

# **DELIVERY CONDITION & ROLLING TOLERANCE**

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# DELIVERY CONDITION

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## DELIVERY CONDITION OF HOT ROLLED STEEL PRODUCTS

In general, all Hot Rolled Steel products shall be delivered free of defects and imperfections however there may be some discontinuities of harmless nature, minor imperfections, e.g. pitting, rolled in scale, indentations, roll marks, scratches and grooves which cannot be avoided completely despite proper manufacturing and which will not be objected to provided they do not exceed the acceptable limits as per specification such as BS EN 10163.

Some of the most common discontinuities are describe as below -

1. Rolled-in Scale and Pitting - marks on the rolled surface varying in shape, thickness and frequency results from inherent surface scaing of the stock before or during hot-rolling or processing.
2. Indentations and roll marks - normally attributed to the natural wear of rolls or pinch rolls. These discontinuities can be distributed at definite distances apart or irregularly throughout the length and width of stock.
3. Scratches, grooves - mechanical scoring at the surface. Scratches are mostly parallel or at right angles to the rolling direction. They may be slightly rolled over and seldom contain scale. This scoring is caused by friction between the stock and parts of the equipment due to relative movements.
4. Spills, slivers - minute surface discontinuities of an irregular and shell like nature. Spills and slivers are elongated in the direction of rolling, their extent depending on the degree of reduction. They are still connected, as minute particles of shell, to the base metal at certain points.
5. Blisters - Blow hole located closely beneath the surface, often appear during hot-rolling.
6. Sand Patches - Non-metallic internal inclusions, elongated in the direction of rolling and distinctly coloured.
7. Cracks - Narrow line of fracture on the surface, cracks are due mainly to material stresses which often develop during the cooling of the feedstock.
8. Shell - Overlapping material partially connected with the base material. There is a preponderance of non metallic inclusions and/or scale among the shell.
9. Seams - Caused mainly when imperfections in the semi-product are elongated and extended during rolling.

Discontinuities not exceeding the limits of respective specification are regarded as being inherent of the manufacturing process and are permissible irrespective of their number. Procedures to determine acceptance shall involve differentiation of Discontinuities in terms of imperfections and defects based on the depth and affected area as defined in the specification. Repair guidelines are provided in specificaiton to rectify the imperfections and some extracts on repair precedures from EM10163 are included herein for reference.

## REPAIR AND PROCEDURES BY GRINDING AND WELD PATCHING

### Grinding

- If the discontinuity has to be repaired, it shall be removed completely by grinding to its full depth.
- The ground areas shall have a smooth transition to the surrounding surface of the product.
- The maximum permitted grinding allowance below the minimum thickness to follow respective specification.

### Welding

- Defects shall be completely eliminated before any weld repair is commenced.
- The procedure shall not reduce the thickness of the product to less than 70% of its nominal thickness.
- The deposited weld material shall reach above the place surfact and shall subsequently be ground smooth and level with the product surface.

# ROLLING TOLERANCES TO JIS G 3192

## IN ACCORDANCE TO JIS G 3192

### 1. SCOPE

1.1 This Japanese Industrial Standard specifies the dimensions, mass and tolerances thereof of hot rolled steel sections as well as the appearance, shapes and permissible variations thereof

1.2 This Standard is applicable to the relevant product standards









### 2. DEFINITION

The steel section referred to this standard shall be the hot rolled steels to the sectional shape specified in 3, and then cut in specified length to be supplied

### 3. SECTIONAL SHAPE AND CLASSIFICATION

The standard sectional shapes of the steel sections and their classification shall be as given in Table 1

Table 1 Sectional Shape of Steel Section and Classification

Classification		Sectional Shape Diagram		
Angles	(A) Equal legs			
	(B) Unequal legs	A	B	C
	(C) Unequal legs and thicknesses			
I sections (or beam)				
Channels				
Bulb flats				
T sections				
H sections (or columns)				

### 4. EXPRESSION OF SIZE

The size of the steel section shall be expressed by each sectional dimension in millimeter, and the length in meter.

### 5. STANDARD DIMENSION

The standard dimensions shall be as follows:

(1) The standard lengths of the steel section shall be as given in Table 2

Table 2 Standard Length

Unit: m

Standard Length											
6.0	6.5	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	

### 6. SHAPE & DIMENSIONAL TOLERANCES

The shape and dimensional tolerances of the steel section shall be as follows:

The tolerances of the steel section other than those specified in (1) and (2), however, shall be agreed upon between the purchaser and supplier

(1) The shape and dimensional tolerances of the angles, I sections, channels, bulb flats and T sections shall be as given in Table 3.

(2) The shape and dimensional tolerances of the H sections shall be as given in Table 4. The tolerances on ends-out-of-square, however, shall be applied on request by the purchaser.

# ROLLING TOLERANCES TO JIS G 3192

## IN ACCORDANCE TO JIS G 3192

Table 3 Shape and Dimensional Tolerances of Angles, I Sections, Channels, Bulb Flats and T Sections

Unit: m

Dimension		Tolerance	Remark	
Leg length (A or B)	Under 50	± 1.5		
	50 or over to and excl. 100	± 2.0		
	100 or over to and excl. 200	± 3.0		
	200 or over	± 4.0		
Depth (H)	Under 100	± 1.5		
	100 or over to and excl. 200	± 2.0		
	200 or over to and excl. 400	± 3.0		
	400 or over	± 4.0		
Thickness (t, t1, t2)	- For leg length A (B for T section): under 130 in depth	Under 6.3		± 0.6
		6.3 or over to and excl. 10		± 0.7
		10 or over to and excl. 16	± 0.8	
		16 or over	± 1.0	
	- For leg length A (B for T section): under 130 in depth	Under 6.3	± 0.7	
		6.3 or over to and excl. 10	± 0.8	
		10 or over to and excl. 16	± 1.0	
		16 or over to and excl. 25	± 1.2	
		25 or over	± 1.5	
Length	7 m or under	+40.0 0		
	Over 7 m	Add 5 mm to the plus side tolerance given in the above column for every 1 m increase in lengths or its fraction		
Out-of-square (T)	I section	2.0% or under of width B		
	Sections excluding I and T sections	2.5% or under of width of flange B (or leg length)		
Bend	I section	0.20% or under of length	To be applied to bend such as sweep and camber	
	Sections excluding I and T sections	0.30% or under of length		
web-off-center (S)	300 or under in width B	± 3.0		
	T section			

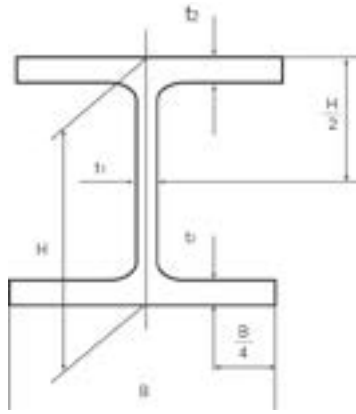
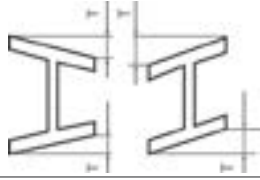



Remark: The purchaser may designate that the out-of-square shall be 2% and under of the leg length for equal leg angles 200mm or more in leg length

# ROLLING TOLERANCES TO JIS G 3192

## IN ACCORDANCE TO JIS G 3192

Table 4 Shape and Dimensional Tolerances of H Section

Unit: m

		Dimension	Tolerance	Remark
<b>Width (B)</b>		Under 100	± 2.0	
		100 or over to and excl. 200	± 2.5	
		200 or over	± 3.0	
<b>Depth (H)</b>		Under 400 in nominal depth	± 2.0	
		400 or over to and excl. 600	± 3.0	
		600 or over	± 4.0	
<b>Thickness</b>	<b>t<sub>1</sub></b>	Under 16	± 1.0	
		16 or over to and excl. 25	± 1.5	
		25 or over to and excl. 40	± 1.7	
		40 or over	± 2.0	
	<b>t<sub>2</sub></b>	Under 16	± 0.7	
		16 or over to and excl. 25	± 1.0	
		25 or over to and excl. 40	± 1.5	
		40 or over	± 2.0	
<b>Length</b>		7 m or under	+40 0	
		Over 7 m	Add 5 mm to the plus side tolerance given in the above column for every 1 m increase in lengths or its fraction	
<b>Out-of-square (T)</b>		300 or under in nominal depth	1.0% or under of width B, provided that 1.5mm is the maximum	
		Over 300 in nominal depth	1.2% or under of width B, provided that 1.5mm is the maximum	
<b>Bend</b>		300 or under in nominal depth	0.15% or under of length	To be applied to bend such as sweep and camber
		Over 300 in nominal depth	0.10% or under of length	
<b>Web-off-center (S)</b>		300 or under in nominal depth and 200 or under in nominal width	± 2.5	$S = \frac{b_1 - b_2}{2}$ 
		Over 300 in nominal depth and over 200 in nominal width	± 3.5	
<b>Concavity of web (W)</b>		Under 400 in nominal depth	2.0	
		400 or over to and excl. 600	2.5	
		600 or over	3.0	
<b>Ends-out-of-square (e)</b>			1.6% or under of width B or of depth H, provided that 3.0mm is the maximum	

# ROLLING TOLERANCES TO JIS G 3192

## IN ACCORDANCE TO JIS G 3192

### 7. MASS

The mass of the steel sections shall be as follows:

- 1) The mass of the steel section shall, as a rule, be expressed by theoretical mass in kilogram.
- 2) The method for calculation of mass of the steel section shall be in accordance with Table 5 based on the nominal dimensions.

Table 5 Method for Calculation of Mass

Calculating Step	Calculation Method	Number of Figures in Calculated Result
<b>Basic Mass</b> Kg / cm <sup>2</sup> .m	0.785 (Mass per cm <sup>2</sup> sectional area per meter length)	
<b>Sectional Area</b> cm <sup>2</sup>	The values calculated by the following formulas shall be multiplied by 1/100.	Round off to 4 significant figures
	For equal leg. angles $t (2A - t) + 0.215 (r_1^2 + 2 r_2^2)$	
	For unequal leg angles $t (A + B - t) + 0.215 (r_1^2 + 2 r_2^2)$	
	For unequal leg angles and unequal thicknesses $At_1 + t^2 (B - t_1) + 0.215 (r_1^2 + r_2^2)$	
	For I sections $Ht_1 + 2t_2 (B - t_1) + 0.615 (r_1^2 + r_2^2)$	
	For channels $Ht_1 + 2t_2 (B - t_1) + 0.349 (r_1^2 + r_2^2)$	
	For bulb flats $At + r dr_1 + 0.289d (2 r_1 + d) - 0.215 (r_1^2 + r_2^2)$	
	For T Sections $Bt_2 + 0.307 r_1^2 + 482.6$	
For H sections $T_1 (H - 2t_2) + 2Bt_2 + 0.858 r^2$		
Unit Mass kg/ m	Basic weight (kg/ cm <sup>2</sup> . m) x Sectional area (cm <sup>2</sup> )	Round off to 3 significant figures. For those exceeding 1000 kg, round off to integer in kg.
Mass of Single Piece kg	Unit mass (kg/ m) x length (m)	Round off to 3 significant figures. For those exceeding 1000 kg, round off to integer in kg.
Total Mass kg	Mass of single piece (kg) x total number of pieces of the same size	Round off to integer in kg.

Remarks:

- 1) The calculation methods for the sectional area of the steel section others than those given in the above Table shall be agreed upon between the purchaser and supplier.
- 2) The rounding off of the numerical values shall be in accordance with JIS Z 8401.

### 8. Tolerance on Mass

When the mass tolerances for steel section are designated by the purchaser, they shall confirm to Table 6. In this case, the tolerances on mass shall be expressed in percentage of the difference between the theoretical mass and actual mass to the theoretical mass.

Table 6 Tolerance on Mass

Thickness	Tolerance	Remark
Under 10mm	±5%	(1) Thicker nominal values shall be applied (2) To be applied to one lot of the same size (1t or over), provided that, when the number of pieces corresponding tp 1t does not amount to 10 pieces, it shall be applied to each lot of 10 or more pieces
10mm or over	±4%	

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# ROLLING TOLERANCES TO JIS G 3192

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## IN ACCORDANCE TO JIS G 3192

Table 4 **Shape and Dimensional Tolerances of H Section**

Unit: m

### 9. APPEARANCE

The appearance of the steel sections shall be as follows:

- 1) The steel section shall be free from defects that are detrimental to practical use.
- 2) In the case where there is any harmful defect on the surface of the steel section, the manufacturer may remove or repair the defects by grinding or welding. In this case, the operation shall be as follows :

#### (2 – 1) Conditioning with Grinder

- a) The sectional dimensions of the steel section after conditioning shall fall within the range of the tolerances. When approved by the purchaser, however, this restriction may be applied flexibly according to its application.
- b) The conditioned parts of the steel section shall be finished neatly, and the boundary between the repaired portions and as rolled surface shall be smoothly finished.



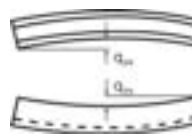
#### (2 – 2) Repair by Welding

- a) The harmful defects of the steel section shall be repaired by buildup welding after complete removal by means of appropriate method such as chipping or grinding.
- b) The depth of the defect removed portion previous to repair by welding shall be not more than 30% of the nominal thickness. For the toe of the flange of the steel section, however, the depth shall fall within the nominal thickness of the flange from the edge ( 12 mm max. )
- c) The repaired area by welding shall fall within 2% of the whole surface area of the steel section.
- d) The weld repairing shall be carried out by suitable means for the kind of steel product.
- e) The welded part of the steel section shall be free from undercut or overlaps around the fringe of welds the reinforcement of weld shall be at least 1.5mm or over height from the rolled surface, and this shall be removed by chipping, grinding, etc. and neatly finished as high as the rolled surface.
- f) The heat-treated steel sections themselves shall be heat treated once again after the repair by welding.

# ROLLING TOLERANCES TO EN 10034

## BS EN 10034: 1993

### TOLERANCES FOR PARALLEL FLANGE CHANNELS

Designation	Property	Range mm	Tolerance mm	Designation	Property	Range mm	Tolerance mm
	Height h	h ≤ 65 65 < h ≤ 200 200 < h ≤ 400 400 < h	+1.5 -1.5 +2.0 -2.0 +3.0 -3.0 +4.0 -4.0		Out of Square k+k <sub>1</sub>	b ≤ 100 100 < b	2.0 2.5% x b
	Flange Width b	b ≤ 50 50 < b ≤ 100 100 < b ≤ 125 125 < b	+1.5 -1.5 +2.0 -2.0 +2.5 -2.5 +3.0 -3.0			Straightness q <sub>xx</sub>	h ≤ 150 150 < h ≤ 300 300 < h
	Web Thickness s	s ≤ 10 10 < s ≤ 15 15 < s	+0.5 -0.5 +0.7 -0.7 +1.0 -0.1	q <sub>yy</sub>		h ≤ 150 150 < h ≤ 300 300 < h	0.50% x L 0.30% x L 0.20% x L
	Flange Thickness t	t ≤ 10 10 < t ≤ 15 15 < t	Tolerance-0.5 limited -1.0 by weight-1.5	Mass Per Unit Length	kg/m	h ≤ 125 125 < h	±6% ±4%
	Heel Radius r <sub>3</sub>	All Sizes	< 0.3 x t	Standard	Length	All	+100 -0
				Alternative Standard (by agreement)	L	All	+50 -50

### MASS TOLERANCES FOR JOISTS

Tolerances shall be applied to the actual mass per unit length of the joist. The rolling tolerances shall either be:

- ± 2.5% of the actual mass per unit length
- or
- + 5.0% of the actual mass per unit length where a minimum mass per unit length is ordered.

### LENGTH TOLERANCES FOR JOISTS

Joists ordered as "specified" or as "exact" lengths shall be supplied as follows:

- Specified lengths. When a joist is cut to a specified length, it shall be cut to within ± 25mm of that length. When a minimum length is specified, it shall be cut to within +50mm of that minimum length.  
-0
- Exact lengths. When a section is to be cut to an exact length, it shall be cold sawn to within ± 3.2mm of that length.

### TOLERANCE ON DEPTH OF SECTION FOR JOISTS

The tolerance on the nominal depth of section shall be as given in Table 1.

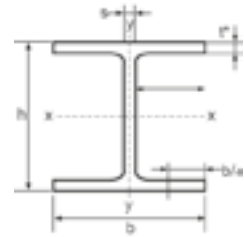
Table 1. Tolerance on Nominal Depth of Joists

Nominal Depth mm	Maximum Permissible Variation from Specified Depth	
	mm	mm
Up to 305	+3.2	-0.8

# ROLLING TOLERANCES TO EN 10034

## BS EN 10034: 1993

This European Standard specifies tolerances on shape dimensions and mass of structural steel universal beams and columns. These requirements do not apply to taper flange sections.



### SECTION HEIGHT (h)

The deviation from nominal on section height measured at the centre line of web thickness shall be within the tolerance given in Table 1(a).

Table 1 (a) Tolerance on Height and Cross-Section.

Section Height h mm	Tolerance mm
Up to and including 180	+3.0 -2.0
Greater than 180 up to & including 400	+4.0 -2.0
Greater than 400 up to & including 700	+5.0 -3.0
Greater than 700	±5.0

### FLANGE WIDTH (b)

The deviation from nominal on flange width shall be within the tolerance given in Table 1(b).

Table 1 (b) Tolerances on Flange Width.

Flange Width b mm	Tolerance mm
Up to and including 110	+4.0 -1.0
Greater than 110 up to & including 210	+4.0 -2.0
Greater than 210 up to & including 325	±4.0
Greater than 325	+6.0 -5.0

### WEB THICKNESS (s)

The deviation from nominal on web thickness measured at the mid-point of dimension (h) shall be within the tolerance given in Table 1(c).

Table 1 (c) Tolerances on Web Thickness

Web Thickness s mm	Tolerance mm
Less than 7	±0.7
7 up to but excluding 10	±1.0
10 up to but excluding 20	±1.5
20 up to but excluding 40	±2.0
40 up to but excluding 60	±2.5
60 and over	±3.0

### FLANGE THICKNESS (t)

The deviation from nominal on flange thickness measured at the quarter flange width point shall be within the tolerance given in Table 1(d).

Table 1 (d) Tolerances on Flange Thickness.

Flange Thickness t mm	Tolerance mm
Less than 6.5	+1.5 -0.5
6.5 up to but excluding 10	+2.0 -1.0
10 up to but excluding 20	+2.5 -1.5
20 up to but excluding 30	+2.5 -2.0
30 up to but excluding 40	±2.5
40 up to but excluding 60	±3.0
60 and over	±4.0

# ROLLING TOLERANCES TO EN 10034

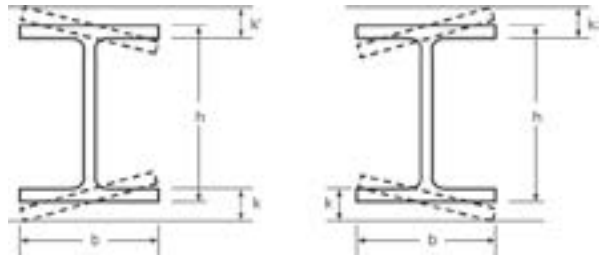
## BS EN 10034: 1993

### OUT-OF-SQUARENESS ( $k + k'$ )

The out-of-squareness of the section shall not exceed the maximum given in Table 2(a).

Table 2 (a) Tolerances on Out-of-Squareness of Universal Beams & Columns.

Flange width b mm	Out-of-squareness of flanges $k + k'$ mm
Up to and including 110	1.5
Greater than 110	2% of b (maximum 6.5mm)

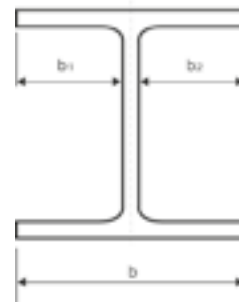


### WEB OFF-CENTRE (e)

The mid-thickness of the web shall not deviate from the mid-width position on the flange by more than the distance (e) given in Table 2(b).

Table 2 (b) Tolerances on Web Off-Centre of Universal Beams & Columns.

	Flange Width B mm	Web off-centre where $e = \frac{b_1 - b_2}{2}$ mm
	mm	mm
$t < 40$	Up to & including 110	2.5
	Greater than 110 up to & including 325	3.5
$t \geq 40$	Greater than 110 up to & including 325	5.0
	Greater than 325	8.0

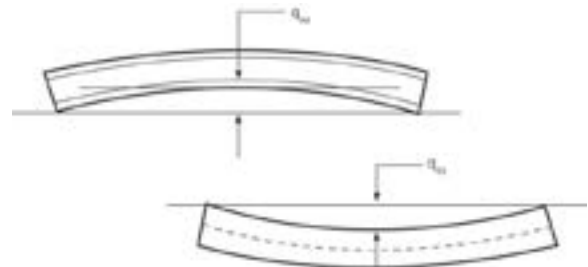


### STRAIGHTNESS ( $q_{xx}$ or $q_{yy}$ )

The straightness shall comply with the requirements given in Table 3.

Table 3 Tolerances on Straightness of Universal Beams and Columns.

Section Height h mm	Tolerance $q_{xx}$ or $q_{yy}$ on Length L %
Greater than 80 up to & including 180	0.30L
Greater than 180 up to & including 360	0.15L
Greater than 360	0.10L



### TOLERANCE ON MASS

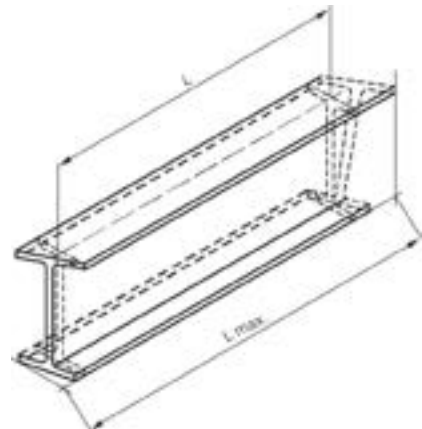
The deviation from the nominal mass of a batch or a piece shall not exceed  $\pm 4.0\%$

The mass deviation is the difference between the actual mass of the batch or piece and the calculated mass. The calculated mass shall be determined using a density of  $7850 \text{ kg/m}^3$ .

### TOLERANCE ON LENGTH

The sections shall be cut to ordered lengths to tolerances of:

- a)  $\pm 50 \text{ mm}$
- or
- b)  $+ 100 \text{ mm}$  where minimum lengths are requested.



L represents the longest length of the section assuming that the ends of the section have been cut square.

# ROLLING TOLERANCES TO EN10056

## BS EN 10056-2: 1993

This European standard specifies tolerances on shape dimensions & mass of hot-rolled structural steel equal & unequal leg angles.

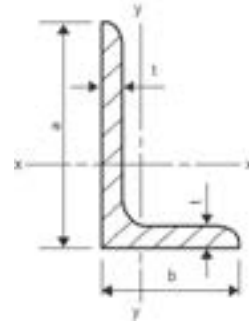
### TOLERANCES ON SHAPES & DIMENSIONS

#### LEG LENGTH (a or b)

The deviation from nominal on leg length shall be within the tolerance given in Table 1(a). For unequal leg angles, the longer leg length (a) shall be used to determine the tolerance band.

Table 1 (a) Dimensional Tolerances.

Leg Length a mm	Tolerance mm
Up to & including 50	±1.0
Greater than 50 up to & including 100	±2.0
Greater than 100 up to & including 150	±3.0
Greater than 150 up to & including 200	±4.0
Greater than 200	+6.0 -4.0



#### SECTION THICKNESS (t)

The deviation from nominal on thickness shall be within the tolerances given in Table 1(b).

Table 1 (b) Thickness Tolerances.

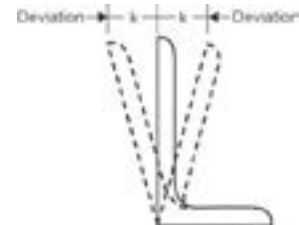
Section Thickness T mm	Tolerance mm
Up to & including 5	±0.50
Greater than 5 up to & including 10	±0.75
Greater than 10 up to & including 15	±1.00
Greater than 15	±1.20

#### OUT-OF-SQUARE (k)

Out-of-squareness of the section shall not exceed the maximum given in Table 1(c). For unequal leg angles, the longer leg length (a) shall be used to determine the tolerance band.

Table 1(c) Squareness Tolerances.

Out of square-Leg Length mm	Tolerance mm
Up to & including 100	1.0
Greater than 100 up to & including 150	1.5
Greater than 150 up to & including 200	2.0
Greater than 200	3.0

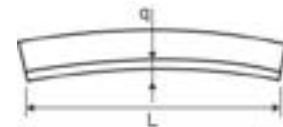


#### STRAIGHTNESS (q)

The deviation from straightness shall not exceed the tolerances given in Table 1(d). For unequal leg angles, the longer leg length (a) shall be used to determine the tolerance band.

Table 1 (d) Straightness Tolerances.

Leg Length a mm	Tolerance (mm)		
	Over Full Bar Length	Over Any Part Bar Length	
	Deviation q (mm)	Length Considered (mm)	Deviation q (mm)
Up to & including 150	0.4% L	1500	6.0
Up to & including 200	0.2% L	2000	
Greater than 200	0.1% L	3000	3.0



#### TOLERANCE ON MASS

The deviation from the nominal mass of any individual piece shall not exceed:

- ± 6% for thickness for  $t \leq 4\text{mm}$
- ± 4% for thickness for  $t > 4\text{mm}$ .

The deviation from the nominal mass is the difference between the actual mass of the piece and the calculated mass. The calculated mass shall be determined using a density of  $7850\text{kg/m}^3$ .

#### TOLERANCE ON LENGTH

The tolerance on ordered length shall be either:

- ± 50mm
  - or
  - + 100mm where minimum lengths are require.
- 0

# ROLLING TOLERANCES ON FLAT PRODUCT TO JIS G 3193

## IN ACCORDANCE TO JIS G 3193 DIMENSIONS, AMSS AND PERMISSIBLE VARIATIONS

### 1. SCOPE

- 1.1 This Japanese Industrial Standard specifies the dimensions, mass and tolerances thereon of the hot rolled steel plates, sheets and strip as well as the appearance, shape and permissible variations thereof. However, this standard is not applicable to the flat steel.
- 1.2 This standard is applicable to the relevant product standards

Remark: The units and numerical values given in { } in this Standard are based on the International System of units (SI) and are appended for informative reference.

### 2. EXPRESSION OF SIZE

The expression of size of the steel plates, sheets and strip shall be as follows:

- 1) The size of the steel plates and sheets shall be expressed by thickness, width and length in millimeters
- 2) The size of the steel strip shall be expressed by thickness and width in millimeters

### 3. STANDARD DIMENSIONS

The standard dimensions shall be as follows:

- 1) The standard thickness of the steel plates, sheet and strip shall as given in Table 1.

Table 1. Standard Thickness

Unit: mm

1.2	1.4	1.6	1.8	2.0	2.3	2.5	(2.6)	2.8	(2.9)	3.2
3.6	4.0	4.5	5.0	5.6	6.0	6.3	7.0	8.0	9.0	10.0
11.0	12.0	12.7	13.0	14.0	15.0	16.0	(17.0)	18.0	19.0	20.0
22.0	25.0	25.4	28.0	(30.0)	32.0	36.0	38.0	40.0	45.0	50.0

#### Remarks

1. The standard thickness not in parentheses should preferably be used.
2. For the steel strip and cut lengths therefrom, the standard thickness of 12.7mm or under shall be applied.
  - 2) The standard widths of the steel plates, sheets and strip shall be as given in Table 2.

Table 2. Standard Width

Unit: mm

600	630	670	710	750	800	850	900	914
950	1000	1060	1100	1120	1180	1200	1219	1250
1300	1320	1400	1500	1524	1600	1700	1800	1829
1900	2000	2100	2134	2438	2500	2600	2800	3000
3048								

#### Remarks

1. For the steel strip and cut lengths therefrom, the standard widths of 2000mm or under shall be applied
2. For the steel plates, excluding the cut lengths from the steel strip, the standard widths of 914mm, 1219mm and 1400mm or over shall be applied.
  - 3) The standard lengths of the steel plates and sheets shall be as given in Table 3.

Table 3. Standard Length of Steel Plates and Sheets

1929	2438	3048	6000	6096	7000	8000	9000	9144
10000	12000	12192						

#### Remark

1. The lengths given in the above Table shall not be applied to the cut lengths from the steel strip.

# ROLLING TOLERANCES ON FLAT PRODUCT TO JIS G 3193

## IN ACCORDANCE TO JIS G 3193

### 4. TOLERANCES ON SHAPE AND DIMENSION

The tolerances on shape and dimension for the steel plates, sheets and strip shall be as follows: However, they shall not be applied to the irregular portions of both ends of the steel strip.

1) The tolerances on thickness of the steel plates, sheets and strip shall be as given in Table 4

Table 4 Tolerances Thickness

Unit: mm

Thickness	Width					
	Under 1600	1600 or over to and excl. 2000	2000 or over to and excl. 2500	2500 or over to and excl. 3150	3150 or over to and excl. 4000	4000 or over to and excl. 5000
Under 1.25	±0.16					
1.25 or over to and excl. 1.60	±0.18					
1.60 or over to and excl. 2.00	±0.19	±0.23				
2.00 or over to and excl. 2.50	±0.20	±0.25				
2.50 or over to and excl. 3.15	±0.22	±0.29	±0.29			
3.15 or over to and excl. 4.00	±0.24	±0.34	±0.34			
4.00 or over to and excl. 5.00	±0.45	±0.55	±0.55	±0.65		
5.00 or over to and excl. 6.30	±0.50	±0.60	±0.60	±0.75	±0.75	
6.30 or over to and excl. 10.0	±0.55	±0.65	±0.65	±0.80	±0.80	±0.90
10.0 or over to and excl. 16.0	±0.55	±0.65	±0.65	±0.80	±0.80	±1.00
16.0 or over to and excl. 25.0	±0.65	±0.75	±0.75	±0.95	±0.95	±1.10
25.0 or over to and excl. 40.0	±0.70	±0.80	±0.80	±1.00	±1.00	±1.20
40.0 or over to and excl. 63.0	±0.80	±0.95	±0.95	±1.10	±1.10	±1.30
63.0 or over to and excl. 100	±0.90	±1.10	±1.10	±1.30	±1.30	±1.50
100 or over to and excl. 160	±1.30	±1.50	±1.50	±1.70	±1.70	±1.90
160 or over to and excl. 200	±1.60	±1.80	±1.80	±1.90	±1.90	±2.10
200 or over to and excl. 250	±1.80	±1.90	±1.90	±2.00	±2.00	±2.20
250 or over to and excl. 300	±2.0	±2.10	±2.10	±2.20	±2.20	±2.50
300 or over to and excl. 350	±2.1	±2.30	±2.30	±2.40	±2.40	±2.80

#### Remarks

- Either plus side or minus side of the thickness tolerances given in the above table may be limited on request. The total tolerances in this case shall be equal to those given in Table 4.
- Thickness shall be measured at any point on the steel strip not less than 25mm from a side edge for the mill edge strip 50mm or over in width and cut lengths therefrom, and on the center line for those less than 50mm in width. For the cut edge steel strip 30mm or over in width and cut lengths therefrom, measurement shall be made at any point not less than 15mm from a side edge and on the center line for those less than 30mm in width.

# ROLLING TOLERANCES ON FLAT PRODUCT TO JIS G 3193

## IN ACCORDANCE TO JIS G 3193

2) The tolerances in width of the steel plates, sheets and strip shall be a given in table 5.

Table 5. Tolerances on Width

Unit: mm

Width	Thickness	Tolerance						
		Mill Edge		Cut Edge				
		Steel Plate as rolled (with untrimmed edge)	Steel strip and cut lengths therefrom	A Normal Cut Edge		B Resheared or Fine Cut Edge		C Slitted Edge
+	-			+	-			
Under 160	Under 3.15	-	±2.0	5	0	2.0	0	±0.3
	3.15 or over to and excl. 6.00			5		3.0		±0.5
	6.00 or over to and excl. 20.0			10		4.0		-
	20.0 or over			10		-		-
160 or over to and excl. 250	Under 3.15	-	±2.0	5	0	2.0	0	±0.4
	3.15 or over to and excl. 6.00			5		3.0		±0.5
	6.00 or over to and excl. 20.0			10		4.0		-
	20.0 or over			15		-		-
250 or over to and excl. 400	Under 3.15	0 +Not specified	±5.0	5	0	2.0	0	±0.5
	3.15 or over to and excl. 6.00			5		3.0		±0.5
	6.00 or over to and excl. 20.0			10		4.0		-
	20.0 or over			15		-		-
400 or over to and excl. 630	Under 3.15	0 +Not specified	±20.00 0	10	0	3.0	0	±0.5
	3.15 or over to and excl. 6.00			10		3.0		±0.5
	6.00 or over to and excl. 20.0			10		5.0		-
	20.0 or over			15		-		-
630 or over to and excl. 1000	Under 3.15	0 +Not specified	±30.00 0	10	0	4.0	0	-
	3.15 or over to and excl. 6.00			10		4.0		-
	6.00 or over to and excl. 20.0			10		6.0		-
	20.0 or over			15		-		-
1000 or over to and excl. 1250	Under 3.15	0 +Not specified	±35.00 0	10	0	4.0	0	-
	3.15 or over to and excl. 6.00			10		4.0		-
	6.00 or over to and excl. 20.0			15		6.0		-
	20.0 or over			15		-		-
1250 or over to and excl. 1600	Under 3.15	0 +Not specified	±40.00 0	10	0	4.0	0	-
	3.15 or over to and excl. 6.00			10		4.0		-
	6.00 or over to and excl. 20.0			15		6.0		-
	20.0 or over			15		-		-
1600 or over	Under 3.15	0 +Not specified	±2.0	10	0	4.0	0	-
	3.15 or over to and excl. 6.00			10		4.0		-
	6.00 or over to and excl. 20.0			1.2%		6.0		-
	20.0 or over			1.2%		-		-

### Remark

- For the mill edge steel strip less than 400mm in width and cut lengths therefrom, the width tolerance on minus side may be limited to zero. In this case, the tolerance on plus side shall be twice the values given in Table 5 above.

# ROLLING TOLERANCES ON FLAT PRODUCT TO JIS G 3193

## IN ACCORDANCE TO JIS G 3193

3) The tolerances on length for the steel plate and sheet shall be as given in Table 6.

Table 6. Tolerance on Length of Steel Plate and Sheet

Unit: mm

Length	Thickness	Tolerance	
		A Normal cutting	B Reshearing or fine Cutting
Under 6300	Under 6.00	+25.0 0	+5.0 0
	6.00 or over	+25.0 0	+10.0 0
6300 or over	Under 6.00	+0.5% 0	+10.0 0
	6.00 or over	+0.5% 0	+15.0 0

Remark

1. Tolerance B does not apply to that of 20mm or over in width
- 4) The maximum value of camber for the steel plates, sheets and strip shall be as given in Tables 7 and 8.

Table 7. Camber for Steel Plates and Sheets

Unit: mm

Length	Width		
	250 or over to and excl. 630	630 or over to and excl. 1000	1000 or over
Under 2500	5	4	3
2500 or over to and excl. 4000	8	6	5
4000 or over to and excl. 6300	12	10	8
6300 or over to and excl. 10000	20	16	12
10000 or over	20 in any 10000 length	16 in any 10000 length	16 in any 10000 length

Remarks

1. For the tolerances on camber of the steel plates and sheets under 250mm in width, Table 8 shall be applied.
2. This table shall not be applied to the steel plates and sheets as rolled (with untrimmed edge)
3. For determination of camber of the steel plates and sheets, it shall be in accordance with Figure 1

Figure 1. Application of Camber of Steel Plates and Sheets

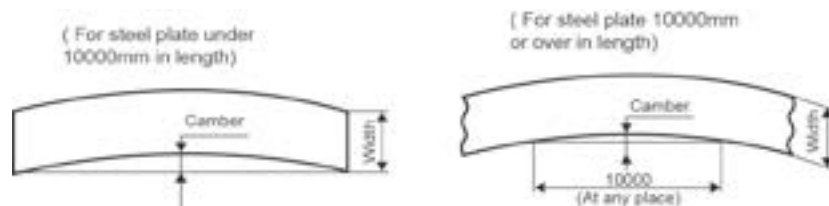


Table 8. Camber of Steel Strip

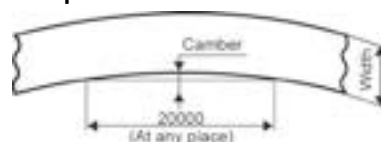
Unit: mm

Width	Maximum Value
Under 250	8 in any 20000 length
250 or over	5 in any 20000 length

Remark

1. The application of camber of the steel strip shall be in accordance with Figure 2.

Figure 2. Application of Camber of Steel Strip



# ROLLING TOLERANCES ON FLAT PRODUCT TO JIS G 3193

## IN ACCORDANCE TO JIS G 3193

2) The maximum deviation of flatness of the steel plates and sheets shall be as given in Table 9

Table 9. Flatness of Steel plates and Sheets

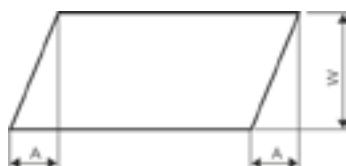
Unit: mm

Thickness	Width				
	Under 1250	1250 or over to and excl. 1600	1600 or over to and excl. 2000	2000 or over to and excl. 3000	3000 or over
Under 1.60	18	20	-	-	-
1.60 or over to and excl. 3.15	16	18	20	-	-
3.15 or over to and excl. 4.00	16			-	-
4.00 or over to and excl. 6.00	14			24	25
6.00 or over to and excl. 10.0	13			21	22
10.0 or over to and excl. 25.00	12			16	17
25.00 or over to and excl. 40.0	9			13	14
40.0 or over to and excl. 63.0	8			11	11
63.0 or over to and excl. 200	7			10	10
200 or over to and excl. 350	20				

### Remarks

- This table shall not be applied to the stretcher leveled steel plates and sheet for delivery.
- The values given in the above table shall be applied to any 2000mm length. For the steel plate and sheet less than 2000mm in length, the values shall be applied to the full length.  
For the steel plate and sheet over 2000mm in wave pitch, the values given in the above Table shall be applied to any pitch of the wave. For those over 4000mm in wave pitch, however, the above values shall be applied to any 4000mm length.
- The deviation from the flatness shall be determined as the difference between the maximum deviation of convex side uppermost from the flat surface and the thickness of the steel plate and sheet themselves.
- This table shall not be applied to the as-rolled steel plates and sheets (with untrimmed edge).
- Measurement of flatness, as a rule, shall be made on a flat surface plate.
- The out-of-square of cut length from cut edged steel strip shall be expressed in A.w as shown in Figure 3 and shall not exceed 1.0%.

Fig. 3. Out-of-square of Cut Lengths from Strip



Remark: A is the measured value, and W is the nominal width.

# ROLLING TOLERANCES ON FLAT PRODUCT TO JIS G 3193

## IN ACCORDANCE TO JIS G 3193

### 5. MASS

#### 5.1 Mass of Steel Plates and Sheets

The mass of the steel plates and sheets shall be as follows:

- The mass of the steel plates and sheet shall generally be the theoretical mass expressed in kilogrammes.
- The method for calculation of mass of the steel plates and sheet shall be in accordance with Table 10 based on their nominal dimensions. For the steel plates and sheets which are specified to limit either plus side or minus side of their thickness tolerance given in Table 4 in accordance with 4. (1), the mean value of the maximum and minimum thicknesses in each range of tolerance shall be used of the normal thicknesses.

Table 10. Method for calculation of Mass of Steel Plates and Sheets

Step of Calculation		Calculation method	Number of figures in Calculated Result
Basic Mass kg /mm.m <sup>2</sup>		7.85 (mass per mm thickness per m <sup>2</sup> area)	-
Unit Mass kg/m <sup>2</sup>		Basic mass (kg/mm.m <sup>2</sup> ) x thickness of plates or sheets (mm)	Round off to 4 significant figures
Area of Steel Plates or Sheets M <sup>2</sup>		Width (m) x Length (m)	Round off to 4 significant figures
Mass of Single Plates or Sheets kg		Unit mass (kg/m <sup>2</sup> ) x area (m <sup>2</sup> )	Round off to 3 significant figures. For those exceeding 1000 kg, integer, round off to in kg.
Neither bundled Nor packed	Total mass kg	Mass of single plate or sheet (kg) x number of plates or sheets of the same size	Round off to integer in kg
Bundled or Packed	Mass of Single Bundle kg	Mass of single plate or sheet (kg) x number of plates or sheets per bundle of the same size	Round off to integer in kg
	Total Mass kg	Sum of mass of each bundle	Integer in kg.

#### Remarks

- Rounding off the numerical values shall be in accordance with JIS Z 8401.
- When the steel plates or sheets are bundle (or packed) the total mass may be calculated as follows:  
Mass of single sheets (kg) x Number of plates or sheets of the same size

#### 5.2 Mass of Steel Strip

The mass of the steel strip shall be as follows:

- The mass of the steel strip shall generally be the actual mass expressed in kilogrammes.
- For the mass of the steel strip, the maximum mass of each coil shall generally be specified by agreement, where not less than 75% of the total number of steel strip shall be not less 70% of the specified mass and the rest may include shorter steel strip of 30% to 70% excluding in specified mass.

### 6 APPEARANCE

The appearance of the steel plates, sheets and strip shall be as follows:

- The steel plates, sheets and strip shall be free from defects that are detrimental to practical use. For the steel strip, however, some irregular portions may be included therein, since generally the steel strip is affordable no opportunity to inspect readily and remove such defective parts.
- For the steel strip and cut lengths the therefrom, the provision concerning harmful surface defects shall generally be applied to one side of the surfaces. The term "one side of the surfaces" means the outside surface for the steel strip and the upper side surface for the cut lengths therefrom.
- In the case where there is any harmful defect on the surface of the steel plates and sheets, the manufacturer may remove or repair the defect by grinding or welding. In this case, the operation shall be as follows:
  - conditioning with grinder
    - The thickness of the steel plates and sheets after conditioning shall fall within the tolerances on thickness.
    - The conditioning parts of the steel plate and sheet shall be finished neatly, and the boundary between the repaired portions on the as-rolled surface shall be smoothly finished.
  - Repair by Welding
    - The harmful defects of the steel plate and sheet shall be removed thoroughly by suitable means such as chipping or grinding prior to selding. The depth of the removed part shall be not more than 20% of the nominal thickness, and the total conditioned area on the side surface shall not exceed 2% of the area of one side of the steel plates and sheets.
    - The repair by welding shall be carried out by suitable means for the kind of steel products.
    - The welded part of the steel plates and sheet shall be free from undercuts or overlaps around the fringe of welds. The reinforcements of weld shall be at least 1.5mm or over height from the rolled surface and this shall be removed by chipping, grinding, etc. and neatly finished as high as the rolled surface.
    - The heat-treated steel plates and sheets themselves shall be heat treated once again after the repair by welding.

# STEEL GRADE SPECIFICATION

## STRUCTURAL STEEL AND SHEET PILE

Type of Product	Classifications		Mechanical Properties								
			Yield Point N/mm <sup>2</sup> (min.)		Tensile Strength N/mm <sup>2</sup>	Yield Ratio % (max.)	Elongation % (min.)			Impact J (min.)	
			Thickness			Thickness	Thickness			Thickness	
			t ≤ 16	16 < t ≤ 40		t ≥ 12	t ≤ 5	5 < t ≤ 16	t > 16	t > 12	
Structural Steel	TIS 1227 1996	SM400	245	235	400-510 490-610 540 min	-	23	18	22	27 <sup>A</sup>	
		SM490	325	315		-	22	17	21	27 <sup>A</sup>	
		SM520	365	355		-	19	15	19	27 <sup>A</sup>	
		SS400	245	235		-	21	17	21	-	
		SS490	285	275		-	19	15	19	-	
		SS540	400	390		-	16	13	17	-	
	JIS G3101 1995	SS400	245	235	400-510	-	21	17	21	-	
		SS490	285	275	490-610	-	19	15	19	-	
		SS540	400	390	540 min	-	16	14	17	-	
	JIS G3106 1995	SM400A	245	235	400-510	-	23	18	22	-	
		SM400B	245	235	400-510	-	23	18	22	27 <sup>A</sup>	
		SM490A	325	315	490-610	-	22	17	21	-	
		SM490B	325	315	490-610	-	22	17	21	27 <sup>A</sup>	
		SM490YA	365	355	490-610	-	19	15	19	-	
		SM490YB	365	355	490-610	-	19	15	19	27 <sup>A</sup>	
	JIS G3136 1994	SN400A	235	235	400-510	-	17	17	21	-	
		SN400B	235-355 <sup>G</sup>	235-355	400-510	80 <sup>H</sup>	18	18	22	27 <sup>A</sup>	
		SN490B	325-445 <sup>G</sup>	325-445	490-610	80 <sup>H</sup>	17	17	21	27 <sup>A</sup>	
	BS4360 1986	43A	275	265	430-580	-	20	20	20	-	
		43C	275	265	430-580	-	20	20	20	27 <sup>A</sup>	
50A		355	345	490-640	-	18	18	18	-		
50B		355	345	490-640	-	18	18	18	27 <sup>B</sup>		
50C		355	345	490-640	-	18	18	18	27 <sup>A</sup>		
BS EN 10025 1993	S275JR	275	265	410-560	-	22	22	22	27 <sup>B</sup>		
	S355JR	355	345	490-630	-	22	22	22	27 <sup>B</sup>		
ASTM 1994	A36	250		400-560	-	20			-		
	A572 Gr.42	290		415 min	-	20			-		
	A572 Gr.50	345		450 min <sup>E</sup>	-	18			-		
DIN 17100 1980	St 33	185	175	290	-	16			-		
	St 37-2	235	225	340-470	-	24			-		
	St 44-2	275	265	410-540	-	20			-		
	St 50-2	295	285	470-610	-	18			-		
		t ≤ 12		12 < t ≤ 40							
AS/NZS 3679.1 1996	250	260	250	410	-	22			-		
	250L0	260	250	410	-	22			-		
	350	360	340	480	-	20			-		
	350L0	360	340	480	-	20			-		
	t < 11		11 ≤ t ≤ 17	t > 17							
	300	320	300	280	440	-	22			-	
300L0	320	300	280	440	-	22			-		
CAN/CSA G40.21-M92 1992	230G	230		380-500	-	21			-		
	260W	260		410-590	-	20			-		
	300W	300		450-620	-	20			-		
	350W	350		450-650	-	19			-		
	380W	380		480-650	-	18			-		
Sheet Pile	JIS A5528 1988	SY295	295	490 min	-	17			-		
	TIS 1390-1996	SY390	390	540 min	-	15			-		

### Remarks

Carbon Equivalent (%) = C + Mn/6 + Si/24 + Ni/40 + Cr/5 + Mo/4 + V/14 (JIS STANDARD)

Carbon Equivalent (%) = C + Mn/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15 (AS STANDARD)

Chemical Composition on sensitivity of welding crack = C + Si/30 + Mn/20 + Cu/20 + Ni/60 + Cr/20 + Mo/15 + V/10 + 5B

A: Impact test on material grades S<400, SM490, 43C and 50C with thickness 12mm at 0°C.

B: Impact test on material grades 50B, S257JR and S355JR with thickness 12mm at 20°C.

C: It is permissible to vary the carbon and manganese contents (ladle analysis) for grades 50B, 50C, 50D, 50DD and 50EE on the basis of an increase of 0.06% manganese content for each decrease of 0.01% carbon or vice versa up to a maximum manganese content of 1.60% and a maximum carbon content of 0.22% for grades 50B and 50C and 0.20% for grades 50D, 50DD and 50EE.

# STEEL GRADE SPECIFICATION

## STRUCTURAL STEEL AND SHEET PILE

Chemical Compositions											
C (max)	Si (max)	Mn	P (max)	S (max)	Carbon Equivalent % (max)	Sensitivity of Welding Crack % (max)	Nb	V	N (max)	Cu (min)	Type of Product
0.20	0.35	0.60-1.40	0.035	0.035	-	-	-	-	-	-	Structural Steel
0.18	0.55	1.60 max	0.035	0.035	-	-	-	-	-	-	
0.20	0.55	1.60 max	0.035	0.035	-	-	-	-	-	-	
-	-	-	0.050	0.050	-	-	-	-	-	-	
-	-	-	0.050	0.050	-	-	-	-	-	-	
0.30	-	1.60 max	0.040	0.040	-	-	-	-	-	-	
-	-	-	0.050	0.050	-	-	-	-	-	-	
-	-	-	0.050	0.050	-	-	-	-	-	-	
0.30	-	1.60 max	0.040	0.040	-	-	-	-	-	-	
0.23	-	2.5 x C min	0.035	0.035	-	-	-	-	-	-	
0.20	0.35	0.60-1.40	0.035	0.035	-	-	-	-	-	-	
0.20	0.55	1.60 max	0.035	0.035	-	-	-	-	-	-	
0.18	0.55	1.60 max	0.035	0.035	-	-	-	-	-	-	
0.20	0.55	1.60 max	0.035	0.035	-	-	-	-	-	-	
0.20	0.55	1.60 max	0.035	0.035	-	-	-	-	-	-	
0.24	-	-	0.050	0.050	-	-	-	-	-	-	
0.20	0.35	0.60-1.40	0.030	0.015	0.36	0.26	-	-	-	-	
0.18	0.55	1.60 max	0.030	0.015	0.44	0.29	-	-	-	-	
0.25	0.50	1.60 max	0.050	0.050	-	-	-	-	-	-	
0.18	0.50	1.50 max	0.040	0.040	-	-	-	-	-	-	
0.23	0.50	1.60 max	0.050	0.050	-	-	0.003-0.100	0.003-0.100	-	-	
0.20 <sup>c</sup>	0.50	1.50 <sup>c</sup> max	0.050	0.050	-	-	0.003-0.100	0.003-0.100	-	-	
0.20 <sup>c</sup>	0.50	1.50 <sup>c</sup> max	0.040	0.040	-	-	0.003-0.100	0.003-0.100	-	-	
0.21	-	1.50 max	0.045	0.045	-	-	-	-	0.009*	-	
0.24	0.55	1.60 max	0.045	0.045	-	-	-	-	0.009*	-	
0.26	0.40	-	0.040	0.050	-	-	-	-	-	-	
0.21	0.40	1.35 <sup>F</sup> max	0.040	0.050	-	-	-	-	-	-	
0.23	0.40	1.35 <sup>F</sup> max	0.040	0.050	-	-	-	0.01-0.15	-	-	
-	-	-	-	-	-	-	-	-	-	-	
0.20	-	-	0.050	0.050	-	-	-	-	0.009*	-	
0.21	-	-	0.050	0.050	-	-	-	-	0.009*	-	
-	-	-	0.050	0.050	-	-	-	-	0.009*	-	
0.25	0.40	-	0.40	0.40	0.43	-	-	-	-	-	
0.20	0.40	1.50 max	0.40	0.40	0.42	-	-	-	-	-	
0.22	0.50	1.60 max	0.40	0.40	0.45	-	-	-	-	-	
0.22	0.50	1.60 max	0.40	0.40	0.45	-	-	-	-	-	
0.22	0.50	1.60 max	0.40	0.40	0.44	-	-	-	-	-	
0.22	0.50	1.60 max	0.40	0.40	0.44	-	-	-	-	-	
0.26	0.40	1.2 <sup>F</sup> max	0.50	0.50	-	-	-	-	-	-	
0.20	0.40	0.5-1.50	0.40	0.50	-	-	-	-	-	-	
0.22	0.40	0.5-1.50	0.40	0.50	-	-	-	-	-	-	
0.23	0.40	0.5-1.50	0.40	0.50	-	-	-	-	-	-	
0.23	0.40	0.5-1.50	0.40	0.50	-	-	-	-	-	-	
-	-	-	0.040	0.040	-	-	-	-	-	0.25	Sheet Pile
-	-	-	0.040	0.040	-	-	-	-	-	0.25	

E: For grade 50 steel of thicknesses 20mm and under, the tensile strength shall be a minimum of 485 N / mm<sup>2</sup>.

F: A Maximum of manganese of 1.50% is permissible, with an associated reduction of the carbon maximum of 0.03%.

G: For the H Section, when the t<sub>1</sub> is 9 mm or less, the upper limit of the yield point or proof stress shall not be applied.

H: For the H Section, when the t<sub>1</sub> is 9 mm or less, the upper limit of the yield ratio shall be 85%.

\* : Nitrogen control excluded.

**- Materials under TIS compulsory standard are for domestic use only, while material under other standards are for exportation.**

# CONVERSION FACTORS

## METRIC EQUIVALENTS OF LENGTH, AREA, VOLUME & WEIGHT

### LINEAR MEASURE

	Millimeter mm	Centimeter cm	Meter m	Inch in	Foot ft	yard yd	Mile mi
Millimeter (mm)	1	0.1	0.001	0.03937	0.0032808	0.0010936	0.000006214
Centimeter (cm)	10	1	0.01	0.3937	0.032808	0.010936	0.00006214
Meter (m)	1 000	100	1	39.37	3.28083	1.0936	0.0006214
Inch (in)	25.4	2.54	0.0254	1	0.0833	0.02778	0.0001578
Foot (ft)	304.8	30.48	0.3048	12	1	0.3333	0.0001894
Yard (yd)	914.4	91.44	0.9144	36	3	1	0.0005682
Mile (mi)	1 609 347	160 934.7	1 609.35	63 360	5 280	1.76	1

### WEIGHT MEASURE

	Kilogram kg	Ounce oz	Pound lb	Net Ton nt	Gross ton (2240 kg) gt	Metric Ton (1000 kg) t
Kilogram (kg)	1	35.274	2.20462	0.001102	0.0009842	0.001
Ounce (oz)	0.02835	1	0.0625	0.00003125	0.0000279	0.00002835
Pound (lb)	0.45359	16	1	0.0005	0.0004464	0.0004536
Net Ton (nt)	907.185	32 000	2 000	1	0.89286	0.90719
Gross ton (gt)	1 016.05	35 840	2 240	1.12	1	1.01605
Metric Ton (t)	1 000	35 274	2 204.62	1.10231	0.98421	1

### SQUARE MEASURE

	Square Millimeter mm <sup>2</sup>	Square Centimeter cm <sup>2</sup>	Square Meter m <sup>2</sup>	Square Inch in <sup>2</sup>	Square Foot ft <sup>2</sup>	Square yard yd <sup>2</sup>
Square Millimeter (mm <sup>2</sup> )	1	0.01	0.00001	0.00155	0.000010764	0.00000119599
Square Centimeter (cm <sup>2</sup> )	100	1	0.0001	0.154999	0.0010764	0.000119599
Square Meter (m <sup>2</sup> )	1 000 000	10 000	1	1 549.99	10.7639	1.19599
Square Inch (in <sup>2</sup> )	645.2	6.452	0.006452	1	0.006944	0.0007616
Square Foot (ft <sup>2</sup> )	92 900	929	0.0929	144	1	0.11111
Square Yard (yd <sup>2</sup> )	836 100	8 361	0.8361	1 296	9	1

# CONVERSION FACTORS

in.→mm (1/64 in. ~ 11 63/64 in.)

1 in. = 25.4mm

in. fraction	in. Decimal	0 mm	1 mm	2 mm	3 mm	4 mm	5 mm	6 mm	7 mm	8 mm	9 mm	10 mm	11 mm
		-	25.40	50.80	76.20	101.60	127.00	152.40	177.80	203.20	228.60	254.00	279.40
1/64	0.016	0.397	25.80	51.20	76.60	102.00	127.40	152.80	178.20	203.60	229.00	254.40	279.80
1/32	0.031	0.794	26.19	51.59	76.99	102.39	127.79	153.19	178.59	203.99	229.39	254.79	280.19
3/64	0.047	1.191	26.59	51.99	77.39	102.79	128.19	153.59	178.99	204.39	229.79	255.19	280.59
1/16	0.063	1.588	27.38	52.39	77.79	103.19	128.59	153.99	179.39	204.79	230.19	255.59	280.99
5/64	0.078	1.984	27.38	52.78	78.18	103.58	128.98	154.38	179.78	205.18	230.58	255.98	281.38
3/32	0.094	2.381	27.78	53.18	78.58	103.98	129.38	154.78	180.18	205.58	230.98	256.38	281.78
7/64	0.109	2.778	28.18	53.58	78.98	104.38	129.78	155.18	180.58	205.98	231.38	256.78	282.18
1/8	0.125	3.175	28.58	53.98	79.38	104.78	130.18	155.58	180.98	206.38	231.78	257.18	282.58
9/64	0.141	3.572	28.97	54.37	79.79	105.17	130.57	155.97	181.37	206.77	232.17	257.57	282.97
5/32	0.156	3.969	29.37	54.77	80.17	105.57	130.97	156.37	181.77	207.17	232.57	257.97	283.37
11/64	0.172	4.366	29.77	55.17	80.57	105.97	131.37	156.77	182.17	207.57	232.97	258.37	283.77
3/16	0.188	4.763	30.16	55.56	80.96	106.37	131.76	157.16	182.56	207.96	233.36	258.76	284.16
13/64	0.203	5.159	30.56	55.96	81.36	106.76	132.16	157.56	182.96	208.36	233.76	259.16	284.56
7/32	0.219	5.556	30.96	56.36	81.76	107.16	132.56	157.96	183.36	208.76	234.16	259.56	284.96
15/64	0.234	5.953	31.35	56.75	82.15	107.56	132.95	158.35	183.75	209.15	234.55	259.95	285.35
1/4	0.250	6.350	31.75	56.15	82.55	107.95	133.35	158.75	184.15	209.55	234.95	260.35	285.75
17/64	0.266	6.747	32.15	57.55	82.95	108.35	133.75	159.15	184.55	209.95	235.35	260.75	286.15
9/32	0.281	7.144	32.54	57.94	83.34	108.75	134.14	159.54	184.94	210.34	235.74	261.14	286.54
19/64	0.297	7.541	32.94	58.34	83.74	109.14	134.54	159.94	185.34	210.74	236.14	261.54	286.94
5/16	0.313	7.938	33.34	58.74	84.14	109.54	134.94	160.34	185.74	211.14	236.54	261.94	287.34
21/64	0.328	8.334	33.73	59.13	84.53	109.93	135.33	160.73	186.13	211.53	236.93	262.33	287.73
11/32	0.344	8.731	34.13	59.59	84.93	110.33	135.73	161.13	186.53	211.93	237.33	262.73	288.13
23/64	0.359	9.128	34.53	59.93	85.33	110.73	136.13	161.53	186.93	212.33	237.73	263.13	288.53
3/8	0.375	9.525	34.93	60.33	85.73	111.13	136.53	161.93	187.33	212.73	238.13	263.53	288.93
25/64	0.391	9.922	35.32	60.72	86.12	111.53	136.92	162.32	187.72	213.12	238.52	263.92	289.32
13/32	0.406	10.32	35.72	61.12	86.52	111.92	137.32	162.72	188.12	213.52	238.92	264.32	289.72
27/64	0.422	10.72	36.12	61.52	86.92	112.32	137.72	163.12	188.52	213.92	239.32	264.72	290.12
7/16	0.438	11.11	36.51	61.91	87.31	112.72	138.11	163.51	188.91	214.31	239.71	265.11	290.51
29/64	0.453	11.51	36.91	62.31	87.71	113.11	138.51	163.91	189.31	214.71	240.11	265.51	290.91
15/32	0.469	11.91	37.31	62.71	88.11	113.51	138.91	164.31	189.71	215.11	240.51	265.91	291.31
31/64	0.484	12.30	37.70	63.10	88.50	113.91	139.30	164.70	190.10	215.50	240.90	266.30	291.70
1/2	0.500	12.70	38.10	63.50	88.90	114.30	139.70	165.10	190.50	215.90	241.30	266.70	292.10
33/64	0.516	13.10	38.50	63.90	89.30	114.70	140.10	165.50	190.90	216.30	241.70	267.10	292.50
17/32	0.531	13.49	38.89	64.29	89.69	115.09	140.49	165.89	191.29	216.69	242.09	267.49	292.89
35/64	0.547	13.89	39.29	64.69	90.09	115.49	140.89	166.29	191.69	217.09	242.49	267.89	293.29
9/16	0.563	14.29	39.69	65.09	90.49	115.89	141.29	166.69	192.09	217.49	242.89	268.29	293.69
37/64	0.578	14.68	40.08	65.48	90.88	116.29	141.68	167.08	192.48	217.88	243.28	268.68	294.08
19/32	0.594	15.08	40.48	65.88	91.28	116.68	142.08	167.48	192.88	218.28	243.68	269.08	294.48
39/64	0.609	15.48	40.88	66.28	91.68	117.08	142.48	167.88	193.28	218.68	244.08	269.48	294.88
5/8	0.625	15.88	41.28	66.68	92.08	117.48	142.88	168.28	193.68	219.08	244.48	269.88	295.28
41/64	0.641	16.27	41.67	67.07	92.47	117.87	143.27	168.67	194.07	219.47	244.87	270.27	295.67
21/32	0.656	16.67	42.07	67.47	92.87	118.27	143.67	169.07	194.47	219.87	245.27	270.67	296.07
43/64	0.672	17.07	42.47	67.87	93.27	118.67	144.07	169.47	194.87	220.27	245.67	271.07	296.47
11/16	0.688	17.46	42.86	68.26	93.66	119.07	144.46	169.86	195.26	220.66	246.06	271.46	296.86
45/64	0.703	17.86	43.26	68.66	94.06	119.46	144.86	170.26	195.66	221.06	246.46	271.86	297.26
23/32	0.719	18.26	43.66	69.06	94.46	119.86	145.26	170.66	196.06	221.46	246.86	272.26	297.66
47/64	0.734	18.65	44.05	69.45	94.85	120.26	145.65	171.05	196.45	221.85	247.25	272.65	298.05
3/4	0.750	19.05	44.45	69.85	95.25	120.65	146.05	171.45	196.85	222.25	247.65	273.05	298.45
49/64	0.766	19.45	44.85	70.25	95.65	121.05	146.45	171.85	197.25	222.65	248.05	273.45	298.85
25/32	0.781	19.84	45.24	70.64	96.04	121.44	146.84	172.24	197.64	223.02	248.44	273.84	299.24
51/64	0.797	20.24	45.64	71.04	96.44	121.84	147.24	172.64	198.04	223.44	248.84	274.24	299.64
13/16	0.813	20.64	46.04	71.44	96.84	122.24	147.64	173.04	198.44	223.84	249.24	274.64	300.04
53/64	0.828	21.03	46.43	71.83	97.23	122.63	148.03	173.43	198.83	224.23	249.63	275.03	300.43
27/32	0.844	21.43	46.83	72.23	97.63	123.03	148.43	173.83	199.23	224.63	250.03	275.43	300.83
55/64	0.859	21.83	47.23	72.63	98.03	123.43	148.83	174.23	199.63	225.03	250.43	275.83	301.23
7/8	0.875	22.23	47.63	73.03	98.43	123.83	149.23	174.63	200.03	225.43	250.83	276.23	301.63
57/64	0.891	22.62	48.02	73.42	98.82	124.22	149.62	175.02	200.42	225.82	251.22	276.62	302.02
29/32	0.906	23.02	48.42	73.82	99.22	124.62	150.02	175.42	201.82	226.20	251.62	277.02	302.42
59/64	0.922	23.42	48.82	74.22	99.62	125.02	150.42	175.82	202.22	226.62	252.02	277.42	302.82
15/16	0.938	23.81	49.21	74.61	100.01	125.41	150.81	176.21	202.61	227.01	252.41	277.81	303.21
61/64	0.953	24.21	49.61	75.01	100.41	125.81	151.21	176.61	203.01	227.41	252.81	278.21	303.61
31/32	0.969	24.61	50.01	75.41	100.81	126.21	151.61	177.01	203.41	227.81	253.21	278.61	304.01
63/64	0.984	25.00	50.40	75.80	101.20	126.60	152.00	177.40	203.80	228.20	253.60	279.00	304.40

# CONVERSION FACTORS

in → cm

1 in = 2.540000 cm

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
1	2.54	2.794	3.480	3.302	3.556	3.810	4.064	4.318	4.572	4.826
2	5.08	5.334	5.588	5.842	6.096	6.350	6.604	6.858	7.112	7.366
3	7.62	7.874	8.128	8.382	8.636	8.890	9.144	9.398	9.652	9.906
4	10.16	10.414	10.668	10.922	11.176	11.430	11.684	11.938	12.192	12.446
5	12.7	12.954	13.208	13.462	13.716	13.970	14.224	14.478	14.732	14.986
6	15.24	15.494	15.748	16.002	16.256	16.510	16.764	17.018	17.272	17.526
7	17.78	18.034	18.288	18.542	18.796	19.050	19.304	19.558	19.812	20.066
8	20.32	20.574	20.828	21.082	21.336	21.590	21.844	22.098	22.352	22.606
9	22.86	23.114	23.368	23.622	23.876	24.130	24.384	24.638	24.892	25.146
10	25.40	25.654	25.908	23.162	26.416	26.670	26.924	27.178	27.432	27.686

cm → in

1 cm = 0.39370079 in

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
1	0.393701	0.433071	0.472441	0.511811	0.551181	0.590551	0.629921	0.669291	0.708661	0.748032
2	0.787402	0.826772	0.866142	0.905512	0.944882	0.984252	1.023622	1.062992	1.102362	1.141732
3	1.181102	1.220472	1.259843	1.299213	1.338583	1.377953	1.417323	1.456693	1.496063	1.535433
4	1.574803	1.614173	1.653543	1.692913	1.732283	1.771654	1.811024	1.850394	1.889764	1.929134
5	1.968504	2.007874	2.047244	2.086614	2.125984	2.165354	2.04724	2.244095	2.283465	2.322835
6	2.362205	2.401575	2.440945	2.480315	2.519685	2.559055	2.598425	2.637795	2.677165	2.716535
7	2.755906	2.795276	2.834646	2.874016	2.913386	2.952756	2.992126	3.031496	3.070866	3.110236
8	3.149606	3.188976	3.228346	3.267717	3.307087	3.346457	3.385827	3.425197	3.464567	3.503937
9	3.5433307	3.582677	3.622047	3.661417	3.700787	3.740158	3.779528	3.818898	3.858268	3.897638
10	3.937008	3.976378	4.015748	4.055119	4.094488	4.133858	4.173228	4.212598	4.251969	4.291339

ft<sup>2</sup> → m<sup>2</sup>

1 ft<sup>2</sup> = 0.092903040 m<sup>2</sup>

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
1	0.092903	0.102193	0.111484	0.120774	0.130064	0.139355	0.148645	0.157935	0.167225	0.176516
2	0.185806	0.195096	0.204387	0.213677	0.222967	0.232258	0.241548	0.250838	0.260129	0.269419
3	0.278709	0.287999	0.297290	0.306580	0.315870	0.325161	0.334451	0.343741	0.353032	0.362322
4	0.371612	0.380902	0.390193	0.399483	0.408773	0.418064	0.427354	0.436644	0.445935	0.455225
5	0.464515	0.473806	0.483096	0.492386	0.501676	0.510967	0.520257	0.529547	0.538838	0.548128
6	0.557418	0.566709	0.575999	0.585289	0.594579	0.60387	0.613160	0.62245	0.631741	0.641031
7	0.650321	0.659612	0.668902	0.678192	0.687482	0.696773	0.706063	0.715353	0.724644	0.733934
8	0.743224	0.752515	0.761805	0.771095	0.780386	0.789676	0.798966	0.808256	0.817547	0.826837
9	0.836127	0.845418	0.854708	0.863998	0.873289	0.882579	0.891869	0.901159	0.910450	0.919740
10	0.92903	0.938321	0.947611	0.956901	0.966192	0.975482	0.984772	0.994063	1.003353	1.012643

m<sup>2</sup> → ft<sup>2</sup>

1 m<sup>2</sup> = 10.763910 ft<sup>2</sup>

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
1	10.7639	11.8403	12.9167	13.9931	15.0695	16.1459	17.2223	18.2986	19.3750	20.4514
2	21.5278	22.6042	23.6808	24.7570	25.8334	26.9098	27.9862	29.0626	30.1389	31.2153
3	32.2917	33.3681	34.4445	35.5209	36.5973	37.6737	38.7501	39.8265	40.9029	41.9792
4	43.0556	44.1320	45.2084	46.2848	47.3612	48.4376	49.5140	50.5904	51.6668	52.7432
5	53.8196	54.8959	55.9723	57.0487	58.1251	59.2015	60.2779	61.3543	62.4307	63.5071
6	64.5835	65.6599	66.7362	67.8126	68.8890	69.9654	71.0418	72.1182	73.1946	74.2710
7	75.3474	76.4238	77.5002	78.5765	79.6529	80.7293	81.8057	82.8821	83.9585	85.0349
8	86.1113	87.1877	88.2641	89.3405	90.4168	91.4932	92.5696	93.6460	94.7224	95.7988
9	96.8752	97.9516	99.0280	100.1044	101.1808	102.2571	103.3335	104.4099	105.4863	106.5627
10	107.6391	108.7155	109.7919	110.8683	111.9447	113.0211	114.0975	115.1738	116.2502	117.3266

lb → kg

1 lb = 0.45399243 kg (1 lb = 0.45359243 kg as determined by agreement between the USA and Britain in 1963)

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
1	0.453592	0.498952	0.544311	0.58967	0.635029	0.680389	0.725748	0.771107	0.816466	0.861826
2	0.907185	0.952544	0.997903	1.043263	1.088622	1.133981	1.179340	1.224700	1.270059	1.315418
3	1.360777	1.406137	1.451496	1.496855	1.542214	1.587574	1.632933	1.678292	1.723651	1.769010
4	1.814370	1.859729	1.905088	1.950447	1.995807	2.041166	2.086525	2.131884	2.177244	2.222603
5	2.267962	2.313321	2.358681	2.404040	2.449399	2.494758	2.540118	2.585477	2.630836	2.676195
6	2.721555	2.766914	2.812273	2.857632	2.902992	2.948351	2.993710	3.039069	3.084429	3.129788
7	3.175147	3.220506	3.265865	3.311225	3.356584	3.401943	3.447302	3.492662	3.538021	3.583380
8	3.628739	3.674099	3.719458	3.764817	3.810176	3.855536	3.900895	3.946254	3.991613	4.036973
9	4.082332	4.127691	4.173050	4.218410	4.263769	4.309128	4.354487	4.399847	4.445206	4.490565
10	4.535924	4.581284	4.626643	4.672002	4.717361	4.762721	4.808080	4.853439	4.898798	4.944157

kg → lb

1 kg = 2.2046223 lb

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
1	2.20462	2.42508	2.64555	2.86601	3.08647	3.30693	3.5274	3.74786	3.96832	4.18878
2	4.40924	4.62971	4.85017	5.07063	5.29109	5.51156	5.73202	5.95248	6.17294	6.39340
3	6.61387	6.83433	7.05479	7.27525	7.49572	7.71618	7.93664	8.15710	8.37756	8.59803
4	8.81849	9.03895	9.25941	9.47988	9.70034	9.92080	10.14126	10.36172	10.58219	10.80265
5	11.02311	11.24357	11.46404	11.6845	11.90496	12.12542	12.34588	12.56635	12.78681	13.00727
6	13.22773	13.44820	13.66866	13.88912	14.10958	14.33004	14.55051	14.77097	214.99143	15.21189
7	15.43236	15.65282	15.87328	16.09374	16.31421	16.53467	16.75513	16.97559	17.19605	17.41652
8	17.63693	17.85744	18.07790	18.29837	18.51883	18.73929	18.95975	19.18021	19.40068	19.62114
9	19.84160	20.06206	20.28253	20.50299	20.72345	20.94391	21.16437	21.38484	21.60530	21.82576
10	22.04622	22.26669	22.48715	22.70761	22.92807	23.14853	23.36900	23.58946	23.80992	24.03038

Note: The pound in this table is equivalent to 1 lb avdp (U.S.) = 0.4535924277 kg

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**PLEASE DO NOT FEEL HESITATE TO CONSULT OUR  
SALES TEAM FOR AVAILABILITY OF PRODUCT SIZES  
AND SPECIFICATIONS IN LOCAL MARKET ESPECIALLY  
FOR DESIGN PURPOSES**

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# NOTES

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