Pre-Preg Moulding

Product Information Sheet

Designing and Manufacturing Composite Solutions
For Industrial Applications

exel COMPOSITES

Pre-Preg Moulding

This particular form of composite fabrication begins with the pre-impregnation (pre-preg) of reinforce4ment materials with a resin or binder. The combining of these two materials occurs prior to the moulding process and therefore enables a very accurate reinforcement to resin ration to be achieved.

Pre-preg materials are used extensively in the aerospace industry due to their ability to maximise strength-to-weight ratios.
Pre-pregs are pliable and therefore able to be cut into various shapes or patterns prior to processing into the moulded products.

The moulding process involves rolling these pre-preg patterns around a tapered or parallel steel mandrel. Other simple shapes are available (ie flat sheet). The mandrel forms the internal shape of the moulding. A flexible outer mould is achieved by wrapping the moulded product with a polypropylene or nylon tape prior to heat curing. Heat curing gives a permanent hard, cross linked composite product.

Following curing the mandrel and tape are removed leaving the completed moulding.
If necessary, the completed moulding can be ground, sanded or painted depending upon the final application.

Reinforcements

Exel composites stock a wide range of pre-impregnated reinforcements including:

Glass Fibre (E-glass)
- Woven Fabrics
- Uni-directional tapes

Carbon Fibre (Graphite)
- Woven Fabrics
- Uni-directional tapes

Aramid
- Woven Fabrics

Hybrid Systems
- Woven Aramid Carbon Fibre Fabric

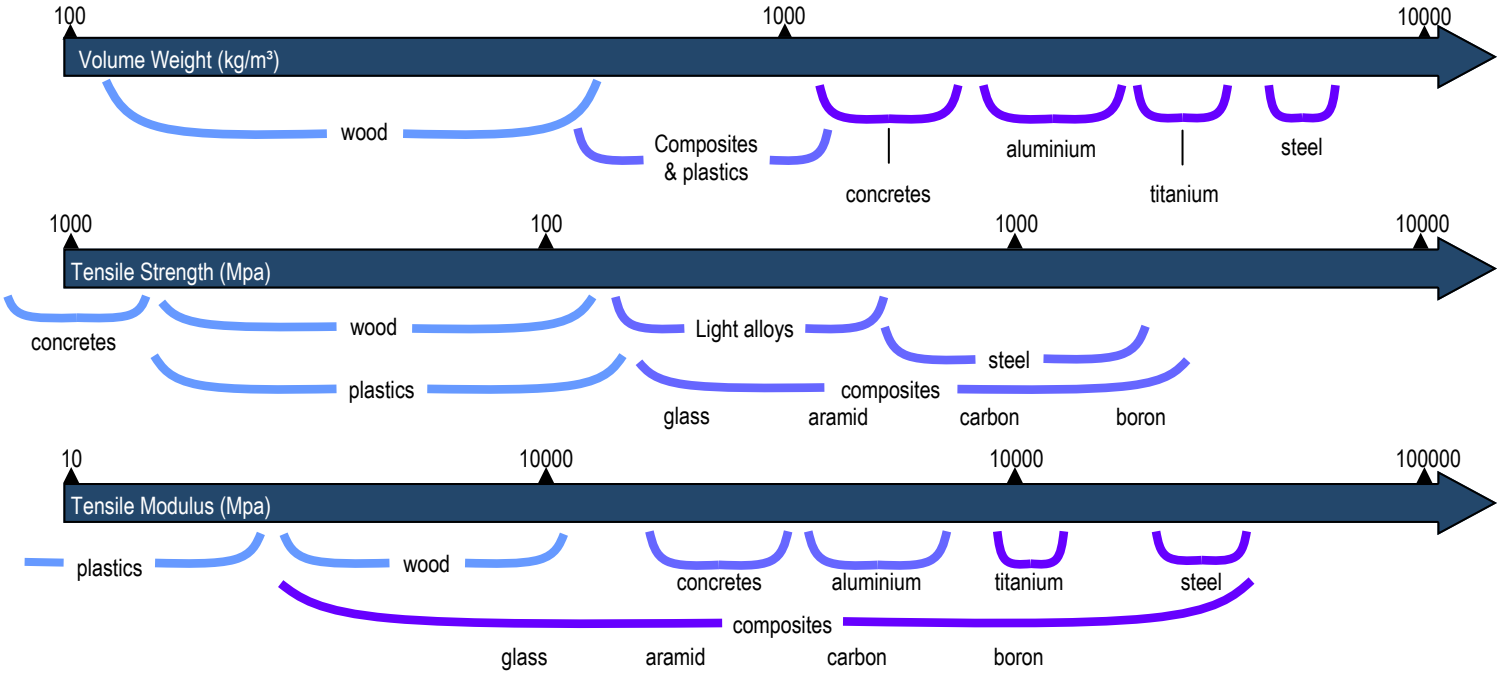
Other reinforcement materials are available through our network of suppliers located around the world.

Resin Systems

A number of high performance resin systems are available. The most commonly used systems being epoxy or polyester.

Different 'pre-preg' colours are also available. These are achieved by adding a colour pigment to the resin prior to the impregnation of the reinforcement material. Standard colours available are Black, White, Blue, Mustard (Honey), Yellow, Military Green.

Comparison of Different Material Characteristics



Typical Mechanical Properties of Epoxy Pre-Preg Laminates

				Fibres									
			UNITS	E-GLASS		ARAMID		HIGH STRENGTH CARBON		INTERMEDIATE MODULUS CARBON	
				UD	FABRIC	UD	FABRIC	UD	FABRIC	UD	FABRIC
Tensile	σℓ				MPa	1100	600	1100	500	2000	800	2400	900
	σt				MPa	35	550	35	450	80	750	80	850
	Eℓ				GPa	43	20	60	30	130	70	170	90
	Et				GPa	8	19	8	30	9	65	9	90
	Poisson's Ratio ν t ℓ				0.28	0.13	0.34	0.2	0.25	0.05	0.27	0.05
Compression	σℓ				MPa	900	550	250	150	1300	700	1600	800
	σt				MPa	150	500	150	150	250	650	250	750
	Eℓ				GPa	42	17	75	31	115	60	150	80
	Et				GPa	10	16	5.5	30	10	55	11	75
Flexure	σℓ				MPa	1200	700	550	400	1800	1000	1400	1200
	Eℓ				GPa	42	20	40	25	120	65	140	75
In-plane	σℓt				MPa	60	55	45	40	95	80	95	80
	Gℓt				GPa	4	4.2	2.1	4	4.4	5.5	4.4	5
Interclaminar shear	σ				MPa	75	50	60	50	95	70	90	70

Benefits of Pre-Preg moulding

The benefits offered by pre-preg moulding are:

- Exceptional tensile strength properties
- Excellent 'flexural strength' properties
- Superior compression characteristics
- Superior corrosion/chemical resistance
- Consistent reinforcement-to-resin ratios
- High strength-to-weight ratios
- ¼ the weight of steel or brass (approx.)
- ¾ the weight of aluminium (approx.)
- Strong lightweight parallel or tapered tube
- 'Short run' capability due to low tooling costs

Custom Work

Exel Composites stocks an extensive range of tapered and parallel mandrels.

Exel Composites is ideally suited to manufacturing product for custom applications. Custom composite tubes have provided solutions to many design problems.

The company is able to offer services including:

Product Design

Materials and the method of construction are selected or developed to ensure that products meet the desired specification or application.

Mandrel Design and Manufacture

Exel Composites can design and oversee the preparation of mandrels to ensure product requirements are fully met.

Production Capabilities

Exel Composites has the capability to produce tubes ranging in diameter from five-200mm. This tubing can be produced in a variety of lengths up to a maximum single length of 4.6 metres.

Tubes can be joined to form longer lengths utilising either external sleeving or internal spigots.

Adhesion to tubes can be easily achieved utilising two part epoxy or acrylic adhesive systems.

Exel Composites also has its own 'centreless grinding' facility. This enables the outside of tubes to be ground to tolerances of ± 0.1mm. Lengths up to two metres can be centreless ground while the largest diameter that can be accommodated is approximately 100mm.

QUALITY ASSURANCE

Exel Composites is committed to quality in all aspects of its products and service.

In 1993 it received accreditation under the ISO 9002 Quality System for quality assurance in production, installation and servicing.

Accreditation to this quality system is continually maintained.

Since 1980, Exel Composites developed an impressive client base both nationally and internationally. These clients have been well serviced over this time because of its expertise, customer service and commitment to quality. Exel Composites look forward to the opportunity to evaluate and assist with solutions to your requirements.

Thermal Properties of Pre-Preg Laminates

	Units	Glass		Aramid		High Strength	
		UD	Fabric	UD	Fabric	UD	Fabric
Coefficient of expansion	10^5/°K	9	11	-0.4	-5.2	-0.1	-0.5
Thermal conductivity	W/m°K	0.4	0.16/0.33	0.4	0.21	1	0.86/1.44

Application

Examples of typical application include:
Specialised piping/rollers/tubes
Electrical equipment/insulation
Marine applications Eg: drive shaft tubes/exhaust tubes, outriggers
Telescopic tubing
Marine Railings and stanchions
Kit spars
Marker poles
Exhaust muffler casings
Antenna radome/Sheaths masts
Outrigger poles
Paddle/oar shafts
High jump bars/javelins
Fishing rod blanks
Forestry poles
Lighting poles

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Parallel Mandrels

Size		Length (metres)	Quantity of Mandrels
Metric (mm)	Imperial (in)		
3.17	⅛	1.500	9
3.96	5/32	1.100	6
4.76	3/16	1.850	7
5.00		0.900	4
6.00		1.100	6
6.35	¼	1.900	13
7.54	19/64	1.100	7
7.93	5/16	2.000	13
8.10		1.000	2
9.00		0.300	8
9.52	⅜	3.500	39
10.00		1.900	2
11.07		1.250	10
11.11	7/16	3.500	23
12.70	½	4.100	36
13.00		2.400	10
14.00		4.000	2
14.28	9/16	2.650	61
15.00		2.150	1
15.87	⅝	2.900	16
16.00		2.200	28
17.46	11/16	2.500	5
18.00		3.200	14
19.05	¾	3.000	12
20.00		2.200	4
20.63	13/16	2.250	11
21.40	27/32	2.400	5
22.00		4.000	6
22.22	7/8	4.500	7
23.81	15/16	3.700	5
25.40	1	4.500	24
26.00		2.000	2
26.50		3.000	23
26.98	1 1/16	4.000	61
28.00		1.200	1
28.57	1 ⅛	4.500	50
28.70		3.950	1
29.50		2.200	2
30.00		3.650	1
31.75	1 ¼	3.900	12
32.00		3.400	10
33.00		3.200	2
34.00		1.950	1
34.92	1 ⅜	3.700	27
36.90		2.450	1
38.10	1 ½	2.900	15
40.60		2.950	3
41.28	1 ⅝	2.300	1
42.00		3.000	1
44.45	1 ¾	3.700	4
46.00		1.950	1
50.30		3.900	1
50.80	2	3.500	5
51.10		0.900	1
53.50		3.000	1
54.00		1.400	2
55.00		1.400	1
57.10	2 ¼	1.450	1
60.25		4.600	7
60.30	2 ⅜	4.700	1
62.00		1.250	1
63.50	2 ½	3.000	2
65.00		1.700	2
66.30		1.100	1
69.85	2 ¾	2.000	1
76.20	3	2.100	2
80.00		1.050	2
82.55	3 ¼	2.250	1
85.72	3 ⅜	1.200	2
88.90	3 ½	1.350	1
89.00		2.200	1
90.00		2.150	1
95.25	3 ¾	2.000	1
99.80		2.350	1
100.40		4.000	1
101.60	4	4.000	1
107.95	4 ¼	1.000	1
120.00		0.400	1
160.00		1.475	1

Tapered Mandrels

Mandrel	Butt Diameter	Tip Diameter	Length (mm)	Taper Rates & Stages
BF	18.90	1.20	3985	4.5mm / mtr
DT	15.88	1.45	3350	Various 3 stage
EFS	34.00	1.15	4380	7.5mm / mtr
FB 1	8.65	4.30	1735	Various 4 stage
FB 2	12.30	5.82	1710	Various 4 stage
FB 3	6.00	3.00	1720	Various 3 stage
FFS	35.90	0.60	3795	Various
FFSU	35.60	0.80	3800	Various
FMT	21.25	1.15	2440	Various 6 stage
FMTL	24.70	1.15	2795	Various 6 stage
FPS	24.30	0.80	2350	10mm / mtr
FPSL	22.00	1.20	2600	8mm / mtr
FR 4	12.60	1.40	2970	4mm / mtr
FSF	25.00	0.70	2100	Various 4 stage
FSU	31.60	1.25	3150	10mm / mtr
FSU 12	37.70	1.25	3760	10mm / mtr
FSUE	30.80	1.25	4140	8mm / mtr
FSUL	31.30	1.25	4210	8mm / mtr
FT 1	8.00	0.80	2400	3mm / mtr
FTF	18.85	1.30	3250	5.5mm / mtr
GB	18.85	1.25	2515	7mm / mtr
MT	20.55	1.25	3355	Various 4 stage
6 MT	19.00	1.15	2620	Various 6 stage
MTE	24.25	1.30	3785	Various
6 MTE	28.35	1.15	3770	Various 6 stage
5 MTL	30.00	1.15	4165	Various 5 stage
MTS	15.60	1.25	2540	Various
PERCH	14.00	0.90	2385	5.5mm / mtr
SFT	30.00	1.00	3750	Various
SSLE	28.50	1.25	4220	7mm / mtr
ST	20.00	1.70	3655	5mm / mtr
STS	25.10	2.60	4100	5.5mm / mtr
SU	31.50	1.75	4575	6.5mm / mtr
UL	10.30	1.00	2320	4mm / mtr
SK 1	46.00	35.00	4720	Parallel Ends 2.6mm / mtr
WS 1	45.95	23.85	4700	Parallel Butt End 2.6mm / mtr
WS 2	48.70	25.00	4820	Parallel Butt End 5.5mm / mtr
WSM 2	39.40	24.00	2650	Various 3 stage
WST 1	39.35	24.95	3000	Parallel Butt End 5.5mm / mtr
WST 2	39.35	24.00	2650	Parallel Ends 7mm / mtr
58 – 34	58.20	34.00	3425	6.5mm / mtr
48 – 33	48.70	33.00	4800	4mm / mtr
35 – 23	37.75	23.00	2300	5mm / mtr