FOILING
the opposition

by Ross Venner

When I started sailing, some 55 years ago, the most common craft in the dinghy fleets were homebuilt plywood designs by Jack Holt. Most people were pretty pleased with themselves if they got around the course without tearing a canvas sail, or deflating one of the buoyancy bags that were then the norm instead of fixed buoyancy tanks.

Well a lot has changed. Certainly, few people today undertake the immensely rewarding project of building their own boats even in the classes pioneered by Jack Holt and the 'Plywood King' Firebug designer John Spencer. Time is scarce – true, skills and tools are lost – also true, but the strongest reason standing against home built boats in many classes is the recognition that they will seldom achieve the performance of their professionally built opposition.

When you ask, "why not" you will learn that the professionals build down to weight, get better stiffness and a multitude of other explanations. Some of this is true and some the hocus pocus that every profession exudes to protect its domain. Certainly fibreglass sandwich hulls can achieve excellent stiffness for small weight, but its relative importance is marginal in many classes. On the other hand minimising drag is essential in any sailing craft, and one place where the professionals tend to have it over us amateurs is in the finish of our foils. This is my approach to building a competitive foil, in this case, the tiny rudder of a Firebug. Even in such a small boat, it is important because of the profile drag and skin friction which it causes.

You have to start with a blank, here is one I was given ...

You will observe it has been cut from a single plank of back sawn timber which has naturally warped already (The annual rings of the timber tend to

straighten out). This warping will continue throughout the life of the foil – but bluntly, it will only get worse if nothing is done. The best technique to counteract this is to cut the blank lengthways and reverse the alternative components. With the rudder already roughly cut out, the choice is fairly limited on where to cut.

The joins are dowelled together and epoxy glued the cramped together for 24 hours. To keep the board flat, I clamped it to a piece of shuttering plywood covered with packing tape to prevent adhesion to this base.

The vital element in shaping a competitive foil is to use a credible section. I selected one of the early symmetrical aerofoils produced by NACA (the predecessor of NASA) in the mid 1940's numbered 0009. The published co-ordinates are provided for a range of intervals. These are easily transferred into a spreadsheet and extrapolated to the dimensions of the foil – remember just 50% of the width of the timber. The selected co-ordinates are lofted onto a thin piece of timber in the usual way.

Station interval	Base
0	0
1.25	1.42
2.5	1.96
5	2.67
7.5	3.15
10	3.51
15	4.01
20	4.3
25	4.46
30	4.5
40	4.35
50	3.97
60	3.42
70	2.75
80	1.97
90	1.09
95	0.6
100	0

The finished test piece is then used to confirm the section of the foil as it is shaped with plane, spokeshave and sander. To ensure that the foil lasts, we will be sheathing it in fibreglass, so it is acceptable for the timber to be up to 1mm undersize to accommodate resin and mat.

Glassing a foil is regarded by some as black magic. The edges present the most difficulty, glass does not like to change direction. Start by carefully cutting out a piece of glass (4oz woven rovings in this case) that is the same length as the leading edge of the rudder and about 40% of its width. Where the curve at the bottom of the leading edge will be covered, cut fillets out of the glass to get close to a consistent single layer of glass. Clamp the rudder trailing edge in a suitable device so that you can work on the leading edge. Impregnate the timber with resin to equal distances on either side of the leading edge so that all the glass is applied to wet resin. Apply the glass and wet it out carefully with a disposable brush. Apply peel ply which covers all the glass and ensure that resin rises up to impregnate this disposable material as well. The peel ply can be kept in position with clamps or tape. Particular care will be required on the curved bottom area of the foil.

With the resin on the leading edge is cured, the peel ply can be removed and rough edges sanded. The process is repeated for the trailing edge. Theoretically, the trailing edge should be virtually knife edged as it is on most aircraft. I take the view that such a thin element invites damage and settle for some 2-3mm of radius. This is strong enough to resist a reasonable amount of damage and since the water through which it passes is already turbulent, I do not believe it significantly increases drag.

The rudder is now upended and a similar process completed for the two sides. This time a single piece of glass cloth is made to overlap the glass already applied to the leading and trailing edges so that the whole rudder is now covered, except the rotation area which fits in the rudder box. Peel Ply should only be used on the bottom and can be held in place with two or three spring clamps.

You are now ready to finish the rudder. Expect to find defects. These can be fixed. Bubbles can be opened with a sharp knife and the cloth not attached to the underlying surface removed and the glass cover patched. Where peel ply has been used, you will find that the weave has left an impression. After light sanding, this is a good sign since it normally shows that the glass cloth has bonded to the underlying surface. Overall you will find some unevenness in the layer of resin. The edges of the patches, the unevenness and the print through left by the peel ply will all yield to 80 grit sandpaper on a random orbital sander. The print through will require minimum sanding, while the other surfaces need to be made fair.

When you are satisfied with the sanding, your will carefully remove as much dust as possibly, before moistening the job with epoxy thinners – acetone (flammable and toxic – handle with care). A cost of resin applied with a small brush should spread easily over the prepared surface.

You should now be in a position to start serious surface preparation – wet and dry sandpaper from now on. It will last much longer if you add some washing-up liquid to your water. I start with 260 grit, moving up through 600 to 1,000 grit. The surface has become almost shiny again, but don't polish it. Epoxy resin is sensitive to sunlight and unprotected, will deteriorate rapidly. Finishing with paint is easier, you can use and then hide bog to fill any imperfections, or a sun protective marine varnish (four coats are recommended) if you want to really impress the guys at the regatta some of whom spend $100's on their foils.