Building a Vailly Aviation Hawker Hurricane....Instalment 12

First Engine Run—Running In and Tuning the DL50:

Due to the limited cooling of the motor in the set up I have come up with it is going to be important that the motor is well run in so as to generate as little heating caused by friction as possible.

I've scoured the web for advice and come up with the usual conflicting suggestions but the consensus is that 10 litres of unleaded petrol mixed with high quality two stroke mineral oil in the ratio of 33:1 is about right for running in. After the 10 litres is consumed, the sages say to change the plug and continue on with unleaded mixed with a good Synthetic oil in a 50:1 ratio.

I am going to use 95 octane unleaded petrol mixed with **Valvoline** high quality two stroke mineral oil for air cooled motors and swap over to **Coolpower** synthetic oil after the 10 litres is consumed.

The crankshaft extender and **Vailleyaviation** spinner have been fitted and a **Bolly** carbon 20" x 12" three blader is the prop of choice. The blades are fairly narrow so I am hoping for around 7,000 r.p.m. eventually.

I adjusted the low speed needle to 1 1/2 turns from closed and the high speed needle to 1 3/4 turns from closed, this is as per the US **DL** website operating manual for the **DL50. DLUSA, www.dlusa.net .** The motor was cranked over with an electric starter until there was some petrol in the carby then hand cranked with choke on until it fired, choke off, one more flick and away she went. I ran the motor without adjustment at 3500 rpm for 10 minutes and so far all good, exhaust pipe didn't overheat and nothing vibrated off. 9 1/2 litres to go, the neighbours are going to love this!

Ignition Problems:
I must have run over a black cat or something as I was running the second tank through the motor when suddenly it just sagged away to nothing, it was not hot but there was no way could I start it. I checked there was fuel at the carby and that was OK, checked spark and no bloody spark. This is a brand new unit on its second run ever.
I have two DL50's so I swapped over the **Rexcel** CDI and away she went. That was a quick $80 down the drain..!! **DL Australia** sent me over a new one express post and hopefully it will last longer than the one that came with the motor.

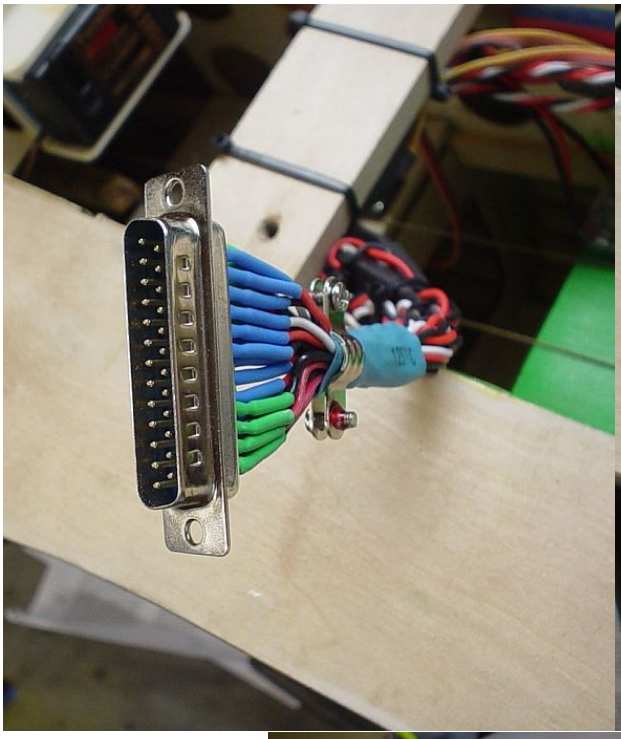
Run In: These pictures were taken after I fitted the new ignition unit and after 3 x 10 minutes running. The motor is spinning a 20" x 12" carbon **Bolly** 3 blader at 6300rpm. I am confident that when the fuel mix goes to 50:1 and I remove the exhaust back pressure caused by the 2.5metres of pipe I have used to quieten the run in period down for the neighbours that I will be getting close to the goal of 7000rpm.

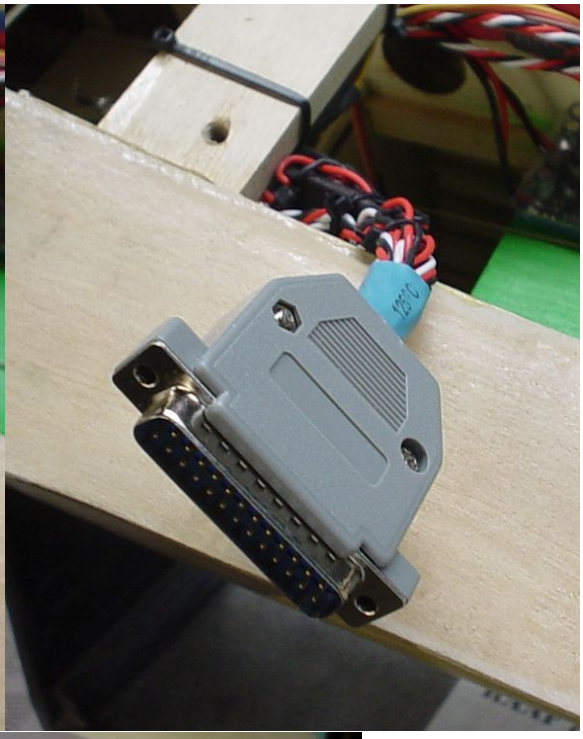
Whatever revs I get the static thrust is impressive even now.

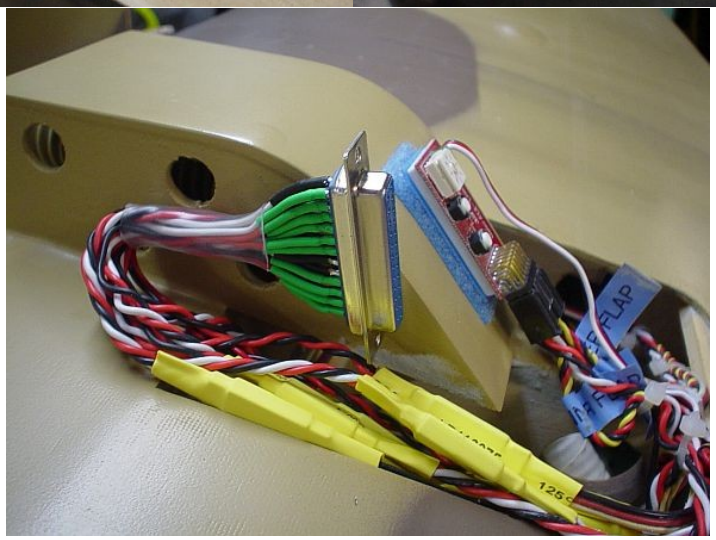
I have done all the running without the cowl being fitted and the motor is running beautifully. It has now had 10 x 10minute runs and there is no evidence of the exhaust pipe burning anything internally and nothing shook loose. It certainly is miserly with fuel consumption. All in all, promising..Next step is a couple of 10 minute runs with the cowl fitted.

Last Minute Mods and Jobs:

1). Wiring: I was rigging the plane prior to an engine run and realised that there was a high risk of incorrectly connecting any of the nine connector leads to the wing from the fuselage or worse one could come loose in flight. It wouldn't take much inattention to create a decent stuff up with consequent tears so I decided to make a single connection and hard wire all servo and switch extension leads to it. The nine extension leads have 27 individual wires but the switch leads do not need the white signal wires connected so I cut them off and soldered 23 wires to a D25 computer connector I bought from **Jaycar** for about $10 including the backshells to support the wiring loom. This connector can only be connected one way and will be taped or screwed together before flight.



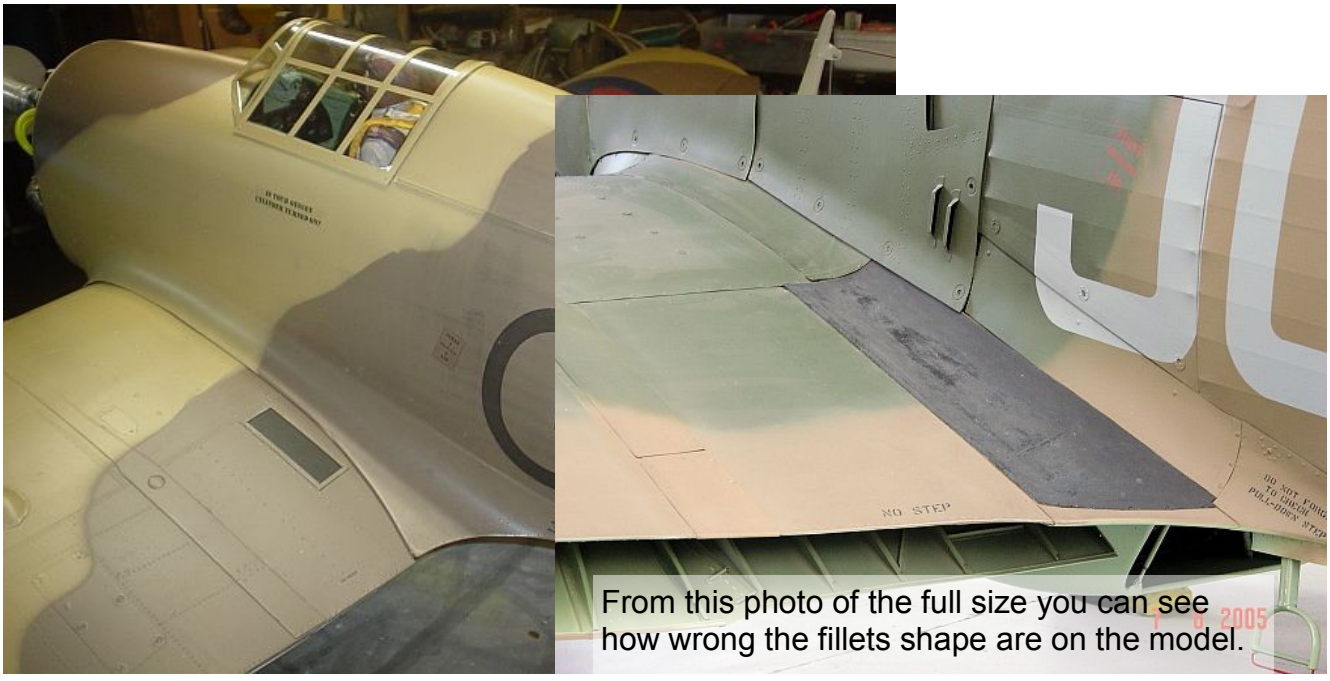




2). Maximum Flap Deflection: After reading the designer, Roy Vaillancourt's flying notes, I realised I had too much deflection on all of the flaps when in the fully down position. Large flap deflection causes a nose down pitch which must be compensated for with up elevator. Due to the relatively small stabiliser and elevators on the Hurricane there is a danger that it will run out of elevator when attempting to flair for landing if flaps over 30 degrees deflection are used. I have re-set all flaps to less than 30 degrees from horizontal in the full down position and about 50% in the mid switch position. The flaps are assigned to the large three way switch above the throttle. (I fly mode 1) and are set to 95% servo slow for a gradual change in attitude when flaps are selected and a more scale appearance when deployed.

The photo shows a **Robart** angle meter measuring maximum full down flap deflection. Each flap had to be individually adjusted as, obviously, they all have to be at the same angle through their travel. This is where the **SmartFly 3D** unit was a godsend.

3). Wing Walkways: I had to assemble the plane to position the wing walkways. These are just painted onto the wing surface with a spray can of flat black acrylic and then painted and riveted card frames will be glued over the edges. Owing to the incorrect wing fillet shape the wing walks are much smaller than they should be and are too far away from the trailing edge.



From this photo of the full size you can see how wrong the fillets shape are on the model.

Pre Flight Checks—Balancing and Control Surface Deflections:

Balancing:

The fore and aft balance of any aircraft is critical to how it will fly. Fighter planes with small tail surfaces especially so.

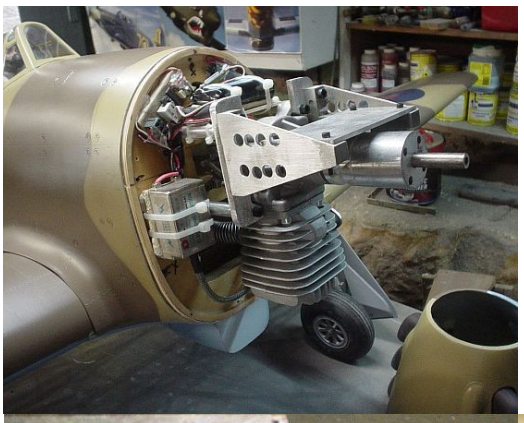
I made this balancing stand some time ago when I found the old finger under the wing tip method too rough.

Its made from pieces of 25mm square aluminium box section with plastic fittings called **Qubelock** in the corners and in the centre for the uprights. Its all available on line from **Accent Hydroponics**

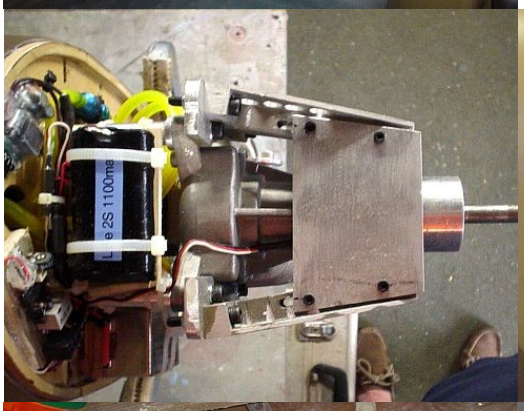
www.accenthydroponics.com

You can see from the above picture that the padded angle bits on the top of the stand pivot on ball bearings and give a perfect indication of the balance point

Vaillyaviation recommends the centre of gravity to be 4 1/2 to 5 Inches (114 to 127mm) back from the leading edge of the wing at the root. Roy emailed me to confirm that I should set up at 4 3/4" . He confirmed that 4 3/4" is correct by both calculation and flight trials so 4 3/4" (121mm) it will be with wheels up and dry.



After a rough check on the plane for balance it was obvious I was going to have to add weight to the nose to achieve the desired C of G. I wanted to add as little weight as possible so that meant having the longest nose lever possible. The pictures below show how I have used an old engine mount bolted to a plate and attached to the airframe by the engine mounting bolts to achieve a strong forward platform for bolting lead ingots to.



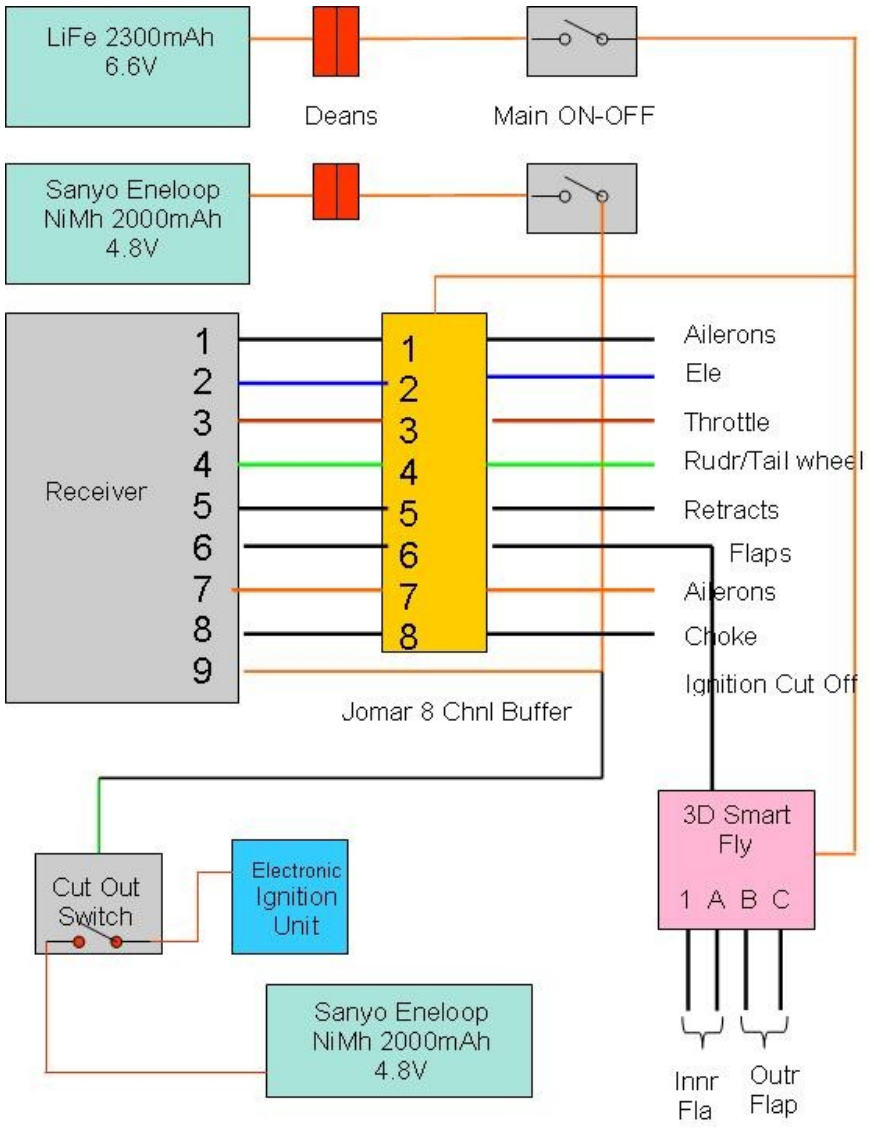
These photos show the plane being hoisted onto the balancing stand and then being aligned with the marks on the tape under the wing at 4 3/4" back from the LE. I will add lead to the tray until the plane balances and then remove the hoist for fine tuning. The lead required was a ***very*** disappointing 1.3kg. This will bring the total weight up to 13.5kg which is about 2kg more than I wanted. I will test fly it as it is but if it needs a too higher landing speed to be comfortable with I might build a new fuze. We'll see.....

The lesson here is **always** build the rear of a warplane as light as you think possible and then remove some more weight again!!

Control Surface Deflections and Re-Wiring:

A bug came to light when I was setting up to measure and adjust control surface deflections. I had assembled the plane and started to waggle the sticks prior to using the **Robart** Angle measuring thingy when I noticed intermittent glitching of rudder, elevators and ailerons, definitely to an unflyable degree. A new receiver made no difference. There was an improvement when I fully re-charged the batteries but the thing still went berserk if I moved the sticks when lowering the flaps. This led me to believe that the total current draw was in excess of what the little voltage regulators could handle. This turned out to be the case. I measured current at the battery connector and found that I could get a spike of about 5amps when waggling sticks and lowering flaps which is near double the rating of the VR. This left me with the choice of eliminating the Voltage Regulators or replacing the current VR's with beefier units, something that could handle the large spikes of current. I chose to get rid of the VR's altogether. I use **Futaba** gear so this meant reverting to a new **Sanyo Eneloop** 4.8 volt NiMh battery for the receiver and ignition ON OFF and retaining the 6.6 volt LiFe for the servos. I wanted minimum draw from the NiMh battery so I switched the throttle, choke and retract leads from the receiver to a new 8 channel opto isolated buffer. I bought one of these Glitch Buster Amplified Opto Coupled Servo Power Isolator units from **E.M.S http:// www.emsjomar.com/default.aspx** for about $80 and voila! No more glitching.

New circuit diagram.



Control Surface Deflections measured at the widest chord.

Elevator:	30mm	UP	20mm	DOWN	
Ailerons	30mm	UP	25mm	DOWN	
Rudder	35mm	LEFT	35mm	RIGHT	
Inner Flaps	75mm	FULL DOWN			
Outer Flaps	70mm	FULL DOWN			

Taxi Tests:

My worries about the plane being too heavy were somewhat alleviated after taking the plane down to the field for some taxi tests, I did several runs with ever increasing speed until I could hold her tail up and float her off the deck. She is quite buoyant and doesn't feel at all heavy on the controls, must be thanks to that big thick wing I think. Rudder control required a bit of concentration as she had a bit of torque swing to the left that had to be compensated for. The tail wheel was too sensitive and I will have to reduce its travel to help keep her straight when transitioning from ground to tail up.

Final Testing before Test Flying:

10 Minutes flat out with the cowl in place didn't cause a fire or any such dramas. The motor started the run at 6100 rpm and finished the run at 6000 rpm. I measured the head temperature at 94 degrees Centigrade.
Must have got a bit hot inside the radiator area under the wing where the exhaust and hot air exits as it had melted the glue on the back of the Velcro holding down the Smart Fly balancer but all else was in order. A bit of shielding will fix that.

The taxi runs were really difficult to hold straight and I was blaming an over sensitive tail wheel until I noticed that the wheel well covers that are attached to the main legs were hitting the ground when the oleos were fully compressed going over the bumps in the field. Out with the snips will soon fix that!!

Flying:
I had hoped to be able to share the first flight pictures and details in this instalment but due to having to replace the ignition system, re-wire the aircraft and modify the cooling within the cowl, time has beaten me.
Next instalment (ominously Instalment 13) will be only about flying and will cover pre-flight checks, test flight profile, more taxi testing, test flight and results, landing parameters, modifications to control surfaces from test flight data and I will try to describe how the Hurricane feels in the air.

I would like to have done all the above before we leave for the Warbirds over Wanaka in New Zealand but as Murphy is alive and well I might have to postpone until we return. We leave on the 31st March and return on the 20th April.

Cheers
Stan