used to describe a material (rather than a physical characteristic) it means wool derived from sheep.

SECTION 2 CRITERIA AND TECHNICAL PROVISIONS

2.1 GENERAL

This Section provides performance criteria and technical provisions for materials to be used in the thermal insulation of buildings and building services.

In addition to this Section the insulating material shall—

(a) meet packaging and labelling requirements of Section 3;

(b) where applicable, meet product specific requirement of Sections 4 to 9, and normative Appendices B, C, D and E.

2.2 VALIDITY OF TEST RESULTS

Insulation products shall be retested if any change is made to material formulation or design that affects the performance.

2.3 THERMAL RESISTANCE

2.3.1 General

Thermal resistance of insulation material is designated as its declared R-value, which is determined as specified in Clause 2.3.3.

NOTES:

1 Some materials achieve a thermal resistance that is lower in the long term than at the time of installation. Common causes include the settlement of dust on IR reflective insulations, changes in cell gas composition in foam insulations and settlement of loose fill insulations.

2 Some compression-packaged materials take time to achieve their stabilized thickness and R-value.

3 For guidance on measurement of thermal resistance, see Appendix A.

4 The moisture content of materials will affect their thermal resistance.

5 For guidance on determination of design R-value, refer to AS/NZS 4859.2.

2.3.2 Category

Materials shall be categorized as follows:

(a) *Formed shapes* Self-supporting shapes that have uniform or regularly repeating geometry on a scale small enough to permit determination of thermal resistance by physical measurement of heat flow through a representative area.

NOTES:

1 Formed shapes include panels, complete building elements such as walls or roofs, or other assemblies of different materials, which could include or combine bulk and IR reflective components internally but satisfy the requirement of small-scale uniformity. Formed shapes include bulk insulation materials with solid, cellular or other regular structure, (e.g. foamed or cellular plastics, insulating concretes, rammed earth, mud brick, wood-based products and rigid cellulose-based products such as cardboard, aerogels, cast resins and plasters). They also include fibrous materials not meeting the definition of ‘compressible’.

2 For guidance on thermal resistance measurement, see Appendix A.

(b) *Formed in situ* Materials such as paints and other coatings, sprayed fibres, and sprayed or injected foams.

(c) *Compressible* Materials that can be compressed by 20% or greater at 2 kPa applied pressure, including segments and blanket, and usually supplied compression packaged (e.g. rock wool, glass wool, polyester fibre, wool and like materials). If the material cannot be compressed by 20% at 2 kPa, it shall be treated as 'formed shapes'.

(d) *Loose fills* Materials and mixtures of materials that are granular or loose and that could compact under load (e.g. cellulose fibre, exfoliated vermiculite, expanded perlite, wool, glass wool, granulated cork, mineral wool, rock wool, slag wool, and expanded plastic beads or chips, granular minerals and earths).

(e) *IR reflective* Formed shapes and compressible materials that incorporate one or more external IR reflective surfaces and that have uniform or regularly repeating geometry on a scale small enough to permit determination of thermal resistance by physical measurement of heat flow through a representative area (e.g. IR reflective foil insulation, IR reflective claddings and facings of buildings and foil-faced pieces and blankets, where used in applications that satisfy the requirement of small-scale uniformity).

NOTE: Only the bulk insulation component R-value can be determined using the test methods detailed in this Standard. Any contribution from IR reflective airspaces external to the material should be calculated according to the methods detailed in AS/NZS 4859.2.

(f) *Vacuum panels* Insulation systems whose gas phase thermal conductivity portion of the overall apparent thermal conductivity has been significantly reduced by reduction of the internal gas pressure.

2.3.3 Determination of thermal resistance R-value

2.3.3.1 *General*

Insulation properties for individual material specimens shall be measured in accordance with the test methods specified in Table 2.3.3.1.

NOTE: This Standard does not prescribe minimum or maximum requirements for thermal resistance.

TABLE 2.3.3.1

STANDARD METHODS FOR DETERMINATION OF THERMAL PROPERTIES

Property	Test methods
Thermal resistance of all categories other than vacuum panels	Any of ASTM C177, ASTM C518, ASTM C1363, ISO 8301, ISO 8302, ISO 8990, EN 12667, EN 12939
Thermal resistance of pipe insulation	ASTM C335 or alternative calculation as per Clause 2.3.3.7 of this Standard
Thermal resistance of loose-fill	ASTM C687 and Appendix C
Thermal resistance of vacuum panels	ASTM C1667 (see Note)
Nominal thickness of compressible fibrous	ASTM C167 and Appendix B
Ageing factor and/or aged thermal resistance of PUR, PIR, PF and XPS rigid foams	Refer to Section 8

NOTE: ASTM C1667 only measures the centre-of-panel thermal resistance. Adjustments shall be made in order to determine the effective thermal resistance of the entire panel.

2.3.3.2 *Sampling*

The test specimens shall be representative of the product, in particular the mass per unit area and thickness.

NOTE: For guidance on sampling plans for factory-made products, see ISO 12576-1, and for site-made products such as loose fill, see ISO 12576-2.

2.3.3.3 *Specimen conditioning*

Test specimens shall be conditioned for at least 12 h at 23 ±2°C and 50 ±5% relative humidity, unless otherwise specified in the test methods or in Sections 4 to 9.

2.3.3.4 *Test thickness*

Thermal conductivity and thermal resistance of compressible insulation materials shall be determined at the lesser of nominal thickness and actual measured thickness.

Thermal conductivity of samples that are greater than nominal thickness and cannot be compressed for thermal measurement shall be determined at actual thickness. Thermal resistance of specimens shall not be reported at thicknesses greater than nominal thickness.

2.3.3.5 *Declared thermal performance*

Thermal resistance shall be declared at a standard mean temperature of 23°C for products sold in Australia, and 15°C for products sold in New Zealand.

NOTE: Where required, declared thermal value should be supported by data summarized in accordance with Clause 2.3.3.9.

Thermal resistance and thermal conductivity may be measured at mean temperatures other than those at which they are declared, and then adjusted to the declared temperature, provided the accuracy of the relationship between temperature and thermal properties is well documented.

NOTE: Calculation methods for common insulants under limited conditions can be found in ISO 10456 and AS/NZS 4859.2.

For categories other than vacuum panels, the declared R-value, R_{declared}, and declared thermal conductivity, $\lambda_{\text{declared}}$, shall be derived from the statistically adjusted mean values $\lambda_{50/90}$ and $R_{50/90}$, representing a 50% fractile with 90% confidence, and a one-sided statistical tolerance interval (see Note 1 and Note 2), and which shall be based on thermal measurements on at least 10 individual specimens.

$R_{50/90}$ and $\lambda_{50/90}$ shall be calculated using the following equations:

$$R_{50/90} = R_{\text{mean}} - k_2.s \qquad \text{. . . 2.3.3.5(1)}$$

$$\lambda_{50/90} = \lambda_{\text{mean}} + k_2.s \qquad \text{. . . 2.3.3.5(2)}$$

where

k_2 = coefficient used when the standard deviation is estimated for one-sided tolerance interval (see Note 2)

s = sample standard deviation for the 10 or more measured values used to determine the declared value

NOTES:

1 For example calculation, see Annex B of ISO 10456:2007.

2 On the basis of an assumed Gaussian distribution, the adjustment coefficient $k_2(n;50\%;90\%)$ used in Equation B.1 of Annex B of ISO 10456:2007 is in column 4, Table C.1, Annex C, ISO 10456:2007.

3 For the particular case of n = 10, the value of k_2 in Table C.1, Annex C, ISO 10456:2007 is 0.44.

If thermal measurements have been performed on specimens at greater than nominal thickness, as permitted by Clause 2.3.3.4, $R_{50/90}$ shall be calculated at nominal thickness from the following equation instead of Equation 2.3.3.5(1):

$$R_{\text{declared}} = d_N / \lambda_{50/90} \qquad \text{. . . 2.3.3.5(3)}$$

where

d_N = nominal thickness, in metres

During calculations, no value shall be rounded to less than three significant figures.

The declared thermal resistance shall not be greater than $R_{50/90}$, and shall be rounded downwards to the nearest 0.05 $(m^2{\cdot}K)/W$ for R-values of 1.0 $(m^2{\cdot}K)/W$ or more, and downwards to the nearest 0.01 $(m^2{\cdot}K)/W$ for R-values of less than 1.0 $(m^2{\cdot}K)/W$.

The declared thermal conductivity shall not be less than $\lambda_{50/90}$, and shall be rounded upwards to the nearest 0.001 W/(m.K).

Where thermal resistance could be lower in the long term (see Clause 2.3.1), the declared values shall take this into account, through the application of the accelerated ageing methods listed in Table 2.3.3.1. The determination of aged thermal performance shall also use at least 10 representative test specimens.

2.3.3.6 *Assessment of similar materials of differing nominal thickness*

Where a group of homogenous bulk insulation products of similar chemical and physical composition and differing only in thickness are expected to have the same thermal conductivity, only the thickest and thinnest products within the group need to be tested as a minimum requirement. Declared thermal conductivity for each tested thickness shall be determined from a minimum of 10 specimens in accordance with Clause 2.3.3.5. The highest declared thermal conductivity shall be taken to apply to the whole group and used to calculate the declared R-value for each product thickness within the group. Extrapolation shall not exceed 20 mm, to a maximum of 20% of the thickness tested, outside the tested thickness range.

Where aged thermal conductivity values are influenced by facings applied to the products (e.g. some rigid foams), separate product groups shall be established for products without facing, for products with diffusion open facing, and for products with diffusion tight facing.

2.3.3.7 *Alternative method for calculation of R-value for pipe insulation*

As an alternative to test method ASTM C335, as specified in Table 2.3.3.1, it is permitted to calculate the material R-value of pre-formed pipe insulation by measuring the thermal conductivity as a formed shape in accordance with Clause 2.3.3 on a planar section of insulation of the same specification as that of the pre-formed pipe section. The following formula shall then be applied to determine the material R-value of the pre-formed dimensions:

$$R = (r_2 \log_e(r_2/r_1))/k \qquad \text{. . . 2.3.3.7}$$

where

R = material R-value of the pre-formed pipe insulation section

r_1 = inner radius of the pipe insulation, in metres

r_2 = outer radius of the pipe insulation, in metres

k = thermal conductivity of the insulation in planar form, in watts per metre kelvin

2.3.3.8 *Reporting of test results*

Test reports shall satisfy the reporting requirements of the relevant test method.

For loose fill materials, the report shall state whether or not the variation set out in Appendix C (for remotely blown pneumatically applied materials) has been adopted and, if so, the density of the material, as nominated by the supplier, and the method of agitation used to restore the sample to the blown density.

2.3.3.9 *Thermal value summary report*

A thermal value summary report shall include the following:

(a) Product label details, including statement of conformance with this Standard, i.e. AS/NZS 4859.1.

(b) Statistical calculation of $R_{50/90}$, in accordance with Clause 2.3.3.5.

2.4 INFRA-RED EMITTANCE

Where insulating materials or assemblies achieve some or all of their thermal resistance through the IR reflective nature of their external surfaces, and these surfaces are claimed to have an infrared emittance less than 0.9, the infrared emittance of these surfaces shall be determined. Measurement shall be in accordance with AS/NZS 4200.1, and shall be stated on the label.

NOTE: See AS/NZS 4859.2 for guidance on infra-red emittance.

2.5 CORROSIVENESS

Materials with the exception of the following shall be tested for corrosiveness:

(a) Composed entirely of mineral or plastic fibres (such as rock wool, glass wool, polyester fibre) with or without inert binders (such as phenyl formaldehyde resins).

(b) Inert plastics (foamed or solid).

(c) Inert minerals that do not react with liquid water.

(d) Cellulose fibre that contains certain formulations of fire-retardant chemicals as its sole additives (see Section 4).

When tested for corrosiveness in accordance with Appendix D, materials shall be non-corrosive.

NOTE: This requirement addresses the possible tendency of some insulation materials, especially those incorporating water-soluble ionic additives (e.g. salts used as fire retardants) to increase the risk of corrosion damage to building structures and elements in contact with such agents. It does not, address the question of the resistance of the insulation itself to corrosion damage. This requires a test that is relevant primarily to foils and sarking (see Clause 9.3.3).

SECTION 3 PACKAGING AND LABELLING

3.1 GENERAL

The packaging of the insulation material or assembly shall be such that it provides protection during handling, transport and storage, and ensures that product performance will be maintained through normal storage and handling.

The declared R-value shall be the long-term value and shall take into account the derating that could arise through ageing. Labelling shall be in accordance with Table 3.1, and be provided with each package. Additional information may be provided by the manufacturer or agent. The required information shall be conspicuous.

The labelled R-value shall be expressed to not more than 2 decimal places, and shall not be rounded to a value greater than the declared value determined in accordance with Clause 2.3.3.5.

3.2 SAFETY ADVICE

Advice on safe handling and installation of the insulation shall be stated on the packaging.

Safety advice shall include the following statement:

> CAUTION: ELECTRICAL CABLES AND EQUIPMENT PARTIALLY OR COMPLETELY SURROUNDED WITH BULK THERMAL INSULATION MAY OVERHEAT AND FAIL.

TABLE 3.1

LABELLING REQUIREMENTS

Type of material	Information required
All types	Product name Description of contents Name and address of manufacturer or supplier Identification of manufacturing plant Batch identification or other traceability information Safety guidance A statement of conformance with this Standard, i.e. AS/NZS 4859.1 Declared material R-value [(m^2.K)/W], and the temperature at which it applies
IR Reflective	Infra-red emittance value of surfaces with declared emittance less than 0.9 Material declared R-value for Product Groups 4, 5, 6 and 7 (see Clause 9.2)
Loose fill and formed in situ	Nominal coverage (area per unit mass) and stabilized thickness (mm), for each declared R-value Nominal net weight of contents or supplied quantity (kg)
Formed shapes and compressible	Number of pieces Nominal total area (m^2) Nominal length, width and thickness of each piece Nominal net weight of contents or supplied quantity (kg)
Containing wool	Wool fibre content (see Clause 5.2.4)

SECTION 4 CELLULOSE FIBRE INSULATION

4.1 GENERAL

This Section provides specific requirements for loose-fill insulation composed of cellulose fibre made from paper or paperboard stock derived from wood, in addition to fire-retardant chemicals, with the total of these ingredients comprising more than 95% by weight of the product on a dry basis.

Sections 1 to 3 apply in addition to this Section.

4.2 PERFORMANCE CRITERIA AND TECHNICAL PROVISIONS

4.2.1 Physical

Either used or unused paper or paperboard stock is permitted for use in the manufacture of cellulose fibre insulation.

The product shall have a stabilized density of between 20 kg/m^3 and 70 kg/m^3.

4.2.2 Corrosion

If the fire-retardant formulation is the sole additive and is a mixture of boric acid and borax, with the borax being between 15% and 35% of the mixture by weight and the total quantity of fire retardant being not less than 17% of the finished product by weight, then this product shall be deemed to be non-corrosive and exempt from the requirement for corrosion testing.

All other formulations shall pass the requirements of Appendix D.

4.2.3 Moisture absorptance

When tested in accordance with ASTM C739, materials shall have a moisture absorption of less than 20%.

SECTION 5 INSULATION CONTAINING WOOL

5.1 GENERAL

This Section provides specific requirements for insulation comprising more than 5% by weight of wool, which includes fire retardants and insect protective agents applied during the manufacturing process.

Sections 1 to 3 apply in addition to this Section.

5.2 PERFORMANCE CRITERIA AND TECHNICAL PROVISIONS

5.2.1 Thermal resistance

As wool can exhibit slow loft recovery after compression packaging, the product shall be conditioned at 45 ±2°C and 60 ±5% relative humidity for 24 h to accelerate relofting prior to thermal testing. The product shall then be further conditioned in accordance with Clause 2.3.3.3 and the thermal resistance shall be determined at the lesser of the relofted thickness and declared thickness.

NOTE: Wool typically recovers to a stable thickness within a month after installation depending on the degree of packaging compression and the ambient environmental conditions. The time interval after installation that the product will achieve the declared thickness and, therefore, R-value, should be stated on the label. The conditioning requirement of this Clause is to expedite lofting to the declared thickness.

5.2.2 Physical

5.2.2.1 *General*

Either used or unused wool is permitted for use in the manufacture of wool insulation.

Raw wool shall be scoured (washed) to effectively remove wool wax (wool grease), suint and dirt present on the raw wool fibre.

If recycled wool is used, it shall be free of processing additives such as spinning oils or other blend fibres that will adversely affect its fire performance.

5.2.2.2 *Vegetable content*

When measured in accordance with AS 1134, vegetable content of scoured wool shall be a maximum of 3%.

NOTES:

1 Vegetable matter mainly affects appearance of the wool product, although under some circumstances it could act as a food source for silverfish or vermin.

2 In some locations, there might also be restrictions on transport of material containing viable seed matter.

5.2.3 Insect resistance

Wool insulation shall be treated to resist insect attack. When tested for insect resistance in accordance with AS 2001.6.1, wool insulation materials shall achieve a 'satisfactory' rating.

Because some insect-resistant agents act as antifeedants, uniform coverage of the wool is required.

Samples for insect bioassay testing shall be representative of insulation as installed.

NOTE: Insulation containing untreated wool is liable to attack by certain insect species (clothes moths or carpet beetles) using the wool as a protein source. Whilst these insects are destroyed by prolonged exposure to temperatures above 50°C, these temperatures are rarely reached through the insulation mass in most parts of Australia. Depending on the method of treatment, some loss of protective agent by dusting during installation is also possible.

5.2.4 Wool fibre content

The wool fibre content shall be measured in accordance with AS 2001.7, except that samples of 10 g rather than the 1 g shall be used

The mass of fire retardant and insect resistant agents shall be independently determined and included with the weight of wool fibre for the purposes of defining the material composition.

If the wool fibre content is greater than 95%, the insulation shall be described as 'wool'. Otherwise, the actual wool fibre content shall be declared.

SECTION 6 LOW DENSITY POLYESTER FIBRE INSULATION

6.1 GENERAL

This Section provides specific requirements for low density fibrous insulation, which is commonly supplied as blankets or cut pieces and composed of polyester fibre, with the possible addition of adhesive binders applied during the manufacturing process, with the total of these ingredients comprising more than 95% by weight of the product.

Sections 1 to 3 apply in addition to this Section.

6.2 PERFORMANCE CRITERIA AND TECHNICAL PROVISIONS

6.2.1 Thermal resistance

As polyester can exhibit slow loft recovery after compression packaging, the product shall be conditioned at 45 ±2°C for 24 h to accelerate relofting prior to thermal testing. The thermal resistance shall be determined at the lesser of the relofted thickness and the declared thickness. The product shall then be further conditioned in accordance with Clause 2.3.3.3 and the thermal resistance shall be determined at the lesser of the relofted thickness and declared thickness.

NOTE: Polyester typically recovers to a stable thickness within a month after installation depending on the degree of packaging compression and the ambient environmental conditions. The time interval after installation that the product will achieve the declared thickness and, therefore, R-value, should be stated on the label. The conditioning requirement of this Clause is to expedite lofting to the declared thickness.

6.2.2 Physical

The polyester fibres shall be bonded into resilient cut pieces or blankets using either heat-bonding of low melt-temperature polyester fibres as a fraction of the fibre mix or using spray-adhesive bonding.

6.2.3 Dimensional tolerances

When any blanket or cut piece from any pack is measured in accordance with ASTM C167, the average length and width dimensions shall be the values nominated by the manufacturer on the product label, within the tolerances given in Table 6.2.3.

TABLE 6.2.3

LOW DENSITY POLYESTER FIBRE INSULATION DIMENSIONAL TOLERANCES

Form of insulation	Length	Width
Cut pieces	+50 mm −5 mm	+10 mm −5 mm
Blankets	+30 mm/m −5 mm/m	+15 mm −5 mm

SECTION 7 LOW DENSITY MINERAL WOOL INSULATION

7.1 GENERAL

This Section provides specific requirements for low density fibrous insulation, which is commonly supplied as blankets or cut pieces, composed of mineral wool, in addition to binders applied during the manufacturing process, with the total of these ingredients comprising more than 95% by weight of the product.

Sections 1 to 3 apply in addition to this Section.

7.2 PERFORMANCE CRITERIA AND TECHNICAL PROVISIONS

7.2.1 Physical

Mineral wool shall be manufactured from inorganic oxides or minerals, rock slag or glass. It shall be processed at high temperatures from the molten state into a non-crystalline, fibrous glassy form. It shall be formed into flexible blankets or formed shapes, which may be cut into pieces of certain sizes, or supplied as rolls. Polymeric binders, usually of a thermosetting composition, may be used.

7.2.2 Dimensional tolerances

When material from any pack is measured in accordance with ASTM C167, the average length and width dimensions shall be the values nominated by the manufacturer on the product label (see Section 3), within the tolerances given in Table 7.2.2.

TABLE 7.2.2

LOW DENSITY MINERAL WOOL INSULATION DIMENSIONAL TOLERANCES

Form of insulation	Length	Width
Cut pieces	+30 mm −5 mm	+10 mm −5 mm
Blankets	+20 mm/m −5 mm/m	+15 mm −5 mm

SECTION 8 RIGID CELLULAR FOAM INSULATION

8.1 GENERAL

This Section provides specific requirements for rigid cellular foam insulation, which is commonly supplied in the form of sheets, board, blocks and cut shapes. It includes, but is not limited to, polyurethane foam (PUR), polyisocyanurate foam (PIR), phenolic foam (PF), expanded polystyrene foam (EPS) and extruded polystyrene foam (XPS) products.

Sections 1 to 3 apply in addition to this Section.

8.2 PERFORMANCE CRITERIA AND TECHNICAL PROVISIONS

8.2.1 Physical

Polyurethane foam shall be a rigid cellular thermoset polymeric material, manufactured from polymers mainly of polyurethane groups expanded with a blowing agent.

Polyisocyanurate foam shall be a rigid cellular thermoset polymeric, manufactured from polymers mainly of polyisocyanurate groups expanded with a blowing agent.

Phenolic foam shall be a rigid thermoset cellular polymeric material, manufactured primarily from the polycondensation of phenol, its homologues and/or derivatives, with or without aldehydes or ketones, and expanded with a blowing agent.

Expanded polystyrene foam shall be a rigid thermoplastic cellular material with an air-filled cellular structure, manufactured by moulding beads or granules of expandable polystyrene or one of its copolymers.

Extruded polystyrene foam shall be a rigid thermoplastic cellular material, manufactured by extrusion of polystyrene or one of its copolymers expanded with a blowing agent.

8.2.2 Thermal resistance

Declared thermal resistance shall be determined from aged values determined in accordance with the following:

(a) For PUR and PIR, either the fixed increment procedure or the accelerated ageing procedure detailed in EN 13165:2012+A2:2016.

(b) For PF, either the slicing method or the heat ageing method detailed in EN 13166:2012+A2:2016.

(c) For XPS, the ageing procedures detailed in EN 13164:2012+A1:2015.

NOTE: These methods take account of the ageing effect, which is due to changes in the cell gas composition with time, and give a prediction of averaged ageing values over 25 years.

The following variations to the methods and procedures specified above shall apply:

(i) Thermal resistance of each test specimen shall be determined by one of the test methods specified in Clause 2.3.3.1.

(ii) Thermal resistance shall be declared at the mean temperatures specified in Clause 2.3.3.5 of this Standard.

Expanded polystyrene (EPS) does not contain low thermal conductivity blowing agents so thermal resistance determination does not require any allowance for ageing. Declared thermal resistance of EPS shall be determined in accordance with Section 2.

SECTION 9 IR REFLECTIVE INSULATION

9.1 GENERAL

This Section provides specific requirements for insulation that incorporates an IR reflective metallic surface in the form of either a rolled metallic foil or a metallic deposit.

Sections 1 to 3 apply in addition to this Section. In addition, insulation materials or assemblies that include bulk insulation components shall conform with the requirements of Sections 4 to 8, as applicable.

9.2 PRODUCT GROUPS

IR reflective insulation falls into one of the following product groups:

(a) *Group 1* Pliable building membranes that have at least one IR reflective surface. If the products within this group are installed facing an appropriate airspace, they can provide thermal insulation.

NOTE: These products are often intended to have a prime function as a sarking or vapour control membrane. For this application, test methods, performance classifications and installation requirements are covered by AS/NZS 4200.1 and AS 4200.2.

(b) *Group 2* Single sheet segmented IR reflective pliable membranes for installation between structural members (e.g. folded single sheet foil laminate).

(c) *Group 3* Multiple layers of segmented IR reflective pliable membranes formed and assembled to give multiple IR reflective airspaces for installation between and over structural members.

(d) *Group 4* IR reflective material bonded directly or via a substrate to a rigid insulation or support to provide a product in sheet form for application to structural members.

(e) *Group 5* IR reflective material bonded directly or via a substrate to a pliable non-IR reflective insulating material for installation between or over structural members or in a continuous length.

(f) *Group 6* IR reflective material bonded directly or via a substrate to the inside of individual wall cladding sheets (metal or plastic), weatherboard type.

(g) *Group 7* IR reflective material bonded directly, or via a substrate, to the underside of a metal roof or wall sheet.

9.3 PERFORMANCE CRITERIA AND TECHNICAL PROVISIONS

9.3.1 Infra-red emittance

All IR reflective surfaces shall be tested for infra-red emittance in accordance with Clause 2.4.

9.3.2 Dry delamination

All products shall pass the requirements of AS/NZS 4201.1, with the following modifications:

(a) *Group 3* Sample size, full product width; number of samples, 4.

(b) *Group 7* Test temperature 90 ±2.5°C.

(c) Group 1 products shall be exempt from this requirement, provided they are in accordance with AS/NZS 4200.1.

9.3.3 Surface corrosion and wet delamination

When tested for resistance to surface corrosion and wet delamination in accordance with Appendix E, all products shall achieve a pass.

9.4 PACKAGING

Where water-based products are used in the manufacture of the IR reflective insulation, the product shall be dry before packaging to prevent damage from exposure to excess moisture.

APPENDIX A

GUIDANCE ON THERMAL RESISTANCE MEASUREMENT

(Informative)

All thermal test apparatus incorporate a 'metering area' over which the heat flowing through a test sample is measured. The size of this area determines the suitability of the apparatus for testing materials with regular spatial variations in thermal resistance, which arise from spatial variations in composition. The metering area should be large enough to 'average-out' such effects.

The nominal size of a test apparatus is generally much larger than its metering area, since the inner metering region is surrounded by a guard area to ensure uniform heat flow and minimal edge effects. With some apparatus, the metering area might be quite small, for example, it might be 150 mm^2 in a typical 300 mm^2 guarded hotplate apparatus.

On a larger 1000 mm^2 heat flow meter apparatus it would typically be about 500 mm^2, large enough to allow measurement of such things as hollow concrete blockwork walls that are uniform on this scale. This metering area is not large to accommodate the spatial irregularities that can arise within many stud walls or extended areas of ceiling with long runs of joists at 460 mm spacing. Such measurements are generally performed in a guarded hot box apparatus, which would typically have a metering area of the order of 1000 mm^2. Even this metering area might be too small in circumstances where there are variations over the complete height of a wall or where a complete roof space is under investigation.

Although it has limited precision and other difficulties, the calibrated hot box method offers the largest metering area, possibly exceeding 3 m^2, as it dispenses with the normal guard area. By definition, 'large scale' insulation materials or assemblies are those that are irregular on too large a scale to permit measurement using test apparatus in commercial operation within Australia and New Zealand.

Smaller test apparatus can offer higher accuracy for thinner test samples but are more limited in accuracy for thick samples, due to edge effects. These effects typically introduce unacceptable errors for samples thicker than about one quarter of the plate dimension (i.e. a 250 mm thick sample in a 1000 mm^2 apparatus).

APPENDIX B

DETERMINATION OF THE THICKNESS AND DENSITY OF COMPRESSIBLE FIBROUS INSULATION USING ASTM C167 WITH VARIATIONS

(Normative)

B1 SCOPE

A production pack of compressible fibrous insulation can contain material with variability in density and thickness as an installed product. This is due both to variabilities in the material itself, as well as the duration and degree of compressive packaging, which affects thickness recovery. Common materials of this type include rock wool, glass wool, polyester fibre and wool. Also included are combinations of these materials and any other fibres with similar properties, which may be bonded so as to produce a flexible, compressible formed shape or blanket. ASTM C167 is applicable to a wider range of material types and for the different standard sizes used in Australia and New Zealand when the variations that are set out in Paragraph B2 are incorporated.

B2 REQUIREMENTS

B2.1 Variation number 1—Applicability

The applicability of ASTM C167 shall be extended to cover all compressible fibrous material used as thermal insulation.

B2.2 Variation number 2—Dimensions

Where ASTM C167 refers to imperial dimensions, the closest corresponding metric dimensions shall be used. The thickness measurement locations on Australian and New Zealand compressible fibrous insulations shall have the same proportion and general form as the locations specified within ASTM C167 for imperial products.

B2.3 Variation number 3—Number of thickness measurements

In order to accommodate a wide range of materials, some of which might have poor thickness uniformity, the number of thickness measuring points described in ASTM C167 shall be doubled by the addition of a mirror-image set of locations for all materials. This shall result in 10 thickness measurements per piece or section of blanket. One of these measurements, at the centre of the piece, is a mirror-image of itself and shall be simply repeated to maintain an appropriate weighting of locations.

B2.4 Variation number 4—Thickness depth gauge

The 75 mm diameter depth gauge described in ASTM C167 shall not be used where the surface of the material has height irregularities greater than 5% of the nominal thickness over the area of the gauge disk at any measuring point.

In such instances, either one of the following shall be used:

(a) A 10 mm diameter disk (see Note 1).

(b) A probe with a 25 mm diameter disk and capable of exerting a pressure of 25 Pa.

NOTES:

1 An example of a compliant depth gauge with 10 mm disk is given in Appendix F.

2 The 10 mm disc or 25 mm disc may be used for all thickness measurements.

APPENDIX C

DETERMINATION OF THE THERMAL RESISTANCE OF LOOSE FILL INSULATION USING ASTM C687 WITH VARIATIONS

(Normative)

C1 SCOPE

Loose fill materials, where used as building insulation, range from mineral granules and pellets with densities above 1000 kg/m^3 to very low density fibrous materials with densities below 5 kg/m^3. They could be either compressible or non-compressible. The density and thickness could be dependent on sample preparation and installation procedures. Settlement could occur over time.

ASTM C687 is designed to take account of these factors; however, ASTM C687 includes requirements for pneumatically blown materials, which involve transportation of the blowing equipment to the site of the test. This is generally impractical within Australia and New Zealand because of great distances and the small number of testing laboratories. An alternative procedure for preparing pneumatically blown insulations is described in Paragraph C2. When incorporating this variation, ASTM C687 is applicable to all loose fill materials.

C2 VARIATION TO SPECIMEN PREPARATION PROVISIONS FOR REMOTELY BLOWN, PNEUMATICALLY APPLIED MATERIALS

Loose fill material that is normally installed pneumatically (by blower or similar technique) may be blown remotely (away from the testing laboratory) and prepared as follows:

(a) The material shall be blown (at the point of supply) into a rigid container (such as a cardboard box) using the technique and equipment that is normally employed to blow this material into place in a building. The container, containing a small excess of material, shall then be delivered to the testing laboratory by normal transportation methods. The blown material shall include the coverage and stabilized thickness at which testing is to be performed, for the case where ceiling joists and other coverage-extending objects are assumed not to exist. This information shall be as follows:

   (i) Coverage—in one of the following alternative units:

      (A) Area per unit mass (m^2/kg or m^2/g).

      (B) Area per bag (m^2/bag) for bags of stated weight (kg).

      (C) Mass per unit area (kg/m^2 or g/m^2).

   (ii) Stabilized thickness (mm). The test thickness shall be considered to be the stabilized thickness and the test density to be the value calculated from the coverage and stabilized thickness nominated by the supplier.

(b) At the testing laboratory, the material shall be agitated to reverse the effects of excess settlement due to transportation. The material shall be placed in an open shallow container and conditioned until it to reaches constant weight, shown to be within 1% weight change in 24 h.

(c) Specimen preparation shall proceed in accordance with Clause 7.3.6 of ASTM C687 (2012) and subsequent clauses of ASTM C687 (2012), using a selected amount of the re-agitated conditioned material.

NOTE: Depending on the material, a number of alternative techniques can be used to agitate blown loose fill materials to restore them to the original density. With cellulose fibre, an impeller or propeller on the end of an electric drill is an effective method. A 220 mm model aircraft propeller on a 500 mm long shaft operating in a variable speed electric drill with a maximum speed of approximately 3000 rev/min has been found to be satisfactory. Wool and other materials with long fibres usually tangle with this technique. For such materials, an effective technique is agitation by a hand-held whisk with a single flexible tine of 5 mm aluminium tubing or similar material about 700 mm long.

APPENDIX D
DETERMINATION OF CORROSIVENESS
(Normative)

D1 GENERAL

Determination of corrosiveness shall be in accordance with the test procedures set out in this Appendix.

NOTE: As the pre- and post-cleaning procedures involve the use of hazardous chemicals, these tests should only be carried out by, or under the supervision of, a qualified chemist.

D2 APPARATUS

The following apparatus is required:

(a) A forced-air humidity chamber capable of maintaining 50 ±1°C and not less than 95% relative humidity.

(b) A balance capable of determining mass to an accuracy of 0.0001 g.

(c) Stainless steel wire mesh (type 304, 24 mesh, 0.355 mm wire diameter, 0.71 mm aperture size), cut into strips measuring 112.5 mm long by 7.5 mm wide.

(d) A water bath.

(e) No. 12 rubber bands, not more than 12 months old.

(f) A stiff nylon bristle brush.

(g) Hair dryer.

(h) Various size beakers, watch glasses and tweezers.

D3 REAGENTS AND MATERIALS

All reagents shall be analytical grade unless specified. The following reagents and materials are required:

(a) 1,1,1-trichloroethane (TCE).

(b) Sodium hydroxide.

(c) Sulfuric acid (specific gravity 1.84).

(d) 1,3-di-o-tolyl-2-thiourea.

(e) Ethanol.

(f) Acetone.

(g) Roll of surgical grade cotton wool wadding.

D4 TEST COUPONS—STEEL

Coupons shall be prepared from steel equivalent to BHP CA2, cold rolled, conforming to AS 1595, matt finish, oiled, 0.6 mm thick, temper approx. 5. Each metal coupon shall measure 100 mm long and 25 mm wide, and shall be free from crimps, punctures and tears.

D5 INSULATION SPECIMENS

Samples of the thermal insulation material submitted for testing shall be materials representative of the insulation manufactured on an industrial scale.

D6 PRE-CLEANING PROCEDURES

The following apply:

(a) For handling and cleaning all metal coupons, the following shall be observed:

(i) During the fabrication, cleaning or testing, the metal coupons shall be handled with gloved hands.

(ii) Gloves, plastic disposable or acetone-extracted cotton, shall be clean and in good condition.

(iii) Chemicals shall be of analytical reagent grade or better, free from oily residues and other contaminants.

(iv) Distilled or deionized water shall be used.

(v) Clean coupons shall be handled with clean forceps, wherever practicable at the edges of the coupon.

(vi) All coupons shall be cleaned until they are completely free of waterbreaks.

(vii) Cleaning procedures shall be performed in a fume hood, to ensure laboratory personnel are not exposed to toxic fumes.

(b) For cleaning steel coupons, the procedure shall be as follows:

(i) Immerse the coupons in room temperature TCE for 15 min with occasional agitation. Rinse coupons twice by dipping into fresh TCE.

(ii) Air-dry.

(iii) Immerse the coupons in 5% by weight aqueous sodium hydroxide at 60°C for 15 min, with occasional agitation.

(iv) Rinse the coupon with water to remove residual alkali.

(v) Immerse the coupons in refluxing or boiling ethanol for 5 min.

(vi) Rinse the coupons twice by dipping in fresh, room temperature ethanol.

(vii) Rinse the coupons with water and inspect for a waterbreak-free surface.

(viii) Immerse the coupons in fresh ethanol and dry in a hot airstream.

D7 SPECIMEN PREPARATION

Two specimens of insulation shall be used, each measuring 37.5 mm × 112.5 mm by approximately 12.5 mm thick when compressed between the stainless steel mesh strips.

Sterile cotton wool wadding shall act as the control material for the corrosion test. The cotton wool shall be solvent extracted with acetone by placing the cotton wool into a beaker filled with analytical grade acetone and soaked for 48 h, with occasional agitation. After 48 h, the cotton wool shall be allowed to drain and then rinsed for a further hour with fresh acetone and re-drained.

The cotton wool shall then be placed in a vacuum oven at 35°C and vacuum-dried (for approximately 5 h) until no residual acetone odour can be detected. Alternatively, it may be air-dried and then thoroughly oven-dried (80°C).

Two specimens of solvent-extracted cotton wool shall be used for the test, each approximately 6 mm thick when compressed between the stainless steel mesh strips.

NOTE: The corrosiveness of loose fill cellulose insulation material can also be tested using this test procedure. Due to the high compressibility of the loose fill material, care should be exercised to ensure that only the minimum quantity of sample is used to produce a stable composite structure of thickness 25 ±3 mm. High packing density of loose fill material in the composite structure could bias the results.

D8 TEST PROCEDURE

The procedure shall be as follows:

(a) Weigh 4 steel coupons and record the mass to nearest 0.1 mg.

(b) Place one coupon of steel between two pieces of insulation material that measure 112.5 mm × 37.5 mm.

(c) Compress the assembly between two pieces of stainless steel wire mesh (112.5 mm × 37.5 mm) to form a composite structure.

(d) At each end, constrain the structure by a No. 12 rubber band. The compressed thickness of the composite structure shall be 25 ±3 mm.

NOTE: The rubber band should be placed at a distance between 20 mm and 30 mm from each end of the composite.

(e) Construct a cotton wool control specimen by placing a steel coupon between two pieces of solvent-extracted cotton wool wadding measuring 112.5 mm × 37.5 mm. When compressed between the steel mesh, the wadding shall measure approximately 12 ±2 mm in thickness.

(f) Construct duplicate composite structures of each test insulation material and cotton wool controls.

(g) Suspend each test specimen composite and the cotton wool composites vertically (long axis) in an atmosphere free from contaminants and having a relative humidity not less than 95% at a temperature of 50 ±1°C for 168 ±2 h. Monitor the chamber atmosphere periodically to ensure that the conditions are within specifications. If dripping occurs in the chamber, position a drip guard in the chamber to direct condensation to the chamber floor.

NOTE: The composites should be suspended in such a manner as to be electrically isolated from the chamber. The composites can be suspended from the shelving within a humidity chamber using plastic clips, glass clips or electrically-isolated steel clips (e.g. plastic-coated clips), thread, and the like.

(h) At the conclusion of the test period, remove the coupons from the chamber and visually inspect for corrosion.

D9 ASSESSMENT AND POST-CLEANING PROCEDURES

The post-cleaning procedure shall be as follows:

(a) Upon completion of the test, disassemble the composite specimens and assess the coupons visually for extent of corrosion compared with the cotton wool controls.

(b) After a visual assessment has been made, thoroughly wash the metal coupons using water and lightly brush them using a nylon bristle brush, or equivalent, to remove loose corrosion products.

(c) Remove the remaining corrosion products from the metal coupons by cleaning them as follows:

  (i) Add 100 mL of sulfuric acid (specific gravity 1.84) slowly to 500 mL of deionized water, followed by 2 mL organic inhibitor solution (0.5 g/L 1,3 di-o-tolyl-2-thiourea). Swirl the solution and add water to make a 1 L solution (see Note).

  (ii) Warm the solution to 50 ±1°C. Dip the coupons in this solution for 30 s. Rinse in deionized water, and dry in a hot airstream. If corrosion products remain on the coupon surface, repeat the cleaning process and note that two cleaning cycles are required. Replenish the cleaning solution as the solution becomes dirty.

(d) Rinse and dry in hot airstream.

NOTE: The organic inhibitor solution should be prepared by initially dissolving 0.005 g organic inhibitor in ethanol (10 mL) and then adding 2 mL to the sulfuric acid solution before making up to the 1 L mark on the volumetric flask.

D10 EXAMINATION POST-CLEANING

All metal coupons shall be equilibrated to room temperature by placing them in a desiccator for at least 30 min after drying with a hot airstream. The coupons shall be weighed and the mass loss (mg) determined relative to the coupons exposed to the cotton wool controls. All coupons shall be examined for surface etching and pitting.

D11 NON-CORROSIVENESS

After cleaning, there shall be no mass gain caused by build-up of corrosion products. Mass loss from test coupons shall be not greater than the mass loss from the coupons exposed to cotton wool.

D12 REPORTING

The following shall be reported:

(a) Pass, if the coupons meet the requirements of Paragraph D11.

(b) Fail, if the coupons do not meet the requirements of Paragraph D11.

APPENDIX E

RESISTANCE TO SURFACE CORROSION AND WET DELAMINATION AT ELEVATED AMBIENT TEMPERATURES (IR REFLECTIVE INSULATIONS)

(Normative)

E1 GENERAL

This Appendix provides a test to determine the ability of IR reflective insulation products that include or comprise IR reflective materials to resist corrosion and delamination in hot, humid atmospheric conditions liable to be encountered in roofs and walls over a prolonged period.

When IR reflective insulation is installed in any situation where there is a possibility of electrochemical corrosion, appropriate measures shall be taken to ensure that, throughout the life of the building, there will never be—

(a) any contact between the IR reflective insulation and metals likely to cause electrochemical corrosion; and

(b) any electrolytic conductor between the IR reflective insulation and such metals.

NOTES:

1 Significant electrochemical corrosion can occur when there is contact in the presence of moisture, either direct or by conductor, between IR reflective insulation and components made of copper, tin, lead, steel and other metals of similar composition.

2 Significant electrochemical corrosion is not likely to occur in most circumstances where there is contact, either by conductor or direct, between IR reflective insulation and components made of aluminium, cadmium, zinc, cadmium-coated or zinc-coated steels or other metals of similar composition.

E2 APPARATUS

The following is required:

(a) Sealed vessel (e.g. a desiccator) to hold the required number of test pieces suspended vertically above the required depth of water.

(b) A frame, of material that does not react with the foil surfaces, to carry the test pieces.

(c) Oven to hold the container and capable of being maintained at a temperature of 60 ±2.5°C for not less than 28 days.

E3 CONDITIONING

The test pieces shall be conditioned for at least 6 h prior to testing, at 23 ±2°C and 50 ±5% relative humidity.

E4 TEST PIECES AND CONTROL SPECIMEN

E4.1 Test pieces

Ten test pieces, each 100 mm long and 100 mm wide, shall be cut from each sample piece and conditioned in accordance with Paragraph E3. Test pieces shall be cut such that the edges do not coincide with any fibre reinforcement.

The test pieces shall be selected from various positions across and along the sample piece so that each section of the sample piece is tested.

The test pieces shall be taken from the sample piece so as to ensure that the characteristics of the sample piece can be measured in the longitudinal direction as well as the transverse or lateral directions, as applicable.

E4.2 Control specimen

The control specimen shall be a piece of unlaminated aluminium foil 100 mm long and 100 mm wide, of the same thickness and the same physical characteristics as the foil surfaces of the test pieces.

E5 CORROSION TESTING

Deionized water shall be used for corrosion testing.

The procedure shall be as follows:

(a) Add deionized water to the test containers to a depth of approximately 10 mm.

(b) Place foil control and sample in separate containers.

(c) Suspend test pieces from frame.

(d) Seal containers.

(e) Place in oven at 60 ±2.5°C, maintain oven and contents for 28 days.

(f) At the end of this time, visually examine the test pieces and the control specimen for corrosion, and the test pieces for delamination. Ignore any delamination within 3 mm of the edges of the test pieces. If delamination is evident in any of the test pieces, estimate the percentage of the area that has delaminated.

(g) If corrosion of the control specimen has occurred, repeat the test after eliminating the cause(s) of the corrosion.

E6 REPORTING

The following results shall be reported:

(a) Wet delamination:

  (i) Pass, if all 10 test pieces are without delamination.

  (ii) Fail, if any of the test pieces have delaminated.

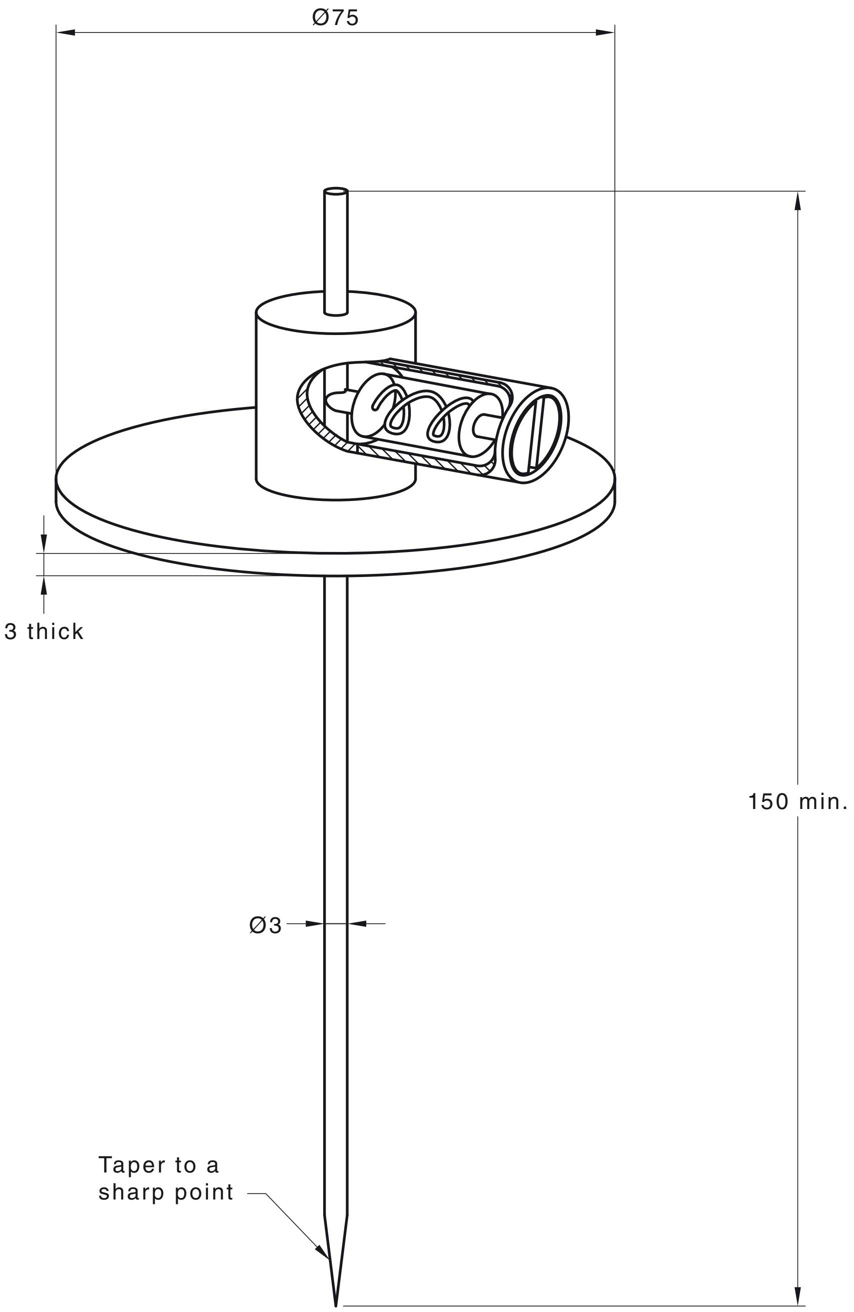
  (iii) In addition, report the percentage area delaminated for each of the 10 test pieces.

(b) Surface corrosion:

  (i) Pass, if corrosion is not worse than the control sample (surface staining of test samples is allowed).

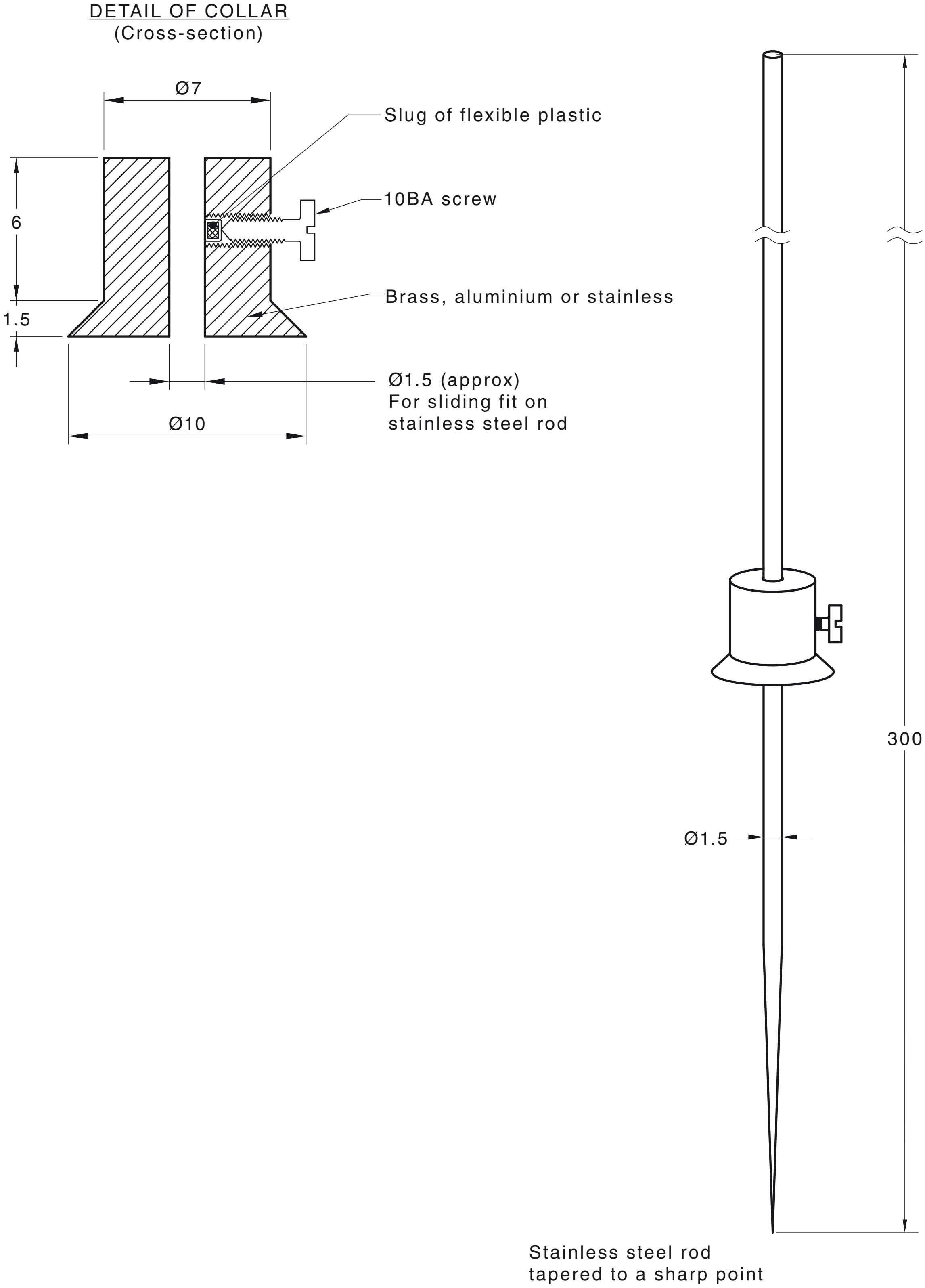
  (ii) Fail, if corrosion of sample is worse than the control or if the sample is perforated.

APPENDIX F
TYPICAL DEPTH GAUGES FOR THICKNESS MEASUREMENTS
(Informative)



DIMENSIONS IN MILIMETRES

FIGURE F1 DEPTH GAUGE WITH 75 mm DISC



DIMENSIONS IN MILMETRES

FIGURE F2 DEPTH GAUGE WITH 10 mm DISC

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NOTES

NOTES

Standards Australia

Standards Australia is an independent company, limited by guarantee, which prepares and publishes most of the voluntary technical and commercial standards used in Australia. These standards are developed through an open process of consultation and consensus, in which all interested parties are invited to participate. Through a Memorandum of Understanding with the Commonwealth government, Standards Australia is recognized as Australia's peak national standards body.

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