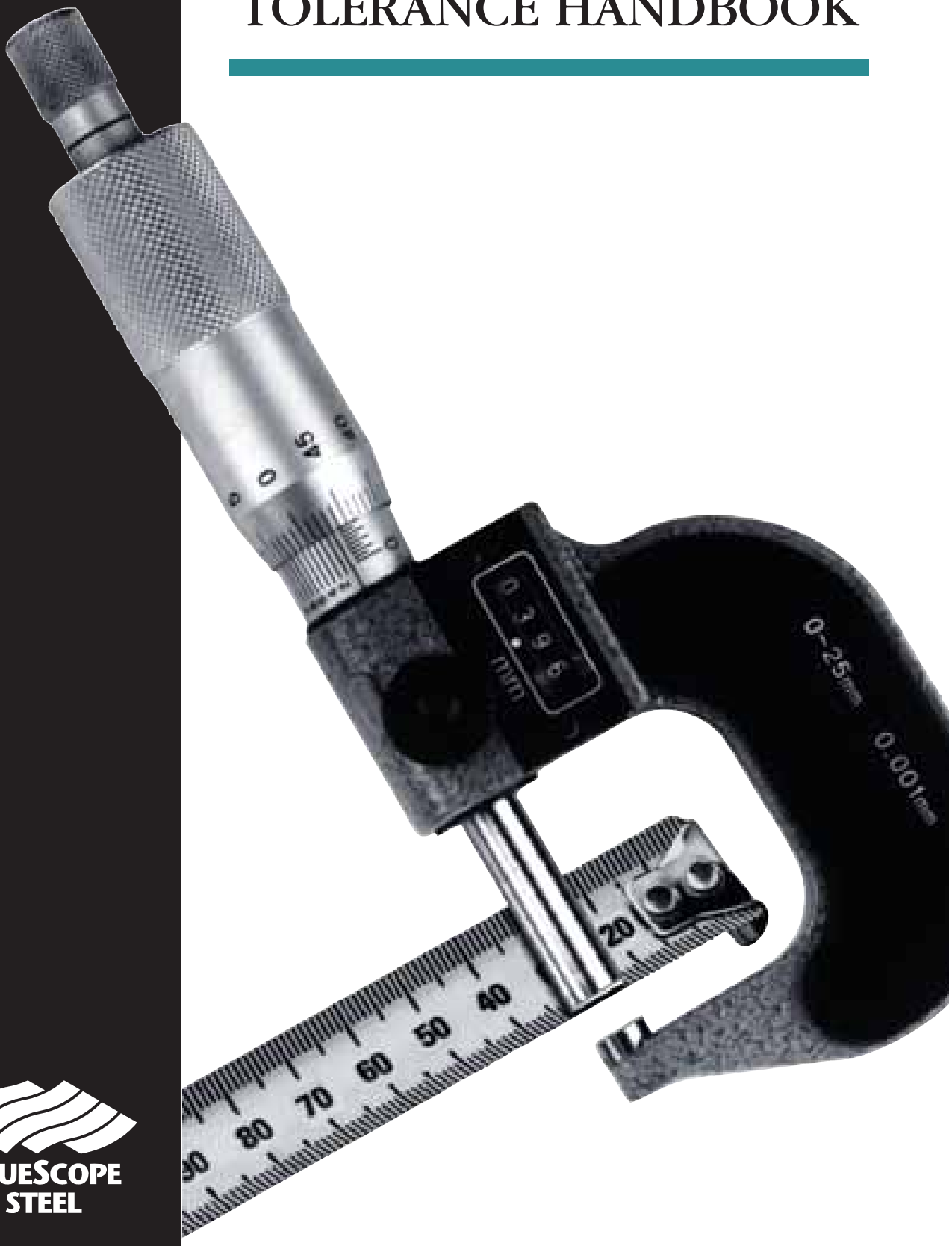
BLUESCOPE STEEL LIMITED PRODUCT DIMENSIONAL TOLERANCE HANDBOOK



BLUESCOPE STEEL

Rev 4, November 2003

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BlueScope Steel Limited Product Dimensional Tolerance Handbook

FOREWORD

BlueScope Steel Limited manufacture steel products to a high quality level, using modern rolling mills and finishing equipment. Whilst every effort is made to ensure that these products comply with the relevant specifications, the characteristics of steelmaking, rolling and finishing processes and the associated equipment, lead to a natural variation in the physical characteristics of the products as supplied. For this reason it is standard practice across steel producers worldwide to include working tolerances in specifications, thereby restricting the variations to limits (tolerances) which are acceptable to both the steel producer and the end user.

The primary purpose of this handbook is to provide tolerances in a convenient form to users of BlueScope Steel products. The tolerances quoted are effective at the time of publication and comply with the relevant Australian/New Zealand Standards. Inclusion of range of sizes or grades in the tolerance tables does not necessarily indicate that all sizes or grades within that range are available.

It is the policy of the company to comply, wherever possible in their product range, with the requirements of relevant Australian/New Zealand standards. This also applies to dimensional tolerances. Where no dimensional tolerances are specified in the relevant standards, in-house tolerances have been applied. It may be possible to negotiate restrictive tolerances that will aid customer fabrication/processing provided there is an agreement for such a supply prior to order placement.

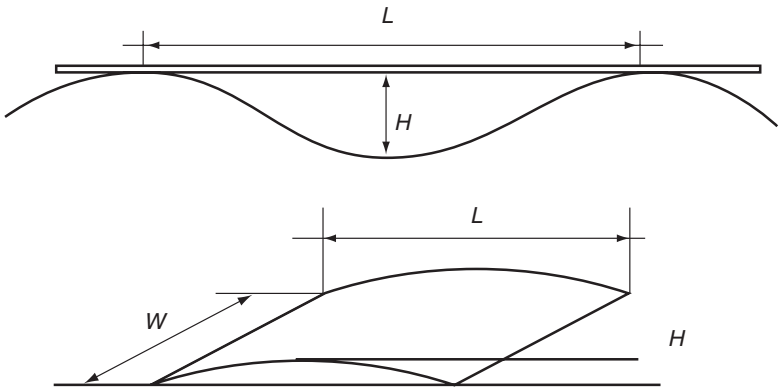
DIMENSIONAL TOLERANCES

The term dimensional tolerance refers to the permissible variation from a specified dimension in a product. The degree of accuracy which may be expected will depend on whether the product is hot or cold rolled, the type of rolling mill equipment used, unavoidable operating contingencies, the specified size or edge condition, and in some cases the steel composition. The tables in this handbook show either the specified BlueScope Steel or appropriate Australian Standard tolerances.

COATED AND UNCOATED FLAT PRODUCTS

Measurement of Flatness (AS/NZS 1365:1996)

Flatness has traditionally been a product feature which is hard to quantify. The flatness is measured on the product under its own weight resting on a flat surface so that any deviation from the flat surface can be observed. The straightedge may be placed in any direction. Only the portion between the two points of contact is taken into consideration.



W = width, L = length, H = deviation

Figure 1 – Measurement of flatness

Measurement of Steepness Ratio (Alternative for Expressing Flatness)

Steepness ratio is calculated by measuring H & L, as defined above for the product resting under its own weight on a flat horizontal surface with the deviation to be measured facing upwards.

Steepness ratio = H/L x 100

Measurement of Edge Camber (AS/NZS 1365:1996)

Camber is the lateral departure of the edge of sheet or strip from a straight line forming a chord.

When sheet or strip is laid on a flat horizontal surface and straight edge placed at the concave side edge, the maximum distance between the side edge and the straightedge is the camber (refer Figure 2).

Camber can also be measured by placing adjacent sheets or pieces of the same length of strip with concave edges together (refer Figure 3). Actual camber is one half of the maximum distance between the two edges. Camber is a measured value divided by length, expressed as a percentage.

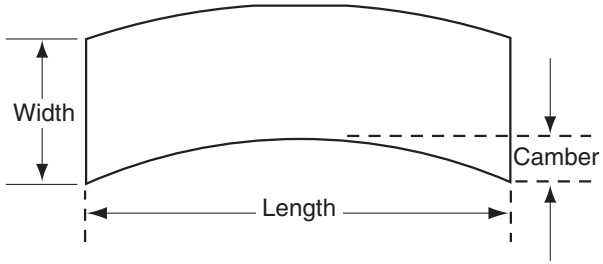


Figure 2 – Measurement of camber – Using straightedge

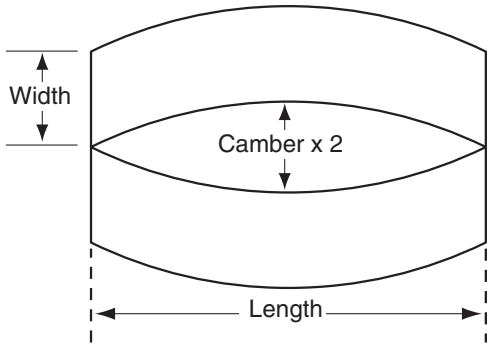
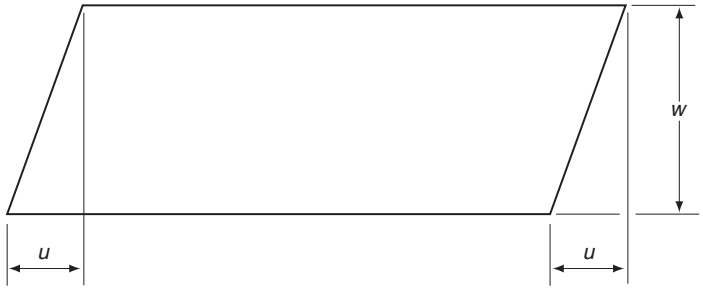


Figure 3 – Measurement of camber – Using two lengths

Measurement of Out-of-Square (AS/NZS 1365:1996)

The deviation from squareness of a length cut from trimmed-edge steel strip is measured by scribing a line normal to the trimmed edge adjacent to the cut. The out-of-square is expressed as a percentage of the measured value of deviation from square divided by the nominal width (see Figure 4).



W = nominal width U = deviation from square

Figure 4 – Measurement of Out-of-Square

Note: Out-of-squareness is expressed as U/W x 100%

PLATE AND FLOORPLATE ROLLED ON A PLATE MILL

Thickness Tolerances (AS/NZS 1365:1996) all Edge Conditions

Specified width mm		Thickness Tolerance*, Plus or Minus mm											
		Specified Thickness mm											
		> 4.50 ≤ 6	> 6 ≤ 8	> 8 ≤ 10	> 10 ≤ 13	> 13 ≤ 18	> 18 ≤ 22	> 22 ≤ 30	> 30 ≤ 42	> 42 ≤ 63	> 63 ≤ 100	> 100 ≤ 180	> 180 ≤ 250
≥ 600	< 1000	0.35	0.35	0.40	0.45	0.50	0.55	0.65	0.80	1.10	1.60	2.25	2.60
≥ 1000	< 1600	0.35	0.40	0.40	0.45	0.55	0.60	0.70	0.85	1.15	1.70	2.30	2.60
≥ 1600	< 2100	0.40	0.45	0.45	0.50	0.60	0.65	0.75	0.90	1.20	1.75	2.35	2.60
≥ 2100	< 2700	0.50	0.50	0.55	0.60	0.65	0.75	0.85	1.00	1.30	1.85	2.40	2.60
≥ 2700	< 3300	0.65	0.65	0.70	0.75	0.80	0.90	0.95	1.15	1.45	1.95	2.40	2.60

*The thickness tolerance for floorplate is for the unraised thickness of the plate.

Note: Thickness tolerances given are applicable to plate and floorplate in all edge conditions, with a specified or typical minimum yield strength of 360 MPa or less. For steels with a specified or typical minimum yield strength greater than 360 MPa, the thickness tolerance is determined by multiplying the values given by 1.5.

PLATE AND FLOORPLATE ROLLED ON A PLATE MILL

Thickness Tolerances (AS 1548:1995) – Pressure vessel plate all Edge Condition

Specified Width mm		Under Tol-erance mm	Permissible Variation over Specified Thickness mm										
			Specified Thickness mm										
			> 4.5 ≤ 6	> 6 ≤ 8	> 8 ≤ 10	> 10 ≤ 13	> 13 ≤ 18	> 18 ≤ 22	> 22 ≤ 30	> 30 ≤ 42	> 42 ≤ 63	> 63 ≤ 100	> 100 ≤ 150
≥ 600	< 1000	0.30	0.40	0.40	0.50	0.60	0.70	0.80	1.00	1.30	1.90	2.90	4.20
≥ 1000	< 1600	0.30	0.40	0.50	0.50	0.60	0.80	0.90	1.10	1.40	2.00	3.10	4.30
≥ 1600	< 2100	0.30	0.50	0.60	0.60	0.70	0.90	1.00	1.20	1.50	2.10	3.20	4.40
≥ 2100	< 2700	0.30	0.70	0.70	0.80	0.90	1.00	1.20	1.40	1.70	2.30	3.40	4.50
≥ 2700	< 3300	0.30	1.00	1.00	1.10	1.20	1.30	1.50	1.60	2.00	2.60	3.60	4.50

PLATE & FLOOR PLATE ROLLED ON A PLATE MILL

Width Tolerances

(AS/NZS 1365:1996 and AS 1548:1995)

Edge Condition	Width	Width Tolerance mm			
		Specified Thickness mm			
	mm	> 4.5 < 16		≥ 16 ≤ 250	
Trimmed	All	Plus	Minus	Plus	Minus
		20	0	25	0
Untrimmed		All Thicknesses			
		Plus		Minus	
	< 2400	80		0	
	≥ 2400	100		0	

Length Tolerances

(AS/NZS 1365:1996 & AS 1548:1995)

Specified Length	Length Tolerance mm			
	Specified Thickness mm			
All	> 4.5 < 25		≥ 25 ≤ 250	
	Plus	Minus	Plus	Minus
	30	0	40	0

BLUESCOPE STEEL

PLATE & FLOOR PLATE ROLLED ON A PLATE MILL

Edge Camber Tolerances

(AS/NZS 1365:1996 and AS 1548:1995)

Specified Width	Edge Camber Tolerance %	
	Trimmed Edge	Untrimmed Edge
All	0.2	0.3

Notes:

1. Edge camber shall be limited to ensure that the dimensions of the ordered plate are within the delivered size.

2. If agreed at the time of enquiry, or order, edge camber shall be limited as shown in the table.

Out-of-Square Tolerance

(AS/NZS 1365:1996 and AS 1548:1995)

For all sizes, the cut lengths shall be such that plates conforming to the ordered nominal dimensions can be obtained.

PLATE & FLOOR PLATE ROLLED ON A PLATE MILL

Flatness Tolerances (AS/NZS 1365:1996 and AS 1548:1995)

Flatness Tolerance for Floorplate and plates with carbon content > 0.25% and specified or typical minimum yield strength ≥ 360Mpa is determined by multiplying the values given in Table by a factor of 1.5

Specified Thickness mm		Distance Between Points of Contact mm		Flatness Tolerance* Specified Width mm				
				<1500	≥1500 <1800	≥1800 <2400	≥2400 <3000	≥3000
> 4.5	≤ 8		≤500	4	4	4	5	8
		>500	≤750	6	6	6	8	12
		>750	≤1500	8	8	8	10	15
		>1500	≤2000	10	10	10	15	20
		>2000	≤3500	15	15	15	25	30
		>3500		20	20	30	35	40
> 8	≤ 12		≤500	3	3	4	5	8
		>500	≤750	5	5	6	8	12
		>750	≤1500	6	6	8	10	15
		>1500	≤2000	8	8	10	15	20
		>2000	≤3500	10	10	15	20	25
		>3500		12	15	20	30	30
> 12	≤ 25		≤500	3	3	3	5	5
		>500	≤750	5	5	5	8	8
		>750	≤1500	6	6	6	10	10
		>1500	≤2000	6	6	10	12	12
		>2000	≤3500	8	10	12	16	16
		>3500		10	15	20	25	25
> 25	≤ 250		≤500	3	3	3	3	3
		>500	≤750	5	5	5	5	5
		>750	≤1500	6	6	6	6	6
		>1500	≤2000	8	8	8	8	8
		>2000	≤3500	8	8	10	10	10
		>3500		10	12	12	20	20

*The tolerances apply when measured at least 20 mm from the longitudinal edges and 100 mm from the transverse edges.

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HOT ROLLED PLATE, FLOORPLATE, SHEET & STRIP – ROLLED ON A CONTINUOUS MILL

Thickness Tolerances (AS/NZS 1365:1996)

All Edge Conditions

For floorplate, the tolerance is obtained by multiplying the figure in the table by 1.5.

Specified Thickness mm		Thickness Tolerance Plus or Minus mm
	≤ 1.60	0.16
> 1.60	≤ 2.00	0.18
> 2.00	≤ 2.50	0.19
> 2.50	≤ 3.00	0.21
> 3.00	≤ 4.00	0.23
> 4.00	≤ 5.00	0.25
> 5.00	≤ 6.00	0.27
> 6.00	≤ 8.00	0.29
> 8.00	≤ 10.00	0.32
> 8.00	≤ 13.00	0.36

Note: Thickness is measured not less than 10 mm from a trimmed edge or not less than 25 mm from an untrimmed edge.

HOT ROLLED PLATE, FLOORPLATE, SHEET & STRIP – ROLLED ON A CONTINUOUS MILL

Thickness Tolerances (AS 1548:1995)
All Edge Conditions

Specified Thickness (see note) mm		Thickness Tolerance, Plus or Minus mm
	≤ 3.00	0.21
> 3.00	≤ 4.00	0.23
> 4.00	≤ 5.00	0.25
> 5.00	≤ 6.00	0.27
> 6.00	≤ 8.00	0.29

Note: Thickness is measured not less than 10 mm from a trimmed edge or not less than 25 mm from an untrimmed edge.

Width Tolerances (AS/NZS 1365:1996 and AS 1548:1995)
Trimmed Edge

Specified Width mm		Width Tolerance mm			
		Specified Thickness mm			
		3.00		3.00	13
		Plus	Minus	Plus	Minus
	< 150	1.00	0	1.50	0
≥ 150	< 300	1.50	0	2.00	0
≥ 300	< 450	2.00	0	2.50	0
≥ 450	< 600	2.50	0	3.00	0
≥ 600	< 750	3.00	0	3.00	0
≥ 750	< 1000	4.00	0	4.00	0
≥ 1000	< 1250	5.00	0	5.00	0
≥ 1250	< 1500	6.00	0	6.00	0
≥ 1500	< 2000	7.00	0	7.00	0

BLUESCOPE STEEL

HOT ROLLED PLATE, FLOORPLATE, SHEET & STRIP

Width Tolerances (AS/NZS 1365:1996 & AS 1548:1995)
Untrimmed Edge

Specified Width mm		Width Tolerance mm	
		Plus	Minus
> 599	≤ 1000	25	0
> 1000	≤ 1250	30	0
> 1250	≤ 1500	35	0
> 1500	≤ 2000	40	0

Length Tolerances (AS/NZS 1365:1996 & AS 1548:1995)
All Edge Conditions

Specified Width mm		Length Tolerance mm	
		Plus	Minus
	≤ 2000	10	0
> 2000	≤ 4000	15	0
> 4000	≤ 6000	20	0
> 6000	≤ 12000	30	0
> 12000		50	0

Edge Camber Tolerances
(AS/NZS 1365:1996 & AS 1548:1995)
All Edge Conditions

Specified Width	Edge Camber Tolerance %
All	0.4

HOT ROLLED PLATE AND SHEET ROLLED ON A CONTINUOUS MILL

Flatness Tolerances (AS/NZS 1365:1996 & AS 1548:1995)

All Edge Conditions

Flatness tolerances given are applicable to steel plate and sheet having a specified carbon content equal to 0.25% or less and a specified or typical minimum yield strength less than 340 MPa.

For floorplate and all other steel plate and sheet, the flatness tolerance is determined by multiplying the values given in the table by a factor of 1.5.

Flatness Tolerance

Nominal Thickness mm	Distance Between Points of Contact mm		Flatness Tolerance mm	
			Class A	Class B
≤ 2		≤ 500	10	3
	> 500	≤ 750	15	4
	> 750	≤ 1000	20	5
	> 1000	≤ 1500	25	8
	> 1500		30	10
> 2 ≤ 5		≤ 500	8	3
	> 500	≤ 750	12	4
	> 750	≤ 1000	15	5
	> 1000	≤ 1500	20	8
	> 1500		25	10
> 5 ≤ 13		≤ 500	5	–
	> 500	≤ 750	8	–
	> 750	≤ 1000	10	–
	> 1000	≤ 1500	15	–
	> 1500		20	–

Note: The tolerances apply when measured at least 20 mm from the longitudinal edges and 100 mm from the transverse edges.

BLUESCOPE STEEL

HOT ROLLED PLATE AND SHEET ROLLED ON A CONTINUOUS MILL

Steepness Ratio (AS/NZS 1365:1996 & AS 1548:1995)

(This is an alternative method for expressing flatness.)

Specified Thickness mm		Steepness Ratio mm	
		Class A	Class B
	≤ 2	1.8	0.6
> 2	≤ 3.2	1.5	0.6
> 3.2	≤ 13	1.5	–

Out-of-Square Tolerance

(AS/NZS 1365:1996 and AS 1548:1995)

For all sizes, the cut lengths shall be such that sheets or plates of the ordered nominal dimensions can be obtained.

When measured as shown on Page 10, the Out-of-Squareness of a cut length from trimmed-edge steel strip shall not exceed 1.0%.

COLD ROLLED AND COLD ROLLED METALLIC COATED SHEET & STRIP

These tolerances apply to cold rolled, metallic coated and organic coated coil and steel. For coated products, including those with organic coating, thickness tolerances apply to base metal only.

Thickness Tolerances all Edge Conditions
(AS/NZS 1365:1996)

Specified Thickness mm		Thickness Tolerance, Plus or Minus mm		
		Specified Width mm		
		≤1200	>1200 ≤1500	>1500 ≤2000
	≤ 0.30	0.02	–	–
> 0.30	≤ 0.50	0.03	0.04	–
> 0.50	≤ 0.80	0.04	0.05	0.06
> 0.80	≤ 1.20	0.05	0.06	0.07
> 1.20	≤ 1.60	0.06	0.07	0.08
> 1.60	≤ 2.00	0.07	0.08	0.09
> 2.00	≤ 2.50	0.08	0.09	0.10
> 2.50	≤ 3.00	0.09	0.10	0.11
> 3.00	≤ 4.00	0.10	0.11	0.12

Note: Class A – measured at a minimum of 50 mm from the strip edge. Within 10 m of welds and coil ends, the thickness may vary by twice the above tolerance.
Class B – thickness measured not closer than 10 mm to the edge of the strip. There is no change of tolerance in the vicinity of welds or coil ends. Class B tolerances are applicable to trimmed edge material only.

COLD ROLLED METALLIC COATED SHEET & STRIP

The table below enables users of metallic sheets to have some idea of the approximate thickness of various coating classes.

Approximate Coating Thickness

Coating Class	Coating Mass Factor* g/m²	Approximate Coating Thickness mm
Z100	130	0.02
Z200	220	0.03
Z275	290	0.04
Z350	370	0.05
Z450	470	0.07
Z600	650 (≤ 2.0 mm thick)	0.09
	680 (> 2.0 mm thick)	0.10
ZS30	70	0.01
ZF100	130	0.02
AZ150	170	0.05
AZ200	220	0.06

*The coating mass in this column was used for thickness calculations and includes the manufacturing margin needed to achieve the specified minima.

Theoretical coating thickness for Z and ZF coatings has been based on 100g/m^2 = 0.014 mm and for AZ coatings 100g/m^2 = 0.027 mm.

COLD ROLLED AND COLD ROLLED METALLIC COATED SHEET & STRIP

Width Tolerances (AS/NZS 1365:1996)

Untrimmed Edge

Specified Width mm		Width Tolerance mm	
		Plus	Minus
> 599	≤ 1000	25	0
> 1000	≤ 1250	30	0
> 1250	≤ 1500	35	0
> 1500	≤ 2000	40	0

Trimmed Edge – Class A

Specified Width mm		Width Tolerance mm	
		Plus	Minus
	≤ 150	1.00	0
> 150	≤ 300	1.50	0
> 300	≤ 450	2.00	0
> 450	≤ 600	2.50	0
> 600	≤ 750	3.00	0
> 750	≤ 1000	4.00	0
> 1000	≤ 2000	5.00	0

COLD ROLLED AND COLD ROLLED METALLIC COATED SHEET & STRIP

Width Tolerances (AS/NZS 1365:1996)

Trimmed Edge – Class B

Specified Width mm		Width Tolerance mm									
		Strip						Sheet			
		Specified Thickness mm									
		< 1.00		≥ 1.00 ≤ 3.00		> 3.00		All			
		Plus	Minus	Plus	Minus	Plus	Minus	Plus	Minus		
	≤ 150	0.20	0	0.40	0	0.60	0	1.00	0		
> 150	≤ 300	0.40	0	0.60	0	0.80	0	1.00	0		
> 300	≤ 450	0.60	0	0.80	0	1.00	0	1.00	0		
> 450	≤ 600	0.80	0	1.00	0	1.00	0	1.00	0		
> 600	≤ 750	1.00	0	1.00	0	1.00	0	1.00	0		
> 750	≤ 1000	1.50	0	1.50	0	1.50	0	1.50	0		
> 1000	≤ 2000	2.00	0	2.00	0	2.00	0	2.00	0		

COLD ROLLED AND METALLIC COATED SHEET & STRIP

Length Tolerances (AS/NZS 1365:1996) Class A

Specified Thickness mm		Length Tolerance mm	
		Plus	Minus
	≤ 1.50	7	0
> 1.50	≤ 4.00	10	0

Length Tolerances (AS/NZS 1365:1996) Class B

Specified Length mm		Length Tolerance mm	
		Plus	Minus
	≤ 750	1.00	0
> 750	≤ 1000	1.50	0
> 1000	≤ 2000	2.00	0
> 2000	≤ 3000	3.00	0
> 3000	≤ 4000	4.00	0

Edge Camber Tolerances (AS/NZS 1365:1996)

Specified Width mm	Edge Camber Tolerance %
All	0.2

Note: Class A applies to sheet ≤ 4.00 mm thick only
Class B applies to sheet ≤ 3.00 mm thick only

BLUESCOPE STEEL

Flatness Tolerances (AS/NZS 1365:1996)

Distance Between Points of Contact mm		Flatness Tolerance mm	
		Class A	Class B (see note)
	≤ 500	5	2
> 500	≤ 750	7	3
> 750	≤ 1000	10	5
> 1000	≤ 1500	15	8
> 1500		20	10

Note: Class A applies to sheet ≤ 4.00 mm thick only
Class B applies to sheet ≤ 3.00 mm thick only

Out-of-Square Tolerances (AS/NZS 1365:1996)

For all sizes, the cut lengths shall be such that sheets of the ordered nominal dimensions can be obtained. When measured in accordance with that shown in Figure 4, page 10, the out-of-squareness of a cut length of trimmed-edge steel strip shall not exceed 1.0%

COLD ROLLED AND COLD ROLLED METALLIC COATED SHEET & STRIP

Steepness Ratio (AS/NZS 1365:1996)

Specified Thickness mm		Steepness Ratio	
		Class A	Class B
	≤ 1.70	1.2	0.5
> 1.70	≤ 3.00	1.5	0.5
> 3.00	≤ 4.00	1.5	–

Note: For ***A*** tolerance where the length between the points of contact ***l***, is less than 1000mm, the steepness ratio is 1%.

Metallic Coating Tolerance

Hot-dipped Zinc Coated Zinc/Aluminium Alloy-Coated Products (AS 1397:1995)

Coating Class	Coating Mass, g/m^2		
	Total Both Surfaces		One Surface Min. Single Spot
	Min. Triple Spot	Min. Single Spot	
Z100	100	90	40
Z200	200	180	80
Z275	275	250	110
Z350	350	315	140
Z450	450	405	180
Z600	600	540	240
ZS30*	30	27	12
ZF100	100	90	40
AZ150	150	135	60
AZ200	200	180	80

*Not covered by AS 1397.

BLUESCOPE STEEL

Approximate Paint Thickness for Single & Double Sided Films

Paint Film Thickness Range	
Single-Sided (ie. Shadow Grey)	0.03mm - 0.05mm
Double-Sided	0.04mm - 0.06mm

BlueScope Steel Direct – Free Call 1800 800 789

All customer service enquiries for BlueScope Steel products described in this publication should be directed to the BlueScope Steel Direct free call service on 1800 800 789.

BlueScope Steel Direct provides a 'one stop shop' service for customers and users of steel requiring information on BlueScope Steel and its products. It is staffed by a centralised team of experienced personnel specialising in Technical, Sales, Marketing and Public Affairs knowledge. BlueScope Steel Direct's services include the following:

- Product and application technical support incorporating a network of expert BlueScope Steel metallurgists, engineers and scientists located throughout Australia.
- Fast brochure and technical information mailout and facsimile services.
- Immediate referral service to approved BlueScope Steel distributors and service providers in your area.

BlueScope Steel Direct's Services are available Mon-Fri from 8.00am to 6.00pm (AEST)

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Please ensure you have the current BlueScope Steel Tolerance Handbook as displayed at www.bluescopesteel.com.au

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