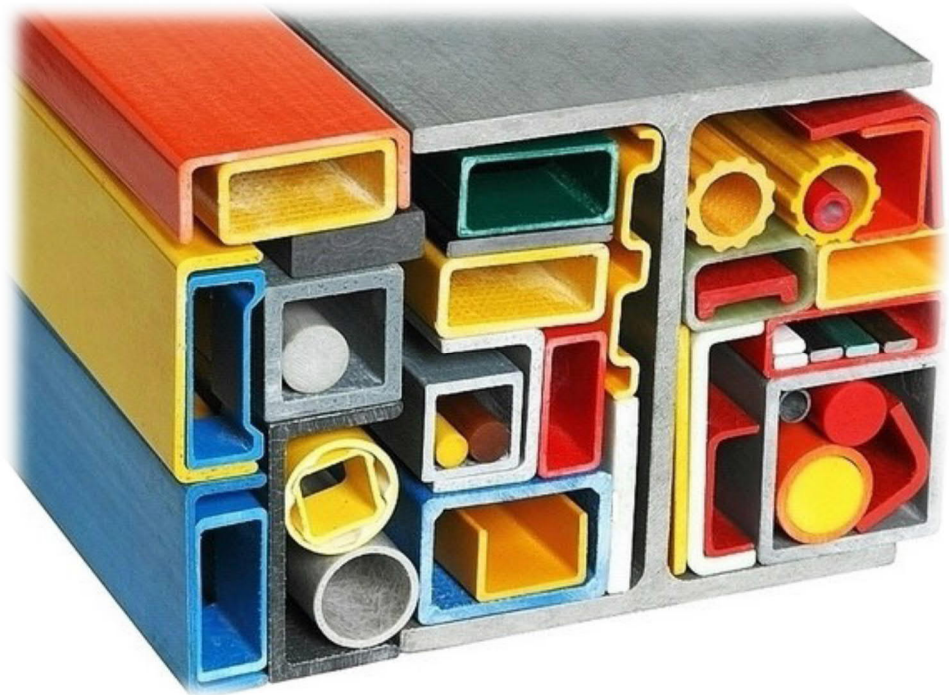




GRP AUSTRALIA

DESIGN GUIDE Pultruded Sections



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PHYSICAL AND MECHANICAL PROPERTIES

GRP Australia is an independent supplier of GRP products including pultruded GRP structural sections, 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 inhouse 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.

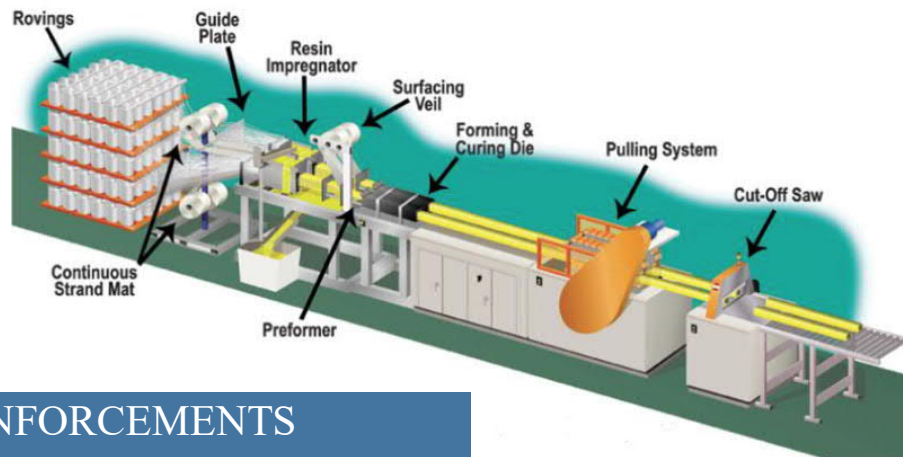
DISCLAIMER

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.

GRP AUSTRALIA - PHYSICAL AND MECHANICAL PROPERTIES

PRODUCTION

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.



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.

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.

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 three 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.

Phenol: Phenol is used when there is a requirement for high fire and temperature resistance, low smoke generation and flame retardation.

GRP AUSTRALIA - PHYSICAL AND MECHANICAL PROPERTIES

TYPICAL MATERIAL PROPERTIES: STRUCTURAL PROFILES

The property values stated are valid for temperatures in the range of -20°C to 60°C. The values are based on ASTM (American Society for Testing and Materials) coupon and full section testing.

For temperatures above 60°C the strength and stiffness must be reduced by the amounts stated on page 6, “Temperature and Weathering”.

	ASTM	Value	Units
Flexural Strength - Longitudinal	D790-17	250	MPa
Flexural Strength - Traverse	D790-17	100	MPa
Tensile Strength - Longitudinal	D638-14	250	MPa
Tensile Strength - Transverse	D638-14	55	MPa
Compressive Strength - Longitudinal	D695-15	250	MPa
Short Beam Shear Strength	D2344-16	25	MPa
Pin Bearing strength—Longitudinal	D953-10	150	MPa
Pin Bearing strength—Transverse	D953-10	70	MPa
Modulus of Elasticity, E , Longitudinal Full Section, angle and channels, I Beam	D790-17	23	GPa
Modulus of Elasticity, E , Longitudinal Full Section, square and rectangular hollow sections	D790-17	26	GPa
Modulus of Elasticity, E , Transverse Full Section	D790-17	8.5	GPa
Poisson’s Ratio—Longitudinal	D3039	0.23	
Poisson’s Ratio—Transverse	D3039	0.09	

Electrical Properties	ASTM	Value	Units
Arc Resistance - Longitudinal	D495	120	Seconds
Dielectric Strength - Longitudinal	D149	1575	kV/m
Dielectric Constant	D150	5.2	@ 60Hz

Physical Properties	Value	Units
Density	1660 - 1930	kg/m ³
Coefficient of Linear Thermal Expansion (LW)	7.92	10 ⁻⁶ m/m °C
Thermal Conductivity	6.9	W/m/K

GRP AUSTRALIA - PHYSICAL AND MECHANICAL PROPERTIES

TEMPERATURE AND WEATHERING

When exposed to continuous high temperatures, polyester and vinyl ester pultrusion sections with fire retardant 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 °C	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%

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

SECTION PROPERTIES

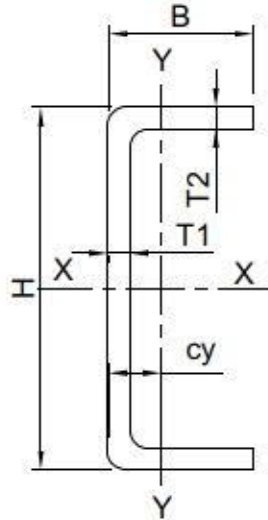
Sections displayed in the following tables are available for purchase, however not all are stocked items. Regularly updated information regarding what is currently in stock can be found at www.grpaustralia.com.au

SECTION NOTATION

H	Section height (mm)
B	Section width (mm)
D	Section diameter (mm)
T	Section thickness (mm)
Wt.	Section weight (kg/m)
A	Section area (mm ²)
I	Moment of inertia (mm ⁴)
E	Modulus of Elasticity (GPa)
r	Radius of gyration (mm)
c	Coordinate of centroid
Z	Elastic Section Modulus mm ³

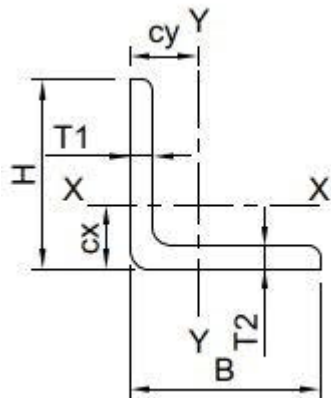
GRP AUSTRALIA - SECTION PROPERTIES

CHANNEL



Product Code	H	B	T	A	Wt.	I _x	Z _x	r _x	e _x	I _y	Z _y	r _y	e _y
	mm			mm ²	kg/m	mm ⁴	mm ³	mm		mm ⁴	mm ³	mm	
C75x35x5x5	75	35	5	675	1.3	543906.3	14504.2	28.4	37.5	74322.9	3032.8	10.5	10.3
C76x38x6.4x6.4	76	38	6.4	890.9	1.7	725342.6	19088	28.5	38	115040.5	4318.9	11.4	11.8
C102x27x3.2x3.2	102	27	3.2	478.7	0.9	654834.4	12839.9	37	51	26396	1348.5	7.4	5.9
C102x44x4.8x4.8	102	44	4.8	865.9	1.7	1314058.5	25765.9	39	51	152112.2	4947.4	13.3	12.0
C102x44x6.4x6.4	102	44	6.4	1134.1	2.1	1667268.2	32691.5	38.3	51	193014.3	6235.5	13	12.5
C150x100x6.4x6.4	150	100	6.4	2158.1	4.1	7980479.4	106406.4	60.8	75	2210355.4	32506.9	32	31.0
C152x42x6.4x6.4	152	42	6.4	1428.5	2.7	4289550.7	56441.5	54.8	76	188297.4	6169.9	11.5	9.9
C152x42x9.5x9.5	152	42	9.5	2061.5	4	5919602.8	77889.5	53.6	76	255960.7	8295	11.1	11.0
C152X50.8X9.5X9.5	152	50.8	9.5	2228.7	4.4	6769661.5	89074.5	55.1	76	450407.7	12311.6	14.2	13.7
C160x48x8x8	160	48	8	1920	3.7	6430720	80384	57.9	80	337920	9728.9	13.3	12.0
C203x56x6.4x6.4	203	56	6.4	1934.1	3.7	10598504	104418.8	74	101.5	468949.6	11599.4	15.6	12.4
C203x56x9.5x9.5	203.2	55.6	9.5	2812.4	5.3	14890090	146556	72.8	101.6	635256.1	15673.4	15	13.4
C203x102x12.7x12.7	203	102	12.7	4846.3	9.2	29419278	289845.1	77.9	101.5	4680412.1	65992.7	31.1	30.2
C254x70x12.7x12.7	254	70	12.7	4681.2	8.9	38548247	303529.5	90.7	127	1670149.5	32676.6	18.9	17.2
C292x70x12.7x12.7	292.1	69.9	12.7	5161.3	9.6	54725761	374705.7	103	146.05	1717581.3	33281.5	18.2	16.2

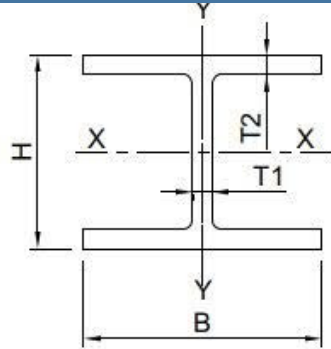
EQUAL ANGLE



Product Code	H	B	T	A	Wt.	Ix/Iy	Zx	rx	cx/cy
	mm			mm ²	kg/m	mm ⁴	mm ³	mm	
EA25x25x6.4	25	25	6.4	279	0.6	14643.2	889.2	7.2	8.5
EA30x30x4	30	30	4	224	0.5	18554.4	882	9.1	9.0
EA32x32x4	32	32	4	240	0.4	22779.7	1010.9	9.7	9.5
EA38x38x5	38	38	5	355	0.7	47249.4	1771.7	11.5	11.3
EA38x38x6.4	38	38	6.4	445.4	0.9	57520.2	2197.6	11.4	11.8
EA50x50x3.2	50	50	3.2	309.8	0.6	75817.8	2087.9	15.6	13.7
EA50x50x6.4	50	50	6.4	599	1.1	138458.2	3938.5	15.2	14.8
EA76x76x6.4	76	76	6.4	931.8	1.8	517219.4	9466.8	23.6	21.4
EA76x76x9.5	76	76	9.5	1353.8	2.6	724774.4	13543	23.1	22.5
EA102x102x6.4	102	102	6.4	1264.6	2.5	1289682.4	17398.5	31.9	27.9
EA102x102x9.5	102	102	9.5	1847.8	3.5	1832486.6	25104.1	31.5	29.0
EA102x102x12.7	102	102	12.7	2429.5	4.6	2343898.4	32625.3	31.1	30.2
EA152x152x9.5	152	152	9.5	2797.8	5.4	6337402	57364.6	47.6	41.5
EA152x152x12.7	152	152	12.7	3699.5	7	8218602.5	75188.5	47.1	42.7

GRP AUSTRALIA - SECTION PROPERTIES

I BEAM



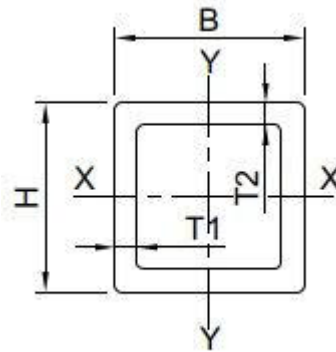
Product Code	H	B	T1	T2	A	Wt.	Ix	Zx	rx	Iy	Zy	ry
	mm				mm ²	kg/m	mm ⁴	mm ³	mm	mm ⁴	mm ³	mm
IB15x25x6.4x4	15.0	25.0	6.4	4.0	240.8	0.4	17866.7	1429.3	8.6	3665.1	488.7	3.9
IB15x32x6.4x4	15.0	32.0	6.4	4.0	268.8	0.4	34471.9	2154.5	11.3	3702.4	493.7	3.7
IB15x38x4x6.4	15.0	38.0	4.0	6.4	312.0	0.5	49240.0	2591.6	12.6	2905.4	387.4	3.1
IB30x38x3x3	30.0	38.0	3.0	3.0	276.0	0.5	63452.0	3339.6	15.2	13572.0	904.8	7.0
IB45x180x12.7x12.7	45.0	180.0	12.7	12.7	3106.4	6.0	11923970.5	132488.6	62.0	219271.3	9745.4	8.4
IB50x102x6.4x6.4	50.0	102.0	6.4	6.4	1210.9	2.4	1843006.0	36137.4	39.0	135281.9	5411.3	10.6
IB50x102x8x8	50.0	102.0	8.0	8.0	1488.0	3.0	2195504.0	43049.1	38.4	170336.0	6813.4	10.7
IB60x180x6.4x6.4	60.0	180.0	6.4	6.4	1838.1	3.6	8281833.2	92020.4	67.1	234052.5	7801.8	11.3
IB76x152x6.4x6.4	76.0	152.0	6.4	6.4	1863.7	3.6	6597526.6	86809.6	59.5	471281.9	12402.2	15.9
IB76x152x9.5x9.5	76.0	152.0	9.5	9.5	2707.5	5.3	9203920.6	121104.2	58.3	704547.9	18540.7	16.1
IB102x203x9.5x9.5	102.0	203.0	9.5	9.5	3686.0	7.2	23087036.2	227458.5	79.1	1693392.4	33203.8	21.4
IB102x203x12.7x12.7	102.0	203.0	12.7	12.7	4846.3	9.5	29419277.8	289845.1	77.9	2276539.7	44638.0	21.7
IB127x254x9.5x9.5	127.0	254.0	9.5	9.5	4645.5	8.6	46354734.6	364997.9	99.9	3260063.3	51339.6	26.5
IB127x254x12.7x12.7	127.0	254.0	12.7	12.7	6129.0	11.3	59642494.7	469625.9	98.6	4374765.7	68893.9	26.7
IB127x152x9.5x9.5	127.0	152.0	9.5	9.5	3676.5	7.1	14130397.4	185926.3	62.0	3252775.7	51224.8	29.7
IB127x152x12.7x12.7	127.0	152.0	12.7	12.7	4833.6	9.2	17839561.0	234731.1	60.8	4357354.5	68619.8	30.0
IB152x305x9.5x9.5	152.0	305.0	9.5	9.5	5605.0	10.7	81586918.3	534996.2	120.6	5580796.8	73431.5	31.6
IB152x305x12.7x12.7	152.0	305.0	12.7	12.7	7411.7	14.3	105651002.6	692793.5	119.4	7481054.3	98434.9	31.8

WIDE FLANGE BEAM

Product Code	H	B	T1	T2	A	Wt.	Ix/Iy	Zx/Zy	rx/ry
	mm				mm ²	kg/m	mm ⁴	mm ³	mm.
HB76x76x6.4x6.4	76.0	76.0	6.4	6.4	1377.3	2.7	1316052.7	34633.0	30.9
HB102x102x6.4x6.4	102.0	102.0	6.4	6.4	1876.5	3.6	3366067.4	66001.3	42.4
HB102x102x8.0x8.0	102.0	100.0	8.0	8.0	2304.0	4.5	3857152.0	77143.0	40.9
HB152x152x6.4x6.4	152.0	152.0	6.4	6.4	2836.5	5.4	11756531.4	154691.2	64.4
HB152x152x9.5x9.5	152.0	152.0	9.5	9.5	4151.5	8.1	16545337.0	217701.8	63.1
HB203x203x6.4x6.4	203.0	203.0	6.4	6.4	3815.7	7.5	28786620.1	283612.0	86.9
HB203x203x9.5x9.5	203.0	203.0	9.5	9.5	5605.0	10.8	41064388.1	404575.3	85.6

GRP AUSTRALIA - SECTION PROPERTIES

SQUARE HOLLOW



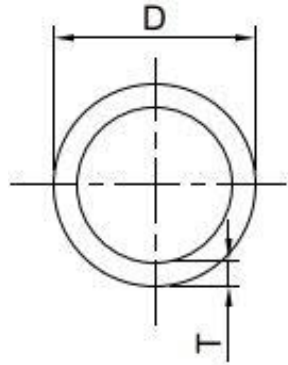
Product Code	H	B	T	A	Wt.	Ix/Iy	Zx/Zy	rx/ry
	mm			mm ²	kg/m	mm ⁴	mm ³	mm.
SHS25x25x3.2	25.0	25.0	3.2	279.0	0.5	22578.1	1806.2	9.0
SHS25x25x6.35	25.0	25.0	6.4	473.7	0.9	30644.7	2451.6	8.0
SHS32x32x6.4	32.0	32.0	6.4	655.4	1.2	76056.7	4753.5	10.8
SHS38x38x3.2	38.0	38.0	3.2	445.4	0.9	90667.8	4772.0	14.3
SHS38x38x5	38.0	38.0	5.0	660.0	1.3	122540.0	6449.5	13.6
SHS38x38x6.4	38.0	38.0	6.4	809.0	1.5	140155.0	7376.6	13.2
SHS50x50x3.2	50.0	50.0	3.2	599.0	1.1	219695.9	8787.8	19.2
SHS50x50x4	50.0	50.0	4.0	736.0	1.4	261525.3	10461.0	18.9
SHS50x50x5	50.0	50.0	5.0	900.0	1.7	307500.0	12300.0	18.5
SHS50x50x6.4	50.0	50.0	6.4	1116.2	2.1	361248.9	14450.0	18.0
SHS76x76x3.2	76.0	76.0	3.2	931.8	1.8	824690.8	21702.4	29.7
SHS76x76x5	76.0	76.0	5.0	1420.0	2.7	1198953.3	31551.4	29.1
SHS76x76x6.4	76.0	76.0	6.4	1781.8	3.4	1450685.2	38175.9	28.5
SHS102x102x3.2	102.0	102.0	3.2	1264.6	2.4	2059609.6	40384.5	40.4
SHS102x102x5	102.0	102.0	5.0	1940.0	3.6	3050326.7	59810.3	39.7
SHS102x102x6.4	102.0	102.0	6.4	2447.4	4.6	3744591.3	73423.4	39.1
SHS152x152x9.5	152.0	152.0	9.5	5415.0	7.1	18407841.3	242208.4	58.3
SHS152x152x12.7	152.0	152.0	12.7	7076.4	13.5	23076011.4	303631.7	57.1

RECTANGULAR HOLLOW

Product Code	H	B	T	A	Wt.	Ix	Zx	rx	Iy	Zy	ry
	mm			mm ²	kg/m	mm ⁴	mm ³	mm.	mm ⁴	mm ³	mm
RHS51x25x3	51.0	25.0	3.0	420.0	0.8	132075.0	5179.4	17.7	40685.0	3254.8	9.8
RHS51x25x6.4	51.0	25.0	6.4	809.0	1.5	219684.2	8615.1	16.5	60625.8	4850.1	8.7
RHS112x91x6.4	112.0	91.0	6.4	2434.6	4.5	4292522.8	76652.2	42.0	3080112.1	67694.8	35.6
RHS120x45x3	120.0	45.0	3.0	954.0	2.0	1664982.0	27749.7	41.8	347719.5	15454.2	19.1

GRP AUSTRALIA - SECTION PROPERTIES

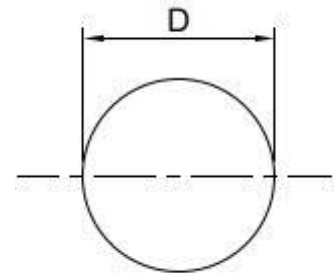
ROUND TUBE



Product Code	D	T	A	Wt.	Ix/Iy	Zx/Zy	rx/ry
	mm		mm ²	kg/m	mm ⁴	mm ³	mm.
RT32x5	32.0	5.0	424.1	0.8	39972.8	2498.3	9.7
RT32x6	32.0	6.0	490.1	1.0	43617.9	2726.1	9.4
RT38x3.2	38.0	3.2	349.8	0.7	53407.8	2810.9	12.4
RT38x4	38.0	4.0	427.3	0.8	62593.1	3294.4	12.1
RT38x5	38.0	5.0	518.4	1.0	72182.0	3799.1	11.8
RT38x6.4	38.0	6.4	635.4	1.2	82558.1	4345.2	11.4
RT42x3.2	42.0	3.2	390.1	0.7	73900.8	3519.1	13.8
RT42x5	42.0	5.0	581.2	1.1	101273.2	4822.5	13.2
RT42x6.4	42.0	6.4	715.8	1.5	117058.7	5574.2	12.8
RT48x6.4	48.0	6.4	836.4	1.6	185216.3	7717.3	14.9
RT50x5	50.0	5.0	706.9	1.3	181132.5	7245.3	16.0
RT50.8x6.4	50.8	6.4	892.7	1.7	224553.5	8840.7	15.9
RT76x6.4	76.0	6.4	1399.4	2.6	854524.1	22487.5	24.7
RT101x6.4	101.0	6.4	1902.0	3.6	2137452.6	42325.8	33.5
RT150x5	150.0	5.0	2277.7	4.4	5993078.9	79907.7	51.3

SOLID ROUND

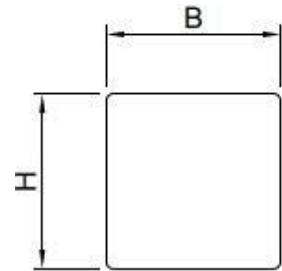
Product Code	D	A	Wt.
	mm	mm ²	kg/m
RSR4.2	4.2	13.9	0.0
RSR6	6.0	28.3	0.1
RSR8	8.0	50.3	0.1
RSR9.5	9.5	70.9	0.1
RSR12.7	12.7	126.7	0.3
RSR16	16.0	201.1	0.4
RSR19	19.0	283.5	0.6
RSR20	20.0	314.2	0.6
RSR22	22.0	380.1	0.7
RSR25.4	25.4	506.7	1.0
RSR31.8	31.8	794.2	1.5
RSR38	38.0	1134.1	2.2
RSR150	150.0	17671.5	1.6



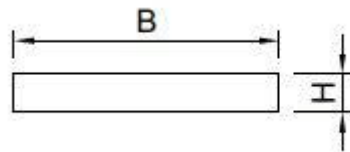
GRP AUSTRALIA - SECTION PROPERTIES

SOLID SQUARE

Product Code	H	B	A	Wt.
	mm	mm	mm ²	kg/m
SSR25x25	25	25	625	1.23
SSR32x32	32	32	1024	2
SSR38x38	38	38	1444	2.8



FLAT PLATE



Product Code	B	H	A	Wt.
	mm	mm	mm ²	kg/m
FP1220x3.2	1220.0	3.2	3904.0	7.4
FP1220x6.4	1220.0	6.4	7808.0	14.8
FP1220x9.5	1220.0	9.5	11590.0	22.0
FP1220x12.7	1220.0	12.7	15494.0	29.4
FP1220x16	1220.0	16.0	19520.0	37.2
FP1220x19	1220.0	19.0	23180.0	44.1

FLAT STRIP

Product Code	B	H	A	Wt.
	mm	mm	mm ²	kg/m
FS19x6.4	19	6.4	121.6	0.3
FS25.4x8	25.4	8	203.2	0.4
FS30x3	30	3	90	0.7
FS30x6.4	30	6.4	192	0.4
FS35x8	35	8	280	0.5
FS38x5	38	5	190	0.37
FS40x8	40	8	320	0.6
FS50x2	50	2	100	0.3
FS50x4	50	4	200	0.4
FS50x8	50	8	400	0.8
FS50x15	50	15	750	1.4
FS50x17	50	25	1250	1.7
FS76x9.5	76	9.5	722	1.42
FS100x10	100	10	1000	1.95
FS102x5	102	5	510	0.97
FS120x10	120	10	1200	2.4
FS152x10	152	10	1520	2.92
FS250x12	250	12	3000	5.7

GRP AUSTRALIA - SECTION PROPERTIES

GENERAL TOLERANCES

The table below details the typical profile dimensional tolerances of GRP pultruded products.

Nominal Dimension (mm)	Tolerance (mm)
0 - 20	±.30
20 - 100	±.40
100 - 300	±0.5

Profile Angular Tolerances

