

Understanding Thermal Expansion & Contraction



WHAT IS THERMAL EXPANSION & CONTRACTION?

Thermal expansion and contraction occurs in all products in response to changes in temperature. Thermal expansion and contraction occurs in all directions, but in roofing and cladding sheets it is most apparent in the longitudinal direction, from the centre of the sheet to the ends.

Compared to other metallic roofing products, such as Aluminium, Zinc or Copper, the Coefficient of Thermal Expansion of steel is significantly less.

Steel is only about half that of Aluminium and Zinc.

Material	Coefficient of Thermal Expansion per °C
PVC	70×10^{-6}
Zinc	26×10^{-6}
Aluminium	24×10^{-6}
Copper	17×10^{-6}
Stainless Steel	17×10^{-6}
Steel: e.g. COLORBOND® and ZINCALUME® steel GALVASPAN® and TRUCORE® steel	12×10^{-6} (= 0.012 mm/m per °C)

The temperature variation experienced on roofing and cladding products depends on the geographical location and orientation, the extent of shading and the absorptivity and surface colour. During summer in most parts of Australia and New Zealand, the temperature of roofing and cladding products exposed to direct sunlight can reach or even exceed 80°C



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The surface colour is a significant factor. Light colours, such as SURFMIST® or unpainted ZINCALUME® steel have much lower absorptivity than dark colours such as MONUMENT®.

In a direct comparison, this can result in a temperature difference of as much as 30°C between the lightest and darkest colours.

To put this into context, consider a typical 10m length roof sheet;

An 80°C temperature change can result in thermal expansion/contraction of some 9.6mm in total, or approximately 4.8mm in each direction, from the centre of the sheet to each end.

For very long runs of roofing, thermal expansion can be significant and therefore thermal expansion and contraction should be taken into account during design and installation.

Steel: Coefficient of Thermal Expansion 0.012 (mm/m per °C)				
Sheet Length (m)	Total sheet length change (mm) for given temperature change			
	10°C	25°C	50°C	Example 80°C
1	0.12	0.3	0.6	0.96
5	0.6	1.5	3	4.8
Example 10	1.2	3.0	6	9.6
15	1.8	4.5	9	14.4
20	2.4	6.0	12	19.2
23.7*	2.8	7.1	14	22.8
25	3.0	7.5	15	24.0
30	3.6	9.0	18	28.8

*Steeline conservatively recommends the maximum length for **LIGHT** coloured pierce fixed roofing sheets (such as Corrugated or Steelclad in Surfsmist®) is 23.7m before an expansion joint is required.

For **MEDIUM** and **DARK** colours, the maximum sheet length should not exceed 20m and 16m respectively, because of the increased Solar Absorptance (SA) and hence the increased thermal expansion and contraction.

For a summary classification of light, medium and dark colours, and their relative Solar Absorptance (SA) refer to the following table:



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Solar Absorptance (SA) Table						
Maximum sheet length before an expansion joint is recommended	LIGHT COLOURS* (≤ 0.40 solar absorptance)		MEDIUM COLOURS* (>0.40 to ≤0.60 solar absorptance)		DARK COLOURS* (>0.60 solar absorptance)	
	COLORBOND® steel colours	SA Index#	COLORBOND® steel colours	SA Index#	COLORBOND® steel colours	SA Index#
23.7m Maximum	Whitehaven®	0.23				
	Coolmax®					
	Surfmist®	0.32				
	Classic Cream®	0.32				
20m Maximum	Surfmist® Matt	0.35				
			Paperbark®	0.42		
			Evening Haze®	0.43		
			Shale Grey®	0.43		
			Dune®	0.47		
			Cove®	0.54		
			Windspray®	0.58		
			Shale Grey® Matt	0.45		
16m Maximum			Dune® Matt	0.48		
			ZINCALUME® steel unpainted	> 0.45		
					Gully®	0.63
					Mangrove®	0.64
					Wallaby®	0.68
					Jasper®	0.69
					Basalt®	0.69
					Manor Red®	0.69
					Terrain®	0.69
					Woodland Grey®	0.71
					Monument®	0.73
					Ironstone®	0.74
					Cottage Green®	0.75
				Deep Ocean®	0.75	
				Night Sky®	0.96	
				Basalt® Matt	0.71	
				Monument® Matt	0.79	

*Reference Volume Two NCC 2019 for solar absorptance classifications

Reference BlueScope Steel website www.colorbond.com



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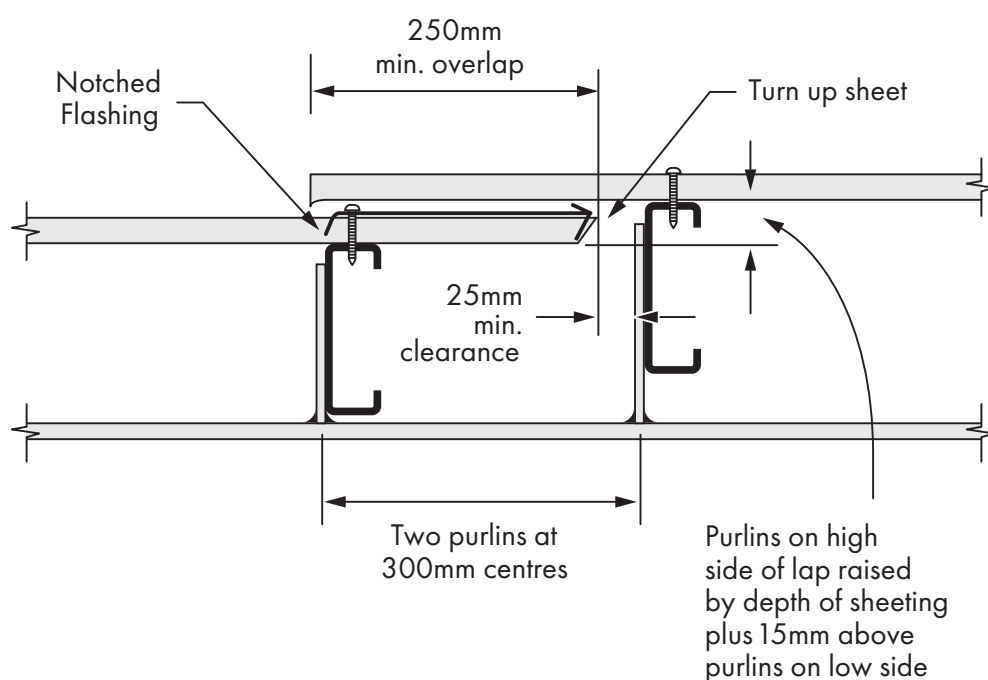
HOW CAN I MANAGE THERMAL CHANGES?

Building designers and installers need to take thermal expansion into account.

The amount of thermal expansion and contraction can be readily calculated, based on the length of the sheets and the estimated total temperature variation that might be expected – from the coldest winter night to the hottest summer day.

This calculation will guide the requirements for the job, including whether or not expansion joints need to be incorporated into the building design.

EXPANSION JOINT



Provisions will also need to be made for roof drainage systems if there is an understanding that thermal variation would cause any damage. This includes considerations for flashings, box gutters, eaves gutters and downpipes.

For more advice on roof and cladding installation, get in touch with your local Steeline expert.

Steeline stocks quality COLORBOND® steel roofing and architectural cladding, available in a wide variety of styles and finishes.

Explore our product ranges here:

steeline.com.au/product-category/roofing

steeline.com.au/product-category/architectural-claddings

