



## **Introduction**

**General information**
**TABLE - 1**
**Wrought alloys: Near equivalent designations**

INDIA		U.S.A. (A.A.)	BRITAIN (B.S.)	CANADA	GERMANY (DIN)	RUSSIA	I.S.O.	FRENCH ND
NEW I.S.	OLD I.S.							
19501	1E	1050(E.C)	1E	C 1S	E-Al 99.5	-	-	-
19500	1B	1050	1B	1S	A-99.5	-	Al-99.5	1050A
24345	H15	2014	H15	B26S	Al-Cu-Si	AK	-	-
24534	H14	2017	H14	17S/16S	-	D1	AL-Cu-4Mg Si	-
-	-	2024	-	24S	Al-Cu.Mg2	-	Al-Cu-4Mg 1	2024
31000	N3	3003	N3	3S	Al-Mn	A-Mn	Al-Mn 1	3003
52000	N4	5052	N4	M57S	Al-Mg.2	A-Mg	Al-Mg-2.5	5051
53000	N5	5086	N5	54S	-	A-Mg-3	Al-Mg-4	-
54300	N8	5083	N8	D54S	Al-Mg-4.5 Mn	-	Al-Mg-4.5 Mn	5083
65032	H20	6061	H20	65S	Al-Mg-Si Cu	-	Al-Mg-1Si Cu	-
63400	H9	6063	H9	50S	Al-Mg-Si 0.5	-	Al-Mg-Si	-
64430	H30	6351	H30	B51S	Al-Mg-Si 1	AV	Al-Si-1 Mg	6081
64423	H11	6066	H11	C62S	-	-	-	-
62400	-	6005	-	C51S	-	-	-	-
63401	91E	6101	91E	D50S	E.Al.Mg.Si 0.5	-	-	-
-	-	7018	-	-	-	-	-	-



## General information

TABLE - 2

### Wrought alloys: Guide to selection

Alloy	Temper	Resistance to Corrosion	Workability (Cold)	Machinability	Brazeability	Weldability	Commonly available forms	Indications of use
EC/1050, 1060 (1B) (19501) (19500) (19600)	F, O	A	A	D	A	A	Flats, Rods, Tubes & other sections	Electrical conductors, cable sheathing, impact-extruded Products, pressing utilities of anodizing quality, pen caps, piping etc.
1100 (1C) (19000)	F, O	A	A	D	A	A	Flats, Rods, Tubes & other sections	Packaging lightly stresses and decorative assemblies in architecture and transport, equipment for chemical, food and brewing industries.
2014 (H 15) (24345)	T4 T6	C C	C D	B B	D D	C C	Rods & Bars Rods & Bars	Highly stressed component of all types in aircraft, ordnance and general engineering.
2017 (H 14) (24534)	T4	C	C	B	D	C	Rods & Bars	Highly stressed parts in aircraft and other structures, screw machine products.
2024	T4	C	C	B	D	C	Rods & Bars	Load Cell Highly stressed component of all types in aircraft, ordnance and general engineering.
5052 (N 4) (52000)	O, F	A	A	D	C	A	Flats, Rods, Tubes & other sections	Structures exposed to marine atmosphere, aircraft parts, wire rope ferrules, rivet stock.
5086 (N 5) (53000)	O, F	A	A	D	D	A	Flats, Rods & other sections	Ship building and other marine applications, rivets, coinage etc.
5056 (N 6) (55000)	O, F	A	A	D	D	A	Rods	Zips, Welding Rods and Rivets.
6061 (H 20) (65032)	O, F T4 T6	A A A	A C D	D C C	A A A	A A A	Rods, Flats, Tubes & other sections	Heavy duty structures, building hardware, sections for bus body, truck and rail coach, furniture, rivets etc.
6063 (H9) (63400)	O, F T4 T6 T5	A A A A	A B C C	D C C C	A A A A	A A A A	Rods, Flats, Tubes & other sections	Building hardware, architectural section with finish, medium strength furniture are anodized sections.

**General information**
**TABLE - 2**
**Wrought alloys: Guide to selection**

Alloy	Temper	Resistance to Corrosion	Workability (Cold)	Machinability	Brazeability	Weldability	Commonly available forms	Indications of use
6066	O, F T4 T6	B B B	B C C	D B B	A A A	A A A	Rods and other solid sections	For welded structures, textile parts, heavy duty machine parts.
6101 (91 E) (63401)	T4 T6	A A	B B	C C	A A	A A	Rods, Flats, Tubes & other sections	High strength electrical busbar sections.
6201 (64401)	T4	A	A	C	A	A	Redraw Rod	Overhead conductors, ACAR and AAAC
6351 (H 30) (64430)	O, F T4 T6	A A A	A C D	D C C	A A A	A A A	Rods, Flats, Tubes & other sections	Structural and general engineering items such as rail & road transport vehicles, bridges, cranes, roof trusses, rivets etc.
7039 (D74S) (74530)	O, F T4 T6	A A A	A C D	D C C	A A A	A A A	Flats, Tubes, Rods & other sections	Defence structures like mobile bridges etc. Tread and chequered plates, Excellent welding property with no loss of strength in welded zone.
7018	O, F T4 T6	A A A	A C D	D C C	A A A	A A A	Flats, Tubes, Rods & other sections	Defence structures like mobile bridges etc. Tread and chequered plates, Excellent welding property with no loss of strength in welded zone.

**Notes:**

- Relative ratings for corrosion, workability and machinability in decreasing order of merit A, B, C and D.
- Weldability & brazeability ratings A, B, C and D are relative ratings defined as follows:
  - Generally weldable by the commercial procedure & methods.
  - Weldable with special technique.
  - Limited weldability due to crack sensitivity or loss in corrosion resistance and mechanical properties.
  - Generally not weldable.
- Availability of other forms subject to special enquiries and methods.



## General information

TABLE - 3

### Wrought alloys: Chemical composition limits (per cent)

Alloy (ISS)		Equivalent alloy (AA) U.S.A.	Copper		Magnesium		Silicon		Iron Max.	Manganese		*Others (Total) Max.	Remarks
Old	New		Min.	Max.	Min.	Max.	Min.	Max.		Min.	Max.		
1C	19000	1100	-	0.10	-	-	-	0.5	0.6	-	0.1	0.1	Aluminium 99.0% Min
		1200	-	0.05	-	-	-	Si+Fe 1.0		-	0.05	0.1	Aluminium 99.0% Min
1 B	19500	1050	-	0.05	-	-	-	0.25	0.4	-	0.05	0.1	Aluminium 99.5% Min
1 E	19501	-	-	0.04	-	-	-	0.15	0.35	-	0.03	0.1	Aluminium 99.5% Min
		19600	1060	-	0.05	-	-	-	0.25	0.35	-	0.03	0.1
H 15	24345	2014	3.8	5.0	0.2	0.8	0.5	1.2	0.7	0.3	1.2	0.5	-
H 14	24534	2017	3.5	4.7	0.4	1.2	0.2	0.7	0.7	0.4	1.2	0.5	-
		2024	3.8	4.9	1.2	1.8	-	0.5	0.5	0.3	0.9	0.15	Zn 0.25
N 3	31000	3003	-	0.1	-	0.1	-	0.6	0.7	1.0	1.5	0.4	-
N 4	52000	5052	-	0.1	1.7	2.6	-	0.6	0.5	-	0.5	0.4	Cr + Mn = 0.5
N 5	53000	5086	-	0.1	2.8	4.0	-	0.6	0.5	-	0.5	0.4	Cr + Mn = 0.5
N 8	54300	5083	-	0.1	4.0	4.9	-	0.4	0.7	0.5	1.0	0.4	Chromium up to 0.25
H 20	65032	-	0.15	0.4	0.7	1.2	0.4	0.8	0.7	0.2	0.8	0.4	**Cr = 0.15 - 0.35
		6061	0.15	0.4	0.8	1.2	0.4	0.8	0.7	-	0.15	0.4	Chromium 0.04 to 0.35
H 9	63400	6063	-	0.1	0.4	0.9	0.3	0.7	0.6	-	0.3	0.4	-
-	-	6066	0.7	1.2	0.8	1.4	0.9	1.8	0.7	0.6	1.1	0.4	-
-	64423	-	0.5	1.0	0.5	1.3	0.7	1.3	0.8	-	1.0	-	-
9 1E	63401	6101	-	0.05	0.4	0.9	0.3	0.7	0.5	-	0.03	0.1	-
H 30	64430	6351	-	0.1	0.4	1.2	0.6	1.3	0.6	0.4	1.0	0.3	-
		6082	-	0.1	0.6	1.2	0.7	1.3	0.5	0.4	1.0	0.3	Chromium up to 0.25
		7018	-	0.20	1.2	1.4	-	0.35	0.4	0.05	0.5	0.15	Zn 3.5 - 4.5

\* Titanium and/or other grain refining elements

\*\* Either Mn or Cr shall be present

General information

TABLE - 4

Wrought alloys: Mechanical properties

Heat Treatable Alloys					
Alloy AA Old (ISS) New (ISS)	Temper	Ultimate Tensile Strength Kg/mm <sup>2</sup>		0.2% Proof Stress Kg/mm <sup>2</sup>	Elongation On 50 mm GL
		Min.	Max.		
2014 [H15] [24345]	T4[W]	39	-	24.0	10
	T6 [WP]	49	-	43.0	6
2017 [H14] [24534]	T4[W]	39	-	24.0	10
2024 [H9]	T4	40.5	-	26.5	12
6063 [H9] [63400]	T4[W]	14	-	8.0	14
	T6 [WP]	19	-	15.5	7
6061 [H20] [65032]	M	11.2	-	5.1	12
	T4[W]	19	-	11.5	14
	T6 [WP]	28.5	-	24.0	7
6351[H30] [64430]	M	11.2	-	8.2	12
	T4[W]	19	-	12.0	14
	T6 [WP]	31.5	-	27.5	7
6066	M	11.0	-	-	12
	T4[W]	28	-	17.5	14
	T6 [WP]	35	-	31.5	7
6101[91E] [63401]	T4[W]	14	-	8.0	12
	T6 [WP]	20.5	-	17.0	10
6201 [64401]	T4[W]	16	-	7.0	14
	T8 [WDP]	32	-	-	3
7039 [74530]	T4[W]	28	-	23.5	9
	T6 [WP]	31.5	-	26.5	7
7018	T6 [WP]	40	-	34.4	6

Properties indicated herein are typical properties and are given for information only. However properties of all the profiles in specific alloy shall be as per I. S. Specification.



## General information

TABLE - 5

### Wrought alloys: Typical tensile properties at various temperatures (Kg/mm<sup>2</sup>)

Alloy & Tempet	Tensile Strength	Temp. °C									
		Below zero			Above Zero						
		-200	-80	-25	25	100	150	200	250	300	350
1100 M (19000)	Ultimate	17.5	10.5	10.0	9.0	7.0	5.5	4.0	3.0	2.0	1.5
	Yield	4.2	3.9	3.5	3.5	3.2	3.0	2.4	2.0	1.4	1.1
2014 T6* (24345)	Ultimate	59.0	52.0	50.5	49	44.0	28.0	11.0	6.0	4.5	3.0
	Yield	50.0	45.5	43.5	42	40.0	24.5	9.0	5.0	3.5	2.5
2017 T4 (24534)	Ultimate	56.0	45.5	45.0	43.5	40.0	28.0	11.0	6.5	4.0	3.0
	Yield	37.0	29.5	29.0	28.0	27.5	21.0	9.0	5.0	3.5	2.5
3003 M (31000)	Ultimate	23.0	14.0	12.0	11.0	9.0	7.5	6.0	4.0	3.0	2.0
	Yield	6.0	5.0	4.5	4.0	4.0	3.5	3.0	2.5	1.7	1.3
5052 M (52000)	Ultimate	31.0	20.5	19.5	19.5	19.0	16.0	12.0	8.5	5.0	3.5
	Yield	11.0	9.0	9.0	9.0	9.0	9.0	7.5	5.0	4.0	2.0
5086 M (53000)	Ultimate	38.5	27.5	26.5	26.5	26.5	20.5	15.5	12.0	7.5	4.0
	Yield	17.0	15.0	15.0	15.0	15.0	13.5	12.0	7.5	5.0	3.0
6061 T4 (65032)	Ultimate	35.0	26.5	25.0	24.5	-	21.0	13.5	5.0	3.0	2.0
	Yield	19.5	15.5	15.5	14.5	-	14.5	10.5	3.8	1.8	1.5
6061 T6	Ultimate	49.0	34.5	33.0	31.5	29.5	24.0	13.5	5.0	3.2	2.1
	Yield	33.0	29.5	28.5	28.0	26.5	21.5	10.5	3.5	1.9	1.3
6063 T4 (63400)	Ultimate	26.0	20.5	19.5	15.5	-	15.5	6.5	3.5	2.1	1.8
	Yield	12.0	12.0	10.5	9.0	-	9.0	4.5	2.8	1.8	1.4
6063 T6	Ultimate	33.0	26.5	25.0	24.5	21.5	14.5	6.5	3.0	2.5	1.6
	Yield	25.0	23.0	22.5	21.5	19.5	14.0	4.5	2.5	1.8	1.4

\*Subject to special enquiry

TABLE - 6

### Wrought Aluminium & Aluminium Alloys: Mechanical and Electrical Properties

Alloy		Temper Designation	Tensile Strength Min.	0.2 Percent Proof Stress Min	Percent Elongation on 5.65√S <sub>a</sub> Min.	Electrical Conductivity at 20° C, Min	Maximum Electrical Resistivity at 20° C	Thickness	Inside bend radius Min.	Coeff. Of thermal expansion	Thermal Conductivity
AA	IS		Mpa	Mpa		% IACS	ohm mm/mm <sup>2</sup>	mm		per°C at 20°C typical	CGS at 25°C typical
1050	19501	M	60	-	25	60.00	0.02874	upto 12	1x thickness	23.8 x 10 <sup>-6</sup>	0.56
6101	63401	W	140	80	12	-	-	-	-	-	-
6101	63401	WP (range 1)	170	135	12	56.50	0.03052	3.00 to 9.50	1x thickness	23.4 x 10 <sup>-6</sup>	0.52
6101	63401	WP (range 2)	200	170	10	55.00	0.03135	3.00 to 9.50	2x thickness	23.4 x 10 <sup>-6</sup>	0.52
6201	-	T81	-	-	-	52.50	0.03283	-	-	23.5 x 10 <sup>-6</sup>	0.50

#### Notes:

1MPa=1N/mm<sup>2</sup> = 0.102 kg/mm<sup>2</sup>

Properties in M temper are only typical values and are given for information only.

If required the cross-section shall be calculated from the mass and length of a straight test piece taking density 2.705 for grade 19501 and 2.700 for grade 63401

General information

TABLE - 7

Wrought alloys: Welding properties

Relatively Suitable for Joining (*)									
Alloy & Temper	Gas	Arc with Inert Gas	Arc With Flux	Resist. Welding	Pressure Welding	Brazing	Soldering		Filler Metal (3) +
							Low Temp	High Temp.	
1050 M	A	A	A	B	A	A	A	A	1260
1100 M	A	A	A	B	A	A	A	A	1100
2014 M	D	C	C	B	C	D	D	D	4145
2017 T4	D	C	C	B	C	D	D	D	4145
T6	D	C	C	B	D	D	D	D	4145
2024 T4	D	C	C	B	D	D	D	D	4145
3003 M	A	A	A	B	A	A	A	A	1100
5005 M	A	A	A	B	A	B	B	A	4043
5052 M	A	A	A	B	B	C	C	C	5356
5086 M	C	A	A	B	C	D	D	D	5356
6061 M	A	A	A	B	A	A	B	A	4043
T4	A	A	A	A	B	A	B	A	4043
T6	A	A	A	A	B	A	B	A	4043
6063 T6	A	A	A	A	B	A	B	A	4043
6101 T6	A	A	A	A	B	A	B	A	4043
6201 T81	A	A	A	A	B	A	B	A	4043
7018 T6	D	C	C	A	C	D	C	C	7039
7039 T6	D	C	C	A	C	D	C	C	7039

- For general purpose only. For specialised applications, e. g. pressure vessels anodised item etc., special process should be used.
- \*Joining ratings A, B, C&D are relative ratings in order of merit.  
 A-Readily weldable.  
 B-Special techniques and close control of procedure are required.  
 C-Limited weldability due to crack sensitivity, loss in strength and or loss in resistance to corrosion.  
 D-Not recommended.
- + Filler metals for general purpose only. For specialised applications requiring high strength ductility, colour match after anodising etc., special filler metals are recommended.



## General information

TABLE - 8

### Wrought alloys: Surface Finishin (Suitability)

Suitable for					
Alloy	Protective Anodising	Anodising & Dyeing	Bright Anodising	Plating	Vitreousea Immelgin
1050/1070	E	E	V	V	G
1100	V	V	G	V	G
2014/2017	M	M(D)	U	V	U
3003	G	G	M	G	V
4043	G	G(D)	U	O	G
5005	V	V	V	O	U
5052	V	V	G-V	O	U
5086/5056	V	V	G	O	U
6061	G	G	M	O	O
6063	V	V	G-V	O	O
6066	M	M(D)	U	V	U
6101	V	V	G-V	O	O
6351	G	G	M	O	O

- E** Excellent  
**V** Very good  
**G** Good  
**M** Moderate  
**U** Unsuitable  
**D** Only Suitable for dark colours  
**O** Modified technique is essential and some initial difficulties may occur.

## General information

### Standard Manufacturing Tolerances

The Standard manufacturing tolerance given here are applicable to the average shape. Wider tolerance may be required for some shapes, and closer tolerances may be possible for others. For 5052, 5056, 5083, 5086, and other high magnesium alloys, special (wider) tolerances will be applicable.

Tolerances stricter standard shall be subjected to special enquiry.

**TABLE: 9**

### Round Bars/Rods: Diameter Tolerance

Specified Diameter mm		Tolerance (mm)		
		Class A		Class B
		+	-	+
	Upto 12.0	0.03	0.07	0.20
Over 12.0	Upto 25.0	0.05	0.10	0.25
Over 25.0	Upto 40.0	0.07	0.13	0.30
Over 40.0	Upto 50.0	0.13	0.13	0.38
Over 50.0	Upto 56.0	0.15	0.15	0.46
Over 56.0	Upto 71.0	0.20	0.20	0.53
Over 71.0	Upto 80.0	0.25	0.25	0.61
Over 80.0			0.5%	1%

**Notes:**

1. Class 'A' is for drawn rods.
2. Class 'B' is normal tolerance for extruded rods.

**TABLE: 10**

### Solid Sections : Width Tolerance (at closed ends)

Specified width or across flats mm	Tolerance mm +
4	0.18
5	0.20
6	0.20
8	0.23
10	0.23
12	0.25
16	0.28
20	0.30
25	0.30
32	0.38
40	0.46
50	0.46
60	0.53
80	0.69
100	0.69
120	0.76
160	1.02
200	1.14
250	1.40

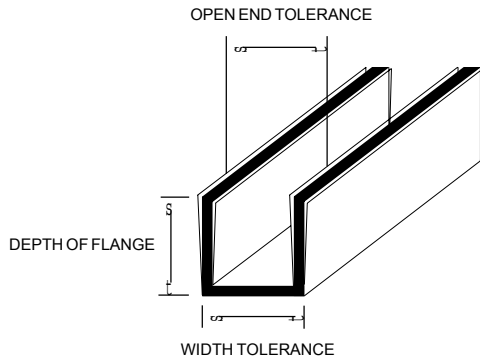
**Notes:**

1. For intermediate size, take tolerance for the next higher value.
2. Width tolerances on open ends of Solid Sections such as Channels, I-Beams, etc. are given separately in table 11

## General information

TABLE 11

### Solid Sections: Width Tolerance (at open ends)



Displacement of any one leg to be controlled independently by tolerance on angle

Tolerance on open ends of channels and I-beams

Specified Width mm	Depth of flange or leg (mm)			
	6.5 to 16.0	16.1 to 32.0	32.1 to 64.0	64.1 to 150.0
	Width Tolerance mm +			
Upto 6.0	0.30	-	-	-
6.1 to 12.0	.35	0.40	0.45	-
12.1 to 20.0	0.40	0.45	0.50	-
20.1 to 25.0	0.45	0.50	0.55	0.65
25.1 to 38.0	0.50	0.55	0.65	0.75
38.1 to 50.0	0.60	0.70	0.80	0.90
50.1 to 100.0	0.80	0.90	1.20	1.50
100.1 to 150.0	1.10	1.30	1.70	2.00
150.1 to 200.0	1.50	1.60	2.10	2.50
200.1 to 250.0	1.70	1.90	2.70	3.00

#### Notes:

1. Tolerance on either internal or external gap (between flanges or legs) can be guaranteed depending on requirements.
2. Width tolerance at closed ends are given in Table-10.
3. These tolerances are applicable to channels, I-Beam and other such sections where there are both opened and closed ends.

General information

TABLE 12

Solid Sections : Thickness tolerance

Specified** Thickness mm	Width of section (mm)														
	12	16	20	25	32	40	50	63	80	100	125	160	200	250	320
1.2	0.20	0.20	0.20	0.20	0.20	∅	∅	∅	∅	∅	∅	∅	∅	∅	∅
1.6	0.18	0.20	0.20	0.20	0.20	∅	∅	∅	∅	∅	∅	∅	∅	∅	∅
2.0	0.18	0.20	0.20	0.20	0.20	0.23	0.25	0.28	0.30	0.33	0.36	0.38	0.41	0.46	∅
2.5	0.18	0.20	0.20	0.20	0.20	0.23	0.25	0.28	0.30	0.33	0.36	0.38	0.41	0.46	∅
3.2	0.18	0.20	0.20	0.20	0.23	0.25	0.28	0.30	0.33	0.36	0.38	0.41	0.43	0.48	∅
4.0	0.20	0.23	0.23	0.23	0.25	0.28	0.30	0.33	0.36	0.38	0.43	0.43	0.46	0.51	∅
5.0	0.20	0.23	0.23	0.23	0.25	0.28	0.30	0.33	0.36	0.38	0.41	0.43	0.46	0.51	∅
6.0	0.20	0.23	0.23	0.23	0.25	0.28	0.30	0.33	0.36	0.41	0.46	0.51	0.56	0.66	∅
8.0	0.23	0.25	0.25	0.25	0.28	0.30	0.33	0.36	0.38	0.43	0.48	0.53	0.58	0.71	∅
10.0	0.23	0.25	0.25	0.25	0.28	0.30	0.33	0.36	0.38	0.43	0.48	0.53	0.58	0.71	∅
12.0	0.25	0.28	0.28	0.28	0.30	0.33	0.36	0.38	0.41	0.46	0.48	0.53	0.58	0.74	0.97
16.0	0.28	0.30	0.30	0.30	0.33	0.36	0.38	0.41	0.43	0.48	0.51	0.56	0.61	0.76	1.02
20.0	-	0.30	0.30	0.30	0.36	0.38	0.41	0.43	0.46	0.51	0.53	0.61	0.69	0.79	1.04
25.0	-	0.30	0.30	0.30	0.36	0.38	0.41	0.43	0.46	0.51	0.53	0.61	0.69	0.79	1.04
32.0	-	-	-	-	0.38	0.41	0.43	0.46	0.48	0.53	0.56	0.66	0.74	-	-
40.0	-	-	-	-	-	0.46	0.48	0.51	0.53	0.56	0.61	0.71	0.79	-	-
50.0	-	-	-	-	-	-	0.53	0.56	0.58	0.61	0.66	0.76	0.84	-	-
63.0	-	-	-	-	-	-	-	0.61	0.64	0.66	0.71	0.81	0.89	-	-
80.0	-	-	-	-	-	-	-	-	0.69	0.71	0.74	0.86	0.94	-	-
100.0	-	-	-	-	-	-	-	-	-	0.76	0.79	0.91	0.99	-	-
125.0	-	-	-	-	-	-	-	-	-	-	0.89	0.97	1.04	-	-

∅ To be regarded as special sections.  
 ∅ ∅ For intermediate size, take tolerance for the next higher value.

TABLE -13

Round Tubes : Wall Thickness Tolerance

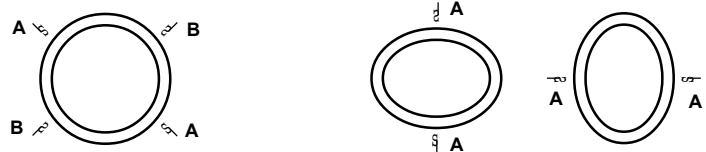
Specified Wall Thickness (mm)	Tolerance (mm)	
	Class 1 +	Class 2 +
Upto 1.2	0.30	-
1.60	0.30	-
1.80	0.30	-
2.00	0.30	-
2.24	0.30	-
2.50	0.33	-
2.80	0.36	-
3.15	0.40	0.90
3.55	0.43	0.94
4.00	0.48	0.97
4.50	0.51	1.02
5.00	0.56	1.07
5.50	0.61	1.12
6.30	0.67	1.18
7.10	0.76	1.27
8.00	0.97	1.47
9.00	1.10	1.60
10.00	1.22	1.73
11.20	1.28	1.79
12.50	1.35	1.85

Notes:

1. Tubes with wall thickness intermediate between standard sizes will have the tolerance of the higher wall thickness.
2. Tolerance on standard wall thickness above 12.50 mm may be as agreed to between the purchaser and the supplier.
3. For Al-Zn-Mg, Al-Mg and Al-Cu alloys, class 2 tolerasnce shall apply.
4. For Al, Al-Mn and Al-Mg-Si alloys, class 1 tolerances

## General information

TABLE -14  
Round Tubes : Diameter Tolerance



Specified Diameter Outside or Inside mm	Allowable Deviation of Mean Diameter 1/2 (AA+BB) from Specified Diameter (Dia. Tolerance) mm +	Allowable Deviation of Diameter at any point from Specified Diameter (Ovalness Tolerance) mm +
From 9 upto 18	0.25	0.50
Over 18 upto 30	0.30	0.60
Over 30 upto 40	0.36	0.80
Over 40 upto 50	0.45	0.90
Over 50 upto 60	0.54	1.00
Over 60 upto 80	0.60	1.30
Over 80	1% of dia	2.5% of dia

### Notes:

- When outside diameter, inside diameter and wall thickness are all specified, standard tolerances are applicable to any two of these dimensions, but not to all three.
- Mean diameter is the average of two diameter measurement taken at right angles to each other at any point along the length. In other words, mean diameter is  $1/2 (AA+ BB)$ .
- Ovalness tolerance is not applicable for annealed temper or if the wall thickness is less than 2.5% of the outside diameter

TABLE 15

## Hollow sections: Wall Thickness Tolerance

Wall Thickness mm	Over mm	Upto mm	Width or overall dimensions (mm)													
			10.0 20.0	20.0 33.0	30.0 40.0	40.0 50.0	50.0 60.0	60.0 80.0	80.0 100.0	100.0 120.0	120.0 140.0	140.0 160.0	160.0 180.0	180.0 200.0	200.0 225.0	225.0 250.0
<b>Class B</b>																
Over	Upto															
1.0	1.5		0.28	0.28	0.28	0.30	-	-	-	-	-	-	-	-	-	-
1.5	2.0		0.30	0.33	0.33	0.36	-	-	-	-	-	-	-	-	-	-
2.0	2.5		0.33	0.33	0.36	0.38	0.43	0.46	-	-	-	-	-	-	-	-
2.5	3.0		0.41	0.43	0.46	0.48	0.51	0.53	0.56	-	-	-	-	-	-	-
3.0	4.0		0.53	0.56	0.58	0.61	0.64	0.66	0.69	0.71	0.74	-	-	-	-	-
4.0	5.0		-	0.71	0.74	0.76	0.79	0.81	0.84	0.86	0.89	0.91	0.94	1.02	-	-
5.0	6.0		-	-	0.97	0.99	1.02	1.04	1.07	1.09	1.12	1.14	1.17	1.19	1.22	1.24
6.0	8.0		-	-	-	1.22	1.24	1.27	1.30	1.32	1.35	1.37	1.40	1.42	1.45	1.47
8.0	10.0		-	-	-	-	1.47	1.50	1.52	1.55	1.57	1.60	1.63	1.65	1.68	1.70
10.0	12.0		-	-	-	-	1.73	1.75	1.78	1.80	1.83	1.85	1.88	1.90	1.93	1.96
12.0	16.0		-	-	-	-	-	1.98	2.00	2.03	2.06	2.08	2.11	2.13	2.16	2.18
16.0	20.0		-	-	-	-	-	-	2.24	2.26	2.28	2.31	2.34	2.36	2.39	2.41
20.0	25.0		-	-	-	-	-	-	2.49	2.51	2.54	2.57	2.59	2.62	2.64	2.67
<b>Class A</b>																
1.5	2.0		0.28	0.30	0.30	0.33	-	-	-	-	-	-	-	-	-	-
2.0	2.5		0.30	0.30	0.33	0.36	0.41	0.43	-	-	-	-	-	-	-	-
2.5	3.0		0.30	0.30	0.30	0.36	0.38	0.43	0.46	0.51	-	-	-	-	-	-
3.0	4.0		0.33	0.36	0.38	0.41	0.46	0.51	0.56	0.61	0.69	-	-	-	-	-
4.0	5.0		-	0.41	0.43	0.46	0.51	0.56	0.61	0.69	0.76	0.84	0.91	0.99	-	-
5.0	6.0		-	-	0.46	0.51	0.56	0.61	0.69	0.76	0.84	0.91	0.99	1.07	-	-
6.0	8.0		-	-	-	0.56	0.61	0.69	0.76	0.84	0.91	0.99	1.07	1.14	-	-
8.0	10.0		-	-	-	-	0.69	0.76	0.84	0.91	0.99	1.07	1.14	1.22	-	-
10.0	12.0		-	-	-	-	0.76	0.84	0.91	0.99	1.07	1.14	1.22	1.30	-	-
12.0	16.0		-	-	-	-	-	0.91	0.99	1.07	1.14	1.22	1.30	1.37	-	-
16.0	20.0		-	-	-	-	-	-	1.07	1.14	1.22	1.30	1.37	1.45	-	-

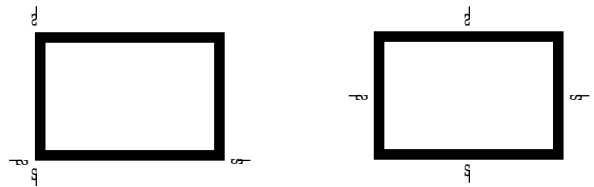
### Notes:

- These tolerance are applicable to hollow sections other than round tubes.
- For non-heat-treatable alloys, these tolerance are applicable when wall thickness of the section is at least 1.5 mm or 1/32 of overall width, whichever is greater. For heat-treated alloys, these tolerances are applicable when all wall thickness is at least 1.5 mm or 1/24 of overall width, whichever is greater.
- Unless otherwise specified, class B tolerances will be applicable.
- For high-magnesium non-heat treatable alloys (5052, 5056, 5083, 5086), an extra tolerance of 50% shall be allowed.

Alupuram

General information

TABLE 16  
Hollow Sections: Width Tolerance

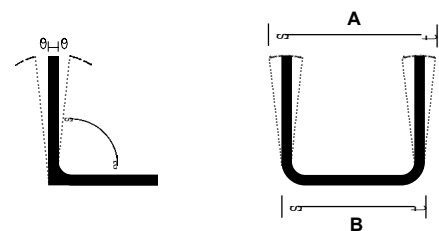


Specified Width or Width across flats (mm)		Width tolerance + when measured	
		at corners	at centre
<b>Over</b>	<b>Upto</b>		
10.0	20.0	0.30	0.46
20.0	30.0	0.38	0.55
30.0	40.0	0.45	0.65
40.0	50.0	0.52	0.80
50.0	60.0	0.60	1.00
60.0	80.0	0.70	1.20
80.0	100.0	0.80	1.40
100.0	120.0	0.89	1.65
120.0	140.0	1.02	1.90
140.0	160.0	1.14	2.20
160.0	180.0	1.27	2.45
180.0	200.0	1.40	2.70

Notes:

- These tolerances are applicable to hollow sections other than round tubes.
- For non-heat-treatable alloys, these tolerance are applicable when wall thickness of the section is at least 1.5 mm or 1/32 of overall width, whichever is greater. For heat-treatable alloys, these tolerances are applicable when wall thickness is at least 1.5 mm or 1/24 of overall width, whichever is greater.
- For high-magnesium non-treatable alloys (5052, 5056, 5083, 5086), an extra tolerance of 50% shall be allowed.

TABLE 17  
Solid & Hollow Sections: Angularity Tolerance



Displacement of any one leg to be controlled independently by angular tolerances

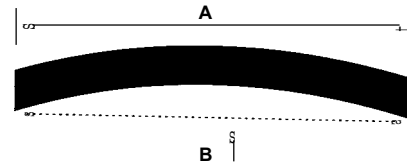
Specified thickness of thinnest leg mm	Allowable deviation from specified angle degree +
Upto 5.0	2.0
Over 5.0 upto 19.0	1.5
Over 19.0	1.0

Notes:

Angles should be measured at the extremities of the section. If the cases of the sections are convex, the angle should be measured by balancing by the arms of the protractor at the middle of the section.

## General information

TABLE 18  
Solid & Hollow Sections: Flatness Tolerance



Width of section (mm) A		Tolerance B
Over	Upto & including	+ mm
-	25	0.18
25	38	0.25
38	50	0.30
50	-	0.30 plus 0.13 mm for every 25 mm of width (see ex. below)

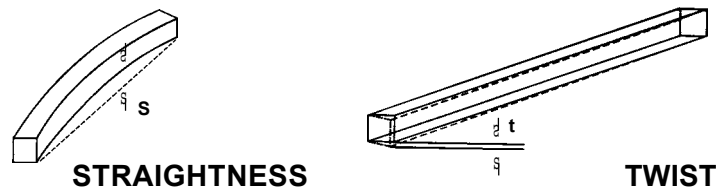
Example: The tolerances for a solid section of 150 mm width shall be as follows:

$$+(0.30 + 0.13 \times \frac{150}{25}) = (0.30 + 0.13 \times 6) = + 1.08 \text{ mm}$$

### Notes:

1. Flatness tolerances is measure of concavity or convexity.
2. While measuring convexity, the straight edge shall be balanced at the middle of the section.

TABLE 19  
Solid & Hollow Section: Twist & Straightness Tolerance



Diameter of circumscribing circle mm	Allowable deviation from straightness mm per metre of length
Upto & including 25.0	2.1
over 25.0	1.7

### Notes:

1. Tolerance values are for same for straightness and twist.
2. Twist is normally measured by placing the extruded section on a flat surface and measuring the maximum distance at any point along its length between the bottom surface of the section and the flat surface. From this measurement, the deviation from true straightness of the section is subtracted. The remainder is the twist. To convert the standard twist tolerance to an equivalent inner value, the tangent of the standard tolerance is multiplied by the width of the surface of the section that is one of the flat surface.

TABLE 20  
Solid & Hollow Section: Cut Length Tolerance

Width or diameter mm	Length 1,524 to 6,096 tolerance mm +	Length 6,097 to 9,144 tolerance mm +
Upto 50.0	6	10
50.1 to 100.0	8	11
100.1 to 150.0	10	13
150.1 to 200	12	14
200.1 to 250	13	16
250.1 to 280	16	19