TECHNICAL BULLETIN 6

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This issue supersedes all previous issues

Curving of corrugated steel sheeting

INTRODUCTION

Corrugated steel roofing has been in continuous use for well over a century in Australia. This same corrugated profile is also used in curved form as roofing for the traditional bullnosed verandah and walls of rainwater tanks.

The curving process involves following the basic practice of feeding the sheets squarely into curving rolls and making sufficient passes to achieve the desired curve.

The purpose of this Technical Bulletin is to list the common problems associated with curving corrugated steel, to explain the causes and suggest remedies.

The two most important factors in the successful production of curved corrugated steel sheet are:

1. Specification of the correct material; and
2. Use of appropriate curving rolls

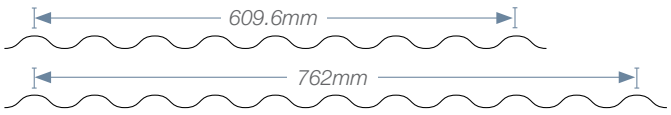
1. Material specification

The appropriate material specification is based on steel type and corrugated profile (number of corrugations). Corrugated steel suitable for curving is available as follows:

Table 1: Recommended BlueScope Steel product for curving

BASE METAL THICKNESS (BMT) (mm)	TOTAL COATED THICKNESS (TCT) (mm)	BLUESCOPE STEEL PRODUCT	NO. OF CORRUGATIONS
ROOFING			
0.60	0.64	ZINCALUME® G300 AM125 steel	8, 10.5
0.80	0.84	ZINCALUME® G300 AM125 steel	8, 10.5
0.60	0.69	ZINCFORM® G300 Z600 steel	8, 10.5
0.80	0.89	ZINCFORM® G300 Z600 steel	10.5
0.60	0.67	COLORBOND® G300 AM100 steel	10.5
TANKS			
0.60	0.83	AQUAPLATE® steel	6, 8, 10, 10.5, 12

Key dimensions of corrugated sheets



NOTE:

i. Orders for this purpose must be specific. Either the correct product name or the notation "for curving" should be used.
e.g. PROFILE: 8 or 10.5 corrugations × 76.2mm pitch × 17mm deep.

ii. The commonly specified dimension of 76mm is a rounded figure and should actually be 76.2mm (3"). Lengths are custom cut to order or as stocked by the distributor. Width tolerance is:
8 × 76.2 ± 2mm = 610 ± 2mm, 10.5 × 76.2 ± 2mm = 762 ± 2mm

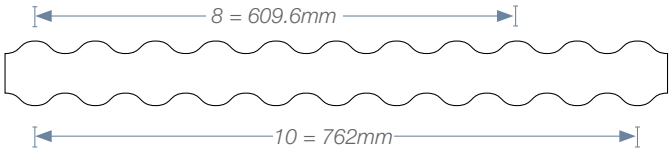
iii. The appropriate Australian Standard is AS1445 'Hot-dipped zinc coated, aluminium/zinc coated or aluminium/zinc/magnesium coated steel sheet – 76mm Pitch Corrugated.'

2. The curving rolls

Curving rolls to suit 6, 8 or up to 12.5 corrugations are available as either horizontal or vertical machines (or machines that can be adjusted from horizontal to vertical). Curving machines are available with either manual or automatic adjustment of the roll intermesh. Manual feed requires a skilled operator to adjust the depth of the tooling to achieve the required curve. Automatic machines change the roll intermesh to achieve the required curve according to a preselected program or number of steps.

Curving machines have rollers which have been contoured to match the intended profile dimensions of the corrugated sheets.

The pitch of these machines is largely based on imperial measurement, with the exception of a very small number of metric machines. Based on a pitch of 3 inches, or 76.2mm, the cover width of a corrugated sheet measures 609.6mm for 8 corrugations and 762mm for 10 corrugations.

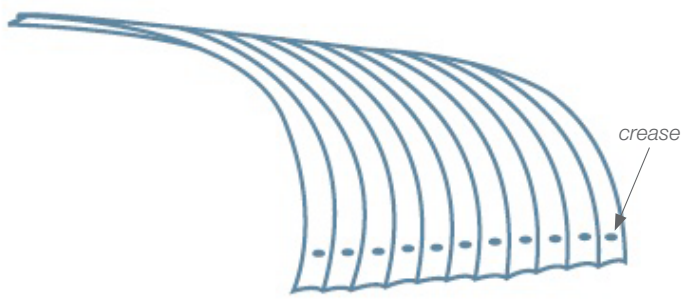


Experience indicates that the depth of the flutes of the curving rolls should be slightly deeper than the intended profile of the sheet.

Sheeting should also match the pitch of the curving rolls (within a small tolerance) in order to achieve good quality curving.

PROBLEMS AND REMEDIES

1. **Problem:** A crease or break occurs across the sheet about 100mm from the leading edge as fed into the curving rolls. The crease occurs where the pressure roll exerts its force between the two bottom rolls.



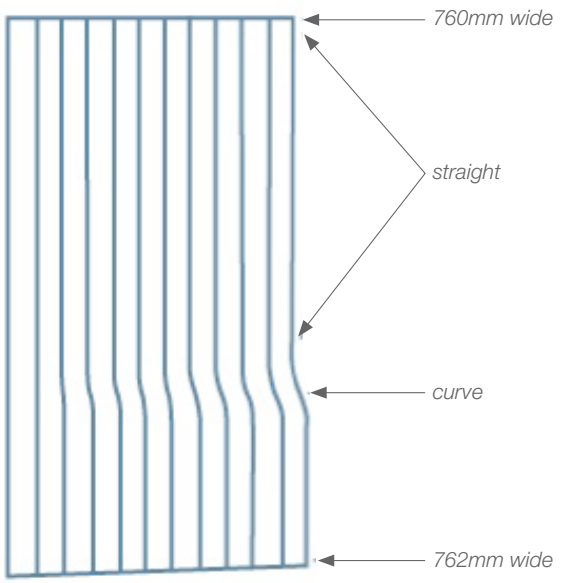
Possible Causes:

a) Setting excessive pressure to the rolls prior to feeding the sheet is most likely.

b) Many curving rolls have a wide space between the lower rolls (200mm). Those with 150mm have fewer problems. It has been observed that creasing is reduced if the sheet pitch/width matches the rolls.

Remedy: The most effective practice involves sizing the sheet ends prior to applying the bending force and then exerting pressure whilst the sheet is moving. Automatic curvers stagger the starting and end positions as the roll intermesh increases, thus reducing this effect.

2. **Problem:** The curved end is a different width to the straight section of the sheet resulting in the misalignment of corrugations. This is more severe when opposed forming occurs, such as for an OGEE shape.



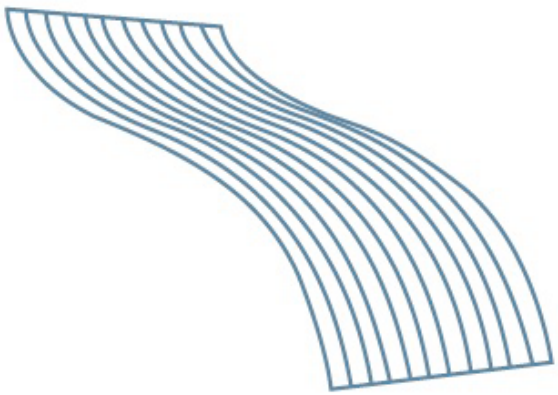
Cause: Although the theoretical cover width dimension should be 762 ± 2mm, the actual dimensions of the sheet may be outside this tolerance. If outside of tolerance, the curved end will naturally follow the roll dimension of 762mm while the straight section will be unaltered. This results in one lap edge being out of line and causes difficulties when the neighbouring sheet with the same problem has its "in line" lap edge mated to the "out of line" edge of the previous sheet.

OGEE forming requires that sheet be formed at both ends and this forms a twist in the corrugation line.

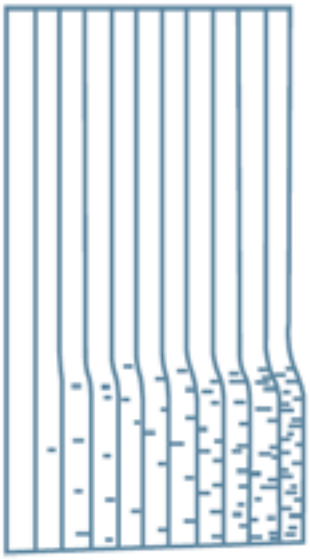
Remedy:

i) The corrugated sheets must be within tolerance of correct total pitch width, or

ii) The total sheet length must be "sized" by repeated passes through the rolls. If the total sum of the pitches is too narrow it may not be possible to "resize" due to distortion.



3. **Problem:** Valley ripples across the curved sheet. Rippling may be consistent or may change in severity across the sheet.



Cause: (*as for Problem 2*)
Where valley ripples occur across the sheet, it could be due to excessive rate of forming or bend radii being too tight.

Remedy: (*as for Problem 2*)

i) Increase the number of passes used to form the bend and increase the minimum bend radii

4. **Problem:** Wavy or rippled edges on the compression side. (Note: The lap which has the sheet edge curved toward the inside of the radius is referred to as the compression edge).

The edge often has a series of waves at regular intervals around the curve. The scalloped effect creates an untidy appearance when installed, particularly for unlined verandahs.

Cause: Excess width of side lap on the compression edge. The ideal width is approximately 23mm from the top centre of the last corrugation to the lap edge.

Rapid forming of the bend causes excessive compression of the sheet edge.

Remedy: Trim the excess edge back to 23mm. Alternatively, request that sheets be supplied to this dimension. Often material for curving is manufactured from reduced feed width so that the compression edge is less than that of a conventional roofing product. Increase the number of passes used to form the bend.

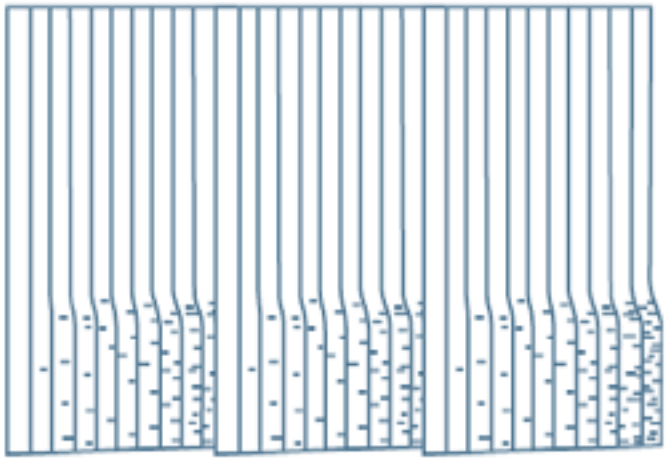
5. **Problem:** Sawtooth Effect. This problem is seen when the fixed sheets have uneven length on the bottom edge when viewed at gutter level. The sheet ends cannot be lined up and each succeeding sheet appears to be considerably shorter or longer than the neighbouring sheet.

Cause: (*refer to Problem 2*)
The progressively worsening valley ripple across the sheet, as described in Problem 3, gradually absorbs length resulting in a shortening of the most affected side.

A further cause could be sheet ends not being cut squarely or the sheet is not fed squarely into the curving machine.

Remedy: (*refer to Problem 2*)
Ensure sheets are fed squarely into the curving roll axis.

NOTE:
Due to the fact that one sheet laps over its neighbour there will always be a very slight difference in length thus creating a saw-tooth effect along the line of the bottom edge of the bullnosed end. This is unavoidable for long length curving, such as barrel vaulting, as the down side lap will always lose length so post trimming may be necessary.



SUMMARY

Problems are usually caused by one or more of the following reasons:

1. Total sheet pitch is not within tolerance across its width,
2. Excessive metal width at side laps,
3. Inaccurate presentation of the sheet to the curving rolls or
4. Insufficient passes of the sheet through the curving rolls.

CURVING OF COLORBOND® STEEL AND ZINCALUME® STEEL CORRUGATED PROFILES

The factors previously discussed apply to COLORBOND® prepainted steel and ZINCALUME® aluminium/zinc/magnesium alloy coated steel. However, scuffing and abrasion can damage the finish unless additional care is taken.

The curving rolls must be clean and free of burrs and metal particles. Grease and dirt can be removed by wiping with a solvent soaked rag but care must be taken to avoid removing the lubricant from transmission and bearings. The rolls should be dry and free from any residual solvent before forming commences as some solvents can affect the surface of the product.

The organic film on ZINCALUME® steel provides self-lubrication thus eliminating the need for lubricating oils for roll-forming or curving in most cases. Lubricant is also not usually required for curving COLORBOND® steel.

If a lubricant is needed, it should be a fully volatile branched chain hydrocarbon type liquid. **KEROSENE OR KEROSENE BASED LUBRICANTS MUST NOT BE USED**, as they may cause softening and partial removal of the organic passivation film (in the case of ZINCALUME® steel) or softening of the paint (in the case of COLORBOND® steel), resulting in possible aesthetic variations. For further information, refer to Forming Technical Bulletin FTB-1 *Lubrication of Sheet Steel and Strip for Forming.*

CURVING OF AQUAPLATE® STEEL CORRUGATED SHEET

Apart from ensuring curving rolls are clean and free of burrs and metal particles, it should be noted that AQUAPLATE® steel sheet does not require any lubrication during curving.

RELATED BLUESCOPE STEEL TECHNICAL BULLETINS

Forming Technical Bulletin FTB-1
Lubrication of Sheet Steel and Strip for Forming

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