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MAXIMUM SAIL POWER

CHAPTER 2

IT STARTS WITH A YARN

A Look at all the Fibers used to Make Sails - Part 4 - Polyethelenes

PENTEX

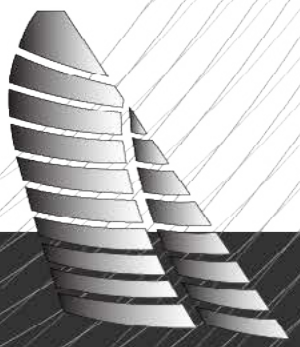
The first real advance on basic polyester came with the development of a fiber called polyethylene napthalate, or Pentex for short. This modified polyester is made by Honeywell Performance Fibers under the trade name of PEN and is, in fact, a super-Dacron combining all the great qualities of Dacron without the one major drawback — stretch. Pentex was developed for the tire and mechanical rubber markets and has several features that make it well suited for sailcloth applications, including the fact that it is rugged and has two and a half times the modulus, or

stretch resistance, of regular Dacron. This translates into two and a half times less stretch for sails of equal weight. One drawback to Pentex is that it only shrinks about 5 percent for its length when exposed to water compared to Dacron, which shrinks from 15 to as much as 20 percent of its length. As a result, when making up a Pentex fabric the weaves are not as tight as those made from Dacron since shrinking the woven fabric is key to creating a tight, stable weave. Unfortunately for the sailmaking industry, Pentex was developed specifically not to shrink. For a while, fabric makers tried adding large amounts of resin to the finished fabric to help stabilize it. This, however, caused problems of its own, and now Pentex is used almost exclusively in laminated sailcloth, i.e., cloth in which fibers are glued to sheets of a substrate material like Mylar instead of being woven into cloth by a conventional loom. The finished fabric benefits from the strength and stretch resistance of the fiber, while the substrate offers overall stability. Today, Pentex fabrics provide a lower-cost option for racing sailors looking for higher performance without the huge increase in expense that comes from using other cutting-edge materials. In fact, the popularity of Pentex is largely driven by the racing rules in some fleets that outlaw more exotic fibers in an effort to keep the cost of remaining competitive down to a reasonable level.

An additional benefit to Pentex is that it retains as much as two to five times its breaking strength compared to standard polyester after being exposed to UV radiation (according to Honeywell Performance Fibers, which conducted its own UV tests on Pentex using a xenon arc to simulate the sun's ultraviolet rays). This improved UV resistance is a significant benefit as it more than doubles the life of sails used in tropical waters. In all, Pentex offers real value as a performance cruising fabric, and is a good alternative to Dacron for a racing fabric.

SPECTRA

Spectra is also made by Honeywell Performance Fibers and is a "highly processed ultra-high molecular weight polyethylene" or UHMWPE, according to the literature put out by Honeywell.



This outstanding fiber has been used to build sails for megayachts and for numerous racing sailboats competing in offshore races like the Volvo Ocean Race, the Vendée Globe, and the Around Alone.

This is my own boat - Great Circle. I had a full inventory of Spectra sails which were very durable and lasted a long time but it was finally UV damage that did them in. These days the fabrics have much better UV protection.

Spectra's initial modulus is second only to carbon fiber, a remarkable attribute for a fiber that, like Dacron, also has terrific flex properties and good UV resistance. The problem with Spectra is that under continuous load it starts to creep, or permanently elongate, with the result that the fiber is not used in ultra-high-performance racing sails like those used in the America's Cup in which precise shape control is crucial. On the other hand, aboard large cruising boats where strength, UV resistance, light weight, and durability are paramount,

Spectra yarns are often ideal. This is especially true when used in a woven format since wovens are extremely durable and offer great chafe protection. One additional drawback to Spectra is that it has a slippery feel and does not bond well with adhesives, making it very difficult to laminate. As a result, fabric makers always try to laminate film to film between the Spectra scrims when making the cloth.

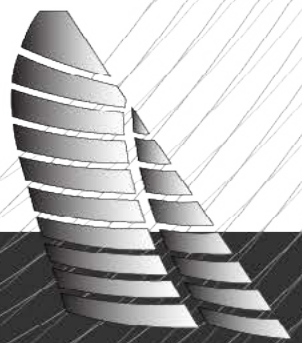
The most commonly used Spectra fiber is called Spectra 1000, but Honeywell Performance Fibers also makes an even higher modulus Spectra called Spectra 2000, which is usually used to make Cuben Fiber sailcloth, although it can also be used for regular laminated Spectra fabric. Spectra's other, more popular application is for making bullet-proof vests and reinforced cockpit doors on airplanes. As a result, when there is a war or general unrest in the world, the price of Spectra skyrockets as demand exceeds supply.

DYNEEMA AND CERTRAN

Dyneema and Certran are very similar to Spectra, but Dyneema is manufactured by a Dutch company called DSM and Certran is made by a company called Celanese. Dyneema is often used by European sailmakers and is growing in popularity in the United States, since among other things it is available in a wider variety of yarn sizes than Spectra allowing for the creation of more fabric styles. Certran has a modulus somewhere between Spectra 1000 and Spectra 2000.

TETRANEEMA

Tetraneema is an ultra high molecular weight polyethylene (UHMWPE) that was originally developed for the production of ballistic protection clothing. It is in the same family of products as Dyneema and Spectra but it doesn't have the creep problems associated with those fabrics. Creep is when the fibers elongate after being under a constant load.



Tetraneema headsail on this Swan. Perfect fiber for this application.

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