

Duct

Some combinations are dangerous – for example, Rangers and Celtic, or gunpowder and spark. Late night, red wine and Banggood.com is one such bad combination. Banggood is a Chinese website which sells all sorts of tat at incredibly low prices, which turn up in the post between 2 weeks and never later, depending on how 'nearly full' the container is when you place your order, and the exact speed of the slow boat from China.

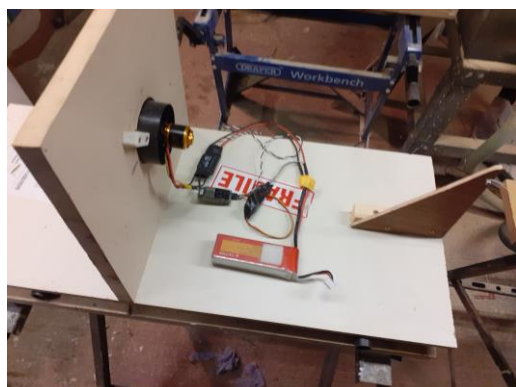
Hence, I was surprised to receive a 64mm ducted fan unit, a 40A ESC and 4 retractable undercarriage units in the post one day, having completely forgotten that I had ordered them.

I recall I had been reading my RCM&E which had a Nijhus EDF Lightning as the free pull-out plan, and this must have inspired my late night clicking. I didn't like that the Lightning was designed for hand launch and belly landing – I feel that fixed undercarriage on a jet looks ridiculous, but that belly landing is downright undignified.

This presumably explains the 4 retracts in the parcel! I'm not exactly sure why I ordered a 64mm unit rather than a 50mm, but I expect it was due to a higher millimetres per pound ratio!

Lockdown 1 build (the Waco) overran into the beginning of lockdown 2, so with time on my hands I decided to try a build a model around the fan unit, with the aim of having a working model that could not only lug around a decent size battery (to have endurance of more than a minute or two), but also 100g of retractable undercarriage.

To 'size' the design, I built a test bench to measure the thrust of the fan, to compare with other models in the fleet.



I found the 'kitchen scales adaptor' to be a bit unreliable, so invested in a 1Kg spring balance. The raw thrust is between 550g and 650g, very heavily dependent on the battery used. I did some experiments with inlet baffles and thrust pipes. The 'word on the street' (internet) is that the tail pipe should have slight nozzling to 85%-90% of the effective fan area (total area minus hub area), which proved about right.



Various test nozzles

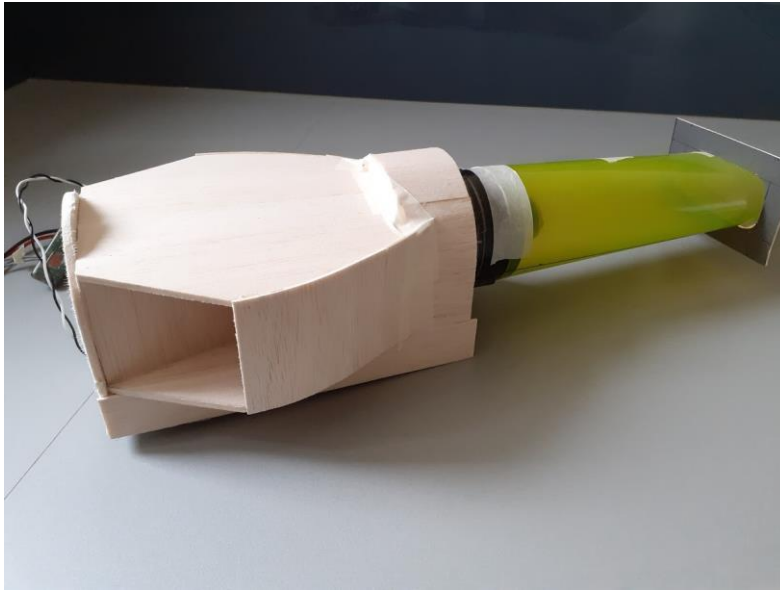
On the inlet side, everything and anything reduced the thrust, potentially significantly (hence the 'cheat holes' on all the Nijhuis designs in the RCM&E series). I don't like the idea of cheat holes, because they are -er- cheating, so I would need to pay a lot of attention to the air inlet to get something which looked OK and let in plenty of air.

Looking at the sizes, weights and thrusts of the existing fleet:

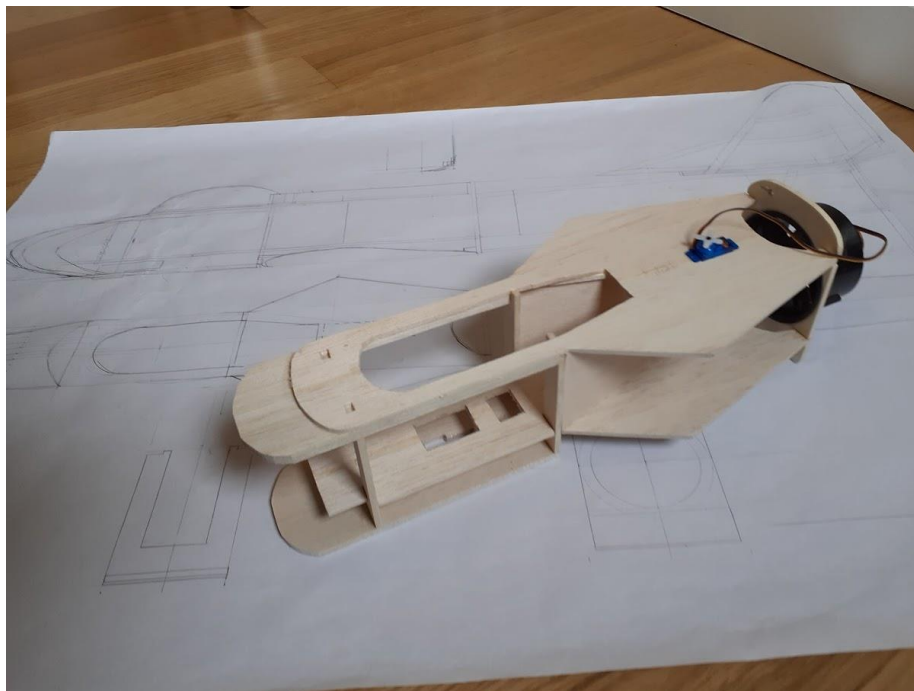
Model	Weight g	Wing Area Sq Ft	Thrust g	Wing Loading Ounces/Sq Foot	Thrust/ Weight	Comment
Apprentice	1600	3.35	800	16.8	0.5	Big Stable Trainer
Gamma	580	1.63	700	12.6	1.2	Takes off like a scalded cat, designed for 2S, therefore over-powered
Trojan	1530	2.53	1300	21	0.85	Big draggy low wing scale
Bambina	495	1.12	380	15	0.77	Small and too fast for me!

I decided that something the size of the Gamma would be appropriate, so 'Duct' (the name I first put in as the model name in my transmitter) has the size, areas, geometry and target weight of the Gamma.

I set about designing the air-box and motor mount, and made a "none-flying bedstead" mock-up to test the design. Basically, instead of fuselage sides, I went for top and bottom plates, which would give a wing-mount below, and a cockpit hatch mount above, leaving the middle free for the air inlet.

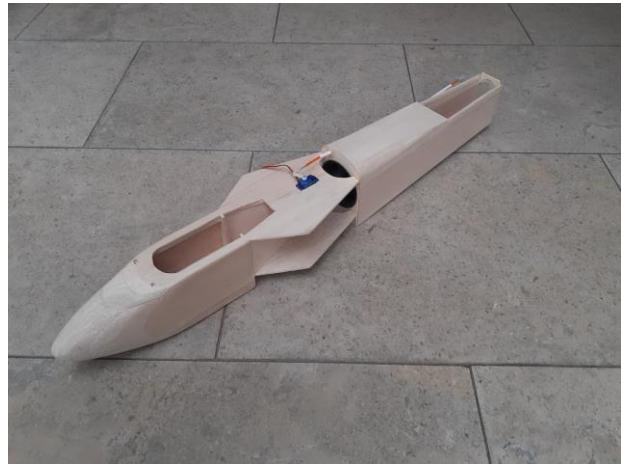


I bench tested the mock and found the thrust to be good. With a few tweaks, I designed the rest of the fuselage and tail based on areas and geometry of the Gamma, with area the forward of the air box narrower than behind the fan unit.

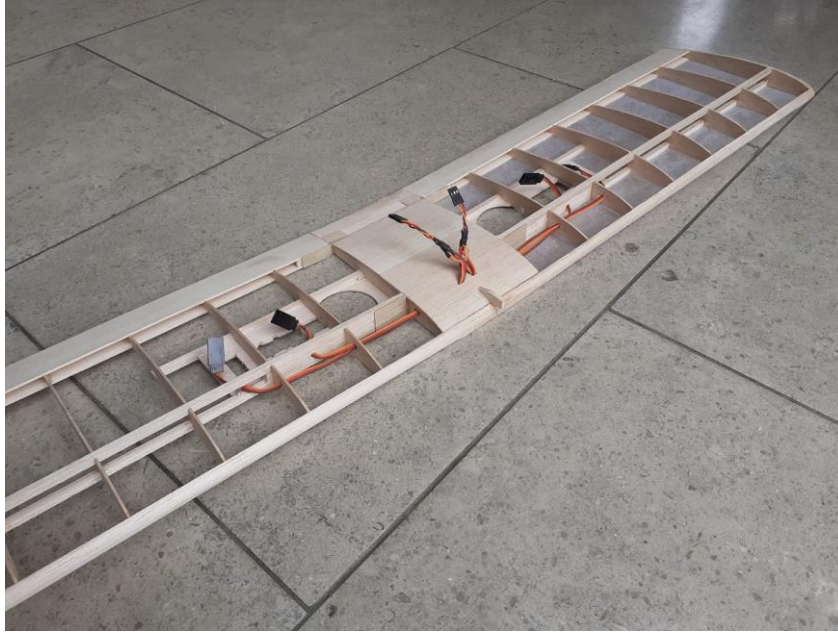


The design was pretty much a competition to keep the weight as low as possible. There are only 4 formers, in 4mm liteply (all mainly hollowed out). Aft of the fan unit, the fuselage is just four 1/8 longerons, skinned with 1/16 sheet.

The nose was fashioned (model boat style) using laminations of thick balsa sheet. The fin and tailplane are built up rather than solid.



The wing is a basic Clark-Y aerofoil, with a reinforced main spar as far as the undercarriage mounting points, with a two-part trailing edge to keep the weight down. There is minimal sheeting of the upper wing mount area, but otherwise it could be a glider wing! I covered it in tissue, water shrunk and finished with two coats of thinned dope.



The canopy was moulded using my home-made A4 vacuum moulder, with a mould sanded out of a lump of 4x2 using an angle grinder. I haven't found better way of making moulds – a bit of silicone spray lubricant serves as a release agent. Rather than using expensive acrylic for the canopy, I used a clear plastic picnic serving tray – another internet tip.



I don't know what the material is exactly, but as soon as you heat it up it goes back to a flat sheet ready for remoulding, and its exactly the right size for my moulder frame! The cockpit and hatch are fitted with two pins at the back, and a couple of magnets at the front. The hatch is hollow to cover the elevator servo (no rudder) and receiver.



There's plenty of room in the front for any size of battery.

I made the undercarriage using my spring coiling device, painted the whole thing red (or should that be RED!). Having had to sell a kidney to pay for the little shaker cans of Humbrol paint for the Waco, I went on ebay and bought a litre of cheap 'RFU' (ready for use, eg pre-mixed ready for spraying) Porsche 'Guardman Red' paint and spayed it using a 'detail' spray gun which has a throughput similar to a spray can.



It comes out with a wing loading of just over 20oz/sqft. I was having a lot of trouble getting repeatable thrust measurements, and this was due to variation depending on batteries. I didn't own a Watt meter, but once I got one, I found that all my batteries are different. I went and bought a brand new 3S 3300 MaH battery (nothing special) and found that the peak current went up from 27A to 35A, with a significant increase in thrust – so I may have slightly 'undersized' the model based on the thrust I was getting with older batteries. The fuselage section on its own will just about hover! The nose isn't quite long enough to get balance with my smaller batteries – originally, I was planning a tapering swept wing, but later decided to keep it simple and match the wing geometry, span (36 in) and area of the Gamma. If it flies and survives, I'll build a Gucci tapered swept wing as a follow up project.

Does it fly, Mister? Well, we don't know yet. As soon as we get some nice weather, I will arrange a rendezvous with the club test pilot (Alan) to see if it does fly. If it doesn't, I'll just screw a handle into the nose, and have the world's only cordless leaf blower with retractable undercarriage!

