Roofing & Walling

User Manual
2008-2009

LYSAGHT

Roofing and walling

User's Guide 2008-9 Edition

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This Guide is the 2008-9 edition of Using Lysaght Roofing & Walling, issued on August 8, 2008. BlueScope Steel and BlueScope Lysaght may make changes to this Guide in its sole discretion. You should check you are using the most up-to-date version of the Guide before you start construction.

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Use of Genuine Materials

Structures in this Guide should only be built or constructed using those genuine LYSAGHT® or recommended third party products. Except as otherwise provide in these terms, any warranties only apply to you (if at all) if you use the recommended genuine LYSAGHT® or third party products and method of construction.

Check Delivery

It is important that you check all materials delivered to site against your invoice before you use them in your building or construction to ensure all components have arrived, are of the appropriate quality and are ready for installation.

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This publication is intended to be an aid for professional engineers in design matters, and builders or roofing contractors in relation to construction and is not a substitute for professional judgement.

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Lysaght Roofing & Walling Users Guide
Previously published as
Steel Roofing and Walling: Installation Manual and
Using Lysaght Roofing and Walling

GENERAL NOTES TO READ BEFORE YOU USE THIS GUIDE

This Guide has been prepared for a range of roofing and walling applications including water drainage systems, using products manufactured or supplied by BlueScope Lysaght.

The information in this booklet is suitable for use only in areas where a tropical cyclone is unlikely to occur as defined in SAA Loading Code AS/NZS 1170. 2-2002 Part 2: Wind Actions (or if used outside Australia, to the equivalent standard).

Information on cyclonic performance may be found in our Cyclonic Area Design manual which is available on-line at www.lysaght.com.

All erection and connection details to be made in accordance with the relevant standard connection details drawing contained in this Guide.

We recommend you get professional advice to ensure your particular needs are adequately met.

a) Before you commence construction:

b) you should check with your local government authority to see if any form of prior permission or approval is required;

c) if you want to build or construct any attached structure, you should seek advice from a suitably qualified engineer to verify the capacity of your existing structure to withstand any additional load arising from the attached structure. You should also check with your local government authority to determine any specific requirements for the attachment to existing structures;

d) you should check with your local workplace health and safety authority to see what safety measures you need to put in place prior to and during construction. It is the responsibility of the installer/erector to ensure all local safe work practices are adhered to and the safety of the whole site is maintained at all times.

To ensure maximum lifespan of your building, consult your nearest BlueScope Lysaght branch for information regarding maintenance, handling, storage and any other technical assistance you may require.

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Contemporary and traditional, residential or commercial: all are accomplished with ease using LYSAGHT building products.

1

Introduction

Scope

This book is a guide to the installation of steel roofing and walling manufactured by BlueScope Lysaght. We intend that it be used by all trades and professions involved with specifying and applying the wide range of our products.

We refer only to genuine steel 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.

Specific product information

We also have specific publications for all of our products, and you should use them in conjunction with this manual.

Cyclonic conditions

In general, this book refers to non-cyclonic conditions. Design information for cyclonic areas is in our Cyclonic Area Design Manual.

Warranties

For over 150 years we have consistently manufactured the highest quality building products. The LYSAGHT® brand is synonymous with Australian building.

Our continuing confidence in our products is shown in the warranties we offer.

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.

Naturally, the warranties require specifiers and installers to exercise due care in how the products are applied and installed and are subject to final use and installation. And, owners need to maintain the finished work.

We invite you to ask about the warranties applicable to your proposed purchase, at your supplier of LYSAGHT products.

Conditions of use

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

Your suggestions

Please send your suggestions for improvements to this manual to BlueScope Lysaght Technology Department PO Box 504, Chester Hill, NSW 2162.

Further information on products and services

- www.lysaght.com
- Your supplier of LYSAGHT products
- BlueScope Lysaght Information Service on 1800-641-417

PART A: DESIGN

2

Design preliminaries

2.1 Product selection

When you design steel cladding into your building you have a wide range of profiles from which to choose. Whilst roofing and walling obviously have to keep out the weather, they also have significant effects on the looks, cost and durability of a building.

If you are unsure about any product feature, visit www.lysaght.com, call our information line or seek advice from the relevant specialists.

Other factors that affect selection are treated in Chapters 2 to 6.

Walls

The design of walling from a steel perspective is fairly straightforward. Once you have made the aesthetic decision of which profile to use, the main considerations are the support spacings (Section 2.3), fixing details (Chapter 3) and the details of flashing (Chapter 11).

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 (Chapter 10);
- 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 them.

This chapter gives tables of recommended support spacings, and the maximum roof length for pitch and rainfall intensity for steel roofing products.

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

2.2 Materials and finishes

Our most widely used cladding profiles are listed in Tables 2.3.1 and 2.3.2. They are available in COLORBOND® prepainted steel complying with AS/NZS-2728:1997, or in unpainted ZINCALUME® aluminium/zinc alloy-coated steel complying with AS-1397—2001.

COLORBOND® steel has either a ZINCALUME® or stainless steel base metal, with a range of organic coatings to cope with exposure to a range of environments.

- COLORBOND® is prepainted steel for exterior roofing and walling. It is the most widely used.
- COLORBOND® METALLIC is prepainted steel for superior aesthetic qualities displaying a metallic sheen.
- COLORBOND® ULTRA is prepainted steel for severe coastal or industrial environments (generally within about 100 to 200 metres of the source).
- COLORBOND® STAINLESS is prepainted stainless steel for very severe coastal or industrial environments (generally within about 100-metres of the source). It is subject to availability and long lead times.

Check with your local BlueScope Lysaght office for availability of profiles, colours, accessories; and for suitability of the product.

Tables 2.3.1 and 2.3.2 list general information for profile selection. Refer to our publications on specific products for detailed specifications. There are also publications on ZINCALUME® steel and COLORBOND® prepainted steel from our information line (Page 1).

Material specifications

- ZINCALUME® aluminium/zinc alloy-coated steel complying with AS 1397—2001. Minimum yield strengths are G550 (550 MPa), or G300 (300 MPa) depending on profile. Minimum coating mass is AZ150 (150 g/m^2), or AZ200 (200 g/m^2) depending on the product.
- Stainless steel complying with AISI/ASTM Type 430; UNS No. S43000.

2.3 Support spacings

The maximum recommended support spacings are shown in Tables 2.3.1 and 2.3.2. They are based on testing in accordance with AS 1562.1—1992 Design and installation of sheet roof and wall cladding: Metal, and AS 4040.1—1992 Methods of testing sheet roof and wall cladding—Resistance to concentrated loads.

The spacings in the tables for roofs are recommended to produce adequate performance of roof claddings under foot traffic loading (incidental for maintenance). For walls, the following conditions apply:

- buildings up to 10m high in Region B Terrain Category 3 conditions (V_s = 38 m/s and V_u=60 m/s);
- $C_{p,e}$ = -0.65 (for walls), $C_{p,i}$ = 0.2 and K_l up to 2.0, in accordance with AS 1170.2—2002 SAA Loading Code: Wind loads.

In all cases, cladding is fixed to a support of 1.0mm minimum base metal thickness (BMT) and minimum yield stress of G550. If you want to use metal battens thinner than 1.0mm, seek advice from our information line.

For support spacings in wind conditions other than those shown, refer to our publications on specific products for wind pressure data or other standards which may apply.

2.4 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 drainage capacity and waterproof-ness 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 (Figure 2.4.1).

The maximum recommended roof lengths for drainage for each profile are given in Table 2.4.1 at the end of this chapter.

2.5 Low roof pitches

Unless there is adequate positive fall in a roof, there is danger of ponding, which can lead to a reduced service life, particularly in coastal areas.

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).

Wherever possible, you should design for a minimum slope of 1 in 30 (2°). Minimum recommended slopes are listed in Table 2.3.1 at the end of this chapter).

2.6 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.

2.8 Codes and performance tests

AS 1562.1—1992 specifies the design and installation of sheet metal roof and wall cladding. Our roofing profiles satisfy all the requirements of this standard, including the ability of the roof to resist outward forces and concentrated loads. The testing is performed according to AS 4040.

Metal roofing products must comply with the performance specifications, and be checked by stringent tests, in accordance with the standard. Such tests have been carried out on all our claddings and the results have been used in the preparation of the fixing and installation recommendations in this manual.

2.9 Environmental conditions

Coated steel products can be damaged by some environmental conditions including industrial, agricultural, marine, intensive animal farming, swimming pools or other aggressive conditions.
If any of our products are to be used in these conditions, or unusually corrosive environments, seek advice from our information line (Page 1).

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

2.10 Metal and timber compatibility

Contact with, or runoff from, some materials can damage coated steel products. Buildings can also be susceptible to condensation on inside sufaces.

The materials include certain metals, treated timbers and chemicals.

- Don't allow any contact of coated steel products with incompatible materials.
- Don't allow discharge of rainwater from incompatible materials onto coated steel products (Table 2.10.1).
- Ensure that supporting members are compatible with the coated steel products or, alternatively, appropriately coated.

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

Incompatible materials include:

- lead
- copper
- monel metal
- bare steel
- stainless steel (except with COLORBOND® stainless cladding)
- carbon (in pencils and some rubbers)
- green or some chemically-treated timber (like CCA or tanalith treatments)
- materials subject to cycles of dryness and wetness or which have excessive moisture content (such as improperly-seasoned timber)
- wet and dry concrete
- soils
- vegetable matter
- any material which will inhibit normal exposure to the atmosphere

Paint and COLORBOND® finishes

COLORBOND® finishes can be damaged by some types of paint. There can also be problems of colour matching due to different weathering characteristics.

Cladding with severely damaged COLORBOND® paint are best replaced rather than patched up. We recommend that you don't touch up minor scratches with paint.

You may overpaint whole roofs and paint accessories to match specific colours. The particular paints and methods recommended are discussed in Technical Bulletin TB-2, published by BlueScope Steel.

2.11 Transportation

Because our roofing and walling is manufactured by continuous processes, sheet lengths can be supplied up to the limits of transport regulations, which vary from state to state.

KL-700HS is available in extra long lengths via an on-site mobile rollformer. This service is available nationally, subject to enquiry.

Table 2.10.1
Acceptability of drainage from one surface onto another

Lower surface materials	Upper surface materials									
	Galvanised steel	ZINCALUME COLORBOND XRW, METALIC & ULTRA	COLORBOND STAINLESS & STAINLESS STEEL	Aluminium	Copper	Zinc	Monel	Lead	Glazed tiles, glass & plastic	Unglazed tiles (concrete)
Galvanised steel	Y	N	N	N	N	Y	N	Y*	N	Y
ZINCALUME COLORBOND XRW, METALIC & ULTRA	Y	Y	Y*	Y	N	Y	N	N	Y	Y
Stainless steel	Y*	Y*	Y	Y*	Y*	Y*	Y*	Y*	Y	Y
Aluminium	Y	Y	Y*	Y	N	Y	N	Y*	Y	Y
Copper	Y*	Y*	Y*	Y*	Y	Y*	Y	Y	Y	Y
Zinc	Y	N	N	N	N	Y	N	Y*	N	Y
Monel	Y*	Y*	Y*	Y*	Y	Y*	Y	Y	Y	Y
Lead	Y*	Y*	Y*	Y*	Y*	Y*	Y*	Y	Y	Y

Y = Acceptable Y* = Drainage acceptable, direct metal contact not acceptable. N = Not acceptable

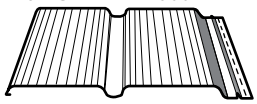
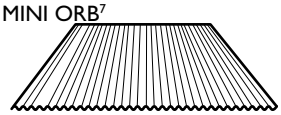
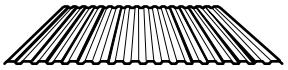
CUSTOM BLUE ORB lends itself to the smooth curves of large arched roofs. This roof has both convex and concave curves.

Table 2.3.1
Specifications of roofing & walling profiles

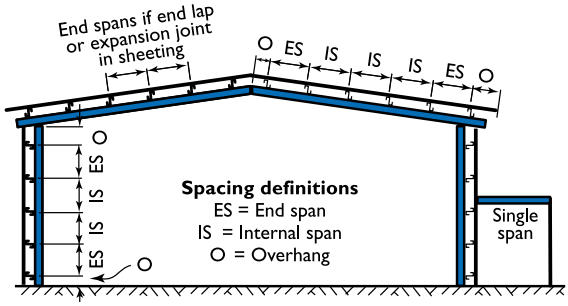
	BMT	Mass[1]	Width overall approx.	Cover width	Rib depth	Roof pitch minimum[2]	Maximum recommended spacing of supports								
							ROOFS					WALLS			
										Overhang[3]					
							Single	End	Internal	Unstiff-ened	Stiff-ened	Single	End	Internal	Over-hang
	mm	kg/m²	mm	mm	mm	degrees	mm	mm	mm	mm	mm	mm	mm	mm	mm
CUSTOM ORB[4]	0.42	4.3	838	762	16	5° (1 in 12)	700	900	1200	200	300	1800	2500	2700	200
	0.48	4.9	838	762	16	5° (1 in 12)	800	1300	1700	250	350	1800	2700	2700	250
CUSTOM BLUE ORB[4]	0.60	6.1	838	762	17	5° (1 in 12)	1600	1600	1800	200	300	2400	3000	3300	200
	0.80	8.0	838	762	17	5° (1 in 12)	1800	1800	2600	400	600	2400	3200	3600	400
FLATDEK[7]	0.42	6.0	272	250	45	2° (1 in 30)	2000	2600	3000	150	400	-	-	-	-
FLATDEK II[7]	0.42	5.2	642	620	45	2° (1 in 30)	2400	2800	3200	150	400	-	-	-	-
INTEGRITY 820	0.42	4.6	895	820	48	2° (1 in 30)	2100	2300	2800	150	300	2600	3400	3600	150
	0.48	5.2	895	820	48	1° (1 in 50)	2500	2550	3050	200	350	2700	3600	3600	200
KLIP-LOK 406[5]	0.42	4.9	432	406	41	2° (1 in 30)	1500	1700	2100	200	600	2600	2600	2600	300
	0.48	5.6	432	406	41	1° (1 in 50)	1800	2400	3000	200	600	2900	3000	3600	400
	0.60	6.9	432	406	41	1° (1 in 50)	2300	2700	3600	300	900	3000	3400	3600	600
KLIP-LOK 700 HI-STRENGTH[5]	0.42	4.7	710	700	43	2° (1 in 30)	1650	1750	2200	150	450	2400	3000	3600	150
	0.48	5.3	710	700	43	1° (1 in 50)	2050	2350	2800	200	500	2700	3300	3900	200
KLIP-LOK MAXIMA	0.42	3.2	783	770	31	2° (1 in 30)	-	-	2200	150	450	1900	2100	2400	150
	0.48	3.7	783	770	31	1° (1 in 50)	1400	1800	2600	200	500	2000	2400	3200	200
	0.60	4.5	783	770	31	1° (1 in 50)	2000	3300	3600	200	500	2900	3300	3900	200
LONGLINE 305 (not tapered)	0.70	9.7	310	305	48	1° (1 in 50)	1800	2000	2500	150	450	-	2700	2700	450
SPANDEK[6]	0.42	4.7	754	700	24	3° (1 in 20)	1300	1800	2400	300	600	2500	3000	3300	300
	0.48	5.3	754	700	24	3° (1 in 20)	2000	2200	3000	400	700	3000	3000	3300	400
SPANRIB	0.42	4.6	895	820	48	2° (1 in 30)	2100	2300	2800	150	300	2600	3400	3600	150
	0.48	5.2	895	820	48	1° (1 in 50)	2500	2550	3050	200	350	2700	3600	3600	200
TRIMDEK	0.42	4.3	816	762	29	2° (1 in 30)	1100	1300	1900	150	300	2400	3000	3000	150
	0.48	4.9	816	762	29	2° (1 in 30)	1600	1850	2600	200	350	2700	3000	3000	200

[1] Masses are for unpainted ZINCALUME steel.
[2] Use caution with roof pitch at 1° .
[3] See Section 10.6 for explanation of 'stiffened'.
[4] With 5 fasteners per sheet, per support
[5] Clips must be 75 mm from ends of sheets for proper functioning of clips.
[6] With 4 fasteners per sheet, per support
[7] FLATDEK/FLATDEK II values are given for N4 (W50N) light foot traffic. Refer brochure for other wind/loading conditions.

Table 2.3.2
Specifications of profiles for walling only

	BMT	Mass[1]	Width overall approx.	Cover width	Rib depth	Maximum recommended spacing of wall supports		
						Single	End	Internal
	mm	kg/m²	mm	mm	mm	mm	mm	mm
EASY-CLAD 2PF 300 	0.42	4.5	330	300	19	–	1500	1500
EASY-CLAD 4P 300	0.42	4.5	327	300	12	–	1500	1500
MINI ORB[7] 	0.42	4.0	841	820	6	1200	1500	1500
	0.48	4.5	841	820	6	1500	1500	1500
MULTICLAD	0.35	3.3	880	840	12	1400	1800	1800
	0.42	3.9	880	840	12	1700	1800	1800
MULTILINE 900	0.35	3.1	901	890	12	–	1000	1000
	0.42	3.7	901	890	12	–	1000	1000
PANELRIB[6] 	0.35	3.2	915	850	4	1100	1200	1200
	0.42	3.7	915	850	4	1200	1200	1200
TRIMWALL	0.35	3.6	816	762	29	2100	2900	3000
WALLCLAD	0.35	3.6	838	762	16	2100	2400	2400
WEATHERBOARD	0.42	4.1	272	260	12	-	1000	1000

[1] Masses are for unpainted ZINCALUME steel.
[6] With 4 fasteners per sheet, per support
[7] With 6 fasteners per sheet, per support



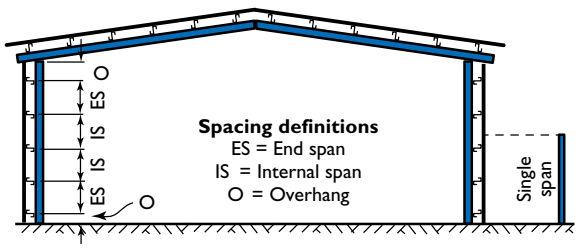
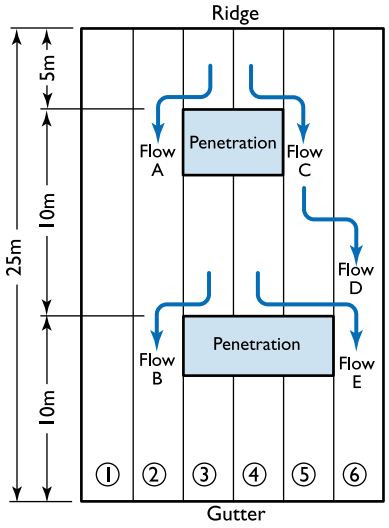


Table 2.4.1
Maximum roof lengths for drainage measured from ridge to gutter (m)
Penetrations alter the flow of water on a roof. Thus, for design, you need to use an effective roof length (Figure 2.4.1).

	Peak rainfall intensity mm/hr	Roof slope						Peak rainfall intensity mm/hr
		1 in 50 (1°)	1 in 30 (2°)	1 in 20 (3°)	1 in 12 (5°)	1 in 7.5 (7.5°)	1 in 6 (10°)	
CUSTOM ORB CUSTOM BLUE ORB	100				29	34	38	100
	150				20	23	25	150
	200				15	17	19	200
	250				12	14	15	250
	300				10	11	13	300
	400				7	8	10	400
	500				6	7	8	500
INTEGRITY 820 SPANRIB	100		410	480	598	713	820	100
	150		273	320	399	476	547	150
	200		205	240	299	357	410	200
	250		164	192	239	285	328	250
	300		137	160	199	238	273	300
	400		102	120	150	178	205	400
	500		82	96	120	143	164	500
KLIP-LOK 406	100	375	467	548	682	813	934	100
	150	250	311	365	454	542	623	150
	200	188	234	274	341	406	467	200
	250	150	187	219	273	325	374	250
	300	125	156	183	227	271	311	300
	400	94	117	137	170	203	234	400
	500	75	93	110	136	163	187	500
KLIP-LOK 700 HI-STRENGTH	100	344	428	502	624	745	856	100
	150	229	285	334	416	496	571	150
	200	172	214	251	312	372	428	200
	250	137	171	201	250	298	342	250
	300	115	143	167	208	248	285	300
	400	86	107	125	156	186	214	400
	500	69	86	100	125	149	171	500
KLIP-LOK MAXIMA	100	238	296	347	432	516	593	100
	150	159	198	232	288	344	395	150
	200	119	148	174	216	258	296	200
	250	95	119	139	173	206	237	250
	300	79	99	116	144	172	198	300
	400	60	74	87	108	129	148	400
	500	48	59	69	86	103	119	500
LONGLINE 305 (not tapered)	100	219	273	320	398	475	546	100
	150	146	182	213	265	317	364	150
	200	110	136	160	199	237	273	200
	250	88	109	128	159	190	218	250
	300	73	91	107	133	158	182	300
	400	55	68	80	100	119	136	400
	500	44	55	64	80	95	109	500
SPANDEK	100			111	133	154	173	100
	150			74	89	103	115	150
	200			55	67	77	86	200
	250			44	53	62	69	250
	300			37	44	51	58	300
	400			28	33	39	43	400
	500			22	27	31	35	500
TRIMDEK	100		220	257	320	382	439	100
	150		146	172	214	255	293	150
	200		110	129	160	191	220	200
	250		88	103	128	153	176	250
	300		73	86	107	127	146	300
	400		55	64	80	96	110	400
	500		44	51	64	76	88	500

- Some lengths in this table may exceed the maximum allowable transport length.
- Data are based on work of CSIRO and BlueScope Lysaght.
- For peak rainfall intensities in your locality, see Chapter 6.
- LYSAGHT FLATDEK and FLATDEK II are recommended for home improvement use only (carports/verandahs) where weathertightness is not of primary importance. Drainage figures are therefore not supplied.



Valley	Effective length
1	25m (Base length)
2	Base length + A + B = 25 + 5 + 10 = 40m
6	Base length + C + D + E = 25 + 5 + 15 + 10 = 55m (Worst case used for design)

Figure 2.4.1
Example of calculating effective roof lengths where penetrations alter the flow of water on a roof.

3

Fasteners

When you select fasteners, you should consider the design life of the structure, because the fasteners and the cladding material should have similar life expectancies.

Fastener change to metric sizing

The Australian fastener industry is moving to a change in fastener description that will bring it into line with international markets.This is an on-going process as product requirements and design changes.

Traditionally self drilling fasteners have been described in gauge (outside thread diameter) by tpi (threads per inch) and by length (mm). The new changes will convert gauge to metric sizing (eg #12 is approx. M5.5)

3.1 Materials for screws

Screws are available in a variety of materials, finishes and colours to match COLORBOND® prepainted steel, and design. You should use screws to AS 3566—2002 Class 3 (or better). Additional information on fastener finishes is in the technical bulletin TB-16.

Product	Appropriate screw materials
For most external applications not closer than 400 metres from the ocean or severe marine influence: • COLORBOND or METALLIC • ZINCALUME AZ150	AS 3566 Class 3
For severe exposure conditions: • COLORBOND (200 to 400 metres from marine environments) • COLORBOND ULTRA (100 to 200 metres from marine environments)	AS 3566 Class 4 Where the colour match of fasteners is an overriding consideration, powder coated/painted fasteners may be used.
For very severe exposure conditions: COLORBOND STAINLESS	Stainless steel

Stainless steel fasteners are recommended for use only with COLORBOND STAINLESS.

Table 3.1.1
Materials for screws

3.2 Materials for nails

Nails should be of galvanised steel. They are only used to fix the clips of some concealed-fixed cladding to timber supports.

3.3 Materials for blind rivets

For COLORBOND® STAINLESS use stainless steel blind rivets with stainless steel mandrels; for GALVABOND®, ZINCALUME® and COLORBOND® steels, use aluminium blind rivets. Blind rivets are used for fixing flashings, accessories and side-laps.

3.4 Materials for sealing washers

Sealing washers used under the heads of screws on COLORBOND® finishes must be made from materials that don't have significant levels of conductive carbon black, particularly in marine environments. Use EPDM washers, not neoprene.

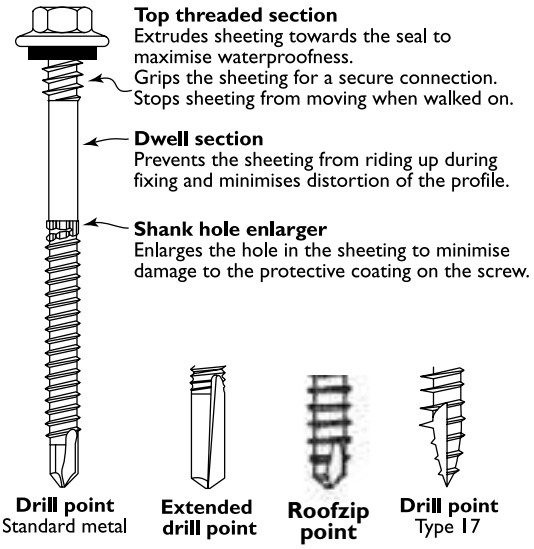


Figure 3.5.1
Typical hexagon-headed screws

3.5 Identification of screws

The format of the number code is:

12 (M5.5) – 20 x 45

- **12 (M5.5)** – Screw gauge (Thread outside diameter - number in brackets is metric equivalent)
- **20** – Thread pitch (threads per inch)
- **45** – Overall length of the screw measured from under the head (mm)

Fasteners must have a coating system to meet AS 3566 Class 3.

or

Fasteners must have a coating system to meet AS 3566 Class 4.

Bremick, ITW Buildex and other quality fasteners which comply to the above standards are recommended for use with LYSAGHT roofing and walling products. Ripple Teks® and Roofzips® are registered trademarks of ITW Buildex and are recommended for specific applications.

Table 3.5.1
Features of recommended screws

Screw type	Head	Seal	Shank protection	Drill point
Metal - Hex head, self drilling screw with seal (Roofzip®)	Hexagon washer, or wafer	EPDM or none	Depends on screw length & use	Self drilling for metal
Timber - Type 17 Hex head, self drilling screw with seal	Hexagon washer, or wafer	EPDM or none	Depends on screw length & use	Self drilling for timber
Hex head, self drilling screw with seal and extended drill	Hexagon washer, or wafer	EPDM or none		Self drilling for metal
Metal - Hex head, self drilling, screw for thin battens	Hexagon washer	EPDM or none	Always	Self drilling for metal
Stitching screws	Slotted hexagon with thin washer. Serrated also available.	EPDM or none		Needle
Ripple Teks®	Special self-sealing head			Self drilling for metal

3.6 Setting of screws

Fasteners with sealing washers should be tightened only until the washer is gripped firmly enough to provide a weathertight seal. The fasteners should not be over-tightened because this may split the sealing washer or deform the sheet, either of which could lead to water penetration. Take particular care when valley fixing because there is no flexibility with the sheet hard against its support.

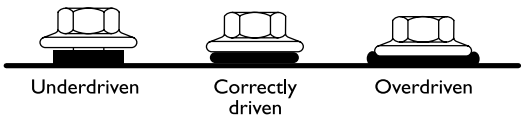


Figure 3.6.1
It is important that you set screws correctly

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3.7 Quantity of fasteners and clips

KLIP-LOK 406, KLIP-LOK 700HS, KLIP-LOK MAXIMA and LONGLINE 305

For number of clips, see equation at right.

For KLIP-LOK 406, there are 2 fasteners per clip.

For KLIP-LOK 700 and KLIP-LOK MAXIMA, there are 3 fasteners per clip.

For LONGLINE 305, there is 1 fastener per clip.

Number of clips per job =
(Number of purlins) x (Number of sheets +1)

Pierce-fixed profiles

For number of fasteners, see equation at right (n is the number of fasteners per support, as shown in the diagrams in Table 3.8.1).

Number of fasteners per job (for pierced fixing) =
n x (Number of sheets) x (Number of supports)

Side-laps

Side-lap fasteners are often placed at about 900mm centres, see equation at right.

$$\text{Number of side-lap fasteners per sheet} = \frac{\text{Support spacing (inmm)} \times \text{Number of supports}}{900}$$

3.8 Recommended fasteners and locations

Recommended fasteners and their locations are in Table 3.8.1.

Fastener length with insulation

Where insulation is installed under cladding, you may need to increase the length of screws given in Table 3.8.1, depending on the density and thickness of the insulation. When the screw is properly tightened (Section 3.6):

- INTO METAL: there should be at least three threads protruding past the support you are fixing to—but the shank protection must not reach that support;
- INTO TIMBER: the screw must penetrate the timber by the same amount that the recommended screw would do if there were no insulation.

Fixing to steel thicker than 3mm

- Use Hex head self drilling screws with seal with an extended drill point; or
- in a pre-drilled hole, use Hex head self drilling screws with seal, of 12 gauge (M5.5)–14 pitch, with the length as specified in Table 3.8.1.

Side-lap and accessory fastenings

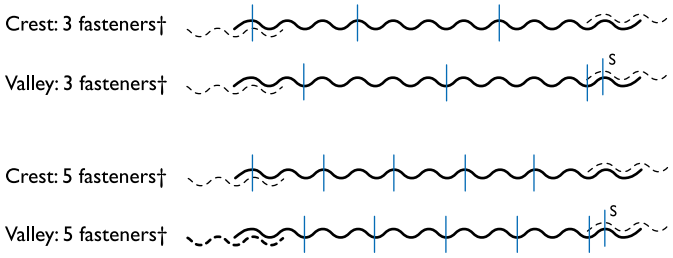
For MINI ORB and PANELRIB use 3.2mm diameter aluminium sealed blind rivets. For all other products use:

- Stitching screws with seal: 8 15 x 15; or
- Hex head self drilling screws with seal: 10 16 x 16; or
- Sealed blind rivets: 4.8mm diameter aluminium (not MINI ORB and PANELRIB—see above).

Table 3.8.1
Guide to fasteners without insulation

CUSTOM ORB AND CUSTOM BLUE ORB

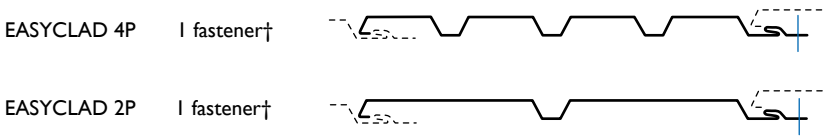
	Fixing to steel up to 0.75 mm BMT	Fixing to steel >0.75 to 3 mm BMT	Fixing to timber
Crest fixed	M6-11x50 Roofzips® or Hex head self drilling screw with EPDM seal for thin metal battens 12-11x50 (M5.5-11x50)	M5.5-14x37.5 Hex head self drilling screw with EPDM seal and hex. washer head and shank protection 12-14x35 (M5.5-14x35)	M6-11x50 Roofzips® or Type 17 Hex head self drilling screw for timber with EPDM seal and shank protection) SOFTWOOD: 12-11x50 (M5.5-11x50) with *Higrip & Shank protection* HARDWOOD: 12-11x40 (M5.5-11x40) with *Shank protection*
Valley fixed	Hex head self drilling screw with EPDM seal and hex. washer head 10-16x16 (M4.8-16x16) Hex head self drilling self tapping screw with hex. washer head for timber & EPDM seal 10-12x20 (M4.8-12x20)	Hex head self drilling screw with EPDM seal and hex. washer head 10-16x16 (M4.8-16x16)	M6-11x25 Roofzips® or Hex head self drilling screw for timber with hex. washer head & EPDM seal SOFTWOOD: 10-12x30 (M4.8-11x30) HARDWOOD: 10-12x20 (M4.8-11x20)



Number of fasteners depends on wind pressure (see brochure on this product).
Do not fix screws less than 25mm from the end of sheet.

EASYCLAD

	Fixing to steel up to 0.75 mm BMT	Fixing to steel >0.75 to 3 mm BMT	Fixing to timber
Concealed fixed	M5.5-11x25 Roofzips Hex head self drilling screws with seal and hex. washer head 10-12x20 (M4.8-12x20)	Hex head self drilling screws with seal and hex. washer head 10-16x16 (M4.8-16x16)	Hex head self drilling screw for timber with hex. washer head & EPDM seal SOFTWOOD: 10-12x30 (M4.8-11x30) HARDWOOD: 10-12x20 (M4.8-11x20)



Do not fix screws less than 25mm from the end of sheet.

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KEY
† Fasteners per sheet per support
S = Side-lap

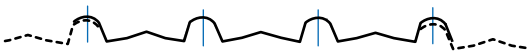
Table 3.8.1 continued
Guide to fasteners without insulation

INTEGRITY 820

	Fixing to steel up to 0.75 mm BMT	Fixing to steel >0.75 to 3 mm BMT
Crest fixed	Hex head self drilling screws with EPDM seal, hex. washer head, shank protection and Integrity sealing plate 12-11x65 (M5.5-11x65)	Hex head self drilling self tapping screws with EPDM seal, hex. washer head, shank protection and Integrity sealing plate 12-14x65 (M5.5-14x65)

Do not fix screws less than 25mm from the end of sheet.

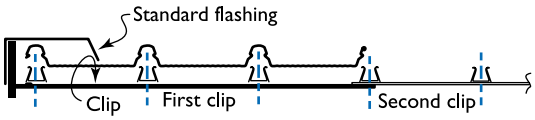
Crest: 4 fasteners†



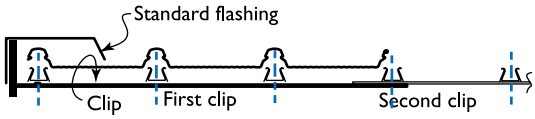
KLIP-LOK 700HS and KLIP-LOK MAXIMA (Use 3 screws per clip)

	Fixing to steel up to 0.75 mm BMT	Fixing to steel >0.75 to 3 mm BMT	Fixing to timber
Concealed fixed	M6-11x25 Roofzips Hex head self drilling self tapping screws for thin metal battens OR Hex head self drilling self tapping screws with hex. washer head 15-15 x 25	Hex head self drilling self tapping screws with hex. washer head 12-14x25 (M5.5-11x25) Longer screws may be easier to install 12-14x30 (M5.5-11x30)	*Type 17* screws with hex. washer-head SOFTWOOD: 12-11x40 (M5.5-11x40) HARDWOOD: 12-11x25 (M5.5-11x25)

KLIP-LOK 700HS



KLIP-LOK MAXIMA

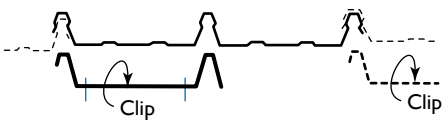


Roofzips® are registered trademarks of ITW Buildex and are recommended for specific applications.

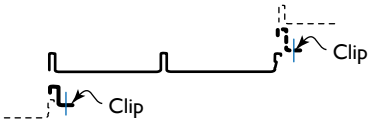
KLIP-LOK 406 and LONGLINE 305

	Fixing to steel up to 0.75 mm BMT	Fixing to steel >0.75 to 3 mm BMT	Fixing to timber
Concealed fixed	Self drilling self tapping screws with wafer-head 12-12x25 (M5.5-12x25)	Self drilling self tapping screws with wafer-head	Self drilling screws with wafer head SOFTWOOD: 10-12x35 (M4.8-12x35) HARDWOOD: 10-12x25 (M4.8-12x25) OR Spiral-threaded steel nails SOFTWOOD: 3.75 dia. x 60 HARDWOOD: 3.75 dia. x 40

KLIP-LOK 406



LONGLINE 305



Note: Although both KLIP-LOK and LONGLINE are normally used as concealed fixed roofing profiles, both may be used as pierce fixed walling profiles, provided the length is not greater than 15m. If this is done, the top girt/support must be designed to carry the weight of the cladding. Fix at each pan adjacent to the ribs using M4.8-16x16 self drilling screws (10-16x16).

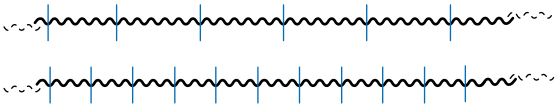
Table 3.8.1 continued
Guide to fasteners without insulation

MINI ORB

	Fixing to steel up to 3 mm BMT	Fixing to timber
Valley fixed	*Ripple Teks*® screws 10-16 x 20 (M4.8-16x20)	*Ripple Teks*® screws SOFTWOOD and HARDWOOD 10-16 x 30 (M4.8-16x30)

Valley: 6 fasteners†

Valley: 11 fasteners†



Number of fasteners depends on wind pressure (see brochure on this product). Do not fix screws less than 25mm from the end of sheet.

MULTICLAD

	Fixing to steel up to 0.75 mm BMT	Fixing to steel >0.75 to 3 mm BMT	Fixing to timber
Valley fixed	Self drilling screws with hex.washer-head 12-12x20 (M5.5-11x25)	Self drilling screws with hex.washer-head 10-16x16 (M4.8-16x16)	Self drilling screws with hex.washer-head SOFTWOOD: 10-12x30 (M4.8-12x30) HARDWOOD: 10-12x20 (M4.8-12x20)

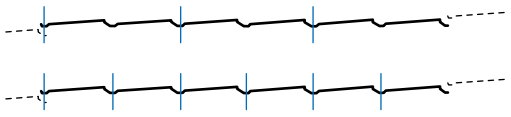
Valley: 4 fasteners†

MULTILINE 900

	Fixing to steel up to 0.75 mm BMT	Fixing to steel >0.75 to 3 mm BMT	Fixing to timber
Valley fixed	Self drilling self tapping screws with wafer head 12-12x20 (M5.5-11x25)	Self drilling self tapping screws with wafer head 10-16 x 16 (M4.8-16x16)	Self drilling screws with wafer head SOFTWOOD: 10-12 x 30 (M4.8-12x30) HARDWOOD: 10-12 X 20 (M4.8-12x20)

Valley: 3 fasteners†

Valley: 6 fasteners†



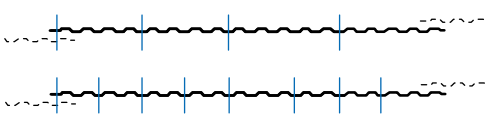
Number of fasteners depends on wind pressure (see brochure on this product). Do not fix screws less than 25mm from the end of sheet.

PANELRIB

	Fixing to steel up to 3 mm BMT	Fixing to timber
Valley fixed	Self drilling screws with hex.washer-head 10-16 x 16 (M4.8-16x16)	Self drilling screws with hex.washer-head SOFTWOOD & HARDWOOD: 10-12 X 20 (M4.8-12x20)

Valley: 4 fasteners†

Valley: 8 fasteners†



Number of fasteners depends on wind pressure (see brochure on this product). Do not fix screws less than 25mm from the end of sheet.

Roofzips® are registered trademarks of ITW Buildex and are recommended for specific applications.

Table 3.8.1 continued
Guide to fasteners without insulation

SPANDEK and TRIMDEK

	Fixing to steel up to 0.75 mm BMT	Fixing to steel >0.75 to 3 mm BMT	Fixing to timber
Crest fixed	Roofzips (M5.5-11x50) OR Self drilling screws with hex. washer-head, EPDM seal, *Higrip & shank protection* 12-11x50 (M5.5-11x50)	Roofzips (M5.5-11x50) OR Self drilling screws with hex. washer-head, EPDM seal, *Higrip & shank protection* 12-14 x 45 (M5.5-14x45)	Roofzips (M6-11x65) OR Type 17 Self drilling screws with hex. washer-head, EPDM seal, *Higrip & shank protection* SOFTWOOD: 12-11 x 65 (M5.5-11x65) HARDWOOD: 12-11 x 50 (M5.5-11x50)
Valley fixed	Self drilling screws with hex. washer-head & EPDM seal 10-12x20 (M4.8-12x20) OR Self drilling screws with hex. washer-head & EPDM seal 10-16x16 (M4.8-16x16)	Self drilling screws with hex. washer-head & EPDM seal 10-16x16 (M4.8-16x16)	Roofzips (M6-11x65) OR Type 17 Self drilling screws with hex. washer-head & EPDM seal SOFTWOOD: 10-12 x 30 (M4.8-12x30) HARDWOOD: 10-12 x 20 (M4.8-12x20)

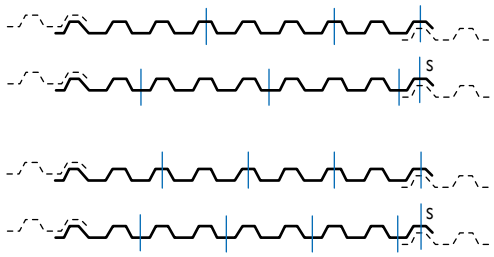
SPANDEK

Crest: 3 fasteners†

Valley: 3 fasteners†

Crest: 4 fasteners†

Valley: 4 fasteners†

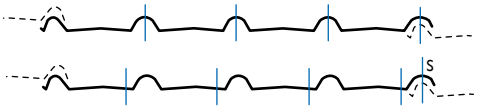


Number of fasteners depends on wind pressure (see brochure on this product).

TRIMDEK

Crest: 4 fasteners†

Valley: 4 fasteners†



TRIMWALL

Valley fixed	All fixing as specified for TRIMDEK

WALLCLAD

Valley fixed	All fixing as specified for CUSTOM ORB

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KEY
† Fasteners per sheet per support
S = Side-lap

4

Curved, bent & tapered cladding

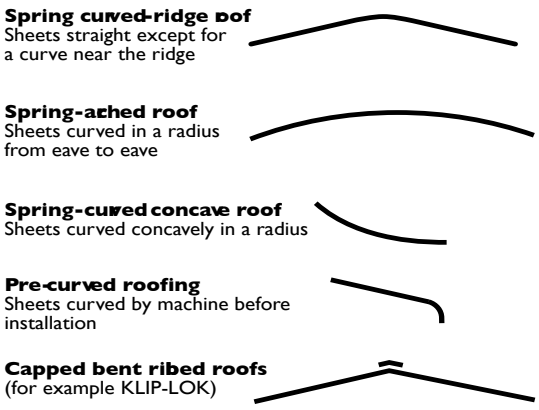


Figure 4.1
Typical curved and bent applications

An excellent method of cladding low-slope gable roofs is to run continuous lengths of roofing from eave to eave, across the full width of the roof. This gives a particularly neat and attractive roof. It is also possible to spring-curve sheets into a concave shape.

With the exception of KLIP-LOK, the ridge capping is eliminated in these roofs, thus avoiding any possibility of leakage along the ridge. KLIP-LOK can be used similarly, but the ribs are cut at the ridge and a metal cap is fitted over the cut.

4.1 Spring-curved-ridge roof

Sheets in a spring-curved-ridge roof remain straight except for a curve near the ridge.

The pans of KLIP-LOK, INTEGRITY, LONGLINE 305 and TRIMDEK tend to oilcan (minor waviness in the pan) when spring curved.
Apart from not looking good, an oilcanned pan may retain water which could lead to discolouration and/or deterioration of the sheet coating and also contributes to thermally induced roof noise. If some oilcanning in the pans is acceptable, these profiles can be spring-curved up to a maximum slope of 1 in 30 (2°); with the spacing between the purlins at the ridge being slightly less than the internal span recommended for the profile in Table 2.3.1.

Over the supports at the ridge, very slight crease marks may appear in the pans or valleys when subjected to foot traffic. They don't affect strength and will usually not be seen from the ground.

Only the sheet profiles recommended for spring-curving are shown in Table 4.1.1.

Each sheet is first fixed to one side of the roof, and then pulled down to be fixed to the other side. To minimise small laying errors, lay alternate sheets from opposite sides of the roof.

Side laps should be sealed with silicone sealant for the length of the curve.

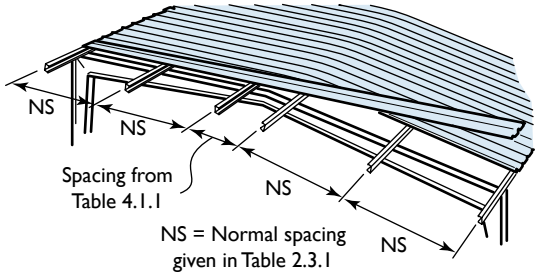


Figure 4.1.1
Spring-curved-ridge roof

Table 4.1.1
Minimum spacing of purlins at ridge for spring curved-ridge roof (mm)

	1 in 20 (3°)	1 in 15 (4°)	1 in 12 (5°)	1 in 10 (6°)	1 in 8 (7°)
SPANDEK 0.42 BMT	1400	1500			
SPANDEK 0.48 BMT	1500	1600	1700		
CUSTOM ORB 0.42 BMT			1200		
CUSTOM ORB 0.48 BMT			1300	1400	
CUSTOM BLUE ORB 0.6 BMT			1200	1300	1400

Blank spaces are combinations not recommended

4.2 Spring-arched roof

Sheets in a spring-arched (convex) roof are curved in a radius from eave to eave. SPANDEK, CUSTOM ORB and CUSTOM BLUE ORB can be spring-curved for an arched roof. Table 4.2.1 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 4.2.1.

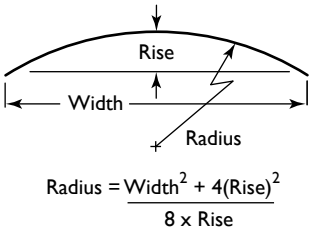


Figure 4.2.1
Calculation of radius

Table 4.2.1
Recommended radii for convex spring curving

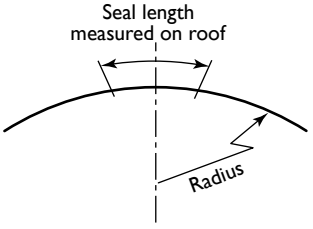
	Minimum radius (m)	Purlin spacing at minimum radius (mm)	Maximum radius [1] (m)
SPANDEK 0.42 BMT	20	1200	60
SPANDEK 0.48 BMT	20	1400	60
CUSTOM ORB 0.42 BMT	12	800	35
CUSTOM ORB 0.48 BMT	10	1000	35
CUSTOM BLUE ORB 0.6 BMT	9	900	35
LONGLINE 305 0.7 BMT [2]	26	1600	180

[1] Maximum radius is to provide sufficient drainage near crest of arch.
[2] Figures shown are for untapered product. Minimum radius for tapered LONGLINE 305 depends on the amount of taper.

At the crest of an arch the roof is flat, which is obviously below the specified minimum roof pitch. Therefore side laps should be sealed over the crest of the arch until there is sufficient pitch to give adequate drainage (see Table 2.3.1). The length of seal is shown in Figure 4.2.2.

Over the supports very slight crease marks may appear in the pans or valleys when subjected to foot traffic. They don't affect strength and will usually not be seen from the ground.

If end laps are necessary they should not be located at or near the crest of the arch and each sheet length must span at least three purlin spacings.



Seal length =
0.035 x Radius x specified minimum roof pitch

Custom Orb and Custom Blue Orb
(min. roof pitch 5): Seal length = 0.18 x radius

Spandek
(min. roof pitch 3): Seal length = 0.11 x radius

Figure 4.2.2
Seal length for side laps on spring-arched roof

Profiles with wide pans manufactured from high tensile steel (such as KLIP-LOK and INTEGRITY 820) are susceptible to local buckling of the pans and are therefore not recommended for spring-arched roofs. These products can be made specially from soft steel (G300) to overcome the problem.

Each sheet is first fixed to one side of the roof, and then pulled down to be fixed to the other side. Alternate sheets are laid from opposite sides of the roof.

4.3 Spring-curved concave roofs

Roofing can be spring-curved into concave shapes. Table 4.3.1 shows the acceptable radii.

Table 4.3.1
Radii for spring curved concave roofs

	Minimum radius (m)	Purlin spacing (mm)
KLIP-LOK 406 BMT 0.42	24	1000
KLIP-LOK 406 BMT 0.48	26	1400
KLIP-LOK 406 BMT 0.60	28	1800
SPANDEK HI-TEN BMT 0.42	18	1200
SPANDEK HI-TEN BMT 0.48	20	1400
TRIMDEK HI-TEN BMT 0.42	20	1000
TRIMDEK HI-TEN BMT 0.48	22	1200
CUSTOM ORB BMT 0.42	10	800
CUSTOM ORB BMT 0.48	10	1000
CUSTOM BLUE ORB BMT 0.60	8	800

The purlin spacing may be increased for radii greater than the minimum radii shown, provided the spacing does not exceed that shown in Table 2.3.1

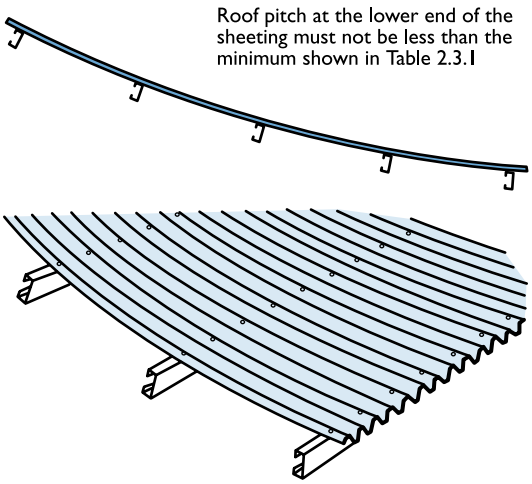


Figure 4.3.1
Spring-curved concave roof

4.4 Pre-curved roofs

Pre-curved corrugated roofing is popular for aesthetics (such as a bullnosed verandah roof), or for function (such as a gutterless eave design). CUSTOM BLUE ORB can be curved to a radius as small as 300mm. We don't recommend pre-curving for other profiles.

MINI ORB can be curved to a radius to as small as 150mm, though it isn't recommended for roofing.

Because of the spacing of curving rolls, there is usually a straight portion at the end of the sheet beyond the curve (often 50 to 110mm for CUSTOM BLUE ORB , and about 50mm for MINI ORB). Allow for this in your design. It can be trimmed off if necessary.

If a pre-curved section of cladding is to be joined to a straight section, you should order the curved and straight sheets at the same time, asking for them to be matched in production.
End-lap the sheets as described in Section 11.4 (End-lapping).

Our CUSTOM BLUE ORB brochure gives more details.

4.5 Capped bent ribbed roofs

Tray cladding can be used in continuous lengths from eave to eave by cutting the ribs and bending the pans at the ridgeline. The same process is used on Mansard roofs. Caps are fitted over the cut ribs, which open up when the pans are bent. Fitting the rib caps can be time-consuming and care must be taken with sealing to avoid any possibility of leakage.

The ribs must be cut squarely, with a metal cutting blade in a power saw, set to the depth of the rib minus 2mm.

In some states pressed steel caps can be obtained to suit KLIP-LOK ribs, though the range of angles is limited. Caps can be handmade to suit any angle from flat sheet.

KLIP-LOK is most frequently used for capped bent ribbed roofs, but LONGLINE 305, TRIMDEK or even SPANDEK can be used. For these four profiles the rib caps can be made from pieces of rib profile cut from a short length of cladding.

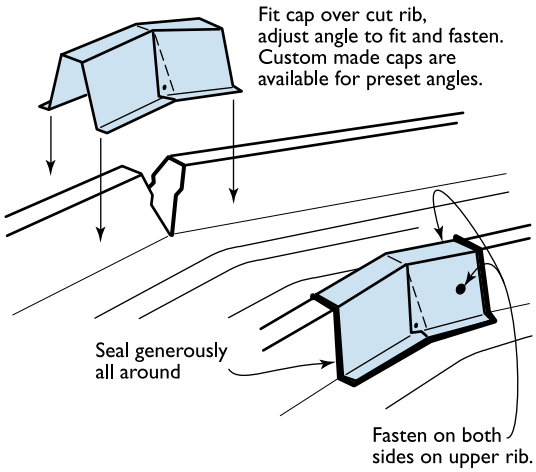


Figure 4.5.1
Capped bent ribbed roof

4.6 Tapered roofing

We can taper LONGLINE 305 in its width, at either end, to produce a sheet that lends itself to a wide range of roof designs. The maximum reduction in width is 50%. The taper can be left-hand or right-hand (Figure 4.6.1). Get our advice for long spans or high loadings.

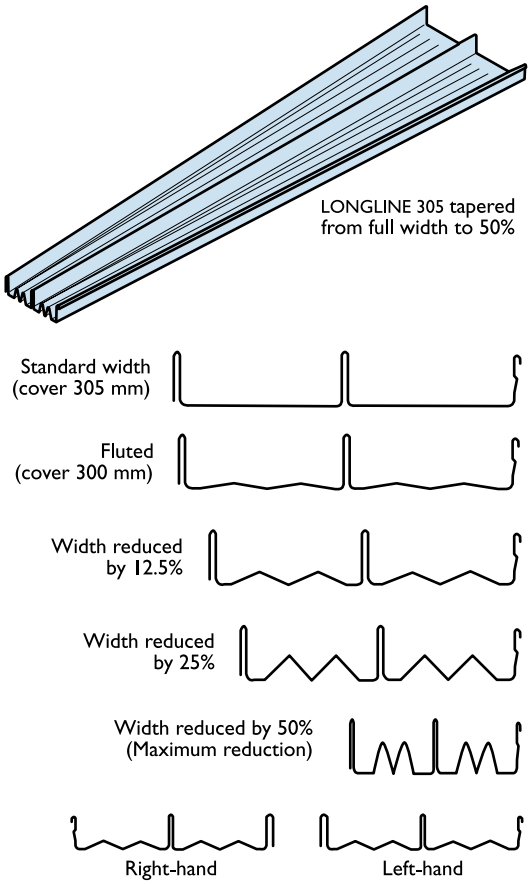


Figure 4.6.1
Tapered LONGLINE 305

5

Insulation & skylights

You often consider insulating a building to reduce:

- heating from the sun in summer;
- loss of heat from inside in winter;
- condensation on the inside of the roofing and walling; and
- noise from rain, thermal expansion and contraction, and other sources.

Usually, when one of these four is treated, there is also a beneficial effect on the others.

You need to compare the initial cost of installing insulation with the savings in costs of heating and cooling. There are also gains for the environment when you save energy.

AS 2627.1—1993 Thermal insulation of dwellings, thoroughly treats the subject, including comprehensive tables of recommended thermal resistance (R values) for over 1000 towns throughout Australia.

5.1 Heat control

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 (Figure 5.1.1).

- 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.

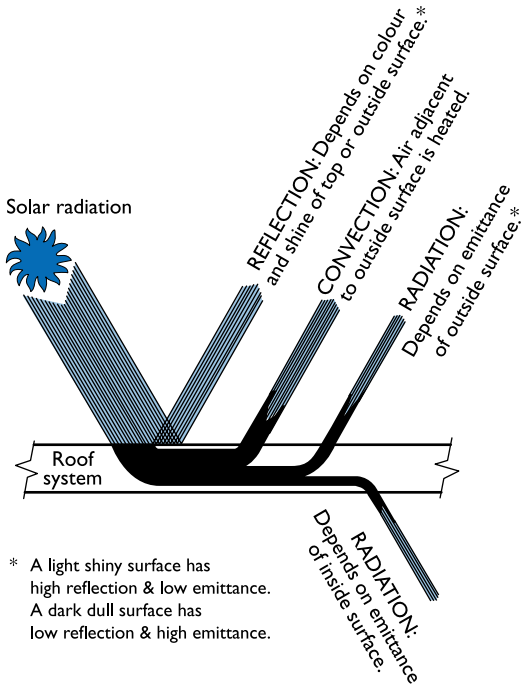


Figure 5.1.1
Heat transmitted into a building

Table 5.1.1
Approximate thermal transmission (for comparisons only)

	Roofing only		Roofing with reflective foil laminate		Roofing with 50 mm insulation blanket & reflective foil laminate	
	Heat radiated from underside	Heat radiated + convected	Heat radiated from underside	Heat radiated + convected	Heat radiated from underside	Heat radiated + convected
	W/m²	W/m²	W/m²	W/m²	W/m²	W/m²
ZINCALUME® 25	40		2.0	9.0	2.0	7.0
COLORBOND®						
Classic Cream 35.5	41.9		1.4	5.8	1.0	4.2
Surfmist 37.1	43.8		1.5	6.1	1.1	4.3
Sandbank 58.1	68.4		2.3	9.4	1.6	6.7
Wilderness 91.2	106.9		3.6	14.4	2.5	10.3
Woodland Grey 101.4	118.7		4.0	15.9	2.8	11.3
Deep Ocean 108.2	126.6		4.3	16.9	3.0	12.0

Assumptions
- solar radiation = 850 W/m² (' average' Australian summer)
- ambient temperature = 30° C
- wind velocity over roof = 3 m/s
- still air under the roof system
- inside temperature = 30° C

Comparison of thermal performance

Table 5.1.1 shows thermal performances of different insulation systems by showing the heat that may be expected through roofs of new materials.

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 (Figure 5.1.2).

Additional heat insulation is often achieved by using bulk insulation blankets or batts (Figure 5.1.3).

The same principles apply to walls, though the foil is not draped.

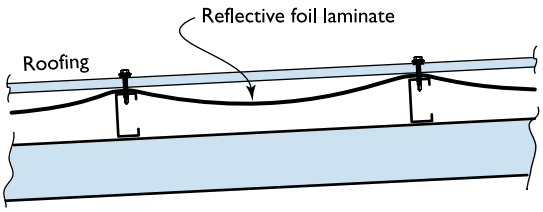


Figure 5.1.2
Reflective foil laminate is simple, cheap and very effective

5.2 Condensation

When the air in a building in contact with metal cladding is warmer than the cladding, water vapour (moisture) in the air can condense on the inside of the cladding.

Water vapour passes fairly freely through most building linings into the ceiling and wall spaces where it may directly contact the cladding.

Condensation can lead to deterioration of building components and staining of ceiling and walls. If insulation blankets or batts are wet, or even slightly dampened by condensation, its efficiency is reduced markedly.

The amount of condensation depends upon the amount of water vapour in the air and this varies with climatic conditions. Activities within a building can add substantially to the amount of water vapour, and typical domestic situations include bathing, showering, cooking, washing and drying clothes and dishes, and breathing. It is essential to vent substantial amounts of water vapour to outside the building.

To minimise the risk of condensation on the underside of roofing, a vapour barrier is often used to prevent contact of warm moist air with the roofing – reflective foil laminate is commonly used.

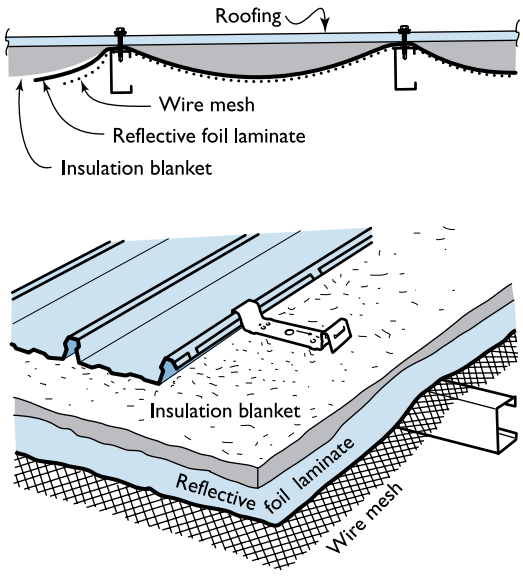


Figure 5.1.3
Typical roof insulation with foil and blanket

To minimise the risk of condensation on the underside of the laminate, the laminate must be draped between roof supports so that the cold cladding is not in contact with the laminate (except at the supports).

5.3 Noise reduction

Rain noise

To reduce rain noise on metal roofing, an insulation blanket can be placed over the foil laminate described above, before laying the roofing. It is important that the laminate is pulled tight enough to hold the blanket hard against the underside of the roofing so as to dampen the rain-induced vibration at the point of impact. If the blanket is not hard against the roofing the noise reduction will not be as good.

For purlin spacings over 1200mm: first lay wire mesh over the purlins, tighten and fix it, before laying the membrane.

Thermally-induced noise

Roofing expands and contracts due to temperature changes in the cladding, and particularly rapid changes can be caused by passing clouds or a strong breeze. For example: if a passing cloud suddenly shades the roof from the sun, the cladding temperature could drop about 3°C after 30 seconds in shade and about 10°C after 2 minutes in shade.

Thermally-induced noise is caused by slipping at fasteners where the roof expands relative to its supports. The slipping is controlled by the friction between the roof and its supports. When the static friction is overcome impulsively, sounds are produced — sometimes as loud as a pistol-shot — the higher the friction, the louder the sound.

The noise can be reduced by:

- placing a material with low coefficient of friction between the roofing and its supports (for example PVC tape or strips of foil laminate);
- choosing steel supports rather than timber (lower coefficient of friction);
- choosing light coloured roofing;
- venting the roof space;
- including an expansion joint (Section 10.5);
- being careful about design details in valleys (where heat tends to be retained); and/or
- insulating the roof space to reduce the thermal differential. In tropical areas it may be better to insulate the ceiling rather than the roofing (which can also reduce noise).

5.4 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 (Section 5.1).

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.

Insulation blankets up to a nominal thickness of up to 100mm for pierce-fixed cladding and KLIP-LOK 700; and up to 50mm for KLIP-LOK 406 and all other concealed-fixed profiles will compress sufficiently over the roof supports to allow normal procedures to be used for fixing. However, you may need to increase the length of fasteners slightly to allow for the thickness of the compressed blanket between the cladding and support, see Table 3.8.1.

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.

5.5 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 and KLIP-LOK 700; and 50mm for KLIP-LOK 406 and all other concealed-fixed cladding (Maximum density 12kg/m^3. For more dense glass wool and rock wool, spacers are recommended.

5.6 Skylighting

One of the simplest methods of getting natural light through a steel roof is the inclusion of translucent sheets which match the steel profiles.

It is preferable to use profiled translucent cladding in single widths so that they can overlap, and be supported by, the steel cladding on both sides. It is also preferable to position the lengths of translucent cladding at the top of a roof run so the high end can lap under the capping or flashing and the low end can overlap a steel sheet. This is because the translucent cladding will readily overlap a steel sheet but the reverse is difficult.

Building regulations require a safety mesh to be fitted under translucent cladding.

Because of its greater thermal expansion, translucent cladding should be fixed using oversized holes and sealing washers recommended by the cladding manufacturer. When used with concealed fixed claddings, ensure the fasteners do not penetrate the steel cladding. There are translucent products available that easily accommodate this. Don't exceed the maximum support spacing specified by the translucent cladding manufacturer.

Skylighting increases the transmission of solar heat. Generally speaking, heat transmission is proportional to light transmission, so the more sunlight that enters a building the hotter it will be. Clear, uncoloured fibreglass has good light transmission of about 65% but this means on a typical summer day, with peak solar radiation of 850 W/m^2, transmission through a clear fibreglass skylight would be about 550 W/m^2.

Translucent fibreglass cladding is available to match CUSTOM ORB, INTEGRITY 820, KLIP-LOK 406 and 700, LONGLINE 305, SPANDEK and TRIMDEK. Polycarbonate cladding is also available for CUSTOM ORB and TRIMDEK.

On KLIP-LOK roofs the translucent cladding should be pierce-fixed.

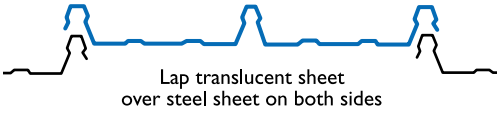


Figure 5.6.1
Placement of translucent sheets - pierce fixed decks

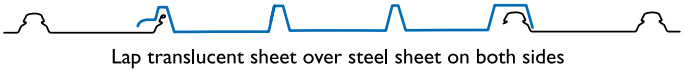
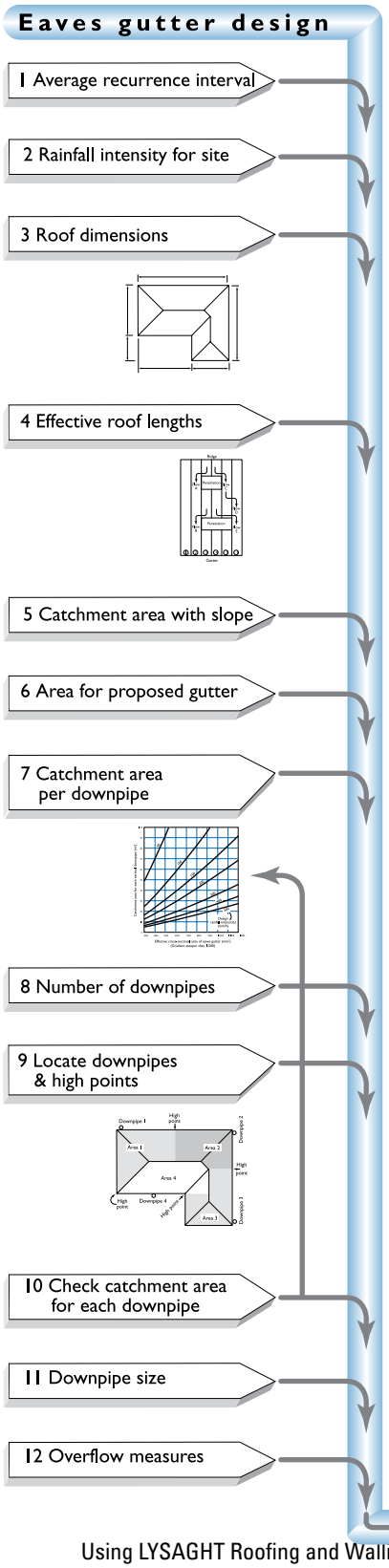


Figure 5.6.2
Placement of translucent sheets - concealed fixed decks

6

Roof drainage



6.1 Introduction

Roof drainage systems 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. (Alternatively, it must be inspected prior to approval and completion by a suitably qualified trade or professional person.)
A thorough design includes:

- The roofing material and its profile
- The pitch of the roof and any penetrations that reduce the capacity of the profile to carry rain efficiently to the gutters
- The catchment area of the roof, including gutters.

  Adjacent roofs and walls can affect the catchment, but are not considered in this book.
- The gutters: their location (at eaves or elsewhere: Figure 6.1.1), cross-sectional area, and gradient
- The downpipes: their cross-sectional area, quantity and location relative to the gradient
- Disposal of water from the downpipes
- Overflow precautions

6.2 Design of drainage (eaves-gutter system)

This section outlines a procedure for designing the drainage of a roof using an eaves-gutter system. It is assumed that the gutters will have a gradient steeper than 1:500. Box gutter systems can be more complex and are thoroughly treated in AS/NZS-3500.3.2:1998.

1. Decide on the average recurrence interval (ARI). Where significant inconvenience or injury to people, or damage to property (including contents of a building), is unlikely (typical of an eaves-gutter system) a minimum ARI can be 20 years.
   If these conditions are likely (typical of box gutters) 100 years is recommended.
2. Determine rainfall intensity for the site from Table 6.2.1.
   More data are in AS/NZS 3500.3.2:1998.
3. Sketch a roof plan showing dimensions in plan view, pitch of roof, layout of ridges and valleys.

4. Check that the effective roof lengths don't exceed the capacity of the roofing profile (Section 2.4).

5. Calculate the catchment area of the roof from the plan.
   To allow for the slope of the roof, increase the plan area by 1% for every degree of pitch up to 40°. For pitches over 40° refer to AS 3500.3: 2003.

6. Get the effective cross-sectional area of the gutter you intend to use from Table 6.2.2.

7. Using the cross-sectional area of the gutter on the graph in Figure 6.2.2, determine the catchment area per downpipe.

8. Calculate (as a first test) the minimum number of downpipes required for the selected gutter using the equation:

$$\left.\begin{array}{l}\text{Number of}\\ \text{downpipes (min.)}\end{array}\right\} = \frac{\text{Total catchment area of the roof}}{\text{Catchment area determined in (7)}}$$

   Round the number of downpipes up to the next whole number.

9. On the plan, select locations for the downpipes and the high points in the gutters. Where practical, the catchments for each downpipe should be about equal in area; and a high point should be located at the bottom of any valleys (Figure 6.2.3).

   Calculate the area of each catchment for each downpipe.

10. Returning to the graph in Figure 6.2.2, with the area of your eaves gutter, check that the catchment area for each downpipe, calculated in Step 9, is equal to or less than the catchment area shown by the graph.

    If a catchment area is too big then you can:

    - increase the number of downpipes;
    - reposition the downpipes and/or the high points;
    - choose a gutter with bigger effective cross-sectional area, then repeat the above from Step 7.

11. Decide on the downpipe size. Recommendations in AS/NZS 3500.3.2:1998 suggest that the area of round pipes should be equal to the area of the gutter, whilst the area of square or rectangular pipes may be 20% smaller (Table 6.2.2).

12. Consider measures to counter overflow of gutters into the building.

6.3 Gutter fall

Install gutters with a suitable fall to avoid ponding and to allow water to easily flow away. Steeper falls are preferred for prolonged life of the gutter. Refer to the BCA and the Australian Standards for guidance.

Table 6.2.1
Design rainfall intensities

	For overflow of eaves gutters once in 20 years mm/hour	For overflow of internal box gutters once in 100 years mm/hour
A.C.T.		
Canberra	137	194
New South Wales		
Broken Hill	130	181
Bathurst	143	197
Sydney	214	273
Newcastle	181	233
Victoria		
Mildura	125	174
Melbourne	127	186
Ballarat	127	184
Queensland		
Brisbane	251	333
Rockhampton	248	336
Mackay	273	363
Mt. Isa	169	223
Townsville	260	346
Cairns	282	368
South Australia		
Mount Gambier	108	168
Adelaide	123	186
Western Australia		
Geraldton	132	173
Perth	146	214
Tasmania		
Hobart	99	155
Northern Territory		
Alice Springs	139	204
Darwin	285	366

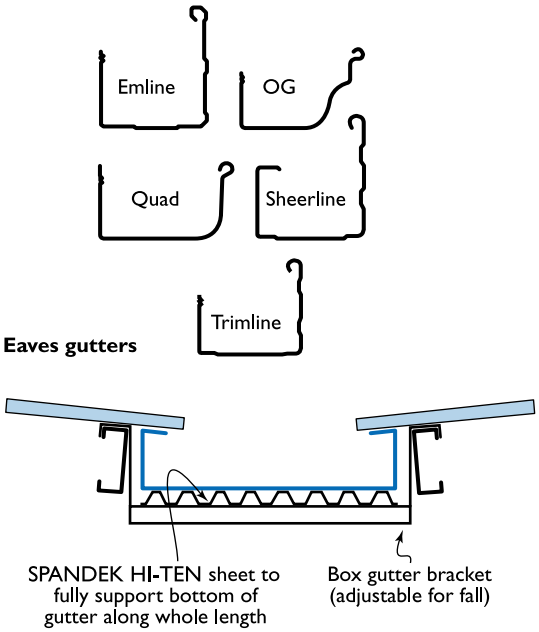
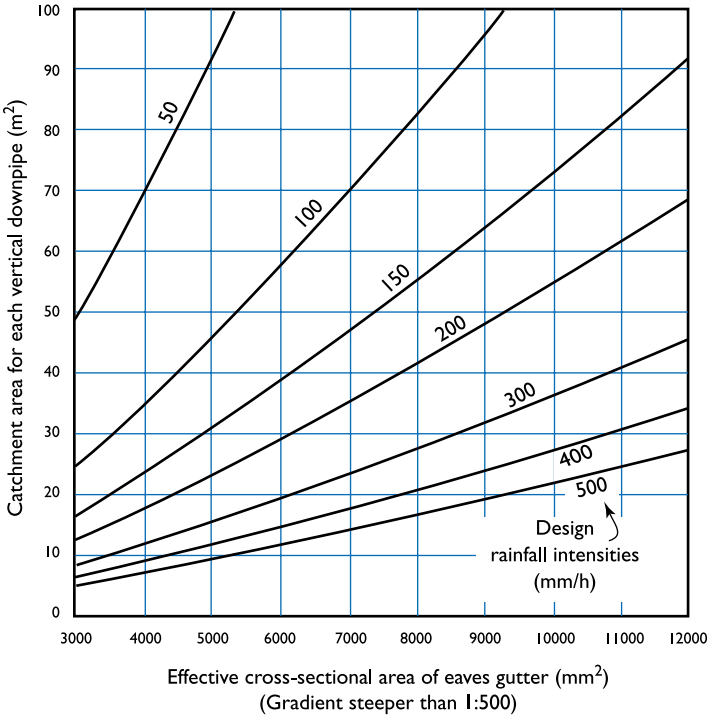


Figure 6.1.1
Typical gutters



Example
Find the maximum catchment area for each downpipe on a house in Hobart using Trimline gutter.

DATA
Design rainfall intensity = 99 (Table 6.2.1)
Gutter area = 7800 (Table 6.2.2)

SOLUTION (from Figure 6.2.2)
Catchment area for each downpipe = 81 m²

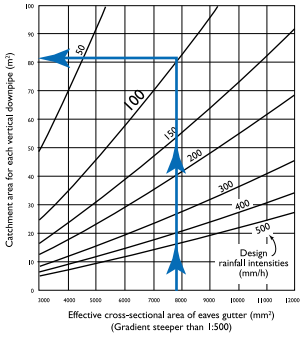


Figure 6.2.2
Cross-sectional area of eaves gutters required for various roof catchment areas (where gradient of gutter is flatter than 1:500). (Adapted from AS 3500.3:2003)

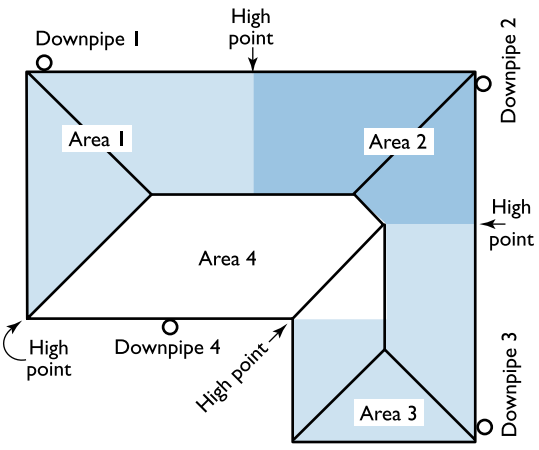


Figure 6.2.3
Locating high points and downpipes

Table 6.2.2
Gutter areas and downpipes

			Minimum standard downpipe sizes to suit gutters (gutter steeper than 1:500)	
	Slotted	Effective cross-section	Round (diameter)	Rectangular or square
	yes/no	mm²	mm	mm
EMLINE	yes	6723	100	100 x 75
EMLINE	no	9540	125	100 x 75
FITFAST	yes	6723	90	100 x 75
FITFAST	yes	7209	90	100 x 75
FLAT BACK	yes	5220	90	100 x 75
FLAT BACK	no	6447	90	100 x 75
HALF ROUND	yes	4775	90	100 x 75
HALF ROUND	no	6995	90	100 x 75
OGEE	no	5242	-	100 x 50
QUAD 115 Hi-front	yes	5225	90	75 x 75
QUAD 115 Hi-front	no	5809	90	100 x 50
Hi-front fluted Qld.	yes	5285	90	75 x 75
Hi-front fluted Qld.	no	5809	90	100 x 50
Low-front	yes	3600	90	75 x 50
Low-front	no	6165	90	100 x 50
QUAD 125	no	6370	90	100 x 50
QUAD 150	no	8910	100	100 x 75
QUAD 175	no	14672	100	100 x 75
SHEERLINE	yes	7600	100	100 x 75
SHEERLINE	no	8370	100	100 x 75
TRIMLINE	yes	6244	100	100 x 75
TRIMLINE	no	7800	100	100 x 75

Values calculated in accordance with AS/NZS 2179.1:1994

PART B: INSTALLATION

7

General care, safety and handling

7.1 Safety

It is commonsense to work safely, protecting yourself and workmates from accidents on the site. Safety includes the practices you use; as well as personal protection of eyes and skin from sunburn, and hearing from noise. Some sunscreens contain titanatium oxides. These have been shown to break down some paint compounds and these should be avoided.

Occupational health and safety laws enforce safe working conditions in most locations. Laws in every state require you to have fall protection which includes safety mesh, personal harnesses and perimeter guardrails. We recommend that you acquaint yourself with all local codes of safe practice and you adhere strictly to all laws that apply to your site.

7.2 Care and storage before installation

Rain or condensation is easily drawn between the surfaces of stacked sheets by capillary action, or they can be driven in by wind. This trapped moisture cannot evaporate easily, so it can cause deterioration of the coating which may lead to reduced life-expectancy or poor appearance.

If materials are not required for immediate use, stack them neatly and clear of the ground. If left in the open, protect them with waterproof covers.

If stacked or bundled product becomes wet, separate it without delay, wipe it with a clean cloth and stack it to dry thoroughly.

7.3 Handling cladding on site

On large building projects you can reduce handling time by lifting bundles with a crane direct from the delivery truck onto the roof frame. Use a spreader bar for long sheets. For small to medium size projects, without mechanical handling facilities, you can unload sheets by hand and pass them up to the roof one at a time.

For personal safety, and to protect the surface finish, wear clean dry gloves. Don't slide sheets over rough surfaces or over each other. Always carry tools, don't drag them.

7.4 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 parallel to the ribs:

- for ribbed roofing walk on at least two ribs or corrugations (CUSTOM ORB, CUSTOM BLUE ORB and SPANDEK);
- for pan-type roofing walk in the pans (LONGLINE 305, KLIP-LOK 406, KLIP-LOK 700, KLIP-LOK 700, TRIMDEK, INTEGRITY 820).

When you walk across the ribs, walk over or close to the roofing supports.

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.

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

If there will be heavy foot traffic on a roof, provide a temporary walkway or working platform to minimise damage.

7.5 Marking out, cutting and drilling

Marking out

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.

Cutting

Where possible, you should minimise site-work by using sheets cut to length in the factory.

For cutting thin metal on site, we recommend that you use a power saw with a metal-cutting blade because it produces fewer damaging hot metal particles and leaves less resultant burr than does a carborundum disc.

Cut materials over the ground and not over other materials where hot particles can fall and cause damage to finishes—especially COLORBOND® prepainted finishes. It is best to have the exterior colour finish of a COLORBOND® prepainted sheet facing down, however you must then protect the paint finish from scratching by your work supports.

If you have to cut materials near sheets already installed, mask them or direct the stream of hot particles away.

Reciprocating nibblers are also widely used in the roofing trade, and they produce an excellent cut.
The resulting small, sharp scraps can rust and damage finishes; and they can cause personal injury. Take special care to collect these scraps.

Making holes
Holes are often made by drilling or cutting by hole saw or jig saw. Mask the area around the hole to protect paint from damage by swarf.

7.6 Clean up

Swarf (metal scraps and/or abrasive particles resulting from cutting and drilling) left on the surfaces of materials will cause rust stains which can lead to reduced life of the material.

- Sweep or hose all metallic swarf and other debris from roof areas and gutters at the end of each day and at the completion of the installation. Failure to do so can lead to blockages of water flow or surface staining (such as when the metal particles rust).
- If swarf has become stuck on a finish, it can be removed. Take great care not to remove the paint or the metal coatings.
- For critical applications inspect the job two weeks after completion, when rain or condensation will have caused any remaining swarf to rust, and thus highlight affected areas.

7.7 Warn other contractors

Many stains arising from swarf do so, not from the work of roofing-installers, but from other contractors working on the job. Similarly, problems can arise from contact with incompatible materials, like copper piping or chemically treated timber. Acid cleaning of bricks can also be a problem. Architects and builders need to be aware of this, and warn contractors accordingly.

7.8 Strippable coatings

To provide temporary protection during production, handling and transport, some COLORBOND® products are coated with a plastic. This coating peels off easily when new, but it has a relatively short life, especially in sunlight. If you don't remove this coating at the time of installation, you may find it very hard to remove later on.

Please dispose of the plastic in an environmentally responsible manner.

7.9 Sealants

Recommended sealants
Neutral-cure silicone sealants have been successfully used with the range of steel finishes on our roofing and walling; and on flashings, cappings, and gutters made from the same materials as the cladding.

Neutral-cure silicone sealants:

- have good adhesion to the clean surface of all our roofing and walling;
- are water resistant and non-corrosive;
- are resistant to extremes of heat and cold while retaining good flexibility;
- provide high resistance to ultra-violet rays (sunlight); and
- have a long service life.

It is important that only neutral-cure silicone be used with sheet steel. Other silicone sealants, often have a vinegar or ammonia smell, and give off aggressive by-products during curing which are detrimental to sheet steel.

If in doubt, look for a message on the sealant package like: Suitable for use with galvanised and ZINCALUME® steel products.

Cleaning surfaces
For effective bonding, all surfaces must be clean, dry and free from contaminants such as old sealant or oil.

Mineral turpentine is suitable for cleaning the surfaces but care must be taken to completely remove all residual solvent with a clean dry cloth. White spirits is an alternative.

Sealant must be applied on the same day as the surface is cleaned.

Joint strength
Seams sealed with sealant should be mechanically fixed for strength. Fasteners in joints should generally be no further apart than 50mm.

The sealant does not require significant adhesive strength in itself, but it must bond positively to all the surfaces it is to seal. To ensure complete sealant cure, the width of sealant in a lap should not exceed 25mm when compressed (Figure 7.8.1).

Applying sealant
Always apply the bead of sealant in a continuous line along the centreline of the fastener holes. This ensures that, when compressed, the sealant positively seals the fastener.

Be careful not to entrap air when applying sealant. Especially, don't place a ring of sealant around fastener holes because entrapped air compresses during tightening of fasteners, and may blow a channel through the sealant, which could prevent the fastener from being sealed.

Fasteners
Use solid or sealed fasteners, otherwise you have to apply sealant to the hollow centre of open blind rivets.

To preserve the life of your cladding, is very important that fastener materials are compatible with the cladding (Section 2.10).

Procedure
The preferred procedure for lap fabrication is:

1. Assemble, clamp and drill;
2. Separate components and remove drilling debris;
3. Clean joint surfaces as recommended above;
4. Apply bead(s) of sealant;
5. Relocate components and fix;
6. Externally seal each fastener if hollow blind rivets are used.

To prevent premature curing (which causes poor bonding), finish the joint as soon as practical after applying the beads of sealant. The manufacturer's specified sealant open times should be followed.

Sealant clean up
With practice you will be able to judge the size of beads thus avoiding squeeze-out and the subsequent need to clean up.

Uncured sealant can be removed with a clean, dry rag and any excess then removed with a cloth lightly dampened with mineral turpentine or white spirits. Excess cured sealant is best removed with a plastic spatula to avoid damage to the surface finish of the metal.

Avoid any unnecessary smearing of sealant on surfaces intended for painting as silicone can affect adhesion of paint. Smeared sealant may be treated by lightly abrading the area with a non-metallic scouring medium.

7.10 Maintenance

Factors that most affect the long life of a roof (or wall) are original design, the environment of the installation, and the maintenance of the installation. Maintenance is probably the biggest factor.

Maintenance includes:

- Regular inspection for problems before they become major corrosion sites;
- Regular washing down, especially near coastal or industrial influences;
- Removal of leaves and other debris from gutters, downpipes, leaf-guards, slots, holes and other overflow devices;
- Keep walls free of soil, concrete and debris near the ground;
- Don't overspray pesticide.

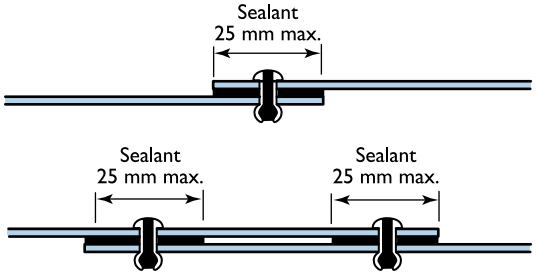


Figure 7.8.1
Typical joints with sealant

Maintenance of COLORBOND® prepainted steel

The paint system on COLORBOND® steel sheet is very durable. Simple maintenance of the finish enhances its life and maintains attractiveness for longer periods.

Where the paint finish is naturally washed by rainwater (roofs, for example) there is usually no additional maintenance needed. However areas to be washed include soffits, wall cladding under eaves, garage doors, and the underside of eave gutters.

Washing should be done at least every six months and more frequently in coastal areas where sea spray is prevalent, and in areas where high levels of industrial fallout occur. Avoid accumulation of salty deposits or industrial dirt.

Establish a regular routine for washing COLORBOND® prepainted steel products. Often garage doors can be washed with clean water at the same time as your car is being washed. Guttering and eaves can be hosed down when windows are being cleaned. Walls can be hosed down while watering the garden.

Where regular maintenance doesn't remove all the dirt, wash the surface with a mild solution of pure soap or non-abrasive non-ionic kitchen detergent in warm water. Use a sponge, soft cloth or soft bristle nylon brush; be gentle to prevent shiny spots. Thoroughly rinse off the detergent with clean water.

Never use abrasive or solvent cleaners (like turps, petrol, kerosene and paint thinners) on COLORBOND® steel surfaces. For advice on grease, oil or deposits not removed by soap or detergent contact our Information Service.

8

Installing pierce-fixed cladding

Pierce-fixing is the method of fixing sheets using fasteners which pass through the sheet. This is different from the alternative method called concealed-fixing (Chapter 9). The method of fixing you use is determined by the cladding profile you are using.

You can place screws through the crests or in the valleys, however, to maximise watertightness, always place roof screws through the crests. For walling, you may fix through either the crest or valley (Figure 8.1).

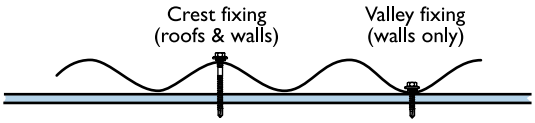


Figure 8.1
Crest and valley fixing

Always drive the screws perpendicular to the cladding, and in the centre of the corrugation or rib.

The following procedures are described for roofs, but the same general principles apply to walls.

8.1 General installation procedure

Check flatness, slope and overhang
Before starting work ensure that:

- the supports for your cladding are truly in the same plane;
- the minimum roof slopes conform to Section 2.5 (Low-roof-pitches); and
- the overhangs of sheets from the top and bottom supports don't exceed those in Table 2.3.1, whilst also overhanging at least 50mm into gutters.

Make any necessary adjustments before you start laying sheets, because they will be difficult or impossible to rectify later.

Orient sheets before lifting
For maximum weather-tightness, start laying sheets from the end of the building that will be in the lee of the worst-anticipated or prevailing weather (Figure 8.1.1).

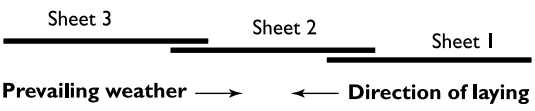


Figure 8.1.1
Lay sheets towards prevailing weather

It is much easier and safer to turn sheets on the ground than up on the roof. Before lifting sheets on to the roof, check that they are the correct way up and the overlapping side is towards the edge of the roof from which installation will start.

Place bundles of sheets over or near firm supports, not at mid span of roof members.

Position first sheet
With particular care, position the first sheet before fixing to ensure that it is correctly located in relation to other parts of the building.
Check that the sheet:

- is aligned with the end-wall (or its barge or fascia), bearing in mind the type of flashing or capping treatment to be used; and
- aligns correctly at its ends in relation to the gutter and ridge (or parapet or transverse wall). Roof sheets should overhang at least 50mm into gutters.

Fix the sheet as described later in this chapter.

Position other sheets
After fixing the first sheet in position, align the following sheets using:

- the long edge of the previous sheet; and
- a measurement from the end of the sheet to the fascia or purlin at the gutter. It is important that you keep the gutter-end of all sheets in a straight line.

Fix the sheet by either:

- fixing each sheet completely, before laying the next; or
- fix the sheet sufficiently to ensure it can't move, complete laying all sheets, then return to place all the intermediate fasteners later.

Check alignment occasionally
Occasionally check that the sheets are still parallel with the first sheet, by taking two measurements across the width of the fixed cladding (Figure 8.1.2).

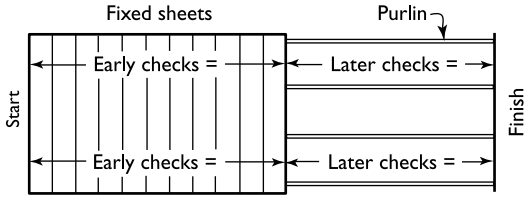


Figure 8.1.2
Check alignment occasionally

At about half way through the job, perform a similar check but take the measurements from the finishing line to aim for the final sheet to be parallel with the end of the roof. If the measurements are not close enough, lay subsequent sheets very slightly out of parallel to gradually correct the error by:

- properly align and fix a lap, then
- fix the other edge of the sheet, placing the fasteners slightly closer or further from where they would normally be if there was no error.

8.2 Side-lapping & positioning pierce-fixed sheets

To prevent moisture being drawn into laps by capillary action, the edges of sheets are slightly modified. CUSTOM ORB and CUSTOM-BLUE ORB have the edges of the sheet over-curved, other products like SPANDEK, TRIMDEK, INTEGRITY 820 all have flutes formed into the underlapping rib. It is important that sheets be lapped correctly (Figure 8.2.1).

After fixing the first sheet, place the next (and subsequent) sheet with its side lap snugly over the previous sheet (Figure 8.2.1). Secure the sheet firmly in place until each end of the sheet has been fixed.

You can do this easily by:

- align the bottom edge accurately by a measurement from the end of the sheet to the fascia or purlin at the gutter;
- clamp the lap with a pair of vice grips (Figure 8.2.2);
- at the top of the sheet: nestle the side lap snugly, check alignment, and fix the sheet with a fastener.

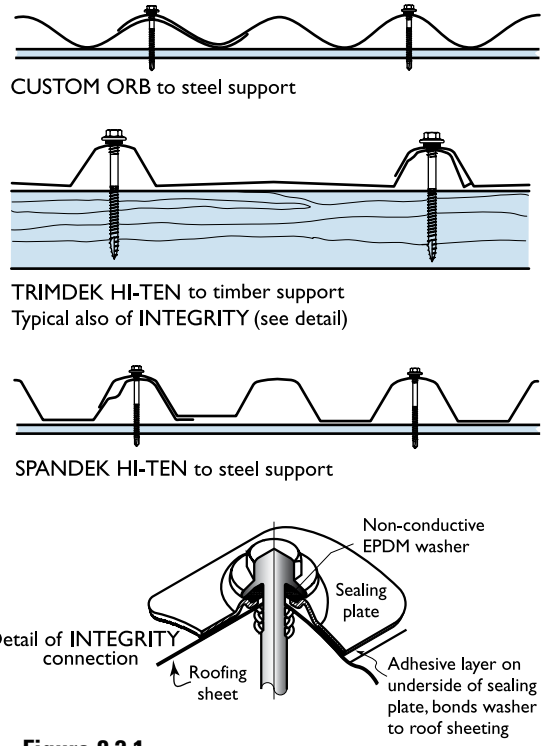


Figure 8.2.1
Crest fixing

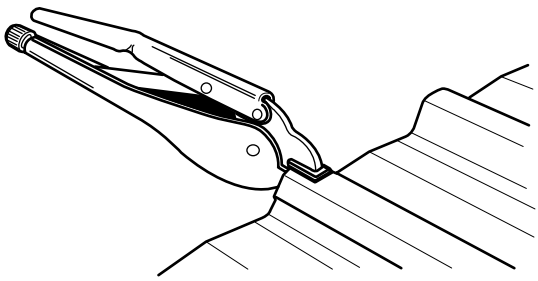


Figure 8.2.2
Clamp one end of the sheet whilst fixing the other end.

8.3 Pierce-fixing on crests

Crest fixing is recommended for roofs made from:

- **CUSTOM ORB**
- **CUSTOM BLUE ORB**
- **SPANDEK**
- **TRIMDEK**
- **INTEGRITY 820**

Crest fixing may also be used for these products when they are used as walling.

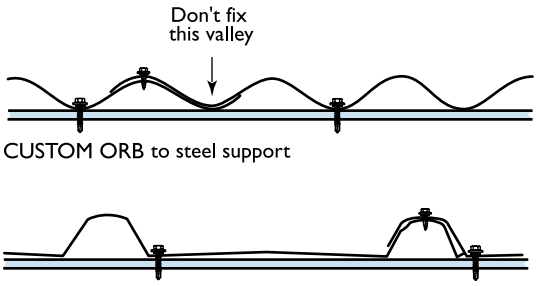


Figure 8.4.1
Typical valley fixing (for walls only)

8.4 Pierce-fixing on valleys (for walling only)

Wall fasteners may be placed on the crests, but they are usually placed in the valley of wall cladding because:

- they are less conspicuous and don't break the aesthetic lines of the steel cladding;
- there is no risk of the profile being deformed, because the fastener is placed through the cladding where it rests flat against its support (Figure 8.4.1); and
- water penetration is not a problem.

However, when valley-fixed, the cladding needs a side-lap fastener in all laps, at each support. You will find it more economical in labour, time and cost of fasteners to use a crest fastener at each side lap in place of the lap fastener and adjacent valley fastener (Figure 8.4.2).

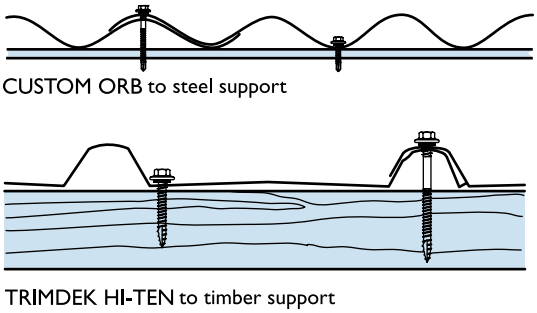


Figure 8.4.2
Alternative valley fixing with crest fixing at side laps (for walls only)

8.5 Pierce-fixing on side-laps

Where roofing is installed according to the support spacings shown in Tables 2.3.1 and 2.3.2, side-lap fasteners are generally not required.

You may need to use side-lap fasteners where the cladding is laid a little out of alignment and the weather resistance of a joint is questionable. Decide on the number of side-lap fasteners by what looks effective in each individual case.

Where valley fasteners are used (walling), you need side-lap fasteners along each lap at each support. Alternatively a crest fastener may be used at each side-lap, in place of the side-lap fastener and adjacent valley fastener (as mentioned above in Section 8.4).

Side-lap fasteners are located in the centre of the crest of the overlapping corrugation (Figures 8.4.1 and 8.4.2).

8.6 Installing MINI ORB

A little extra care is needed with MINI ORB to get the best appearance. Detailed notes are in our brochure on MINI ORB. We recommend using Ripple Teks® for best visual results.

Ripple Teks® are a registered trademark of ITW Buildex.

9

Installing concealed-fixed cladding

Concealed-fixing is the method of fixing sheets using fasteners which do not pass through the sheet. Instead, the cladding is held in place with clips. This is different from the alternative method called pierce-fixing (Chapter 8). The method of fixing you use is determined by the cladding profile you are using.

Concealed-fixing is used for:

- **KLIP-LOK MAXIMA**
- **KLIP-LOK 700**
- **KLIP-LOK 406**
- **LONGLINE 305**
- **EASYCLAD**

Very steep pitches
To prevent concealed-fixed cladding from sliding downward in the fixing clips, on very steep pitches, you should pierce-fix through each sheet under the flashing or capping, along the top of the sheets.

9.1 Installing KLIP-LOK roofs

Use the same general procedure described in Section 8.1 (General installation procedure). However, at the start of installing KLIP-LOK 406, KLIP-LOK 700 or KLIP-LOK MAXIMA a row of clips is fixed to the supports before the first sheet is located over them and locked in position.

Clips

For KLIP-LOK MAXIMA use MAXIMA clips.
KLIP-LOK 700HS use 700HS clips.
For KLIP-LOK 406 use KL65 clips.

The orientation of the clips is important because they are not symmetrical (Figure 9.1.1).

The fixing holes are pre-punched. On KL65 and KL75 clips you can use the dimples to locate other fasteners where a fastener breaks or a timber support splits.

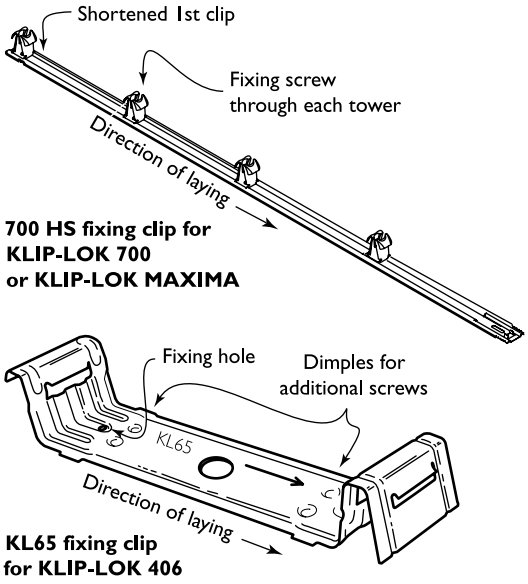
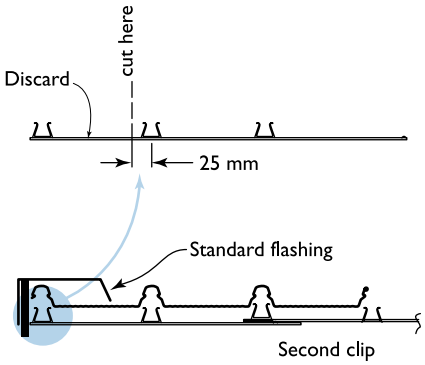
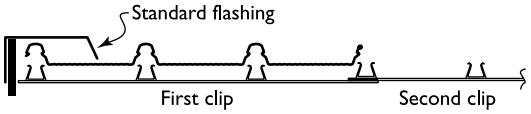


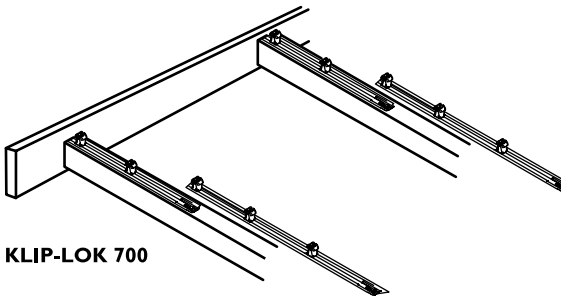
Figure 9.1.1
KLIP-LOK clips



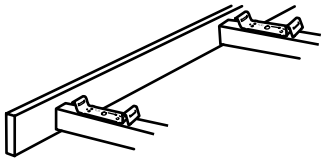
KLIP-LOK 700HS: Starting method 1



KLIP-LOK 700HS: Starting method 2



KLIP-LOK 700



KLIP-LOK 406
(KL65 clips shown)

Figure 9.1.2
Fix the first row of clips

Preparation

As described in General installation procedure (Section 8.1):

- check flatness, slope and overhang;
- orient the sheets before lifting. Note the overlapping rib is towards the end of the building where you start (Figure 9.1.3);
- Check that the overhang of the sheets from the clips, at both eaves and ridge, is not less than the minimum in Table 2.3.1.
- The first and the last supports and clips should be at least 75mm from each end of the sheet to keep maximum holding power.

Position the first sheet

With particular care, position the first sheet before fixing, to ensure that it will correctly locate in relation to other parts of the building. Check that the sheet:

- is aligned with the end-wall (or its barge or fascia), bearing in mind the type of flashing or capping treatment to be used; and
- aligns correctly at its ends in relation to the gutter and ridge (or parapet or transverse wall). Roof sheets should overhang at least 50mm into gutters.

Fix the first clips

KLIP-LOK 700

Starting method 1. Cut the 1st clip 25mm from the centre of the second tower (as shown). The first tower on the cut clip locates in the 1st rib of the first sheet (Figure 9.1.2). This method is preferred because you don't have to reach so far to fix the remote end of the clip.

Starting method 2. The first tower on the first clip locates in the first rib of the first sheet (Figure 9.1.2). The clip fixes the edge of the first sheet, but you must fix two clips at the start, and thus reach out further for the first and all subsequent sheets.

The following description is for Method 1.

ALL KLIP-LOK PROFILES

Fix the first clip on the purlin nearest the gutter, with the clip pointing correctly in the direction of laying (Figures 9.1.1 and 9.1.2). Be sure the clip is 90-degrees to the edge of the sheet.

Using a string line (or the first sheet as a straight edge) to align the clips as you fix a clip to each purlin working towards the high end of the roof.

Place the first sheet

1. Locate the first sheet over the fixed clips (Figure 9.1.3).
2. Using a measurement from the gutter-end of the sheet to the fascia or purlin, position the sheet so that it overhangs the desired amount into the gutter (usually about 50mm). It is important that you keep the gutter-end of all sheets in a straight line.
3. **KLIP-LOK 406**: If a spur on the edge of a KLIP-LOK 406 sheet fouls a clip, flatten the spur with a rubber mallet to allow the clip to sit down over the rib (Figure 9.1.4).

   ALL KLIP-LOK PROFILES: Fully engage the sheet with the clips, using vertical foot pressure on all the ribs over each clip.

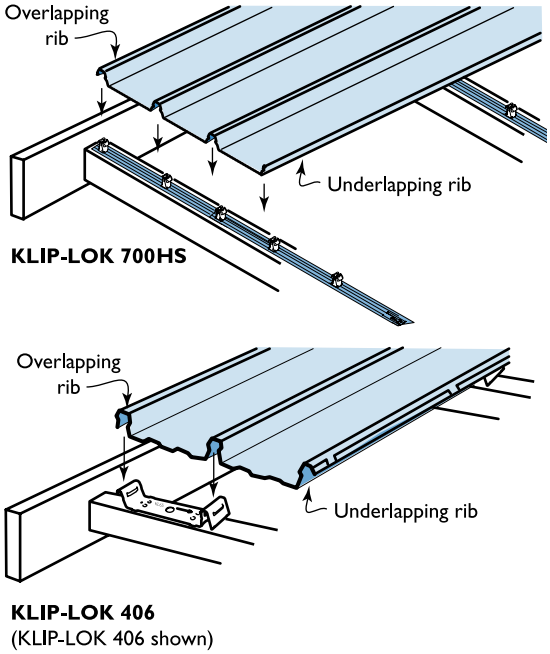


Figure 9.1.3
Placing the first sheet

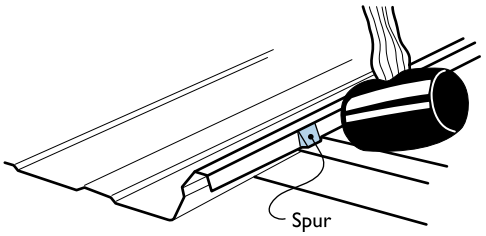


Figure 9.1.4
Flatten spurs in way of clips

Fix the next (and subsequent) clips and sheets

1. Fix the next row of clips, one to each support. Be sure the clip is 90 degrees to the edge of the sheet, and the embossed arrow on the clip points in the correct direction (Figure 9.1.1).

   KLIP-LOK 700: Engage the slots and tabs on the clips.

   KLIP-LOK 406 & 700: Engage the clips over the rib of the installed sheet (Figure 9.1.5). If a spur on the edge of the sheet fouls a clip, flatten the spur with a rubber mallet to allow the clip to sit down over the rib (Figure 9.1.4).

2. As before, place the next sheet over its clips also engaging the edge of the preceding sheet.

3. Accurately position the sheet so that it overhangs the desired amount into the gutter. It is important that you keep the gutter-end of all sheets in a straight line.

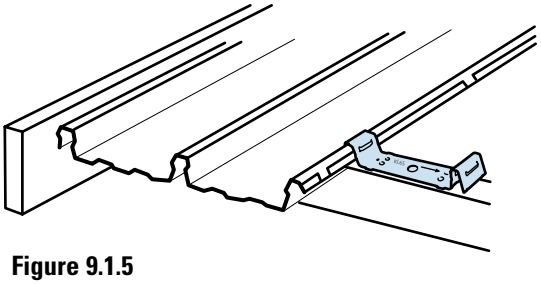


Figure 9.1.5
Clip engaged over rib of installed sheet

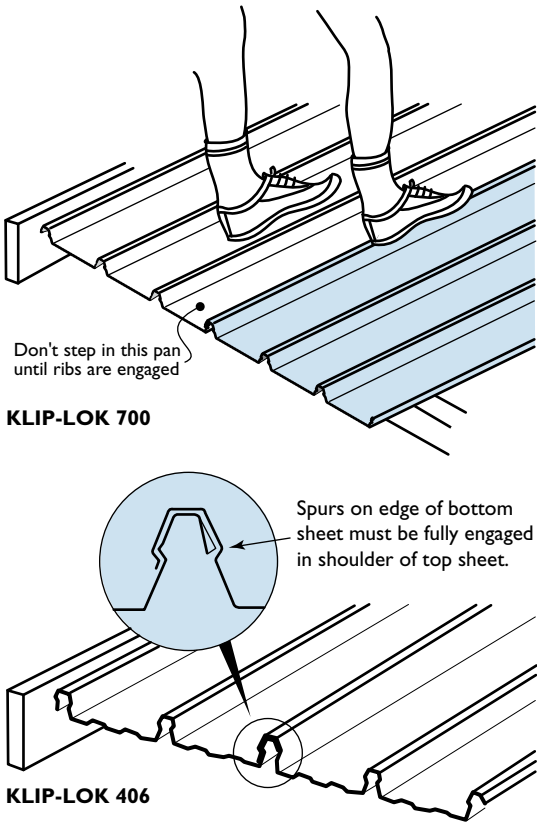


Figure 9.1.7
Engaging edges of sheets

4. Fully engage the two sheets along the overlapping rib.
   You can do this by walking along the full length of the sheet with one foot in the centre pan of the previous sheet and the other foot applying vertical pressure to the top of the interlocking ribs at regular intervals. It is important that you don't walk in the unsupported pan beside the overlap (Figure 9.1.7). A rubber mallet may help engagement of laps on long spans.

5. Similarly, engage all the clips by applying vertical foot pressure to the top of the other ribs over each clip.

It is essential that the sheets interlock completely. It is important that your weight is fully on the sheet you are installing.

KLIP-LOK 406 & 700: The spurs on the free edge of the underlapping rib must be fully engaged in the shoulder of the overlapping rib (Figure 9.1.7). You will hear a distinct click as the spurs snap in.

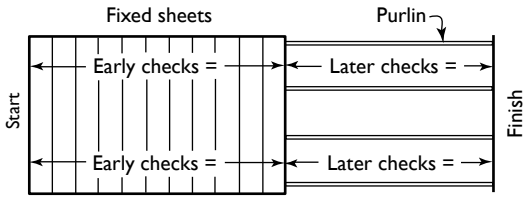


Figure 9.1.8
Check alignment occasionally

Check alignment occasionally

Occasionally check that the sheets are still parallel with the first sheet, by taking two measurements across the width of the fixed cladding (Figure 9.1.8).

At about half way through the job, perform a similar check but take the measurements from the finishing line to aim for the final sheet to be parallel with the end of the roof. If the measurements are not close enough, lay subsequent sheets very slightly out of parallel to gradually correct the error. To allow this to happen, flatten the tabs on the base of subsequent clips—the slot in the clip will allow the clips to be fixed out of standard pitch.

Place the last sheet

KLIP-LOK 700: If the final space is less than the full width of a sheet, you can cut a sheet along its length and shorten the clips as appropriate.

KLIP-LOK 406 & 700: If the final space is more than half the width of a sheet, you can cut a sheet along its length leaving the centre rib complete (Figure 9.1.9). Place the cut sheet onto a row of clips, as for a full sheet.

If the final space is less than half the width of a sheet, fix the edge of the sheet at each purlin, with a clip that has been cut in half (Figure 9.1.10). Cover the gap with the capping or flashing.

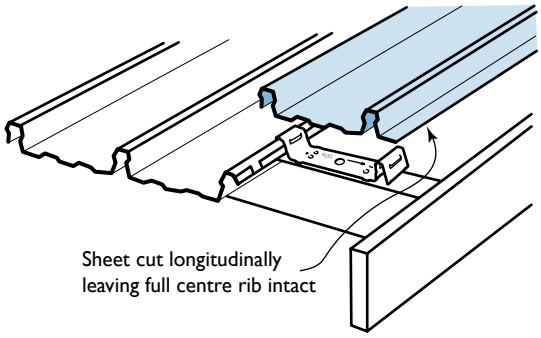


Figure 9.1.9
KLIP-LOK 406
Placing last sheet where half a sheet will fit

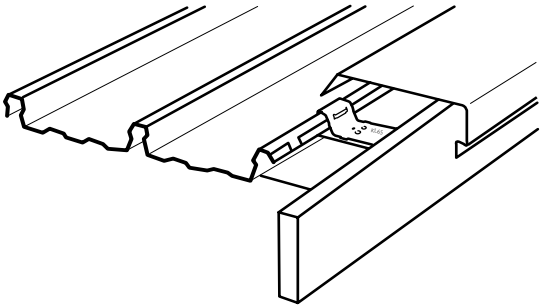


Figure 9.1.10
KLIP-LOK 406
Placing last sheet where half a sheet won't fit

9.2 Installing KLIP-LOK walls

The installation procedure for walls is similar to that described for roofs (Section 9.1). To engage clips, use a rubber mallet (instead of foot pressure).

To prevent KLIP-LOK from sliding downward in the fixing clips, you should pierce-fix through each sheet under the flashing or capping, along the top of the sheets.

9.3 Installing Easyclad

You can use EASYCLAD for walls, soffit linings or ceilings. Use a similar installation procedure for all.

EASYCLAD 2PF300 (2 pans per sheet) and 4P300 (4 pans per sheet) are pierce-fixed through the underlapping edge of each sheet. The fasteners in one sheet are concealed by the leading edge of the next. For the last sheet, a trim channel is used.

If you are using EASYCLAD with the ribs horizontal, start installing from the bottom of the wall so that the joints between panels tend to shed water (Figure 9.3.6).

You can use either of two methods to fix the first panel: a CD39 trim channel or CD40 starting clips.

Start method 1 – Using a trim channel

With particular care, fix a trim channel at each support.
Be careful to locate it correctly in relation to other parts of the building (see Section 8.1 Position first sheet).

- Use trim channel CD1 with EASYCLAD 4P300.
- Use trim channel CD39 with EASYCLAD 2PF300.

The first EASYCLAD panel is held in place by fitting it into the fixed trim channel (Figure 9.3.1).

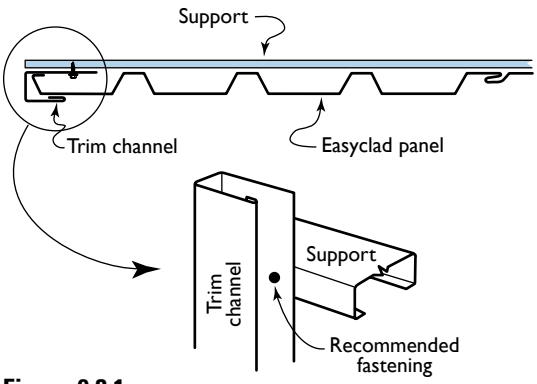


Figure 9.3.1
Using a trim channel to start

Start method 2 – Using clips

With particular care, fix starting clips at each support. Be careful to locate them correctly in relation to other parts of the building (see Section 8.1 Position first sheet).

Hook the lip of an EASYCLAD sheet under these clips (Figure 9.3.2).

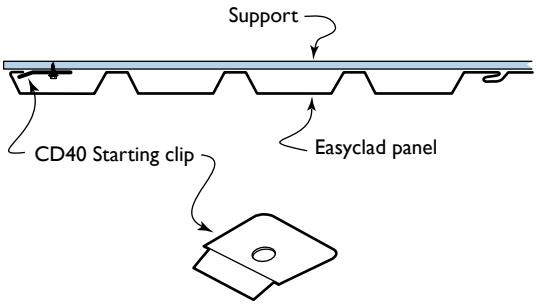


Figure 9.3.2
Using a clip to start

Fixing EASYCLAD panels

Locate the first panel either in its trim channel or under the clips (depending on the start method you used).

Fix the underlapping side of the panel, to each support, through the flat edge, with the recommended fastener (Chapter 3). The indentations along the edge help you locate the fasteners (Figure 9.3.3).

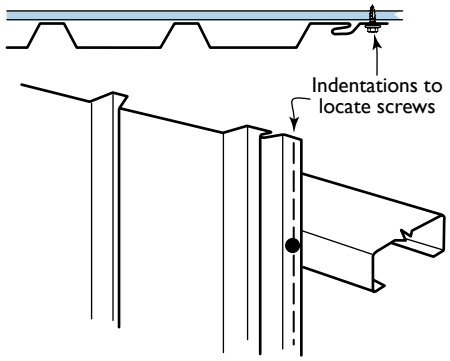


Figure 9.3.3
Indents on edge of sheet help to locate screws

Fit subsequent panels by hooking the lip of your next sheet under the folded-back edge of the previous panel before fixing in the same way as before (Figure 9.3.4).

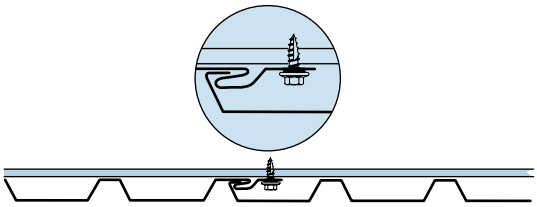


Figure 9.3.4
Starting for subsequent sheets

Usually the last EASYCLAD panel will have to be cut in width to suit the building. The panel may require exposed pierce-fixing. If you use a trim channel at the end of the EASYCLAD walling, position it and pierce-fix with the last panel (Figure 9.3.5).

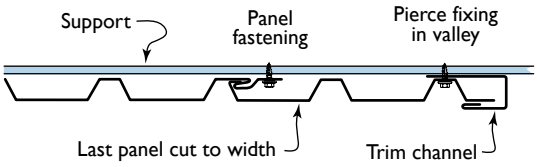


Figure: 9.3.5
Using trim channel to finish

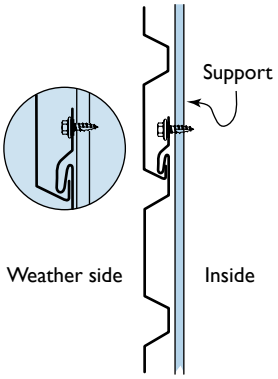


Figure 9.3.6
Start external walls from the bottom

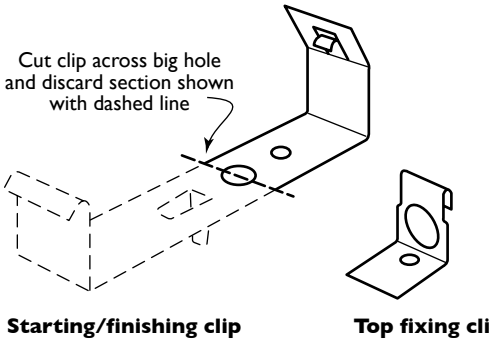


Figure 9.4.1
LONGLINE 305 clips

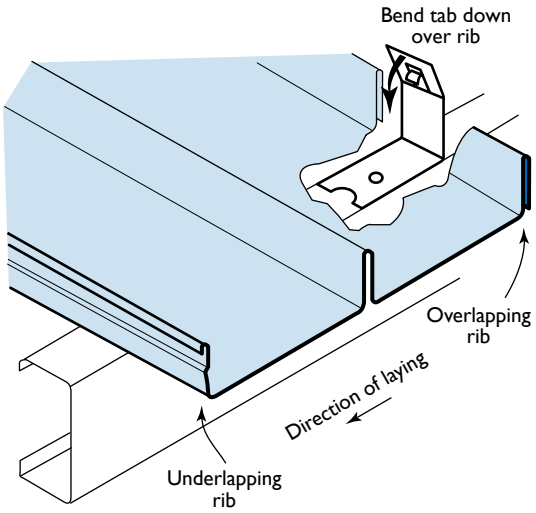


Figure 9.4.2
Placing first sheet

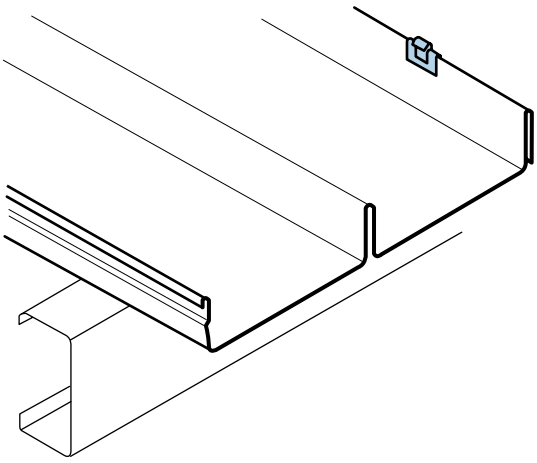


Figure 9.4.3
Place top fixing clips

9.4 Installing LONGLINE 305 roofs

For LONGLINE 305 (standard width, fluted or tapered) use the same general procedure described in Section 8.1 (General installation procedure). However, at the start of installing LONGLINE 305, a row of clips is fixed to the supports before the first sheet is located over them and locked in position.

Clips

The 2 clips are shown in Figure 9.4.1.

Preparation

Cut all starting/finishing clips and discard the unwanted pieces (Figure 9.4.1).

As described in General installation procedure (Section 8.1):

- check flatness, slope and overhang, and
- orient the sheets before lifting. Note the overlapping rib is towards the end of the building where you start. (Figure 9.4.2).

Fix the first row of clips

With particular care, determine the location of the first sheet and mark the edge of the sheet on the purlins (see Section 8.1 Position first sheet).

Fix the first clip on the purlin. Using a string line (or the first sheet as a straight edge) fix the other starting clips for the first sheet.

Place the first sheet

1. Locate the first sheet over the fixed clips (Figure 9.4.2).
2. Using a measurement from the gutter-end of the sheet to the fascia or purlin, position the sheet so that it overhangs the desired amount into the gutter. When setting the first sheet, remember that it is important you keep the gutter-end of all sheets at a constant distance from the edge of the gutter or fascia.
3. Bend the tab of all clips over the rib (Figure 10.4.3).

Fix the next (and subsequent) clips and sheets

1. Using the rib closing tool, flatten the rib of the first (previous) sheet at each purlin where the top fixing clips will fit (Figure 9.4.4).
2. Place top fixing clips over each flattened rib and fix to the purlins (Figure 9.4.5). With a felt-tipped pen, make a small mark in the pan to enable you to locate the clips in the later locking operation with the button punch (Figure 9.4.6).
3. Place the next sheet over the edge of the preceding sheet, (Figure 9.4.5). Accurately position the sheet so that it overhangs the desired amount into the gutter. It is important that you keep the gutter-end of all sheets at a constant distance from the edge of the gutter or fascia.
4. Fully engage the sheet with the clips, using foot pressure on the ribs over each clip. You can do this by walking along the full length of the sheet with one foot in the tray next to the overlapping rib and the other foot applying pressure to the top of the interlocking ribs at regular intervals.

For walling applications use a rubber mallet instead of the weight on your feet.

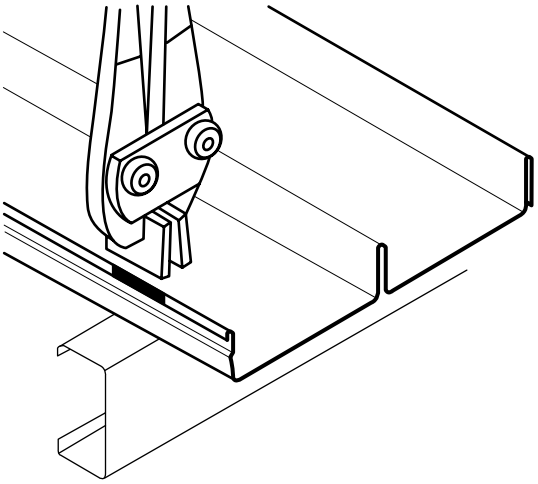


Figure 9.4.4
Flatten rib for top fixing clips

Check alignment periodically

Check alignment as described in Section 8.1 (General procedure).

Place the last sheet

Assess how the last sheet will fit as described for installation of KLIP-LOK (Figures 9.1.8 and 9.1.9).

Fix a cut starting/finishing clip to the purlins.

Place the last sheet over the starting/finishing clips, flatten the rib at each purlin, and bend the tab of all clips over the rib.

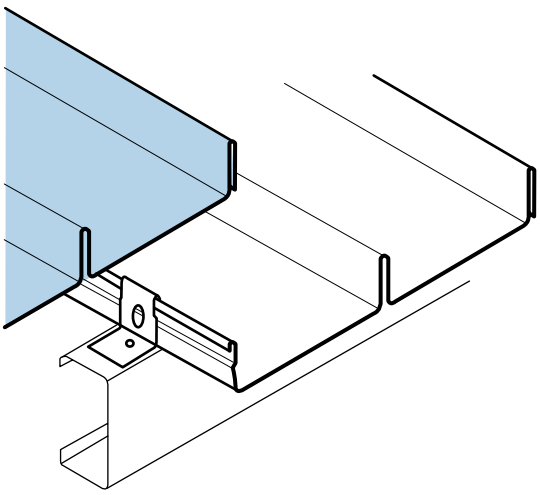


Figure 9.4.5
Placing subsequent sheets

Lock all ribs

All lapped ribs must be locked along their length, by button punching at no greater than 900mm centres (Figure 9.4.6).
You must button punch through the hole in each top fixing clip —you locate the clip with the pen mark made previously. When operating the punching tool, stand on the pan of the overlapping sheet to ensure that the sheets are fully engaged.

9.5 Installing LONGLINE 305 walls

The installation procedure for walls is similar to that described for roofs (Section 9.4).

To prevent LONGLINE 305 from sliding downward in the fixing clips, you should pierce-fix through each sheet under the flashing or capping, along the top of the sheets.

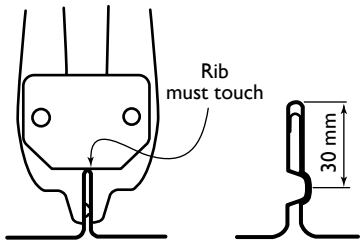


Figure 9.4.6
Lock all ribs with button punch

10

Ends of sheets

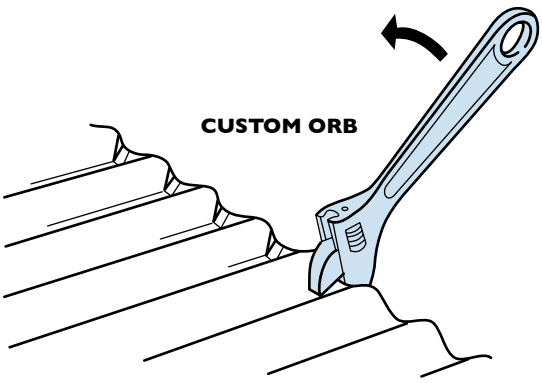


Figure 10.1.2
Turning-up CUSTOM ORB

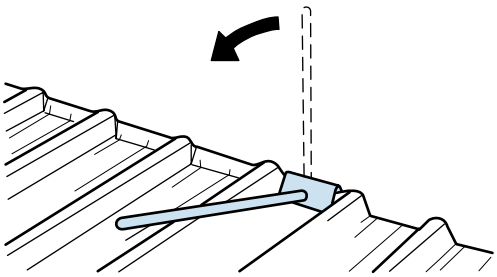


Figure 10.1.3
Turning-up (TRIMDEK shown)

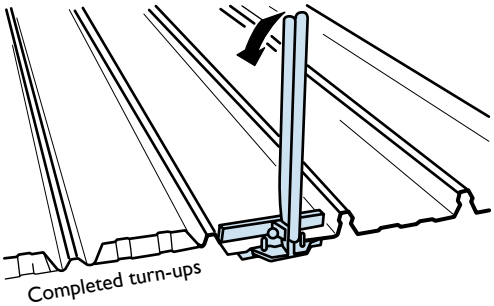


Figure 10.1.4
KLIP-LOK tool ready for turn-up

This chapter describes how you can treat the ends of sheets to maximise waterproofing, or to stop vermin entering.

10.1 Turn-ups

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.

Turn-up tools are available for all our roofing profiles except CUSTOM ORB and LONGLINE 305 when it is tapered (Figure 10.1.1 on the next page).

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).

Turning-up CUSTOM ORB

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 (Figure 10.1.2). Be careful not to tear the sheet.

Turning-up TRIMDEK and SPANDEK

Slide the 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 10.1.3).

Turning-up KLIP-LOK

You get the best results by first cutting off the corner of the down-pointing leg of each female rib. Do this before you place the sheets on the roof.

- With the hinged turn-up tool open: position the tool on the sheet with the locating pins hard against the end of the sheet.
- Hold the handles together to clamp the tool onto the tray, and pull them to turn-up the tray 90° (Figure 10.1.4).

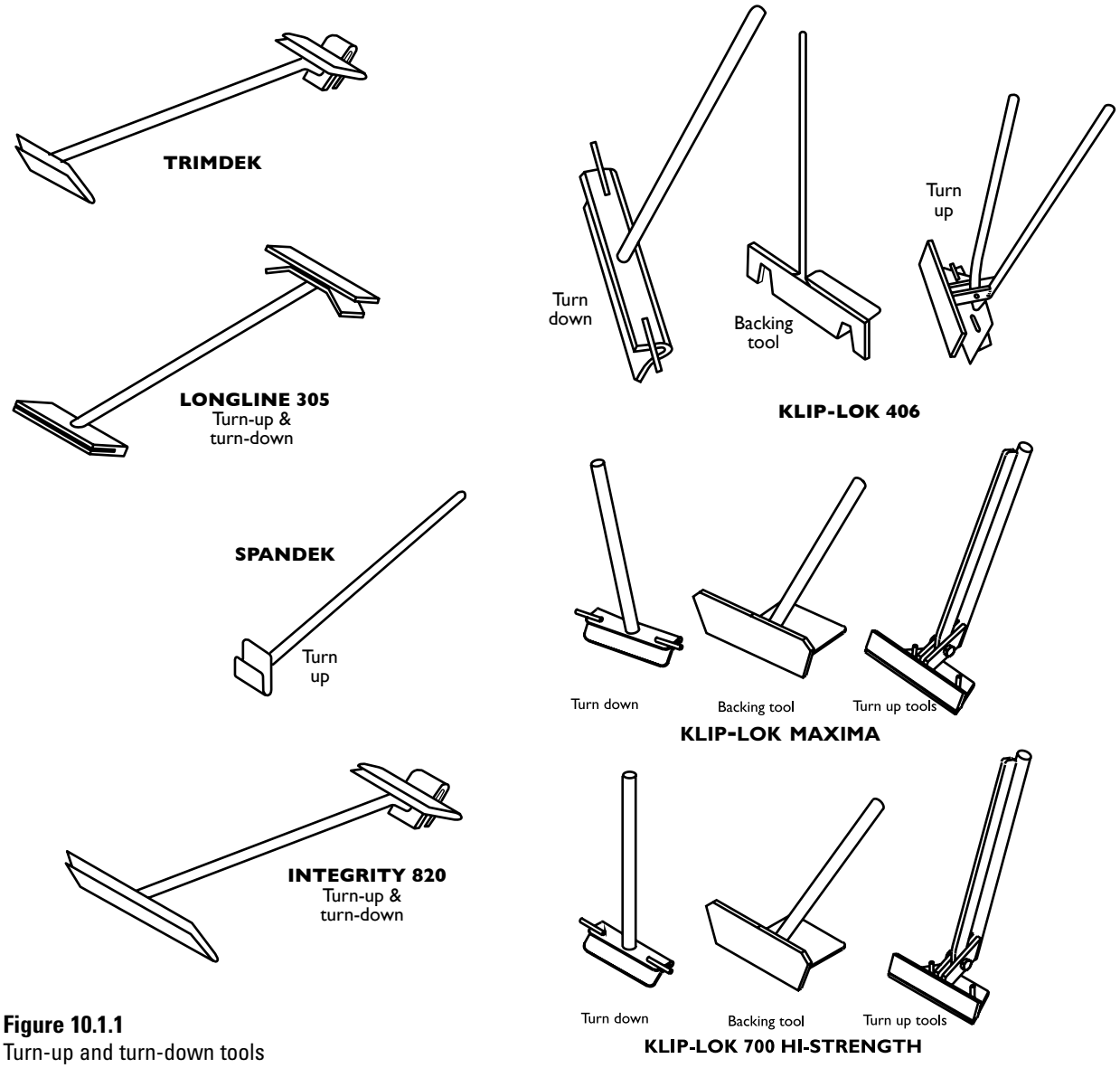


Figure 10.1.1
Turn-up and turn-down tools

Flush turning-up KLIP-LOK

In normal turning-up of KLIP-LOK, the tops of the ribs protrude past the turned up tray. Consequently the turn-ups cannot be positioned hard against a fascia or wall, or the ends of the sheets on either side of the ridge cannot be butted together. This is usually of no consequence because the turn-up is completely covered by a flashing or capping. However, if you want the ribs not to protrude past the turn-up, you can make a flush turn-up. You need an extra 40mm in sheet length for flush turn-ups.

1. Cut the top of each rib before turning-up the pans (Figure 10.1.5). Turn-up the pans as described before.
2. Position the backing tool in the tray and hold it hard against the turn-up with a foot.
3. With a rubber mallet, fold the protruding 'ears' flush against the backing tool.

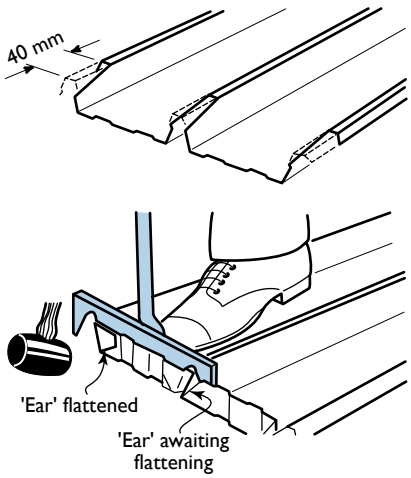


Figure 10.1.5
Using the backing tool for flush turn-up on KLIP-LOK

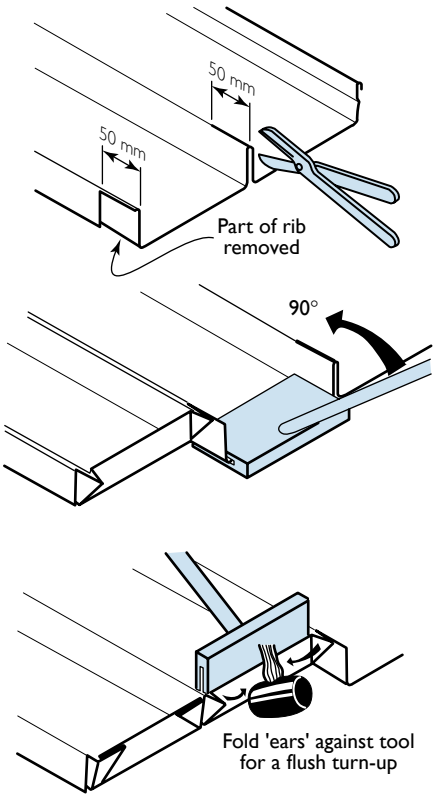


Figure 10.1.6
Turning up LONGLINE 305

Turning-up LONGLINE 305
Flush turn-ups are usually used on LONGLINE 305. Cut off a portion of the female rib for at least 50mm. For a flush turn-up, you also need to cut the crown of the centre rib for at least 50mm.

Holding the end of the tool against the end of the sheet, pull the handle up 90°. If turning-up flush, fold the protruding 'ears' flush against the turn-up tool with a rubber mallet (Figure 10.1.6).

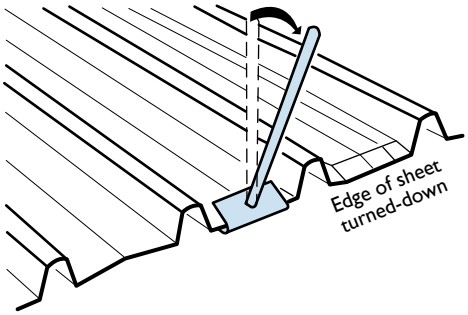


Figure 10.2.1
Turning-down the gutter end (TRIMDEK shown)

10.2 Turning-down

At the low end of roofing, wind or capillary action can cause water to run back up the underside of the cladding. To minimise this problem, you turn down the valleys (or pans) at the low end of roofing. The process is called turning-down (or lipping).

All roofing on slopes below 1 in 5 (10°) must be turned-down.

Turn-down tools are available for all our roofing profiles except CUSTOM ORB, SPANDEK and tapered LONGLINE 305. The valleys of CUSTOM ORB corrugated cladding can be turned down with multigrips, pliers or a shifting spanner (Figure 10.1.2).

Turning-down is usually done after the cladding is fixed on the roof, provided there is no obstruction to the operation of the turn-down tool.

- Push the turn-down tool over the end of the tray, as far as it will go.
- Hold the tool hard against the end of the tray and push the handle to form a turn-down about 20°.

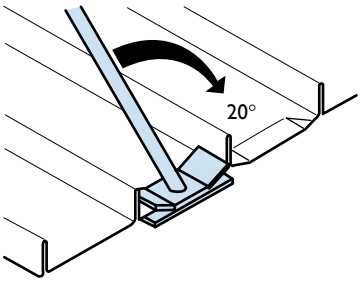


Figure 10.2.2
Turning-down the gutter end (LONGLINE 305 shown)

Sheet-ends on low slopes and overlaps
For claddings laid on laid on slopes of 5 degrees or less, the underlap lip of the under-sheet may require to be cut back on the corner at the downhill end of the sheet, to block capillary action (Figure 10.2.3).

This may be required where the return lip of the underlapping sheet nests snugly with the overlapping sheet without a gap, or where there is interference with the down-turning of the valley.

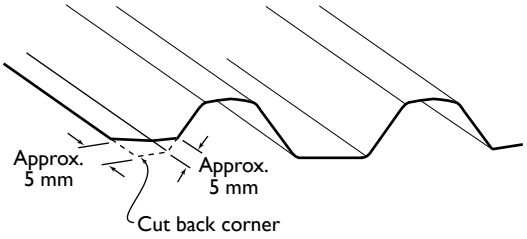


Figure 10.2.3
Cut SPANDEK on low slopes.

10.3 Blocking off rib cavities

Dust, insects, birds, rodents and wind-driven rain can enter a building through the cavities under ribs. To minimise these problems the cavities can be blocked off. Rib end-stops are available for KLIP-LOK; strips of plastic foam can be used for other profiles.

Fitting KLIP-LOK rib end-stops during sheet installation
Fix the rib end-stops to the side of the eaves support after the KLIP-LOK clip has been secured in position. Align the rib end-stops with the upstands of the fixing clips (Figure 10.3.1).

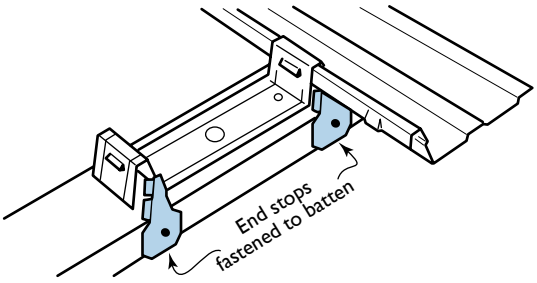


Figure 10.3.1
Fitting rib end-stops during installation of sheets

Fitting KLIP-LOK rib end-stops after sheet installation
Bend the flat of the end-stops 90°. Push an end-stop into the space under each rib until the flat is wedged firmly between the underside of the cladding and support (Figure 10.3.2).

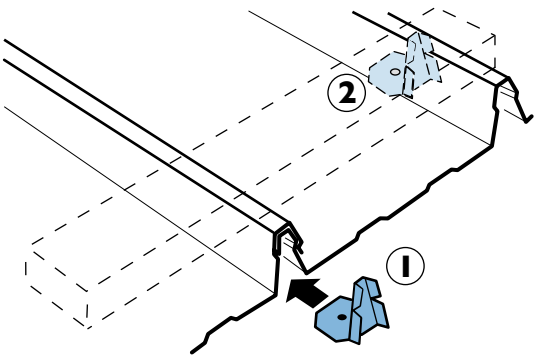


Figure 10.3.2
Fitting rib end-stops after installation of sheets

Infill strips
Closed-cell, foam-plastic infill strips are available to match the top or bottom profile of our roof claddings.

At the lower end of cladding, the strip is sandwiched under the roof cladding. Similarly, at the upper end, the strip is sandwiched between topside of the roofing and the underside of the flashing or capping (Figure 10.3.3).

Don't use infill strips that can absorb water because retained moisture can lead to deterioration of the sheet coating. Avoid using infill strips made from, or treated with, flammable materials, particularly in areas prone to bushfire (Section 11.8).

Where roof pitches are below 1 in 5 (10°), you should incorporate infill strips to maximise waterproofness.

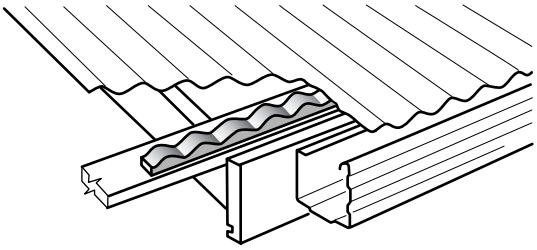


Figure 10.3.3
Profiled closed-cell infill at eaves

10.4 End-lapping

Because our roofing and walling is manufactured by continuous processes, sheet lengths can be supplied up to the limits of transport regulations which are frequently long enough to cover roofs without end-lapping the sheets.

If you contemplate using sheets that are shorter than the full span, and overlap them, you need to consider:

- the roof slope, because it affects the amount of overlap (see Table 10.4.1);
- the method of fixing of the cladding to its supports, because it affects the maximum length of sheet (see Section 10.5 (Expansion joints) and Table 10.5.2).

Table 10.4.1
End-laps

	End-lap minimum (mm)	End-lap maximum (mm)
Roof slope		
Less than 1 in 4 (15°)	200	300
See 'End-laps in pitches less than 15 degrees' (later in this section)		
Greater than 1 in 4 (15°)	150	250
Walls	100	200

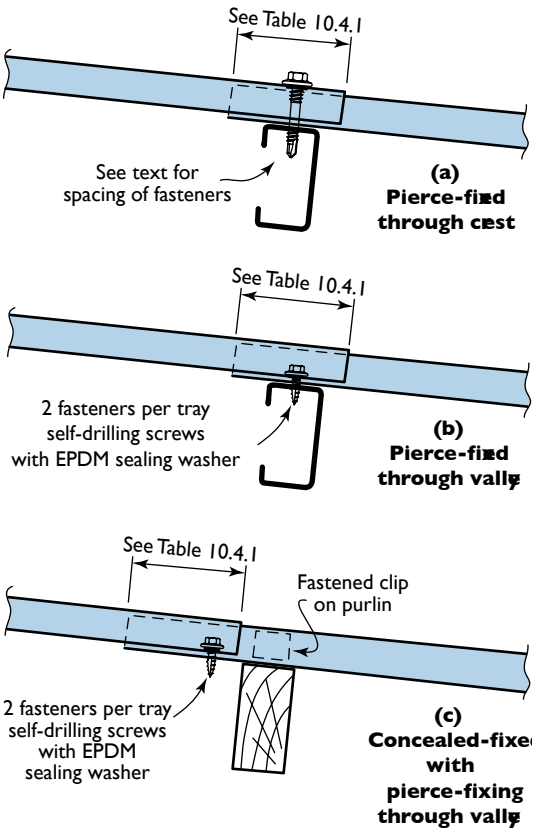


Figure 10.4.1
Fixing at end laps

Fixing methods for end laps

There are three methods of fixing cladding at end laps.

- **Pierce-fixed through crests:**

Position the lap centrally over the support; and the fastening secures both the lap and the cladding. Space the fasteners as for an end span (layout in Figure 10.4.1.a, terminology and spacing in Table 2.3.1). The thermal expansion is away from the fastener and towards the outer ends of the sheet run.

- **Pierce-fixed through valleys:**

Position the lap centrally on the support, and the fastening secures both the lap and the cladding (Figure 10.4.1.b). The thermal expansion is away from the fastener and towards the outer ends of the sheet run.

- **Concealed-fixed sheets:**

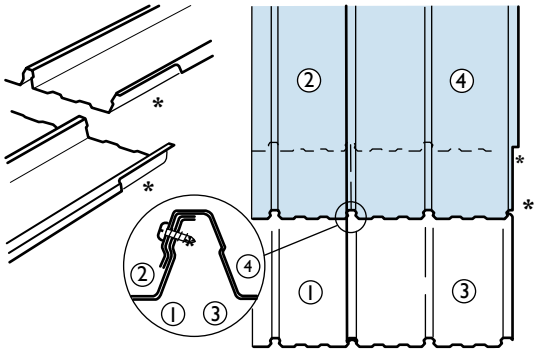
You can either pierce-fix through the crests or the valleys (Figures 10.4.1.a and 10.4.1.b), or use clips near the lap (Figure 10.4.1.c).

KLIP-LOK 406 sheets deform at the clips so that sheets won't nest together. If you use clips, the lap is placed just clear of and on the high side of the clip (Figure 10.4.1.c). The lap is secured with pierce-fixing through the valleys. The clips allow the sheets to slip when they expand with heat.

To make the end-lapping of KLIP-LOK 406 easier: remove, for the length of the lap, the down-turn of the underlapping ribs of the top and bottom sheets in each sheet run (Figure 10.4.2). The cut-back ribs are covered by the sheets of the next sheet run.

LONGLINE 305 can be fixed using any of the three methods.
The underlapping ribs have to be slightly squashed at the lap to allow them to nest. An end-lap tool is available.

KLIP-LOK 700HS should not be end lapped. Instead, an expansion joint must be used. (Refer to Section 10.5 below.) Ideally long length sheets from a mobile rollformer should be used where possible as this eliminates the need for joining.



* Downturn of male rib removed for length of lap

Figure 10.4.2
Remove down-turn of male rib when end-lapping KLIP-LOK 406

Order of laying
For profiles other than LONGLINE 305, lay each run of sheets in turn from bottom to top before moving on to the next run. For LONGLINE 305, lay all lower run of sheets first, then lay the upper sheets (Figure 10.4.3).

Spacing of supports at end-laps
For the maximum spacing between purlins, either side of an end lap in a roof, use the spacing given for end spans (terminology and spacing in Table 2.3.1).

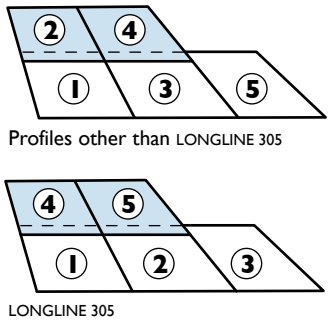


Figure 10.4.3
Laying sequence for end-lapped sheets

End laps in pitches less than 15 degrees
End laps in roofs of less than 1 in 4 (15°) slope should be sealed with a sealant.

Use two runs of sealant (Figure 10.4.4):

- one run of sealant at the low end of the lap (to prevent moisture being drawn in by capillary action);
- the other run at the high end (to prevent condensation from running down the underside of the top sheet and entering the lap).

When the sheets are lapped together and fixed, the compressed sealant should just appear at the end of the lap.

1. With the top sheet upside down, extrude a 3mm bead of sealant across the underside of this sheet about 25mm from the end.
2. Position the bottom sheet, then extrude a 3mm bead of sealant across the top of the sheet to encapsulate the cut end of the underlapping sheet.
3. Turn the top sheet over and fit it in place.

The side-lap between sheets of roofing has a cavity to prevent capillary action between adjacent sheet runs (Section 8.2).
It is important that excess sealant extruded from an end-lap does not enter this cavity because, if it does, moisture that may have entered the side lap will not be able to drain unimpeded down the roof slope.

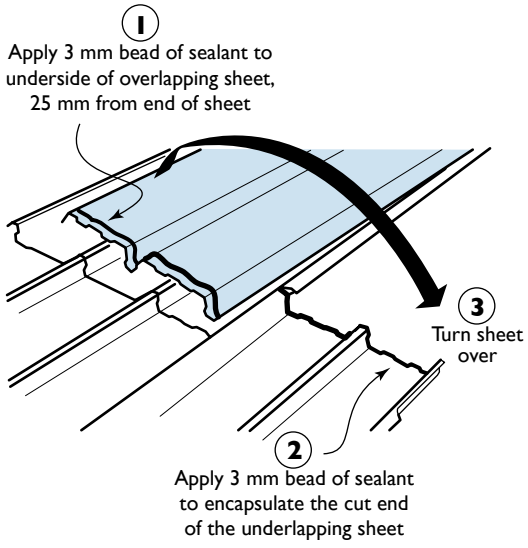


Figure 10.4.4
Sealing end-laps on very low pitched roofs

10.5 Expansion

Background on thermal expansion

All metals expand and contract with changes in temperature. Although steel is by far the least affected of all the metals commonly used for roof and wall cladding, the changes in length experienced in very long runs of roofing are significant.

On a clear hot summer day, with no wind, the steel temperature in roof cladding can reach approximately 50°C in COLORBOND® SURFMIST®, 60°C in plain ZINCALUME® and more than 80°C in COLORBOND® NIGHT SKY®.

Examples of the thermal changes in lengths of steel cladding that would result from various temperature changes in the steel are shown in Table 10.5.1.

The actual expansion or contraction between the end of a sheet and the last support would only be a fraction of the figures shown because the movement in the length of fixed cladding would normally take place from the centre towards each end of the sheet. The movement at each end is thus only half the total expansion or contraction.

Transverse thermal expansion poses no problems in ribbed cladding because each rib absorbs some transverse movement.

Expansion joints

Thermal expansion effects are mitigated by slight bending of fastener shanks, thermal movement of the building structure, and slight flexing of the purlins (where they are not restrained by cleats or bridging). However, for very long runs of roofing, you should include an expansion joint to overcome linear thermal expansion.

Table 10.5.2 shows the maximum distance between the top and bottom rows of fasteners on a sheet. If the total length of two sheets pierce-fixed through the lap, or a single sheet exceeds this distance, then an expansion joint is needed. There should be no more than one pierce-fixed end-lap between expansion joints.

An expansion joint involves overlapping the ends of the upper sheets over the ends of the lower sheets—but with a clearance between them (about 15mm). A typical overlap is 250mm (this overlap is not the same as the overhang in Table 2.3.1 which does not apply to expansion joints). The clearance is usually created by having all the purlins for the roofing on the high side of the joint, higher than the roofing on the low side of the joint. An extra purlin is needed at the joint. A baffle flashing provides weatherproofing. See Figure 10.5.1.

Where there is a risk of high winds, or the ribs are big, you may need extra flashing, including closed-cell foam plastic infill strips.

Table 10.5.1
Thermal expansion and contraction of steel cladding

Sheet length (mm)	Expansion or contraction (mm)		
	10 C° change	50 C° change	75 C° change
5000	0.6	3	4.5
10000	1.2	6	9
15000	1.8	9	13.5
20000	2.4	12	18
25000	3	15	22.5
30000	3.6	18	27

Table 10.5.2
Maximum distance between top & bottom rows of fasteners on a sheet, before expansion joint is needed

Fixing system	Maximum distance between top and bottom rows of fasteners (m)
Pierce-fixed through crests	24
Walling pierce-fixed in valleys	15

10.6 Roof overhang with edge stiffener

For the stiffened overhangs listed in Table 2.3.1, you need to stiffen the gutter ends of the roofing.

Our SHEERLINE gutter, fixed through the return lip to the underside of roofing at 200mm centres will provide the required stiffening.

Alternatively, you can use a 50 x 50 x 1.2mm steel angle fixed at 200mm centres to the underside of the roofing about 50mm from the end.

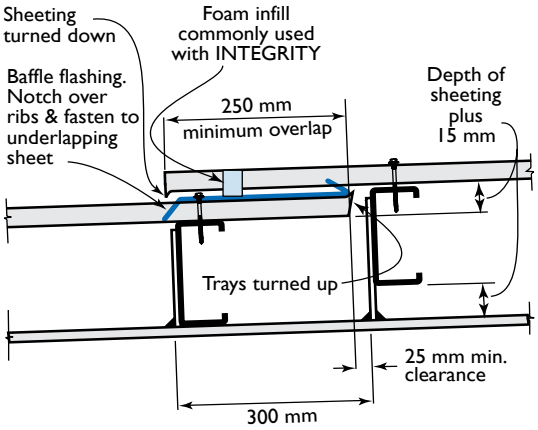
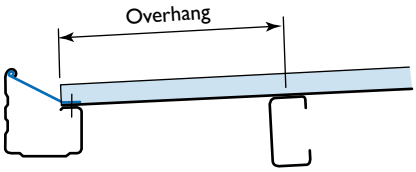
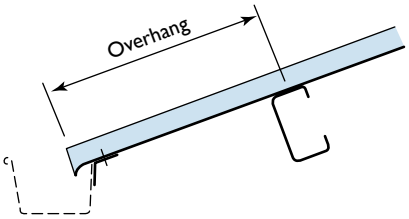


Figure 10.5.1
Expansion joint detail



Sheerline gutter fixed to underside of roofing (200 mm centres)



Steel angle 50 x 50 x 1.2 mm fixed to underside of roofing (200 mm centres). Gutter may be fixed to angle.

Figure 10.6.1
Methods of stiffening roof overhangs

Flashings provide the essential weatherproofing at the edges, and they sharpen the image of the finished job.

11

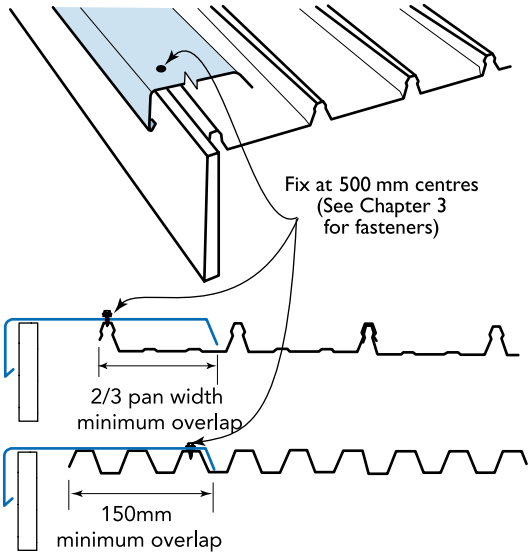
Flashings

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 in the pan immediately adjacent to flashings or translucent sheeting. Walk at least one pan away.

BlueScope Lysaght has a range of standard flashings. We can also supply custom flashings to your requirements – ask your local service centre for details.



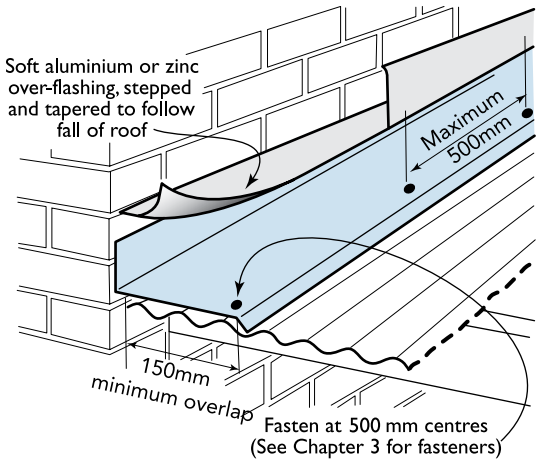


Figure 11.2.1
Typical longitudinal flashings

11.1 Materials

It is very important that flashings be made from materials that are compatible with the cladding (Section 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 2179.1:1994, and be compatible with the cladding (Section 2.10).

Materials for flashings are available in ZINCALUME® or COLORBOND® finishes.

11.2 Longitudinal flashings

Longitudinal flashings run parallel to the pans or valleys, and are made to suit the cladding profile (Figure-11.2.1). They should have an edge turned-down to dip into the pan or valley.

Flashing Cover

The minimum recommended cover of longitudinal flashings over cladding

Pierce fixed roof sheet	150mm min.
Concealed fixed roof sheet	Into full pan (2/3 pan covered)

(as taken from HB39-1997) should be as follows:

11.3 Transverse flashings

Transverse flashings run across the pans or valleys (Figure 11.3.1). They usually have a stiffening lip, along the lower edge, which is turned-down to dip into the pan or valley. To maximise weather proofing, the bent lip is fashioned to fit the profile.

The turn-down for transverse flashings for CUSTOM ORB and CUSTOM BLUE ORB 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.

Flashing Cover

LYSAGHT produces a range of standard flashings (hip, barge, apron). To increase weathertightness, BlueScope Lysaght recommends you maximise the overlap between flashings and claddings.

Fixing of Flashings

Transverse flashings shall be fastened in accordance with HB39-1997, as detailed below.

Profile	Recommended Fixing Spacing
CUSTOM ORB/CUSTOM BLUE ORB	Every 4th rib
INTEGRITY 820	Every rib
KLIP-LOK 406	Every rib
KLIP-LOK 700 HIGH STRENGTH	Every rib
KLIP-LOK MAXIMA	Every rib
LONGLINE 305	Every rib
SPANDEK	Every 3rd rib
TRIMDEK	Every rib

The above fastener spacing relates to the stitching of flashings to sheeting. It does not constitute the minimum number of fasteners required to fix the sheeting to purlins.

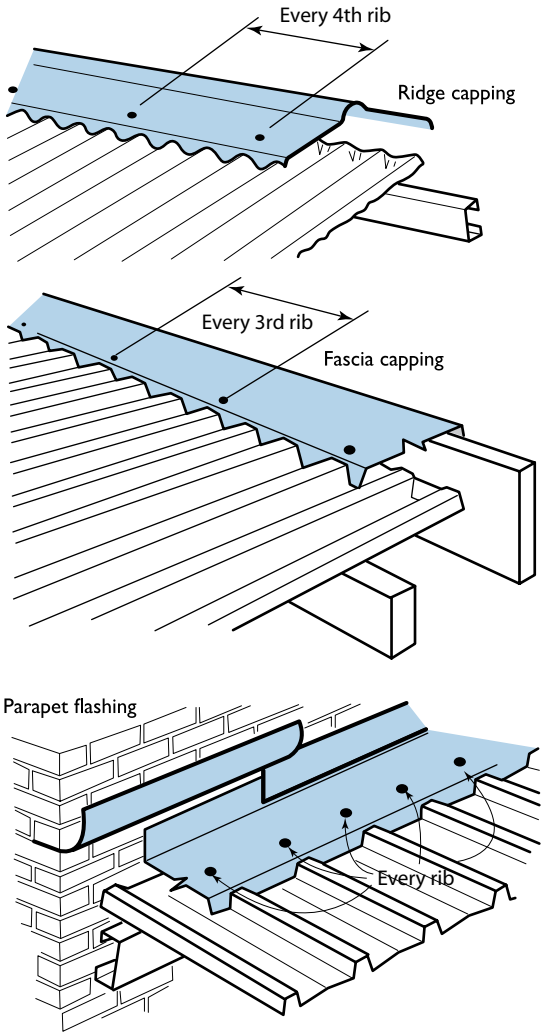


Figure 11.3.1
Typical transverse flashings

Notching tools

Hand-operated notching tools cut one notch at a time. Each tool matches only one cladding profile. There are two types of tool; their use depends on whether or not the edge of the flashing has first been bent down (Figure 11.3.2).

Table 11.3.1
Notching tools

Type of tool	Edge turned down before notching	Available for
Horizontal notching tools	**No**	Availablity subject to inquiry
Vertical notching tools (also called speed notchers)	**Yes**	KLIP-LOK, KLIP-LOK 700HS, SPANDEK, TRIMDEK, INTEGRITY, LONGLINE 305, CUSTOM ORB, CUSTOM BLUE ORB

Using notching tools

After the cladding is fixed and the turn-ups finished, proceed as follows.

- Place a flashing with the notch-edge resting on the ribs.
- Locate your notching tool over a rib with the notching head against the flashing.

  VERTICAL TOOL: The body locates along the rib.

  HORIZONTAL TOOL: the lugs on the underside locates on top of the rib.
- Raise the handle to open the tool and:

  VERTICAL TOOL: lift the flashing into the mouth of the tool;

  HORIZONTAL TOOL: slide the mouth of the tool over the edge of the flashing as far as it will go.
- Push down on the handle to perform the notching.
- Repeat for all ribs, checking in each case that the flashing is correctly positioned.
- If you are using a horizontal tool, bend down the tongues between the notches over a suitable straight edge (such as a piece of timber).

Notching with tinsnips

If notching tools are not available, flashings can be notched to the rib profile with tinsnips (Figure 11.3.3). 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.

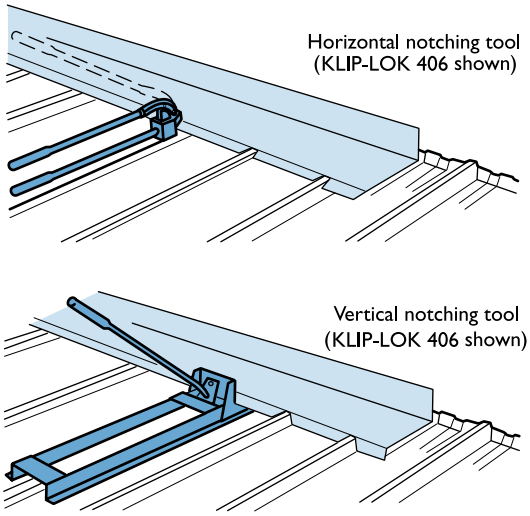


Figure 11.3.2
Using notching tools

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.

Table 3.8.1 shows the fasteners and their locations for the ends of sheets (Figure 11.3.1).

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.

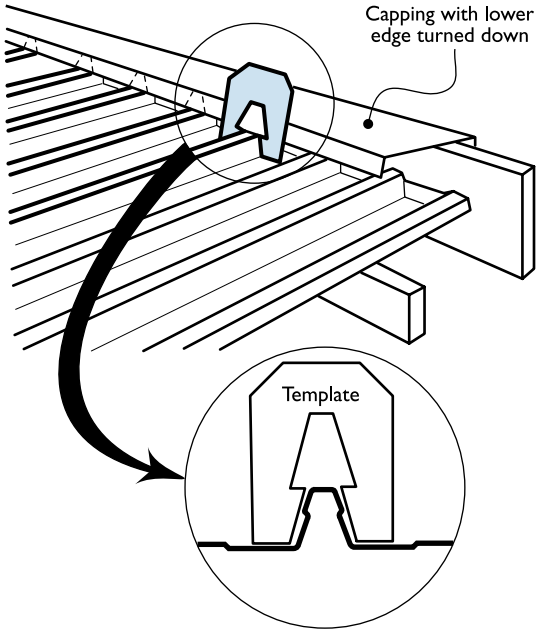


Figure 11.3.3
Using a template to mark out for notching with tinsnips

11.4 Flashing at change of pitch

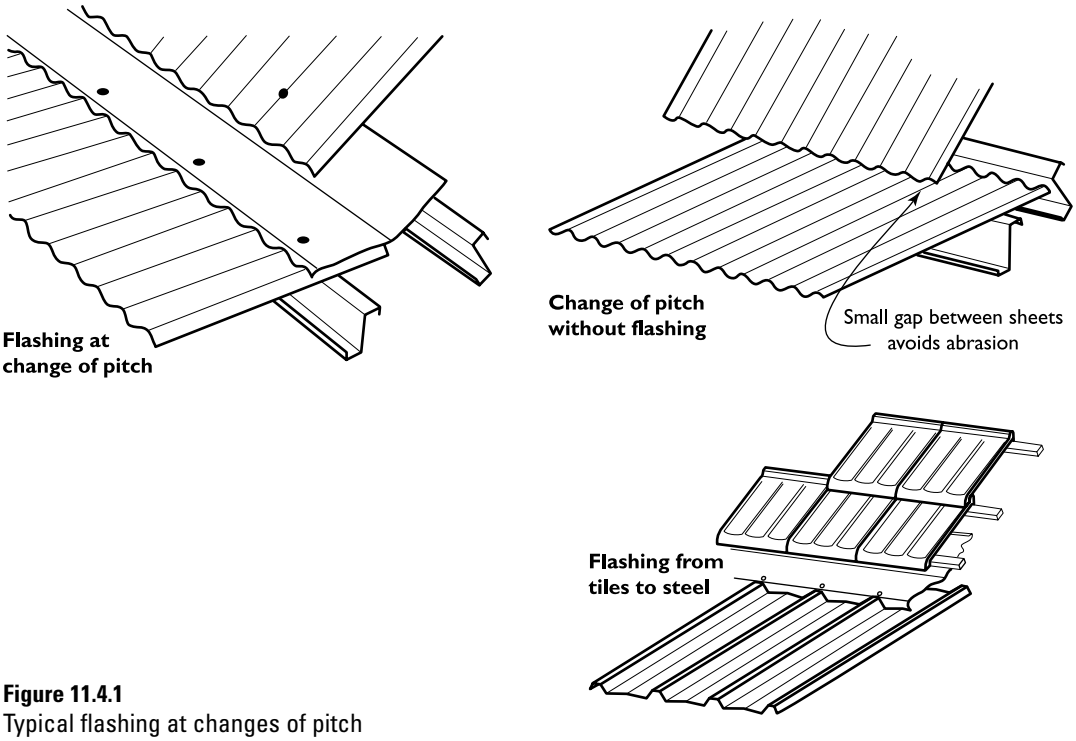


Figure 11.4.1
Typical flashing at changes of pitch

11.5 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.

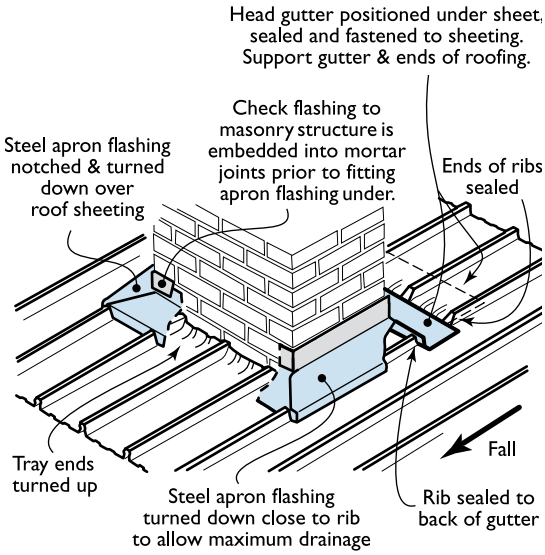


Figure 11.5.1
Flashing method 1: Head gutter

Support framing

Wherever one or more of the sheet ribs are cut, 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 (Section 11.1).

Method 1: Head gutter and apron flashings

This is often the simplest method, and commonly used for existing protrusions (Figure 11.5.1).

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.

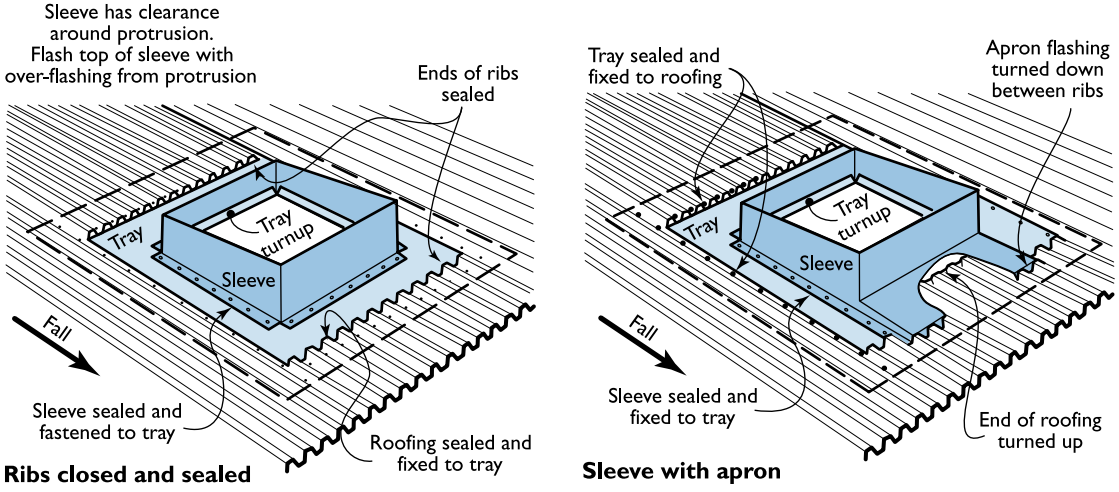


Figure 11.5.2
Flashing method 2: Flat tray and sleeve

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 11.5.3).

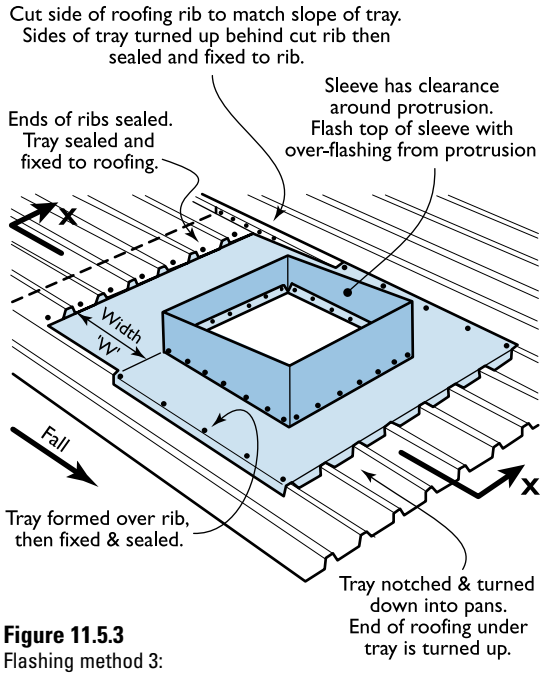
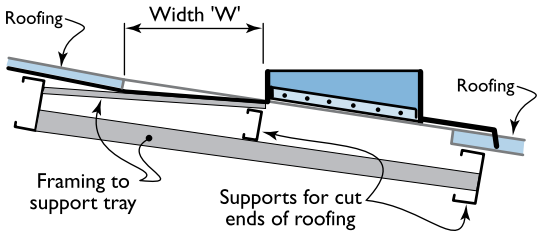


Figure 11.5.3
Flashing method 3:
Tray gutter for steeper roofs



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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
29 mm	420 mm
41 mm	590 mm

Method 4: Penetration close to ridge capping

If a roof penetration is close to a ridge capping (or flashing above the penetration), you can fit a simple flat tray, on top of the roofing, so that it extends from under the capping down to a sleeve around the penetration.

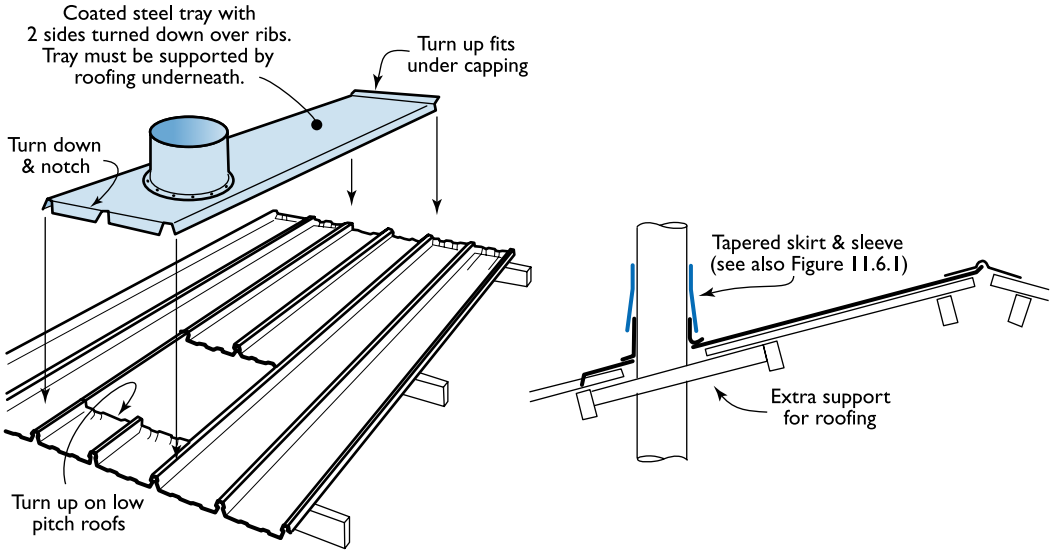
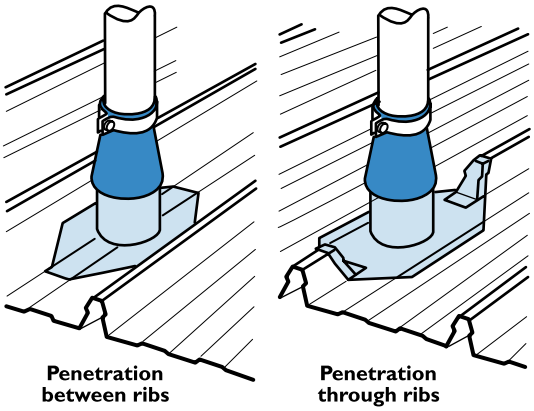


Figure 11.5.4
Penetrations close to ridge capping



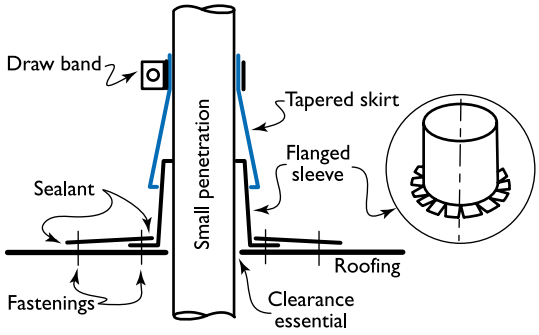


Figure 11.6.1
Small penetration with metal skirt and sleeve

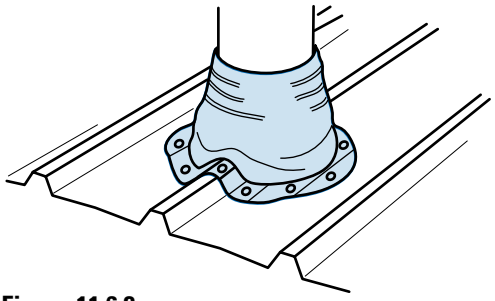


Figure 11.6.2
Small penetration with sleeve

11.6 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.

Three methods are described here. Wherever roofing is cut, you must consider providing extra support for the roofing above and below the penetration.

Method 1: Tapered metal skirt and sleeve

This method uses parts custom-fabricated from metal. There is no positive seal between inside the building and the outside atmosphere (Figure 11.6.1).

Method 2: Sleeve

This is often the simplest method (Figure 11.6.2). Flexible flanged sleeves can be bought for flashing around penetrations of at least 350mm diameter. They overcome the problem of capping and sealing the open ends of cut ribs. A sleeve is commonly used, though silicone sealant has a wider operating temperature range and is available in a wider range of colours.

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. Moisture held in such areas can cause deterioration of the sheet coating, reduced life expectancy or poor appearance.

Where damming of any valley or tray is unavoidable, due to the size of the pipe penetration, treat the installation as a large penetration (Section 11.5).

Copper penetrations

All copper pipe penetrations through ZINCALUME® or COLORBOND® cladding must be physically and electrically isolated from the cladding. This can be done by using a sleeve of PVC polythene or similar plastic that is also ultra-violet stable.

11.7 Flashing walls

Cladding is usually installed with the profile running vertically or horizontally, though sheets have been laid diagonally—the choice is aesthetic.

Wind can drive rain hard against wall flashings, so it is important that you pay attention to the detailing of flashings around windows, doors, re-entrant and external corners, to ensure you get a watertight building. You also want a neat appearance.

We make wall flashings for some wall claddings (like EASYCLAD and MINI ORB) which are sometimes called trims. Where these are not suitable, custom-made flashings can be easily produced following the general principles described in this section.

Walling profile running horizontally

- It is usual to lay the first sheet at the bottom of a wall and work upwards towards the eaves. You want the window and door flashings to fit properly into the valleys, so you should locate the first sheet relative to the heads and sills of doors and windows. Thus, you first have to decide where the cladding will eventually be located at the heads of doorways and at the heads and sills of windows before you place the first sheet.
- Where possible, select the vertical size of windows so that the flashings at both heads and sills will coincide neatly with the pitch of your profile (Figure 11.7.1).
- Be sure that the crests of the profile align with each other on adjacent walls, either side of a corner—this ensures that horizontal flashings fit properly into all valleys.
- Where valleys create a void at flashings, use closed-cell foam plastic infill (Figure 10.3.3).
- Where wind-driven rain can be expected, turn back the edges of flashing to restrict water movement past the flashing.

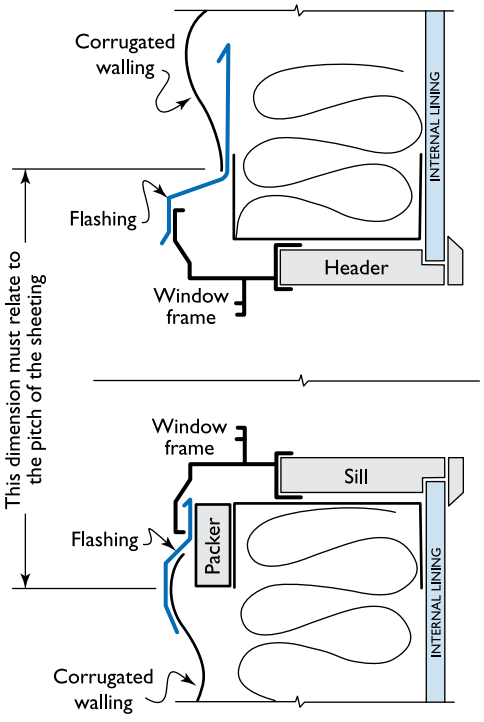
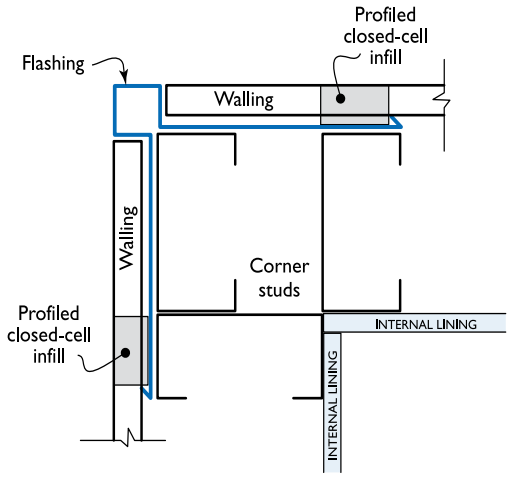
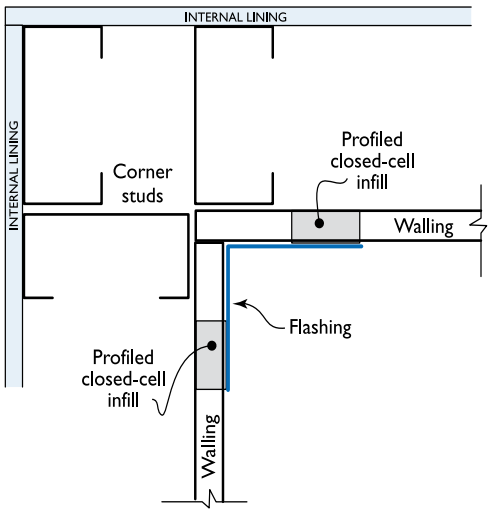


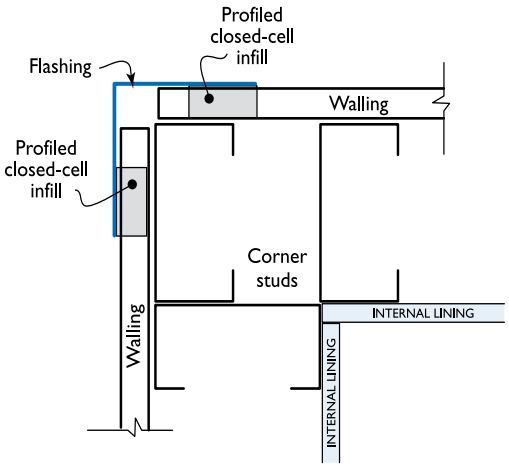
Figure 11.7.1
Typical header and sill flashing: profile running horizontally (elevation)



Typical external corner flashing type 1: profile running horizontally (plan)

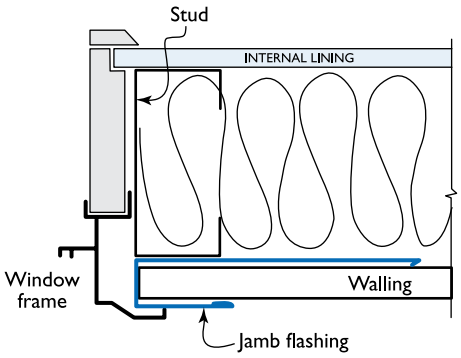


Typical re-entrant corner flashing: profile running horizontally (plan)

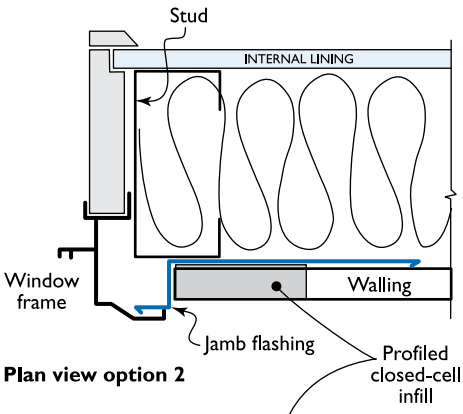


Typical external corner flashing type 2: profile running horizontally (plan)

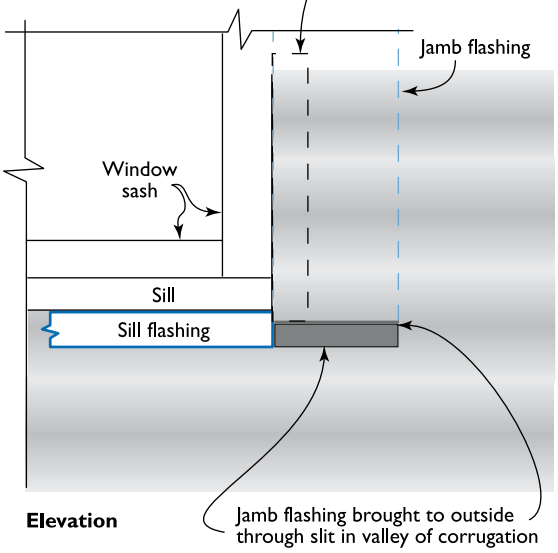
Figure 11.7.2
Typical corner flashings: profile running horizontally (plan view)



Plan view option 1



Plan view option 2



Elevation

Figure 11.7.3
Typical flashing at window and door jambs: profile running horizontally

Walling profile running vertically

Flashings are generally easier on jobs where the profile runs vertically (Figures 11.7.4 and 11.7.5).

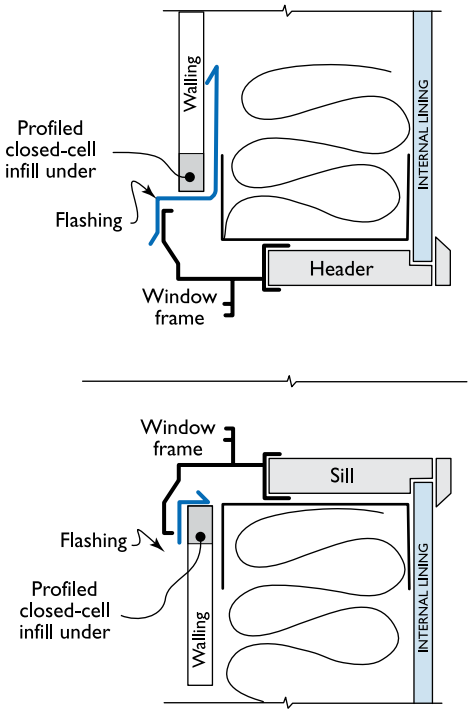


Figure 11.7.4
Typical header and sill flashing: profile running vertically (elevation).

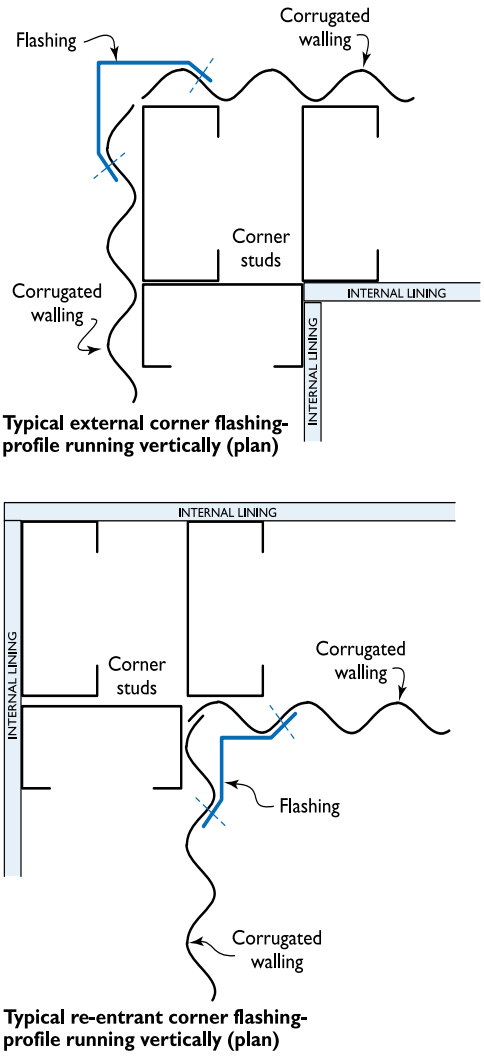


Figure 11.7.5
Typical corner flashings: profile running vertically (plan). Jamb flashings follow same principle.

11.8 Bushfire protection

AS-3959—1999 sets out requirements for the design and construction of buildings in bushfire-prone areas. It calls for flashings to be bedded on fire resistant insulation material.

Be sure that flashings fit closely. Transverse flashings should be notched or scribed (Figures 11.3.1 and 11.8.1)

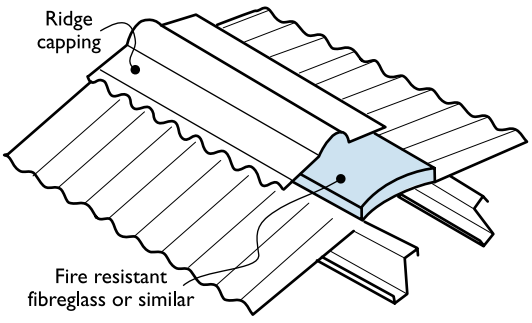


Figure 11.8.1
Typical protection from sparks at ridge

References

Australian standards

AS 1170.1—2002 SAA Loading Code: Dead and live loads and load combinations

AS 1170.2—2002 SAA Loading Code: Wind loads

AS 1170.3—2002 SAA Loading Code: Snow loads (and the Supplement)

AS 1170.4—2002 SAA Loading Code: Earthquake loads (and the Supplement)

AS 1397—2001 Steel sheet and strip—Hot-dipped zinc-coated or aluminium/zinc-coated

AS 1562.1—1992 Design and installation of sheet roof and wall cladding: Metal

AS/NZS 2179.1:1994 Specification for rainwater goods, accessories and fasteners: Metal shape or sheet rainwater goods, and metal accessories and fasteners

AS 2334—1980 Steel nails—Metric series

AS 2627.1—1993 Thermal insulation of dwellings

AS/NZS 2728: 1997 Prefinished/prepainted sheet metal products for interior/exterior building applications—Performance requirements

AS 3500.3—1990 National plumbing and drainage code—Part 3: Stormwater drainage

AS 3566.1-2002 Self-drilling screws for the building and construction industries - General requirements and mechanical properties

AS 3959—1999 Construction of buildings in bushfire-prone areas

AS 4040.1—1992 Methods of testing sheet roof and wall cladding—Resistance to concentrated loads

AS 4040.2—1992 Resistance to wind pressures for non-cyclone regions

AS 4055—1992 Wind loads for housing

AS/NZS 4256—1994 Glass fibre reinforced polyester

SAA HB39—1997 Installation code for metal roof and wall cladding

SAA HB106—1998 Guidelines for the design of structures in snow areas.

BlueScope Lysaght

Amongst the publications of BlueScope Lysaght, the following are particularly appropriate.

Technical bulletins (General)

TB-1 Steel roofing and walling products: Selection guide

TB-2 Overpainting and restoration of COLORBOND® prepainted steel sheet

TB-4 Maintenance of COLORBOND® prepainted steel roofing

TB-5 Swarf staining of steel roofing and walling profiles

TB-8 Flashing materials for ZINCALUME® & COLORBOND® steel sheet

TB-13 General guide to good practice in the use of steel roofing and walling products

TB-15 Recommended steel gutter systems

TB-16 Fasteners for roofing and walling product: Selection guide

TB-17 Selection guide for galvanised steel purlin products

Technical bulletins (Corrosion)

CTB-1 General introduction

CTB-8 Building applications

CTB-10 Roof penetrations

CTB-11 Condensation

CTB-12 Dissimilar metals

CTB-13 Contact with timber

CTB-15 Acid cleaning brickwork

CTB-16 Immersion

CTB-17 Following trades

CTB-18 Painting lead flashing

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