permalite

ALUMINIUM ROOFING SOLUTIONS

The durable solution to the toughest conditions

AUSTRALIAN STANDARDS

Australian Standard	Definition
AS 1530.3:1999	
AS 1562.1:2018	Design and installation of sheet roof and wall cladding - Part 1: Metal
AS 4040.1-2991 (Reconfirmed: 2016)	Methods of testing sheet roof and wall cladding - Method 1: Resistance to concentrated loads
AS 4040.2-1992 (Reconfirmed 2016, Amendment 1:2018)	Methods of testing sheet roof and wall cladding, Part 2: Resistance to wind pressures for non-cyclone regions
AS/NZS 1664.1:1999	Aluminium structures Part 1: Limit state design (Reconfirmed 2020)
AS/NZS 1170.0:2002	Structural design actions - Part 0: General principles
AS/NZS 1170.1:2002	Structural design actions Part 1: Permanent , Imposed and other actions
AS/NZS 1170.2:2021	Structural design actions, Part 2: Wind actions
AS/NZS 1734:1997	Aluminium and aluminium alloys - Flat sheet, coiled sheet and plate (Reconfirmed 2020)
AS/NZS 2179.1:2014	Specifications for rainwater goods, accessories and fasteners Metal shape or sheet rainwater goods, and metal accessories and fasteners
AS/NZS 3500.3:2021	Plumbing and drainage Part 3: Stormwater drainage
AS/NZS 4020:2018	Testing of products for use in contact with drinking water

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Introduction

Aluminium is a long lasting, durable, lightweight alternative to other cladding materials.

Aluminium provides high thermal insulation and minimal maintenance to remain corrosion-free.

It is easier to transport and erect because it is significantly lighter than many alternate cladding materials.

This book is a guide to the installation of aluminium roofing and walling manufactured by Lysaght. We intend that it be used by all trades and professions involved with specifying and applying the range of our products. Reference to this manual will allow you to maximise the benefits of aluminium in your next project.

We refer only to genuine PERMALITE® aluminium roofing and walling manufactured by us and marketed under our brand names. Our recommendations should only be used for our products because they are based on comprehensive testing of our profiles, Base Metal Thicknesses (BMT) and material finishes.

Our products are engineered to perform according to our specifications only if they are used in the appropriate conditions and installed to the recommendations in this manual and our other publications.

Where we recommend use of third party materials, ensure you check the qualities and capabilities of those products with the relevant manufacturer before use.

Walls

When you design PERMALITE® aluminium cladding into your building you have a range of profiles from which to choose. Whilst cladding obviously needs to keep out the weather, it also has significant effects on the looks, cost and durability of a building.

Roofs

There are many factors in designing roofs including:

- the shape: is the roof to be 'flat' or pitched or curved?
- the supporting structure and support spacing;
- the wind forces that the roof must sustain;
- the pitch which affects the looks, the profile's ability to efficiently carry rain to the gutters, and fixing details;
- thermal expansion of long sheets (Section 1.6);
- the attributes of other materials used in the roof design.

This book doesn't attempt to cover the structural design details of supports or aesthetics: there are many other texts and Australian Standards that cover these areas.

This manual provides tables of load capacities, and the maximum roof length for pitch and rainfall intensity for PERMALITE® aluminium roofing products.

The appropriate design will depend on your particular needs and circumstances. You should get advice from the relevant specialists where required.

Eco-Friendly & Recyclable

Choosing the optimum material for your next project should take account of the full lifetime of the material. This will include construction, use, maintenance and disposal. Materials which can be recycled easily and economically and which do not require landfill disposal should be preferred.

Aluminium's formability, high strength-to-weight ratio, corrosion resistance, and ease of recycling makes it the ideal material for a wide range of building applications. It is almost uniquely suited for projects in harsh industrial and marine environments.

Benefits

Durability:

The outstanding benefit of PERMALITE® aluminium roofing products is their long-term durability in aggressive environments. PERMALITE® roofs have been installed in Australia since the 1960s. This proven track record in Australia's harshest conditions means you can be assured of an effective roof life significantly longer than for most other roofing materials.

Thermal Efficiency:

Unpainted aluminium can reduce heat transmission by up to 9.5°C due to its high thermal insulation properties. This is significant in reducing the ever-increasing operating cost of air conditioning.

Weight:

The lighter mass of aluminium may provide a reduction of the cost of transport to remote locations.

1.0 Materials

1.1 Testing Standards

AS 1562.1 specifies the design and installation of sheet metal roof and wall cladding. Our PERMALITE® profiles satisfy all the requirements of this Standard, including the ability of the roof to withstand concentrated loads according to AS 4040.1 and wind pressure in non-cyclonic regions according to AS 4040.2.

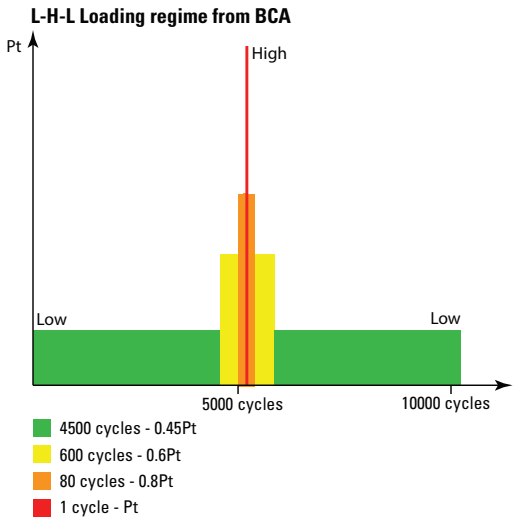
CYCLONE TESTING STATION

Note on testing for cyclonic areas

The Building Code of Australia (BCA) currently requires all metal roof claddings, its connections and immediate supporting members to withstand a low-high-low (LHL) pressure sequence. PERMALITE® aluminium claddings are subjected to cyclonic conditions, according to the BCA definition, and as such, must be tested using the LHL cyclonic testing methodology to determine their capacity.

James Cook University's Cyclone Testing Station has performed comprehensive simulated wind loading pressure tests of the entire range of PERMALITE® aluminium claddings fastened to 1.9mm BMT G450 steel purlins for the most accurate results. These tests were conducted on a direct air pressure rig in the University's Cyclone Testing Station laboratory.

Figure 1.1: The sequence L-H-L loading regime is shown in the graph above where Pt is the ultimate limit state test pressure.



1.2 Wind Forces on Roofs

Winds create considerable forces on both the topside and the underside of roof cladding, and you must consider these forces in the design and fixing of any roof. The forces are:

- inward forces tending to collapse the roof cladding inwards, caused by wind acting directly on the windward side; and
- outward forces tending to lift the roof cladding from its framing, and the entire roof structure from the rest of the building. Outward forces can be caused both by uplift from negative wind pressures, outside the building; and by positive wind pressure inside the building.

Generally the greatest wind forces imposed on roofs are due to the outward forces. Because the dead weight of roofing materials is relatively small, the outward forces must be resisted by the roof fasteners.

It is very important that the battens and roof framing are adequately fixed to the rafters and walls, and that under extreme conditions the wall framing is anchored to the footings. Special anchoring provisions may apply in cyclonic areas. Specialist advice should be sought in these circumstances.

1.3 Materials and Finishes

All PERMALITE® aluminium roofing profiles and flashings are produced from marine grade aluminium alloy entirely. No coatings or claddings are required to enhance performance or economy; you don't have to consider coating thickness. Due to this PERMALITE® aluminium sheeting is deemed to comply with Table 3.5.1a Acceptable Corrosion Protection for Sheet Roofing under Note 6 of the Building Code of Australia.

The quality of the paint systems used on PERMALITE® aluminium roofing products (Refer Section 2.2) is an additional bonus to the durability of the sheet itself.

LT7®, ALSPAN®, WAVELINE® and V-RIB® are manufactured entirely from aluminium alloy 5251 or 5052 produced by Permalite to AS/NZS 1734

Alloy 5251/5052 are high strength marine grade alloys with exceptional resistance to corrosion in marine or industrial environments.

The profiles are available in three finishes:

Mill Finish – an unpainted smooth lustrous finish which will dull relatively quickly and enhances corrosion resistance.

Stucco Finish – stucco embossed mill finish, which reduces the specular reflectance of mill finish sheet.

Painted Finish – a range of quality painted finishes (Section 2.2) are available.

1.4 Alloy Mechanical Properties

The following properties are typical of mill finish, unpainted sheet.

Alloy	5251	5052
Temper	H38	H38
Minimum Yield Strength, MPa	225	220
Ultimate Tensile Strength	260	270
Elongation 0.70 BMT	3%	3%
Elongation 0.90 BMT	4%	4%
Elongation 1.20 BMT	4%	4%
Coefficient of Thermal Expansion	24 x 10^{-6} per °C (Approx. 1.2mm/m over 50°C)	

1.5 Quality Assurance

The in-line painting and rollforming of PERMALITE® aluminium roofing and walling products are conducted in Australia in accordance with BlueScope's strict quality control guidelines.

1.6 Thermal Expansion

Although aluminium has twice the coefficient of expansion of steel, (24×10^{-6} compared to 12×10^{-6} °C) the effect of this is often over estimated.

Usually aluminium cladding is fixed to a steel structure, which, under the same thermal influence, expands or contracts also.

The combination of these factors results in a low relative expansion between the aluminium cladding and the steel structure. It has been observed in practice that the theoretical expansion of an aluminium roof, relative to the steel structure on which it is fixed, is reduced by up to 50%.

Note: As an approximation, aluminium expands 1.2mm/m over 50° temperature change.

1.7 Thermal Protection

The low emissivity of unpainted aluminium roofing greatly reduces heat gain in a building where an air space is provided on the underside of the roof. The factors of reflectivity and absorptivity of unpainted aluminium are also favourable, particularly when the underside of the roof is insulated.

On painted roofs, the use of light colours will help to reduce the thermal absorptivity of the paint coating.

Table 1.1: Thermal factors

	Unpainted (Weathered)	Galvanised Steel (New to Weathered)
Reflectivity	0.74	0.34 to 0.11
Absorptivity	0.26	0.66 to 0.89
Emissivity	0.11	0.28 to 0.42
The following thermal transmittance values (U) are applicable to a weathered aluminium roof with no ceiling.		
Aluminium Roofing Sheet Under Roof Insulation	U Value Summer	(W/m3K) Winter
50mm wool and reflective foil	0.43	0.58
40mm space and 50mm wool and reflective foil	0.36	0.51

1.8 Combustibility

PERMALITE® aluminium claddings have been tested to AS 1530.3 1999 with the following combustibility results:

Ignitability Index: 0

Spread of Flame Index: 0

Heat Evolved Index: 0

Smoke Developed Index: 2

And as such, complies with clause C1.12 of the Building Code of Australia as a non-combustible material.

Refer to 9.0 Certification of Non-Combustibility.

1.9 Environmental Conditions

Aluminium products are generally specified for severe environmental conditions including industrial, agricultural, marine, intensive animal farming, swimming pools or other aggressive conditions. To get the best performance from our products in these conditions, or other unusually corrosive environments, seek advice from our technical representatives.

1.9a Suitability for contact with Potable water

PERMALITE® Claddings and Purlins have been tested to AS/NZS 4020 - Testing of products for use in contact with drinking water by NATA accredited, AWQC, with the following results:

AS/NZS 4020 - Testing of products for use in contact with drinking water		
Clause	**Criteria**	**Results**
C	Taste	Passed at an exposure of 9840 mm2 per litre
D	Appearance	Passed at an exposure of 30,000 mm2 per litre
E	Growth or Aquatic Micro-Organisms	Passed at an exposure of 7500 mm2 per litre
F	Cytotoxic Activity	Passed at an exposure of 30,000 mm2 per litre
H	Metals	Passed at an exposure of 9840 mm2 per litre
6.8	Organic Compounds	Passed at an exposure of 30,000 mm2 per litre

Finishes tested include

Aluminium Alloy	Temper	Material Usage	Finishes
5251	H38	Roof and Wall Cladding and associated Flashings	Mill Finish
			Pre-Painted by BlueScope
5052	H36	Structural Roof Purlins and Wall Girts and associated connection brackets	Mill Finish

Please refer to Appendix 10 for final test report.

Additionally, Trocellen Crosslinked Polyethylene material used for PERMALITE® Foam infills have been tested to AS/NZS 4020 - Testing of products for use in contact with drinking water by NATA accredited, AWQC, with the following results:

AS/NZS 4020 - Testing of products for use in contact with drinking water		
Clause	**Criteria**	**Results**
C	Taste	Passed at an exposure of 15,000 mm2 per litre
D	Appearance	Passed at an exposure of 15,000 mm2 per litre
E	Growth or Aquatic Micro-Organisms	Passed at an exposure of 15,000 mm2 per litre
F	Cytotoxic Activity	Passed at an exposure of 15,000 mm2 per litre
H	Metals	Passed at an exposure of 15,000 mm2 per litre
6.8	Organic Compounds	Passed at an exposure of 15,000 mm2 per litre

1.10 Storage and Handling Prior to Use

Aluminium roofing requires care during handling and installation. Installation damage can be avoided by taking reasonable care and following the recommendations of this manual.

Keep the product dry and clear of the ground. If stacked or bundled product becomes wet, separate it, wipe it with a clean cloth and stack it to dry thoroughly.

Product that has become wet in transport is to be unpacked immediately and each section dried thoroughly prior to repacking. Bundled sections and accessories should not be left exposed in the open for any period as water staining may result between any aluminium surfaces in contact with each other. Mill finish aluminium is particularly susceptible to this type of staining.

Contact with moisture, cement dust, lime or abrasive dust is to be avoided. If not required for immediate use, sections should be neatly stacked off the ground, covered and on a slight slope so that water can drain away It should be noted that whilst water staining is unsightly it will not affect the structural integrity or durability of the product in any way. Packs of sheet stored on the roof must be placed over trusses or purlin supports.

1.11 Load Capacities

The maximum recommended load capacities are shown in the following pages. They are based on AS 1562.1 Design and installation of sheet roof and wall cladding: Metal.

Cladding in cyclonic areas is assumed fixed to a support of 1.9mm minimum base metal thickness (BMT) and minimum yield stress of G450 or 1.5mm BMT G450 in non-cyclonic areas[1]. If you want to use metal battens thinner than those nominated, seek advice from our information line.

1.12 Maximum Lengths of Roofing

The valleys (or pans) of roofing have to carry water to the gutters. If in heavy rain, the valleys overfill, water can flow into the roof through the side-laps and flashings.

Factors affecting waterproof and drainage capacity of the laps of a profile include:

- the width and depth of the valleys or pans;
- the pitch of the roof—rain flows faster on a steeper pitch;
- rainfall intensity for the geographical area;
- the length of the roof from ridge to gutter; and
- penetrations that cause nearby valleys to carry extra rain diverted from valleys obstructed by the penetration

The maximum recommended roof lengths for drainage for each profile are given in Section 2.14.

1.13 Roofs Not Accessible Except for Normal Maintenance

Maximum support spacings as shown in Table 1.2 are suitable for roofs not accessible except for normal maintenance and are based on test data for concentrated loads according to AS 4040.1 Methods of testing sheet roof and wall cladding—Resistance to concentrated roof traffic loads.

1.14 Walking on Roofs

It is important that you walk on roofing carefully, to avoid damage to either the roofing or yourself. Generally, keep your weight evenly distributed over the soles of both feet to avoid concentrating your weight on either heels or toes. Always wear smooth soft-soled shoes; avoid ribbed soles that pick up and hold small stones, swarf and other objects.

When you walk across the ribs, walk over or close to the roofing supports. (Usually over fastener locations.) Be careful when moving between supports. Do not walk in the pan immediately adjacent to flashings or translucent sheeting. Walk at least one pan away.

Temporary plank walkways should be provided while other trades walk on the roof. (High traffic areas)

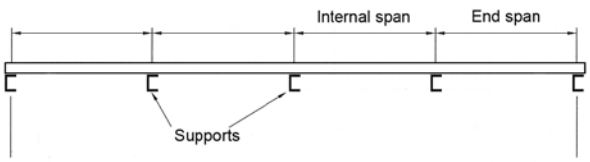
Always take particular care when walking on wet or newly laid sheets — particularly on steeply pitched roofs.

Table 1.2: Maximum support spacings based on foot traffic loadings

	Internal Span	End Span	Overhang
PERMALITE LT7®			
0.70mm*	1.8m	1.4m	120mm
0.90mm	2.4m	2.1m	150mm
1.20mm	>2.4m	>2.1m	>150mm
PERMALITE ALSPAN®			
0.70mm*	2.1m	1.9m	150mm
0.90mm	3.0m	3.0m	180mm
1.20mm	3.6m	3.6m	180mm
PERMALITE V-RIB®			
0.70mm	N/A	N/A	N/A
0.90mm	2.4m	2.1m	150mm
1.20mm	>2.4m	>2.1m	>150mm
PERMALITE WAVELINE®			
0.90mm	1.5m	1.2m	120mm

PERMALITE V-RIB® 0.7mm BMT is not suitable for trafficable roofing. Please seek specialist advise from our technical advisory service.
* NB: Additional care is required installing Permalite 0.7mm bmt roof sheeting, in industrial applications, to avoid damage from heavy installation foot traffic

Figure 1.2: Cladding spans



(1) 1.9mm BMT for PERMALITE ALSPAN® 1.2mm BMT

2.0 Product Data

2.1 System Profiles

Permalite offers four different solutions to provide a range of stylish, economical and durable systems suitable for almost any cladding applications.

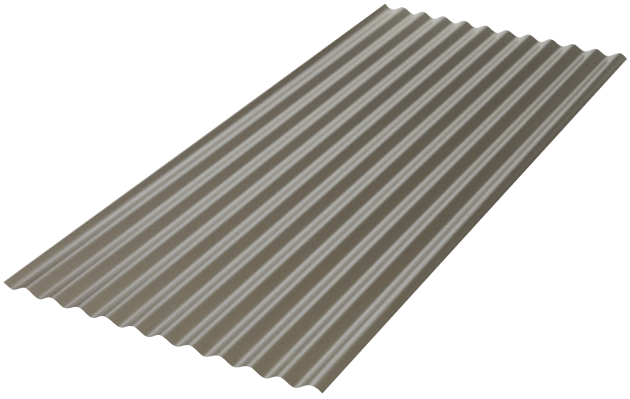
2.1.1 PERMALITE V-RIB®

The symmetry and 915mm cover width of this product provide exceptional economy through faster fixing and minimum wastage. These factors are important on smaller projects and complex roof and walls or where a striking design is required.

2.1.2 PERMALITE ALSPAN®

This profile was designed specifically to provide a wide spanning capability and a distinctive appearance. Cover width is 864mm.

The large robust ribs and exceptional water carrying capacity of this profile make it ideal for large high performance roofs such as power stations and industrial or commercial buildings. The profile is also used on walls where a strong visual effect is required.



2.1.3 PERMALITE WAVELINE®

The traditional corrugated style and 990mm cover width of this product provides minimum wastage and quick installation.

Whether you want a traditional style or the modern look, the universal appeal of WAVELINE® is the right choice.

2.1.4 PERMALITE LT7®

The versatility of this profile is due to its strength, water carrying capacity and fixing economy. The cover width is 875mm.

It is widely used for roofing and can be reversed to provide a bold wall effect.

2.2 Paint Systems

PERMALITE® roof and wall sheet may be supplied pre-painted on one or both sides.

Aluminium provides an excellent painting base for paint systems. Before roll forming, the paint is applied to the coiled sheet by reverse roller coating and heat curing on paint lines employing the latest painting technology.

2.2.1 Polyesters

The new generation polyester paints have outstanding colour and gloss retention characteristics. This, coupled with their resistance to scratching during transportation and installation; make these paints suitable for the majority of severe marine and industrial environments. Polyester paint systems have been extensively tested in Australia's tough environment over many years. Colours available in store are:

ENDURO GREEN®

GLACIER WHITE™

MOON SHADOW®

GULL GREY™

SAHARA®

SLATE GREY™

OBELISK GREY®

Brochures colours are only approximate - refer to painted colour chip for actual colour.

Colour Equivalents:

COLORBOND® Steel Colour Name	PERMALITE® Equivalent Colour Name
Bushland	Bush Smoke
Pale Eucalypt	Enduro Green
Deep Ocean	Eternal Blue
Classic Cream	Full Cream
Surfmist	Glacier White
Shale Grey	Gull Grey
Manor Red	Heritage Red
Ironstone	Iron Grey
Jasper	Jasmine Brown
Windspray	Moon Shadow
Wilderness	Perpetual Green
Headland	Resilient Red
Dune	Sahara
Woodland Grey	Slate Grey
Monument	Obelisk Grey®
Wallaby	Pademelon®
Night Sky	Midnightsky

2.2.2 Fluorocarbons

In certain applications and colours, fluorocarbon paints may offer improved colour and gloss retention levels over polyester paints. However fluorocarbon paints have a lower scratch resistance and as such are more susceptible to damage during transportation and installation. This needs to be considered against the additional cost of these paint systems. Ask our Lysaght technical team for advice regarding your project.

2.2.3 Colour Range

Most standard COLORBOND® steel colours based on minimum order quantities of 3.0 tonne. Other colours available on application with minimum order quantities and extended lead times.

2.3 Design Information

2.3.1 Introduction to design data

The following section is intended to provide the designer of the building cladding with the data required to specify the most cost effective use of the products and their efficient installation.

The data applies to conventional structures in both cyclonic and non-cyclonic areas.

All design data is valid for the following conditions.

- Minimum Support member material is 1.5mm BMT G450 steel for Non Cyclonic regions and 1.9mm BMT G450 for Cyclonic Regions. Please Note that published capacities for PERMALITE ALSPAN® 1.2mm BMT are based on 1.9mm BMT supports for both Cyclonic and Non Cyclonic applications.
- Deflection limit equal to Span/120 + Maximum fastener pitch/30 in accordance to AS 1562.1

If your requirement is outside these parameters you are invited to call on the services of Lysaght's experienced technical staff by contacting the Lysaght Sales Offices listed in this publication.

2.4 PERMALITE LT7® Cladding

The versatility of this profile is due to its strength, water-carrying capacity and fixing economy. It is widely used for roofing and can be reversed for a bold wall effect.

Thickness Range	0.70mm, 0.90mm, 1.2mm
Length Range	850mm to 23 metres
Pan Cross Section Area	26,000mm²/ metre sheet width
Tolerances	Length +0mm, -15mm
	Width ±4mm
Finishes	Mill, Stucco Embossed, Painted

(Note: stucco embossed not available in 1.2mm)

Purlin and girt spacings

The wind loadings used in conjunction with these charts are to be determined in accordance with AS/NZS 1170.2.

The values apply to the sheet being fastened with the PERMALITE® Positive Fix System (Section 3.15).

Figure 2.1: PERMALITE LT7® profile

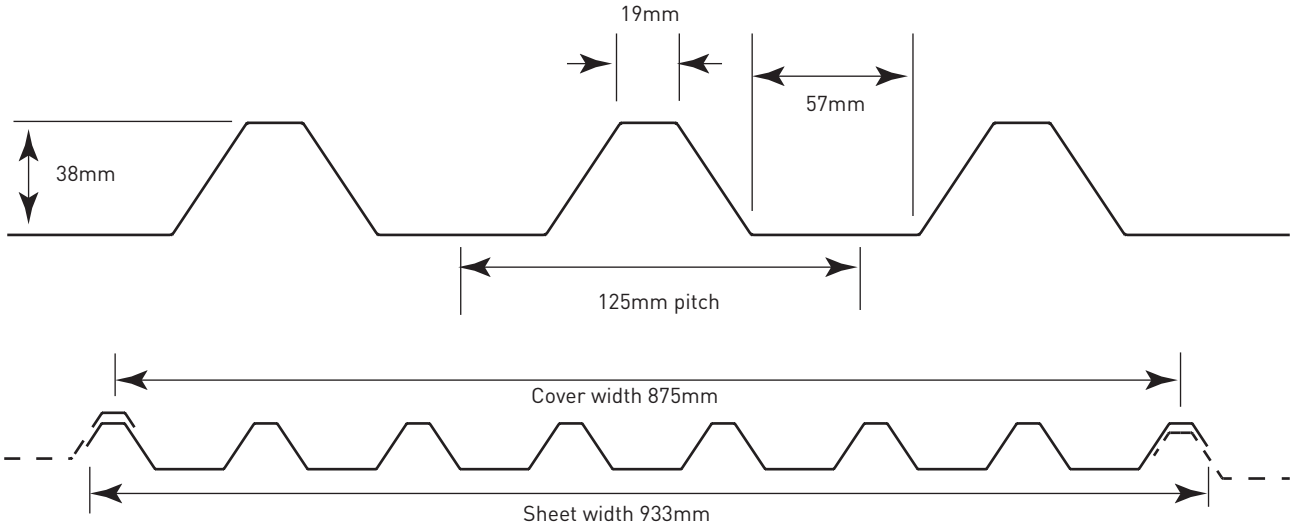


Table 2.1: Profile properties PERMALITE LT7® Cladding

Thickness (mm)	kg/m² Cover Width (Mill Finish)	kg/m Length (Mill Finish)	m² /tonne (Mill Finish)	Section Modulus About Principal Axis (x10³mm³)		2nd Moment Of Area About Principal Axis (x10³mm⁴)	
				Z_x	Z_y	I_x	I_y
0.70	2.645	2.314	378	8.274	135.9	186.4	63390
0.90	3.401	2.976	294	10.64	174.7	239.7	81500
1.20	4.534	3.967	221	14.18	232.9	319.5	108700

Table 2.2: PERMALITE LT7®: Limit state wind pressure capacities (kPa)

Continuous spans with all spans equal

BMT (mm)	Limit State (kPa)	Span (mm)					
		900	1200	1500	1800	2100	2400
Non-cyclonic based on screws on every rib							
0.7	Serviceability	8.75	7.93	5.2	3.09	-	-
	Strength	15.05	9.32	8.25	8.11	-	-
0.9	Serviceability	-	7.93	5.3	3.44	2.2	1.57
	Strength	-	10.17	9.45	8.74	7.95	7.25
Non-cyclonic based on screws on alternate ribs							
0.7	Serviceability	2.73	1.82	1.50	1.46	-	-
	Strength	11.74	7.58	5.40	4.97	-	-
0.9	Serviceability	-	2.36	2.10	1.82	1.68	1.37
	Strength	-	9.00	7.00	5.75	4.85	4.42
Cyclonic based on screws on every rib							
0.7	Serviceability	8.75	7.93	5.2	3.09	-	-
	Strength	9.48	5.98	4.5	4.3	-	-
0.9	Serviceability	-	7.93	5.3	3.44	2.2	1.57
	Strength	-	9.45	7.7	6.32	5.3	4.73

Notes:

1. Refer to Lysaght for any further details of cladding installation not covered in this manual, details of test results or other design matters.
2. These design capacities are based on legislation and standards that are current at the time of publication and may be subject to change - therefore the published capacities should be reappraised by the date noted.
3. For 1.2mm BMT, use 0.9mm BMT values.

2.5 PERMALITE ALSPAN® Cladding

This profile was designed specifically to provide a wide spanning capability, to have a high water-carrying capacity and to accommodate foot traffic without damage.

All of these requirements are realised in the distinctive ribs and wide pans which offer a well-defined presentation of large areas.

Thickness Range	0.70mm, 0.90mm, 1.2mm
Length Range	850mm to 23 metres
Pan Cross Section Area	37,500mm²/metre sheet width
Tolerances	Length +0mm, -15mm
	Width ±4mm
Finishes	Mill, Stucco Embossed, Painted

(Note: stucco embossed not available in 1.2mm)

Purlin and Girt Spacings

The wind loadings used in conjunction with these charts are to be determined in accordance with AS/NZS 1170.2.

The values apply to all ribs of the sheet being fastened with the PERMALITE® Positive Fix System (Section 3.15).

The eave span for 0.70mm thickness should not exceed 1.8 metres where access to the roof may be required.

Figure 2.3: PERMALITE ALSPAN® profile

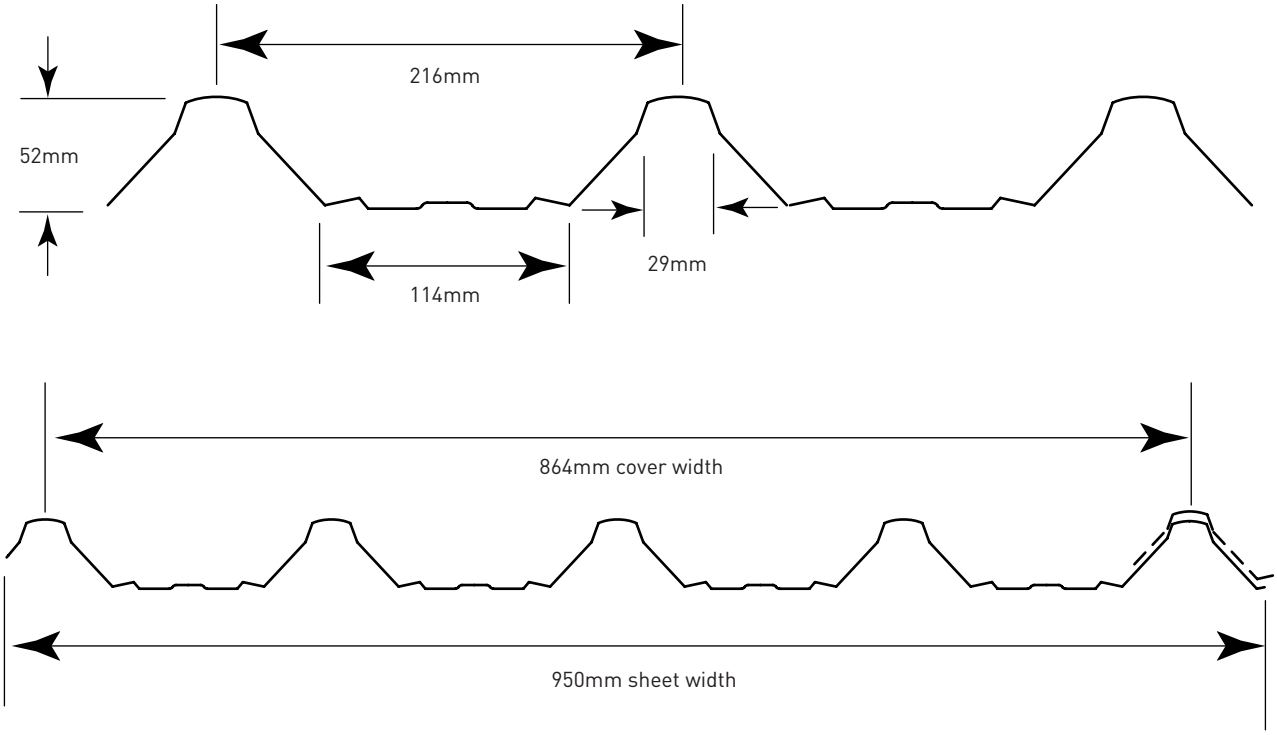


Table 2.3: Profile properties PERMALITE ALSPAN® Cladding

Thickness (mm)	kg/m² Cover Width (Mill Finish)	kg/m Length (Mill Finish)	m² /tonne (Mill Finish)	Section Modulus About Principal Axis (x10³mm³)		2nd Moment Of Area About Principal Axis (x10³mm⁴)	
				Z_x	Z_y	I_x	I_y
0.70	2.679	2.314	373	8.841	139	301	66010
0.90	3.444	2.976	290	11.367	178.7	387	84870
1.20	4.592	3.967	218	15.156	238.2	517	113160

Table 2.4 PERMALITE ALSPAN®: Limit state wind pressure capacities (kPa)

Continuous spans with all spans equal

BMT (mm)	Limit State (kPa)	Span (mm)										
		600	900	1200	1500	1800	2100	2400	2700	3000	3300	3600
Non-cyclonic based on screws on every rib												
0.7	Serviceability	8.26	6.20	4.59	3.40	2.55	2.00	-	-	-	-	-
	Strength	15.00	10.10	6.21	4.20	3.10	2.67	-	-	-	-	-
0.9	Serviceability	-	8.35	6.50	5.03	3.77	2.70	1.93	1.50	1.08	-	-
	Strength	-	13.00	9.82	7.41	5.50	4.33	3.41	2.75	2.17	-	-
1.2*	Serviceability	-	-	8	6.71	5.8	4.28	3.08	2.49	1.74	1.32	1.06
	Strength	-	-	13.83	11.53	9.67	7.54	5.89	4.68	3.50	2.93	2.58
Cyclonic based on screws on every rib												
0.7	Serviceability	8.26	6.20	4.59	3.40	2.55	2.00	-	-	-	-	-
	Strength	9.50	7.50	6.00	4.60	3.55	2.80	-	-	-	-	-
0.9	Serviceability	-	8.35	6.50	5.03	3.77	2.70	1.93	-	-		-
	Strength	-	9.50	7.40	5.70	4.51	3.80	3.39	-	-		-

Notes:

1. Refer to Lysaght for any further details of cladding installation not covered in this manual, details of test results or other design matters.
2. These design capacities are based on legislation and standards that are current at the time of publication and may be subject to change - therefore the published capacities should be reappraised by the date noted.
3. Minimum Support thickness = 1.9mm BMT, G450 for Alspan 1.2mm BMT Minimum support thickness for 0.7mm BMT and 0.9mm BMT is 1.5mm BMT for Non Cyclonic and 1.9mm BMT for Cyclonic.
4. It is a good practise to provide stitching screws for spans greater than 2.4m

2.6 PERMALITE V-RIB® Cladding

The wide (915mm) cover width of PERMALITE V-RIB®, in conjunction with its symmetrical profile, provides a roofing sheet which can be used effectively on walls also. A double capillary drain in the rib overlap ensures weather security.

As well as providing a neat, balanced appearance on buildings, this profile is also effectively used as insulation jacketing in power stations and chemical processing plants.

Thickness Range	0.70mm, 0.90mm, 1.2mm
Length Range	850mm to 23 metres
Pan Cross Section Area	16, 342mm²/metre sheet width
Tolerances	Length +0mm, -15mm
	Width ±4mm
Finishes	Mill, Stucco Embossed, painted

(Note: stucco embossed not available in 1.2mm)

Purlin and Girt Spacings

Wind loadings used in conjunction with the following graphs are to be determined in accordance with AS/NZS 1170.2.

The values apply to the sheet being fastened with the PERMALITE® Positive Fix System (Section 3.15).

Figure 2.4: PERMALITE V-RIB® profile

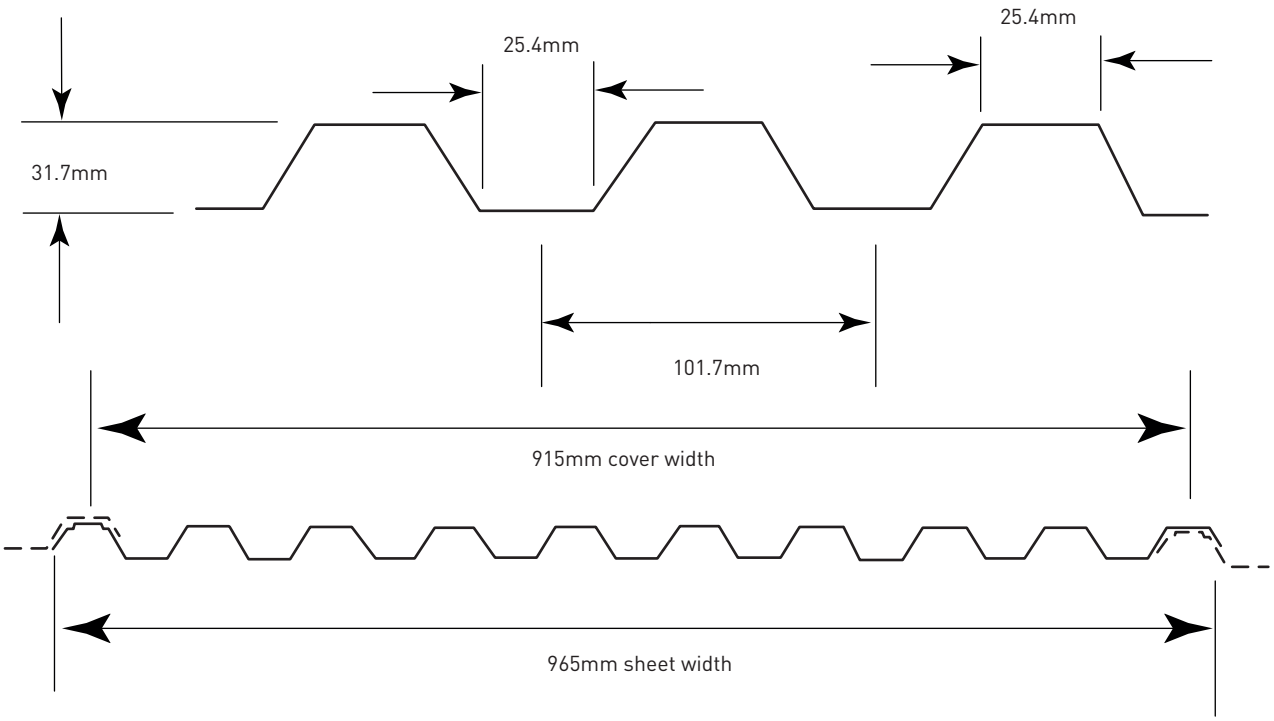


Table 2.5: Profile properties PERMALITE V-RIB® Cladding

Thickness (mm)	kg/m² Cover Width (Mill Finish)	kg/m Length (Mill Finish)	m² /tonne (Mill Finish)	Section Modulus About Principal Axis (x10³mm³)		2nd Moment Of Area About Principal Axis (x10³mm⁴)	
				Z_x	Z_y	I_x	I_y
0.70	2.529	2.314	395	7.693	140	127.1	67710
0.90	3.252	2.976	308	9.89	180	163.5	87050
1.20	4.336	3.967	231	13.19	240	217.9	116100

Table 2.6: PERMALITE V-RIB®: Limit state wind pressure capacities (kPa)

Continuous spans with all spans equal

BMT (mm)	Limit State (kPa)	Span (mm)					
		900	1200	1500	1800	2100	2400
Non-cyclonic based on screws on every rib							
0.7	Serviceability	8.34	5.50	3.29	1.90	1.26	-
	Strength	13.69	11.60	9.60	7.10	4.63	-
0.9	Serviceability	8.34	6.02	4.03	2.43	1.50	1.03
	Strength	19.00	14.00	10.73	8.40	7.25	7.16
Non-cyclonic based on screws on alternate ribs							
0.7	Serviceability	3.95	2.80	2.04	1.45	1.05	-
	Strength	12.19	8.80	6.48	4.80	3.83	-
0.9	Serviceability	6.13	4.40	3.04	2.00	1.30	0.93
	Strength	10.4	9.10	7.98	6.90	5.90	4.94
Cyclonic based on screws on every rib							
0.7	Serviceability	8.34	5.5	3.29	1.9	1.26	-
	Strength	7.9	6.4	5.25	4.3	3.77	-
0.9	Serviceability	8.34	6.02	4.03	2.43	1.5	1.03
	Strength	9.45	8.6	7.8	6.98	6.1	5.25

Notes:

1. Refer to Lysaght for any further details of cladding installation not covered in this manual, details of test results or other design matters.
2. These design capacities are based on legislation and standards that are current at the time of publication and may be subject to change - therefore the published capacities should be reappraised by the date noted.
3. For 1.2mm BMT, use 0.9mm BMT values.
4. PERMALITE V-RIB® 0.7mm BMT is not suitable as roofing. Please seek specialist advise from our technical advisory service.

2.7 PERMALITE WAVELINE® Cladding

The classic Australian profile is used in traditional as well as modern applications.

PERMALITE WAVELINE® is available in 2 widths. Traditional 762mm* cover width for curving and our standard 990mm cover width for greater fixing economy. These cover widths for PERMALITE WAVELINE®, provides a roofing sheet which can also be used effectively on walls.

Thickness Range	0.70 & 0.90mm Other thicknesses available subject to minimum order quantity.
Length Range	850mm to 11.3 metres
Pan Cross Section Area	8423mm²/metre sheet width
Tolerances	Length +0mm, -15mm
	Width ±4mm
Finishes	Painted, Mill finish

* Extended lead times apply.

Purlin and Girt Spacings

Wind loadings used in conjunction with the following graphs are to be determined in accordance with AS/NZS 1170.2.

Figure 2.5: PERMALITE WAVELINE® Profile

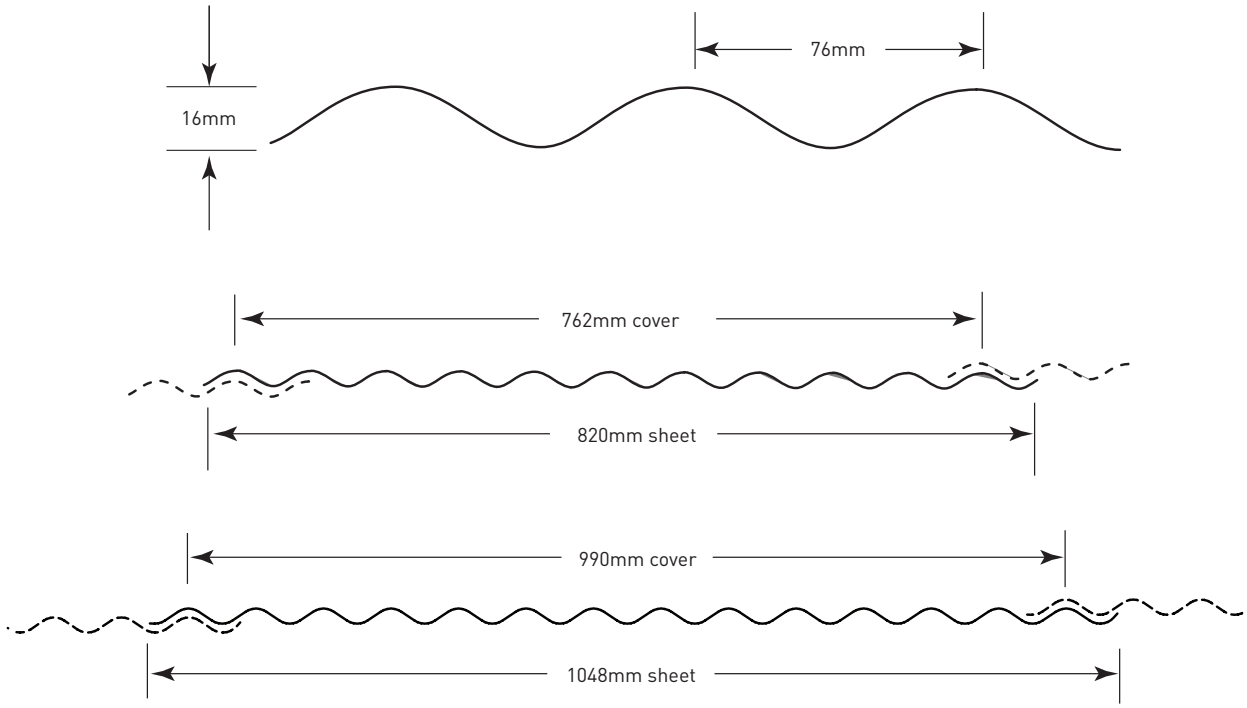


Table 2.7: Profile properties PERMALITE WAVELINE® Cladding

Thickness (mm)	Cover Width (mm)	kg/m² Cover Width (Mill Finish)	kg/m Length (Mill Finish)	m² /tonne (Mill Finish)	Section Modulus About Principal Axis (x10³mm³)		2nd Moment Of Area About Principal Axis (x10³mm⁴)	
					Z_x	Z_y	I_x	I_y
0.70	762	2.340	1.783	427	2.546	93.03	22.55	39030
0.70	990	2.338	2.314	428	3.356	157.9	29.11	87070
0.90	762	3.009	2.293	332	3.274	119.6	28.99	50180
0.90	990	3.006	2.976	333	4.314	203	37.43	112000

Table 2.8: PERMALITE WAVELINE®: Limit state wind pressure capacities (kPa)

Continuous spans with all spans equal

BMT (mm)	Limit State (kPa)	Span (mm)			
		900	1200	1500	1800
Non-cyclonic based on screws on alternate ribs (without washers)					
0.9	Serviceability	6.07	2.47	0.90	0.73
	Strength	-	7.27	5.39	3.58
Non-cyclonic based on screws on every rib with washers					
0.9	Serviceability	6.07	2.47	0.9	0.73
	Strength	-	9.09	6.74	4.48
Cyclonic based on screws on every rib with washers					
0.9	Serviceability	6.07	2.47	0.9	0.73
	Strength	9.31	7.0	5.0	4.13

Notes:

1. Refer to Lysaght for any further details of cladding installation not covered in this manual, details of test results or other design matters.
2. These design capacities are based on legislation and standards that are current at the time of publication and may be subject to change - therefore the published capacities should be reappraised by the date noted.
3. Refer to PERMALITE® Aluminium Residential Solutions for 0.7mm BMT design data.

2.8 Timber and Metal Compatibility

Under no circumstances should galvanised steel, ZINCALUME® steel, lead, copper, brass, or copper alloys be placed in contact with aluminium, nor should you permit water run off from these materials to discharge onto aluminium sheets.

Care must be taken to avoid contact with building materials such as unseasoned or chemically treated timber, lime cement, concrete, mortar or plaster during construction and to provide impermeable barriers against long term contact.

In most situations the face of a dissimilar timber support, against which the sheeting is fastened, is to be painted with a moisture-impermeable paint system (such as bituminous paints or similar) or in the case of metal purlins / battens or supports, a good quality (and appropriate width i.e. support width + 20mm) adhesive PVC or polyethylene tape with a minimum thickness of 250microns.

Under severe marine and/or aggressive industrial environments Denso tape or closed cell polyethylene tape should be used to completely fill the sheet/structure interface to avoid moisture retention by capillary action. Permalite will provide advice in such situations.

If there are doubts about the compatibility of other products being used, seek advice from our technical representative.

See tables below for direct contact and rainwater discharge compatibility issues.

Figure 2.6: Intermaterial preparation measures

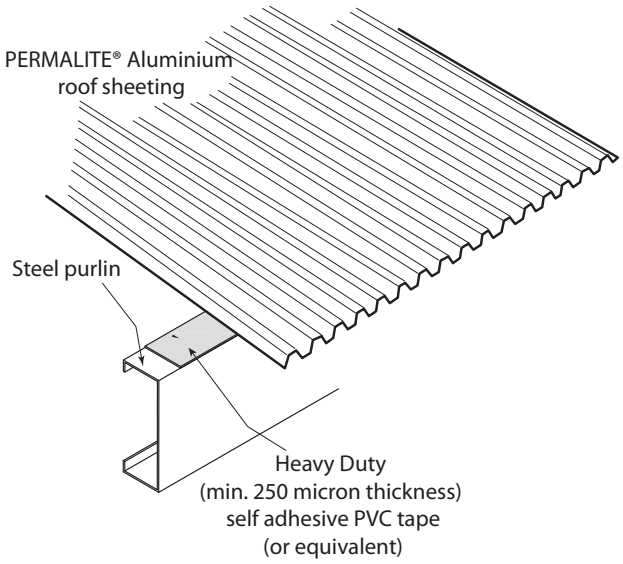


Table 2.9: Compatibility of direct contact between metals or alloys

Roof Drainage System Components & Any Cladding Material	Accessories or Fastener or (Upper Surface)								
	ZINCALUME®	Galvanised Steel	Zinc	COLORBOND® Including Ultra & Metallic	SUPERDURA® Stainless steel	Stainless Steel [3]	Aluminium Alloys	Copper & Copper Alloys [1]	Lead
Aluminium Alloys	No [4]	No	Yes	No	No	Yes	Yes	No	No
ZINCALUME® steel [4]	Yes	Yes	Yes	Yes	No	No	No	No	No
Galvanised steel [4]	Yes	Yes	Yes	Yes	No	No	No	No	No
Zinc	Yes	Yes	Yes	Yes	No	No	Yes	No	No
COLORBOND® steel (Plus Ultra & Metallic)	Yes	Yes	Yes	Yes	No	No	No	No	No
SUPERDURA® Stainless steel	No	No	No	No	Yes	Yes	No	No	No
Stainless steel	No	No	No	No	Yes	Yes	No	No	No
Copper & Copper Alloys [1]	No	No	No	No	No	No	No	Yes	No
Lead	No	No	No	No	No	No	No	Yes	Yes

(1) Monel - copper/nickel alloy
(2) For further guidance refer to AS/NZS 3500.3
(3) Fixings only
(4) Our experience is that these materials are not compatible in extremely corrosive environments, so our advice differs from AS/NZS 3500.3

Table 2.10: Acceptability of drainage from an upper surface to a lower metal surface

Lower Roof Drainage System Material	Upper Cladding or Roof Drainage System Material									
	ZINCALUME®	Galvanised Steel	Zinc	COLORBOND® Including Ultra & Metallic	SUPERDURA® Stainless steel	Stainless Steel	Aluminium Alloys	Copper & Copper Alloys [1]	Lead	Glazed Tiles, Glass & Plastic
Aluminium Alloys	No	No	Yes[3]	No[3]	Yes	Yes	Yes	No	No	Yes
ZINCALUME® steel	Yes	Yes	Yes	Yes	Yes	Yes	Yes[3]	No	No	Yes
Galvanised steel	No	Yes	Yes	No	No	No	No	No	Yes	No
Zinc	No	Yes	Yes	No	No	No	No	No	Yes	No
COLORBOND® steel (Plus Ultra & Metallic)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes
SUPERDURA® Stainless steel	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Stainless steel	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Copper & Copper Alloys [1]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lead	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

(1) Monel - copper/nickel alloy
(2) For further guidance refer to AS/NZS 3500.3
(3) Our experience is that these materials are not compatible in extremely corrosive environments, so our advice differs from AS/NZS 3500.3

2.9 Aluminium Purlins

The major benefits of aluminium purlins are their corrosion resistance, ease of handling, and crane-hire savings in difficult situations.

In areas of applications of difficult access aluminium purlins (and other structural components) may be handled manually thereby providing substantial savings in crane hire.

The PERMALITE® brochure Aluminium Purlin Solutions for Structural Applications provides loading tables, assembly details, and components is available at www.permalite.com.au

Figure 2.7a: Standard purlin dimensions

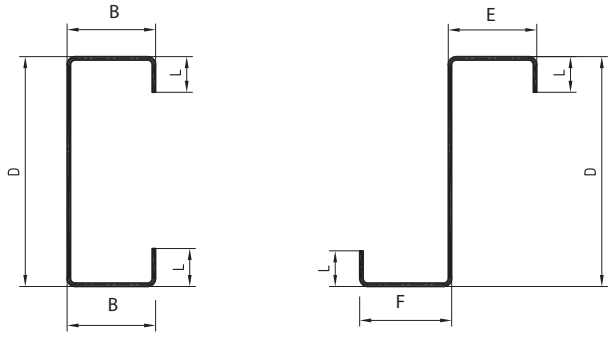
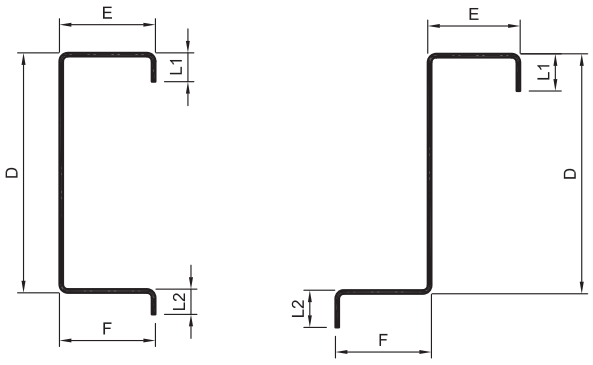


Figure 2.7b: Purlin dimensions (Downturned lips)



PERMALITE® aluminium purlins with downturned lips are also available. Refer Aluminium Rollformed Purlin Solutions manual for purlin dimensions

Table 2.11: Purlins & Girts Dimensions

Dimensions of PERMALITE® Cees

Section	t (mm)	D (mm)	B (mm)	L (mm)	M (kg/m)
AC10025	2.5	105	51	15.5	1.457
AC10030	3.0	105	52	16.0	1.748
AC15025	2.5	155	62	23.0	2.046
AC15030	3.0	155	63	23.5	2.455
AC20025	2.5	205	76	25.0	2.602
AC20030	3.0	205	77.5	25.0	3.122
AC25025	2.5	255	76	25.5	2.947
AC25030	3.0	255	77	26.0	3.537
AC30025	2.5	300	109	30.0	3.760
AC30030	3.0	300	110.5	30.0	4.512
AC35030	3.0	350	125.5	30.0	5.163
AC40030	3.0	400	125.5	30.0	5.569

Dimensions of PERMALITE® Zeds

Section	t (mm)	D (mm)	E (mm)	F (mm)	L (mm)	M (kg/m)
AZ10025	2.5	105	55	47	16.0	1.457
AZ10030	3.0	105	56.5	48.5	16.0	1.748
AZ15025	2.5	155	66	58	24.0	2.046
AZ15030	3.0	155	67	59	24.5	2.455
AZ20025	2.5	205	81	73	25.0	2.602
AZ20030	3.0	205	82.5	74.5	25.0	3.122
AZ25025	2.5	255	81	73	25.5	2.947
AZ25030	3.0	255	82	74.5	26.0	3.537
AZ30025	2.5	300	114	106	30.0	3.760
AZ30030	3.0	300	115.5	107.5	30.0	4.512
AZ35030	3.0	350	130.5	122.5	30.0	5.163
AZ40030	3.0	400	130.5	122.5	30.0	5.569

Note: Dimensions in these purlin tables are nominal. For the latest sizes and Downturned lip sizes refer to the Permalite Aluminium Rollformed Purlin Solutions manual.

2.10 Convex Curved Roofing

In addition to aesthetic appeal, curved roofing avoids the requirement for a ridge cap flashing. This is a benefit on low slope ridged roofs.

Sheet may be curved over the full width of the roof or curved only at the ridge. Curved sheet at the eaves may also form effective sun control, roof drainage or cyclonic security.

There are three methods of curving sheet:

1. Spring curving – Straight sheet is held to the roof curve by the fixing screws, all purlins must be set at 90° to the arc tangent and there should be no curve between the eave purlins. End laps may be used on straight roof sections only.
2. Crimp curved – This factory process forms a curve by crimping the profile at controlled intervals providing a striking visual effect and a small radius of curvature. Concave curves may also be supplied. Crimp curved ridge caps are recommended on the basis of their superior strength and lower cost compared to the ridge cap flashing system.
3. Roll curving - This factory process is only suitable for WAVELINE®.

2.11 Spring Curved Roofs

Sheets in a spring-arched (convex) roof are curved in a radius from eave to eave. LT7®, ALSPAN®, V-RIB® and WAVELINE® can be spring-curved for an arched roof. Table 2.12 shows the acceptable radii.

The top face of all purlins must accurately follow and be tangential to the radius of the arch. The radius of curvature can be calculated from the formula in Figure 2.9.

Table 2.12: Recommended radii for convex spring-curving

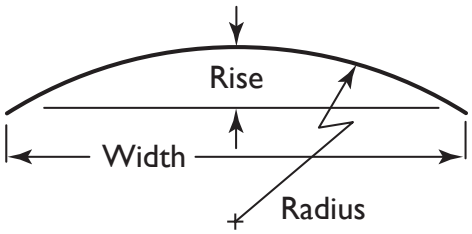
Minimum Curving Radius	Minimum Radius (m)	Purlin Spacing at Minimum Radius (mm)	Maximum Radius[1] (m)
ALSPAN® (Spring Curve)	24	1600	200
LT7® (Spring Curve)	18	1400	60
LT7® (Crimp Curve)	0.5	1400	60
V-RIB® (Spring Curve)	18	1400	70
WAVELINE® (Spring Curve)	12	1000	30
WAVELINE® 762 (Roll Curve)	0.6	1000	30

[1]Maximum radius is to provide sufficient drainage near crest of arch.

NOTE: Stucco embossed sheeting can not be roll or crimp curved.

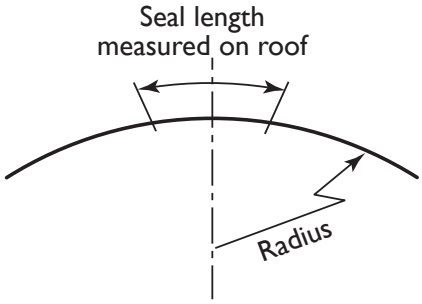
To ensure an adequate seal against moisture ingress the following formula should be applied to determine the minimum seal length for low pitched sprung curved roofs with apex joins. A neutral cure silicone sealant should be applied as per Section 3.10. Typical roof and wall lapping is shown in Figures 3.6 and 3.7.

Figure 2.8: Calculation of radius



$$\text{Radius} = \frac{\text{Width}^2 + 4(\text{Rise})^2}{8 \times \text{Rise}}$$

Figure 2.9: Seal length calculation



Seal length =
0.035 x Radius x specified minimum roof pitch, therefore use the following formulas for PERMALITE® claddings.

WAVELINE®
(minimum roof pitch 5): Seal length = 0.18 x radius

V-RIB®
(minimum roof pitch 3): Seal length = 0.11 x radius

LT7® and ALSPAN®
(minimum roof pitch 1): Seal length = 0.055 x radius

2.12 Condensation

Condensation occurs on the underside of all metal roofing when the roof metal temperature falls below the dew point of humid air held against the underside of the roof.

Control of under roof condensation can be affected through the reduction of the moisture content of the air under the roof by one or more of the following procedures.

a) Providing ample ventilation, which allows air to move through the ceiling space.

b) Using ceiling linings with a moisture barrier on the upper surface.

c) Stretching 50mm insulation blanket, with aluminium foil laminated to the underside, over the purlins before laying the roof. All joins in the blanket, and around penetrations, should be sealed with waterproof adhesive tape.

Of the above b) provides the best ceiling/roof condensation control. Although c) may be less effective in controlling ceiling condensation it significantly reduces the effect of roof noise.

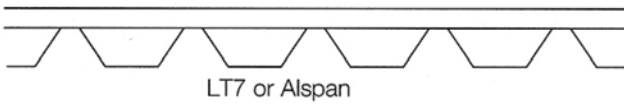
Consideration should also be given to the effect of condensation on the underside of exposed exterior roofing such as eaves or awning. The unsightly discolouration which can occur may be avoided by placing a lining underneath with a 100mm air gap between the lining and the metal roof. Alternatively, painting the underside of the roof sheeting will retard discolouration but not condensation.

2.13 Reversed Profile

A variation to the appearance of walls can be made by fixing LT7® or ALSPAN® with the pans out thereby creating a bold effect. However, design capacities, may be adversely affected.

Note: Not suitable for cyclonic regions. Contact Permalite technical staff for further advice.

Figure 2.10: Reversed profile



2.14 Design of Drainage

Roof drainage systems can be affected by a number of variables and must be designed and detailed by a suitable qualified trade or professional. The design of roof drainage aims to protect people, property and the building. The designed drainage system must be installed under the supervision of a qualified trade or professional. The steps of the design process are illustrated below.

1. Determine average recurrence interval (ARI)
2. Obtain rainfall intensity of site
3. Work out roof dimensions.
4. Determine catchment area with slope
5. Determine area for proposed eaves gutter.
6. Determine catchment area per downpipe
7. Determine number of downpipes required
8. Determine location of downpipes and high points
9. Check catchment area for each downpipe.
10. Determine downpipe size
11. Determine overflow measures

More guidance is given in BCA, AS/NZS 3500.3, HB114:1998 and Lysaght publication - Roofing & Walling Installation Manual.

2.15 General Rainwater System Design Recommendations

The Minimum gutter fall should be 1:200 for effective gutter operation and prevention of ponding.

Gutter lengths should not exceed 12.0 metres, on site joints within this length should be as recommended herein. Bridge expansion gap with an aluminium saddle flashing fixed to one gutter only.

Table 2.13: Design rainfall intensity

	For Overflow of Eave Gutters once in 20yrs (mm/hr)	For Overflow of Internal Box Gutters once in 100yrs (mm/hr)
A.C.T.		
Canberra	137	194
N.S.W		
Broken Hill	130	181
Bathurst	143	197
Sydney	214	273
Newcastle	181	233
VIC.		
Mildura	125	174
Melbourne	127	186
Ballarat	127	184
QLD.		
Brisbane	251	333
Rockhampton	248	336
Mackay	273	363
Mt. Isa	169	223
Townsville	260	346
Cairns	282	368
S.A.		
Mount Gambier	108	168
Adelaide	123	186
W. A.		
Geraldton	132	173
Perth	146	214
TAS.		
Hobart	99	155
N. T.		
Alice Springs	139	204
Darwin	285	366

Table 2.14: Maximum lengths for drainage (m)

Intensity (mm/hr)	Roof Slope (degrees)								
	1°	2°	3°	5°	7.5°	10°	15°	20°	25°
ALSPAN®									
100	357	445	522	649	774	890	985	1095	1188
150	238	297	348	433	516	593	657	730	792
200	179	222	261	325	387	445	492	547	594
250	143	178	209	260	310	356	394	438	475
300	119	148	174	216	258	297	328	365	396
333	107	134	157	195	232	267	296	329	357
500	71	89	104	130	155	178	197	219	238
LT7®									
100	90	111	131	163	194	223	247	274	298
150	60	74	87	108	129	149	165	183	198
200	45	56	65	81	97	111	123	137	149
250	36	45	52	65	78	89	99	110	119
300	30	37	44	54	65	74	82	91	99
333	27	33	39	49	58	67	74	82	89
500	18	22	26	33	39	45	49	55	60
WAVELINE®									
100	-	-	-	23	28	32	35	39	42
150	-	-	-	15	18	21	23	26	28
200	-	-	-	12	14	16	18	20	21
250	-	-	-	9	11	13	14	16	17
300	-	-	-	8	9	11	12	13	14
333	-	-	-	7	8	10	11	12	13
500	-	-	-	5	6	6	7	8	8
V-RIB®									
100	-	-	161	200	239	275	304	338	367
150	-	-	107	134	159	183	203	225	245
200	-	-	81	100	120	137	152	169	183
250	-	-	64	80	96	110	122	135	147
300	-	-	54	67	80	92	101	113	122
333	-	-	48	60	72	83	91	101	110
500	-	-	32	40	48	55	61	68	73

2.15.1 Box Gutters

Box gutters should be fabricated from aluminium sheet preferably of alloy 5251 or 5052 and of the next standard thickness to the thickness of the roof i.e. 1.2mm thick box gutter for 0.9mm thick roof. The minimum aluminium thickness for box gutters is 0.90mm. Refer to Figure 2.11 for typical aluminium box gutter detail.

Box gutters must be adequately supported on sides and bottom in consideration of their full water load, and the possibility of being used as footways. Box gutters should be designed and installed in accordance with AS/NZS 3500.3, AS/NZS 2179.1, HB114:1998 and the BCA. Generally, the sides should be supported by framework or purlins, if not, sides should be stiffened.

Fastening the gutter to the framework or purlins should only be done at the outlet end. The remainder of the gutter should be free to move.

Overflashings are not to be fastened to the gutter and saddle flashings between gutter ends are to be fastened to one gutter only. Fixings, supports and outlets must allow complete freedom for thermal movement of the gutter. The gutter as a whole must not be restrained in any way.

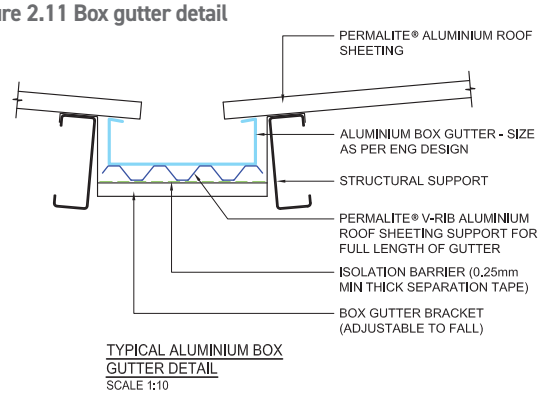
Drop sumps should be provided at outlets to increase the flow efficiency from gutter to downpipe. Sumps should be a square by the width of the gutter and have a depth of not less than one quarter of the gutter depth. Overflows should be provided by spouts at the gutter ends or by secondary sump outlets.

Eave and box gutter joins may be made using silicone sealant provided the join consists of overlapping surfaces separated by silicone sealant and fastened by two lines of staggered rivets.

Blind rivets used to join gutter sections must be of aluminium only, the heads of the rivets should be on the outer surface.

Alternatively joints may be made by TIG Aluminium welding; soldering or brazing is not recommended.

Figure 2.11 Box gutter detail



2.16 Turn Up Roof Cladding

At the high end of roofing, wind can drive water uphill, under the flashing or capping, into a building. To minimise this problem, you turn up the valleys (or pans) at the high end of roofing.
(The process is called turning-up (or stop-ending).

All roofing on slopes below 1 in 2 (25°) should be turned-up. During the turn-up operation, care should be exercised to prevent tearing or puncturing the steel sheets. You can turn-up sheets before or after they are fixed on the roof. If you do the latter, you must have sufficient clearance for the turn-up tool at the top end of the sheets (about 50mm).

2.17 Roof Slopes

Minimum

On very low slopes care must be taken to ensure that purlin sag or misalignment does not result in water ponding on the roof, particularly if end laps are used.

At low slopes, say around 1 in 50 (1°) slope, all roof supports must be in the one plane because slight variations can result in zero or negative fall. This may occur even after completion of the building as the result of settlement, timber warping or shrinking, or extra loadings (like air conditioners).

Minimum recommended roof slopes are listed in this document. As a guide, wherever possible, you should design for a minimum slope of 1 in 30 (2°). Roof slopes lower than the recommended minimum may be available subject to enquiry and will be dependent upon the roof application and building details.

Maximum

The high discharge velocity of rainwater from slopes over 25° can result in side lap leakage. Where the slope exceeds 25°, a continuous run of silicone sealant is to be placed under the outer leg of the side lap during sheet installation.

Table 2.15: Roof Slopes

	LT7®	ALSPAN®	V-RIB®	WAVELINE®
Minimum slope - no end laps	1°	1°	3°	5°
Minimum slopes - sealed end laps	3°	3°	6°	5°
Minimum slope - unsealed end laps	6°	6°	10°	5°
Maximum slope - unsealed side laps	25°	25°	25°	25°

Note: To maintain minimum 1° pitch on ALSPAN®/LT7®, step joints should be considered for sheets in excess of transportable length. (Figure 3.4)

Turning-up WAVELINE® Profile

With pliers, multi-grips or a shifting spanner closed down to approximately 2mm, grip the valley corrugations 20mm in from the end of the sheet and turn up as far as possible. Be careful not to tear the sheet.

Turning-up V-RIB®, ALSPAN® and LT7® Profiles

Slide an appropriate turn-up tool onto the end of the sheet as far as it will go. Holding the tool against the end of the sheet, pull the handle to turn up the tray about 80°.

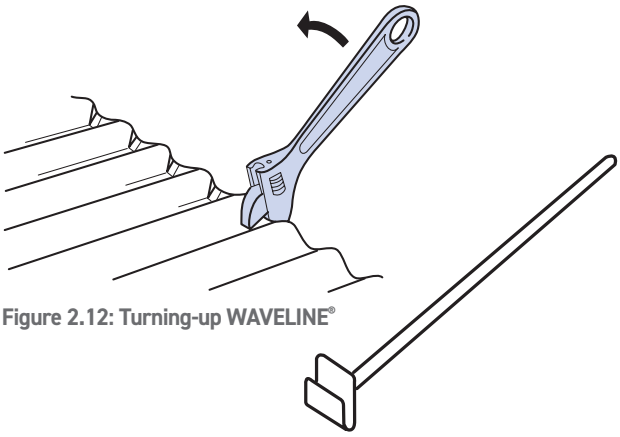


Figure 2.12: Turning-up WAVELINE®

Figure 2.13: V-RIB® turn-up tool

3.0 Installation

3.1 Safety

It is most important for safety reasons that during sheet laying walking on the roof is reduced to an absolute minimum and along the purlins only. See Section 1.14 Walking on Roofs.

3.2 Preparation

Before commencing to lay the sheet, consideration should be given to the installation of gutter and eave flashings, insulation and the location of roof penetrations such as vents, skylights etc.

A pencil of any colour may be used except black or so-called lead pencils. Don't use black pencils to mark roofing or walling because the graphite content can create an electric cell when wet and thus cause deterioration of the finish. You can also use a string line with chalk dust, or a fine, felt-tipped marker.

3.3 Squareness

Check the roof or wall structure for squareness before commencing to lay sheet. Sheet must be laid square to the ridge wherever practical. Out-of-square which exceeds 100mm over the sheet length should be corrected by trimming the edge of the sheet laid against the out-of-square edge. Any sag of purlins should be corrected before commencement, particularly on low-pitch roofs to avoid water "ponding".

If insulation is to be laid on wire mesh, the mesh should be laid first. Insulation should be laid with the roofing to avoid the possibility of rain wetting the insulation.

3.4 Purlin / Batten Isolation

Isolating PERMALITE® aluminium sheeting from potential causes of Intermaterial corrosion is an important, but easily achieved, design / installation consideration. Failure to provide simple isolation against incompatible materials can lead to premature failure of PERMALITE® aluminium products and is not covered by PERMALITE® warranties.

Minimum Timber Battens / Purlins

A number of timber treatments contain elements that can react to aluminium. As a consequence, timbers should be isolated from PERMALITE® aluminium components via;

I. a good quality (and appropriate width i.e. support width + 20mm) adhesive PVC or polyethylene tape with a minimum thickness of 250 microns or

II. foil bound insulation blankets between the roof battens and PERMALITE® sheeting

Metal Purlins / Battens (other than aluminium) require isolation via;

I. a good quality (and appropriate width i.e. support width + 20mm) adhesive PVC or polyethylene tape with a minimum thickness of 250 microns or

II. foil bound insulation blankets between the roof battens and PERMALITE® sheeting

As noted above, the common practice of laying foil bound insulation blankets over roof battens will provide effective isolation between the batten and sheet, although special attention is required at building edges to prevent wind borne moisture ingress and ensure isolation is maintained as per Figure 4.14. Additional consideration for isolation methods for situations where roof safety mesh is utilised are set out at Figures 5.1 and 5.2.

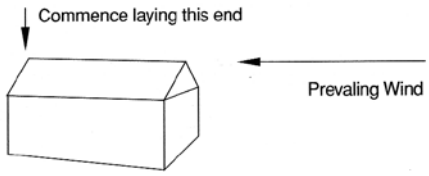
3.5 Sheet Installation

Customary practice is to lay out an area of sheet and secure each sheet with a crest fastener at the centre of the ends and middle, at the same time checking the profile to avoid profile spread. The area of sheet laid out should be no more than that which can be fully fixed within the day of laying. When the area of sheet has been laid, install side lap fasteners and then the balance of crest fasteners. See Sections 3.15-3.18.

Wherever possible commence laying the sheet farthest from the expected direction of the heaviest rain or wind and from the eave toward the ridge.

The top end of the sheet should be not more than 100mm from the ridge or fascia line and the bottom end should extend 50mm into the gutter. The ridge and eave ends are to have the pans upturned and downturned respectively. End forming tools are available for this purpose. Roof slopes greater than 25° require side lap sealing, with a continuous run of silicone sealant.

Figure 3.1: Commencing installation



3.6 Sheet Cutting

Where possible, you should minimise site-work by using sheets cut to length in the factory. Aluminium is best cut with a wax-lubricated fine tooth circular saw.

3.7 Wall Cladding

Wherever possible, commence fixing farthest from the expected direction of the heaviest wind or rain. Where more than one length is used for the wall height an overlap of 100mm should be allowed at a girt with the upper sheet overlapping the lower as for roofing end laps.

For non-cyclonic applications, the sheet is hard fixed to girts through the pan next to the rib using the screws as nominated in Table 3.1. Additionally RA018 Stitching screws or Bulb-tite rivets are required at lap ribs for LT7® and V-RIB® profiles at purlins and equal mid span points but not exceeding 500mm spacing.

For cyclonic applications wall sheeting shall be installed as per cyclonic roof sheeting (i.e. with washer at each rib)

Note: Expansion fixing notes are at Section 3.16 of this Manual.

3.8 Post Painting

Manual post painting is generally not recommended. Where there is no other option, we advise the following:

Flashings which are to be painted by the installer should first be washed with household detergent and dried. The flashing is then painted with an etch primer and finally brush painted with the colour coat.

Standard colours may be obtained on enquiry to major paint manufacturers.

Touch up of scratched to pre-painted sheet should be by brush only. Spray paints may fade prematurely.

3.9 Translucent Sheeting

Translucent fibreglass sheet is available in the PERMALITE LT7®, PERMALITE ALSPAN®, PERMALITE WAVELINE® and PERMALITE V-RIB® profiles.

The recommendations for end lapping roofing sheet apply also to the placement of translucent sheets into a roof.

Because of slight differences in profile all overlapping surfaces should have flexible silicone sealant or foam tape placed between them and the side laps should be fastened with Bulb-Tite® fasteners or similar at not more than 400mm centres. Fasteners must have a sealing washer under the head. All ribs at the ends of the sheeting, and alternate ribs at intermediate purlins, are to be fastened with crest fasteners and washers. Refer to the manufacturer's instructions for further details.

3.10 Sealants

Silicone sealants used with aluminium sheeting must be neutral cure, however in some roofing applications a non-curing sealant may be required. (Please refer to PERMALITE® for advice.) Neutral-cure silicone sealants have good adhesion to the clean surface of all our roofing and walling. They are water resistant and non-corrosive; and are resistant to extremes of heat and cold while retaining good flexibility. In addition they are excellent gap fillers and provide high resistance to ultra-violet rays (sunlight) and have a long service life.

Note: They are NOT adhesives.

3.11 Fastener Information

Table 3.1: Use of Fasteners

Fixed to:	LT7®	ALSPAN®	V-RIB®	WAVELINE®	
Crest fixed to steel less than 15mm but greater than 3mm (note Pilot hole requirement as per Table 3.2)	RA115 14-14x80	RA116 14-14x90	RA115 14-14x80	RASH1450 14-14x52	
Crest fixed to steel less than 3mm but greater than 0.50mm or aluminium less than 5mm but greater than 3mm	RA115 14-14x80	RA116 14-14x90	RA115 14-14x80	RASH1450 14-14x52	
Crest fixed to steel between 0.42mm and 0.48mm or aluminium between 1mm and 3mm (note Pilot hole requirement as per Table 3.2)	RA206 14-11x80	RA207 14-11x90	RA206 14-11x80	RA205 14-11x52	
***Crest fixed to timber (note Pilot hole requirement as per Table 3.2)	RA206 14-11x80	RA207 14-11x90	RA206 14-11x80	RA205 14-11x52	
Valley fixed to steel greater than 3mm (note Pilot hole requirement as per Table 3.2)	RA114 14-14x31	RA114 14-14x31	RA114 14-14x31	RA114 14-14x31	
Valley fixed to steel less than 3mm but greater than 0.75mm or aluminium less than 5mm but greater than 3mm	RA114 14-14x31	RA114 14-14x31	RA114 14-14x31	RA114 14-14x31	
Valley fixed to steel between 0.42mm and 0.75mm or aluminium between 1mm and 3mm (note Pilot hole requirement as per Table 3.2)	RA018 12-11x20	RA018 12-11x20	RA018 12-11x20	RA018 12-11x20	
Valley fix to steel between 0.42mm and 3mm or aluminium less than 5mm but greater than 3mm - Low wind applications eg soffits & ceilings	RA110 10-16x19	RA110 10-16x19	RA110 10-16x19	RA110 10-16x19	
***Valley fixed to timber	RA009 14-10x25	RA009 14-10x25	RA009 14-10x25	RA009 14-10x25	
Sidelap Fastening	*RA018 12-11x20	N/A	*RA018 12-11x20	N/A	
Flashings to roof sheet	*RA018 12-11x20	*RA018 12-11x20	*RA018 12-11x20	*RA018 12-11x20	
Flashings through roof sheet to supports	As per crest fix fastener for sheet				

* Full aluminium Rivets may be used in lieu of RA018 screws. Permalite recommend bulb-tite rivets

***Screw may need to be up-sized to ensure min embedment of 25mm into timber to make allowance for Insulation etc

Pilot holes are to be drilled in accordance with Table 3.2.

Pilot holes are to be drilled in accordance with the following chart:

Table 3.2: Pilot Hole Drill Diameter (mm) - Metal Thickness (mm)

	Fasteners	Aluminium			Steel					Timber	
		Up to 1.2mm	1.2mm to 3.0mm	3.0mm - 5.0mm	.42mm to .48mm	.55mm to .75mm	1.0mm to 4.8mm	4.8mm - 8mm	8.0mm - over	Hardwood	Softwood
304 / 316 Grade Stainless Steel	RA009, RA010SP	4.5	4.5	5	4.5	4.5	N/S	N/S	N/S	4	Self Drilling
	RA114 , RA115 , RA116, RASH1450	N/S	N/S	Self Drilling	N/S	Self Drilling	Self Drilling	5.6	5.7	N/S	N/S
	RA205, RA206, RA207	N/S	Self Drilling	Self Drilling	Self Drilling*	N/S	N/S	N/S	N/S	4	Self Drilling
	RA018	Self Drilling	3.5	4	3.5	3.5	N/S	N/S	N/S	Self Drilling	Self Drilling
	RA110	N/S	Self Drilling	Self Drilling	Self Drilling	Self Drilling	Self Drilling	Self Drilling	N/S	N/S	N/S

Notes
1. N/S = Not Suitable
2. Stainless steel screws are not to be installed using impact drivers. Powered or cordless screw guns should be used in lieu
3. Type 17 screws must be installed at a driving speed in excess of 1500rpm but not in excess of 3000rpm
4. Self drilling screws must not be installed at a driving speed in excess of 2500rpm
5. At speeds over 300rpm lubrication may be required when driving fasteners into hot rolled steel sections, especially using 316 stainless steel fasteners
* Pre-drilling a 4.5mm hole may be required.

3.12 Installation Instructions

3.12.1 Ordering Sheet

The quantity and length of sheet should not be determined from drawings but from actual measurements of the structure making due allowance for squareness of the structure. Where sheets are to be lapped, the minimum lap length on the underlapped sheet will be 300mm and must occur over a support. The longest sheet to be used is 23 meters. Requirements in excess of this 23m length are to be met by end lapping sheets or providing a step in the roof. An additional 50mm is to be allowed for gutter overhang. Remember that lengths that exceed 12.0 metres may incur additional transport costs.

Table 3.3: Use of washers

	LT7®	ALSPAN®	V-RIB®	WAVELINE®
Formed washer	RA023	RA137	BP082	RAWLCYCP
Hard fix Rib seal	RA036	RA039	RA039	RAWLCYSW
Expansion Fix Rib seal	RA033	RA041	RA041	RAWLCYSW

Note: Hard fix top 9m of each sheet.

Table 3.4: Rib Fasteners (per metre of purlins) - non-cyclonic

	LT7®	ALSPAN®	V-RIB®*	WAVELINE®
Intermediate Purlins	4.5 (1)	4.6	6.0	7.0
Eave/Ridge Purlins	7.8	4.6	10.0	7.0
Side lap stitching RA018 (2)	3.4	2.3	2.2	2.3
Girts	4.5 (1)	4.6	6.0	7.0

* V-RIB®: 5 fasteners/sheet
1. Based on fixing alternate ribs.
2. Based on 1.5 metre purlin centres, to be increased proportionally for each 500mm increase in purlin centres.

3.13 Fastenings

Screwguns with a depth sensitive nose-piece should be used to ensure that screws are properly set and not over driven. Over-driving of screws can lead to stripping of screws, deformation of sheeting and potential water leaks. (Figure 3.2)

Note: Impact driver screw guns should not be used with Stainless Steel screws.

3.14 Fixings

PERMALITE® provides a range of fixing screws and washers to provide all aspects of fixing the roofing sheet and flashings. The specification of fixings supplied by PERMALITE® is aimed at matching the durability of the roofing sheet. Purchase of inferior alternatives from other sources should be avoided.

3.14.1 Crest Fasteners –

The PERMALITE® Positive Fix system provides full security against wind uplift and water penetration whilst at the same time allowing movement of the roof sheeting and roof structure due to thermal expansion or contraction.

3.14.2 Valley Fasteners –

Used mainly for wall fixing to girts, the stainless steel fasteners with an aluminium/EPDM bonded washer are hard fixed into the girts. (Refer to Table 3.1: Use of Fasteners and 3.19 Fastener Specifications).

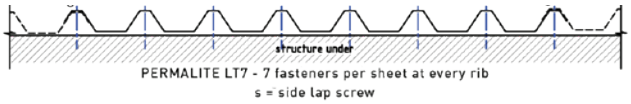
NOTE: Valley fixing is not appropriate in Cyclonic areas and wall sheeting in Cyclonic regions should be Crest fixed with formed washers as per Table 3.1 : Use of Fasteners and 3.19 Fastener Specifications as per fixing patterns shown at 3.14.6 Cyclonic fasteners - roof and wall cladding.

3.14.3 Flashing and Side Lap Fastening –

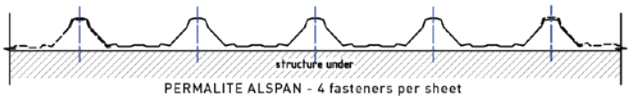
The RA018 self-drilling stainless steel screw fastens aluminium sheeting and flashings firmly together.

Full aluminium rivets may be used in lieu of RA018 screws. Use 4.8mm rivets for non-cyclonic regions and 11.9mm Bulb-tite® rivets for cyclonic regions.

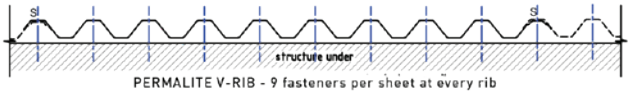
3.14.6 Cyclonic fasteners - roof and wall cladding



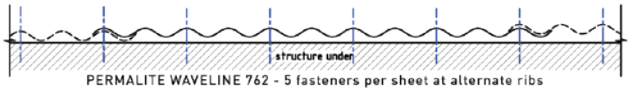
PERMALITE LT7 - 7 fasteners per sheet at every rib
s = side lap screw



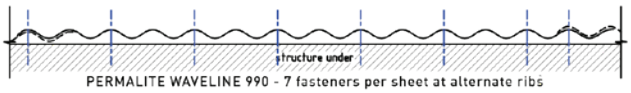
PERMALITE ALSPAN - 4 fasteners per sheet



PERMALITE V-RIB - 9 fasteners per sheet at every rib
s = side lap screw



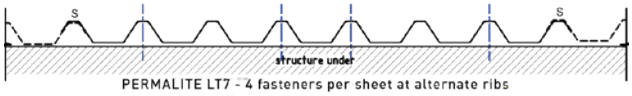
PERMALITE WAVELINE 762 - 5 fasteners per sheet at alternate ribs
(fasten at overlap ribs)



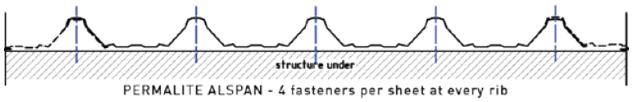
PERMALITE WAVELINE 990 - 7 fasteners per sheet at alternate ribs
(fasten at overlap ribs)

Notes:
1. Fixings based on PERMALITE® positive fixing system - refer Figure 3.4
2. Side lap fasteners are not required for ALSPAN® or WAVELINE® profiles
3. Screws can be placed on every rib to achieve better wind pressure capacity
4. WAVELINE 762 cover subject to availability, extended lead times and minimum order quantities

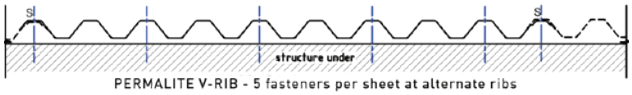
3.14.4 Non-cyclonic fasteners - roof cladding



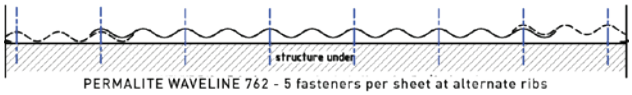
PERMALITE LT7 - 4 fasteners per sheet at alternate ribs
(Do not fasten overlap ribs unless all ribs are fastened)
s = side lap screw



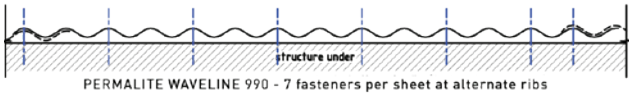
PERMALITE ALSPAN - 4 fasteners per sheet at every rib



PERMALITE V-RIB - 5 fasteners per sheet at alternate ribs
s = side lap screw

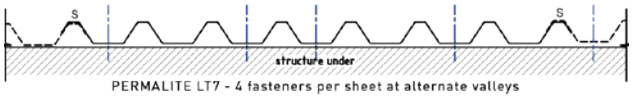


PERMALITE WAVELINE 762 - 5 fasteners per sheet at alternate ribs
(fasten at overlap ribs)

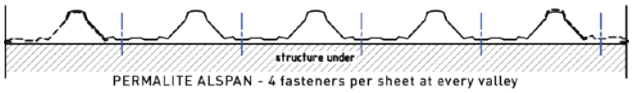


PERMALITE WAVELINE 990 - 7 fasteners per sheet at alternate ribs
(fasten at overlap ribs)

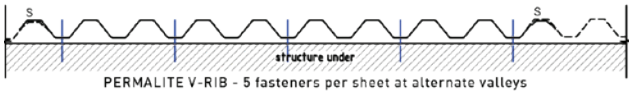
3.14.5 Non-cyclonic fasteners - wall cladding



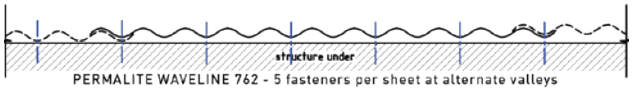
PERMALITE LT7 - 4 fasteners per sheet at alternate valleys
s = side lap screw



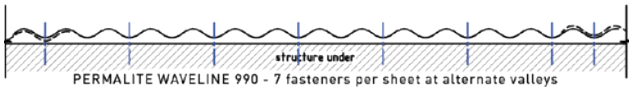
PERMALITE ALSPAN - 4 fasteners per sheet at every valley



PERMALITE V-RIB - 5 fasteners per sheet at alternate valleys
s = side lap screw



PERMALITE WAVELINE 762 - 5 fasteners per sheet at alternate valleys
(fasten at overlap valley)



PERMALITE WAVELINE 990 - 7 fasteners per sheet at alternate valleys
(fasten at overlap valleys)

3.15 Pierce-fixed Roof Fixing

The PERMALITE® Positive Fix System provides for thermal expansion of the roofing sheet by "hard" fixing at the top of the sheet slope with "expansion" fixing being used to accommodate expansion towards the lower end of the sheet slope.

For both types of fastening the screw should be screwed down until it presses on the washer with a medium pressure. Under no circumstances should the screw be overtightened to the point where the formed washer, or the bonded washer under the screw head, commence to distort.

3.16 Types of Pierced Fixings

Hard Fixing

"Hard" fixing is used where sheet lengths are such that thermal expansion is not a significant issue i.e. 9m or less (6m for water reservoirs).

Appropriate pilot holes are required to be drilled through the sheet and purlin when certain fasteners are used. Refer to Table 3.2 for pilot hole requirements and sizes. The hole in the PERMALITE® sheeting should then be enlarged to 6-6.5mm diameter after which the fastener is installed.

In applications where self drilling screws are used, then a 6- 6.5mm diameter hole should be drilled through the sheet prior to installation of the fastener. (Figure 3.4)

Expansion Fixing

For roof lengths in excess of 9m, "Hard" fixing is used for the first 9m from the ridge or skillion head (in water reservoirs, this dimension is reduced to 6m). Expansion fixing is used for the remainder of the sheet length and follows the same procedure as hard fixing with the exception that the hole in the rib crest is slotted after drilling the tapping hole, using tool RA165 for LT7®, ALSPAN® and V-RIB® profiles. (Figure 3.4) On large projects contact your PERMALITE® sales representative regarding use of this tool (RA165). Note that for expansion fixing a rubber washer with an elongated hole and Teflon facing on one side is used. This washer must be installed with the Teflon side facing up toward the head of the screw. Ensure the fastener is installed in the centre of the slot. For WAVELINE®, expansion is provided by drilling an 7mm hole in lieu of slots noted above.

Roof furniture (for example vents, walkways, etc.) should make allowance for the roof sheeting to expand and contract within the expansion zone, and must not be installed over endlaps.

For low pitched roofs and roof lengths in excess of 60m consideration should be given to step joints to provide expansion in addition to expansion fixing requirements.

All flashing runs over 9m shall make allowance for expansion. Each lap within the run shall be sealed with a non-curing silicone sealant to allow for movement. Lap fasteners shall have the upper flashing pre-drilled with a 7mm hole as per Figure 3.8.

For examples of typical hard/expansion fixing roof sheeting layouts, refer to PERMALITE® Roofing Appendix, which can be found at www.permalite.com.au

Wall Cladding

Non-cyclonic wall sheets may be pan "Hard" fixed up to 23m in length using fasteners as per Table 3.1.

Cyclonic wall sheets must be crest "Hard" fixed with washers up to 23m in length. Long lengths of flashings may likewise be "Hard" fixed. However in regions of high temperature variations it is advisable to consider expanding sheeting holes to 7mm for both flashing and wall sheeting applications.

Figure 3.3: It is important that you set screws correctly

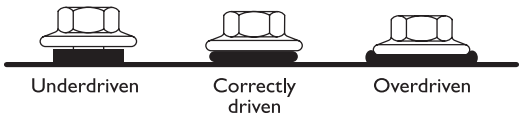
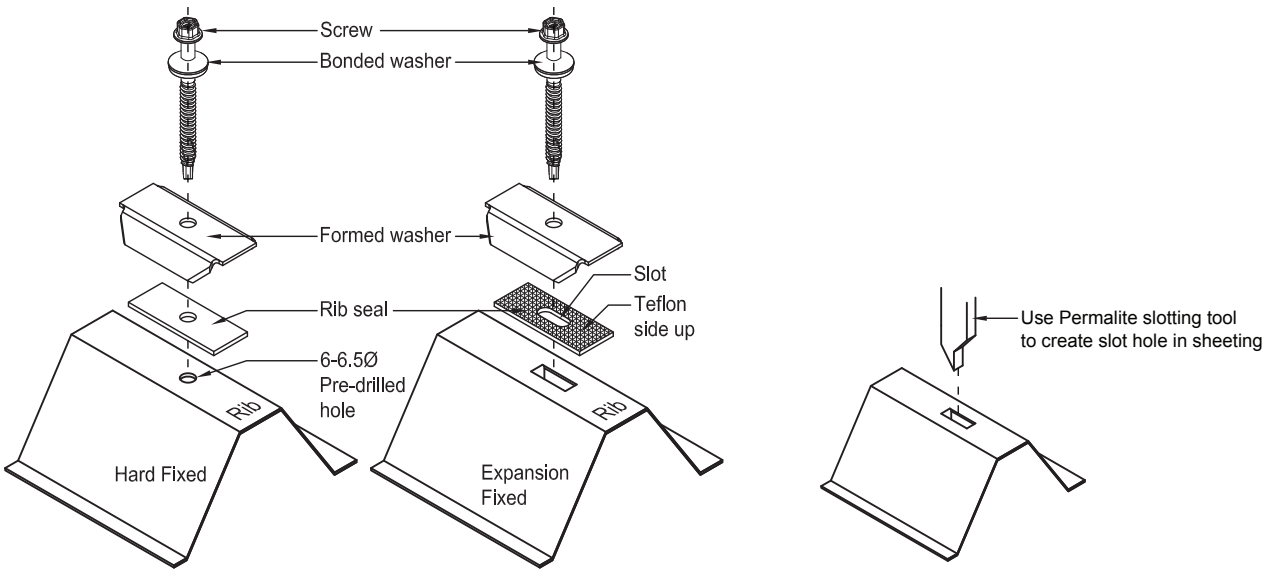


Figure 3.4: PERMALITE® Positive Fix fastening system



3.17 End Laps

When end laps are used the lower sheets are fixed first, without holes being drilled for fasteners to the purlin at the top of the sheet slope. When the next sheet up the roof slope is laid the sheet is first temporarily secured from the upper end towards to lower. Where the sheet overlaps the previously laid sheet, the end of the top sheet is lifted and the rib crest slotted using special slotting tool RA165. The top sheet is lowered and a pilot hole drilled, at the centre of the top sheet slot, through the lower rib into the purlin with the fastener then being installed. This methodology ensures the top sheet is expansion fixed and the lower sheet is hard fixed. (Figure 3.7) End laps for WAVELINE® can have an 7mm pre-drilled hole through the crest of both sheets.

Note: the overlapping sheets should not be rib crest slotted together. (Figure 3.7)

Figure 3.5: Step joint detail

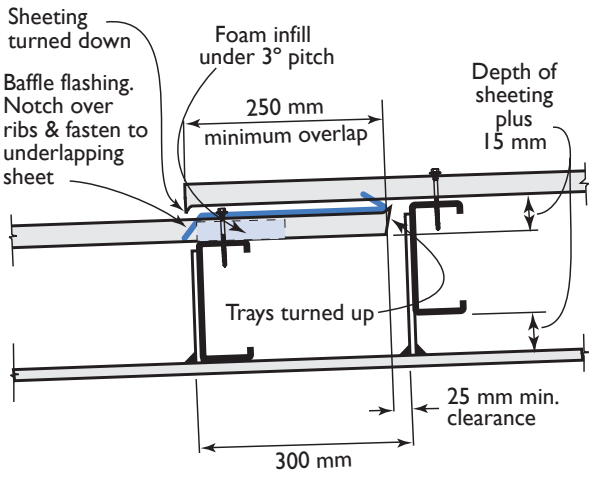
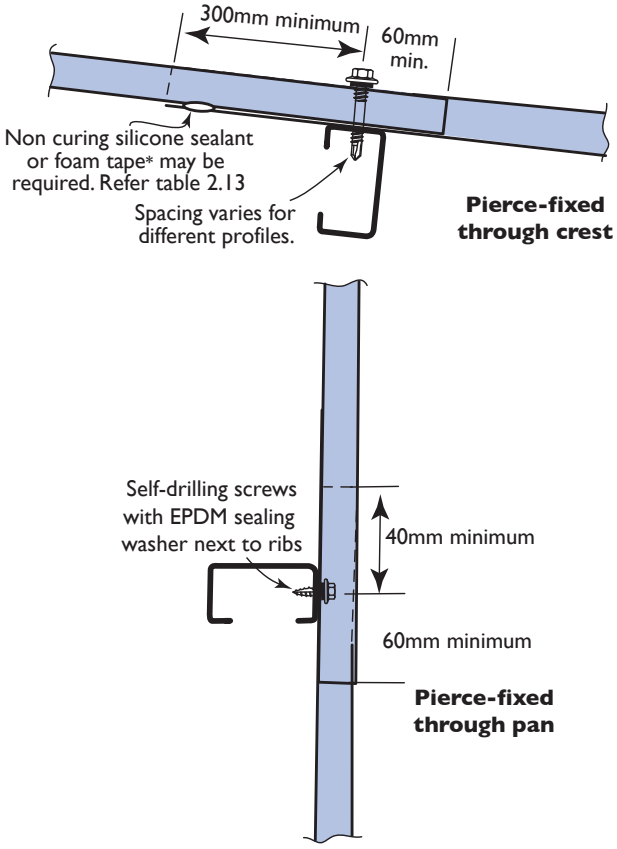


Figure 3.6: Typical roof and wall lapping.



*Tapes such as STOPAQ CZH Wrappingband-DS are a suitable substitute for non curing sealant

Figure 3.7: Typical Expansion Endlap Detail

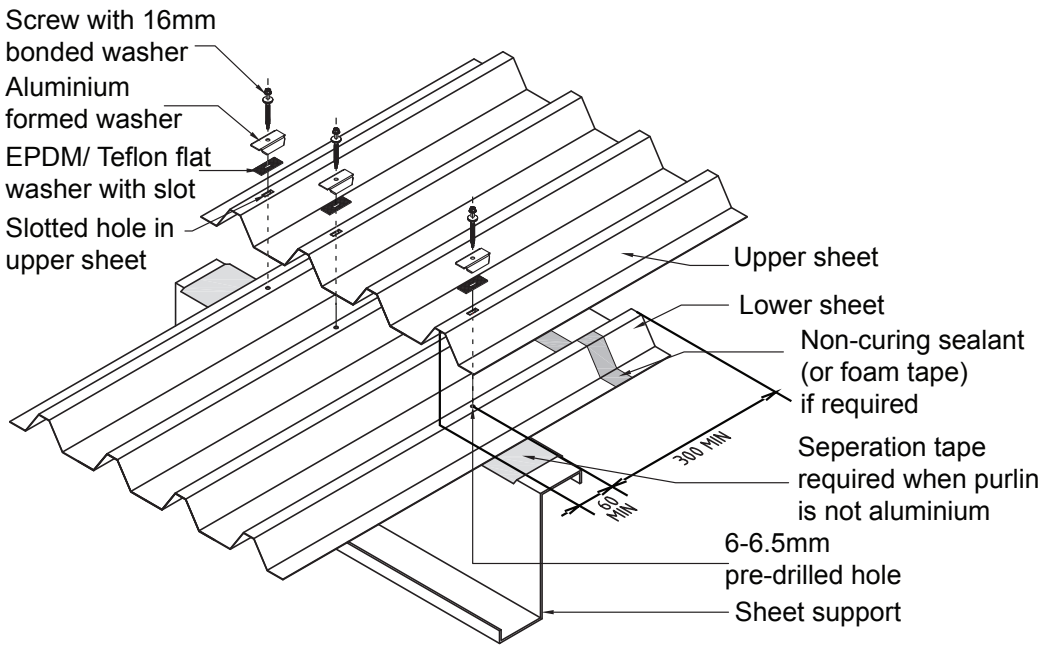
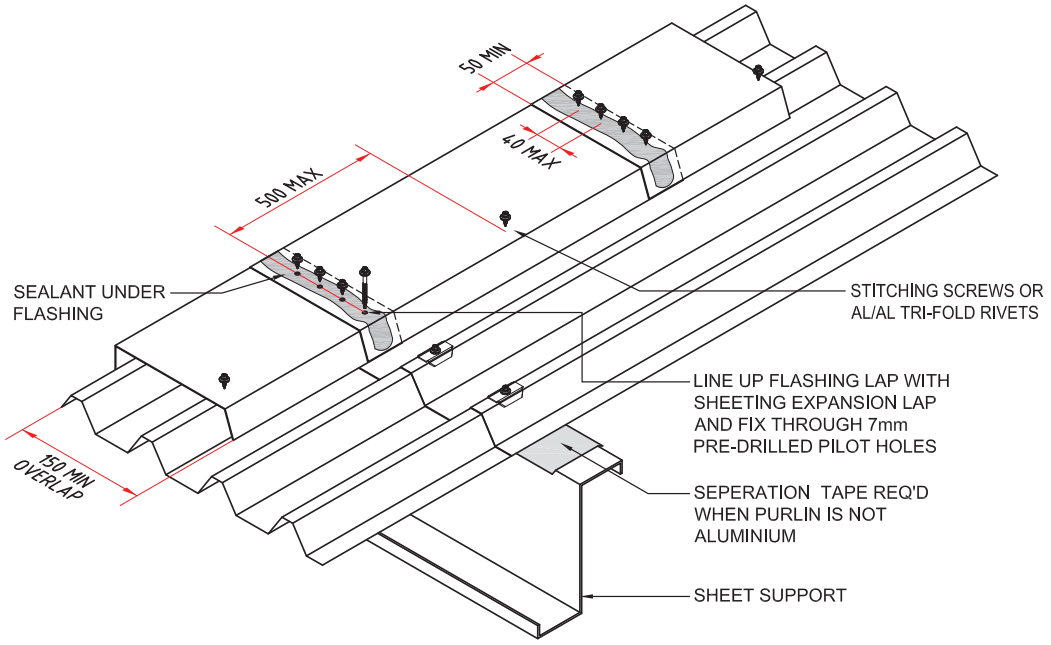


Figure 3.8: Typical Longitudinal Flashing Endlap Detail



3.18 Side Laps

When required, all side lap fasteners (RA018 or full aluminium rivets) should be installed after the sheet is temporary fixed and before all crest fasteners are installed. The fasteners are placed in the centre of the rib crest and at equal spacings between purlins but not exceeding 500mm. When installing the fasteners, place one foot on the overlapping ribs to ensure they are firmly together.

3.19 Fastener Specifications

LT7®

RA206
14x80 Roofzip with aluminium bonded washer

***** RA009**
14x25 hex. head stainless steel Type 17 screw with aluminium bonded washer

RA115
14x80 hex. head stainless steel Teks® self drilling screw with aluminium bonded washer

RA114
14x31 hex. head stainless steel Teks® self drilling screw with aluminium bonded washer

RA018
12x20 hex. head stainless steel stitching screw with aluminium bonded washer

V-RIB®

RA206
14x80 Roofzip with aluminium bonded washer

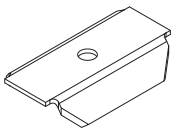
***** RA009**
14x25 hex. head stainless steel Type 17 screw with aluminium bonded washer

RA115
14x80 hex. head stainless steel Teks® self drilling screw with aluminium bonded washer

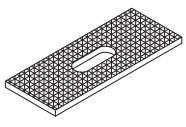
RA114
14x31 hex. head stainless steel Teks® self drilling screw with aluminium bonded washer

RA018
12x20 hex. head stainless steel stitching screw with aluminium bonded washer

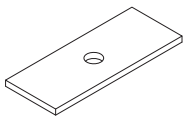
Washer Specifications



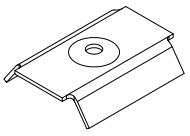
RA023
57x20mm aluminium formed washer with 6mm diameter hole



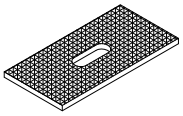
RA033
45x20x2mm EPDM/Teflon flat washer with slot. Teflon faced on one side



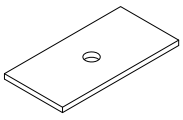
RA036
50x20x2mm EPDM flat washer with 6mm diameter hole



BP82
57x27mm aluminium formed washer with 6mm diameter hole



RA041
50x25x2mm EPDM/Teflon flat washer with slot with Teflon face on one side



RA039
50x26x2mm EPDM flat washer with 6mm diameter hole

NB Stainless steel screws are not to be installed using impact drivers. Powered or cordless screw guns should be used at maximum 2500rpm for Teks and Stitching screws, and maximum 3000rpm for Zips and T17 screws.

*** When fastening to timber, screw may need to be up-sized to ensure min embedment of 25mm.

ALSPAN®

RA207
14x90 Roofzip with aluminium bonded washer

RA009
14x25 hex. head stainless steel Type 17 screw with aluminium bonded washer

RA116
14x90 hex. head stainless steel Teks® self drilling screw with aluminium bonded washer

RA114
14x31 hex. head stainless steel Teks® self drilling screw with aluminium bonded washer

RA018
12x20 hex. head stainless steel stitching screw with aluminium bonded washer

WAVELINE®

RA205
14x52 Roofzip with aluminium bonded washer

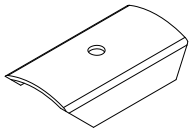
***RA009**
14x25 hex. head stainless steel Type 17 screw with aluminium bonded washer

RASH1450
14x52 hex. head stainless steel Teks® self drilling screw with aluminium bonded washer

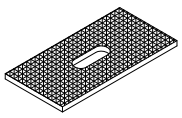
RA114
14x31 hex. head stainless steel Teks® self drilling screw with aluminium bonded washer

RA018
12x20 hex. head stainless steel stitching screw with aluminium bonded washer

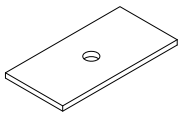
Washer Specifications



RA137
65x30mm aluminium formed washer with 6mm diameter hole



RA041
50x25x2mm EPDM/Teflon flat washer with slot. Teflon faced on one side



RA039
50x25x2mm EPDM flat washer with 6mm diameter hole

RAWLCYCP
WAVELINE® stainless steel cyclonic plate (Available separately or as Wavelok assembly with screw, washer and formed washer.)

RAWLCYSW
WAVELINE®cyclonic sealing washer for under cyclonic plate (Hard fix only)

NB Stainless steel screws are not to be installed using impact drivers. Powered or cordless screw guns should be used at maximum 2500rpm for Teks and Stitching screws, and maximum 3000rpm for Zips and T17 screws.

* When fastening to timber, screw may need to be up-sized to ensure a min embedment of 25mm.

4.0 Flashings

4.1 Purpose of Flashing

The purpose of a flashing is to divert water away from any point of entry, and to make any building weatherproof.

Flashings and cappings are strips of metal formed to weatherproof the edges of roofing and walling.
For the purposes of this chapter, only the term flashing is used.
The following sections should be considered as a guide only.
For a comprehensive account of flashing guidelines, refer to HB39-1997.

Similar methods of flashing are used for different cladding-profiles. You can adapt the principles to suit your application.
In all cases it is important to have ample cover provided by the flashing and proper turn-up of the cladding underneath.

Be careful when moving between supports. Do not walk on the ridge immediately adjacent to flashings or translucent sheeting. Walk at least one pan away.

Flashings are not only required to provide weather-resistance the many junctions on a roof or wall structure, but are also a very visible part of the roof and wall cladding design, and perform an important role in the aesthetic appearance of the building.

Experience is required to design, cut and fasten flashings that will last the lifetime of the roof or wall cladding, and specialist assistance should be sought where this experience is not available.

All flashings must be designed to prevent ponding of water or build-up of debris. Flashings must be designed to provide weather-resistance for the roof or wall cladding without reliance on sealant as the prime means of providing weather-resistance.

4.2 Flashing Materials

It is very important that flashings be made from materials that are compatible with the cladding (Refer Tables 2.9 and 2.10).

Lead flashing is not recommended, however it will usually be retained when re-roofing, because it is usually cemented into the structure. In these cases:

- the top surface of the lead flashing must be painted with a good quality exterior paint system (to limit contamination with lead compounds in water running off the flashing); and
- there must be a barrier between the lead flashing and the cladding: either a plastic strip (such as polythene dampcourse), or paint.

Flashings should conform to AS/NZS 2179.1, and be compatible with the cladding (Refer Tables 1.3 and 1.4).

Materials for flashings are available in Mill or Painted finishes.

4.3 Roof Flashing

For the purposes of this chapter, only the term flashing is used.
The following sections should be considered as a guide only.
For a comprehensive account of flashing guidelines, refer to AS/NZS 3500.3.

Similar methods of flashing are used for different cladding-profiles. You can adapt the principles to suit your application.
In all cases it is important to have ample cover provided by the flashing and proper turn-up of the cladding underneath.

The correct installation of flashings to seal the roof perimeters or penetrations is essential to the security and weather tightness of the roof. Consideration should be given to movement between the roof and building walls and to length expansion of flashings. (Figure 3.8).

Lysaght is able to supply a range of flashings which are provided to the same metal specification as the roofing sheet. Where custom made flashings are required the metal should be to the following specification.

Alloy	5251/5052 preferred, (5005 alternatively*)
Temper	H38
Thickness	0.90mm
Bend Radius	0.9-1.2mm - 1.5-2t where 't' represents thickness of material unpainted sheet.
	0.9-1.2mm 4-6t where 't' represents thickness of material pre-painted sheet *5251 / 5052 H38 Aluminium is not suitable for tight radius bends. Minimum Bend radii apply. Squash or Crush folds are not achievable.

*Warranties may not apply to 5005 material.

4.4 Barge Flashing

The installation of this flashing must allow for movement between the roof sheeting and the wall parallel to the edge of the sheeting. The following fixing procedures are recommended.

Note: Where overlaps occur on the roof a corresponding overlap is to be made in the barge flashing.

Be careful when moving between supports. Do not walk in the pan immediately adjacent to flashings or translucent sheeting. Walk at least one pan away.

PERMALITE® supplies custom flashings to your requirements – ask your local service centre for details.

4.5 Longitudinal Flashings

The pans or valleys, and are made to suit the cladding profile. They should have an edge turned-down to dip into the pan or valley. The minimum recommended cover of longitudinal flashings over cladding should be taken from AS/NZS 3500.3.

4.6 Transverse Flashings

Transverse flashings run across the pans or valleys. They usually have a stiffening lip, along the lower edge, which is turned-down to dip into the pan or valley. To maximise weatherproofing, the bent lip is fashioned to fit the profile.

The turn-down for transverse flashings for WAVELINE® can be fashioned to fit the profile by either notching or scribing to match the corrugations, or lightly dressed into the valleys. The type of fashioning (if any) depends upon profile shape and the type of material used to flash. Fashioning is preferred for low-slope roofs.

The turn-down for transverse flashings for wide panned cladding is always notched or scribed to fit over the ribs.

Figure 4.4: Barge flashing

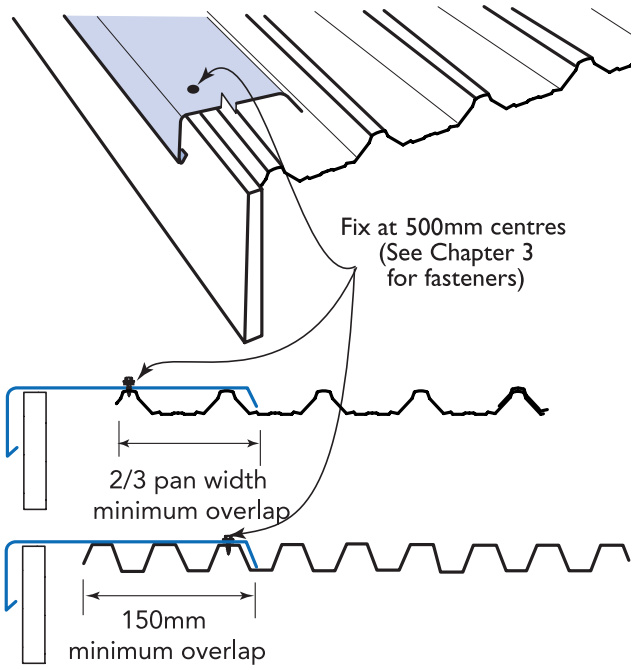
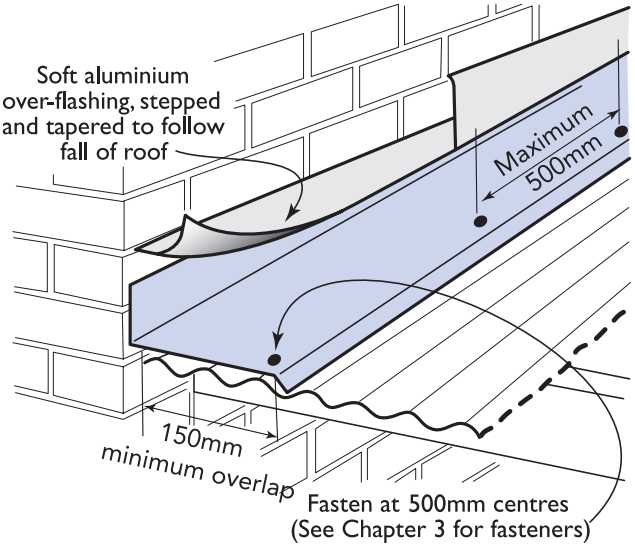


Figure 4.5: Longitudinal flashing



4.7 Flashing Cover

Permalite® can produce a range of flashings to suit your needs and design (hip, barge, apron). To increase weather-resistance, Permalite® recommends you maximise the overlap between flashings and claddings.

4.8 Fixing of Flashings

Longitudinal flashings shall be fastened at maximum 500mm centres. Transverse flashings shall be fastened in accordance with AS/NZS 3500.3.

4.9 Flashing at Laps

A lap is that part of a flashing that overlaps or covers any portion of the same shaped component, and is variously described as an end lap, overlap or underlap.

Laps should comply with the following criteria:

- an overlap must run in the same direction as the water i.e. downhill;
- an overlap must run over not under;
- an overlap must be across the fall or at a shallow angle;
- water must flow over a lap not into it;
- a lap must be self-draining and not rely solely on sealant;
- a lap must be mechanically fixed;
- a sealed lap must have a minimum of width of 25mm

4.10 Flashing Small Roof Penetrations

A flanged cylindrical sleeve is a fairly simple method of flashing around small penetrations (such as pipe penetrations) which fit between the ribs of a roof sheet, or penetrate only a single rib.

The flange around the base of the sleeve can be contoured by hand to match the cladding profile before it is sealed and fixed to the cladding.

Be careful not to dam any valleys or pans so that rainwater can drain freely from the high side of the roof penetration.

Figure 4.6: Ridge capping

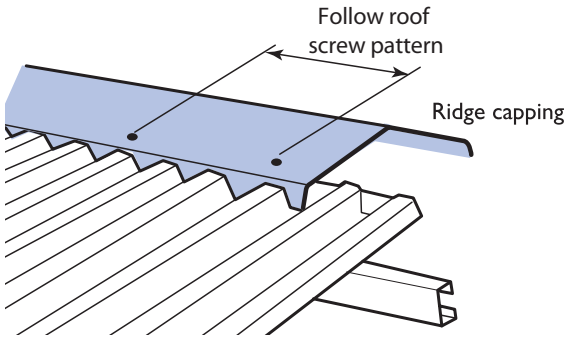


Figure 4.7: Fascia capping

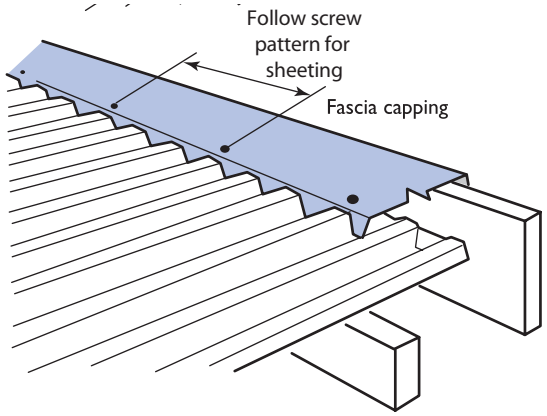


Figure 4.8: Parapet flashing

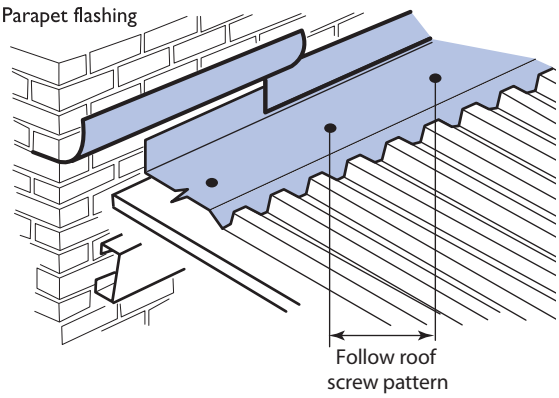
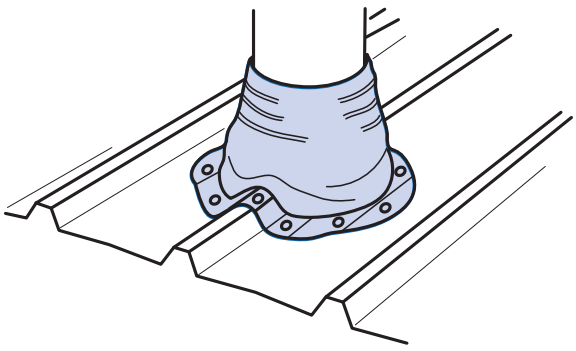


Figure 4.9 :Small penetration with sleeve (Dektite® sleeve illustrated)



4.11 Flashing Large Roof Penetrations

Penetrations through ribbed cladding block the valleys (or pans), and thus affect the free flow of rainwater down a roof. All flashings have to weatherproof the cladding – but on the uphill side of large penetrations, they also have to channel rainwater sideways into valleys that run unobstructed to the eaves.

Four methods are described here. In all methods the ends of cut ribs may be closed off with caps on the outside of the rib, or with plugs inside the ribs. Plugs must be used on side-laps to allow the anti-capillary cavity to drain.

Note: For masonry construction, Building Code Australia (BCA) requires the use of Damp Proof Course (DPC) to ensure weatherproofing. For acceptable methods see BCA section on weatherproofing masonry.

Support Framing

Wherever more than one of the sheet ribs are cut and is at a distance of 200mm or greater from the nearest support, you must provide framing to support the cut ends of the roof cladding each side of the penetration.

Existing Flashing

If you have to re-use lead flashings that are built into the structure, special protection is needed.

Method 1: Head gutter and apron flashings

This is often the simplest method, and commonly used for existing protrusions.

Method 2: Flat tray and sleeve

To avoid fitting and sealing end caps to all the sheet ribs on the low side of the penetration, an apron flashing can be fitted to the sleeve and sealed to the tray each side.

Method 3: Tray gutter for steeper roofs

If the roof pitch is more than, say 1 in 12 (5°), you cut the roof cladding sufficiently high above the penetration to allow a tray gutter to raise rainwater over the top of the sheet ribs and divert it around the penetration.

Figure 4.10: Method 1: Head gutter and apron flashings

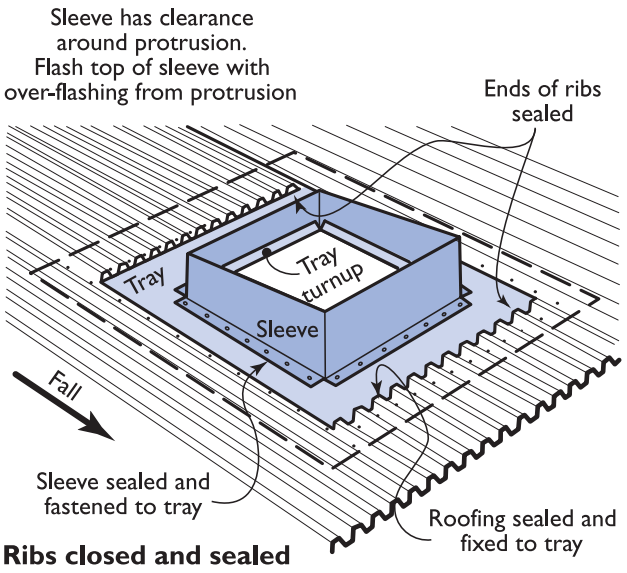
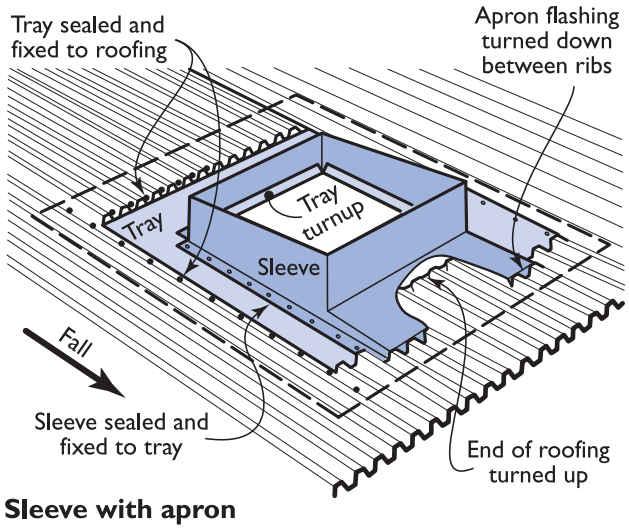
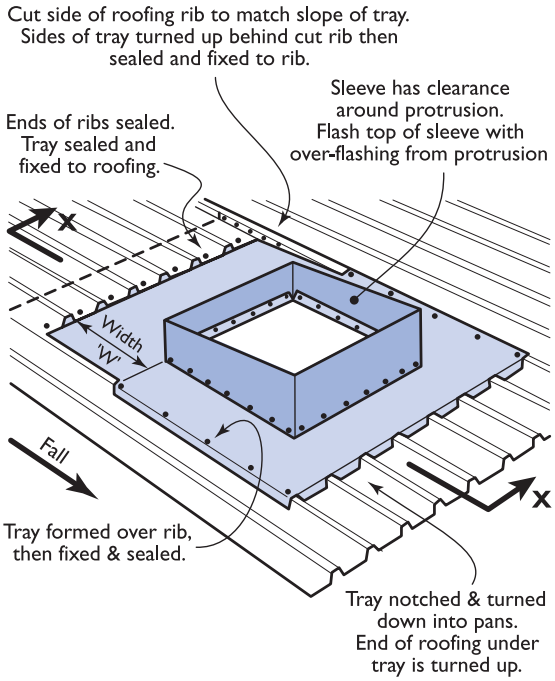


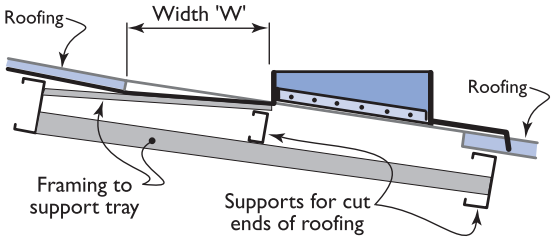
Figure 4.11: Method 2: Flat tray and sleeve



Note: Careful consideration is to be made in relation to contraction/expansion of aluminium roof sheeting prior to designing the position of the roof furniture. Consult Lysaght for further information.

Figure 4.12: Method 3: Tray gutter for steeper roofs





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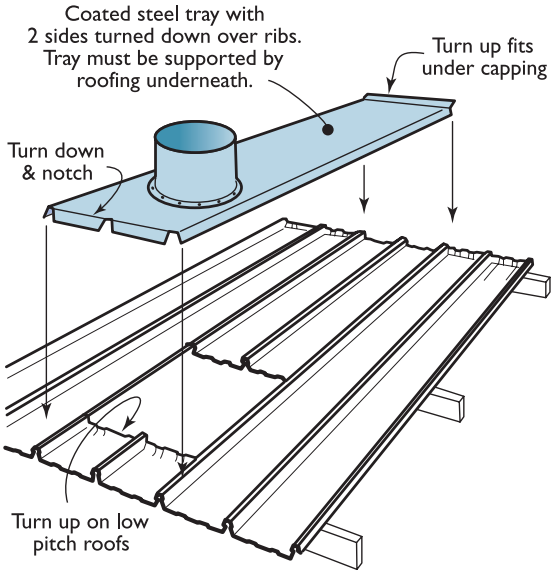
The base of the tray over width 'W' slopes slightly towards the protrusion. The width 'W' varies with this slope, the roof pitch and the rib height. Thus:

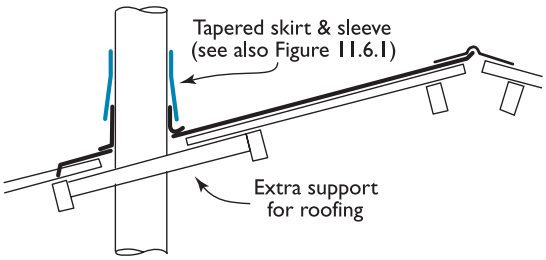
$$W = \frac{\text{Rib height}}{\sin(\text{roof pitch} - \text{slope of tray})}$$

For example: if the tray slopes 1 in 50 (1) and the roof pitch is 1 in 12 (5).

RIB DEPTH	WIDTH 'W' (minimum)
25 mm	360 mm

Figure 4.13: Method 4: Flat tray and sleeve to ridge





4.12 Notching with Tinsnips

If notching tools are not available, flashings can be notched to the rib profile with tinsnips (Figure 4.12). The procedure is sometimes known as scribing. After the cladding is fixed and the turn-ups finished, proceed as follows.

- Place the flashing with the turned-down edge resting on the ribs.
- Mark out the notching using a template positioned over each rib.
- Cut the notches with tinsnips.

This procedure is also used for hip cappings.

Fasteners for Transverse Flashings

You must properly fix both flashings and the ends of all sheets.

Where the cladding is pierce-fixed through crests, and the position of the purlin allows it, the fasteners used to fix the sheets, may also fix the flashings.

On all other installations, pierce-fix your flashing to the ribs or crests of the sheets.

Joining Flashings

The overlaps of transverse flashings should be sealed with a recommended sealant and fastened. Before finally positioning and fixing the lap, turn over the top piece and apply a 3mm bead of sealant across the flashing, about 12mm from the end.

4.13 Apron Flashings

Cladding should not fit tightly down onto the horizontal surface of any apron flashing as it will retain moisture and collect dirt and debris and should have minimum clearance of 25mm.

4.14 Gutter apron

Where the ends of roof cladding are exposed to contaminants such as sea salt or industrial pollutants it is better practice to provide an over flashing which discharges into the gutter or spouting for the following reasons. (see Figures 4.14 & 4.15)

- It provides a measure of protection to the underside of the roof cladding and the underlay.
- It provides support for the roofing underlay which is subject to damage from wind and UV.
- If there is no spouting or it has a low front.
- It provides protection against wind-borne embers.
- Where the ends of roof cladding are exposed in a severe environment, contaminants can be driven up the ribs of the cladding. Metal scriber flashings or filler blocks can be used to prevent or inhibit ventilation.

The over-flashing should extend 50mm into the gutter and the underlay finishes on the down-slope of the flashing. If there is no over-flashing to the gutter the underlay should be extended into the gutter by a minimum of 50mm.

Figure 4.14: Gutter apron: Quad

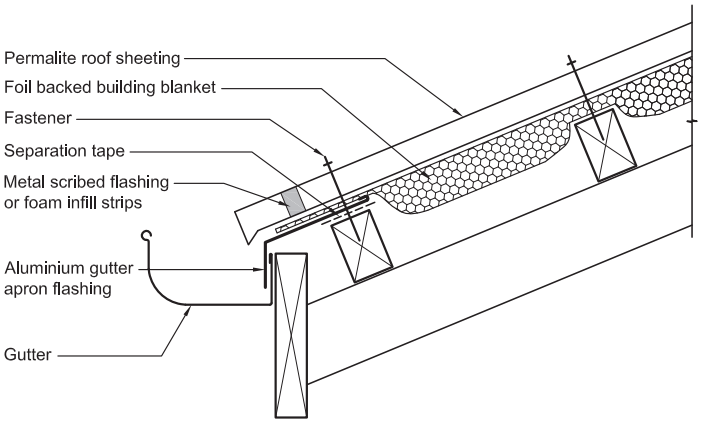
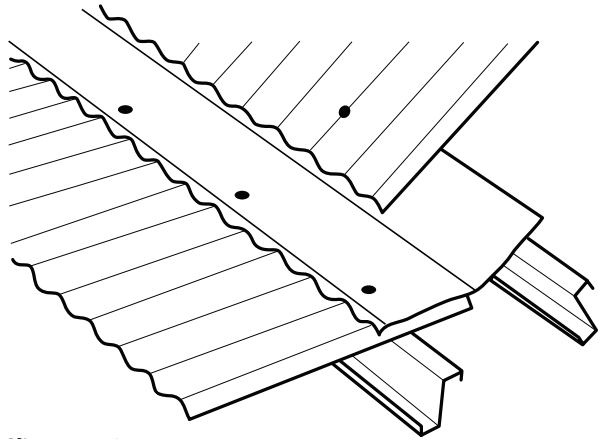


Figure 4.15: Typical flashing at changes of pitch



5.0 Insulation

In summer buildings get hot from the sun and we want to cool the inside; in winter we often heat the inside and want to avoid losing that heat. Factors in controlling heat include:

- the orientation of the building relative to the sun;
- external shading from trees or other buildings;
- design of the building, especially ventilation and sealing at doors and windows;
- the colours and surface gloss of the cladding.

The first three factors are outside the scope of this book. Heat is absorbed into a sheet on one side, and some of that absorbed heat is re-radiated from the other side.

- Light-coloured or shiny surfaces don't absorb much heat, and they radiate little.
- Dark-coloured or dull surfaces absorb a lot of heat, and they radiate a lot. This doesn't stop you using darker claddings because you can use reflective foil laminate under the cladding.

5.1 Insulation Materials

Typical insulation materials are reflective foil laminates, insulation blankets or batts made from fibreglass, and boards made from polystyrene. Remember that the colour of cladding also has a marked effect.

Foil Laminates

Foil laminates reflect heat and can double-up as a vapour barrier to control condensation. Where they are used as a vapour barrier the joints between successive strips are overlapped about 100mm, and sealed with a tape impervious to moisture.

Blankets and Batts

Blankets and batts minimise heat convection and are available with the laminate bonded to the fibreglass. They are also effective in reducing noise.

Insulation blankets must be protected from moisture, particularly around the edges of the roof and even more particularly at the bottom end of the cladding where rainwater run-off can be blown back under a low-pitched roof. If the blanket overhangs the bottom support, it may even come into contact with water in the gutter, where the insulation will absorb moisture and remain damp for extended periods, thus leading to deterioration of the coating on the underside of the roofing and reducing the effectiveness of the insulation.

Polystyrene Boards

Expanded and extruded polystyrene is also used for the same purposes as blankets and batts. The boards are more rigid and relatively less compressible which demand different fixing to that mentioned above. Seek advice from manufacturers of polystyrene insulation.

5.2 Insulation Thickness (Glass Wool)

Insulation blankets and batts can cause cladding to bow out between the fasteners. To minimise this problem, the maximum thickness of blankets and batts should be 100mm for pierce-fixed cladding. (Maximum density 12kg/m^3). For more dense glass wool and rock wool, and thicker insulation, spacers are recommended.

5.3 Roof Safety Mesh

When selecting roof safety mesh for use with Aluminium cladding and or purlins, consideration should be given to:

a) Isolation from incompatible materials

b) Corrosion resistance of the mesh in the installed environment.

As shown in Figure 5.1, insulation materials will often provide sufficient isolation of the PERMALITE® aluminium sheeting from steel safety mesh and steel purlins. However in many applications, where the interior of the building is a corrosive environment, or if no insulation is used, then appropriately certified PVC coated Stainless steel mesh or PVC mesh should be used. Where no insulation is used, then a closed cell foam strip should also be installed between the PVC coated mesh and the sheeting, both at purlins supports and mid span of purlins (refer to Figure 5.2). For best practice, the foam tape should be 10mm wider than the purlin top flange.

5.4 Heat Control Methods

In roofs, a simple, inexpensive and very effective method is to drape a membrane of reflective foil laminate over the supports before laying the cladding. The laminate can also provide a vapour barrier to minimise condensation. If the membrane is allowed to drape 50 to 75mm between the supports the air space between the membrane and the roof cladding will further improve heat insulation

For installation instructions, refer to the LYSAGHT® Roofing & Walling Installation Manual, which is available at: www.lysaght.com.

Figure 5.1: Typical roof insulation with foil or combined foil and blanket insulation

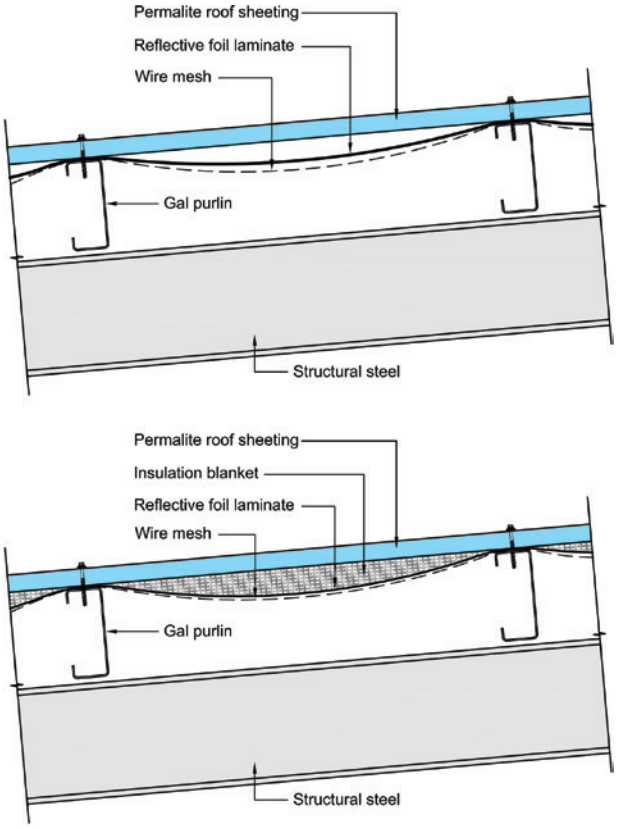


Figure 5.2: Typical wire mesh separation methodology when corrosive environment is internal

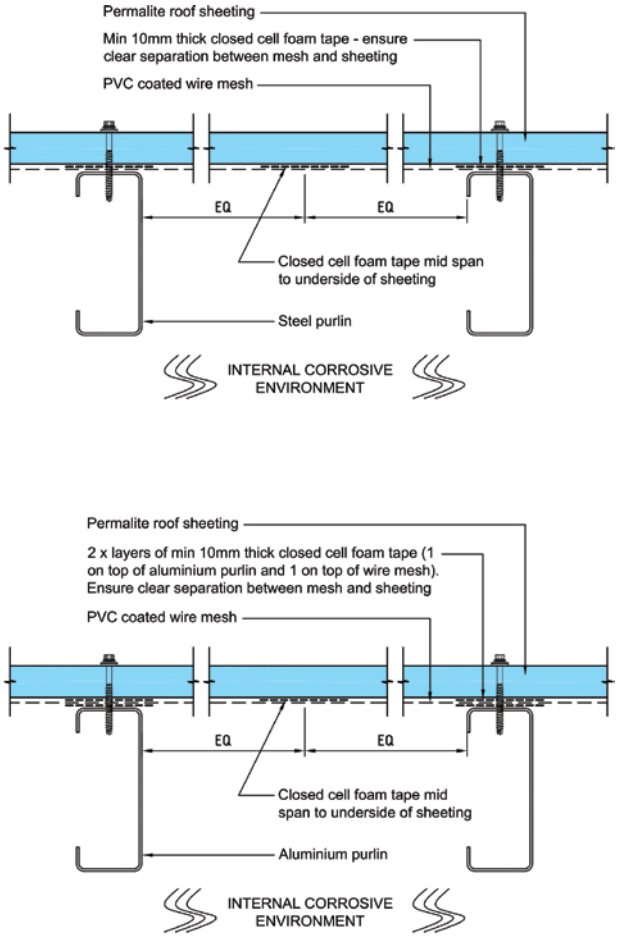
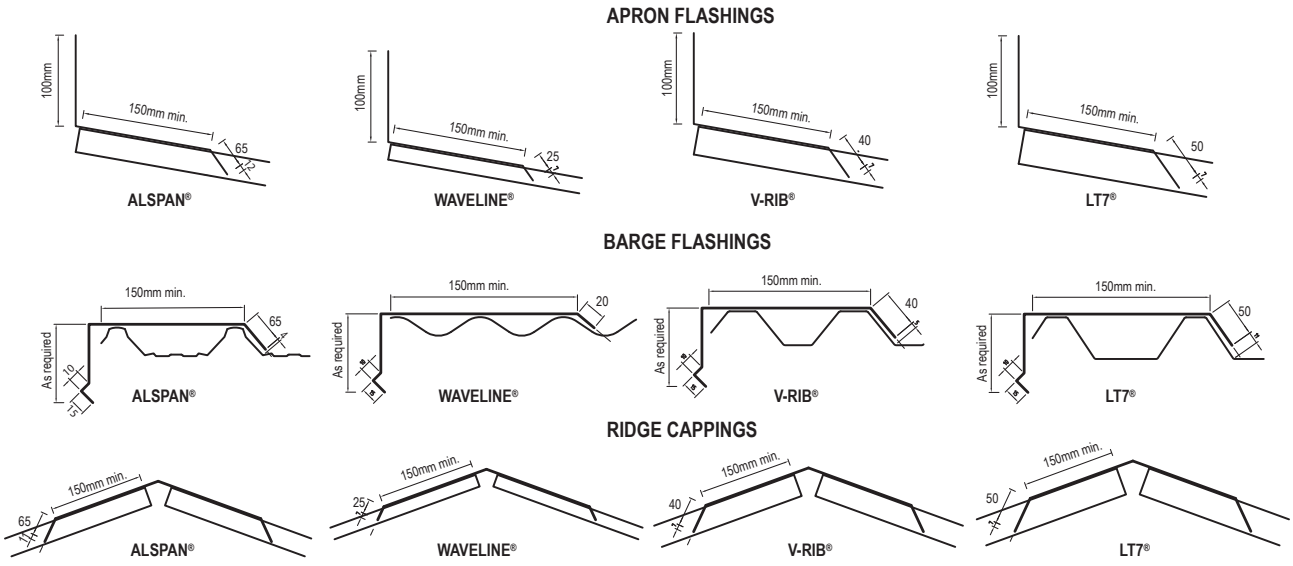


Figure 5.3: Typical flashing dimensions for PERMALITE® profiles



Note: All depicted flashing returns on PERMALITE® profiles are based on a 135° bends.

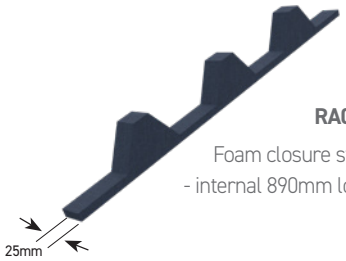
6.0 Anchor Points, Static Lines, Guard Rails & Walkways

Any safety/walkway systems fixed to PERMALITE® products should be tested to the relevant Australian Standards. For more information contact your Permalite office.

7.0 Accessories

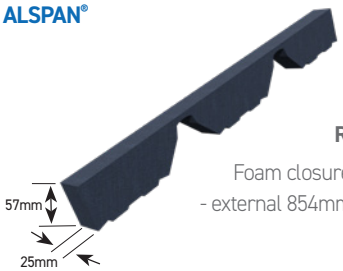
LT7®

RA092
Foam closure strip
- external 890mm long

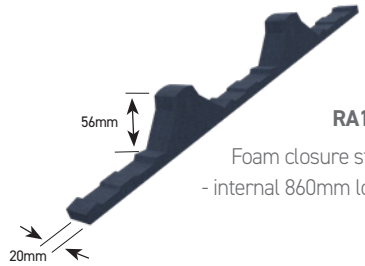


RA093
Foam closure strip
- internal 890mm long

ALSPAN®

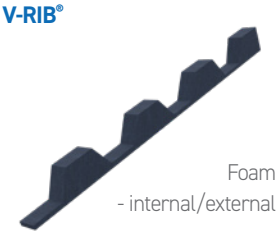


RA154
Foam closure strip
- external 854mm long



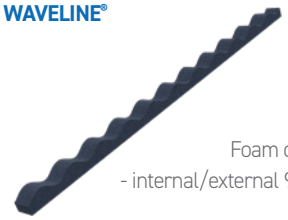
RA156
Foam closure strip
- internal 860mm long

V-RIB®



RA073
Foam closure strip
- internal/external 910mm long

WAVELINE®



ISCO
Foam closure strip
- internal/external 915mm long

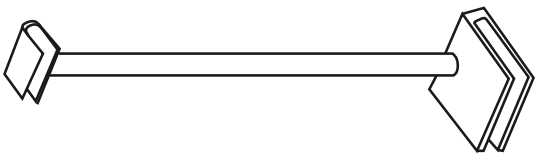
Note: Accessories which do not carry an RA designation are not held in stock but may be available subject to enquiry. Colours are not necessarily in stock.

All Profiles

Expansion Slot Punching Tools

RA165 Slotting Tool (Standing) for LT7® or ALSPAN®/V-RIB®

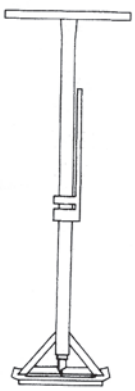
RA166 Spare blade for RA165



RA158 - Turn-up/turn-down tool for ALSPAN®

RA082 - Turn-up/turn-down tool for LT7®

RA237 - Turn-up/turn-down tool for V-RIB®



RA165

8.0 Engineering Certification

BlueScope Steel Limited
ABN 16 000 011 058
Lysaght Building Solutions Pty Ltd trading as Ranbuild
27 Sterling Road, MINCHINBURY NSW, 2770
Telephone +612 8887 5114
Facsimile +612 9675 4911
www.bluescopesteel.com

Certificate of compliance - Design

Tuesday, 19 July 2016

Project: Permalite Aluminium Roofing Solutions

Extent of Certificate: This Structural Design Certificate hereby certifies the design of "Permalite Aluminium Sheeting " as detailed in reference Documentation: Permalite Aluminium Roofing Solutions [printed July 16]

Limit State Capacity tables contained within Permalite Aluminium Roofing Solutions [printed July 16] are structurally adequate, meet serviceability requirements and comply with relevant regulations, including:

- AS/NZS 1170.0:2002 Structural design actions - Part 0: General principles
- AS/NZS 1170.1:2002 Structural design actions Part 1: Permanent , Imposed and other actions
- AS/NZS 1170.2:2021 Structural design actions, Part 2: Wind actions
- AS/NZS 1664.1:1999 Aluminium structures Part 1: Limit state design (Reconfirmed 2020)
- BCA 2015 Specification B1.2
- AS 1562.1:2018 Design and installation of sheet roof and wall cladding - Part 1: Metal
- AS 4040.1-1992 (Rec :2016) Methods of testing sheet roof and wall cladding - Method 1: Resistance to concentrated loads
- AS 4040.2-1992 (Rec 2016, Amd 1:2018) Methods of testing sheet roof and wall cladding, Part 2: Resistance to wind pressures for non-cyclone regions

I further certify that designs utilising data from Permalite Aluminium Roofing Solutions will be structurally adequate subject to the following conditions:

1. Compliance with design data and connections contained within Permalite Aluminium Roofing Solutions
2. Installation and Construction shall be in accordance with the attached specifications and accepted good practice
3. All input data of this Project is excluded from this Certificate
4. This Certification becomes invalid if there are any pertinent changes to the relevant Australian Standards or the Building Code of Australia or relevant technical data which post-dates this Certificate

Signed

Alexander Filonov ME,
GradDip (Struct),
MIE Aust CPEng
NPER
RPEQ: 8094; CC 4719P; EC 27759; 24332ES
BlueScope Steel Lysaght Building Solutions Engineering Manager

9.0 Combustion Certification

Full certification documents may be downloaded from the Permalite website www.permalite.com.au

Certificate of Test

Quote No.: NE7281 **REPORT No.: FNE11321A**

AS/NZS 1530.3:1999 SIMULTANEOUS DETERMINATION OF IGNITABILITY, FLAME PROPAGATION, HEAT RELEASE AND SMOKE RELEASE

TRADE NAME: Permalite

SPONSOR: BlueScope Cold Form Solutions Pty Ltd trading as Permalite Aluminium Roofing Solutions
20 Fairbairn Place
EAGLE FARM QLD 4009
AUSTRALIA

DESCRIPTION OF SAMPLE: The sponsor described the tested specimen as polyester paint system applied onto a range of profiled aluminium roof/wall sheeting: LT7-2, VRib-1, Alspan-1, and Waveline-2. For the test, the specimens were tested on a range of paint colours from darkest to lightest shades.

Nominal base metal thickness (BMT):	0.9-mm
Nominal total dry film thickness (DFT) of primer and top coat (exposed side):	20-µm
Nominal dry film thickness (DFT) of backing coat (unexposed side):	9-µm
Nominal total mass:	2.6 kg/m^2
Colours:	various (green, grey, white)

TEST PROCEDURE: Six samples were tested in accordance with Australian Standard 1530, Method for fire tests on building components and structures, Part 3: Simultaneous determination of ignitability, flame propagation, heat release and smoke release, 1999. For the test, each sample was clamped to the specimen holder in four places.

RESULTS: The following means and standard errors were obtained:

Parameter	Mean	Standard Error
Ignition Time (min)	N/A	N/A
Flame Spread Time (s)	N/A	N/A
Heat Release Integral	N/A	N/A
Smoke Release ($log_{10}D$)	-1.840	0.158

For regulatory purposes these figures correspond to the following indices:

Ignitability Index (0-20)	Spread of Flame Index (0-10)	Heat Evolved Index (0-10)	Smoke Developed Index (0-10)
0	0	0	2

The results of this fire test may be used to directly assess fire hazard, but it should be recognised that a single test method will not provide a full assessment of fire hazard under all fire conditions.

DATE OF TEST: 6 January 2015

Issued on the 6th day of February 2015 without alterations or additions. This certificate supersedes Report No. FNE11321 issued on 14 January 2015.

Heherson Alarde
Testing Officer

Brett Roddy
Team Leader, Fire Testing and Assessments

NATA Accredited Laboratory
Number: 165
Corporate Site No 3625
Accredited for compliance with ISO/IEC 17025

CSIRO INFRASTRUCTURE TECHNOLOGIES

14 Julius Avenue, Riverside Corporate Park, North Ryde NSW 2113 AUSTRALIA
Telephone: 61 2 9490 5444 Facsimile: 61 2 9490 5555 www.csiro.au

10.0 Contact with Potable water Certification

Full certification documents may be downloaded from the Permalite website www.permalite.com.au

PO Box 1751 **250 Victoria Square** **Tel: 1300 653 366**
Adelaide SA 5001 **Adelaide SA 5000** **Fax: 1300 883 171**

Internet: www.awqc.com.au **Email: producttesting@awqc.com.au**

FINAL REPORT

This report supersedes the following issued reports: 271677.

Report ID : 271976

Report Information

Submitting Organisation :	00100517 : Bluescope Lysaght
Account :	143925 : Bluescope Lysaght
AWQC Reference :	143925-2019-CSR-1 : Permalite Aluminium Cladding and Permalite Aluminium Purlins (refe
Project Reference :	PT-4094
Product Designation :	Permalite Aluminium Cladding and Permalite Aluminium Purlins (refer to summary comment)
Composition of Product :	Aluminium Cladding-5251 H38, Aluminium Purlins-5052 H36, Roof Sheeting Temper H38
Product Manufacturer :	Permalite by Lysaght, Sydney (NSW) and Gilman (South Australia)
Use of Product :	Aluminium cladding and purlins - corrosive enviroment cladding
Sample Selection:	As selected by the submitting organisation.
Testing Requested :	**AS/NZS 4020 TESTING OF PRODUCTS FOR USE IN CONTACT WITH DRINKING WATER**
Product Type :	Composite
Samples :	Samples were prepared and controlled as described in Appendix A of AS/NZS 4020:2018
Extracts :	Extracts were prepared as described in Appendix/Clause C, D, E, F, H, 6.8.
Project Completion Date :	30-Jan-2020
Project Comment :	The results presented herein demonstrate compliance of Permalite Aluminium Cladding and Permalite Aluminium Purlins (refer to summary comment) to AS/NZS 4020 when exposed at area to volume ratios up to 9840 mm²/L at 20°C ± 2°C.

THE RESULTS STATED IN THIS REPORT RELATE TO THE SAMPLE OF THE PRODUCT SUBMITTED FOR TESTING. ANY CHANGES IN THE MATERIAL FORMULATION, PROCESS OF MANUFACTURE, THE METHOD OF APPLICATION, OR THE SURFACE AREA-TO-VOLUME RATIO IN THE END USE, COULD AFFECT THE SUITABILITY OF THE PRODUCT FOR USE IN CONTACT WITH DRINKING WATER

Michael Glasson
APPROVED SIGNATORY

Corporate Accreditation No.1115
Chemical and Biological Testing
Accredited for compliance with ISO/IEC 17025

Product Descriptions

All descriptions, specifications, illustrations, drawings, data, dimensions, and weights contained in this publication and websites containing information from Lysaght are approximations only. They are intended by Lysaght to be a general description for information and identification purposes and do not create a sale by description. Lysaght reserves the right at any time to:

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FOR MORE INFORMATION VISIT:

WWW.PERMALITE.COM.AU

FOR ENQUIRIES CALL 1300 850 389

The colour swatches shown have been reproduced to represent actual product colours as accurately as possible. However, we recommend checking your chosen colour against an actual sample of the product before purchasing, as varying screens and devices may affect colour tones and finishes.

LYT0121 - 03/2024