



DRIVE Marine Services

Fibreglass Fabrics

E-GLASS FIBRE

Calcium-Aluminium-Borosilicate is better known as electrical grade, low alkali, E-glass. E-glass has a softening point of 845°C and is drawn into filaments through a platinum bushing, coated with a special direct size, then wound onto packages as low twist roving. These rovings can be further twisted and plied into yarns. Both roving and yarn are suitable for weaving into fabrics. E-glass is by far the most widely used composite reinforcement due to its relative low cost.

Our Suppliers direct size is AB7, meaning the fabrics need no further heat cleaning or treatment with a coupling agent. These additional treatments usually result in a 50% reduction in tensile strength which, in turn, transfers to a reduction in composite mechanical properties.

CARBON FIBRE

Carbon fibres begin as polyacrylonitrile (PAN) fibres which are highly tensioned and slowly heated to over 1650°C. This process causes complete carbonisation and results in a carbon fibre with high modulus and high strength. Varying the process conditions allows many types of carbon fibre to be produced with high strength (HS) and high modulus (HM) types being the most common.

An epoxy size (finish EP) is applied to the fibre after carbonisation, its role being to protect the filaments during processing and provide compatibility with epoxy resins.

Carbon fibre reinforced laminates exhibit high strength and very high modulus properties but are very susceptible to brittle failure and poor impact resistance.

HIGH MODULUS P-ARAMID (KEVLAR)

p-Aromatic polyamide fibre (also known as p-Aramid) is a low density organic material having a high tensile strength and modulus and a characteristic yellow-gold colour.

p-Aramid reinforced composites show excellent fatigue resistance and impact strength although the compressive strength is considered poor. This combination of properties makes the composite damage tolerant and gives it a built-in safety factor so that mechanical failure will not be catastrophic.

p-Aramid fabrics are scoured (finish SC) after weaving to remove lubricants used to protect the filaments during processing. The scoured fabric may be used with most resin systems although epoxy and vinylester are the commonly used resins. p-Aramid is very sensitive to UV light with a marked reduction in mechanical properties on exposure. This is not a problem in an opaque composite.

INNEGRA

Innegra S is a high performance polypropylene fibre. It is very light in weight and extremely tough. It is cost competitive compared to other high performance fibres, and has been effectively applied as a hybrid with Carbon, Aramid and Polyethylene fibres. The fibre was developed in 2004 by U.S Company Innegritty. While still being tested in many applications Innegra S has found some success in the motorsport and surf craft industries.

BASALT

Basalt Fibre begins as Basalt rock, an igneous rock, originally beginning in a molten state. Basalt fibre is produced in a continuous process, similar to E-glass. In many ways the Basalt fibre out performs E-glass. It has superior strength, more akin to S-glass and has a much higher operating temperature up to 650°C, melting at 1450°C. Basalt fibre is priced accordingly, falling into the range between E-glass and S-glass. With properties within the same range it is a viable alternative for many applications.

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*For a Comprehensive Range of **Boat Building & High Strength Adhesives** requirements including*

Bote Cote 2:1 Epoxy Resin, Fillers, **Pour-on-Gloss** Decoupage Coating, **COP-R-BOTE** Epoxy Antifouling, **AQUACOTE** Polyurethane Coatings, **PURBOND** Waterproof Single Pack Glue, **TREDGRIP** Rubberised non-slip Paint, **Fibreglass & Carbon Reinforcing Fabrics**, **FERONITE** Rust converter and Primer, Pink & Gaboon Marine **Plywoods**, **NIDAPLAST** Composites, **Silicon Bronze** Fasteners **DAVEY** Traditional Bronze & Marine Fittings **WOT ROT** Rot Repair Kit



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NATURAL FIBRES (BIOTEX) STYLES BF

Flax and Jute can be used to produce reinforcements that are lighter with equivalent performance and cost. Natural fibre composites have lower density and much higher damping which can reduce noise, vibration and harshness (NVH) issues associated with other fibres. As well as providing high-performance reinforcement, Flax and Jute reinforcements give a natural look to composite components, providing an image that is in tune with modern environmentally-conscious consumers, and appropriate to outdoor sports such as snowboarding and surfing. Flax and Jute reinforcements are also safe to the touch and can therefore be handled far more easily in the workplace than glass or carbon fibres.

HYBRID FABRICS

These are fabrics which have been manufactured using different combinations of fibre types to improve specific performance characteristics at a cost effective level. The number of combinations is nearly limitless, considered that a multitude of fibres, in various weights, combinations and weaving techniques, can be used both in the warp (along the fabric) and the weft (across the fabric) directions. Common hybrids include Carbon/E-glass, E-glass/Aramid and Carbon/Aramid.

		Aramid	Basalt	Carbon (PAN)	E-Glass	S-Glass	UHMWPE	Innegra	Quartz
Density	g/cm ³	1.44	2.70	1.78	2.54	2.48	0.97	0.84	2.20
Tensile Strength	MPa	2400 - 3600	4840	5313	2600	4800	2200 - 3900	667	6000
Modulus	GPa	60 - 120	89	292	72	85	65 - 132	15	72
Elongation at Break	%	2.2 - 4.4	3.2	1.8	4.0	5.5	3 - 4	9.5	3.0
UV Resistance		Poor	Excellent	Excellent	Excellent	Excellent	Very Good	Very Good	Excellent
Solvent Resistance		Fair	Excellent	Very Good	Very Good	Very Good	Excellent	Excellent	Excellent
Moisture Absorption	%	3.2 - 7.0	0.2 - 12.0	0	0.1	0.1	< 0.1	< 0.1	0
Max Processing Temp	°C	450 Td = 427 - 500	980 Tm =	3500 Td = 3700	730 Tm = 825	850 Tm =	140 Tm = 144 - 152	150 Tm = 162 - 164	1070 Tm =
Dielectric Constant (Dk)		3.4	2.0 - 3.2	conductive	6.2	5.2	2.25	2.2	3.7
Dissipation Factor (Df)		0.014-0.01	0.003 - 0.015	conductive	0.003-0.004	0.002	0.0002	0.0009	0.0001
Coefficient of Linear Thermal Expansion	ppm / K	-4.0 to -4.9	8.0	-1.1	5.4	2.9	-12.0	-8.0	0.54

Data for fibers other than Innegra are from manufacturer literature.



Table 1 – Fabrics used for Fibreglassing

Note: UHMWPE (Ultra-high-molecular-weight polyethylene) is a subset of the thermoplastic polyethylene.

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