



DESIGN GUIDE

PULTRUDED SECTIONS MATERIAL & SECTIONAL PROPERTIES

GRP AUSTRALIA | 2021 | PART 1



DESIGN GUIDE

NOTATIONS

A	Section area (mm ²)
B	Section width (mm)
c	Coordinate of centroid
D	Section diameter (mm)
E	Modulus of Elasticity (GPa)
f_b	Flexural Strength (MPa)
f_c	Compressive Strength (MPa)
f_{cb}	Pin Bearing Strength (MPa)
f_t	Tensile Strength (MPa)
f_v	Shear Strength (MPa)
G	Shear Modulus of Elasticity (GPa)
H	Section height (mm)
I	Moment of inertia (mm ⁴)
L	Length of Span; or segment length (m)
L_e	Effective length of a compression member (m)
r	Radius of gyration (mm)
T	Section thickness (mm)
ν	Poisson's Ratio
$Wt.$	Section weight (kg/m)
w	Deflection
Z	Elastic Section Modulus (mm ³)

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1.0 INTRODUCTION

GRP Australia is an independent supplier of GRP products including pultruded GRP structural sections, pultruded decking, pultruded grating and GRP moulded grating. We source and import pultruded products from international manufacturers to ensure we provide our customers with quality products at competitive prices. GRP Australia also has in-house engineers capable of providing design services to our customers and assisting in the design of custom pultruded shapes to suit client specific requirements.

The pultruded GRP sections displayed in this guide are a selection of the most common pultruded sections however, these do not include the full range of profiles available. Please contact GRP Australia for assistance with custom or specific profiles not contained in this manual. This manual has been divided into three parts:

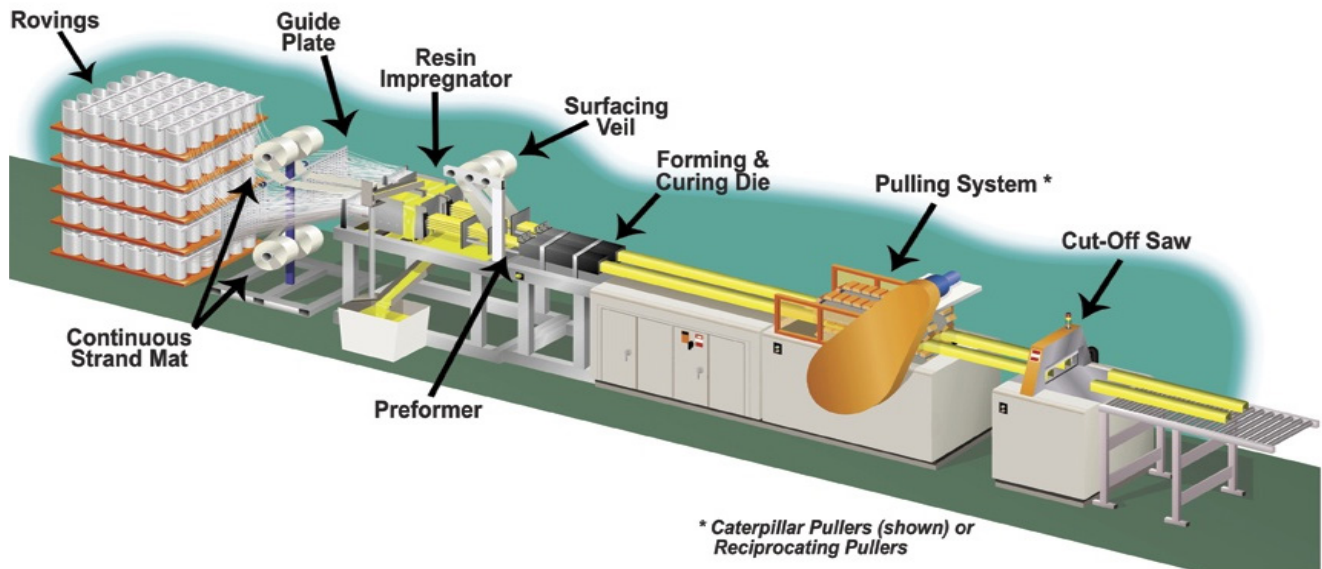
Part 1 - Introduction, material and sectional properties (this section)

Part 2 - Capacity tables

Part 3 - Common connections

1.1 PRODUCTION PROCESS

Pultruded glass reinforced products (GRP) are a composite material made by a continuous moulding process using fibre reinforcement in a thermosetting resin. Glass mat and roving are drawn through a resin bath and then pulled through a heated steel die to form the desired shape. This process ensures the quality of the product remains consistent. Pultruded profiles are available in a wide variety of shapes and colours, they are dimensionally stable and easy to work with.



1.2 REINFORCEMENTS

Roving

Fiberglass roving provides the high longitudinal strength of pultruded products. The amount and location of these reinforcements can be determined in the design stage and can alter the subsequent physical properties of the finished product. Roving also provides the tensile strength needed to pull the other reinforcements through the die and is therefore a necessary ingredient in the profile design. The roving used in GRP pultrusions is E Glass Direct.

Mat

Continuous strand mat provides the most economical method of obtaining a high degree of transverse physical properties. The mats are layered with roving, which forms the basic composition found in most pultruded products. The ratio of mat to roving determines the relationship of transverse to longitudinal physical properties.

Veil

Veils are used to enhance the surface of pultruded profiles and can influence the appearance, corrosion resistance and ease of handling of the finished product. All standard structural shapes are manufactured using a surface veil as well as UV inhibitors to protect against UV degradation. The total glass content of GRP pultrusions is typically 65 to 66%.

1.3 RESINS

The resins that form the matrix in the composite profile bind the reinforcement together and hold them in the right position within the pultruded section, giving the structure the required properties. There are two main types of resins used as the matrix in our products:

Isophthalic polyester resin

Isophthalic polyester resin is the most commonly used resin in our products and is suitable for most applications. Its all round properties include corrosion resistance, dielectric properties, low thermal conductivity, and excellent mechanical properties. This is supplied in two fire rating classes, IFR-10, ASTM E-84 class 1 flame spread rating 10 or less, and IFR25, class 1 flame spread rating 25 or less. Both contain UV inhibitors.

Vinyl ester resin

Vinyl ester resin is chosen when greater corrosion resistance and thermal properties are required. This resin also has increased impact resistance and fatigue properties than isophthalic polyester. This resin is supplied in two fire rating classes, VER-10, ASTM E-84 class 1 flame spread rating 10 or less, and VER-25, class 1 flame spread rating 25 or less. Both contain UV inhibitors. GRP Australia stock products that are manufactured from VER-25.

The table below is a summary of the general properties of the resins.

Resin type	Resin base	Description	Corrosion resistance	Flame Spread Rating ASTM E84	Cost
VEFR-25	Vinyl ester	Superior corrosion resistance and retardant.	Excellent	Class 1, 25 or less	
VEFR-10	Vinyl ester	Superior corrosion resistance and enhanced retardant	Excellent	Class 1, 10 or less	Most Expensive
IFR-25	Isophthalic polyester	Industrial grade corrosion resistance and fire retardant	Very good	Class 1, 25 or less	Least Expensive
IFR-10	Isophthalic polyester	Industrial grade corrosion resistance and extra fire retardant	Very good	Class 1, 10 or less	

1.4 DISCLAIMER

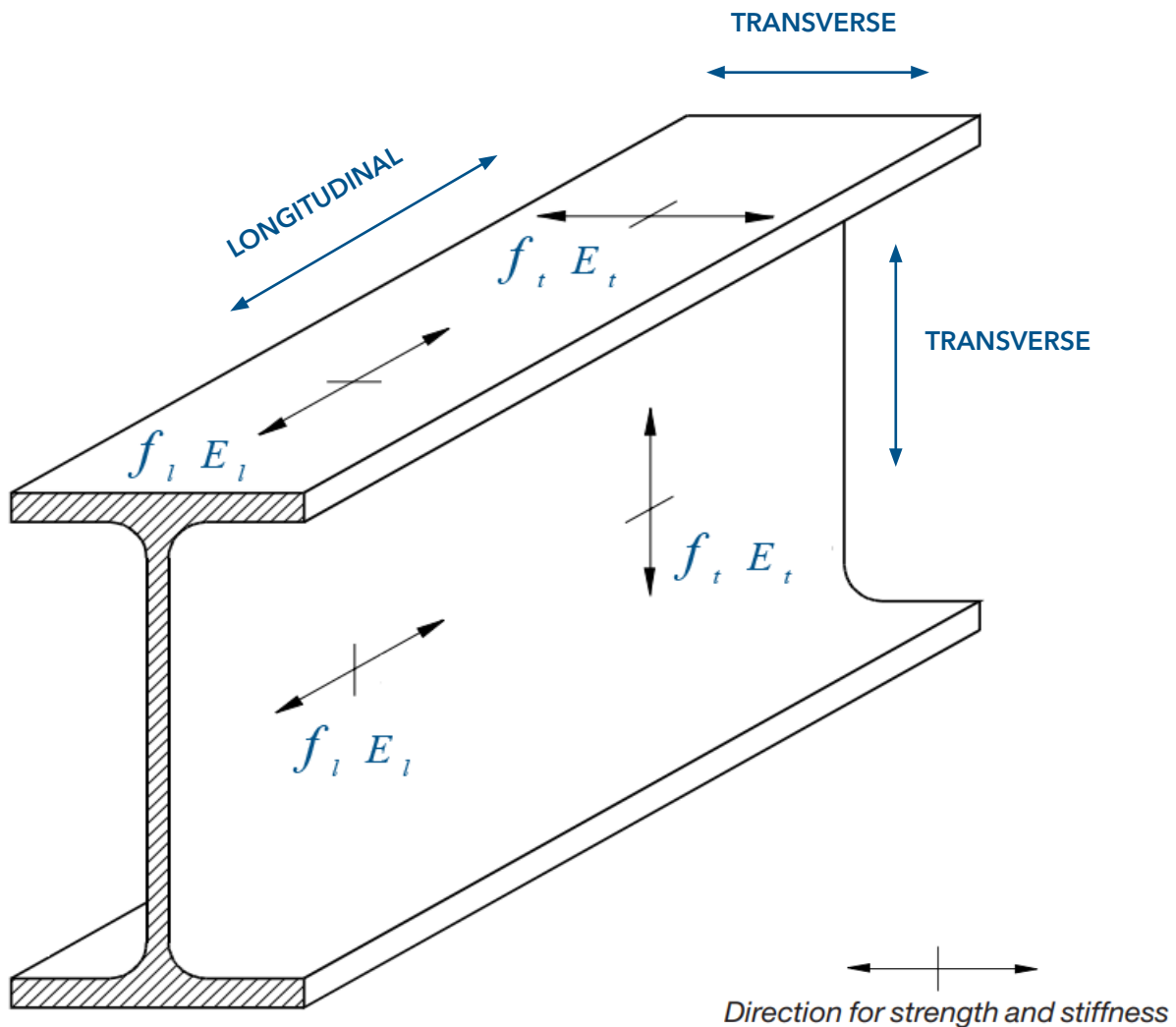
The data presented in this manual is to the best current knowledge of GRP Australia and may be subject to change at any time. GRP Australia does not warrant or certify the information provided to be free of errors or deficiencies.

2.0 MATERIAL PROPERTIES: STRUCTURAL

2.1 PROPERTY DEFINITIONS

The property values stated are valid for temperatures in the range of -20°C to 50°C . The values are based on ASTM (American Society for Testing and Materials) coupon and full section testing. For temperatures above 50°C the strength and stiffness must be reduced by amount as stated in section 2.4, "Temperature and Weathering".

Pultruded GRP is an anisotropic material in that the material properties are different in different directions. This is due to the manufacturing process whereby the glass roving runs along the longitudinal length of the members. For this reason, the material properties noted in section 2.2 have been defined for the longitudinal direction and the transverse direction which are defined in the diagram below.



2.2 MECHANICAL PROPERTIES

Mechanical Properties	Symbol	ASTM	Value	Units
Flexural Strength - Longitudinal	$f_{b,l}$	D790-17	250	MPa
Flexural Strength - Traverse	$f_{b,t}$	D790-17	100	MPa
Tensile Strength - Longitudinal	$f_{t,l}$	D638-14	250	MPa
Tensile Strength - Transverse	$f_{t,t}$	D638-14	55	MPa
Compressive Strength - Longitudinal	$f_{c,l}$	D695-15	240	MPa
Compressive Strength - Longitudinal	$f_{c,t}$	D695-15	70	MPa
Short Beam Shear Strength	f_v	D2344-16	25	MPa
Pin Bearing strength—Longitudinal	$f_{cb,l}$	D953-10	150	MPa
Pin Bearing strength—Transverse	$f_{cb,t}$	D953-10	70	MPa
Modulus of Elasticity, E , Longitudinal Full Section, angle and channels, I Beam	E_l	D790-17	23	GPa
Modulus of Elasticity, E , Longitudinal Full Section, square, rectangular hollow sections	E_l	D790-17	26	GPa
Modulus of Elasticity, E , Transverse Full Section	E_t	D790-17	9.0	GPa
Poisson's Ratio—Longitudinal	ν_l	D3039	0.23	
Poisson's Ratio—Transverse	ν_t	D3039	0.09	
Shear Modulus	G		3	GPa
Poisson's Ratio - Longitudinal	ν_l		0.23	
Poisson's Ratio - Transverse	ν_t		0.09	
Short Term Safety Factor	Y_{me}		3.00	
Interlaminar Shear Strength			24	MPa

2.3 PHYSICAL PROPERTIES

Physical Properties	Value	Units
Density	1850 - 1950	kg/m ³
Coefficient of Linear Thermal Expansion (LW)	7.92	10 ⁻⁶ m/m °C
Thermal Conductivity	6.9	W/m/K

2.4 TEMPERATURE AND WEATHERING

When exposed to continuous high temperatures, polyester and vinyl ester pultrusion sections experience property loss, which should be considered during the designing stages. The following table shows the percentage of property retention at certain continuous temperatures.

Ultimate Stress (% of property retention)		
Continuous Temperature	Polyester	Vinyl Ester
37	85%	90%
50	70%	80%
65	50%	80%
79	Not recommended	75%
93	Not recommended	50%

Modulus of Elasticity (% of property retention)		
Continuous Temperature °C	Polyester	Vinyl Ester
37	100%	100%
50	90%	95%
65	85%	90%
79	Not recommended	88%
93	Not recommended	85%

2.5 CHEMICAL RESISTANCE GUIDE

This chemical resistance guide provides guidance to engineers for the selection of resin type of pultruded sections to be used in the particular application. The selection of the resin type depends on the following:

- Corrosion environment
- Normal operating chemical concentration
- Normal operating temperature

This table is to be treated as a guide only, further testing or field trials may be required prior to final selection.

Chemical Environment	% CONC.	ISOPHTHALIC	VINYL ESTER
		Max. Temp. °C	Max. Temp. °C
Acetic Acid	0-50	NR	38
Acetone	100	NR	NR
Aluminium Hydroxide	5-20	NR	65
Aluminium Chloride	10	NR	65
Ammonium Bicarbonate	15	NR	50
Ammonium Hydroxide	5-20	NR	50
Ammonium Sulphate	15	50	65
Barium Sulphate	100	NR	38
Benzene	100	NR	NR
Benzoic Acid	5-20	NR	38
Borax	5-20	38	65
Calcium Carbonate	10	NR	38
Calcium Hydroxide	5-20	NR	38
Calcium Hypochlorite	10	NR	50
Calcium Nitrate	5	50	65
Chlorine - Dry Gas	ALL	NR	70
Chlorine Water	10	NR	50
Chromic Acid	50	NR	38
Citric Acid	5-30	50	65
Copper Chloride	5	65	82
Copper Cyanide	5	65	82
Copper Nitrate	ALL	65	NR
Crude Oil	ALL	NR	65
Ethanol Glycol	ALL	38	65
Ferric Chloride	10	50	65
Ferric Nitrate	10	50	65
Ferrous Chloride	ALL	65	70
Fluoro silicic Acid	10	NR	70

2.5 CHEMICAL RESISTANCE GUIDE - CONT.

		ISOPHTHALIC	VINYL ESTER
Chemical Environment	% CONC.	Max. Temp. °C	Max. Temp. °C
Formaldehyde	5-30	NR	38
Gasoline	ALL	NR	70
Glucose	ALL	65	82
Glycerin	ALL	65	82
Hydrobromic Acid	5-50	38	65
Hydrogen Peroxide	30	NR	50
Lactic Acid	100	NR	70
Lithium Chloride	25	NR	50
Magnesium Chloride	10	38	65
Magnesium Nitrate	10	NR	50
Magnesium Sulphate	10	38	50
Mercuric Chloride	10	50	65
Mercurous Chloride	10	50	65
Nickle Chloride	10	50	65
Nickle Sulphate	10	50	65
Nitric Acid	5-30	NR	38
Oxalic Acid	ALL	65	70
Phosphoric Acid	5-50	38	65
Potassium Chloride	100	NR	50
Potassium Dichromate	100	NR	50
Potassium Nitrate	10	50	65
Potassium Sulphate	10	50	65
Propylene Glycol	100	65	65
Sodium Acetate	ALL	NR	70
Sodium Bisulfate	ALL	65	70
Sodium Bromide	ALL	65	70
Sodium Cyanide	ALL	NR	70
Sodium Hydroxide	0-50	NR	65
Sodium Nitrate	ALL	65	70
Sodium Sulphate	ALL	65	70
Sulphuric Acid	0-30	65	70
Sulphuric Acid	30-50	NR	70
Sulphuric Acid	50-70	NR	50
Tartaric Acid	ALL	65	70
Vinegar	ALL	65	70
Water (Distilled)	ALL	C	C

NR = Not recommended for the Concentrations and Temperatures listed.

GRP Australia believes the data to be true and accurate but no guarantee is expressed or implied as to specific performance. Testing for specific environments is recommended. Responsibility for claims arising from breach of warranty, negligence or otherwise is limited to the purchase price of the material sold.

2.6 FIRE PROPERTIES

All GRP Australia products contain fire retardants, typically alumina trihydrate. Our standard profiles are classified as class 1,25 or less flame spread index to ASTM E84. The ultimate fire rating properties of GRP pultruded products will depend on the composite mix. Pultruded profiles made with isophthalic resin (IFR-10) tested to AS 1530 achieved the following results:

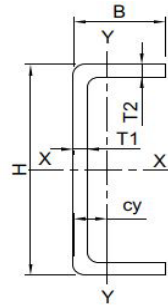
	Range	Value
Spread of Flame index	(0-10)	0
Heat Evolved Index	(0-10)	1
Smoke developed Index	(0-10)	5
Ignitability Index	(0-20)	13

2.7 ENVIRONMENTAL & DISPOSAL

GRP pultruded profiles (fiberglass–reinforced unsaturated polyesters) are a stable and virtually non-degradable material. Offcuts and profiles which are at the end of their service life, can be disposed as normal industrial waste as the materials do not give off substances which can harm the environment.

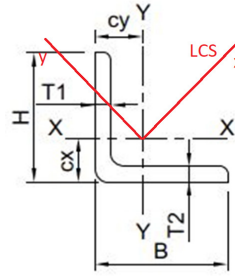
3.0 SECTION PROPERTIES

3.1 CHANNEL



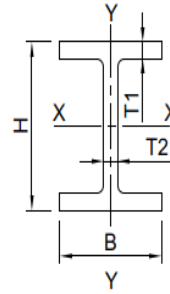
Product Number	B	H	T1/T2	A	Wt.	ix	ly	Zx	Zy	cx	cy	rx	ry	Ay	Ax	J (Torsion constant)	r (Torsion radius)	Iw (Wrapping constant)	Internal radius	External radius
	mm	mm	mm	mm	10 ³ mm ²	kg/m	10 ⁶ mm ⁴	10 ⁶ mm ⁴	10 ³ mm ³	10 ³ mm ³	mm	mm	mm	mm	m	10 ³ mm ²	mm ⁴	mm	10 ⁹ mm ⁴	(mm)
C50x14x3.2x3.2	50.0	14.0	3.2	0.229	0.4	0.071	0.003	2.832	0.307	3.8	0.0	17.6	3.7	0.142	4.51E-02	825.806	4.6013	1.18E-03	2.5	2.5
C75x35x5x5	75.0	35.0	5.0	0.675	1.3	0.543	0.074	14.477	3.000	10.3	0.0	28.4	10.5	0.311	2.17E-01	5745.92	8.1949	6.34E-02	2.5	2.5
C76x38x6.4x6.4	76.0	38.0	6.4	0.905	1.8	0.736	0.115	19.371	4.381	11.8	0.0	28.5	11.3	0.409	3.35E-01	13689.2	9.2152	9.56E-02	6.4	3.2
C102x27x3.2x3.2	102.0	27.0	3.2	0.481	0.9	0.658	0.026	12.902	1.248	5.9	0.0	37.0	7.4	0.296	7.91E-02	1705.16	4.2531	4.62E-02	3.2	2.5
C102x44x4.8x4.8	102.0	44.0	4.8	0.866	1.7	1.309	0.151	25.669	4.729	12.0	0.0	38.9	13.2	0.419	2.54E-01	6967.88	6.7786	2.46E-01	4.8	4.8
C102x44x6.4x6.4	102.0	44.0	6.4	1.118	2.2	1.626	0.191	31.879	6.095	12.7	0.0	38.1	13.1	0.543	3.26E-01	15216.7	10.1044	2.98E-01	2.5	6.4
C120x40x6x6	120.0	40.0	6.0	1.114	2.2	2.139	0.144	35.644	4.866	10.4	0.0	43.8	11.4	0.627	2.44E-01	13415.9	8.7115	3.24E-01	3.2	6.4
C150x100x6.4x6.4	150.0	100.0	6.4	2.144	4.2	7.899	2.196	105.317	31.908	31.2	0.0	60.7	32.0	0.727	8.83E-01	29329.4	9.498	7.86E+00	3.2	6.4
C152x42x6.4x6.4	152.0	42.0	6.4	1.414	2.8	4.206	0.187	55.337	5.842	10.0	0.0	54.5	11.5	0.865	2.44E-01	19381.5	8.9497	7.00E-01	3.2	6.4
C152x42x9.5x9.5	152.0	42.0	9.5	2.047	4.0	5.834	0.254	76.759	8.233	11.1	0.0	53.4	11.1	1.272	3.79E-01	61956.2	14.9493	9.08E-01	3.2	6.4
C152X50.8X9.5X9.5	152.0	50.8	9.5	2.214	4.3	6.684	0.448	87.944	12.093	13.8	0.0	54.9	14.2	1.252	5.02E-01	66984.9	14.5751	1.59E+00	3.2	6.4
C160x48x8x8	160.0	48.0	8.0	1.912	3.7	6.367	0.336	79.582	9.353	12.1	0.0	57.7	13.3	1.132	3.77E-01	41659.3	11.8205	1.36E+00	4.8	6.4
C203x56x6.4x6.4	203.0	56.0	6.4	1.926	3.8	10.502	0.467	103.466	10.726	12.5	0.0	73.8	15.6	1.166	3.28E-01	26734.2	8.7268	3.22E+00	4.8	6.4
C203x56x9.5x9.5	203.2	55.6	9.5	2.804	5.5	14.796	0.646	145.777	15.243	13.6	0.0	72.6	15.2	1.717	4.95E-01	85681.1	14.0881	4.31E+00	4.8	6.4
C203x102x12.7x12.7	203.0	102.0	12.7	4.814	9.4	29.076	4.649	286.466	64.963	30.4	0.0	77.7	31.1	2.089	1.62E+00	260152	20.4132	2.92E+01	4.8	9.6
C254x70x12.7x12.7	250.0	70.0	12.7	4.649	9.1	38.014	1.660	299.320	31.543	17.4	0.0	90.4	18.9	2.858	8.18E-01	251175	19.3265	1.71E+01	4.8	9.6
C292x70x12.7x12.7	292.1	69.9	12.7	5.140	10.0	54.193	1.720	371.185	32.043	16.3	0.0	102.7	18.3	3.327	7.55E-01	280033	18.8506	2.41E+01	6.4	9.6
C305x76x12.7x12.7	305.0	76.0	12.7	5.457	10.6	63.783	2.220	418.252	38.010	17.6	0.0	108.1	20.2	3.473	8.35E-01	297004	18.568	3.41E+01	6.4	9.6
C356x89x19x19	356.0	89.0	19.0	9.392	18.3	145.784	5.042	819.013	75.495	22.2	0.0	124.6	23.2	6.036	1.52E+00	1152120	26.9982	1.02E+02	9.6	12.7

3.2 EQUAL ANGLE



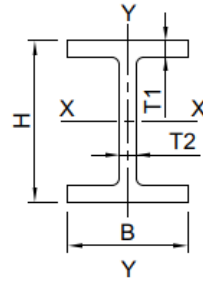
Product Number	H	B	T	A	Wt.	I_x / I_y	I_y	Z_x / Z_y	Z_y	c_x / c_y	c_y	r_x / r_y	r_y	A_y	J (Torsion constant)	r (Torsion radius)	Iw (Wrapping constant)	I_{xp}	I_{yp}	Alpha	Internal radius	External radius
	mm	mm	mm	10^3 mm^2	kg/m	10^6 mm^4	10^6 mm^4	10^3 mm^3	10^3 mm^3	mm	mm	mm	mm	10^3 mm^2	mm^4	mm	10^9 mm^4	10^6 mm^4	10^6 mm^4	degree	(mm)	(mm)
EA25x25x6.4	25	25	6.4	0.278	0.6	0.015	0.015	0.886	0.886	8.6	8.6	9.0	4.8	0.139	3607.3	12.4997	1.29E-04	2.26E-02	0.006523897	-45	1	2.5
EA30x30x5	30	30	5.0	0.274	0.6	0.022	0.022	1.069	1.069	9.4	9.4	11.3	5.8	0.127	2215.95	8.5765	1.36E-04	3.49E-02	0.009162896	-45	1	2.5
EA32x32x4	32	32	4.0	0.239	0.4	0.023	0.023	1.008	1.008	9.5	9.5	12.3	6.2	0.108	1247.51	6.4815	9.29E-05	3.62E-02	0.00917984	-45	1	2.5
EA38x38x5	38	38	5.0	0.355	0.7	0.047	0.047	1.769	1.769	11.4	11.4	14.5	7.4	0.163	2955.02	7.1986	2.99E-04	7.49E-02	0.0193223	-45	2.5	2.5
EA38x38x6.4	38	38	6.4	0.445	0.9	0.057	0.057	2.194	2.194	11.8	11.8	14.3	7.4	0.210	6009.16	9.4139	5.75E-04	9.07E-02	0.0240705	-45	2.5	2.5
EA50x50x3.2	50	50	3.2	0.310	0.6	0.076	0.076	2.087	2.087	13.7	13.7	19.8	9.9	0.135	1054.57	4.6378	2.05E-04	1.21E-01	0.0304856	-45	1.5	1.5
EA50x50x6.4	50	50	6.4	0.595	1.1	0.137	0.137	3.923	3.923	15.0	15.0	19.2	9.6	0.274	8047.95	9.2334	1.44E-03	2.20E-01	0.0552663	-45	5	3
EA76x76x6.4	76	76	6.4	0.930	1.8	0.516	0.516	9.457	9.457	21.4	21.4	29.8	14.9	0.410	12609.3	9.7001	5.54E-03	8.25E-01	0.207926	-45	2.5	3.5
EA76x76x9.5	76	76	9.5	1.351	2.6	0.723	0.723	13.526	13.526	22.5	22.5	29.2	14.8	0.609	39949.6	16.177	1.67E-02	1.15E+00	0.296019	-45	2.5	4
EA102x102x6.4	102	102	6.4	1.257	2.5	1.284	1.284	17.359	17.359	28.0	28.0	40.5	20.1	0.548	17000.7	8.4515	1.39E-02	2.06E+00	0.50814	-45	6.4	3
EA102x102x9.5	102	102	9.5	1.830	3.5	1.818	1.818	25.004	25.004	29.3	29.3	39.9	19.8	0.817	54174.7	13.757	4.30E-02	2.92E+00	0.717436	-45	9.5	4
EA102x102x12.7	102	102	12.7	2.430	4.6	2.332	2.332	32.514	32.514	30.3	30.3	39.1	19.7	1.133	133005	17.3418	9.59E-02	3.72E+00	0.943644	-45	9.5	9.5
EA152x152x9.5	152	152	9.5	2.798	5.4	6.324	6.324	57.276	57.276	41.6	41.6	60.1	30.0	1.240	85712.4	12.9962	1.51E-01	1.01E+01	2.52607	-45	9.5	9.5
EA152x152x12.7	152	152	12.7	3.700	7.0	8.186	8.186	74.984	74.984	42.8	42.8	59.5	29.7	1.679	203936	17.5182	3.46E-01	1.31E+01	3.26793	-45	12.7	12.7

3.3 I-BEAM



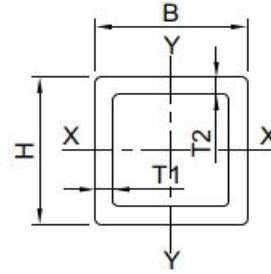
Product Number	B	H	T1	T2	A	Wt.	I _x	I _y	Z _x	Z _y	c _x	c _y	r _x	r _y	A _y	A _x	J (Torsion constant)	r (Torsion radius)	I _w (Wrapping constant)	Fillet radius
	mm	mm	mm	mm	10 ³ mm ²	kg/m	10 ⁶ mm ⁴	10 ⁶ mm ⁴	10 ³ mm ³	10 ³ mm ³	mm	mm	mm	mm	10 ³ mm ²	10 ³ mm ²	mm ⁴	mm	10 ⁹ mm ⁴	(mm)
IB15x25x6.4x4	15.0	25.0	6.4	4.0	0.245	0.5	0.018	0.004	1.439	0.492	0.0	0.0	8.6	3.9	0.099	1.82E-01	2843	8.8736	2.78E-04	2
IB15x32x6.4x4	15.0	32.0	6.4	4.0	0.273	0.5	0.035	0.004	2.174	0.497	0.0	0.0	11.3	3.7	0.122	1.85E-01	2991.96	9.529	5.44E-04	2
IB15x38x4x6.4	15.0	38.0	4.0	6.4	0.316	0.6	0.050	0.003	2.633	0.394	0.0	0.0	12.6	3.1	0.217	1.92E-01	3821.64	8.6156	6.03E-04	2
IB30x38x3x3	30.0	38.0	3.0	3.0	0.280	0.5	0.064	0.014	3.387	0.906	0.0	0.0	15.2	7.0	0.103	1.64E-01	937.074	4.8948	4.03E-03	2
IB45x9x180x12	45.0	180.0	9.0	12.0	2.788	5.4	10.392	0.162	115.471	7.197	0.0	0.0	61.1	7.6	1.975	1.10E+00	129442	16.7465	1.01E+00	6
IB50x102x6.4x6.4	50.0	102.0	6.4	6.4	1.249	2.4	1.914	0.136	37.538	5.448	0.0	0.0	39.1	10.4	0.616	6.35E-01	20947.3	10.5162	2.94E-01	6.4
IB50x102x8x8	50.0	102.0	8.0	8.0	1.548	3.0	2.297	0.173	45.043	6.903	0.0	0.0	38.5	10.6	0.772	8.33E-01	42553	13.5694	3.49E-01	8
IB70x140x6.35x6.35	70.0	140.0	6.4	6.4	1.749	3.4	5.247	0.370	74.959	10.559	0.0	0.0	54.8	14.5	0.845	8.42E-01	27731.4	10.122	1.60E+00	6.4
IB76x152x6.4x6.4	76.0	152.0	6.4	6.4	1.902	3.7	6.776	0.472	89.156	12.426	0.0	0.0	59.7	15.8	0.917	9.04E-01	29829.8	10.247	2.44E+00	6.4
IB76x152x9.5x9.5	76.0	152.0	9.5	9.5	2.792	5.4	9.554	0.709	125.711	18.658	0.0	0.0	58.5	15.9	1.363	1.43E+00	102906	15.3773	3.41E+00	9.5
IB102x203x9.5x9.5	102.0	203.0	9.5	9.5	3.771	7.4	23.770	1.698	234.185	33.291	0.0	0.0	79.4	21.2	1.818	1.82E+00	132188	16.5083	1.54E+01	9.5
IB102x203x12.7x12.7	102.0	203.0	12.7	12.7	4.998	9.7	30.535	2.291	300.836	44.917	0.0	0.0	78.2	21.4	2.433	2.56E+00	329001	20.6197	1.96E+01	12.7
IB127x254x9.5x9.5	127.0	254.0	9.5	9.5	4.730	9.2	47.480	3.265	373.861	51.410	0.0	0.0	100.2	26.3	2.275	2.21E+00	160860	15.1213	4.79E+01	9.5
IB127x254x12.7x12.7	127.0	254.0	12.7	12.7	6.280	12.2	61.519	4.389	484.401	69.118	0.0	0.0	99.0	26.4	3.042	3.07E+00	397676	20.3044	6.17E+01	12.7
IB127x152x9.5x9.5	127.0	152.0	9.5	9.5	3.761	7.3	14.481	3.257	190.533	51.295	0.0	0.0	62.0	29.4	1.322	2.20E+00	131964	15.275	1.61E+01	9.5
IB127x152x12.7x12.7	127.0	152.0	12.7	12.7	4.985	9.7	18.391	4.372	241.989	68.844	0.0	0.0	60.7	29.6	1.780	3.04E+00	328485	20.7846	2.01E+01	12.7
IB152x305x9.5x9.5	152.0	305.0	9.5	9.5	5.215	10.2	72.893	3.268	477.985	51.467	0.0	0.0	118.2	25.0	2.745	2.22E+00	174323	15.1134	7.01E+01	9.5
IB152x305x12.7x12.7	152.0	305.0	12.7	12.7	6.928	13.5	94.913	4.398	622.382	69.255	0.0	0.0	117.0	25.2	3.666	3.08E+00	432354	20.4412	9.11E+01	12.7

3.4 WIDE FLANGE



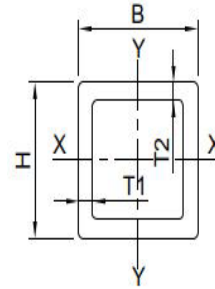
Product Number	B	H	T1	T2	A	Wt.	I _x	I _y	Z _x	Z _y	c _x	c _y	r _x	r _y	A _y	A _x	J (Torsion constant)	r (Torsion radius)	I _w (Wrapping constant)	Fillet radius
	mm	mm	mm	mm	10 ³ mm ²	kg/m	10 ⁶ mm ⁴	10 ⁶ mm ⁴	10 ³ mm ³	10 ³ mm ³	mm	mm	mm	mm	10 ³ mm ²	10 ³ mm ²	mm ⁴	mm	10 ⁹ mm ⁴	(mm)
HB76x76x6.4x6.4	76.0	76.0	6.4	6.4	1.416	2.8	1.351	0.471	35.551	12.383	0.0	0.0	30.9	18.2	0.440	8.98E-01	23218.1	10.487	5.46E-01	6.4
HB102x102x6.4x6.4	102.0	102.0	6.4	6.4	1.915	3.7	3.438	1.135	67.402	22.251	0.0	0.0	42.4	24.3	0.586	1.17E+00	30014.7	10.3121	2.53E+00	6.4
HB102x102x8.0x8.0	102.0	102.0	8.0	8.0	2.380	4.6	4.140	1.421	81.167	27.860	0.0	0.0	41.7	24.4	0.736	1.49E+00	60265	13.2769	3.02E+00	8
HB152x152x6.4x6.4	152.0	152.0	6.4	6.4	2.897	5.6	12.032	3.751	158.317	49.351	0.0	0.0	64.5	36.0	0.878	1.73E+00	45074.9	10.7738	1.96E+01	6.4
HB152x152x9.5x9.5	152.0	152.0	9.5	9.5	4.236	8.3	16.895	5.574	222.308	73.346	0.0	0.0	63.2	36.3	1.296	2.59E+00	146229	15.5291	2.77E+01	9.5
HB203x203x6.4x6.4	203.0	203.0	6.4	6.4	3.854	7.5	29.123	8.928	286.930	87.963	0.0	0.0	86.9	48.1	1.157	2.25E+00	56035.3	10.2135	8.58E+01	6.4
HB203x203x9.5x9.5	203.0	203.0	9.5	9.5	5.690	11.1	41.747	13.263	411.302	130.669	0.0	0.0	85.7	48.3	1.723	3.40E+00	189720	15.0588	1.23E+02	9.5
HB203x203x12.7x12.7	203.0	203.0	12.7	12.7	7.563	14.7	53.795	17.751	530.003	174.890	0.0	0.0	84.3	48.4	2.313	4.63E+00	466666	21.2439	1.57E+02	12.7
HB254x254x9.5x9.5	254.0	254.0	9.5	9.5	7.143	13.9	83.561	25.967	657.960	204.468	0.0	0.0	108.2	60.3	2.152	4.20E+00	232015	15.3197	3.85E+02	9.5
HB254x254x12.7x12.7	254.0	254.0	12.7	12.7	9.506	18.5	108.518	34.739	854.476	273.537	0.0	0.0	106.8	60.5	2.885	5.70E+00	570677	20.2111	4.98E+02	12.7
HB305x305x12.7x12.7	305.0	305.0	12.7	12.7	11.449	22.3	191.546	60.117	1,256.040	394.212	0.0	0.0	129.3	72.5	3.457	6.78E+00	671114	20.4097	1.27E+03	12.7

3.5 SQUARE HOLLOW



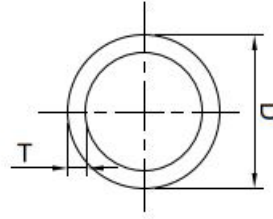
Product Number	H	B	T	A	Wt.	I _x /I _y	Z _x /Z _y	c _x / c _y	r _x / r _y	A _y	A _x	J (Torsion constant)	r (Torsion radius)	I _w (Wrapping constant)	Internal radius	External radius
	mm	mm	mm	10 ³ mm ²	kg/m	10 ⁹ mm ⁴	10 ³ mm ³	mm	mm	10 ³ mm ²	10 ³ mm ²	mm ⁴	mm	10 ⁹ mm ⁴	(mm)	(mm)
SHS25x25x3.2	25.0	25.0	3.2	0.273	0.5	0.022	1.741	0.0	8.9	0.126	1.26E-01	3.58E+04	14.8318	7.78E-05	0.5	2.5
SHS25x25x6.35	25.0	25.0	6.4	0.471	0.9	0.030	2.392	0.0	8.0	0.262	2.62E-01	5.09E+04	16.54	3.31E-05	1	2.5
SHS32x32x6.4	32.0	32.0	6.4	0.650	1.3	0.075	4.672	0.0	10.7	0.328	3.28E-01	1.24E+05	20.4192	1.77E-04	1	2.5
SHS38x38x3.2	38.0	38.0	3.2	0.440	0.9	0.089	4.672	0.0	14.2	0.194	1.94E-01	1.41E+05	24.0742	2.06E-03	0.5	2.5
SHS38x38x5	38.0	38.0	5.0	0.655	1.3	0.121	6.354	(0.0)	13.6	0.303	3.03E-01	1.95E+05	22.6353	9.19E-04	1	2.5
SHS38x38x6.4	38.0	38.0	6.4	0.804	1.6	0.138	7.279	0.0	13.1	0.388	3.88E-01	2.27E+05	23.536	6.19E-04	1	2.5
SHS50x50x3.2	50.0	50.0	3.2	0.594	1.2	0.217	8.665	0.0	19.1	0.259	2.59E-01	3.41E+05	29.7336	1.65E-02	1	2.5
SHS50x50x4	50.0	50.0	4.0	0.731	1.4	0.258	10.337	0.0	18.8	0.322	3.22E-01	4.08E+05	30.0908	1.15E-02	1	2.5
SHS50x50x5	50.0	50.0	5.0	0.895	1.7	0.304	12.175	0.0	18.4	0.400	4.00E-01	4.84E+05	30.79	7.85E-03	1	2.5
SHS50x50x6.4	50.0	50.0	6.4	1.111	2.2	0.358	14.323	0.0	18.0	0.510	5.10E-01	5.75E+05	29.616	5.08E-03	1	2.5
SHS76x76x3.2	76.0	76.0	3.2	0.927	1.8	0.818	21.516	0.0	29.7	0.397	3.97E-01	1.26E+06	45.2754	3.86E-01	1	2.5
SHS76x76x5	76.0	76.0	5.0	1.416	2.8	1.193	31.395	0.0	29.0	0.617	6.17E-01	1.86E+06	47.7386	1.95E-01	1.5	2.5
SHS76x76x6.4	76.0	76.0	6.4	1.778	3.5	1.445	38.014	0.0	28.5	0.784	7.84E-01	2.27E+06	47.9622	1.30E-01	1.5	2.5
SHS76x76x9.5	76.0	76.0	9.5	2.510	4.9	1.876	49.375	(0.0)	27.3	1.149	1.15E+00	3.02E+06	45.8377	6.53E-02	1.5	4.5
SHS89x89x6.4	89.0	89.0	6.4	2.111	4.1	2.411	54.172	0.0	33.8	0.921	9.21E-01	3.76E+06	57.2461	4.40E-01	1.5	2.5
SHS102x102x3.2	102.0	102.0	3.2	1.261	2.5	2.049	40.185	0.0	40.3	0.537	5.37E-01	3.15E+06	60.4274	3.33E+00	1.5	2.5
SHS102x102x5	102.0	102.0	5.0	1.936	3.8	3.040	59.604	0.0	39.6	0.832	8.32E-01	4.69E+06	77.7789	1.80E+00	1.5	2.5
SHS102x102x6.4	102.0	102.0	6.4	2.444	4.8	3.734	73.212	0.0	39.1	1.059	1.06E+00	5.80E+06	76.0042	1.25E+00	1.5	2.5
SHS102x102x8	102.0	102.0	8.0	2.991	5.8	4.418	86.633	(0.0)	38.4	1.312	1.31E+00	6.95E+06	64.5112	8.69E-01	1.5	4.5
SHS100x100x10	100.0	100.0	10.0	3.583	7.0	4.878	97.556	0.0	36.9	1.599	1.60E+00	7.73E+06	64.6215	5.08E-01	1.5	4.5
SHS125x125x8	125.0	125.0	8.0	3.733	7.3	8.535	136.553	(0.0)	47.8	1.627	1.63E+00	1.33E+07	71.7485	3.98E+00	3	4.5
SHS152x152x9.5	152.0	152.0	9.5	5.390	10.5	18.256	240.216	0.0	58.2	2.343	2.34E+00	2.85E+07	92.5009	1.35E+01	3	6
SHS152x152x12.7	152.0	152.0	12.7	7.051	13.7	22.921	301.593	0.0	57.0	3.110	3.11E+00	3.61E+07	96.4613	8.45E+00	3	6

3.6 RECTANGULAR HOLLOW



Product Number	H	B	T1	T2	A	Wt	lx	ly	Zx	Zy	cx	cy	rx	ry	Ay	Ax	J (Torsion constant)	r (Torsion radius)	lw (Wrapping constant)	Internal radius	External radius
	mm	mm	mm	mm	10 ³ mm ²	kg/m	10 ⁶ mm ⁴	10 ⁶ mm ⁴	10 ³ mm ³	10 ³ mm ³	mm	mm	mm	mm	10 ³ mm ²	10 ³ mm ²	10 ⁶ mm ⁴	mm	10 ³ mm ⁴	(mm)	(mm)
RHS51x25x3	51.0	25.0	3.0	3.0	0.420	0.819	-0.132	0.040	5.159	3.236	0	0	17.698	9.814	0.274	0.096	2.06E+05	36.481	0.038	2.0	2
RHS51x25x6.4	51.0	25.0	6.4	6.4	0.809	1.577	0.218	0.060	8.551	4.798	0	0	16.418	8.610	0.569	0.202	1.60E+05	20.818	0.018	2.5	2.5
RHS75x38x4	75.0	38.0	4.0	4.0	0.838	1.634	0.580	0.191	15.470	10.053	0	0	26.313	15.098	0.535	0.195	4.67E+05	28.055	0.660	2.0	2.5
RHS80x60x5	80.0	60.0	5.0	5.0	1.300	2.535	1.129	0.709	28.217	23.642	0	0	29.465	23.358	0.689	0.453	1.38E+06	38.242	0.582	2.5	2.5
RHS91x38x4	91.0	38.0	4.0	4.0	0.977	1.905	0.970	0.230	21.313	12.124	0	0	31.502	15.354	0.662	0.185	6.14E+05	29.922	2.408	4.0	2.5
RHS112x91x6.4	112.0	91.0	6.4	6.4	2.444	4.765	4.310	3.090	76.966	67.916	0	0	41.997	35.560	1.228	0.909	5.63E+06	55.571	3.885	4.0	2.5
RHS120x45x3	120.0	45.0	3.0	3.0	0.963	1.878	1.691	0.350	28.191	15.559	0	0	41.907	19.065	0.662	0.159	9.51E+05	36.457	24.064	4.0	2.5
RHS175x50x9	175.0	50.0	9.0	9.0	3.722	7.258	11.959	1.387	136.678	55.468	0	0	56.685	19.302	2.806	0.399	4.29E+06	43.452	73.614	4.0	4.5
RHS90x45x4x4	90.0	45.0	4.0	4.0	1.025	1.999	1.046	0.339	23.250	15.072	0	0	31.946	18.188	0.652	0.240	8.29E+05	33.381	2.427	4.0	2.5
RHS100x75x5x5	100.0	75.0	5.0	5.0	1.646	3.210	2.285	1.446	45.698	38.551	0	0	37.258	29.636	0.868	0.573	2.81E+06	47.229	2.897	4.0	4.5
RHS101x51x6.35x6.35	101.0	51.0	6.4	6.4	1.773	3.458	2.165	0.698	42.881	27.366	0	0	34.945	19.837	1.150	0.419	1.75E+06	38.546	3.045	4.0	5
RHS120x45x4x6	120.0	45.0	4.0	6.0	1.396	2.721	2.557	0.449	42.616	19.970	0	0	42.805	17.943	0.881	0.270	1.30E+06	38.608	11.670	4.0	5
RHS140x45x4x6	140.0	45.0	4.0	6.0	1.556	3.033	3.772	0.517	53.891	22.968	0	0	49.245	18.227	1.030	0.241	1.56E+06	39.437	32.207	4.0	5
RHS150x100x6.35x6.35	150.0	100.0	6.4	6.4	3.028	5.904	9.299	4.890	123.983	97.809	0	0	55.419	40.190	1.687	0.934	1.01E+07	66.709	50.294	4.0	5
RHS175x50x9x9	175.0	50.0	9.0	9.0	3.722	7.258	11.959	1.387	136.678	55.468	0	0	56.685	19.302	2.806	0.399	4.29E+06	43.452	73.614	4.000	1.500

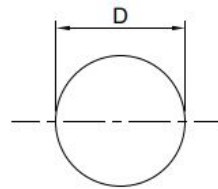
3.7 ROUND TUBE



Product Number	D	T	A	Wt.	Ix/Iy	Zx/Zy	Cx/Cy	Rx/Ry	Ay	Ax	J (Torsion constant)	r (Torsion radius)	Iw (Wrapping constant)
	mm	mm	10 ³ mm ²	kg/m	10 ⁶ mm ⁴	10 ³ mm ³	mm	mm	10 ³ mm ²	10 ³ mm ²	mm ⁴	mm	10 ⁹ mm ⁴
RT25x3.2	25	3.2	0.219	0.8	0.013	1.065	0.0	7.8	0.093	9.35E-02	2.66E+04	12.5	0.00E+00
RT32x5	32	5.0	0.424	0.8	0.040	2.502	0.0	9.7	0.173	1.73E-01	7.99E+04	16.0	0.00E+00
RT32x6	32	6.0	0.490	1.0	0.044	2.730	0.0	9.4	0.188	1.88E-01	8.72E+04	16.0	0.00E+00
RT38x3.2	38	3.2	0.350	0.7	0.053	2.815	0.0	12.3	0.159	1.59E-01	1.07E+05	19.0	0.00E+00
RT38x4	38	4.0	0.427	0.8	0.063	3.299	0.0	12.1	0.188	1.88E-01	1.25E+05	19.0	0.00E+00
RT38x5	38	5.0	0.518	1.0	0.072	3.804	0.0	11.8	0.220	2.20E-01	1.44E+05	19.0	0.00E+00
RT38x6.4	38	6.4	0.635	1.2	0.083	4.351	0.0	11.4	0.253	2.53E-01	1.65E+05	19.0	0.00E+00
RT42x3.2	42	3.2	0.390	0.7	0.074	3.524	0.0	13.7	0.179	1.79E-01	1.48E+05	21.0	0.00E+00
RT42x5	42	5.0	0.581	1.1	0.101	4.829	0.0	13.2	0.251	2.51E-01	2.03E+05	21.0	0.00E+00
RT42x6.4	42	6.4	0.716	1.5	0.117	5.581	0.0	12.7	0.294	2.94E-01	2.34E+05	21.0	0.00E+00
RT48x6.4	48	6.4	0.836	1.6	0.185	7.727	0.0	14.8	0.354	3.54E-01	3.70E+05	24.0	0.00E+00
RT50x5	50	5.0	0.707	1.3	0.181	7.255	0.0	16.0	0.314	3.14E-01	3.62E+05	25.0	0.00E+00
RT50.8x6.4	51	6.4	0.893	1.7	0.225	8.852	0.0	15.8	0.382	3.82E-01	4.49E+05	25.4	0.00E+00
RT60x5.5	60	5.5	0.942	1.9	0.353	11.788	0.0	19.3	0.423	4.23E-01	7.06E+05	30.0	0.00E+00
RT60x6.5	60	6.5	1.092	2.1	0.397	13.238	0.0	19.0	0.480	4.80E-01	7.93E+05	30.0	0.00E+00
RT70x8	70	8.0	1.558	3.2	0.761	21.776	0.0	22.0	0.679	6.79E-01	1.52E+06	35.0	0.00E+00
RT76x6.4	76	6.4	1.399	2.6	0.855	22.516	0.0	24.6	0.635	6.35E-01	1.71E+06	38.0	0.00E+00
RT100x5	100	5.0	1.492	2.8	1.688	33.806	0.0	33.5	0.707	7.07E-01	3.38E+06	50.0	0.00E+00
RT101x6.4	101	6.4	1.902	3.6	2.137	42.380	(0.0)	33.4	0.887	8.87E-01	4.27E+06	50.5	0.00E+00
RT150x5	150	5.0	2.278	4.4	5.993	80.010	(0.0)	51.1	1.100	1.10E+00	1.20E+07	75.0	0.00E+00

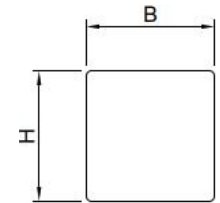
3.8 ROUND SOLID ROD

Product Number	Dimension mm	A	Weight (kg/m)
	mm	mm ²	kg/m
RSR4.2	4.2	13.9	0.03
RSR6	6.0	28.3	0.08
RSR8	8.0	50.3	0.10
RSR9.5	9.5	70.9	0.14
RSR12.7	12.7	126.7	0.26
RSR16	16.0	201.1	0.41
RSR19	19.0	283.5	0.55
RSR20	20.0	314.2	0.62
RSR22	22.0	380.1	0.72
RSR25.4	25.4	506.7	1.00
RSR31.8	31.8	794.2	1.51
RSR38	38.0	1,134.1	2.15



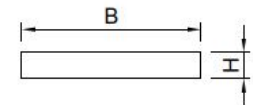
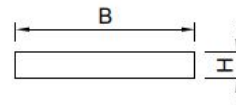
3.9 SQUARE SOLID ROD

Product Number	Dimension mm	A	Weight (kg/m)
	mm	mm ²	kg/m
SSR25x25	25.0	625.0	1.23
SSR32x32	32.0	1,024.0	2.00
SSR38x38	38.0	1,444.0	2.80



3.11 FLAT STRIP

Product Number	W	T	A	Wt.
	mm	mm	10 ³ mm ²	kg/m
FS19x6.4	19.0	6.4	0.122	0.3
FS25.4x8	24.4	8.0	0.195	0.4
FS30x3	30.0	3.0	0.090	0.7
FS30x6.4	30.0	6.4	0.192	0.4
FS35x8	35.0	8.0	0.280	0.5
FS38x5	38.0	5.0	0.190	0.37
FS40x8	40.0	8.0	0.320	0.6
FS50x2	50.0	2.0	0.100	0.3
FS50x4	50.0	4.0	0.200	0.4
FS50x6	50.0	6.0	0.300	0.6
FS50x8	50.0	8.0	0.400	0.8
FS50x15	50.0	15.0	0.750	1.4
FS50x25	50.0	25.0	1.250	2.5
FS102x5	102.0	5.0	0.510	1.0
FS120x10	120.0	10.0	1.200	2.4
FS152x10	152.0	10.0	1.520	2.9
FS250x12	250.0	12.0	3.000	5.7



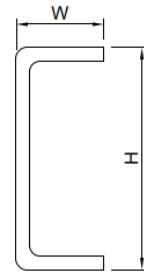
3.10 FLAT PLATE

Product Number	W	T	A	Wt.
	mm	mm	10 ³ mm ²	kg/m
FP1220x3.2	1,220.0	3.2	3.90	7.4
FP1220x6.4	1,220.0	6.4	7.81	14.8
FP1220x9.5	1,220.0	9.5	11.59	22.0
FP1220x12.7	1,220.0	12.7	15.49	29.4
FP1220x16	1,220.0	16.0	19.52	37.2
FP1220x19	1,220.0	19.0	23.18	44.1

3.12 GENERAL TOLERANCES

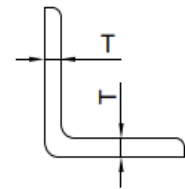
Profile Outer Dimension Tolerance

Nominal Dimension (mm)	Tolerance (mm)
0 - 20	± 0.20
20 - 100	± 0.30
100 - 300	± 0.35



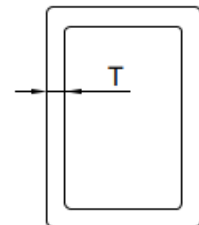
Profile Tolerance For Open Profiles

Nominal Dimension (mm)	Tolerance (mm)
0-2	± 0.15
2-5	± 0.20
5-10	± 0.35
> 10	± 0.40

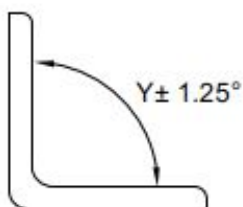


Profile Thickness Tolerance For Closed Profiles

Nominal Dimension (mm)	Tolerance (mm)
0-2	± 0.30
2-5	± 0.35
5-10	± 0.45
> 10	± 0.5



Profile Angular Tolerance





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