35" GR7 HARRIER

For those of you who have seen my exploits over the last few years, trying to get a model Harrier to successfully VTOL, you may be a little disappointed that this offering doesn't have the VTOL features. However, I would stress that you really won't be disappointed building and flying this little beauty, it is an absolute peach of a model, and performs faultlessly.

So putting aside the complexities of my early VTOL Harrier exploits, it was time to concentrate on a much more simplified and conventional hand launch version. Now I thought to myself, how hard can this be. Well it did prove a little more difficult than I had imagined and unfortunately, I had a few disasters along the way, but you'll be glad to hear, I did eventually achieve success.

The VTOL Harrier took 13 attempts to get the model to hover and fly successfully and the final lucky 13, I still own and demonstrate today.

The all-important flying characteristics of that 13 VTOL harrier, have been used to develop this latest offering, but as I'm about to share, it still wasn't all plain sailing. In fact it took a further 4 prototypes of this version to get the model to be stable enough, when attempting to hand launch. I have to say there is a true sense of British madness that if you keep failing, keep going as every crash is a defined learning experience….well that's what I kept telling myself….It was more pig headedness and not wanting to be beaten.

So why was the Harrier such a difficult model to master. Well strangely enough it was when I met a retired Harrier pilot, that the penny finally dropped. The full-size Harrier very simply could not take off conventionally….It was inherently unstable until it achieved flying speed. If you watch a Harrier seemingly doing a conventional runway take-off…it's not….The nozzle's are rotated downward slightly and it simply 'hovers' into the air! Very clever but if you didn't know this, building and expecting a non-VTOL model of a Harrier to ROG, will end in disaster, as I had found out to my cost.

My early tests, using a fixed undercarriage and racing down the runway, ended up with the model flicking on to its back, almost instantaneously without any chance of correction. Thinking about it now, a Bungee launch may have been the answer but hey, I had spent time building a lovely scale undercarriage, and wasn't going to waste it.

So moving on to this latest design. Because the design of this model adopts 80% of the features used in my successful VTOL version, I knew the model would fly ok, but I was mindful of the take-off issues, especially for hand launch, which is still my preferred way of getting an undercarriage-less model away cleanly and easily.

For the first prototype, I decided to use a pair of 50mm 4S EDF units, but the design complexity, of installing the thrust tubes out the side of the fuselage, soon rendered it obsolete. It did however prove an invaluable test bed for mastering the hand launch though!. This early prototype would see the model on hand launch, swing either to the left or to the right. Trying to correct it proved difficult with little or no aileron response available. This proved fatal on two occasions, but it did confirm my original fears of the tendency to flick or in this case, 'dig into' an uncontrolled tight turn.
This issue was finally overcome by reducing the anhedral, adding wing straights to the

leading edge of the wing and adding some fences (anti stall devises) to the wing tips. I was starting to understand why no one else was silly enough to think about designing a conventional flying harrier!...but hey, I just carried on and took some more 'stupid pills'.

When the fourth and final prototype was built incorporating these changes and the installation of a single 70mm 4S EDF unit, it was a changed model and I have to say a joy to fly.

Now I did say 4 prototypes were tried, and those of you who have followed my previous 70mm EDF designs, will have noticed that this model has a built up wing. Prototype Number 3 did in fact have a sheet wing design. It proved to be both a handful to launch and had very odd flying characteristics….so this prototype was consigned to the harrier balsa scrap heap, which I can confirm, kept the wood burner going all winter!

One of the key elements I really wanted to achieve on this model, was to keep the wing loading down to less than 23oz/sq' and less than 3lbs AUW.

The new Harrier has been tested using the 4S PowerFun 70mm fan unit which gives around 1.4kg of thrust and available from www.4-max.co.uk. These units will give another 200g or so of thrust over other 4S fan versions and are considerably cheaper too. I would only recommend this fan unit, principally because they have excellent static thrust and will accelerate the Harrier to flying speed with no 'sink' on launch.

So after the Harrier, and just to whet your appetite, a swing wing Tornado has now been tested and almost ready to go…now that really is two models in one!

To assist the builder, I have once again made available a VAC set and CNC/wood pack, for those who wish to make the building process a little easier and quicker. These parts will ONLY be available through Tony Nijhuis Designs Ltd (TND) and not via Mortons. The plan itself will only be available in this edition of the magazine with future copies only being available again through TND Ltd.

The battery used in the prototype was a 4s-3300mah 60c Lipo. The servos were metal geared 6g, 1kg/cm torque for the ailerons and 8g 1.2kg/cm servos for each elevator. For the ESC, a 60amp 4S controller was used. Make sure you set the timing to "High", which will suit the EDF unit and the low voltage cut off to "Disabled".

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.

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 5mm x 3mm obechi lower forward spar and pinning this over the plan. Now fit all of the wing ribs remembering to use the angle template against the outside face of W1.

The top obechi front and rear spars can now be glued into position. Note that the rear spar fits between W1 and W6.

Now fit the inner leading edge (made from 3mm sheet balsa). Next make up the trailing edge, using 5mm sheet balsa that fits between W6 and W10.

Using 1.6mm sheet balsa, begin to sheet the wing panel from the leading edge, back.

Roughly trim the sheeting against W1, W10 and the leading/trailing edges. Mark on the sheeting, the line of trailing edge between W1 and W6.

Remove the wing from the plan and glue the bottom rear 5mm x 3mm obechi spar into position. Using a straight edge, cut the sheet trailing edge to the line marked earlier.

Now make up the opposite wing panel to the same standard.

Before sheeting the underside, remove the jig tabs from the underside of each rib and sand smooth. Make up the servo support mounts and fit the servo wiring. When done, the wing sheeting can be applied in the same sequence as the top sheeting.

Trim the sheeting flush to the finished wing perimeter and join the wings. Do this upside down to take account of the wing anhedral. If you have used the anhedral template against W1, you will have the correct anhedral and will not need to check the distance, under each wing tip.

Using 12.5mm sheet balsa, and as shown on the plan, make up the anti-stall wing tips and glue these into position.

Now make up each individual aileron as shown on the plan. Start by cutting to shape the bottom skin. Now trim and fit the leading edges which are made from 5mm sheet balsa. Now fit the riblets and the control horn support block. Trim the leading edge flush with the angle of the riblets. Finally enclose with the top skin and trim to shape as shown on the plan.

Using 20mm wide strips of 1.6mm and 5mm from balsa sheet, make up a 6.6mm thick outer leading edge and glue this onto the inner leading edge. This can now be profiled, using a razor plane and sanding block, to a smooth flowing curve, and as shown on the plan.

To add a little more strength to the wing joint, cut a 25mm wide strip of wing tape and apply this to the wing joint, securing with either PVA or epoxy resin.

Rear Fuselage

On the assumption you have bought the CNC pack, number all the parts to avoid any confusion later.

Begin by marking the vertical positions of the formers onto the fuselage sides. Glue into position the wing seat, WS1 and the lower 12.5mm triangle piece between F6 and the rear, making a left and right hand side.

Add a small length of 12.5mm triangle to the top inside edge of the fuselage between F11 and the tail.

Using a SLEC building jig, begin assembling the fuselage, adding F7 and F8, checking the squareness as you proceed.

Dry fit formers F10 and F11 and chamfer the top rear triangle, to allow the fuselage sides to pull in and join at the rear. When happy, glue the two formers in position and the rear vertical fuselage edges.

Remove the fuselage from the jig and add the fan mounting plates, FP1. Position the fan unit and mount this to the plates with two retaining screws.

Install the ESC and check the fan functions and rotates in the correct direction. Now make up the under-sheeting from two pieces of 75mm wide sheet balsa and butt glue these together. On the plan, you will notice a template for this. You can either make this in one piece or two separate pieces, with the join line along F8. If you decide to make this in two pieces, glue the rear sheeting into position and in-line with the front edge of F8.

Now fit former F9 and add the forward under-sheeting, up to F7.

Using 2.4mm soft balsa sheet, make up the rolled bottom fuselage sides. You may need to wet the wood surface to assist bending around the corner of F9.

Now make up the thrust tube, using the template shown on the plan. This is made from an A3 sheet of 140-micron thick acetate and is normally available from a Stationary supplier or ebay.

Add F12 into position and the rear under sheeting from 3.2mm sheet balsa. Again there is a template on the plan to assist you in making this.

Begin shaping the bottom sheeting and trim the thrust tube outlet to the side profile of the fuselage.

Add former F13 and the 6mm Sq stringer, spanning between F12 and F13.

Using 2.4mm soft balsa sheet, make up the rolled top fuselage sheeting and glue in two halves with the join along the top of the Sq stringer.

At this point, it may be worth adding the elevator servo extension leads and taping these to the servo outlet holes.

Now add the top rear fuselage sheeting, made from 5mm balsa. Finally shape the remainder on the rear fuselage using a razor plane and sanding block.

Front Intake Cheeks

Glue into position F6 using the openings in this former to line it up against F7. Now glue into position, SP1, SP2 and SP3. Now glue F5 into position and add the short 6mm Sq stringers, between F5 and F6.

Using scrap 3mm Lite Ply, make up the battery tray and secure this using scrap 12.5mm triangle, against F5 and F6.

Using 1.6mm soft balsa, sheet across the F5-F6 opening, using the stringers to join the sheet sections.

Trim away any 1.6mm sheet overhang, flush against F5 and F6 and finally make up the small fairings that fit behind F6.

Front Fuselage

Make up the front fuselage sides and line the bottom edges with 9.5mm triangular balsa. Saw cuts will have to be made (as shown on the plan) to aid bending of the fuselage sides.

Using the SLEC building jig again, begin assembling the fuselage, adding F2 and F3 first, checking squareness as you proceed. Then add F1 and F4.

Now slide in the top 9.5mm triangle in the position shown on the plan.

Remove the fuselage from the jig and finish gluing the top parts of F3 and F4 to the fuselage sides.

Trim the top 9.5mm triangle flush with the fuselage sides around the cockpit area and add the top front decking using 12.5mm soft balsa.

Add the bottom decking using 5mm sheet balsa and make up the nose block using a sandwich of 12.5mm sheet balsa, and fix this to F1.

Add the rear top decking using 3.2mm sheet and with a razor plane and sanding block, profile the whole front fuselage to the finished shape.

Now attach the front and rear fuselage sections together using the hole in former F4 and F5 to act as an alignment.

Finally, using a sanding block, blend in the front to the rear fuselages.

Fin & Tailplane

Make up the fin parts as shown on the plan. Glue them together and profile the fin leading and rudder trailing edges. Put the fin aside and only glue into position once the model is nearing completion.

Now make up the tailplane and elevator parts. Round off the tailplane leading edge and chamfer the elevator leading edge ready for the hinges to be fitted. Note that the

tailplane has 10 degrees of anhedral, so lightly sand the fuselage tailplane slot, with a flat file, at the approximate angle. Using the anhedral template shown on the plan, position and glue the tailplane halves, to the fuselage, at the correct angle.

Finishing off

The wings can now be glued into position. A little fettling maybe needed to get them to fit properly on to the wing seat and between F6 and F13. Note that F8 extends into the wing under sheeting so a 6mm strip of sheeting, between W2 on each wing, will have to be removed to let the wing sit correctly.

Fit former F14 against F13. This will act as a guide rail for the top wing fairing.

Using 2.4mm soft balsa, make up the rear wing fairing. Note there is a template shown on the plans. The fairing will need a little fettling and wetting of the surface to aid bending.

The fin slot can now be cut into the rear fuselage top deck and the fin installed.

The battery access hatch and underside fan vent opening is shown on the plan and can now be marked and cut out. The material removed can then be cut down to make a smaller square hatch which is hinged at the front using solar film. The hatch does not require a latch as it stays nicely closed when the fan is in operation.

Make sure you chamfer and smooth the trailing edge of the hatch to allow smooth air entry to the fan.

Two dummy rocket launch pods are made from scrap 12.5mm balsa and glued either side of the battery hatch. This allows for a good grip when hand launching.

The VAC formed intake vents need to be trimmed and F15 fitted to strengthen the opening edge. These can now be glued into position and the 1.6mm sheeting blended into the plastic edge, using a sanding block.

Covering

The prototype was covered using light grey Oracover from J Perkins. The vac formed intakes were painted in the corresponding and matching Orapaint. Allow the Oracover to cover the VAC formed joint by 3mm, to allow a smooth contrast between the film and painted surface. A good alternative covering is available from www.4-Max.co.uk

A decal set, exhaust vents and a pilot are available from www.tonynijhuisdesign.co.uk.

Fit all the control surfaces with cyano hinges and secured with glue. Fit
all the servos and all the control horns. For the control horns, I made these out of 2mm birch ply and slotted these into the control surfaces.

The C of G position should be achieved with just the positioning of a 4S-3300mah LiPo and a small amount of nose weight. Do not be tempted to move the C of G back from the stated position or this model will bite!

The battery is secured using self-adhesive Velcro and a securing strap.

The canopy can either be fitted before or after covering. I prefer to detail the cockpit, fit the canopy and then cover the model around the canopy, but it's up to you.

Flying

The first thing to note with the Harrier is the wing loading is quite low; only 22oz/sq' so hand launching it is very easy.

For years I have launched my own models but have always previously used the overhead 'glider' type launch. This is all very well but the speed of launch is limited. It always resulted in the model sinking and then a sudden rush to get your finger back on to the elevator stick.

As I mentioned in the introduction and the early issues with the Harrier's launch speed, I decided to try the javelin launch technique ….What a revelation…as a result you get a more powerful throw and the projection of the model upwards too, giving you time to get those fingers back onto the controls; Why has it only taken me 40 years to work this one out. lol.

So using this technique, the Harrier will climb away with gusto and once trimmed, you can almost let it climb away without any control input…it is that steady in the air!

However, I suggest for its maiden flight you get a trusted helper to launch the model for you. The model is remarkably strong and if it doesn't get it away first time, she'll survive.

Once the hand launch is mastered and the Harrier trimmed for flight, the model will get away with little fuss and very little control input. Even on calmer days, the Harrier will always get away cleanly.

When you get the Harrier airborne you will notice how nippy the model is. Once the initial climb out has been executed, you can easily pull back the throttle to around half stick position and enjoy what is a very scale flying performance.

You'll find the model simply grooves and flies on rails especially on a calm day. However, if you fly on a windy day, the model will be thrown around a little so be prepared to fly with more throttle. Don't be tempted to 'bank and yank' this model, the swept anhedral wings can have a habit of airbraking and dropping the nose!, so be warned.

All the classic jet manoeuvres can be done with this model, but you will need full throttle and speed on some, as the model doesn't have the momentum to carry through manoeuvre such as big loops etc. Just remember to keep the routine smooth and keep what little momentum it has, going.

Landings are very straightforward and generally you will run out of elevator control before the model will stall.

Don't be tempted to adjust the C of G. This model has been thoroughly tested and where it is shown on the plan is exactly where it needs to be!

The 4S 11 bladed PowerFun EDF unit does give an amazing punch and flight times are surprisingly good. So expect a good 5 minutes depending on throttle use.

I have to say the Harrier was a challenge to design and get right, but what a lovely flying model this has turned out to be and has far outweighed my expectation. Dare I say it, it is one of the best models in my collection. It's small enough to sit in the back of the car, ready to go, but it looks, feels, sounds and flies like a turbine model, So, all in all this 70mm EDF Harrier is a cracking little model and flies incredibly well. I think this really will be a popular model as it is such an iconic aircraft; You really will enjoy flying this one!

Specification:

GR7 Harrier
Wing span- 35" (889mm)
Length- 42.5" (1080mm)
Wing loading- 22.oz/sq'(6.4kg/m2)
Target Weight- 46oz /2.9lbs / 1.3kg

Addition Plans, Vac set, combined CNC / Wood pack, pilots and decal sets, are available from :

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