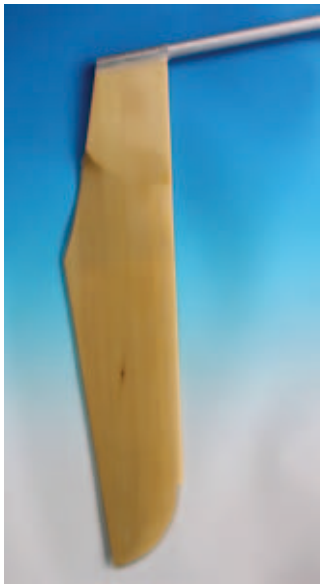
Foiled Again

Phil Milanes, of Milanes and White, Toils over Foils

Over the last seven or eight years there has been a steadily increasing awareness of the real importance that first-class foils make to the performance of a racing dinghy. This awareness is now at a high level and sailors are prepared to pay for a good product. A high performance dinghy's centreboard or rudder blade is now a very sophisticated piece of equipment, far removed from the one-time solid piece of shaped timber that warped and twisted and probably was never a fair section in the first place.

THE PROBLEM with foils made from solid timber is that they warp and go out of shape and also have a greater tendency to split. The use of top quality plywood offers little more as it is again prone to warping and is heavier than an equivalent foil made with laminated timber. It is a skilled job selecting the correct timber for a foil. There are many factors to take into account, starting with the design, specification and use of the foil which will dictate the right species or combination of species of wood from which it is made. Having made that choice, it is then necessary to select the actual pieces of timber of the chosen species, checking density, strength, weight and stiffness or flexibility. Each foil must be made from timber with the correct characteristics or else the finished article will not perform as expected.



WOOD IS STILL a superior core material compared to other exotic materials. Obviously some exotic materials do have a place in a modern foil as we shall see shortly, but the use of honeycomb core materials is emphatically not the answer.

Wood is very near to perfection and it has so much variety. Exotic materials are very expensive to use in foils. However, carbon fibre is a marvellous material to use as it can add so much stiffness for

virtually no increased weight.

THE ACTUAL CONSTRUCTION of a state-of-the-art foil is very much a craftsman's job. Even the use of computer-controlled milling machines can only complete the basic sectioning of a foil; the milling machine leaves steps which have to be carefully faired –in by hand. And if this is done carelessly the end result is quite likely to be worse than an average hand-shaped foil. In classes where the centreboard is unrestricted or only loosely controlled, sailors are using longer, wider, and more powerful centreboards. If they are not wider, they will probably be stiffer than a few years ago. Finer and flatter sections are popular, typically with a 37% chord. Fireballs and International Fourteens in particular are finding flat sections to be very fast.

WHEN DESIGNING a foil you have got to encourage early laminar flow. A larger radius on the leading edge helps here and is likely to be very successful for rudder blades used in extreme conditions such as when doing a lot of roll tacking or when requiring a lot of, perhaps violent, adjustments to the helm, as on hairy reaches. In more steady conditions, however, a finer (smaller radius) leading edge is preferable. Today's flatter sails enable the use of bigger, stiffer centre-boards. If and when this situation changes, we may have to revert back to more flexible foils. There must be some flexibility in a dinghy rig. If you have a very stiff board, then the tip of the mast must bend to allow the mainsail leech to fall off; with a very stiff mast there needs to be some flex in the centreboard. There must be this degree of flex to help the boat work over the waves. It is all a question of balance between the top and bottom components of your boat. The crew weight is very important to the foil maker as he needs to know if the boat is short of power or suffering from too much.

THE MOST POPULAR sections are 30% chord for gybing boards, 33 to 37% chord for fixing boards; rudder are standard at 33% except for some single-handers such as Finns, which go for a 20 to 25% chord and a more rounded leading edge as discussed earlier. Concave trailing edge sections can promote very good release characteristics but are very difficult to achieve acceptably high standards. A foil's trailing edge must either be very fine or cut off at a slight angle. A trailing edge which is too thick, or rounded, can cause a foil to cavitate which, in its least problematic stage, results in singing and at its worst in vibration to perhaps an extent at which a rudder, for instance, could eventually break because laminar flow has finally broken down over most of the foil.

IN PLANFORM maximum area at the head of the board inside the case is very important. And the centreboard must fit the case correctly. It is no use having a centreboard built with special flex characteristics if it is a loose fit in the case. Centreboards are now being made wider at the top where they leave the case with more taper on the trailing edge. The shape and section of the tip of the centreboard is critical to its performance. A square tip, unless it has a very flat section, will prove to be a liability on reaches when the board is raised. A cutaway or elliptical tip is the most satisfactory. A daggerboard or centreboard that can be lifted

vertically on a reach has an advantage in that the design of the tip of the board is not dictated by the demands of the reach.

Construction Techniques

WITH THE CORRECT selection of materials, used in the most appropriate way, a wide variety of performance characteristics can be built into a foil. A typical combination of materials for a high-tech foil would be obeche, balsa and carbon fibre. The distribution and jointing techniques depend on the characteristics required.

At Milanes and White we are producing an increasing number of boards with the head made out of stiff wood, splice jointed into a more flexible timber for the lower section.

CARBON FIBRE plays an important part in increasing local and overall stiffness and is used extensively in high-tech foils where maximum stiffness and minimum weight are required. In such foils balsa splice-jointed to spruce, mahogany or obeche; the foil is shaped and then laminated with twill glass and 150mm carbon fibre tape over practically the whole board. Such a construction is particularly useful in gybing centre-board, for example for 505s and International Fourteens. The addition of carbon fibre adds very little to the overall weight of the board but does add enormous strength.

WHEN LAMINATING the timber for a foil, each strip is reversed and turned through 180 degrees to eliminate cupping and twisting and to increase the strength of the laminate. If this is not done, then the natural tendency of wood to move after cutting (caused by the release of tension or more slowly by reduction of moisture content) will only transfer itself into the finished laminate.

THE GLASS SHEATHING must be carried out with great care. All our foils are very carefully sectioned, sometimes to customers' own particular templates, but this skilled work can be wasted if the sheathing is done carelessly. The cloths we use are not easy to wet out without leaving minute bubbles and need to be handled carefully to avoid unequal stretching. Dependent on the particular specification of each foil, we have three main clothes to choose from: 5.5oz twill, 8oz satin and 8oz harness; this choice of materials gives a very wide range of options.

IT IS ESSENTIAL to use epoxy resin as the alternative, polyester resin shrinks when curing and can then distort the foil, particularly near fine trailing edges. Also epoxy has very good bonding characteristics between wood and glass and additionally will not crack like polyester when subjected to the usual flexing under normal sailing/loading conditions.

We use epoxy resins for every stage of the manufacturing process - glueing, laminating (glass sheathing) and flow coating (two coats). We then finish every foil with two-pack polyurethane white paint or clear lacquer to give extra protection against UV deterioration.

THE MANUFACTURE of high-tech foils is always going to be a highly skilled job. Producing foils from a mould sounds a nice idea, one that ought to produce consistent results. But unfortunately this is not the case because as the resin cures it generates heat and unequal tension that causes twist. The natural characteristics of carefully selected timbers are such that they are still to be surpassed by modern exotic core materials. It is worth remembering that a highly sophisticated state-of-the-art foil still costs less than a mainsail and if it is well looked after will last forever.