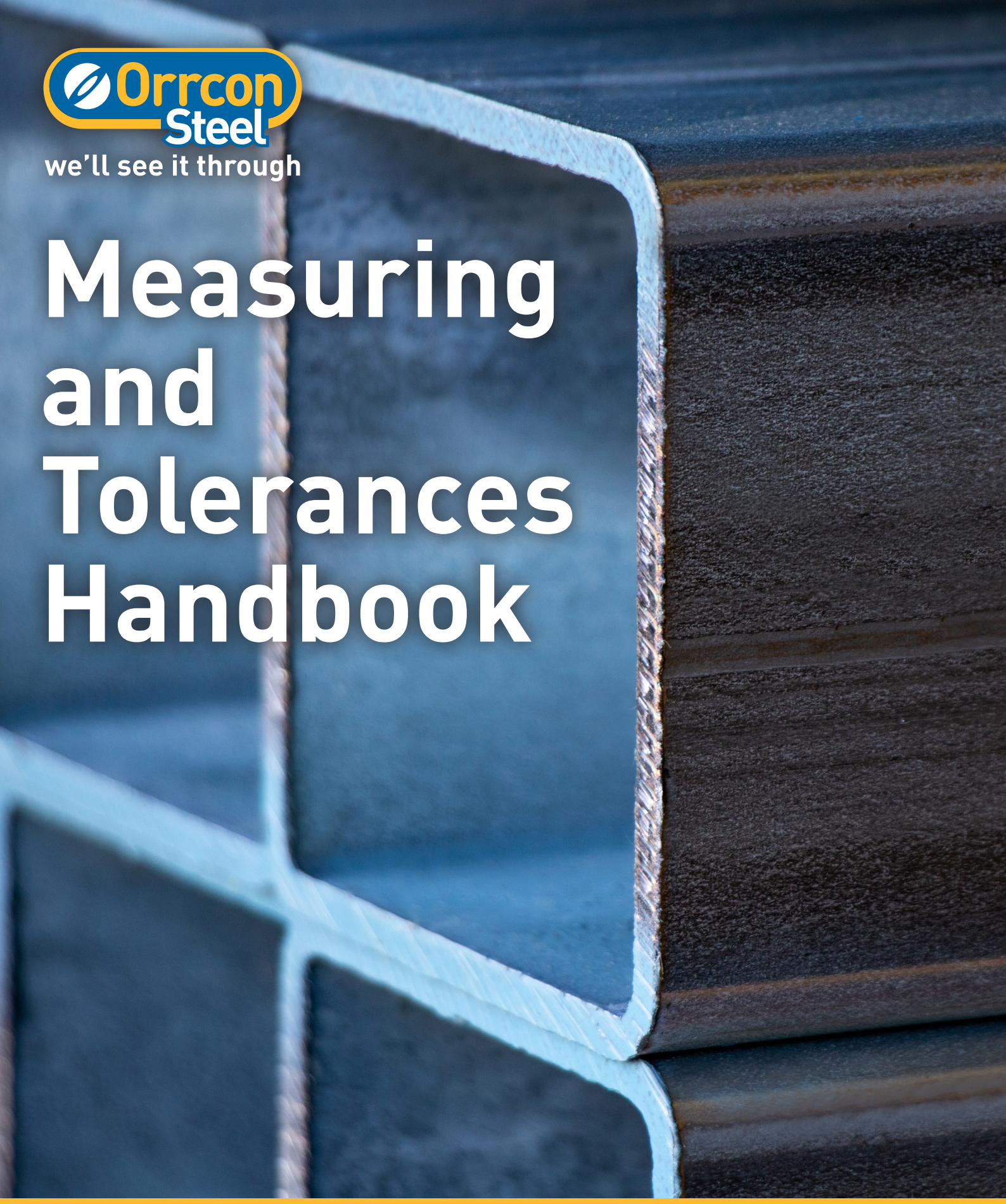
Orrcon Steel

we'll see it through

Measuring and Tolerances Handbook



BlueScope

AUSTRALIAN MADE Orrcon Steel

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Purpose & Scope

This document defines the finished product tolerances and measuring techniques for Structural Hollow Section products manufactured by Orrcon Steel.

Product dimensional requirements are specified within Australian / New Zealand Standard: AS/NZS 1163:2016 Cold-Formed structural steel hollow sections.

Special tolerances may be applied to specific products to meet customer requirements where agreed.

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1. Measuring Dimensions with Vernier Callipers

Vernier Callipers

Vernier callipers are used to check the width & height on Rectangular Hollow Section (RHS), Square Hollow Section (SHS) & Circular Hollow Section (CHS) product. They are also used to measure the inside (bore) diameter when a nominal bore is required.

Vernier Scale

The Vernier scale consists of two scales, the main scale & the Vernier scale.

The main scale is graduated into standard divisions similar to a graduated steel rule.

In a metric Vernier, the main scale is graduated into millimetres (mm), with each tenth millimetre being numbered.

The Vernier scale is made so that when its length is divided into a number of equal parts, each part represents a proportional length on the corresponding main scale division.

Reading a Vernier scale

- Read the Main scale to determine the distance between the zero (0) on the Main scale & the zero (0) on the Vernier scale.
- On the Vernier scale find which mark best lines up with ANY mark on the Main scale.
- Once determined read the value on the Vernier scale for that mark.
- Add the Main scale reading to the reading on the Vernier scale to determine result.

Digital Calliper

Electronic callipers are available with a digitial read out. Its important to check the zero '0' when jaws are closed together prior to use. Best practise includes checking measurement on known reference blocks to confirm accuracy on a routine basis.

Measuring

- Loosen the lock screw.
- Inspect jaws are free of damage and wipe clean.
- Close jaws to contact and check 'Zero'.
- Open the callipers by sliding the moveable jaws away from the fixed jaws.

External Dimensions

- Close jaws around product keeping it **square** with tube.
- Applying light force on slide.

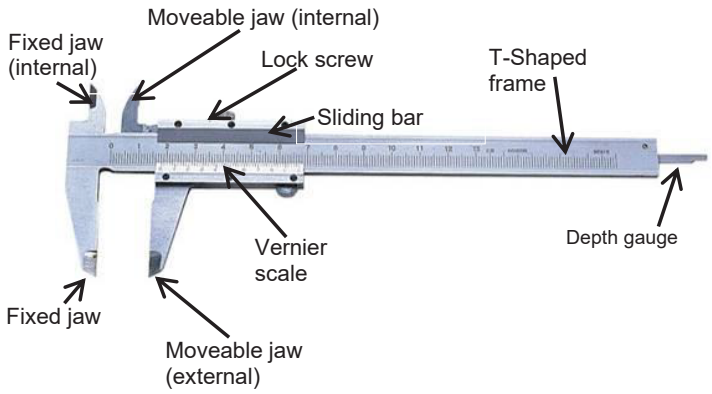
Internal Measurement

- Adjust callipers so internal jaws fit into pipe.
- Once positioned in pipe open so both jaws are touching opposite sides of the inside face of tube.
- Applying light force on slide.

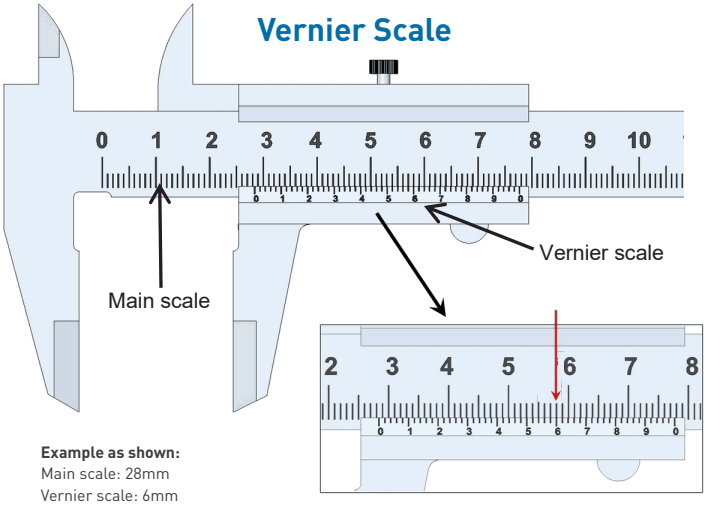
Results

- Digital: Read result off LCD.
- Vernier Scale: - Use locking screw to hold position.
  - Remove tool and read scale.

Vernier Calliper

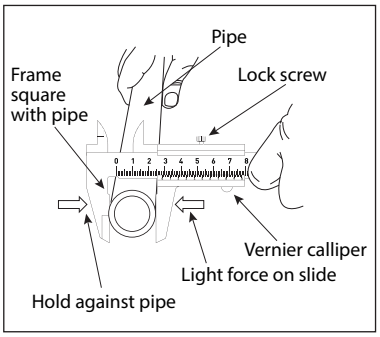


Vernier Scale

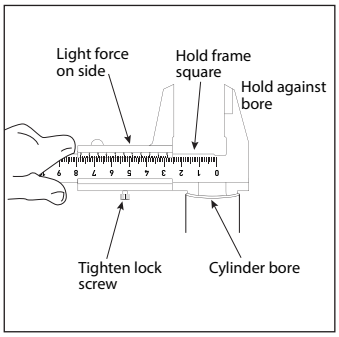


Example as shown:
Main scale: 28mm
Vernier scale: 6mm
Total measurement: 28.6mm

Taking External Measurements



Taking Internal Measurements



1. Measuring Dimensions with Vernier Callipers

Size Requirements

The maximum & minimum acceptable size (AS/ NZS 1163) should be no greater than +/- 1% of the nominal size. See opposite tables.

To ensure quality standards are met, the following size requirements **must** be followed:

- All measurements are to be taken within the same plane & a minimum of 200mm from end of tube.

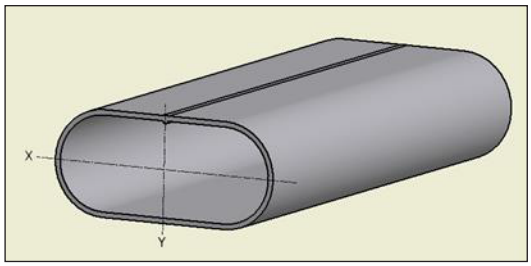
Note: The height of the tube is judged when the weld is located at the top of the tube, irrespective of the orientation of the weld when exiting the mill.

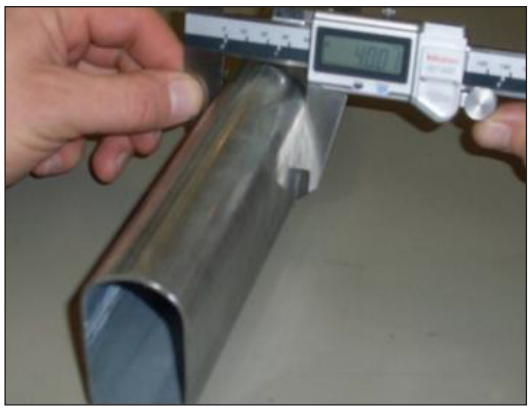
Rectangular Hollow Section / Square Hollow Section (RHS / SHS)

- Measurements shall be taken in four (4) directions at 90 degrees to each other (2 x Width & 2 x Height).
- Starting with side 1; measure each face of the product 1 to 4. Side 1 is the top and work in a clockwise direction.

Rail / Silo Section

- Rail - Measurements shall be taken in two (2) directions (1 x Width & 1 x Height) at 90 degrees to each other.
- Silo – Measurements shall be taken in three (3) directions (2 x Width & 1 x Height).
- Measure each face of the product as shown in the diagram.
- Ensure that product is measured in at least 300mm from saw cut, and along x and y axis.
- For correct way of measuring see photos below (note difference in size affected by saw cut).

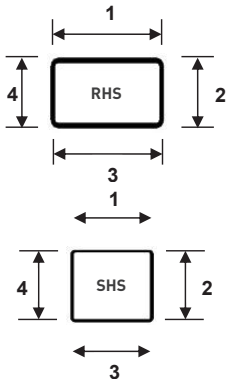




Circular Hollow Section (CHS)

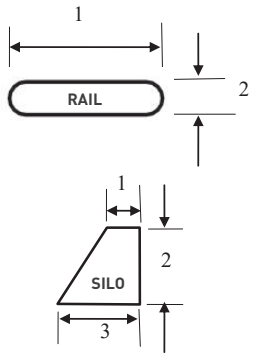
- Measurements shall be taken in four (4) directions (1 x Height, 1 x Width, 2 x Diagonals).
- Starting with the weld at the top of the tube, measure the product as shown in the diagram.

No of Measurements Required for RHS & SHS



RHS & SHS Size Tolerances (mm)		
Nominal size	Minimum size (-1% of nominal)	Maximum size (+1% of nominal)
20	19.8	20.2
25	24.75	25.25
30	29.7	30.3
35	34.65	35.35
38	37.62	38.38
40	39.6	40.4
50	49.5	50.5
65	64.35	65.65
75	74.25	75.75
89	88.11	89.89
100	99	101
125	123.75	126.25
185	183.15	186.85

No of Measurements Required for Rail / Silo Section



Rail Section Size Tolerances (mm)		
Nominal size	Minimum size (-1% of nominal)	Maximum size (+1% of nominal)
30	29.7	30.3
38	37.62	38.38
40	39.6	40.4
42	41.58	42.42
44	43.56	44.44
48	47.52	48.48
50	49.5	50.5
58	57.5	58.5
59	58.41	59.59
61	60.4	61.6
62	61.38	62.62
66	65.34	66.66
75	74.25	75.75
80	79.2	80.8
85	84.15	85.85
97	96.03	97.97
108	106.92	109.08
115	113.85	116.15
124	122.76	125.24
145	143.5	146.5

Silo Section Size Tolerances (mm)		
Nominal size	Minimum size (-1% of nominal)	Maximum size (+1% of nominal)
64	63.36	64.64
75	74.25	75.75

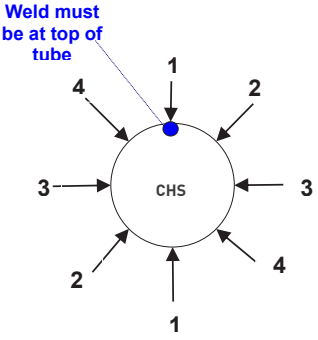
Out of Roundness

A maximum of 2% difference between the height & width is allowed on CHS product – because the maximum acceptable tolerance between the size-limits is to be no greater than +/-1% of the nominal size, the product will always be with in the acceptable limits of round.

To measure out of round, complete the following:

- Measure height & width.
- Calculate the difference between the 2 measurements by subtracting the smallest measured result from the largest measured result.
- Use the Pipe size tolerance table to check product is within tolerance.

No of Measurements Required for CHS



CHS Size Tolerances (mm)			
Nominal size	Minimum size (-1% of nominal)	Maximum size (+1% of nominal)	Out of round (Max difference between height & width)
Ø 25.4	25.15	25.65	0.51
Ø 26.9 (20NB)	26.63	27.17	0.54
Ø 33.7 (25NB)	33.36	34.04	0.67
Ø 42.4 (32NB)	41.98	42.82	0.85
Ø 48.3 (40NB)	47.82	48.78	0.97
Ø 60.3 (50NB)	59.70	60.90	1.21
Ø 76.1 (65NB)	75.34	76.86	1.52
Ø 88.9 (80NB)	88.01	89.79	1.78
Ø 101.6 (90NB)	100.58	102.62	2.03
Ø 114.3 (100NB)	113.16	115.44	2.29
Ø 127	125.73	128.27	2.54
Ø 139.7 (125NB)	138.30	141.10	2.79
Ø 165.1 (150NB)	163.45	166.75	3.30
Ø 168.3	166.62	169.98	3.37

2. Measuring Wall Thickness with a Metric Micrometre

Metric Micrometre

Micrometres are measuring instruments that allow accurate measurements to be taken.

Ball-end Metric Micrometres can be used to check the wall thickness of RHS, SHS & CHS product. The ball end design is used to cater for the circular characteristics of CHS product.

Flat end Micrometres are used for checking strip and flat specimens.

Checking Wall Thickness

This is to be performed at a position greater than twice the wall thickness or 25mm (whichever is the lesser) away from the weld seam.

Note: Localised wall thickness adjacent to the weld or where local polishing has occurred can be -10% of the nominal wall thickness.

Graduations

The datum line on the sleave is graduated with 1 mm divisions & 0.5mm subdivisions, with every 5th 1mm graduation being numbered.

The thread is ground with a pitch of 0.5mm so that one full revolution of the thimble moves it along a distance of 0.5 mm on the datum line.

The thimble is divided into 50 equal parts, with each graduation being 0.01mm. Every 5th graduation is numbered.

(50 equal parts X 0.01 mm = 0.5mm or one full revolution).

Reading

- On the sleeve, read only the number of millimetres (mm) completely visible.
- Note if zero (0) or one (1), 0.5mm division is visible.
- Determine which graduation on the thimble scale that best aligns with the datum line.
- Add the number of 1 mm divisions to the 0.5mm subdivision, if any.
- To this result, add the number of graduation on the thimble scale to calculate final result.

Measuring

- Loosen the lock nut.
- Turn the Thimble anti-clockwise so there's enough clearance to allow the wall thickness of the material to pass between the anvil & spindle.
- Position the micrometre so Anvil is inserted into the hollow of the section.
- Close micrometre so strip is almost clamped but no pressure applied.
- Making sure micrometre is square to section; use the ratchet to torque the correct amount of pressure onto the strip. The ratchet will slip once this is achieved. **DO NOT OVER TIGHTEN.**
- Read result.

Digital Micrometre

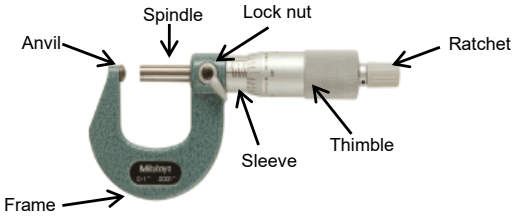
Mechanical and Electronic micrometres are available with a digitial read out. It's important to check the anvil is clean and free from damage. Check the zero '0' when anvil and spindle are closed together. Reset zero if necessary. Best practise includes checking measurement on known reference blocks to confirm accuracy on a routine basis.

Wall Thickness Requirements

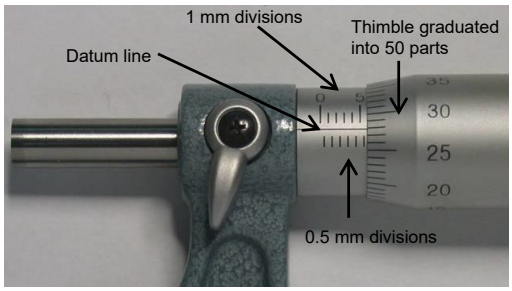
Products must conform to the requirements of the Wall Thickness Tolerance Table.

AS/NZS 1163 permits local wall thickness +/- 10% of the nominal wall thickness, which is shown in the Wall Thickness Tolerance Table. Due to linear mass requirements average wall thickness is generally closer to nominal.

Metric Micrometre



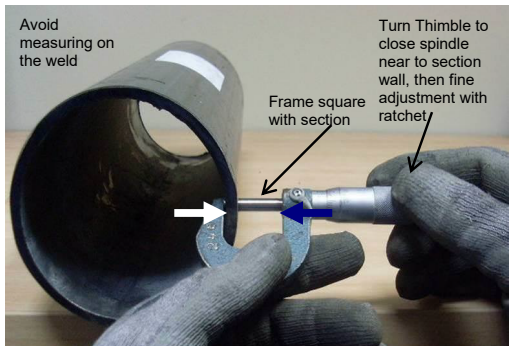
Metric Micrometre Graduations



Example as shown:

Main scale: 6mm
0.5mm division: 0.5mm
Thimble: 28mm.
TOTAL: 6.78mm.

Taking Measurement



Wall Thickness Tolerance Table

Nominal size	Minimum size (-10% of nominal)	Maximum size (+10% of nominal)
mm	mm	mm
1.6	1.44	1.76
2	1.8	2.2
2.5	2.25	2.75
2.6	2.34	2.86
3	2.7	3.3
3.2	2.88	3.52
3.5	3.15	3.85
4	3.6	4.4
4.5	4.05	4.95
5	4.5	5.5
5.4	4.86	5.94
5.5	4.95	6.05
6	5.4	6.6
6.4	5.76	7.04

3. Measuring Length with a Tape Measure

Tape Measures

Tape Measures are used for ensuring that the measured length of the product is satisfactory to the ordered length.

Measuring with Tape Measures

- For a 1 person operation the tape measure is extended inside the hollow section until the toggle extends past the end of the hollow section.
- Retract the tape until the toggle engages on the end of the hollow section.
- Record the length of section in millimetres.

Length Requirements

All measured lengths must be within a manufacturing tolerance of -0mm to +10mm of the nominal length specified.
(Note: Standard permits mill lengths -0mm to +100mm).

The tolerance of -0mm to +10mm of the nominal mill length is specified during manufacturing to provide a consistent product. For lengths cut after manufacture less than 6m, a tolerance of -0mm to +5mm applies. A closer tolerance may be specified by agreement.

Measurement Accuracy

Ensure that hook is in good condition. If loose or damaged this may cause error. Best practice is to check tape measure against a reference length such as a calibrated 1000mm or 1500mm steel rule.

Tape Measure

4. Measuring External Corner Radius with Corner Radius Gauges

Corner Radius Gauge

A Corner Radius gauge is a set of steel blades used to measure the length of the external corner profile on RHS & SHS product.

Each steel blade has a cut-out with a radius equal to the value stamped on its face.

Corner Radius gauges come in a set range. Each blade cut-out typically increases by 0.25 mm in size but can also increase in 0.5 & 1mm increments.

AS/NZS 1163 allows a choice of methods to measure the external corner. These are:-

(a) Measure the external corner radius.

Or

(b) Measure the length of the external corner profile.

Measuring with Corner Radius Gauge

- Select the radius gauge that is closest to double the wall thickness of the section being measured – this is considered as the nominal radius. Refer to Tolerance charts.
- As shown in the diagrams, place the Radius Gauge on the radius.
- Continue to select blades until there is nil to minimum air gap between the start and end of the product external corner radius and the radius gauge.
- The value stamped on the blade is the value of the corner radius.

Corner Radius Requirements

All RHS & SHS product must conform to the following:

- Corner dimensions for sizes equivalent to 50 x 50 or less – The minimum, maximum & variation of corner dimensions must conform to Table 1.
- For sizes greater than 50 x 50 or equivalent – The minimum, maximum & variation of corner dimensions must conform to Table 2.

Note: "t" is the Nominal gauge, measured in millimetres.

To ensure quality standards are maintained, the following corner requirements must be followed:

- All 4 corners are to be checked within the same plane on a single length.
- Measurements are to be conducted in a clockwise direction starting at the corner to the right of the weld, refer Diagram 2.

TABLE 1
Corner Radius Tolerance for Product Sizes 50 x 50 or Less
Product sizes: 20 x 20, 25 x 25, 30 x 30, 35 x 35, 40 x 40, 50 x 50, 38 x 25, 50 x 25, 75 x 25, 65 x 35

Nominal gauge (t) *	Nominal radius (2.0t)	Minimum radius (1.5t)	Maximum radius (3.0t)	Max Variation
1.6	3.2	2.4	4.8	1.2
2.0	4.0	3.0	6.0	1.5
2.3	4.6	3.5	6.9	1.7
2.5	5.0	3.8	7.5	1.9
2.8	5.6	4.2	8.4	2.1
3.0	6.0	4.5	9.0	2.3
3.5	7.0	5.3	10.5	2.6
4.0	8.0	6.0	12.0	3.0
5.0	10.0	7.5	15.0	3.8
6.0	12.0	9.0	18.0	4.5

Notes: * t = Nominal gauge (mm). All readings are in mm.

TABLE 2
Corner Radius Tolerance for Product Sizes Greater than 50 x 50
Product sizes: 65 x 65, 75 x 75, 89 x 89, 100 x 100, 125 x 125, 76.2 x 38.1, 75 x 50, 125 x 75, 100 x 50, 125 x 75, 150 x 100

Nominal gauge (t) *	Nominal radius (2.0t)	Minimum radius (1.8t)	Maximum radius (3.0t)	Max Variation
1.6	3.2	2.9	4.8	1.0
2.0	4.0	3.6	6.0	1.2
2.5	5.0	4.5	7.5	1.5
3.0	6.0	5.4	9.0	1.8
3.5	7.0	6.3	10.5	2.1
4.0	8.0	7.2	12.0	2.4
5.0	10.0	7.5	15.0	3.8
6.0	12.0	9.0	18.0	4.5

Notes: * t = Nominal gauge (mm). All readings are in mm.

External Corner Radius Gauge

Measuring External Corner Radius

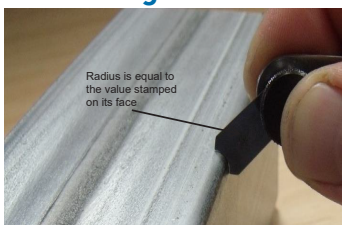
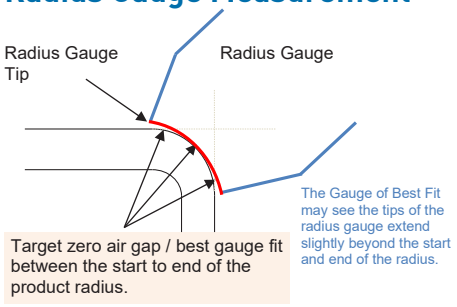


Diagram 1 -Schematic of an Ideal Radius Gauge Measurement



Measuring the Length of External Corner Profile

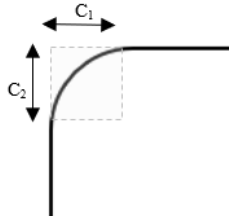
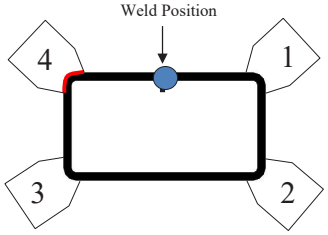


Diagram 2 - Corner Radius Checks Required for RHS & SHS Product



5. Measuring Concave / Convex with a Square & Feeler Gauge

Feeler Gauge & Engineers Square

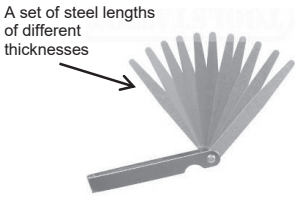
Feeler gauge is a set of steel lengths of different thicknesses used to measure a clearance between two points. They're flexible enough that even though they're all on the same hinge, several can be stacked together to gauge intermediate values.

The thickness of each piece is marked on its face.

An **Engineer square** is composed of two parts, the stock and the blade. They are positioned in an "L" shape 90° to each other. It's primarily used to check concave/convex & the end cut angle – when cut angle is in doubt.

Engineers Square

Feeler Gauge

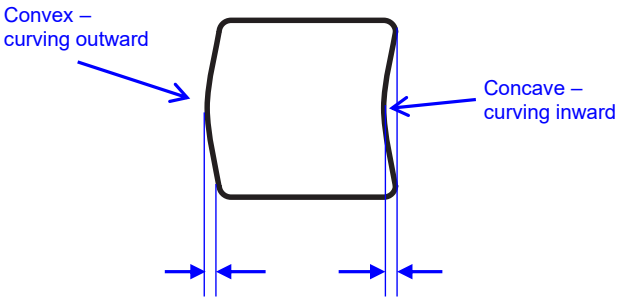


Concave & Convex

Due to the roll forming process for RHS & SHS product, each tube face may have a slight curve.

The word **Concave** means curving in or hollowed inward.

Convex is the opposite to concave, meaning curving out or bulging outward.



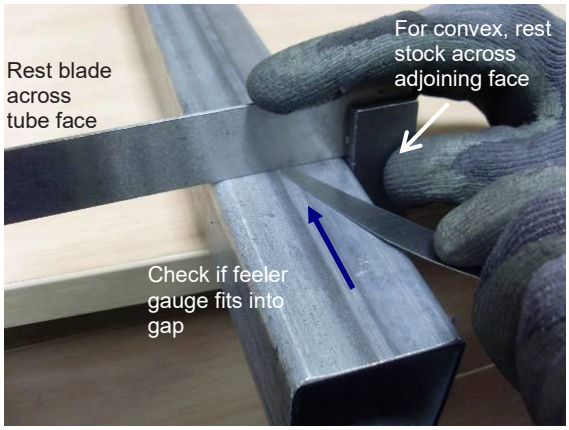
SHS & RHS
Convex & Concave Tolerance Table (mm)

Nominal size	Maximum concave & convex allowed (0.8% of nominal size or 0.5 mm, whichever is greater)
20	0.5
25	0.5
30	0.5
35	0.5
38	0.5
40	0.5
50	0.5
65	0.5
75	0.6
89	0.7
100	0.8
125	1.0
150	1.2
185	1.48

Checking Concave & Convex

- Refer to tolerance chart & select the Feeler gauge that represents the maximum concave/ convex allowed.
- For **Concave**, Place blade of square across the tube face.
- For **Convex**, rest blade on tube face with the Stock sitting across adjoining face.
- Try inserting the feeler gauge in the space between the blade & the tube face
  Note: Concave gap in centre of tube & blade, Convex gap between blade and corner of tube.
- If the feeler gauge does not fit into gap then it is **within tolerance.**
- If the feeler gauge **does** fit into gap, then product is **out of tolerance.**

Checking Concave / Convex



Concave & Convex requirements

To conform to AS/NZS 1163 standard, convex & concave cannot exceed 0.8% of the nominal size, or 0.5 mm – which ever value is greater.

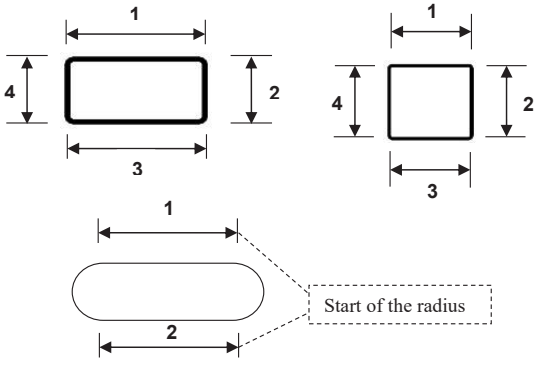
To ensure concave & convex quality standards are met, the following checks must be followed:

- **RHS & SHS** - All 4 sides 1 to 4 on section must be checked.
- **Flat Oval -** The 2 long flat sides must be checked from the start/ end point of the radius.
- Ensure that product is measured in **at least 300mm from the saw cut** to ensure away from size affect from the saw clamp/cut.

FLAT OVAL
Convex & Concave Tolerance Table (mm)

Nominal size	Maximum concave & convex allowed (0.8% of nominal size or 0.5 mm, whichever is greater)
59	0.5
62	0.5
66	0.5
75	0.6
80	0.6
85	0.7
97	0.7
115	0.9
145	1.2

No. of Concave / Convex checks required



6. Measuring Deviation (Bend) in a length

Straightness Requirements

To conform to AS/NZS 1163, the deviation per length shall be no greater than 0.2% of the total length for CHS product and no greater than 0.15% for SHS & RHS product.

The straightness test is to be applied anytime there is doubt that the amount of deviation in a length does NOT conform to standard.

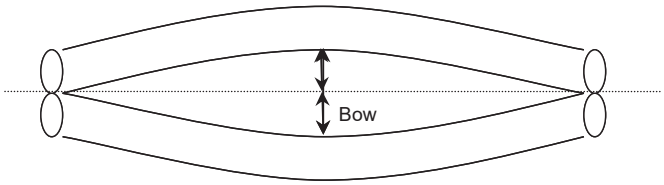
To check if deviation is with in tolerance, the following straightness test is to be followed:

Checking Deviation (Bend)

- Place 2 lengths with equal bend back to back so tube ends are touching.
- Measure at the point where the distance between both lengths is at its greatest.
- Divide the result by 2.
- Check deviation result is no greater than the allowable tolerance stated in opposite tolerance chart.
- Reject non-conforming product.

Material Ripple / Snaking

A ripple effect in the product may be experienced; this is also referred to as 'Snaking', see photo below. This is considered unacceptable and requires the product to be rejected.



Measure Gap and Divide By 2

Maximum Deviation (Bend) Tolerance Table

Length (mm)	CHS Max 0.2% (mm)	RHS & SHS Max 0.15% (mm)	Length (mm)	CHS Max 0.2% (mm)	RHS & SHS Max 0.15% (mm)
5500	11.0	8.3	9000	18.0	13.5
5600	11.2	8.4	9100	18.2	13.7
5700	11.4	8.6	9200	18.4	13.8
5800	11.6	8.7	9300	18.6	14.0
5900	11.8	8.9	9400	18.8	14.1
6000	12.0	9.0	9500	19.0	14.3
6100	12.2	9.2	9600	19.2	14.4
6200	12.4	9.3	9700	19.4	14.6
6300	12.6	9.5	9800	19.6	14.7
6400	12.8	9.6	9900	19.8	14.9
6500	13.0	9.8	10000	20.0	15.0
6600	13.2	9.9	10100	20.2	15.2
6700	13.4	10.1	10200	20.4	15.3
6800	13.6	10.2	10300	20.6	15.5
6900	13.8	10.4	10400	20.8	15.6
7000	14.0	10.5	10500	21.0	15.8
7100	14.2	10.7	10600	21.2	15.9
7200	14.4	10.8	10700	21.4	16.1
7300	14.6	11.0	10800	21.6	16.2
7400	14.8	11.1	10900	21.8	16.4
7500	15.0	11.3	11000	22.0	16.5
7600	15.2	11.4	11100	22.2	16.7
7700	15.4	11.6	11200	22.4	16.8
7800	15.6	11.7	11300	22.6	17.0
7900	15.8	11.9	11400	22.8	17.1
8000	16.0	12.0	11500	23.0	17.3
8100	16.2	12.2	11600	23.2	17.4
8200	16.4	12.3	11700	23.4	17.6
8300	16.6	12.5	11800	23.6	17.7
8400	16.8	12.6	11900	23.8	17.9
8500	17.0	12.8	12000	24.0	18.0
8600	17.2	12.9	12100	24.2	18.2
8700	17.4	13.1	12200	24.4	18.3
8800	17.6	13.2	12300	24.6	18.5
8900	17.8	13.4	12400	24.8	18.6
Table continues above→			12500	25.0	18.8

7. Measuring Squareness with an Adjustable Protractor

Adjustable Protractors

Adjustable Protractor's are used to check the squareness of RHS & SHS product.

They consist of 2 blades that when an angle is created the dial can be used to work out the angles value.

Measuring with an Adjustable Dial Protractor

- Open the protractor to create a right angle (90˚).
- Position the protractor so the corner of the section is sitting in the corner where the two blades overlap.
- Make sure each blade is sitting flat across tube face.
- Check the "0" on the inner dial with the graduation it best aligns with on the outer dial – this is the angle value.

Squareness Requirements

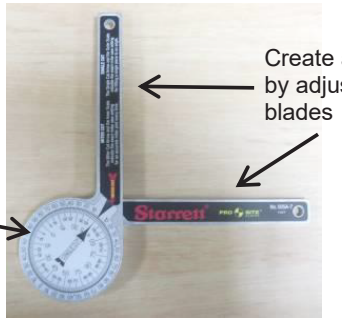
To conform to AS/NZS 1163 standards, two joining sides must be at right angle (90˚) with a tolerance of +/- 1˚.

The acceptable range for squareness on all RHS & SHS product will therefore be between 89˚- 91˚.

Adjustable Digital Protractor

- Open the protractor to create a right angle (90˚).
- Position the protractor so the corner of the section is sitting in the corner where the two blades overlap.
- Make sure each blade is sitting flat across tube face.
- Refer to the angle shown on the readout.

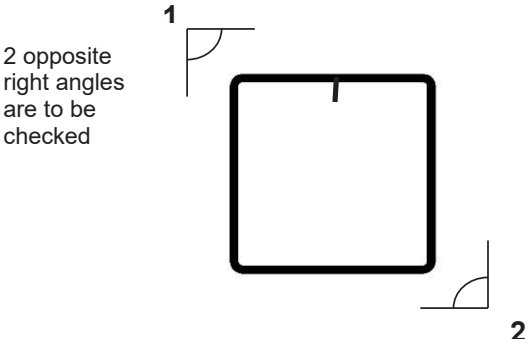
Adjustable Protractor



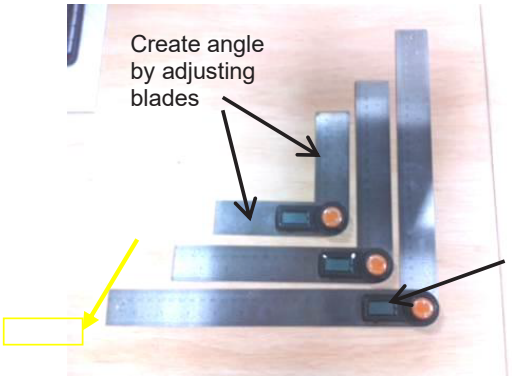
Measuring with an Adjustable Protractor

Adjust blades so they both sit flat on tube

No of square checks required for RHS & SHS



Adjustable Protractor



Adjust blades so they both sit flat on product face

Product Print Mark Quality Standard

INSTRUCTIONS & EXPLANATIONS:

- A Product Print Mark is applied **ONCE PER LENGTH** on every length.
- Product specified as 'Powder Coat Quality' (PQC) or 'No Product Print Mark' has no tube mark as per agreement.
- Julian date is also referred to as the unique identifier and is found on the test certificate.
- The production time and coil reference number is included for additional manufacturing traceability.

Issue Date: 25/3/2022

Customer: ORRCON DISTRIBUTION MELBOUR
Account No.: 0000003070 Customer Order No.: 4203470003
Delivery No.: 0080213729

Orrcon Manufacturing Pty Ltd
121 Evans Rd, Salisbury, QLD 4107
Tel: 07 3274 0500
Email: brizzyquality@orrcon.com.au
Website: www.orrconsteel.com.au
ABN: 15 113 998 066

TEST CERTIFICATE NO: 20223025701623290

PRODUCT TRACEABILITY

Line #	Work Order /Pack No	Part Number	Material ID	Description	Standard & Grade	Site & Mill	Unique Identifier[9]	Coil Number	Heat Number	Steel make[1]
8	1068739/29	MS03669	110105	89X89X6.0 PNT 12.000M	AS/NZS 1163 C350L0	SAL005	22082,22083	1H2I8863	6818249	B
9	1068739/30	MS03669	110105	89X89X6.0 PNT 12.000M	AS/NZS 1163 C350L0	SAL005	22082,22083	1H2I8863	6818249	B

Product is clearly marked once per length with the following:

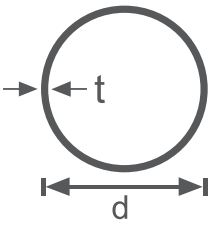
- "ORRCON", "AUS MADE", *Site-Mill ID*, Unique Identifier, Time, Coil Reference Number

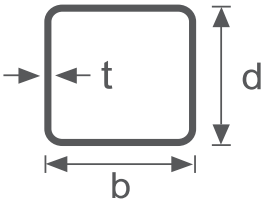
Notes:

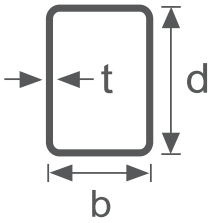
- Unique Identifier is the ***Julian date***. This is also found on the test certificate. YYDDD.
  - Example 22083 is 83rd day of 2022 = 24 March 2022
- Coil Reference number is for internal traceability (not the HEAT number).
- SAL/ S = Salisbury Site. Mill: 004 / 4 = RS90, 005 / 5 = OTO, 009 / 9 = Mill 6.
- For **450 Grade** Product Only Product Marking to include reference to "C450L0"

Appendix 2: Structural Standards & Tolerances

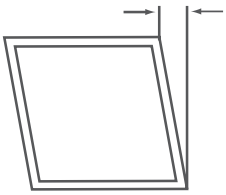
Standard Tolerances - Structural Tube & Pipe

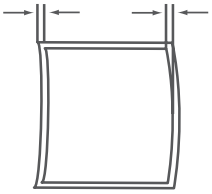


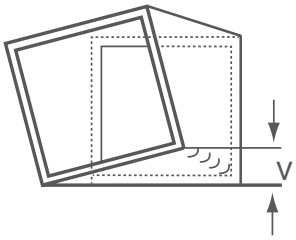




AS1163		Dimensional Tolerances	
Characteristic		Pipe (CHS)	Rectangular & Square (RHS / SHS)
External dimensions (d, b, d_0)		±1% with minimum of ±0.5mm & maximum ±10mm	±1% with minimum of ±0.5mm
Thickness (t)	d≤406.4mm	±10%	±10%
	d>406.4mm	±10% with max of ±2mm	
All Sections			
Mass		Not less than 96% of specified nominal mass	







AS1163		Shape Tolerances	
Characteristic		All Sections	
Corner Radius	≤ 50 x 50mm equivalent perimeter	1.5t to 3t	
	> 50 x 50mm equivalent perimeter	1.8t to 3t	
Twist (v)		≤2mm ±0.5mm /m Lengths	
Concavity / Convexity		Max 0.8% or 0.5mm, whichever is greater	
Squareness		90 ± 1°	
		Pipe (CHS)	Rectangle & Square (RHS/SHS)
Straightness		0.20% of total Lengths	0.15% of total Lengths

Standard Mechanical Properties - Structural Tube & Pipe

Standard	Grade*	Yield Strength MPa (min)	Tensile Strength MPa (min)	Elongation, % (min)					
				CHS (d_o/t)			RHS & SHS (b/t)		
				<15	15-30	>30	<15	15-30	>30
AS/NZS 1163	C250L0	250	320	18	20	22	14	16	18
	C350L0	350	430	16	18	20	12	14	16
	C450L0	450	500	12	14	16	10	12	14

***L0 designation indicates guaranteed impact strength properties at 0°C.**
C = Cold formed hollow section.