50" DUCTED FAN HAWK

It was in 2015 when the first Hawk offering was made to the readership of the RCM&E and it proved to be a great success especially when we made the ducted fan installation a lot simpler and did away with the fan intake ducting which could always over complicated a scratch built ducted fan model.

In recent years ducted fan design has offered the inlet bell-mouth which effectively does away with the moulded intake and as a consequence has allow a simpler installation of the fan unit into the fuselage and only requires the fitting of the discharge tail pipe to the back end of fan unit.
As long as you make enough holes in the front of the fuselage to allow the fan to breathe, then you would have a ducted fan model that will work without the faffing about trying to make smooth intake ducts. Now there is a penalty for not have a smooth ducted intake instead of a bell-mouth entry but the losses are no more than 10% in power or thrust. If you then think of the potential weight saving that is made by not fitting the smooth intake ducts, often made out fibre glass, there may almost be negligible difference in terms of flight performance and duration….

One thing I did mention at the end of the 2015 article, was the next logical step would be to make the 42" Hawk slightly bigger and fit a nice 90mm fan instead of the 70mm fan. Now there were a couple of reasons for this but mainly the extra power available from a 90mm fan is nearly double that of the 70mm fan and all we needed to do was widen the fuselage by 20mm or so. The result was the model only increased in size by 18% but had twice as much power.
Now those of you who understand the effects of scaling up will appreciated that increasing the size by 18% will not correspond to an 18% increase in additional weight. There is a 'rule of thumb' guide:

Scale up a model by 25%- it doubles the weight
Scale up a model by 50%- it adds 4x the weight
Scale up a model by 100% (or double)- it adds 8x the weight

So at 18%, the weight of our 50" Hawk should around the 8lb mark……I'll let you know later if this was achieved.

Anyway, I digress so let's get back to this year's offering; the 50" ducted fan BAE Hawk.

When the redesign process started I very much wanted to follow the 42" scale version and this meant a scale model with flaps, retracts, Red Arrows detailing, and a quality fan unit operating on 8s batteries. One of the benefits of operating at the high cell count of 8s is to reduce the current consumption which in turn will give you a longer flight duration. Now 8s might sound off putting in terms of size that most modellers may not have kicking around, but most of you will have a number of 4s batteries and as long as the brand, the capacity (is above 4000mah) and the C rating (at least 40c) is the same, a pair of these can be used in series connection, to achieve 8s and fly the model without forking out for an expensive 8s battery.

The quality 90mm fan unit can be sourced for around the £100 mark. An 8s 120mp speed controller is however quite expensive and cost of a quality controller is again around the £100.

As with the smaller 42" version, retracts were sourced from HobbyKing and fitted to the models. The only slightly downside to having scale retracts, is the size of the wheels which are only around the 2" mark. Match this to a 8lb plus model and you'll good take-off surface to operate from. Needless to say if you fly from a tarmac runway or a well mown summer strip, then you should have no problem taking off. If your club field is not good or the grass is too long, then you will be disappointed….

To assist the builder, I have once again made available a VAC form set and CNC pack for those who wish to make the build a little easier. The CNC pack and VAC set will only be available through Tony Nijhuis Designs Ltd (TND) and not Myhobbystores. The plan itself will only be available in this edition of the magazine with future copies again only being available again through TND Ltd.

A few other points to note, the 8s-90mm 12 bladed fan units (1250KV-3700w) and controllers for the prototype were both sourced through HobbyKing but 4-MAX.co.uk are now stocking these fan units in the UK.
The thrust you are looking for is around the 4.5kg mark

Lastly and possibly the most important, a photographic build log is available as a free download to print out from www.tonynijhuisdesigns.co.uk. These photos will be invaluable and I would suggest downloading these so you can familiarise yourself with the build before you start.

Ok so let's crack on with the build.

Fuselage

Now to a seasoned builder, the fuselage is simplicity itself. Ill assume for sake of this article that you haven't bought the CNC pack and ill treat it as a true scratch build.

Begin by cutting out all the fuselage side pieces (10 off in total), the 8 doubler pieces and all the fuselage formers.

Now make up a pair of fuselage sides using FS1, 2 & 3. Now glue into position doublers FS4, 5, 6 & 7 to each fuselage side making sure you make up a left and right hand panel.

Trim and fit 12mm triangle to the inside bottom edge of each fuselage side and fit WS1.

Former F6 is the 'fan wall' so make sure that your choice of fan fits through F6 comfortably.

Now mark the positions of all the fuselage formers on the inside of both fuselage sides and fit former F2, 3 & 6 to one fuselage side and fit WP1.

Now add the other fuselage side and add the two top triangular pieces between F1 & 2.

To make the fan installation easier, cut the 12mm sq fan bearers to the correct length and drill the mounting holes.

Now fit the rear fan bearer support F7 and glue into position the bearers themselves.

Formers F1 & F9 can now be fitted along with battery support plate BF1

The nose retract plate RP1 is now fitted along with the steerable nose wheel servo and the retract unit. It's important to make sure you check the operation of both the retract and the steering mechanism before enclosing with sheeting as access thereafter is very limited.

Once happy, enclose the fuselage bottom between F1 and F3 using 6mm balsa.

Cut out & fit FS7 from 12mm balsa and then add 12mm triangle to the inside edge and flush with the top edge.

Now add the top rear sheeting to the fuselage using two laminates of 12mm sheet balsa.

Now pin into position F8 against the solid rear section and F6A.

Now mark the position of formers F4 & glue into position. Now pin F5 to F4 and fit the three 6mm sq longerons as shown on the plan.

The top can now be sheeted. Begin to 'roll' 3mm balsa sheet between F3 and F7 in two pieces and joining along the central longeron. You will need to wet the outer sheeting surface to aid bending. When glued and done, the pin can be removed from inside the fuselage.

The rear fuselage can now be shaped using a razor plane and sandpaper. Mark out the fin slot and cut this out. Make up the fin and test fit this into the slot. Put the fin aside and only glues into position once the model is nearing completion.

The top hatch can now be removed. Use a hacksaw blade to cut between F4 and F5 and F7 and cut along the fuselage/longeron edge.

Now make up the two halves of the tail plane and test fit these into the fuselage. Trim the entry points on the fuselage and use the template shown on the plan to get the correct tail plane angle. Put the tail plane aside for the moment and only glues into position once the model is nearing completion.

Fan Fitment

To fit the fan unit, the top cross bar on F6 can be removed so the fan could drop in from above.

Before fitting the fan, make up the thrust tube from an A3 sheet of 180 or 250 micron thick acetate/rigid PVC. You can get this sheeting from craft suppliers or from Ebay.

The fitment onto the fan unit needs to be as tight as possible with no slack.
You may have noticed that the tube is tapered slightly, reducing in diameter to 90% at F9. The thrust tube is rolled to shape and secured using clear 3M tape. You may have to re-tape a couple of times before you are happy with the fitment on to the fan and through the hole in F9. The 3M tape does allow for easy adjustment.

Make an elongated slot in the tube to allow the fan motor wiring to pass out the tube and make sure this exists at the top at about 1 o'clock (when in the model) so you can access the wire ends.

To fit the tube, you'll need to roll the tube in on itself and slide it up through F9 and then ease the tube end over the fan unit. The tube is a push fit on to the fan unit and I used UHU glue to secure the thrust tube to F9. Securing here means you don't have to secure onto the fan unit.

Back to the Fuselage

Now fit the rear under sheeting to enclose the fan tube. If you haven't secured the tube yet, you can refit the fan thrust tube even after the under sheeting is fitted.

Now add the top front sheeting to the fuselage using two laminates of 12mm sheet balsa.

If you have bought the VAC set, trim the nose cone and fit the ply support ring NR1 to the inside edge of the nose cone.

When happy, glue the nose cone centrally to F1. Using a razor plane, begin to shape the front fuselage section smoothly into the nose cone.

On the underside of the nose cone, cut a way a slot in the underside to allow the retracts leg to pass through.

The air intakes are again part of the VAC set and these require a backing plate (made from 3mm stock balsa) to allow rigid fitment against the fuselage sides. To assist, there is an indicative template of the backing plate shown on the plan, but this will need fettling to get a snug fitment.

Don't be tempted to fit the intake just yet; wait until the model is finished and covered and the intakes are painted.

To add a touch of scale detailing, you may want to cockpit seating and 1/8th scale jet pilots.

Wings

The wings are a traditional ‘built up’ construction and are made over the plan. The sequence detailed below should be followed closely to avoid construction difficulties.

Begin by taking the 12mm x 3mm obechi lower spar and pinning this over the plan. Now fit all of the wing ribs remembering to use the angle template against the front section of W1. Now add the wing spar B1.

The top obechi spar can now be glued into position along with the rear section of W1, remembering to again use the angle template.

Now fit the 6mm obechi stub spar to the front of B1 between W1 & W3.

Now fit the trailing edge (made from 6mm balsa) between W2 and W10. I suggest you use a straight edge along the top of the rear ribs in order to get the level straight and true before fitting the trailing edge.

From 12mm sheet balsa, make up the infill between W1 & W2 where the wing bolt fits through.

Now fit the inner leading edge made from 3mm balsa. The wing panel can now be removed from the building board.

Now add the lower 6mm sq obechi stub spar, the retract mounts UC1 & 2 and the rib doublers W3A and W4A.

At this point make up the aileron and flap servo mounts and run the servo extension ready for the final connections.

Add the shear webbing to both sides of the spars to make a strong ‘box’ section spar.

I would suggest you test fit the retracts and make any adjustments to W2 at this point.

Now make up the opposite wing panel to the same standard and join the wing taking note of the dihedral under each wing.

The wings can now be top sheeted using 1.5mm medium grade balsa. Make sure the wing panel is flat on the building board while sheeting each panel.

Before sheeting the underside, remove the jig tabs from the underside of each rib and sand smooth. When done, the wing sheeting can be done. Use the plan to determine the where the holes need to be cut to reveal the retracts and the servo mounts.

The outer leading edges can now be cut from 9mm sheet, fitted and shaped to smooth flowing curve.

Using laminates of 6mm and 12mm sheet balsa, make up the wing tip and glue these into position

Now make up each individual ailerons and flaps as shown on the plan. Start by cutting to shape the bottom skin. Now trim and fit the leading edges which are made from 6mm sheet balsa. Now fit the riblets and the control horn support block. Finally enclose with the top skin and trim to shape as shown on the plan.

The photo log on www.tonynijhuisdesigns.co.uk should assist here.

Finally drill and fit the wing dowel and drill the wing securing bolt holes

To add a little more strength to the wing joint, cut a 100mm strip of wing tape and apply this to the wing joint, securing with either PVA or epoxy resin.

The last and probably the most important items to fit on to the wing are the two wing fences. I suggest you fit these before covering and spend a little time get the fitment of these correct.
Wing fence are fitted to the full-size Hawk and they act as an anti-stall device and effective allow the flying speed to be reduced beyond what would have been the stall point, if the fences weren't fitted. This will certainly help on landings and down wind passes.

Finishing

Fit the tailplane and fin and the Canopy.

The prototype was covered using red Easycoat from J Perkins

The intakes were fitted only after covering and with the wings fitted

The lettering and roundels were supplied via pyramidmodels.com but the white stripes and fin flashes were made up from Solartrim.

Fit all the control surfaces with pin hinges and secured with glue and pins. Fit all the servos and the all the control horns.

The C of G position should be achieved without any ballast and adjusting the position of the batteries.

I mentioned earlier about the weight and the scaling factor, well the AUW came out to just over 9lbs so the rule of thumb did its job!

Flying

The first thing to re-check is the balance position….make sure this is exactly where it is shown on the plan (155mm from the leading edge at the wing root). If It is correct and with the model sitting on its wheels, you should only need a slight pressure applied to the tail end for the model to easily rock the model back on it main wheels…

The first thing to note is the wing loading is quite high for this model so it does benefit from a 5-10 knot head wind to get the model off the ground. I did mention earlier that a

smooth cut runway is a must for this model due to the small scale wheels and a head wind will greatly assist take-off.

Unlike the full-size aircraft, the model does not have an all moving tail plane and uses a conventional fixed tailplane and movable elevator. The result is you will need a slightly longer take-off run to build up the speed (50-75m) before the elevators give you the authority to rotate.

Once the Hawk is ready to rotate on the back wheel, she'll be a way. The small elevator has the benefit of stopping you from hauling the model off the ground too early…..

You will need to use full throttle and a fair amount of elevator to achieve rotation, but once away the elevator authority is strong and positive and you can reduce the up elevator input to match your preferred climb out rate.

Once the initial climb out has been executed, you can easily pull back to half/ two thirds throttle and enjoy what is a beautifully balanced model.

Once trimmed and assuming you have dialled in the recommended movements, you'll find the model simply groves and flies on rails. All the classic Hawk manoeuvres can be done with this model, but just remember to keep the routine smooth and keep the momentum up. The recommended expo settings give the Hawk a little more response at slower flying speeds and moreover assist with flaring the model on landing.

Landings are straightforward and can be quite quick unless you deploy flaps or there is a strong head wind. Either way, make sure you approach is a smooth and with power on, any mistakes, the retracts will not easily forgive a heavy landing.

The flaps deployment will not pitch the aircraft….in fact when I deployed them for the first time, I was convinced they weren't working as I was expecting a pitch down effect but nothing. With flaps deployed, the Hawk will feel a little more 'floaty' and will happily cruise around like a trainer!

Don't be tempted to adjust the C of G rearwards for any reason as the model will bite!

The 12 bladed HobbyKing fan unit I have to say was very impressive. The power was excellent and the sound was almost turbine like…brilliant!

So all in all this really is a cracking model…its smooth and precise and everything you want from a jet.

Flight duration is dependent on throttle control so set the timer at 3 to 4min to start with and take it from there….

So the question is, do I prefer the 50" over the 42"….well I have to yes…. Going larger general means a more stable model and one that can withstand those all too familiar windy conditions down the club field without batting an eyelid…..I have to say this model is fast becoming my absolute favourite.

Specification

Wing span- 50” (1282mm)
Length- 51” (1307mm)
Wing loading- 43oz/sq’(12.9kg/m^2)
Weight- 9lbs to 10lbs (4 to 4.5kg)
Wing area- 0.315 m^2