



**Pacific Composites**

# **PRE – PREG MOULDING**

**Pre-Preg Moulding**

This particular form of composite fabrication begins with the pre-impregnation (pre-preg) of reinforcement 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 ratio to be achieved.

Pre-preg materials are used extensively in the aerospace industry due to their ability to maximize 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 mouldings process occurs by rolling these pre-preg patterns around a tapered or parallel steel mandrel. 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.

**Reinforcements**

Pacific Composites stock a wide range of pre-impregnated reinforcement materials including:-

**Fibreglass (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**

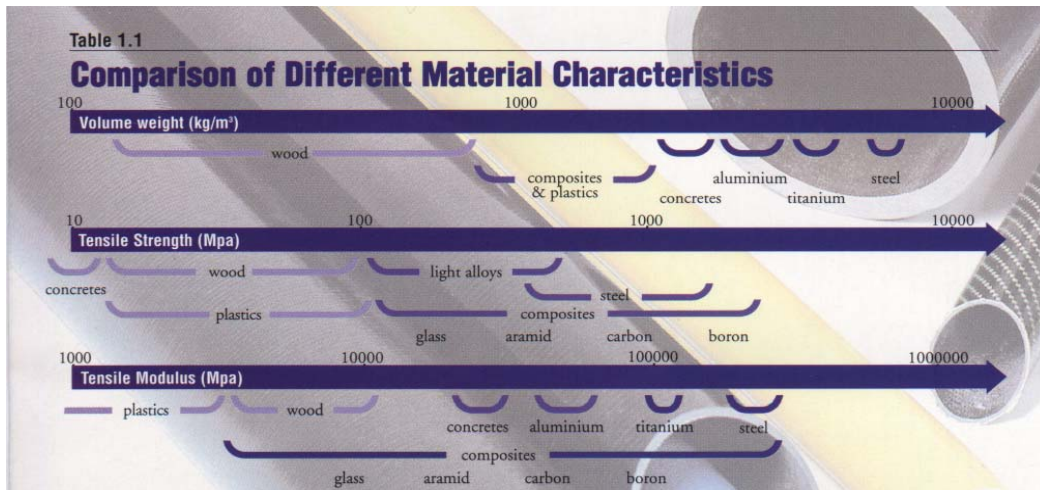
A number of high performance resin systems are available. The most commonly used systems being epoxy or polyester.

**Resin Spec Data**

Neat Resin Properties	Epoxy
Specific gravity	1.27
Tg Dry	100 C
Linear coefficient	
Of thermal expansion	75.10-6/k
Tensile modulus	2.9 GPa
Tensile strength	70 MPa
Tensile strain	2,7%
Poisson ratio	0,35

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.



**Table 1.2 Typical Mechanical Values on Epoxy Pre-Preg Laminates**

		E-GLASS		ARAMID		HIGH STRENGTH CARBON		INTERMEDIATE MODULUS CARBON	
		UD	FABRIC	UD	FABRIC	UD	FABRIC	UD	FABRIC
Tensile	MPa	1100	600	1100	500	2000	800	2400	900
	MPa	35	550	35	450	80	750	80	850
	GPa	43	20	60	30	130	70	170	90
	GPa	8	19	8	30	9	65	9	90
Poisson's Ratio		0.28	0.13	0.34	0.2	0.25	0.05	0.27	0.05
Compression	MPa	900	550	250	150	1300	700	1600	800
	MPa	150	500	150	150	250	650	250	750
	GPa	42	17	75	31	115	60	150	80
	GPa	10	16	5.5	30	10	55	11	75
Flexure	MPa	1200	700	550	400	1800	1000	1400	1200
	GPa	42	20	40	25	120	65	140	75
In-plane Shear	MPa	60	55	45	40	95	80	95	80
	GPa	4	4.2	2.1	4	4.4	5.5	4.4	5
Interlaminar Shear	MPa	75	50	60	50	95	70	90	70

**Table 1.3 Chemical Resistance Guide**

Chemical	Epoxy
Nitric Acid 10%	R
Phosphoric Acid 20%	R
Acetic Acid 10%	R
Sodium Hydroxide	R
Ammonium Hydroxide	R
Calcium Sulfate	R
Sodium Nitrate	R
Sodium Chloride	R
Ammonium Chloride	R
Calcium Hypochloride	R
Water	R
Gasoline	R
Motor Oil	R
Hydraulic Fluid	R

**R - recommended**

## 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
- 1/4 of the weight of steel or brass (approx)
- 3/4 the weight of aluminium (approx)
- Electrically and thermally non-conductive
- Transparent to radio frequency radiation
- Strong lightweight parallel or tapered tube
- 'Short run' capability due to low tooling costs

## Custom Work

Pacific Composites stocks an extensive range of [tapered](#) and [parallel](#) mandrels. Pacific 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 & Manufacture

The company can design and oversee the preparation of mandrels to ensure product requirements are met in full.

### Production Capabilities

Pacific Composites has the capability to produce tubes ranging in diameter from 5mm to 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 2 part epoxy adhesive systems. Pacific Composites also has it's own 'centerless grinding' facility. This enables the outside of tubes to ground to tolerances of +/- 0.1mm. Lengths up to 2 metres can be centerless ground while the largest diameter that can be accommodated is approximately 100mm.

### Independent Testing

If required Pacific Composites can arrange independent test reports of materials at specific thicknesses to ensure customer specifications are achieved. Table 1.5 below is an example of test results for a particular project in the past.

### Quality Assurance

Pacific Composites is committed to quality in all aspects of its products and service. In 1993 we received accreditation under the ISO 9002 Quality System for quality assurance in production, installation and servicing.

Accreditation to this quality system is continually maintained.

Over it's 25 year history of manufacturing 'pre-preg' moulded products the company has developed an impressive client base both nationally and internationally. These clients have been well served over this time because of our expertise, customer service and commitment to quality. We look forward to the opportunity to evaluate and assist with solutions to your requirements.

Table 1.4

### Thermal Properties of Pre-Preg Laminates

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

Table 1.5 Tensile Test

No	Dimensions (mm)		Ultimate Load (kN)	Ultimate Tensile Strength (Mpa)	M.O.E (Mpa)
1	25.1	7.6	91.8	480.5	31400
2	25.0	7.5	90.5	479.7	32700
3	25.1	7.5	91.0	482.8	32400
4	25.2	7.6	92.3	485.7	33400
5	25.2	7.6	98.4	514.4	32900

Average Tensile Strength	Average Tensile Modulus	Average Density
Specimens # 1-5 = 489	Specimens # 1-5 = 32800	1663 kg/m <sup>3</sup>

Table 1.6

### Examples of typical application include:

Specialised piping/rollers/tubes  
 Electrical equipment/insulation  
 Marine applications  
 eg: drive shaft tubes/exhaust tubes  
 Telescopic tubing  
 Marine railings and stanchions  
 Kite spars  
 Marker poles  
 Exhaust muffler casings  
 Antenna radome/Sheaths masts  
 Sailboard masts  
 Outrigger poles  
 Paddle/Oar shafts  
 High jump bars/javelins  
 Hang glider frames  
 Fishing rod blanks  
 Forestry poles  
 Billiard cues  
 Lighting poles

**Pacific Composites stocks an extensive range  
of tapered and parallel mandrels...**

<b>Parrellel Mandrels</b>		
<b>MM</b>	<b>Inches</b>	<b>Metres</b>
4.76	3/16	1.7
6.35	1/4	1.85
7.93	5/16	1.9
9.52	3/8	3.75
10.3	-	2.0
11.11	7/16	3.0
12.0	-	1.975
12.7	1/2	2.12
13.0	-	2.0
14.0	-	1.8
14.28	9/16	2.0
15.87	5/8	2.225
16.0	-	1.75
16.3	-	2.0
17.6	-	2.4
18.0	-	3.0
19.05	3/4	3.0
20.0	-	2.3
20.63	13/16	2.4
22.22	7/8	4.5
25.0	-	2.8
25.4	1	4.5
26.0	-	2.0
26.98	1 1/16	3.5
28.57	1 1/8	4.5
29.5	-	2.0
30.0	-	2.3
31.75	1 1/4	3.0
32.0	-	3.0
33.0	-	3.0
34.92	1 3/8	3.75
38.1	1 1/2	3.0
40.6	1 5/8	2.9
42.0	-	3.0
44.45	1 3/4	3.7
50	-	2.7
50.8	2	3.0
60.0	-	4.7
63.5	2 1/2	4.0
69.85	2 3/4	2.1
85.72	3 3/8	1.0
90.0	-	2.2
100.0	-	4.0
107.95	4 1/4	1.0
120.0	-	0.4

<b>Tapered Mandrels</b>					
<b>Type</b>	<b>Butt</b>	<b>Tip</b>	<b>Length</b>	<b>Taper Rate and</b>	<b>Stages</b>
FPS	24.30	0.80	2350	10 mm/mtr	
FMT	21.25	1.15	2440	Various	6 stage
PERCH	14.00	0.90	2380	5.5 mm/mtr	
MT	20.55	1.25	3175	Various	4 stage
UL	10.30	0.75	2385	4 mm/mtr	
FT 1	8.00	0.80	2400	3 mm/mtr	
FTF	18.85	1.30	3250	5.4 mm/mtr	
FPSL	22.10	1.30	2600	8 mm/mtr	
FB 1	8.60	4.3	1730	Various	4 stage
FB 2	12.30	5.8	1730	Various	4 stage
FB 3	6.0	3.00	1720	Various	3 stage
FMTL	24.70	1.15	2795	Various	6 stage
FSUL	31.30	1.25	4210	8 mm/mtr	2 stage
6MTE	28.35	1.15	3370	Various	6 stage
MTS	15.65	1.25	2540	Various	4 stage
MTE	24.25	1.25	3785	Various	4 stage
SU	31.50	1.75	4575	6.5 mm/mtr	
STS	25.30	2.50	4140	5.5 mm/mtr	
SSL	28.50	1.30	4010	7 mm/mtr	2 stage
5MTL	30.00	1.15	4165	Various	5 stage
SS	25.25	1.25	3605	7 mm/mtr	2 stage
GB	18.85	1.25	2515	7 mm /mtr	
FSU	31.60	1.25	3150	10 mm /mtr	2 stage
FFS	35.90	0.60	3765	Various	3 stage
FSU 12	37.70	1.25	3760	10 mm/mtr	2 stage
FSF	25.00	0.70	2100	Various	4 stage
FFSU	35.60	0.80	3800	Various	2 stage
RL	28.00	5.00	4575	7 mm/mtr	
FR4	12.60	1.40	2970	4 mm/mtr	2 stage
6MT	19.00	1.15	26.15	Various	6 stage
FSUE	30.80	1.25	4140	8 mm/mtr	2 stage
DT	15.75	1.45	3350	Various	3 stage
BF	19.00	1.25	3940	4.5 mm/mtr	
ST	20.00	1.80	3650	5 mm/mtr	
BC	25.40	6.30	1680	Various	4 stage
WSM 2	39.40	24.00	2650	Various	3 stage
EFS	34.00	1.15	4380	7.5 mm/mtr	
SSLE	28.60	1.30	4220	7 mm/mtr	
SKI	46.00	35.00	4720	Parallel Ends 2.6mm / mtr	
WS1	45.95	23.85	4699	Parallel Butt end 5 mm /mtr	
WS2	48.70	25.00	4820	Parallel Butt End 5.45mm/mtr	
WSB	48.70	39.45	2425	Parallel Ends 5.5 mm /mtr	
WST 1	39.35	24.95	3000	Parallel Butt End 5.5mm /mtr	
WST 2	39.40	24.00	2650	Parallel Ends 7mm/mtr	
58-34	58.20	34.00	3425	6.5 mm/mtr	
35-23	35.75	23.85	2300	5 mm/mtr	
48-33	48.70	33.00	4800	4 mm/mtr	