AS 1562.1:2018

Australian STANDARD

Design and installation of sheet roof and wall cladding

Part 1: Metal

STANDARDS Australia

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- Australian Aluminium Council
- Australian Building Codes Board
- Australian Garage Door Association
- Australian Steel Association
- Australian Steel Institute
- Bureau of Steel Manufacturers of Australia
- Consult Australia
- Curtin University of Technology
- Cyclone Testing Station, James Cook University
- Housing Industry Association
- Insulated Panels Council Australasia
- Insurance Council of Australia
- Metal Roofing & Cladding Association
- Queensland University of Technology

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Australian Standard®

Design and installation of sheet roof and wall cladding

Part 1: Metal

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PREFACE

This Standard was prepared by the Standards Australia Committee BD-014, Metal Cladding, to supersede AS 1562.1—1992.

This Standard is part of a series on sheet roof and wall cladding which comprises the following:

AS
1562 Design and installation of sheet roof and wall cladding
1562.1 Part 1: Metal (this Standard)
1562.3 Part 3: Plastic

AS/NZS
1562 Design and installation of sheet roof and wall cladding
1562.2 Part 2: Corrugated fibre-reinforced cement

The objective of this Standard is to provide designers and installers with clear information to determine the minimum requirements for the correct and safe design and installation of sheet metal roof and wall cladding, based on the best available evidence and current industry practice.

The main technical changes to the Standard are the following:

(a) Revision of the design section to align with current versions of AS/NZS 1170 series.

(b) Revision of the installation section to provide flashing requirements to minimize the risk of water ingress, and to highlight the importance of fixing ancillary equipment to the roof structure rather than just the roof cladding.

(c) Revision of the testing section to align it with current practice whereby roof cladding for cyclonic areas must withstand a Low-Hi-Low test regime.

(d) Alignment with HB 39 and relevant Australian Standards including AS/NZS 1170 series and AS 4040 series.

(e) Clarification of the design aspects such as rainwater capacity, adjacent metal suitability, and minimum fixing requirements for flashings have been clarified.

(f) Incorporation of factors for variation of repeat load testing have to align with current practice.

(g) Requirements to fix flashing of wall and roof joints and ridge capping with screw connectors at a minimum spacing of either 300 mm for some flashing edges and 600 mm for others.

(h) Improved presentation of design documentation and test report for the performance verification of cladding systems.

In this Standard, notes are for information and guidance only. Statements expressed in mandatory terms in notes to tables or figures 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.

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STANDARDS AUSTRALIA

Australian Standard

Design and installation of sheet roof and wall cladding

Part 1: Metal

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard sets out requirements for the design and installation of self-supporting metal roof and wall cladding subjected to out-of-plane external actions and in-plane thermally induced actions, permanent actions on walls and steep roofs and frictional drag of wind and snow actions.

NOTES:

1 The term 'metal roof' is considered to include metal tiles.

2 Stressed-skin design (diaphragm action) is not covered in this Standard. Design and installation of cladding for stressed-skin buildings should be undertaken using relevant manuals such as EN 1993-1-3. Information on evaluating bracing capacity of cladding is given in Appendix E.

3 Some of the design and testing provisions in this Standard may apply to metal faced structural insulated panels although some of the material specifications for these products are not covered in this Standard.

1.2 NORMATIVE REFERENCES

The following are the normative documents referred to in this Standard:

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

AS	
1397	Continuous hot-dip metallic coated steel sheet and strip—Coatings of zinc and zinc alloyed with aluminium and magnesium
1566	Copper and copper alloys—Rolled flat products
1789	Electroplated zinc (electrogalvanized) coatings on ferrous articles (batch process)
2179	Specifications for rainwater goods, accessories and fasteners
2179.1	Part 1: Metal shape or sheet rainwater goods, and metal accessories and fasteners
2334	Steel nails—Metric series
AS	
3566	Self-drilling screws for the building and construction industries
3566.1	Part 1: General requirements and mechanical properties
4040	Methods of testing sheet roof and wall cladding
4040.1	Part 1: Resistance to concentrated loads
4040.2	Part 2: Resistance to wind pressures for non-cyclone regions
4040.3	Part 3: Resistance to wind pressures for cyclone regions
4055	Wind loads for housing

AS	
4397	Electroplated coatings of zinc on steel fasteners with imperial threads
AS/NZS	
1170	Structural design actions
1170.0	Part 0: General principles
1170.1	Part 1: Permanent, imposed and other actions
1170.2	Part 2: Wind actions
1170.3	Part 3: Snow and ice actions
1214	Hot dipped galvanized coatings on threaded fasteners (ISO metric coarse thread series) (ISO 10684:2004, MOD)
1734	Aluminium and aluminium alloys—Flat sheet, coiled sheet and plate
2728	Prefinished/prepainted sheet metal products for interior/exterior building applications—Performance requirements
3500	Plumbing and drainage
3500.3	Part 3: Stormwater drainage
ASTM	
A240	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
A276	Standard Specification for Stainless Steel Bars and Shapes
A666	Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
D2000	Standard Classification system for rubber products in automotive applications
ISO	
3506	Mechanical properties of corrosion-resistant stainless steel fasteners (series)
9223	Corrosion of metals and alloys—Corrosivity of atmospheres—Classification, determination and estimation
EN	
10088	Stainless steels
10088-1	Part 1: List of stainless steels
IFI	Industrial Fasteners Institute, USA
114	Break Mandrel Blind Rivets

1.3 DEFINITIONS

For the purpose of this Standard, the definitions below apply.

1.3.1 Accessories

Ridge, gable and hip capping, flashings and fasteners.

1.3.2 Anti-capillary feature

A depression in the rolled profile that creates a gap wider than 1 mm at the side lap of installed sheets, which prevents capillary action drawing moisture into the side lap.

1.3.3 Cladding system

Roof or wall cladding, accessories and fasteners, which are defined by a single profile, sheet thickness, material grade and specification, fastener type and size, fastener spacing (p), and washer configuration, and which may have various spans (S).

1.3.4 Creep

The phenomenon of increasing deformation under constant load.

1.3.5 Cyclone regions

Wind Regions C and D as defined in AS/NZS 1170.2 or site classifications C1 to C4 in AS 4055.

1.3.6 Design documentation

Details of the mandatory requirements for cladding systems that are in accordance with this Standard (see Clause 3.5).

NOTE: Design documentation is used to ensure that the design and the test verification of the performance of the cladding matches the requirements for installation (see Clause 4).

1.3.7 De-indexing

The releasing of the interlock between preformed sheets.

1.3.8 Fastener spacing (p)

The maximum distance between fasteners, measured along the centre-line of the supporting member.

1.3.9 Non-cyclone regions

Wind Regions A and B as defined in AS/NZS 1170.2 or site classifications N1 to N6 in AS 4055.

1.3.10 Oil canning

Minor elastic distortion in the form of waviness or out-of-flatness in a preformed sheet, normally caused by local buckling of the sheet metal.

1.3.11 Pan

The flat, or curved portion between the ribs in a pan-type preformed sheet.

1.3.12 Pierce fastened profile

A metal cladding fixed only by screws or nails that pass through the cladding.

1.3.13 Preformed sheet

A metal roofing sheet preformed to increase its resistance to vertical loads, which may have longitudinal ribs of corrugated type or of pan type, in which the distance between the ribs is greater than the width of the ribs, or be formed in other ways to represent tiles or other shapes.

1.3.14 Rainwater goods

Downpipes, rainheads, sumps, spreaders, soakers, nozzles and eaves, box and valley gutters.

1.3.15 Rib

A longitudinal upstand produced by bending, folding or crimping the sheet during manufacture.

1.3.16 Secret (concealed) fastened profile

A metal cladding fixed by secret (hidden) brackets, clips, etc including standing seam profile.

NOTE: Where deformation of the sheeting under ultimate test loading could cause loss of engagement of the fastening system, typically from opening of rib from deformation of pans or unzipping of laps, the sheeting is regarded as secret fastened profile.

1.3.17 Serviceability limit state

State that corresponds to conditions beyond which specified service criteria for a structure or structural element are no longer met.

1.3.18 Shall

Indicates that a statement is mandatory.

1.3.19 Should

Indicates a recommendation.

1.3.20 Span (*S*)

The distance between the centre-lines of sheet fastenings to adjacent purlins or battens measured normal to such centre-lines.

1.3.21 Strength limit state

State associated with collapse or with other similar forms of structural failure.

1.3.22 Supporting member

The member to which the cladding is attached (e.g. purlins, battens, girts).

1.3.23 Unclipping

The releasing of preformed secret fixed sheets from their fastenings.

SECTION 2 MATERIALS

2.1 SHEETS, ROLLED SECTIONS AND EXTRUSIONS USED FOR THE MANUFACTURE OF CLADDING AND ACCESSORIES

2.1.1 Aluminium

Aluminium for the manufacture of sheet cladding shall conform to the requirements of AS/NZS 1734. The copper content of any aluminium alloy used in sheet roof and wall cladding shall not exceed 0.25%.

Aluminium alloys used shall be alloy 5251 or 5052 with temper not exceeding H 38.

Base metal thickness shall be not less than 0.7 mm.

2.1.2 Copper

Copper shall conform to the requirements of AS 1566, relevant to sheet and coil products.

2.1.3 Steel

The material shall be metallic-coated steel.

Except where the requirements of Clause 2.1.5 apply, the material shall conform to the requirements of AS 1397 for minimum coating Class Z450, AZ150 or AM125.

2.1.4 Stainless steel

Stainless steel shall conform to the requirements of ASTM A240, ASTM A276, ASTM A666, EN 10088-1 or JIS G4305, as applicable.

2.1.5 Prepainted

Prepainted and organic film/metal laminate products shall conform to the requirements of AS/NZS 2728.

2.1.6 Other metals

Metals that are not specifically referred to may be used, provided they fulfil all other requirements of this Standard.

NOTE: Due to toxicity, lead is not recommended for cladding.

2.2 SHEET FASTENINGS

2.2.1 General

Fasteners shall be durable and corrosion resistant. The coating shall be appropriate for the corrosion environment specified in ISO 9223 with a design life equal to or superior to the cladding. Fasteners shall be compatible with any other material with which they may be in contact or, if not compatible, shall be electrolytically insulated from such material to minimize the risk of dissimilar metal corrosion.

NOTES:

1 Fasteners should only be used in the applications and environments recommended by the fastener manufacturer.

2 The fastenings, including any retained mandrels (e.g. rivet stems), may be suitably plated or coated to achieve the necessary corrosion resistance and compatibility. Such platings or coatings should be sufficiently robust to remain substantially undamaged by the fixing process.

3 For information on all materials referenced in Clause 2.2, see Table C3, Appendix C.

4 For a comparison table from AS 4312, see Table C2, Appendix C.

Where fitted, fastener sealing washers and all other seals in direct contact with the cladding shall be made from materials that conform to ASTM D2000 Specification 3BA 606, A14 B13, such as EPDM or neoprene chlorinated rubber. Fillers shall be completely encapsulated when conductive materials such as carbon are used. Linear electrical resistance between contact points on opposing surfaces of the washer shall be greater than 1 MΩ when tested at 1000 V.

NOTE: The use of inert or non-conductive fillers is preferred, as the risk of a conductive rubber with a carbon-metal corrosion cell is eliminated.

Where fitted, load spreading washers shall be compatible with any other material that they are in contact with (e.g. fasteners or cladding material).

2.2.2 Aluminium

Aluminium fastenings shall conform to the following requirements:

(a) Nails and hook bolts shall be made from extruded aluminium: 6000 series aluminium alloy.

(b) Fastenings such as clips, brackets and washers shall be made from sheet aluminium: 3000 series or 5000 series aluminium alloy.

(c) Screws and other fasteners made from non-compatible materials such as stainless steel shall be isolated from aluminium cladding.

NOTE: See Tables C2 and C3, Appendix C, for further information.

2.2.3 Copper and copper alloys

The fastenings used to retain copper and copper alloy sheeting shall be of a compatible material.

2.2.4 Steel

Steel fastenings shall conform to the following requirements:

(a) Non-self-drilling screws, self-drilling screws, nails and bolts shall be in accordance with AS/NZS 1214, AS 2334, AS 3566.1, AS 1789 or AS 4397.

(b) Clips, brackets, straps and washers shall be in accordance with Clause 2.1.3 or Clause 2.1.6.

2.2.5 Stainless steel

Stainless steel fastenings shall conform to the composition requirements of ISO 3506 (series) and shall be in accordance with Clause 2.2.1.

NOTE: See Table C3, Appendix C, for further information.

2.2.6 Rivets

Rivets shall conform to IFI 114.

SECTION 3 DESIGN

3.1 SCOPE

This Section sets out requirements for the design of cladding systems comprising cladding, and cladding fasteners.

NOTES:

1 Guidance on roof ventilation is given in Appendix A.

2 Guidance on water penetration is given in Appendix B.

3 This Section requires the specification of the supporting members in order to define the capacity of the cladding fasteners, but the scope of this Section does not cover the design of the supporting members themselves.

4 Cladding systems are not normally designed to carry additional loads from accessories fixed directly to the cladding, e.g. air-conditioning units, vents or antennas. If these are to be fixed directly to the cladding then the capacity of the cladding to carry these loads should be verified.

3.2 LOADING

3.2.1 General

The cladding and its fastenings to the supporting member shall be designed to withstand the loads derived from the actions specified in AS/NZS 1170.1, AS/NZS 1170.2 and AS/NZS 1170.3, when combined in accordance with the load combinations in AS/NZS 1170.0, for the particular circumstances in which the cladding and fastening system will be used.

Materials and installation specifications shall achieve resistance to the loads and actions identified in this Clause (3.2) and shall be recorded in design documentation as specified in Clause 3.5.

3.2.2 Imposed actions

Imposed actions shall be appropriate for the roof categories defined in AS/NZS 1170.1. For roof category R2, the design documentation (see Clause 3.5) shall clearly identify whether the roof is designed for either one of the following:

(a) Cladding providing direct support and that persons may walk or stand anywhere on the roof without causing damage to the sheet.

(b) Cladding over which boards or ladders are required to be laid, and including indication of—

   (i) the positions on the roof sheet on which a person may walk or stand without causing damage to the sheet;

   (ii) temporary walkways that are to be provided for access; or

   (iii) the marking of roofing with a visible sign or sticker with the warning ‘FOOT TRAFFIC IS NOT ALLOWED’.

3.2.3 Wind actions

Local pressure factors defined in AS/NZS 1170.2 or edge region pressures defined in AS 4055 shall be applied to the external pressures for cladding system at edges, ridges and corners of building roofs and walls.

3.2.4 Snow and ice action

Design for loads from the accumulation of snow shall conform to AS/NZS 1170.3.

NOTE: AS/NZS 1170.3 does not address loads from hail.

3.2.5 Lateral restraint

Cladding is not considered to be efficient restraint for supporting structures against buckling, in particular cold-formed steel purlins, unless experimental (test) data are available for cladding assemblies including cladding, its fixings and supporting structures.

3.2.6 Thermally induced movement or loadings

Thermally induced effects shall be accommodated by either—

(a) demonstrating that the system can resist the applied thermal loads; or

NOTE: This may be achieved by limiting maximum length between top and bottom rows of fasteners on a sheet.

(b) detailing the system to absorb the applied thermal movement.

NOTE: Absorbtion of applied thermal movements may be achieved by the—

(a) provision of expansion joints; and/or

(b) use of elongated slots on sheets.

NOTES:

1 Appendix C provides guidance on typical coefficients of linear expansion.

2 To give an indication of the extent of thermal expansion that needs to be considered, an unrestrained 15 m steel sheet expands through approximately 12 mm and aluminium for 24 mm for a temperature variation from 0°C to 65°C. In practice, cladding movement in roofs may be less than this due to many factors including friction and flexibility of the supporting structure.

3 Practical demonstration of bracing capacity of the sheeting may be required for systems with provision for accommodating thermal induced movement (see Appendix E).

4 Transverse thermal expansion in ribbed cladding is absorbed by lateral distortion of the ribs.

3.3 ROOF DRAINAGE

3.3.1 General

The cladding system shall provide water resistance and drainage when subjected to a rainfall resulting from a storm having an average recurrence interval of 100 years as determined in accordance with AS/NZS 3500.3 or local meteorological data.

NOTE: Roof drainage is affected by—

(a) the length and pitch (i.e. slope) of the roof;

(b) the profile of the cladding and its water channel drainage capacity;

(c) the risk of ponding in the case of a low pitch roof;

(d) anti-capillary feature geometry and location design on side laps;

(e) the potential penetration of water through end and side laps;

(f) drainage from an upper roof to a lower roof;

(g) change of pitch or a concave roof leading to a transition from laminar to turbulent flow;

(h) any penetrations in the roof that affect the flow of water down the roof pitch; and

(i) deflection of a roof structure will alter the roof pitch; the initial pitch, which therefore, should include an allowance for any permanent deflection of the roof structure, in particular long-term deflections in timber-framed structures.

3.3.2 Roof pitch

Minimum roof pitch shall be the greater of—

(a) the value given in Table 3.1; and

(b) the value calculated in accordance with Appendix D.

TABLE 3.1

MINIMUM ROOF CLADDING PITCH FOR PLANAR ROOFS

Roof cladding	Minimum pitch degree
Closely spaced sheeting ribs with depth less than 20 mm	5
Corrugated closely spaced sheeting ribs with depth between 20 mm and 30 mm	3
Corrugated closely spaced sheeting ribs over 30 mm depth	2
Closely spaced trapezoidal sheeting ribs with depth between 20 mm and 35 mm	3
Trapezoidal sheeting ribs between 20 mm and 35 mm	2
Trapezoidal sheeting ribs over 35 mm depth	1
Secret fastened sheeting ribs up to 30 mm depth	2
Secret fastened sheeting ribs over 30 mm depth	1
Long run metal tile	10
Metal tiles < 25 mm upstand	15
Metal tiles > 25 mm upstand	12

NOTE: Sections of curved roofs below the minimum pitch in the design documentation (see Clause 3.5) shall be fully sealed at side laps for profiles with depth up to 35 mm, and not incorporate end laps.

3.3.3 Rainwater goods

Rainwater goods shall conform to AS 2179.1.

3.4 PROTECTION AGAINST CORROSION

3.4.1 General

Cladding systems shall be of materials, fasteners and details that are suitable for the environment in which they are to be used.

NOTE: For guidance on corrosivity zones in Australia and their effect on the corrosion of steel and other metals, see AS 4312.

3.4.2 Direct contact

Cladding systems shall be designed so that direct contact between incompatible materials does not occur.

NOTES:

1 A method of separating incompatible materials is the use of an impervious non-conducting material between the incompatible elements.

2 Appendix C provides guidance on acceptable combinations of metals in the light of current knowledge, based on the premise that the area of cladding and accessories is relatively large in comparison to that of the fastener material.

3 If the atmosphere inside a building with metal cladding contains corrosive gases or vapours, some roof materials will need extra protection against the corrosive agents if the cladding is not lined. Such extra protection should also apply to the fastenings and accessories.

4 Ponding of rainwater and accumulation of dust can accelerate corrosion.

5 The life of most metals in severe marine atmospheres and industrial areas with atmospheres contaminated by acid-bearing agents can be extended by the use of special painting procedures (refer to AS/NZS 2312.1).

3.4.3 Run-off

The roof shall be designed to prevent run-off from one surface damaging a lower surface.

NOTE: Appendix C provides guidance on acceptable combinations of upper and lower metals and alloys with regard to run-off from one to the other.

3.5 DESIGN DOCUMENTATION

Design documentation shall include the following:

(a) A statement that the design meets the requirements of this Standard.

(b) A description of system elements for cladding, fastening and supporting members which shall include:

   (i) Profile and dimensions of cladding.

   (ii) Specification of materials.

   (iii) Dimensions, specification and configurations of fasteners.

   (iv) Testing criteria as specified in Section 5.

   (v) Maximum sheeting overhang.

   (vi) Cladding spans (e.g. span dimensions for end spans, internal spans, single spans).

(c) If roofing, the imposed action category, that is, R1 or R2 and any special access requirements (see Clause 3.2.2) and design concentrated imposed actions.

(d) Design wind pressures for edge, corner and general zones defined in AS 4055 or AS/NZS 1170.2.

(e) A description of the corrosion protection system.

(f) Minimum roof pitch as a function of roof length and rainfall intensity.

(g) Limitations on fixing of rooftop-mounted equipment such as solar panels or air-conditioning equipment directly to the cladding.

(h) Limitations on bracing and lateral restraint capacity of the cladding system.

NOTE: Information on minimum pitch may be presented as a table or diagram.

Reference to design documentation within this Standard shall be limited to the requirements listed in Items (a) to (h).

Any information in addition to the requirements listed in (a) to (h) shall be clearly indicated as recommendations and shall not form part of the mandatory design documentation.

SECTION 4 INSTALLATION

4.1 OVERVIEW

4.1.1 General

The roof and wall cladding systems shall be installed as specified in design documentation (see Clause 3.5).

In addition, they shall conform to the requirements of Clauses 4.2 to 4.8.

NOTES:

1 Installation directly to the cladding of rooftop-mounted equipment such as solar panels and air-conditioning equipment is not included in this Standard.

2 HB 39 provides guidance on the installation of metal roof and wall cladding.

4.1.2 Loading during construction

Loads on cladding during construction shall not exceed the loads used in the design of the cladding system. Potential additional loads include:

(a) Internal pressures for the expected configuration of the building during construction.

NOTE: This may include absence of ceilings, wall cladding, glazing and doors.

(b) Stacking of materials that exceed the imposed actions for roofs given in AS/NZS 1170.1.

4.2 SUPPORTING MEMBERS

4.2.1 Spacing of supporting members

Spacing between supporting members shall not exceed the maximum spans detailed in the design documentation (see Clause 3.5)—

(a) for cladding spans adjacent to eaves, ridges, hips or end laps of sheets, the end span distances;

(b) in continuous spanning systems, the internal span distances; and

(c) for single spans, the single span distance.

4.2.2 Supports at hips and valleys

The raking cut edges of roof sheets at hips and valleys shall be supported on trimmers that are fixed flush with the top face of purlins or battens and span between them. Hip and valley trimmers shall be fixed parallel to the edge of the sheeting and be placed so as to enable the fixing of the sheeting and hip capping.

4.2.3 Tolerance in position of supporting members

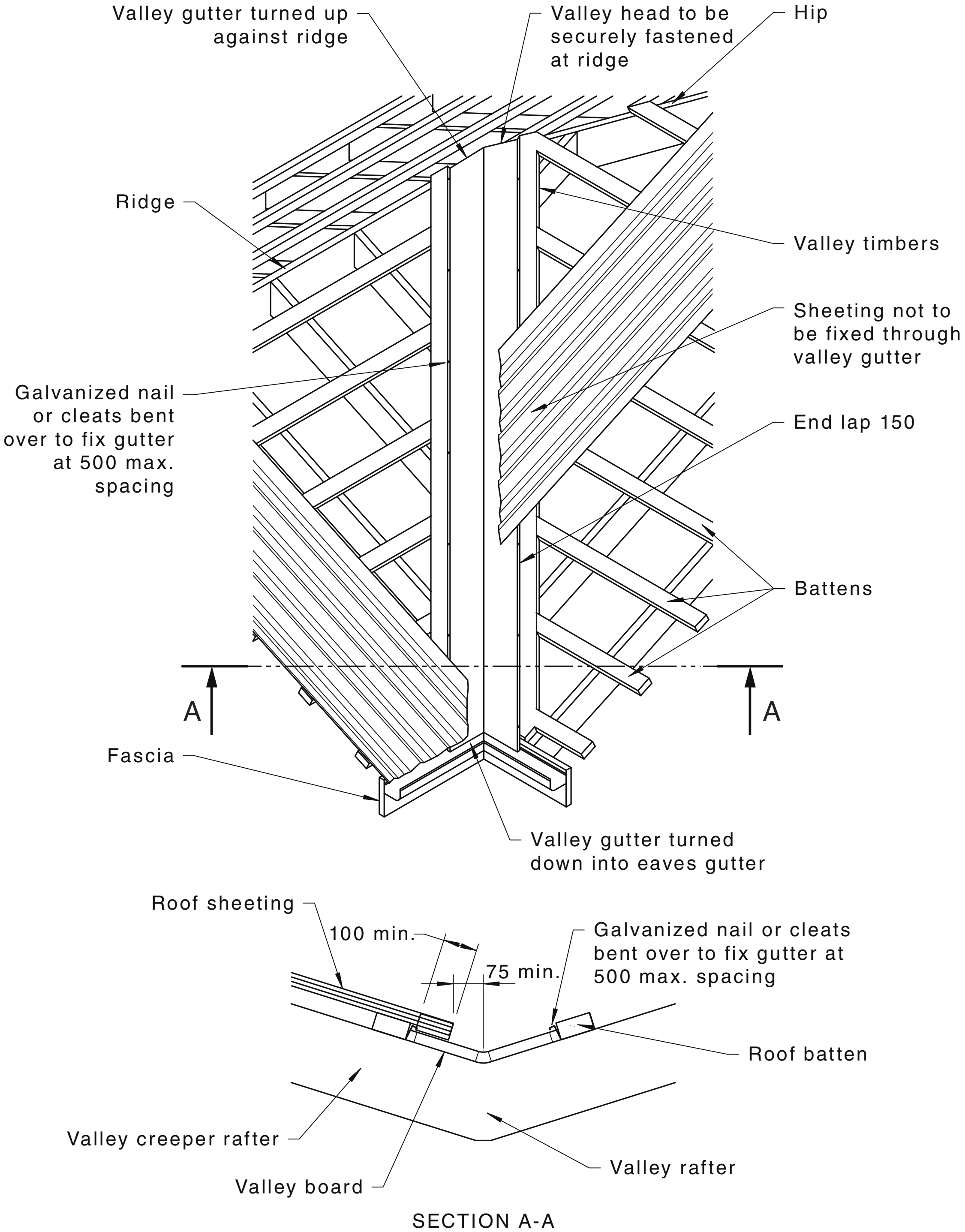
The tops of the supporting members shall be in a plane parallel to the specified roof pitch, with a tolerance, in vertical position, of 7 mm per metre length of supporting member.

4.3 LAYING THE SHEETING

All sheets shall be supported as near to their ends as practicable, notwithstanding that the sheet end shall always positively overhang the full width of the supporting surface to prevent water intrusion by capillary action. The maximum and minimum unsupported end overhang for any type of sheet shall be as specified in the design documentation (see Clause 3.5).

The sheet overhang on valley gutters shall be not less than 100 mm from edge of valley gutter, as measured perpendicular to centre-line of valley, unless, in the case of metal tiles, it is turned down into the valley.

NOTE: For guidance on the dimensions of sheet overhang, see Figure 4.1.



NOTES:

1 For shallow pierce-fastened cladding, laying the initial sheet at the leeward end of the building for the prevailing weather may protect the side laps from the worst anticipated weather. Refer to HB 39 for further details.

2 Refer to HB 39 for use of suitably contoured accessories (e.g. caps, filler strips, or mesh), typically at the eaves, may minimize entry of birds or vermin to the roof space.

DIMENSIONS IN MILLIMETRES

FIGURE 4.1 DETAIL OF SHEET OVERHANG FOR VALLEY GUTTER

4.4 FASTENING

4.4.1 General

Fasteners shall be those specified in the system configuration description from the documentation and appropriate for the type of supporting member used.

NOTE: Only the correct cladding/fastener system as specified in the design documentation (see Clause 3.5) has demonstrated the resistance to wind forces of the system.

Where the system uses washers as part of the fastening assembly, the washers shall be appropriate for the wind loading and the sheeting profile and material.

Fasteners shall be located in the centre of the supports or, where hook bolts are used, as close as practicable to the top edge of supports.

Where holes are punched for the installation of fasteners, the operation shall not cause local distortion to the sheet.

NOTE: Special tools for punching holes may be available from the roofing manufacturer.

4.4.2 Pierced-fastened cladding

Fasteners in valleys or crests shall be tightened to compress flexible seals without deforming the cladding or damaging any washers.

Where nails are used, any local distortion shall not extend beyond the area covered by the washer and seal.

NOTES:

1 Compressed washers should be used to minimize water leakage and provide cladding performance as per design documentation (see Clause 3.5).

2 Care is to be exercised to prevent the entrapment of swarf between the seal and the cladding for both crest and valley fasteners.

4.4.3 Concealed-fastened cladding

Sheeting shall be installed onto the clip system using the methods outlined in the configuration description from the design documentation.

4.5 CLADDING LAPS

End laps for sheeting systems shall be as follows:

(a) 200 mm min. to 300 mm max. for roof sheeting on pitches less than 1:4 (15°).

(b) 150 mm min. to 250 mm max. for roof sheeting on pitches steeper than 1:4 (15°).

(c) 100 mm min. to 200 mm max. for wall cladding.

For end laps, the upper sheet shall sit above the lower sheet.

For pierce-fastened cladding systems, the end lap shall be positioned symmetrically over a support. For concealed-fastened cladding systems, the end lap shall be positioned on the high side of a support and not interfere with (just clear of) the concealed fastening system.

NOTES:

1 Some concealed fastened claddings are not suitable for end lapping—refer to design documentation (see Clause 3.5).

2 HB 39 provides guidance for sealing of side and end laps.

4.6 PROTECTION OF CLADDING DURING INSTALLATION

All installation debris including fasteners, metal clips and filings shall be removed from the roof and adjacent gutters.

NOTE: Surface coatings should be protected from damage during installation as per manufacturer's recommendations.

4.7 PROJECTIONS THROUGH THE CLADDING

Flashings shall be installed around any projections through roof or wall cladding so that all pans drain.

All cut sections of the sheeting shall be supported by additional roof framing.

NOTE: Refer to HB 39 for examples on flashings around penetrations..

4.8 FLASHINGS

4.8.1 General

Roof flashings and cappings shall be purpose-made, machine-folded sheet metal sections of materials compatible with all upstream and downstream roof covering materials, including guttering and downpipes.

NOTES:

1 Refer to HB 39 for watertightness details including anti-capillary breaks.

2 Flashings and cappings should, as far as practicable, have material specifications that are compatible with the adjacent roof sheeting or wall cladding as per Appendix C but with reference to minimum thickness as defined in Table 4.1.

4.8.2 Minimum thickness

The minimum sheet metal thickness for roof flashings and cappings shall be as given in Table 4.1.

TABLE 4.1

MINIMUM THICKNESS FOR FLASHINGS AND CAPPINGS

Materials	Paint coating	Metallic coating	Base thickness mm	Grade
Aluminium	Prepainted/unpainted		0.7	
Copper and alloys			0.55	
Galvanized steel	Prepainted	Z275	0.55	G550 or G300
Galvanized steel	Unpainted	Z450	0.55	G550 or G300
Stainless steel	Prepainted/unpainted		0.45	
Zinc			0.65	
Aluminium/zinc coated steel	Prepainted/unpainted	AZ150	0.55	G300
Aluminium/zinc coated steel	Prepainted/unpainted	AZ150	0.42	G550
Aluminium/zinc/magnesium coated steel	Prepainted	AM100	0.55	G300
Aluminium/zinc/magnesium coated steel	Unpainted	AM125	0.55	G300
Aluminium/zinc/magnesium coated steel	Prepainted	AM100	0.42	G550
Aluminium/zinc/magnesium coated steel	Unpainted	AM125	0.42	G550

NOTES:

1 Materials may be used for flashings and capping except for zinc which is restricted to flashings.

2 This Table is based on HB 39, Table 8.1.2.

4.8.3 Fastening

All exposed parts of flashings shall be fastened in accordance with Table 4.2 using self-drilling screws. Where the total area is less than 0.25 m^2, blind rivets may be used on flashings.

Barge capping shall be fastened on upper and side surfaces.

NOTE: Many flashings are near or on the edges of the buildings and, therefore, are subjected to more severe wind pressures than the main body of the roof. They need to be securely fixed to the structure where possible and elsewhere to the cladding.

TABLE 4.2

FASTENER SPACING FOR FLASHINGS AND CAPPINGS

Flashing type	Fastener spacing	
	Non-cyclonic wind regions	**Cyclonic wind regions**
Transverse flashing edge (at an angle to the ribs or profile greater than 5°)	At not more than 310 mm centres	At not more than 310 mm centres
Longitudinal flashing edge along cladding (at an angle less than or equal to 5°)	At not more than the batten/purlin/girt spacing	At not more than 500 mm centres along the cladding
Flashing edge to material other than metal cladding (e.g. barge flashing edge fixed to concrete wall)	At the same or less spacing as the fastener spacing on the other flashing surface (e.g. roof or wall cladding)	At not more than 500 mm centres

NOTES:

1 This Table is based on HB 39, Table 8.2(B).

2 Minimum fixing distances are appropriate for flashings of thicknesses presented in Table 4.1.

3 End laps of flashings and cappings may be joined with blind rivets.

SECTION 5 TESTING

5.1 GENERAL

Testing is required to demonstrate the conformance of the cladding system with the requirements of this Standard.

NOTES:

1 While testing of accessories is not included in the Standard, pressures and loads and the provisions of this Standard may be used to verify the performance of accessories.

2 By way of example, accreditation bodies which are signatories to the International Laboratory Accreditation Cooperation (ILAC) Mutual Recognition Arrangement (MRA) for testing laboratories may be able to offer accreditation against the requirements of AS ISO/IEC 17025. A listing of ILAC signatories is available from the ILAC website (www.ilac.org). In Australia and New Zealand, the National Association of Testing Authorities (NATA) and International Accreditation New Zealand (IANZ) are signatories to the ILAC MRA.

5.2 TEST SPECIMEN

Test specimens shall be fabricated as full-size assemblies of the documented cladding system as defined in Clause 3.5.

The cladding system shall be fully documented in the test report, listing all of the parameters in Clause 3.5, including design loads and pressures that are used as the basis of these tests.

The fabrication of the test specimen in the test rig shall not affect the capacity or failure modes of the system (for example, at boundary conditions of the specimen such as end supports and free edges).

5.3 DERIVATION OF DESIGN VALUES

5.3.1 Serviceability test pressure

The reported test serviceability pressure (P_{ts}) shall be the minimum test pressure ($P_{ts\text{-}min}$) at serviceability limit as per Clause 5.5.1 and Clause 5.6.2 for all the tests of the same span configurations and length, on the same profile, material and thickness.

5.3.2 Ultimate test pressure

The reported test ultimate pressure (P_{tu}) shall be the minimum ultimate pressure ($P_{tu\text{-}min}$) that can be sustained for all the tests of the same span configurations and length on the same profile, material and thickness.

5.3.3 Serviceability design pressure

Design value for serviceability (P_{ds}) shall satisfy:

$$P_{ds} \leq \frac{P_{ts}}{k_{t\text{-}min}} \qquad \text{. . . 5.3.3}$$

where

$K_{t\text{-}min}$ = a sampling factor, which is a function of the number of tests N and the coefficient of variation of structural characteristics V_{sc} as given in Table 5.1

P_{ts} = serviceability pressure

5.3.4 Ultimate design pressure

Design value for strength (P_{du}) shall satisfy the following:

$$P_{du} \leq \frac{P_{tu}}{k_{t\text{-min}}} \qquad \text{. . . 5.3.4}$$

where

$K_{t\text{-min}}$ = a sampling factor which is a function of the number of tests N and the coefficient of variation of structural characteristics V_{sc} as given in Table 5.1

P_{tu} = ultimate pressure

NOTES:

1 Strength tests are based on ultimate limit states loads.

2 Deflection tests are based on serviceability limit states loads.

TABLE 5.1

FACTORS TO ALLOW FOR VARIABILITY OF STRUCTURAL UNITS (k_t)

No. of units to be tested n	Coefficient of variation of structural characteristics (V_{sc})			
	5%	10%	15%	20%
1	1.20	1.46	1.79	2.21
2	1.17	1.38	1.64	1.96
3	1.15	1.33	1.56	1.83
4	1.15	1.30	1.50	1.74
5	1.13	1.28	1.46	1.67
10	1.10	1.21	1.34	1.49
20	1.06	1.13	1.21	1.29
100	1.01	1.01	1.01	1.01

NOTES:

1 Where tests evaluate deflection under serviceability limit states loads, a coefficient of 5% may be assumed unless there is evidence showing that a higher figure is warranted.

2 A coefficient of variation of 10% may be assumed for strength of metal claddings and metal supporting systems unless there is evidence showing that a higher figure is warranted.

3 A coefficient of variation of 20% should be assumed for connection sub-assemblies unless there is evidence showing that a different figure is warranted.

4 Higher coefficients of variation for serviceability, strength of cladding and strength of connections may be expected if a compliant material (e.g. coil) is to be sourced from more than one supplier subsequent to the testing program.

5 Interpolation is allowed in Table 5.1 within the same category (V_{sc}).

6 Guidance on determining the number of units to be tested is available in *Guide to the Low-High-Low cyclic testing* by the Cyclone Testing Station.

7 This Table based on Table B1 of AS/NZS 1170.0 and Table 8.2.3 of AS 4600

5.4 RESISTANCE TO CONCENTRATED LOADS

5.4.1 General

The test requirements of this Clause apply only to roof claddings that support loads as defined in Clause 3.2.2(a) (Cladding providing direct support). Testing shall be performed in accordance with AS 4040.1.

5.4.2 Serviceability test

For any part of the path specified by the sheeting manufacturer (see Clause 3.2.2) subjected to a concentrated test load for serviceability limit state by the method described in AS 4040.1, no de-indexing, unclipping, permanent local deformation, fracture or failure of any part of the cladding or failure of the fastening shall occur. The residual deflection directly under the point of application of the load within a maximum of 5 min after removal of the load shall not exceed S/1000 or 1.5 mm, whatever is higher.

The concentrated load shall be applied to those parts of the cladding that will produce maximum deflection and maximum permanent deformation.

NOTES:

1 Limits on residual deflection have been included to preserve the appearance of the sheeting and to reduce ponding. Residual deflection is normally measured after light tapping of the sheeting to settle the sheeting to its rest position.

2 The location of maximum deflection may not necessarily coincide with the position of maximum deformation. When testing for maximum permanent deformation, consideration should be given to the application of the concentrated load directly over a supporting member or between sidelap fasteners.

5.4.3 Strength test

When any part of the cladding is subjected, for not less than 1 min, to a concentrated test load for strength limit state in accordance with AS 4040.1, the load shall be sustained, irrespective of any permanent deformation that may occur.

5.5 RESISTANCE TO WIND PRESSURES FOR NON-CYCLONE REGIONS

5.5.1 Serviceability test

For the cladding system subjected to the test pressure for serviceability limit state in accordance with AS 4040.2, the maximum deflection of the cladding relative to the supporting members shall not exceed ($S/120 + p/30$) except for overhangs where maximum deflection shall not exceed $S/60 + p/30$, no de-indexing, unclipping, permanent local deformation, or fracture or failure of any part of the sheeting or of the fastenings shall occur, and the residual deflection, 1 min after the removal of the pressure, shall not exceed $S/1000$ or 1.5 mm, whichever is higher.

NOTE: See also Note 1 to Clause 5.4.2.

5.5.2 Strength test

The cladding system shall be subjected to the test pressure for strength limit state for non-cyclone regions in accordance with AS 4040.2. The pressure shall be sustained and with no failure of fasteners and all parts of the cladding system shall remain in position, notwithstanding any permanent distortion that may occur in the sheeting and fastenings.

NOTE: 'Remain in position' means that the cladding has not disengaged or separated from any fastener/clip/bracket/tongue or along the side laps of the test specimen.

5.6 RESISTANCE TO WIND PRESSURES FOR CYCLONE REGIONS

5.6.1 General

Cladding systems to be used in cyclone regions shall be tested for their capacity to resist low-cycle fatigue loading. These test requirements shall apply to cladding for both roofs and walls. Testing shall be performed in accordance with AS 4040.3.

NOTE: It is important to differentiate between cyclic fatigue failure, associated with disengagement of cladding from its supports after repeated load applications, and static failure which is associated with a strength capacity of a cladding system. Low cycle fatigue cracking of cladding, fixings, immediate supports and their fixings during tropical cyclones is a complex process where small changes in load, geometry or material properties can significantly affect the fatigue performance of the system. At present, there is no way to assess this type of performance apart from testing.

5.6.2 Serviceability test

The serviceability test for resistance to wind pressure for cyclone regions shall be as specified in Clause 5.5.1.

5.6.3 Strength test

The cladding system shall be subjected to the sequence of fatigue loading for cyclone regions specified in AS 4040.3, and shall have no failure of fasteners and remain in position, notwithstanding any permanent distortion, cracks or tears that may occur in the sheeting and fastenings.

NOTE: 'Remain in position' means that the cladding has not disengaged or separated from any fastener/clip/bracket/tongue or along the side laps of the test specimen.

APPENDIX A

ROOF VENTILATION, WATER VAPOUR AND CONDENSATION

(Informative)

A1 CAUSES OF CONDENSATION

All air contains some moisture in the form of water vapour, the amount of which depends on the local environment. The amount of water vapour that the air can hold is a function of its temperature. As air cools, its ability to hold water vapour reduces until such point that it is unable to retain water vapour and the excess moisture is released as dew, which is referred to as its dew point temperature. Condensation is the term used to describe moisture formation on a surface as a result of air coming into contact with a surface below its dew point temperature. Moisture formed from condensation is referred to as condensate.

Air inside a roof cavity will contain moisture from outdoor air and moisture generated by the activities in the building. Substantial quantities of moisture can be generated from activities within a building such as cooking, washing dishes and clothes, drying clothes indoors, combustion heating, showering and bathing, perspiration and the breathing of occupants and plants. Moisture can also be generated from other sources such as building water leaks through pipes or unprotected ground moisture. Persistent high levels of moisture in the roof cavity may cause problem condensation.

A2 ROOF CONDENSATION

The roof is the most exposed element of the building fabric. On clear still nights the roof temperature often drops below the outdoor air temperature as it loses heat via radiation to the cold night sky. The cold roof combined with the moisture generated at times within homes makes overnight condensation within roofs likely; however, condensate is also likely to dry during the day due to high roof and roof space temperatures. While it is good practice to minimize the risk of condensation, significant problems will usually only eventuate if condensation is persistent or condensate becomes trapped. Generally, the risk of persistent condensation in roofs is greatest in the coolest climate zones (NCC climate zones 7 and 8). Persistent condensation may also eventuate in other climates with poor detail or in special circumstances, such as when high internal or ground moisture levels are not controlled, roofs are unable to adequately dry due to lack of outdoor ventilation or roofs are perpetually shaded.

A3 PROBLEMS CAUSED BY CONDENSATION

Persistent condensation or condensate that is unable to dry can cause problems in buildings. The cause is often due to poor design or inappropriate use of materials and once present can be difficult to eliminate. Problems that may be encountered include rotting of timber or corrosion of structural steel components, mould growth that may affect indoor air quality, reduction in the efficiency of bulk insulation, physical deterioration of ceilings made from absorbent materials and staining of walls and ceilings. Often repair of condensation effects and retrospective control measures are significantly more expensive than measures available to prevent condensation in the first instance.

A4 PREVENTING THE EFFECTS OF CONDENSATION

The underside of metal deck roofs provide conditions under which condensate may occur. Insulation, such as sarking, reflective foil, bubble foil or blanket and foil insulation placed beneath the sheeting are of value in reducing the likelihood of condensate forming and potentially dripping from under roof sheeting. The insulation membranes should be vapour impermeable to protect the metal roofing from moisture inside the building.

When blanket insulation is placed beneath a metal deck roof it should incorporate impermeable foil or similar and installed as a vapour barrier underneath the blanket insulation to prevent moisture from inside the building penetrating and wetting the blanket insulation.

A minimum of draped sarking, reflective foil or bubble foil is recommended to reduce the prevalence of condensation in climates with cold winters (NCC climate zones 4, 7 and 8), noting that blanket and foil will provide greater protection.

Ventilation of the roof cavity may assist with removing moisture in the roof space. Minimal ‘trickle’ ventilation is usually all that is required. Natural ventilation of roofs allowing air in at the eave or soffit and out at the ridge is often suitable for roofs with larger cavities, however, supplementary venting may be required where the roof cavity is made relatively air-tight including the need for greater condensation protection measures for very low pitch skillion roofs.

Uninsulated steel roof systems may be unsuitable for farm buildings used for intensive husbandry of animals. These buildings, because of their occupation and purpose, may contain air of a high relative humidity together with high concentrations of ammonia and organic acids. When these occur in the water condensed on the underside of the roof, rapid corrosion will occur.

In buildings without ceilings, such as factories, condensate may fall on the machinery or stock in the space below and consideration should be given to the inclusion of insulation beneath the metal deck roof to reduce this risk.

NOTES:

1 The information above may not be applicable to the tropics or homes that are built to meet bushfire requirements.

2 Specialist advice should be sought for special purpose buildings, such as where high humidity may exist, e.g. swimming pools or where high levels of environmental control are required, e.g. museums.

3 Use of vapour permeable membranes beneath metal roofing are not commonly used in Australia and expert guidance should be sought. The use of these membranes as an underlay beneath metal roofing are common in New Zealand and work because of their installation practice and requirement for vapour permeability and absorptivity.

4 Condensation can occur for buildings that lock up moisture or water during construction that is subsequently unable to dry. Care should be taken to ensure that the building can dry and reach equilibrium prior to locking it up.

APPENDIX B

WATER PENETRATION

(Informative)

B1 WATER PENETRATION

Correct installation of cladding and flashings will minimize water entry through the building envelope. Water may penetrate the building envelope where flashings are not properly installed (e.g. flashings that do not allow drainage from all pans or troughs in the cladding, or are inadequately fixed or inadequately overlapped with cladding). See Clauses 4.7 and 4.8.

Wind in severe storms may cause the following effects:

(a) Water may be driven up roof surfaces at or above the minimum pitch so that roofs do not drain properly.

(b) Differential pressure across the building envelope can force air that may have water entrained in it under flashings.

Consideration in determining the extent of wind-driven rainwater ingress should be given to—

(i) the length and pitch of the roof;

(ii) the profile of the cladding and its water channel drainage capacity;

(iii) the risk of ponding in the case of a low pitch roof;

(iv) the potential penetration of water through end and side laps;

(v) number of penetrations through cladding;

(vi) complexity of flashings;

(vii) size and pitch of valley gutters;

(viii) length of lap of flashing over the sheeting; and

(ix) overlap of adjoining flashing sections.

B2 MINIMIZING WATER PENETRATION

The following references offer advice on installing flashings and reducing water penetration in cladding systems:

(a) SA HB 39.

(b) NZ Acceptable Solution E2/AS1.

(c) NZ Metal Roof and Wall Cladding Code of Practice.

To provide an effective seal against wind-driven rain, most flashings should also be designed to protect against upward-moving water. This is particularly the case for flashings at the top of roof surfaces such as valley gutters, ridges or apron flashings. The gap between the cladding and these flashings may also be sealed with closed-cell foam strips. Such strips need to be anchored in position to resist wind pressures. Turned up edges of roofing and hems and hooks on flashings are required to achieve weatherproofing and also anchor the foam strips.

Valley gutters should incorporate upstands or weather hooks on edges and tops. Closed cell foam at the top of valley gutters will reduce the overtopping as wind drives water up the roof pitch (i.e. slope).

APPENDIX C

MATERIAL PROPERTIES

(Informative)

Table C1 provides guidance on coefficients for linear expansion of several materials. Tables C2, C3 and C4 provide information on suitability of materials in direct contact or moisture path from one surface to the next.

TABLE C1

TYPICAL COEFFICIENT OF LINEAR EXPANSION

Base material	Coefficient of linear expansion (K^{-1})
Aluminium	24×10^{-6}
Copper	17×10^{-6}
Steel	12×10^{-6}
Stainless steel	17×10^{-6}
Zinc	26×10^{-6}

NOTE: Coefficient of linear expansion may be dependent on the metallurgy of the base material.

TABLE C2

CORROSION ZONES COMPARED TO EARLIER VERSIONS OF AS/NZS 2312

ISO Category	Description	Corrosion rate µm/y	Equivalent in AS/NZS 2312: 2002	Equivalent in AS/NZS 2312: 1994	Approx. equivalent in AS 2312—1984
C1	Very low	<1.3	A	—	—
C2	Low	1.3–25	B	Mild	Mild—rural arid
					Mild—rural/mild
				Moderate	Moderate—urban/light industrial
C3	Medium	25–50	C	Industrial	Severe industrial
				Marine	Very severe—coastal/marine
C4	High	50–80	D	Industrial	Severe industrial
				Marine	Very severe—coastal marine
C-5I	Very high—industrial	80–200	E-I	Industrial	Severe industrial
C-5M	Very high—marine	80–200	E-M	Marine	Very severe—coastal/marine
(T)	Tropical	—	F	Tropical	Very severe—tropical

NOTE: This Table is based on Table D1, Appendix D, of AS 4312

TABLE C3

ACCEPTABILITY OF DIRECT CONTACT BETWEEN METALS OR ALLOYS

Cladding material	Accessory or fastener material													
	Aluminium and aluminium alloys		Copper and copper alloys		Stainless steel (300 series)		Zinc-coated steel and zinc		Aluminium/zinc and aluminium/zinc magnesium alloy-coated steel		Lead		Zinc–tin (20–30 %) mechanically plated steel	
	Atmospheric classification													
	SI and VS	**Mild**	**SI and VS**	**Mild**	**SI and VS**	**Mild**	**SI and VS**	**Mild**	**SI and VS**	**Mild**	**SI and VS**	**Mild**	**SI and VS**	**Mild**
Aluminium and aluminium alloys	Yes	Yes	No	No	No*	Yes	Yes†	Yes†	Yes	Yes	No	No	Yes	Yes
Copper and copper alloys	No	No	Yes	Yes	No	Yes	No	No	No	No	No	Yes	No	No
Stainless steel (300 series)	No	No	No	No	Yes	Yes	No	No	No	No	No	Yes	No	No
Zinc-coated steel and zinc	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Aluminium/zinc and aluminium/zinc magnesium alloy-coated steel	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes

* Grade 316 may be suitable.

† Zinc-coated steel and zinc are suitable for direct contact, but are not suitable if drainage from an aluminium or aluminium alloy roof passes over the fastener or accessory.

LEGEND:

SI, VS, Mild = severe industrial, very severe and mild classifications (refer to Table C2 for comparable climatic zone classifications)

Yes = acceptable combination of metals

No = not acceptable combination of metals

NOTES:

1 ‘Acceptable’ and ‘not acceptable’ imply the following:

(a) *Acceptable* As a result of bimetallic contact, either no additional corrosion of the cladding system will take place or, at the worst, slight additional corrosion. It also implies that the degree of corrosion would not significantly shorten the service life.

(b) *Not acceptable* Moderate to severe corrosion of the cladding or accessories will occur, a condition which may result in a significant reduction in the service life.

2 Unless separation can be ensured, prepainted cladding materials should be considered in terms of the base material.

TABLE C4

ACCEPTABILITY OF DRAINAGE FROM ONE SURFACE TO A LOWER METAL OR ALLOY SURFACE

Upper cladding/ accessory material	Lower cladding/accessory materials					
	Aluminium and aluminium alloys	Copper and copper alloys	Stainless steel (300 series)	Zinc-coated steel and zinc	Aluminium/zinc and aluminium/ zinc magnesium alloy-coated steel	Lead
Aluminium and aluminium alloys	Yes	No*	No*	No	Yes	No*
Copper and copper alloys	No	Yes	No*	No	No	No*
Stainless steel (300 series)	No*	No*	Yes	No	No*	No*
Zinc-coated steel and zinc	Yes	No*	No*	Yes	Yes	No*
Aluminium/zinc and aluminium/zinc magnesium alloy-coated steel	Yes	No*	No*	No	Yes	No*
Lead	No*	Yes	Yes	No*	No	Yes
Prepainted metal	Yes	Yes*	No*	No	Yes	No*
Glazed roof tiles	Yes	Yes	Yes	No	Yes	Yes
Unglazed roof tiles	Yes	Yes	Yes	Yes	Yes	Yes
Acrylic/plastics	Yes	Yes	Yes	No	Yes	Yes
Glass	Yes	Yes	No	No	Yes	Yes

* Whilst drainage between the materials shown would be acceptable, direct material contact should be avoided (see Table C3).

LEGEND:
Yes = acceptable combination of metals
No = not acceptable combination of metals

NOTE: ‘Acceptable’ and ‘not acceptable’ imply similar service performances to those noted in Table C3.

APPENDIX D

ROOF PITCH CALCULATION FOR WATER DRAINAGE

(Normative)

For closely spaced rib roofing profiles, the minimum required pitch angle (θ) shall be determined from the following equations:

$$na' = (10.44\,AR)^{0.8}\ \text{mm}^2 \qquad \text{. . . D1}$$

Roofing profiles shall be treated as closely spaced rib profiles if ratio w'/D does not exceed 2.5 as shown in Figure D1, where w' is trough or valley width as measured at profile middepth $D/2$ as shown in Figure D1.

D = rib depth

For all other roofing profiles, the minimum required pitch angle (θ) shall be determined from the following equation:

$$n\,a' = 2 \times \left[2.88\,A\,R\,w^{0.5}\right]^{0.667}\ \text{mm}^2 \qquad \text{. . . D2}$$

where

$$n = 0.5 + 3.507\sqrt{\sin(\theta)} + \sqrt{0.25 + 3.507\sqrt{\sin(\theta)}}\ ;\ \text{or} \qquad \text{. . . D3}$$

$$\sin(\theta) = \left(\frac{n - \sqrt{n}}{3.507}\right)^2 \qquad \text{. . . D4}$$

w = width of the top surface of water in valley or trough, in millimetres (see Figure D1)

A = catchment area, in metres square

= $l \times m$

R = rainfall intensity, in millimetres per hour

l = length of catchment area

= total roof pitch length, in metres

m = width of roofing module, in metres (see Figure D1)

= centre to centre spacing of ribs in sheeting

a' = cross-sectional area of water in roofing module (valley or trough), in millimetres square (see Figure D1)

n = pitch factor within limits 1 and 4

NOTE: Where $n < 1$ use minimum pitch for the roofing profile from Table 3.1 or if $n > 4$, roof pitch is higher than 20° and would require other means of verification such as testing.

θ = roof pitch angle, in degrees

The depth of water (d_m) in a valley or trough of a profile shall be taken as follows:

(a) Where an anti-capillary feature is provided (see Figure D2):

$d_m = 0.6h_u$ for closely spaced rib profiles

$d_m = 0.75h_u$ for all other profiles

where

d_m = maximum depth of water, in millimetres (see Figure D1)

h_u = distance from the bottom surface of a profile to the top of a capillary feature, millimetres (see Figure D2)

(b) Where the anti-capillary feature is not provided (see Figure D1):

$d_m = 0.75h_{ol}$

where

h_{ol} = distance from the bottom surface of a profile to the overlap lip, in millimetres (see Figure D1)

The anti-capillary feature shall meet the following requirements:

(i) The anti-capillary feature shall be positioned on the overlap lip side of the roofing side lap.

(ii) The anti-capillary feature shall be between the mating surfaces of the lapping ribs.

(iii) The anti-capillary feature shall provide a minimum separation of 1 mm.

(iv) The anti-capillary feature shall not be compromised by installation practices such as over-tightening of crest fasteners.

If any one parameter (i) to (iv) above is not met, the profile shall be deemed as not having an anti-capillary feature.

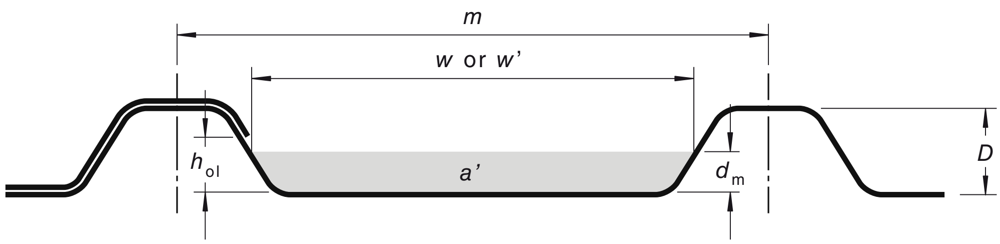


FIGURE D1 ROOFING PROFILE WITH NO ANTI-CAPILLARY FEATURE

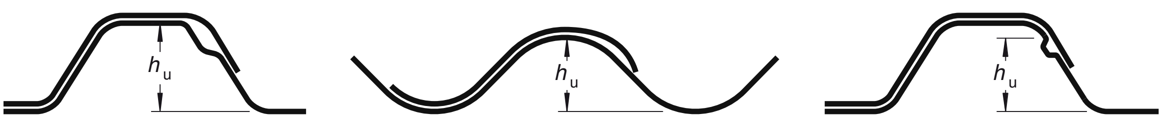


FIGURE D2 ROOFING PROFILES WITH ANTI-CAPILLARY FEATURE

APPENDIX E

BRACING

(Informative)

Cladding can be an integral part of wall/roof shear diaphragms, contributing to the strength and stiffness of buildings. The structural performance of the sheeting system in shear diaphragms is not covered in this Standard.

The bracing behaviour should be evaluated by testing—

(a) in steel frame buildings using AS/NZS 4600; or

(b) in timber frame buildings using ISO 19049 or TR 440.

As cladding is simultaneously subjected to out-of-plane and diaphragm loads, where bracing resistance is required from the cladding system, allowance should be made for the interaction between the sheeting capacity under the two loading directions. The interaction may be different for non-cyclonic wind loads and cyclonic wind loads. Where the maximum shear stress due to diaphragm action does not exceed 25% of the maximum bending stress, it is anticipated that interaction is negligible.

BIBLIOGRAPHY

Informative references

The following are the informative documents referenced in this Standard:

AS
2312 Guide to the protection of iron and steel against exterior atmospheric corrosion
2312.1 Part 1: Paint coatings

4600 Cold formed steel structures

4312 Atmospheric corrosivity zones in Australia

ISO
19049 Timber structures—Test method—Static load tests for horizontal diaphragms including floors and roofs

EN
1993-1-3 Eurocode 3—Design of steel structures—Parts 1-3: General rules—Supplementary rules for cold-formed members and sheeting

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NZ Metal Roof and Wall Cladding Code of Practice (2012), New Zealand Metal Roofing Manufacturers Inc

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Additional reading matter

Martin K.G, *Roof Drainage*, Commonwealth Scientific and Industrial Research Organisation, Australia, 1978

NOTES

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NOTES

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