Project News Special

Blue 2: an update

A self-confessed 'man of steel' gets to grips with carbon spars... and Blue 2's fuel system

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Well, what a great Rally. I took my fuselage, on its wheels, with the tailplane and elevator assembly, to the last year's LAA Rally with, I must say, a little trepidation. I have seen some of the beautiful work that other builders are capable of, particularly some of the wooden constructions, whereas my effort was in rather a raw state with some untidy edges. However, I wanted to show what a lone builder could reasonably do in his garage.

I talked to some wonderful people, including a man from Canada who had been following my exploits through the LAA magazine. In general, it was the younger guys who were the most enthusiastic about carbon fibre composite construction. Imagine my surprise when I won The Albert Codling Trophy for the best part-built aircraft in the show. What a thrill to have my name added to those of previous winners, many of whom have been a great inspiration to me.

Coming back down to earth was surprisingly difficult; self-motivation can be harder than making some of the parts. Anyway, it occurred to me that once the fuselage was permanently on its wheels it would be difficult to paint the underside - I didn't fancy lying on my back in a cloud of paint overspray - so I set about filling, sanding, filling, sanding and more sanding of the bottom of the fuselage.

The most effective way of sanding that I have is an air-fed dual-action sander (unfortunately without dust extraction, which would be a boon) but it still takes forever. Reading blogs of American composite builders, they recommend putting between 1/8 and 1/4 inch thick layer of micro-balloons all over the surface in a single operation and then contouring and final sanding. I'm sure this is the best method but the thought of all that weight gives me the screaming ab dabs and for a 450kg microlight it's just not on. So, the result, as you can see from the first photograph, is a reasonably glossy but rather wavy underside.

The paint (the colour is Ford Diamond White) is a two-pack poly-acrylic and is carcinogenic, so an air-fed mask is essential. The secret is to dust on an initial very light coat and allow 10-15 minutes for this to stabilise before spraying further light coats (about three) until a gloss finish and coverage is achieved. Trying to cover the primer in one or two coats will result in runs which are a pain to sand out.

I have found the best results come on vertical surfaces as the paint flows slightly, giving a gloss finish with the minimum of paint, with dirt landing in the wet paint greatly reduced. Incidentally, one of the most valuable tips that I got from the Rally was from two splendid enthusiasts (who by the way, offered to come and paint my plane for me) who recommended using 'U-Pol Dolphin Glaze' to fill the inevitable pin holes that every composite builder has to deal with. They were right.

MAjOr cOMpONeNTs

At last, time to start the last major components, the wings ailerons and flaps, and as usual I began with the smaller parts, the ailerons and flaps. Each basic half-span wing panel is 12ft long and I have debated endlessly about whether to have 8ft flaps and 4ft ailerons or 9ft flaps and 3ft ailerons. As every pilot knows, you are eternally grateful for responsive ailerons when you are slowed right down for landing in a gusting crosswind but on the other hand, I am conscious that my wing area is on the low side at 113 sq ft (not as low as the Dyn-Aero Banbi) and must meet the minimum stall speed of 35kt for compliance with BCAR section 'S' (microlights), so the flaps need to be large.

Estimating the maximum coefficient of lift that my single-stage Fowler type slotted flaps could achieve, and hence the lift at 35kt, is beyond the realms of my ability. Perhaps if I had access to a Computational Fluid Dynamics package then these things could be worked out. So, in the end, the flaps won, at 9ft, and now I worry about the aileron response! This, of course, is typical of the compromises made during the design process.

The second photograph shows the basic aileron 3ft x 10in, which ›

(Main) **This is what Blue 2 will eventually look like, hopefully as a 450kg microlight.**

(Above) **Fuel filter and pump will fit neatly under the floor.**

(Below) **Filled, using a minimum of micro-balloons, and painted, the underside of the fuselage.**

weighs 720gm (apologies for the mixed units). Unfortunately, I will be adding a mass balancing arm of nearly 500gm, as I also worry about flutter. Note the carbon fibre hingesmade by wrapping carbon cloth (200gm/sq m) around a waxed stainless steel wire and then on removal of the wire, cutting away the recesses for the other half of the hinge.

Picture three is of the aforementioned flaps. With the 9ft span and chord of 1ft the total flap area is 18sq ft. The 6mm thick carbon hinges are quite long which allows the flaps to move rearwards on extension, thus increasing the wing area. I am using an IGUS plastic bearing in the hinge which will rotate on a short section of stainless steel tube, which in turn is clamped between the sides of a folded stainless steel bracket (using an M6 bolt) that is bonded into the main wing. The full depth shear web behind the flap leading edge is 160gm/sq m carbon cloth with a +/-45° orientation. Local reinforcement is added around the hinges and some 140gm/sq m UNI on the top side above the hinges (the area of max. bending moment) to help with the compression loads. It's still difficult for me to think in terms of compression failure as being dominant in composite structures, after a lifetime of being 'a man of steel' where 95% of failures are in tension.

Covering the entire outer flying surfaces in a single layer of 160gm/sq m carbon twill gave a finished (apart from the dreaded filling, sanding and painting) weight of 2.7kg. Manual operation of the flaps will be by push rods and bellcranks in the wing. The downside of this is that an access hatch has to be cut through the stressed wing skin (never a good idea) in order to assemble and service the bellcrank assembly. Some local reinforcement will be added. The alternative of driving the flaps by torque tube is well tried and tested but for some reason I am never attracted to it.

Just as a change from 'gluing and sticking', I decided some minor mechanical assembly work might be therapeutic and to some extent it was. For some time I had been wondering if I could fit the electric fuel pump, filter, by-pass valve and stop tap under the floor next to the front fuel tank (see pic previous page). It does just fit, with the fuel tap being operated by a slotted extension tube which passes up through the floor, appearing just to the side of the P1 seat. The Facet electric pump is held in place with M4 'Bighead' fasteners bonded to the lower internal skin.

The great debate about fuel system plumbing is whether to use flexible hose, as I have, or metal pipes. I like the simplicity and cost of the flexible pipe systems and accept that regular inspection and intermittent replacement is necessary. My experience of automotive fuel systems has taught me that great care must be taken when mounting thin wall tubes on vibrating structures. Can you be sure that there will be no resonance in any of the pipes over the full rev range of the engine?

When the pipes don't quite line up on assembly and are tweaked to fit, some large stresses can be induced and finally (sorry it's a bit of a moan) expansion and contraction from the inevitable heat cycle will also introduce stresses. I do hope Rotax have been thorough with that long metal fuel pipe that runs across the top of the 912iS engine.

I do hate to be negative but... fuel taps. Why, with the vast amount of paperwork governing the design and operation of light aircraft, do we allow switchable fuel tanks? People die as a result of this nonsense – remember John Denver in his Long Eze over Monterey Bay? Surely having the wing tanks automatically supplying a single central feed tank from which the engine is supplied, is not too difficult?

Anyway, enough of that as I've just received a large cardboard tube from R&G in Germany, containing some carbon pultrusions with which I hope to make the wing spars. So, back to 'gluing and sticking'! ■

(Above) **9ft long flaps should help keep Blue 2 within the 35kt microlight stall speed limit.**

(Left) **Three foot ailerons though, make me worry about low speed roll control!**