

MARINE

In marine applications, ZOLTEK™ carbon fiber reduces weight without sacrificing strength. The next generation of yachts, cruisers and racing vessels will be lighter and stronger when made with carbon fiber composites. Tough, durable carbon composite material stands up to the extremes of marine environments. The high specific stiffness of carbon fiber lends itself well to use in applications such as masts, hulls and propellers.

CASE STUDY: THE SPIRIT OF HUNGARY SAILING PROJECT

Led by sailor and boat builder Nándor Fa, Team Fahajó began building their full-carbon, 60 foot (18.3 meter) racing yacht in April 2012. In total, the team will compete in four IMOCA World Champion Series races, the last of which is the Vendée Globe 2016-2017 – a 25,000 mile, single handed, non-stop race, without assistance around the world. ZOLTEK Corporation is sponsoring this project and supplying the carbon fiber needed to construct the racing vessel. The entire hull was built with ZOLTEK PX35, ZOLTEK's primary carbon fiber product. Toray fiber was used for the mast and other parts.

CARBON FIBER USED

ZOLTEK supplied PX35 Continuous Tow and Multi-Directional carbon fiber fabrics. The continuous tow was made into Uni-Directional prepreg on site. The addition of ZOLTEK PX35 carbon fiber resulted in a finished vessel which weighs significantly less than similar sized boats built with traditional materials such as fiber glass.

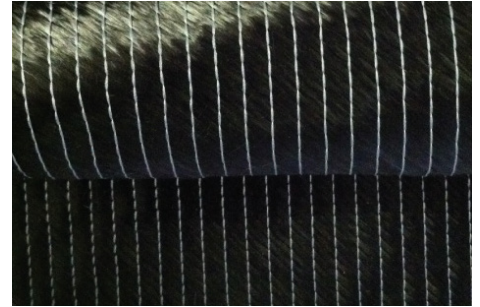


MARINE PRODUCTS

MULTI-DIRECTIONAL FABRICS

ZOLTEK'S Multi-Axial Fabric is produced from our ZOLTEK PX35 continuous carbon fiber tow. Quick composite part build-up is cost effectively achieved with our range of low-cost carbon fabric products. Engineers and designers take advantage of the directional stiffness of this carbon fiber fabric when planning the part layout.

| | SI | US |
|-------------------------|----------------|--------------------------|
| Tensile Strength | 4,137 MPa | 600 ksi |
| Tensile Modulus | 242 GPa | 35 msi |
| Electrical Conductivity | 0.00155 ohm-cm | 0.00061 ohm-in |
| Density | 1.81 g/cc | 0.065 lb/in ³ |
| Fiber Diameter | 7.2 µm | 0.283 mils |



UNI-DIRECTIONAL FABRICS

ZOLTEK PX35 stitch-bonded Uni-Directional Carbon Fabrics are produced from our 50K Continuous Tow carbon fiber. Unique fiber spreading techniques are utilized to obtain a wide range of UD fabric weights for a varied set of composite part applications. ZOLTEK PX35 fabrics can be used to produce carbon fiber composite parts including hulls and decks for marine vessels.

| | SI | US |
|----------------------|-----------|----------|
| Tensile Strength | 1600 MPa | 232 ksi |
| Tensile Modulus | 120 GPa | 17.4 msi |
| Compressive Strength | 1,000 MPa | 145 ksi |
| Compressive Modulus | 110 GPa | 16.0 msi |

CONTINUOUS TOW (50K)

ZOLTEK's Continuous Carbon Fiber Tow is the premier commercial carbon fiber on the market. It is a 50K lamen fiber available in a range of sizings for optimal processing and compatibility with a variety of resin systems.

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|-------------------------|----------------|--------------------------|
| Tensile Strength | 4137 MPa | 600 ksi |
| Tensile Modulus | 242 GPa | 35 msi |
| Electrical Conductivity | 0.00155 ohm-cm | 0.00061 ohm-in |
| Density | 1.81 g/cc | 0.065 lb/in ³ |



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