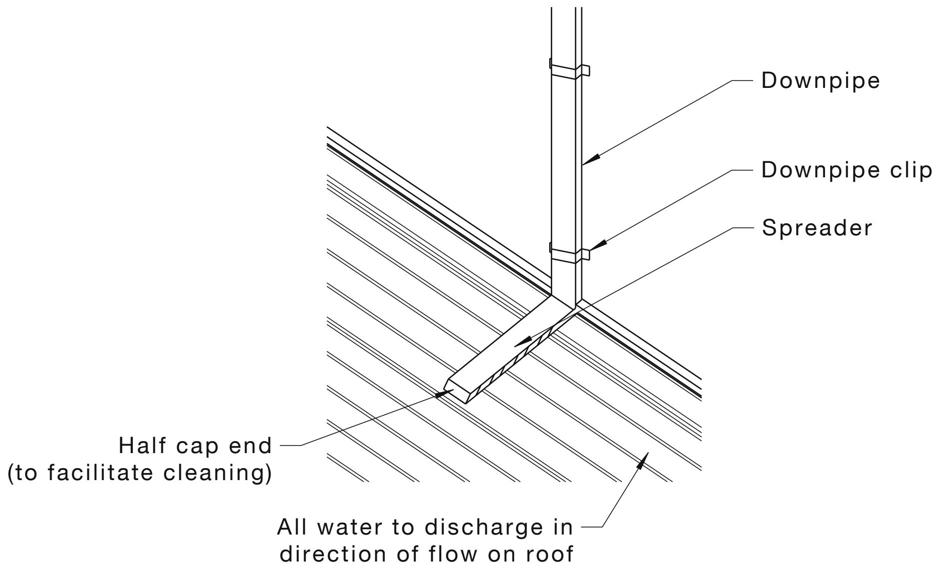


FIGURE 5.7.7 SPREADERS

5.8 JOINTING METHODS FOR OTHER THAN ALUMINIUM

5.8.1 General

Soldered or silicone-sealed joints are to be flush and lapped 25 mm in the direction of the fall, with one row of rivets or other approved type fastenings at spacings not exceeding 40 mm. This applies to all joints in flashings, cappings, eaves, gutters, box gutters, soakers, penetrations and all general sheet metal joints in roof plumbing.

5.8.2 Soldered joints

5.8.2.1 *Preparation of joint surfaces*

The surface area to be jointed is to be clean and free from oils, grease and rust.

5.8.2.2 *Fluxing for soldering*

Immediately after being cleaned, the surfaces to be jointed are to be prepared with the appropriate flux as set out in Table 5.8.

NOTE: For health and safety reasons, care should be taken during any soldering operation.

TABLE 5.8

SUITABILITY OF FLUXES

Material to be joined	Type of flux
Zinc-coated steel	Zinc chloride or diluted hydrochloric acid —3 parts water (muriatic acid)
Copper	Zinc chloride (killed spirits)
Stainless steel	Phosphoric acid
Zinc	Zinc chloride (killed spirits)
Lead	Candle wax

NOTE: Aluminium/zinc and aluminium/zinc/magnesium alloy-coated steel cannot be soldered.

5.8.2.3 *Soft soldering*

Joints in zinc-coated steel, copper, stainless steel and sheet lead flashings and cappings are to be fastened at intervals not exceeding 40 mm and sweat-soldered with 50/50 lead/tin solders.

NOTE: For improved appearance, joints in stainless steel may be soldered with 60/40 or 80/20 solders.

5.8.2.4 *Cleaning joints after soldering*

Flux-affected areas are to be thoroughly cleaned with a clean wet cloth to remove all traces of flux. Damaged zinc coating is to be coated with heavy-duty zinc paint.

5.8.3 Fastening and sealing with sealants

Joints in aluminium/zinc, aluminium/zinc/magnesium alloy-coated steel, prepainted steel flashings and cappings are to be fastened at intervals not exceeding 40 mm and silicone sealed with neutral cure silicone sealants.

Sealants are to be sandwiched between the laps of the joint to provide a positive seal and to protect the silicone sealant from exposure to ultraviolet radiation (see Figure 2.9).

5.8.4 Fastening and sealing with rivets for steel sheets

Rivets are to be of plugged or waterproof aluminium alloy or zinc-coated steel sealed over with solder or neutral curing silicone sealant. While steel rivets need to be soldered over, this is not necessary if the waterproof aluminium rivets are located so they pass through wet silicone rubber sealant.

5.8.5 Fastening and sealing with rivets for stainless steel

Rivets are to be of stainless steel or Monel sealed with solder or neutral curing silicone sealants.

5.8.6 Fastening with spot welds

Rivets may be substituted with spot welds.

5.8.7 Fastening and sealing with welded joints

Joints in aluminium, stainless steel and copper may be welded using the tungsten-inert gas welding process, provided the thickness of the metals permits such welding. After welding, the joint and gutter profile is to not be deformed.

5.8.8 Fastening with aluminium and zinc-alloy diecasts

Rainwater goods, including internal and external angle joints, stop-ends, joiners and outlets may be jointed with aluminium castings or zinc alloy pressure diecast accessories provided such fittings are installed to comply with manufacturer’s instructions.

5.8.9 Sealing PVC downpipes

For best practice, the PVC downpipes are to be sealed as follows:

(a) Cut pipe ends square, and clean both spigot and sockets with cleaning fluid.

(b) Coat both spigot and socket with solvent cement.

(c) After joining, keep the joint immobile until solvent cement sets.

(d) Remove excess solvent cement.

5.8.10 Performance of joints

On completion of the installation, all joints are to be watertight and not prohibit water flow.

5.9 JOINTING METHODS FOR ALUMINIUM RAINWATER GOODS AND ACCESSORIES

5.9.1 Mechanically fastened lap joints

Silicone sealed joints are to be flush and lapped 25 mm in the direction of the fall, with one row of rivets at spacings not exceeding 40 mm. Fasteners are to be rivets or bolts in aluminium alloys or 300 series stainless steel. All joints are to be made watertight with neutral cure silicone sealants.

5.9.2 Brazed joints

Brazed joints are to have a minimum lap and be brazed with aluminium/silicon alloy filler containing 10% to 13% silicon. After brazing, all traces of flux are to be removed by washing with water to prevent subsequent corrosion of the joint by residual flux.

NOTE: Lower melting point silicon aluminium brazing alloys containing copper cannot be used for brazing aluminium.

5.9.3 Soldered joints

The use of soldered joints for joining aluminium rainwater goods in the presence of moisture is to be avoided, as both soft and hard solders will suffer corrosion at the joint.

5.9.4 Welded joints

Welded joints are to be either GMAW (MIG) or GTAW (TIG) type in accordance with AS/NZS 1665 and all assemblies shop fabricated. The use of field welding is to be avoided, unless the joints are fully protected from air movement and moisture. After welding, the joint and gutter profile is to not be deformed.

5.9.5 Jointing with aluminium and zinc-alloy castings

Rainwater goods, including internal and external angle joints, stop-ends, joiners and outlets may be joined with aluminium castings or zinc alloy pressure diecast accessories provided such fittings are installed to comply with manufacturer's instructions.

5.10 FIXING AND JOINING ROOF FLASHINGS AND CAPPINGS

As aluminium expands twice as much as steel for the same temperature change, greater attention is to be given to the correct procedure for the installation and provision for thermal movement of aluminium roof flashings and cappings. For this reason, the relevant manufacturer's technical literature is to be referred to for details as to method of fixing roof flashings and cappings, length of lap and how to provide for thermal movement associated with the particular roofing profile to be installed. Standard practices for installing steel roof flashings are not to be used for aluminium roof flashings.

5.11 RAINFALL INTENSITIES

5.11.1 General

Consideration of rainfall intensities is very important to ensure that the installed roof is designed to prevent the ingress of rainwater into the building.

The greater the intensity of rainfall in a given period of time, the more it is essential that the roof system (including rainwater goods) has a greater capacity to convey the rain into the stormwater system (which in some cases means to ground).

Precautions are to be taken to prevent the accumulation of debris and, if hail is common, from hailstones impeding the flow of rainwater.

5.11.2 Average recurrence interval (ARI)

The appropriate recurrence intervals are as follows:

(a) For external eaves gutters .... 20 ari.

(b) For external eaves gutter overflow provision.. 100 ari.

(c) For internal gutters .... 100 ari.

(d) For internal eaves gutter overflow provision .... 100 ari.

SECTION 6 THERMAL AND CONDENSATION CONTROL

6.1 SCOPE OF SECTION

This Section provides guidance on the various methods of insulating metal roofs, including assessing the amount of insulation required and controlling condensation.

6.2 INSULATION OF STEEL ROOFING

Steel roofing systems are used for a wide range of building types, as follows:

(a) Houses.

(b) Supermarkets.

(c) Factories and warehouses.

(d) Offices.

(e) Farm buildings including buildings for animals and birds.

In each case, details of the roof systems should be determined to provide adequate performance in respect of energy conservation and condensation of atmospheric moisture.

Insulation is essential to reduce fuel bills, control condensation, retard heat flow and reduce unwanted noise created by rain and expansion and contraction of the roof.

Rain noise is particularly noticeable with metal roofing and it is strongly recommended that blanket insulation be pressed up tightly against the underside of the sheeting to minimise noise caused by rain and hail. This then serves the dual requirements of thermal insulation and sound reduction.

Every new metal roof construction should have an insulation blanket with an appropriate R-value and a suitable vapour barrier incorporated in the original design. (It is difficult and expensive to insulate a flat or raked roof area after construction.)

6.3 CONDENSATION

The roof is the most exposed element of the building fabric. Overnight its temperature often drops below the outdoor air temperature as it loses heat via radiation to the cold night sky. The cold roof combined with the vast amount of moisture generated at times within homes makes condensation within roofs likely. While it is good practice to minimise the risk of condensation, significant problems will usually only eventuate if condensation is persistent or becomes trapped. The risk of persistent condensation in roofs is greatest in the coolest climate zones (NCC climate zones 7 and 8) although persistent condensation can also eventuate in all climate zones when high internal moisture levels are not controlled. [Reference: ABCB handbook, *Condensation in Buildings Handbook*].

The underside of metal deck roofs provide conditions under which condensation of water vapour can occur. Insulation, such as sarking, reflective foil or blanket and foil placed beneath the sheeting are of value in reducing the likelihood of condensation forming and potentially dripping from under roof sheeting. When blanket insulation is placed beneath a metal deck roof it should incorporate foil or similar to provide a vapour barrier underneath the blanket insulation to prevent moisture from inside the building penetrating and wetting the blanket insulation.

It is commonly thought that condensation under metal roofing can be eliminated by liberal ventilation of the roof space. Whilst this can help any condensation to dry quickly avoiding persistent condensation, it will not eliminate condensation that may form from time to time on clear still nights. In line with the ABCB handbook, *Condensation in Buildings Handbook*, a minimum of sarking or reflective foil laminate is recommended in climates with cold winters (NCC climate zones 4, 7 and 8), noting that blanket and foil will provide greater protection.

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

NOTE: Aluminium roofing for farm buildings may be used without an insulation/moisture barrier, although the buildings benefit from its inclusion both thermally and protection against condensation.

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

NOTES:

1 For further details on condensation in buildings and metal roofs, see ABCB handbook, *Condensation in Buildings Handbook*.

2 The information above may not be applicable to the tropics or homes that are built to meet bushfire requirements. Please refer to the ABCB handbook, *Condensation in Buildings Handbook* for further information.

3 Specialist advice should be sought for buildings that are not constructed in typical environments and or for special purpose buildings, such as where high humidity may exist, e.g. swimming pools or where high levels of environmental control are required, e.g. museum.

6.4 RESISTANCE TO HEAT TRANSFER (R-VALUES)

In selecting the thickness of the insulation blanket to give the necessary resistance to heat flow (R-value) it should be noted that where the blanket will be compressed by the roof sheeting for rain noise reduction, the R-value will be reduced and other devices such as reflective air spaces may need to be added to achieve the necessary R-value for the roof system.

Table 6.4(A) gives the R-value for various roof systems as a guide only. Note that blanket compression has not been taken into account in these examples. The various types of insulation available and their applicability are given in Table 6.4(B). To design a roof system to achieve a specific R-value, refer to the NCC.

TABLE 6.4(A)

THERMAL RESISTANCE (R) OF FLAT AND SLOPING ROOFS FOR DIRECTION OF HEAT FLOW

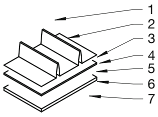
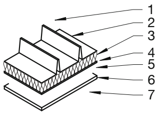
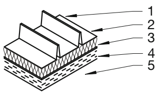
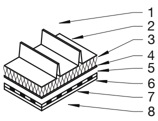
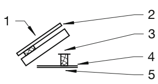
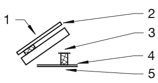
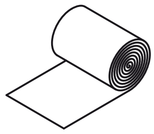
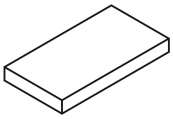
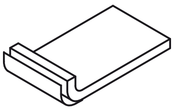
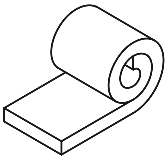
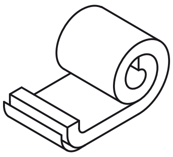
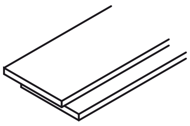
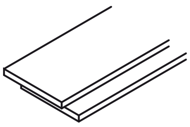
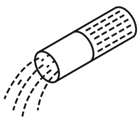
Type	Construction	Component		Thermal resistance (R) $m^2.K/W$ (up winter)	Thermal resistance (R) $m^2.K/W$ (down summer)
		Key	Material		
Metal deck, reflective foil laminate, gypsum plasterboard		1	Outdoor air film	0.03	0.03
		2	Metal deck	0	0
		3	Reflective foil laminate covered with dust	0	0
		4	Airspace, 25 mm	0.30	0.37
		5	Reflective airspace, 100 mm	0.36	1.42
		6	Gypsum plasterboard, 13 mm	0.08	0.08
		7	Indoor air film	0.11	0.16
		Ro	Total thermal resistance	0.88	2.06
Metal deck, bulk insulation, reflective foil laminate, gypsum plasterboard		1	Outdoor air film	0.03	0.03
		2	Metal deck	0	0
		3	Bulk insulation	1.50	1.50
		4	Reflective foil laminate	0	0
		5	Airspace, 25 mm	0.36	1.42
		6	Reflective airspace, 100 mm	0.08	0.08
			Gypsum plasterboard, 13 mm	0	0
		7	Indoor air film	0.11	0.16
		Ro	Total thermal resistance	2.20	3.03
Metal deck, bulk insulation, compressed straw (faced)		1	Outdoor air film	0.03	0.03
		2	Metal deck	0	0
		3	Bulk insulation	1.50	1.50
		4	Compressed straw	0.62	0.62
		5	Indoor air film	0.11	0.16
		Ro	Total thermal resistance	2.26	2.31
Metal deck, bulk insulation, reflective foil laminate, bulk insulation, gypsum plasterboard		1	Outdoor air film	0.03	0.03
		2	Metal deck	0	0
		3	Bulk insulation	1.50	1.50
		4	Reflective foil laminate	0	0
		5	Airspace, 50 mm	0.42	1.00
		6	Glass fibre	1.30	1.30
		7	Gypsum plasterboard	0.08	0.08
		8	Indoor air film	0.11	0.16
		Ro	Total thermal resistance	3.44	4.07
Galvanised iron, softboard		1	Outdoor air film	0.03	0.03
		2	Metal roof	0.00	0.00
		3	Roof space	0.18	0.28
		4	Softboard, 12.7 mm	0.25	0.25
		5	Indoor air film	0.11	0.16
		Ro	Total thermal resistance	0.57	0.72
Aluminium roofing softboard		1	Outdoor air film	0.03	0.03
		2	Metal roof	0.00	0.00
		3	Roof space	0.29	0.37
		4	Softboard, 12.7 mm	0.25	0.25
		5	Indoor air film	0.11	0.16
		Ro	Total thermal resistance	0.68	0.81

TABLE 6.4(B)

INSULATION TYPES AND APPLICABILITY

Types of insulation suitable for application	Application	
	Ceilings pitched roofs	Cathedral ceilings and metal deck roofs
 Reflective foil laminate (RFL)—Rolls	✓	✓
 Fibreglass batts	✓	✓
 Fibreglass batts foil facing	✓	✓
 Fibreglass blankets		✓
 Fibreglass blankets with RFL facing		✓
 Expanded polystyrene (EPS)		✓
 Extruded polystyrene boards		✓
 Loose fill material	✓	✓

SECTION 7 ROOF SHEETING

7.1 TYPICAL PROFILES

7.1.1 General

This Section is not restricted to existing profiles. There are many variations with different fixing methods, and new decks are appearing regularly. Therefore, only the common and typical profiles are considered (see Figure 7.1).

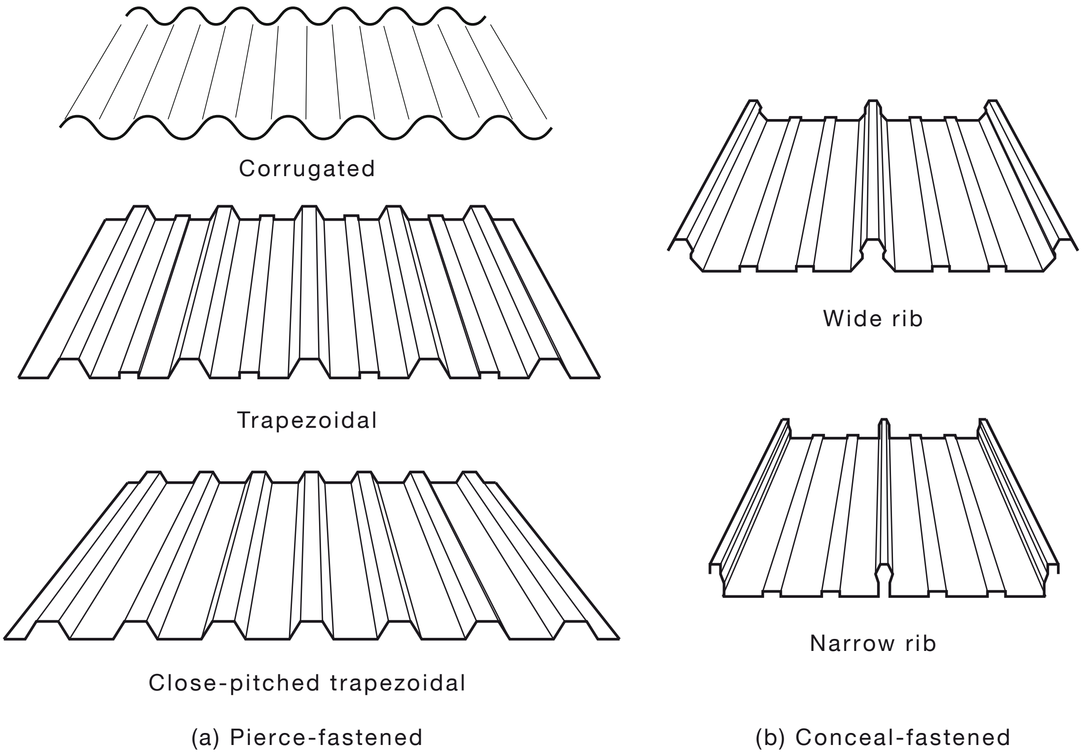


FIGURE 7.1 TYPICAL PROFILES

7.1.2 Insulated roof panels

An insulated panel is any laminated panel that is manufactured from different materials, permanently bonded together so that they act as a single element (see Appendix B for further information).

A typical description of an insulated panel (sandwich panel or composite panel) refers to building cladding panels having metal facings to both surfaces, with an insulation core that completely fills the space between the two facings and is continuously and permanently bonded to both.

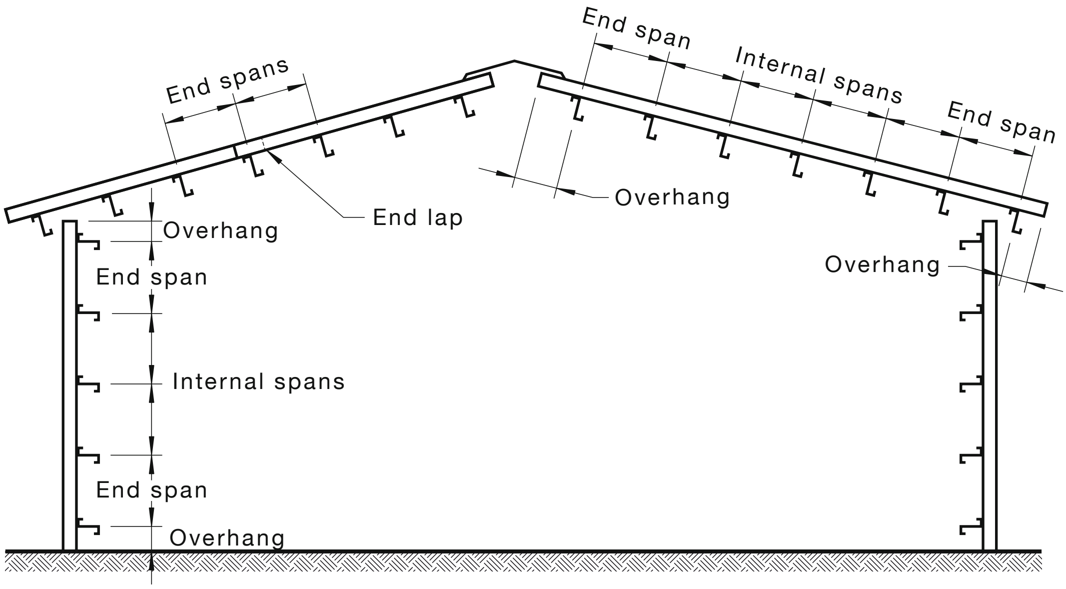
Laying sequences and fixing methods and patterns are sometimes different to traditional built-up roofing systems and the panel manufacturer should be consulted prior to installation.

Practitioners/installers are to refer to manufacturer's specifications when selecting, installing and working safely with these products.

7.2 ROOF SHEET SPAN INFORMATION

The roof sheet support spacing for the various profiles are listed in the typical span information of the manufacturer's product literature. This information varies depending on whether it is an end span, internal span or overhang (see Figure 7.2).

The typical span charts are based on the ability of sheeting to withstand the wind loads specified in AS/NZS 1562.1 and the NCC. All sheeting is to be fixed to each and every roof support unless otherwise approved by a structural engineer.



NOTE: This Figure is reproduced in adapted form with permission from BlueScope Steel Limited trading as BlueScope Lysaght.

FIGURE 7.2 EFFECTIVE SPANS

7.3 WIND FORCES ON ROOFS

Winds create considerable forces on both the upper surface and the underside of a roof cladding system. These forces may take the form of positive pressure or suction (negative pressure) and are to be considered in the overall design and fixing of a roof. Generally, the greatest wind forces imposed on roofs are due to suction, tending to lift the roof cladding from its framing and the entire roof structure from its supports. As the dead weight of roofing materials is relatively small, the suction forces are to be resisted by the roof fastenings.

Before replacing the roof sheeting on an existing structure, it is important to check the condition of the roof framing and fixings. Framing members that are structurally unsound are to be replaced and in, some cases, the existing members or fixings may need to be upgraded to meet local building regulations. The local building regulatory authority will need to be consulted to determine their requirements for this type of work before commencing any work.

7.4 CYCLONE AREAS

7.4.1 Testing requirements

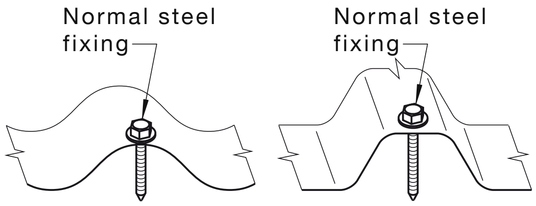
For applications in cyclone areas, the loading or performance capacity of the respective products are to be determined from testing to AS 1562.1.

7.4.2 Installation

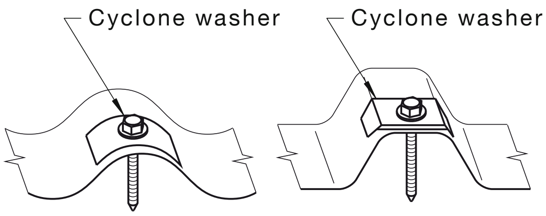
In general, the same products and installation procedures previously detailed for normal conditions are also applicable for cyclonic conditions.

Cyclone washers or caps for pierce-fastened decks are recommended to improve the performance of the sheeting and also give greater allowance for thermal expansion (see Figure 7.4.2).

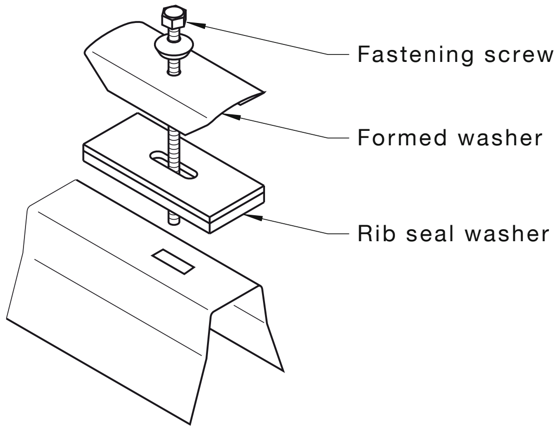
For aluminium pierce-fastened roofing, the fixing screws are to be fitted with a washer system similar to that illustrated in illustration (c) of Figure 7.4.2 for both normal and cyclonic wind regions. For support spacings, the manufacturer’s technical data is to be consulted.



(a) Normal fasteners for steel



(b) Cyclone fasteners for steel



(c) Normal and cyclone fasteners for aluminium

FIGURE 7.4.2 FIXING DETAILS

7.5 STANDARDS AND PERFORMANCE TESTS

AS 1562.1 and the NCC specify the performance requirements for a metal roofing system.

These requirements include the ability of the roof to resist wind uplift forces and concentrated loads with an appropriate factor of safety. AS 1562.1 requires that compliance of steel roofing products be checked by stringent proof tests, carried out in accordance with a specified procedure. All specified products are to comply with AS 1562.1 in all respects.

7.6 ROOF SLOPE AND PITCH

The drainage or run-off capacity of roof sheeting is a roof design and construction criteria to be considered in determining the roof slope and total length of a sheet run.

The minimum roof pitch is to be limited to ensure that the depth of water in the roof slopes does not exceed the height of the overlaps.