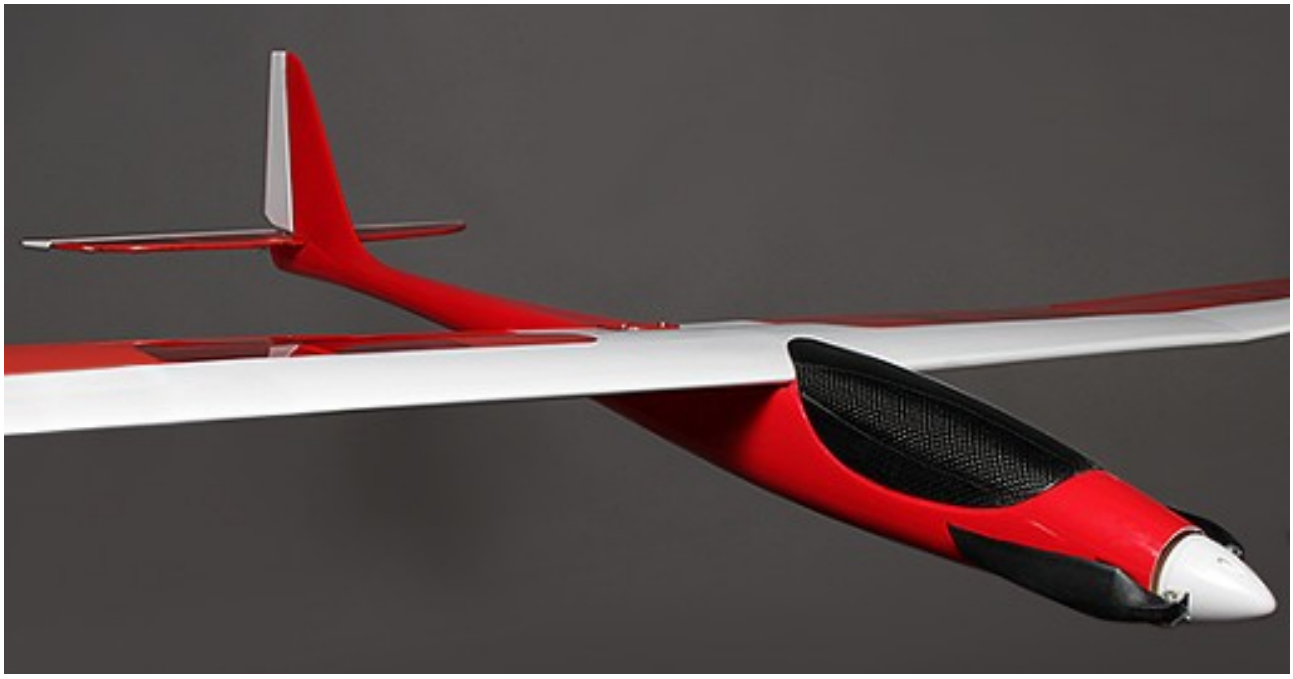
Modifying the Dragonfly Glider

Several years ago I bought a couple of radio control planes from HobbyKing. I had had a bit much wine at the time and so my judgment was “mildly impaired” as was the thoroughness of my research. I think a breathiliser on my credit card would be a good idea. So a few weeks later I received a large package with the two aircraft in it. One was the Wicked Wing XL slope soaring wing which is a great piece of kit, and the other was a Dragonfly Glider. The Dragonfly Glider is a rather pretty glider with a fibreglass fuselage and a built up balsa wing. It looked so pretty and the built up wings kinda fragile so it remained in its box for several years. Partly this was also due to the potential for shifting out of Wellington and having assembled planes would be harder to shift without damaging them.



Seeing as I am still in Wellington, I thought I may as well assemble the plane anyway. The assembly went well and I got to the point where I was looking to find a good location for the receiver. I decided to see if anyone on the web had any cunning locations for it, and to my horror I found this discussion thread that described in great detail the shortcomings of this plane and what they had done about it.

http://www.rcgroups.com/forums/showthread.php?t=2079389&page=6

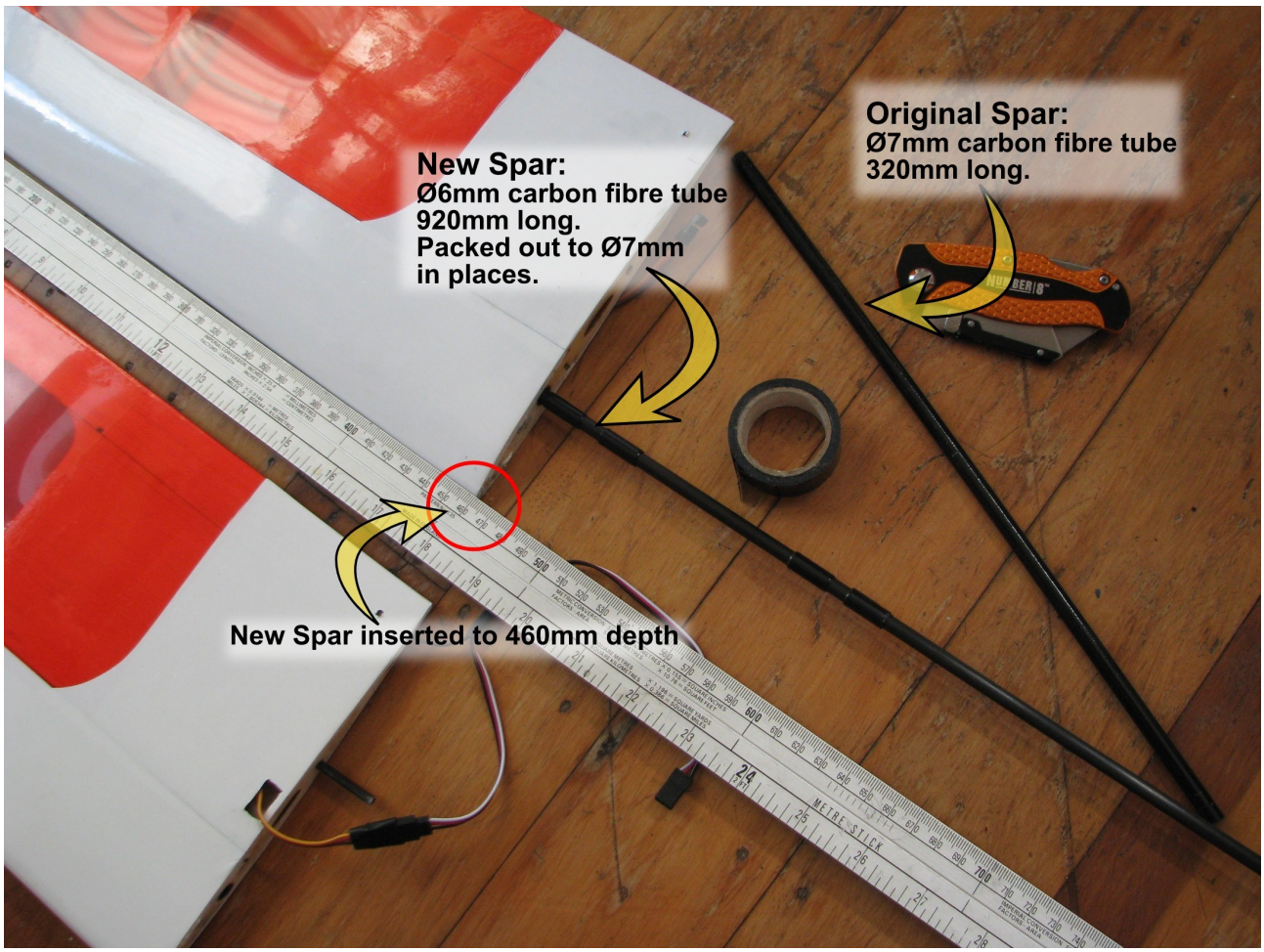
The plane had some pretty big design flaws in it. The most significant was that the wing spar was far too short to be effective so there were many descriptions of the planes simply folding up in mid-air. Almost as serious was the stock motor was completely wrong for the propeller which was leading to the motors burning out. The was not helped by the inadequate ventilation around the motor. There were a host of other minor issues discussed but those described above were the major ones.

Because Wellington's winds are a bit rugged most of the time, strengthening the wings was a priority.

This article is intended to describe what I did to get the plane into a flyable state that would hopefully avoid the problems identified by the participants in the RCgroups forum. I am also keen to share the method I used for drilling holes for the new spars so that I did not need to remove the wing covering.

A New Spar

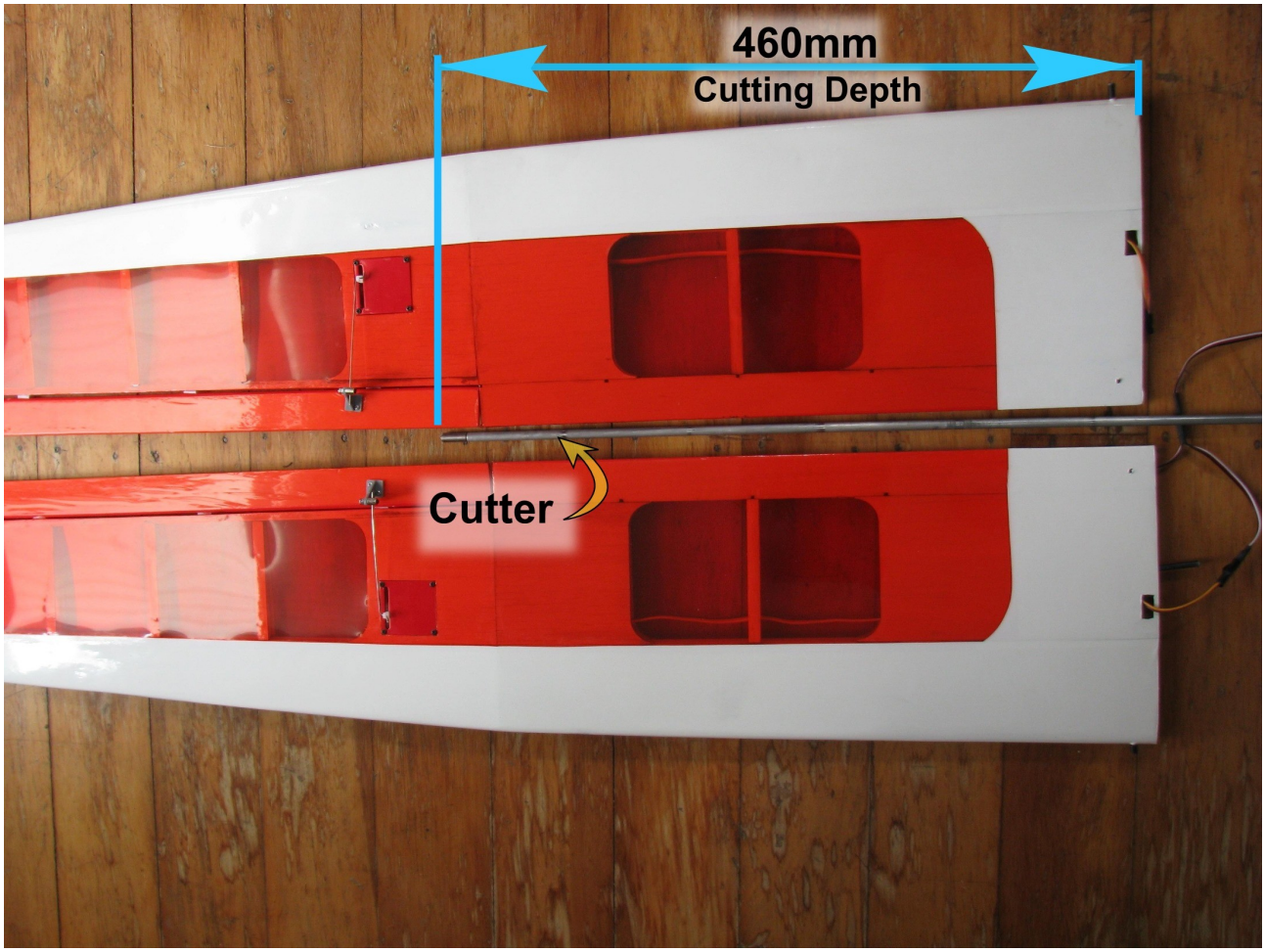
The original spar was 320mm long and Ø7mm in diameter. The new spar is 920mm long and Ø6mm packed out to fit the existing Ø7mmID sheath. Ø6mm diameter carbon fibre was all that I could get hold of but in the end it was helpful in that it allowed me to use commonly available metal tubing for the cutter described below.



To avoid having to remove the wing covering material I came up with a cutter that could reach down the length of the wing to cut through the various ribs. I constructed it from a small length of Ø6mmOD stainless steel tubing. I slightly coned the metal tube's internal size with a centering drill to try to get a relatively sharp rim. In hindsight I think this was probably unnecessary and made it a little harder to cut though the plywood ribs that are on the join between the main wing and the dihedral section. Having done that I used a small needle file to cut some saw teeth into the end of it.

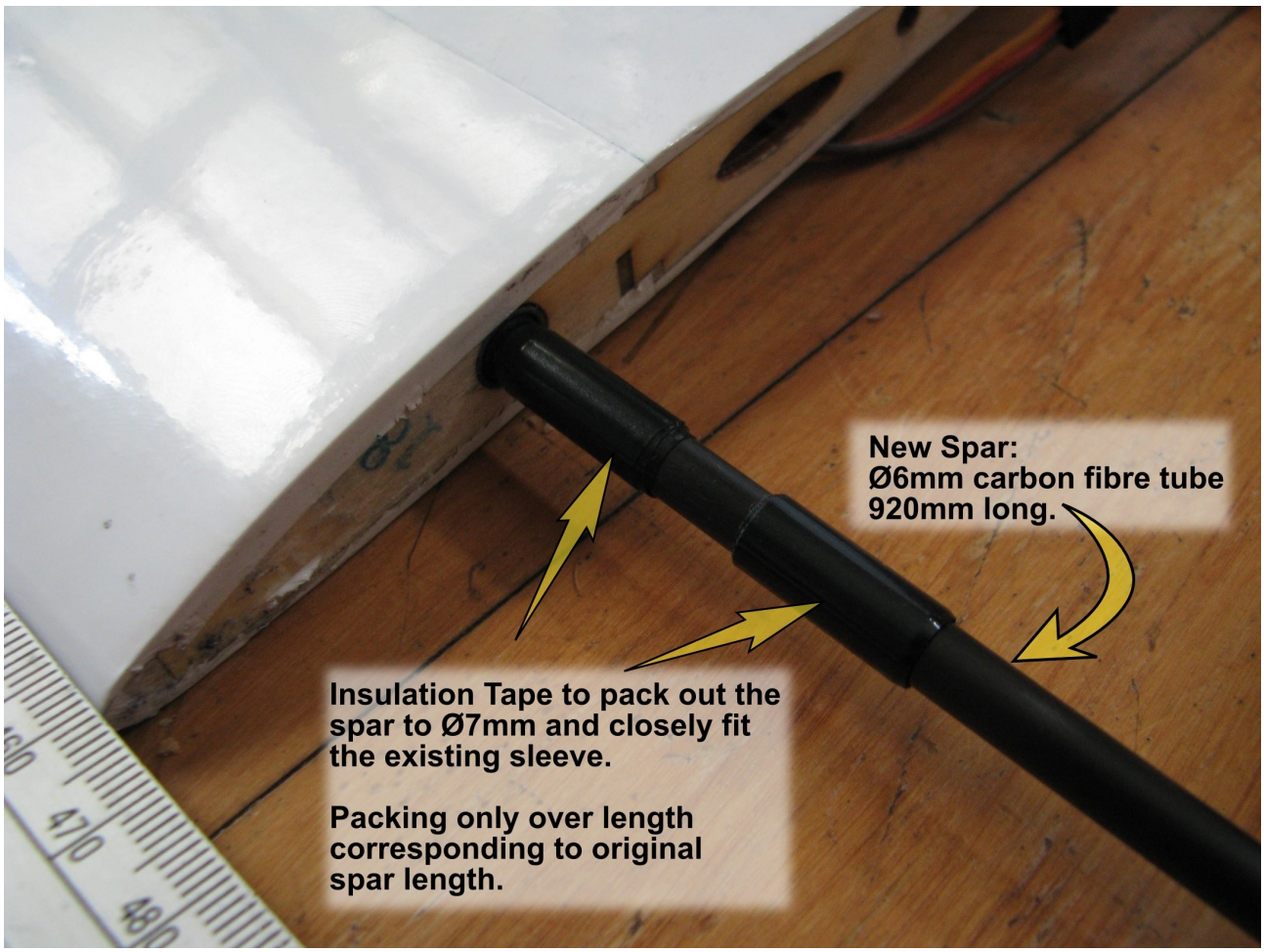
To drive the cutter I used a length of Ø6mm aluminium rod which I machined down to a press fit into the end

of the stainless steel cutter. Covering the cutter's teeth with some MDF, I tapped the cutter onto the end of the rod. Now I had a very long fine cutter which would be able to cut through all of the ribs to the depth I needed.



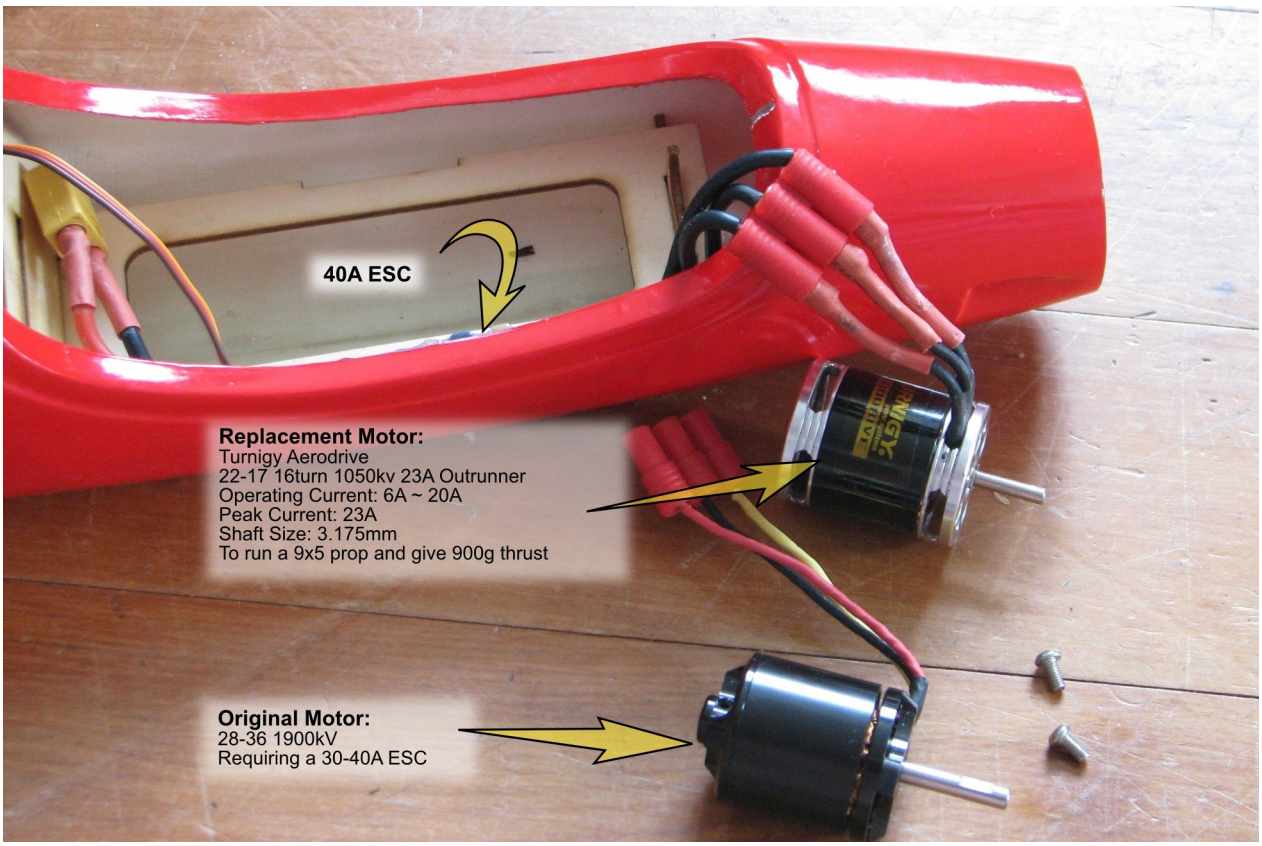
Cutting the ribs was surprisingly painless. I found I could cut the balsa ribs just by hand turning the cutter, but the plywood ribs needed a drill and a bit of pressure to drive the cutter through.

Because the carbon fibre tube I had was Ø6mmOD rather than the necessary Ø7mmOD for a tight fit, I packed out the tube with insulation tape to get a very snug fit in the wing. The friction of the insulation tape within the existing Ø7mmID sheath also prevents the new spar from shifting. So the end result was a wing with a 920mm long spar rather than the minimal 320mm spar of the original. Hopefully this will now be sufficiently strong to take the typical beating all my planes get from the infamous Wellington winds.



A New Motor, Propeller, and Spinner.

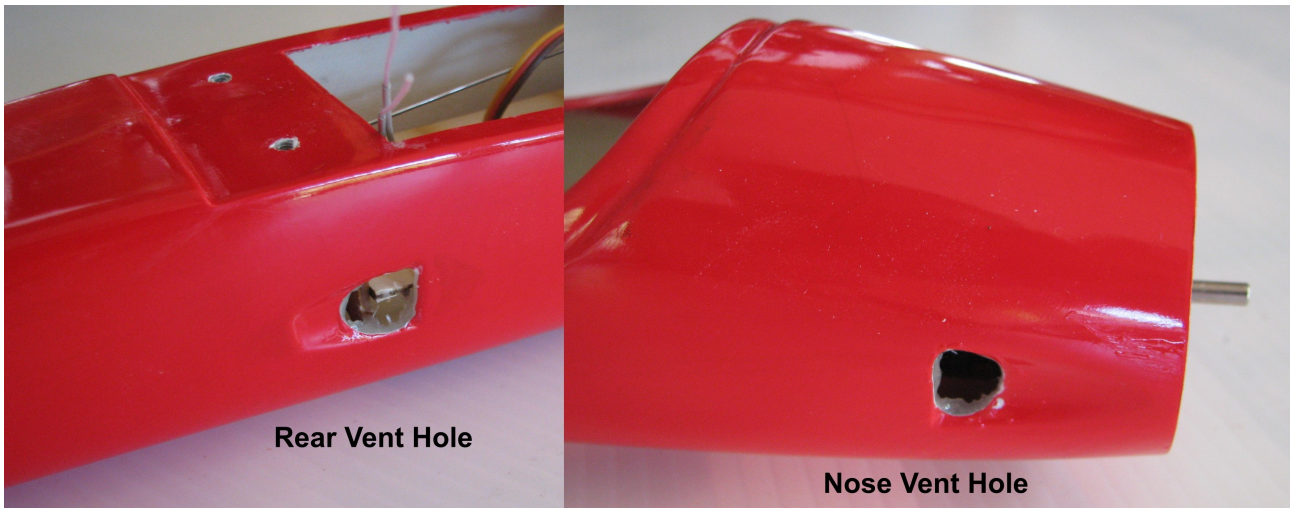
Looking at the specs for the original plane I wondered what on earth had possessed HobbyKing to package it so. Even I know that a large propeller needs a slow motor with a high torque. The 28-36 1900kv brushless outrunner motor driving an 11 x 6 propeller provided was clearly not right as people on the forums had indicated. The solution I want for was to use one of the spare motors from my Quadcopter (http://www.techmonkeybusiness.com/quadcopter-v2-quadcopterus-robusticus.html) and purchase from Banggood (www.banggood.com) some suitably sized folding propellers (a 9x5 set and a 10x6 set). The motor I had to hand was a Turnigy Aerodrive 27-17 16 turn 1050kV 23A outrunner with a Ø3.175mm shaft. John Carri's Webocalc (http://flbeagle.rchomepage.com) indicated that the 9 x 5 propeller would give 900g of thrust which would be adequate and definitely not challenge the motor or the 40A ESC. I did not need to do any modifications to the plane to accommodate the replacement motor.



Although it's not shown here I used a new aluminium spinner too because it had a collet that allowed it to fit the Ø3.175mm motor shaft. Well....when I say the collet fitted that's not quite true. The Ø3mm collet fit once I had run an appropriately sized drill bit through it.

Adding Ventilation

Forum participants had identified inadequate cooling around the motor and ESC. The fuselage included some little indents that were crying out to be opened, so some quick work with a rotary tool soon had them ready to pass air through the machine. I goobed a bit of epoxy around the edges to try to pin the loose fibreglass threads that remained. I tidied it up with a rotary tool once it had hardened.



Post First Flight Comments

By getting up early I was able to squeeze in a first flight with with modified glider. It flew very smoothly and had a good glide-slope. The wings did not fold up nor did the motor burn out. I think I can say I have been successful with my modifications.

A flight later in the day once the winds had increased a bit also did not end with the wings folding up or the motor burning, but the wings (or something) creaks and rattles a bit as it goes through pockets of turbulence. I have not owned a plane with built up and covered wings before so I assume that is just the sound they can make as they flex. The wing was still as firm as it was at the beginning of the day after these later flights so I'm comfortable that it it going to remain wing shaped for the long term. I was a little worried at one point though that it was going to come to grief because of effects beyond my control. It was aggressively followed by a NZ Falcon which has decided that the park I fly in looks like a good place to live. The NZ Falcon is more rare (and a damn sight more interesting) than our Kiwi. Luckily it lost interest in my glider after a few circuits.

Here is a photo of the glider before its maiden flight.

And this is the photo of the glider after its maiden flight. You will notice the wings are still in one piece and the nose is not a smoldering melted wreck.

The after photo shows the glider with the trail where it has scythed through to dew on the grass. You will notice that there are no foot prints around the trail. Hopefully that will satisfy you that I did not simply place the plane there and pretend that it had had a successful flight to get there.

6 February 2016 – Some more modifications

I epoxied a 65 x 40mm patch of polyethylene sheet under each area where the carbon fibre rod would end. This means the patches are more or less between the aileron servo cover plates and the wing's leading edge. I reasoned that the ends of the carbon fibre rod pass through the joiner between the flat wings section and the dihedral section (which is good) but they don't reach the next rib out in the dihedral section. The ends of the rods are therefore going to be pressing on the inside of the balsa sheet which is probably not going to take too kindly to that and potentially give way in strong turbulence. Add the sheet of plastic will help spread the load with a material that is somewhat tougher than the balsa. When I say polythene sheet I really mean some squares cut out of the side of a waste plastic milk bottle.

In my most recent flight, I kinda crashed. The wings are completely damaged which is very pleasing and indicates the modifications described above in the article above worked well. The internals took a bit of a shunt though and so I have fixed them up and added a great deal more epoxy around them to hold them in place better.

So here's what happened. I was gliding along happily and was close to the ground and wanted to climb back up to height for another round. I powered on but one of the propeller blades had wedged itself under the edge of the canopy. It was going nowhere. So with little height and also little clear room to land straight ahead I (foolishly) opted to try to go about and reorient the plane for a better landing. Unfortunately I stalled and the plane dropped. Had the propeller not become wedged it would have been a good flying session. In future I shall either put a large rubber band around the canopy to prevent the propeller being able to get under it, or add a line of tape around the edge of the canopy each time I close it up.