



Force 800 - Technical Data Sheet

Pultruded structural composites are much lighter and more corrosion resistant than their metal equivalents resulting in easier handling and reduced maintenance with the potential for achieving a lower overall cost.

The Force 800 structural standard range consists of 18 profiles specially designed to provide the optimum properties for each application.

Force 800 represents the most efficient structural shapes which will perform a particular engineering task or combination of tasks.

All products are manufactured in accordance with ISO 9002, assuring full conformance with all our customers' requirements and full traceability.

Force 800 is supplied in a polyester, non fire retardant resin system from stock, other systems are available, but minimum production runs may be applicable.

In addition to Force 800, Grp Grating Systems has a whole range of standard profiles that can be supplied - please ask for the standard profile list.

There is also a custom design service where a profile is specially designed to suit your application.

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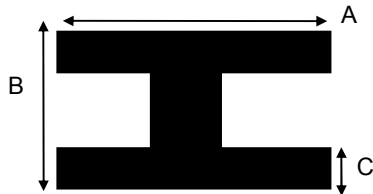
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Force 800 Mechanical Data

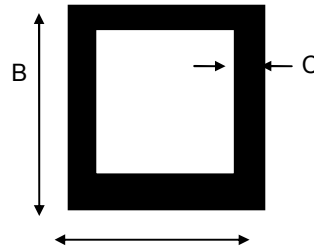
Force 800 represents our stocked range of profiles. This is a range of structural standards with specially selected engineering properties

I Beams



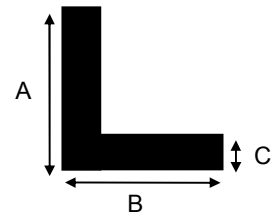
A	B	C
102	51	6.35
150	150	10
200	200	10

Boxes



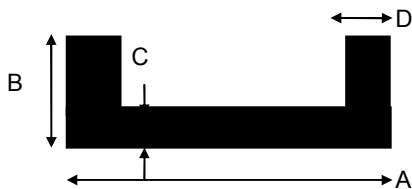
A	B	C
25	25	3
31.8	31.8	3
38	38	3
44	44	6
51	51	3.2
51	51	∅ 38
60	60	4.5
100	100	4
101	51	6 x 3

Angles



A	B	C
25	25	3
50	50	6
75	50	8
75	75	4
100	75	8
100	100	10
125	75	10

Channels



A	B	C	D
73	25	5	5
100	40	5	5
200	60	8	8

Other Sections

Profile	Dimensions
Tube	∅ 38 x ∅ 33
Ladder Rung	∅ 34 x ∅ 25
Kerb Angle	38 x 25 x 6.35

Colour Grey to Ral 7001 (other colours may also be available)

Lengths Stocked lengths are 6 m - shorter lengths may be available

Tolerances Manufactured to tolerances specified in ASTM D3917 - 84

Quality Manufactured in accordance with ISO 9002

Resin Isophthalic Polyester - NFR (Fire retardant formulations may also be available)

Force 800 is a must for any design application, which requires any combination of:

- High strength to weight ratio
- Excellent corrosion and UV resistance
- Electrical and thermal insulation
- Non conductivity
- Self - colour
- Excellent creep and fatigue performance
- Electromagnetic transparency
- Dimensional stability
- Minimal maintenance

Comparative Properties

	Unit	Force 800	Aluminium T 651	Mild Steel	Stainless Steel - 316
Density		1.8	2.7	7.8	7.9
Tensile Strength (L/T)	N/mm ²	207/48	310	414	552
Tensile Modulus (L/T)	kN/mm ²	17/5	69	207	193
Flexural Strength (L/T)	N/mm ²	207/69	310	414	552
Flexural Modulus (L/C)	kN/mm ²	14/5	69	207	193
Coefficient Of Thermal Expansion (L)	X10 ⁻⁶ /°C	9	24	13	17
Thermal Conductivity	W/m°C	0.6	170	35 - 60	15 - 25

Designing with Force 800 is similar to designing with conventional materials. The designer should however consider the following:

- High_Strength - Force 800 is stronger than steel on a weight per weight basis and can be used to form considerable weight bearing structures.
- Modulus of Elasticity - Force 800 has a lower modulus of elasticity than steel. Deflection can be a limiting design factor.
- Shear Modulus - Force 800 has a lower shear modulus than conventional materials
- Lightweight - Force 800 weighs approximately 30% less than aluminium and 80% less than steel, resulting in structures which can easily be transported, handled and lifted into place.
- Temperature - Force 800 becomes stronger in cold temperatures, but may suffer from slight degradation at high temperatures.

When specific properties (performance per weight) are considered, pultrusions have excellent tensile and flexural strengths. The designer has the option of increasing the stiffness of the pultruded section by increasing the overall dimensions whilst maintaining cross sectional area.

Mechanical Properties

The mechanical properties of pultruded profiles depend on a number of factors including:

- Quantity and type of reinforcement
- Resin type,
- Resin formulation
- Profile geometry.

For the profiles in the Force 800 range the construction has been standardised in order to give the best balance of properties for the majority of structural applications. However, due to the above factors, the mechanical properties of one particular profile can differ from those of another. Consequently, Exel Composites has made the decision to adopt a set of standardised values that the design engineer can use with confidence for all the profiles in the range. The values chosen are the characteristic material properties for pultrusions as defined in Structural Design of Polymer Composites - EUROCOMP Design Code and Handbook¹. These values were chosen because they form part of a unified design code for structural composite materials which is readily accessible to all design engineers. Testing of Force 800 profiles has shown that the EUROCOMP values may be treated as minimum guaranteed properties. (Test data is available)
An exception to this is the 51 x 51 x Ø 38 box, which has been specifically designed for stiffness critical applications. The $E_{x,t,k}$ for this profile is 30 kN/mm²

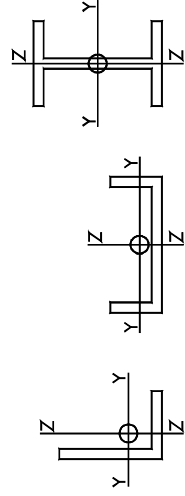
Characteristic Material Properties - Pultrusion (1:1 Mat/Roving Construction)		
Property	Symbol	Characteristic Value
Tensile Strength (longitudinal)	$\sigma_{x,t,k}$	207 N/mm ²
Tensile Strength (transverse)	$\sigma_{y,t,k}$	48 N/mm ²
Tensile Modulus (longitudinal)	$E_{x,t,k}$	17.2 kN/mm ²
Tensile Modulus (transverse)	$E_{y,t,k}$	5.5 kN/mm ²
Compressive Strength (longitudinal)	$\sigma_{x,c,k}$	207 N/mm ²
Compressive Strength (transverse)	$\sigma_{y,c,k}$	103 N/mm ²
Compressive Modulus (longitudinal)	$E_{x,c,k}$	17.2 kN/mm ²
Compressive Modulus (transverse)	$E_{y,c,k}$	6.9 kN/mm ²
Shear Strength (in plane)	$\tau_{xy,k}$	31 N/mm ²
Shear Modulus (in plane)	$G_{xy,k}$	2.9 kN/mm ²
Flexural Strength (longitudinal)	$\sigma_{x,b,k}$	207 N/mm ²
Flexural Strength (transverse)	$\sigma_{y,b,k}$	69 N/mm ²
Flexural Modulus (longitudinal)	$E_{x,b,k}$	13.8 kN/mm ²
Flexural Modulus (transverse)	$E_{y,b,k}$	5.5 kN/mm ²
Poisson's Ratio (longitudinal)	ν_{xy}	0.33
Poisson's Ratio (transverse)	ν_{yx}	0.11

Section Properties

Section	Profile	Area mm ²	Weight g/m	I _{yy} ⁴ mm ⁴	I _{zz} ⁴ mm ⁴	W _{yy3} mm ³	W _{zz} mm ³	I _{yy} mm	I _{zz} mm	J mm ⁴
Angle	25 x 25 x 3	141	257	8.19 x 10 ³	8.19 x 10 ³	464	464	7.62	7.62	423
Angle	50 x 50 x 6	547	1018	126 x 10 ³	126 x 10 ³	3.60 x 10 ³	3.60 x 10 ³	15.2	15.2	7.06 x 10 ³
Angle	75 x 50 x 8	908	1618	504 x 10 ³	180 x 10 ³	10.3 x 10 ³	4.90 x 10 ³	23.6	14.1	20.0 x 10 ³
Angle	75 x 75 x 4	571	1012	318 x 10 ³	318 x 10 ³	5.85 x 10 ³	5.85 x 10 ³	23.6	23.6	3.12 x 10 ³
Channel	73 x 25 x 5	574	1092	411 x 10 ³	29.2 x 10 ³	11.3 x 10 ³	1.63 x 10 ³	26.8	7.13	4.71 x 10 ³
Channel	100 x 40 x 5	850	1503	1.21 x 10 ⁶	119 x 10 ³	24.2 x 10 ³	4.07 x 10 ³	37.7	11.8	7.08 x 10 ³
Channel	200 x 60 x 8	2360	4050	12.3 x 10 ⁶	671 x 10 ³	123 x 10 ³	14.8 x 10 ³	72.2	16.9	51.9 x 10 ³
Channel	200 x 50 x 10	2777	5021	13.7 x 10 ⁶	427 x 10 ³	137 x 10 ³	11.3 x 10 ³	70.2	12.4	93.3 x 10 ³
I-Beam	102 x 51 x 6.35	1210	2262	1.84 x 10 ⁶	141 x 10 ³	36.2 x 10 ³	5.55 x 10 ³	39.0	10.8	16.3 x 10 ³
I-Beam	150 x 150 x 10	4382	7335	16.8 x 10 ⁶	5.61 x 10 ⁶	224 x 10 ³	74.8 x 10 ³	61.9	35.8	143 x 10 ³
I-Beam	200 x 200 x 10	5882	9935	41.6 x 10 ⁶	13.3 x 10 ⁶	416 x 10 ³	133 x 10 ³	84.1	47.6	193 x 10 ³
Box	38 x 38 x 3	416	748	84.5 x 10 ³	84.5 x 10 ³	4.45 x 10 ³	4.45 x 10 ³	14.3	14.3	129 x 10 ³
Box	44 x 44 x 6	912	1704	225 x 10 ³	225 x 10 ³	10.2 x 10 ³	10.2 x 10 ³	15.7	15.7	329 x 10 ³
Box	51 x 51 x 3.2	602	1051	227 x 10 ³	227 x 10 ³	8.94 x 10 ³	8.94 x 10 ³	19.4	19.4	345 x 10 ³
Box	100 x 100 x 4	1536	2729	2.36 x 10 ⁶	2.36 x 10 ⁶	47.3 x 10 ³	47.3 x 10 ³	39.2	39.2	3.54 x 10 ⁶
Tube	Ø 38 x Ø 33	298	508	47.0 x 10 ³	47.0 x 10 ³	2.47 x 10 ³	2.47 x 10 ³	12.6	12.6	93.4 x 10 ³
Box	51 x 51 x Ø 38	1432	2597	446 x 10 ³	446 x 10 ³	17.6 x 10 ³	17.6 x 10 ³	17.7	17.7	
Rung	Ø 34 x Ø 25	343	614	37.4 x 10 ³	37.4 x 10 ³	2.17 x 10 ³	2.17 x 10 ³	10.4	10.4	
Kerb	38 x 25 x 6.35	673	1229							

NOMENCLATURE

Location of centroid for angle, channel and I Beam sections



I_{yy} - Second moment of area (Y-Y axis) I_{yy} - Radius Of Gyration (Y-Y axis)
I_{zz} - Second Moment Of Area (Z-Z axis) I_{zz} - Radius Of Gyration (Z-Z axis)
W_{yy} - Section Modulus (Y-Y axis) W_{zz} - Section Modulus (Z-Z axis)
J - Torsion Constant

Fabrication

The techniques for working with FORCE 800 are very similar to wood working techniques (some differences do exist with cutting and fastening)

FORCE 800 can not be formed, bent or pressed.

Traditional safety precautions should be observed at all times including :

- Wearing of a face mask when sawing the material
- Although the dust created is non toxic and does not present a health hazard, it may however cause skin irritation. This can be reduced or eliminated by the use of a protective cream.

Finishing

FORCE 800 can be :

Jointed by	Bonding
	Bolting
	Riveting
Machined by	Drilling
	Punching
	Sawing
	Laser Cutting

For adhesive bonding, ensure that the surface is properly prepared for bonding prior to the application of the adhesive.

Carbide tips and diamond coated blades are recommended.

All cut edges should be resin sealed

Corrosion

The resins used for the Force 800 series are resistant to many chemicals. A synthetic veil is incorporated onto the surface of all the Force 800 profiles which produces a resin rich layer enhancing corrosion protection.

Ultraviolet Radiation Effects

Extreme exposure to sunlight can cause degradation of polymers. The synthetic surface veil aids in protecting the composite from UV degradation. Painting or lacquering will ensure almost permanent resistance

Custom Pultrusions

In addition to Force 800 , GRP Grating Systems stocks custom pultrusions. These custom pultrusions can vary from Force 800 in a number of ways including shape, resin type and reinforcement packs. Custom pultrusions are often designed to achieve improved performance in certain criteria including strength, corrosion resistance and other characteristics.

Full data sheets are available on request.