Jet Dog Fight Duo

MiG-25 'Foxbat' & English Electric Lightning

This is the fifth in the 'dogfight double' series I have produced and one that pretty well brings me back to where I stated with RCM&E back in 2001. During that year I had great fun playing with a small little pusher jet design, which was loosely based on the F-16. In 2002 it became one of my first published plans for RCM&E. The model relied on the ubiquitous Speed-400 brushed motors and push-on Günther prop combination and a 9.6v 800 AR Ni-Cd pack. This combination really did open up the flood gates to cheap and more importantly, workable electric models. I have to say I did exploit it and boy what fun was there to be had. So it seamed quite fitting to resurrect those early design concepts and bring them kicking & screaming into the fold of brushless motors and lithium polymer batteries.

Now the term Dogfight Double is some what misleading in the case of my two new design subject. One would expect the Spitfire and ME-109 or last years offering of the Corsair and Zero would imply as they fought against each other in the various conflicts. To date however, the MiG-25 and Lightning never meet in battle. The MiG-25 being a child of the late 1970s and the Lightning being the 60's muscle man, meant they were never destined to meet each other. So why the subject choice? Well I think we all know the Lightning was years if not decades ahead of its time, capable of an incredible climb rate of 50,000 feet per minute, a speed well in excess of mach 2 and a ceiling of 87,000 feet. It would on paper, out perform the MiG-25 hands down. The Mig-25 had a greater top speed of mach 2.8, its ceiling was however 20,000 feet short of the Lightning and would taken eight time longer to get there. It's a bit like comparing a Porsche with a Lada….bit of a 'no contest' really…or is it?

So having deliberated over this conundrum, what better way to get some sort of answer, than to build a model of each aircraft and 'go compare' …….

Ok so now the subjects have been chosen, what's the best way to power them? Well, with the advent of affordable and high performance blushless motors and Li-Poly batteries, the old question of 'will the motor be powerful enough?' just doesn't exist any more. The problem now is not to overpower the model! So with power availability not being an issue, my first thoughts turned to an (EDF) electric ducted fan setup which I have to say would have suited these model brilliantly. "So why has he made them prop drive then?" I hear you ask. Well the initial design and first prototype of the MiG-25 was EDF powered with a package supplied by BRC Hobbies up in Newcastle upon Tyne. The package included the 68mm fan unit with an outrunner brushless motor, a 25 Amp ESC and 2,200mAh 20C lithium polymer battery. This setup is apparently recommended for the RCM&E EZE-fan and some initial test on my EDF thrust rig suggested 12oz of static thrust (in open air) which seemed very respectable and certainly capable of flying a 16-20oz model

So prototype number one was duly made. The fan unit nestled in the fuselage, just behind the C of G position and a smooth discharge tube slightly tapered towards the rear. The air intake arrangement simply allowed air to enter the main body through the front air intakes. To keep the weight to an absolute minimum and give me the best chance of success, I used a smaller 1000mAh FlightPower EVO pack. The AUW came out at a very respectable 16oz. Believe it or not this was my first ever ducted fan model, so I was

itching to give it a go. A claim day was duly arranged at my local Westfield Testfield and the model was hand launched straight & level into the lightest of breeze. What happened next was somewhat of a disappointment. A powered glide ensued which then, on the feeding of up elevator culminated in a sudden sharp flick-roll into the ground. Amazingly there was no damage, so the model was duly launched again, but this time with more of a 'javelin' like throw. This time a little more duration but again a little too much elevator to check the decent and she flick rolled into the ground. The front end broke cleanly away so it was time to call it a day.

Reflecting upon my earlier disappointment and the broken pieces, it soon became clear that no mater what the tweak or modification to the airframe, it simply wasn't going to work with the set-up installed. Now this might seem like giving up but if you going to design a model for 'public consumption' then its got to work in most if not all circumstances. It should hand launch easily, it should fly if its heavier than the plan suggests and it should be able to the odd knock or two etc. Call me fussy but a reputation is at stake here. There's no doubt the fan unit wasn't at fault, the uncomplicated design of the air intake just strangled the fan into submission!
I could improve the intake ducts to squeeze a few more ounces of thrust out of the fan, but this is a simple model designed to be built simply and quickly and this concept was now under threat. Installing a larger and more powerful fan and motor would be the only option to make this model work, but suddenly we are talking about hundreds of pound rather than a few quid. Minimum cost and maximum fun is what these two models are all about.

So the only sensible option was to revert back to those early days of my old F-16 and go the conventional pusher route which will definitely work. Now if any of you die hard EDF boys out there want to pick up where I left off, then be my guest. There is space to fit a 68mm fan unit in the MiG, so let me know how you get on.

When comparing these new models to my old F-16 there is really very little difference. The MiG and Lightning are slightly larger but the wings and tailplane I like to make 15-20% larger and in the case of the Lightning, the sweep has been reduced slightly to avoid the chance of 'Dutch roll' (rocking of the wings in certain manoeuvres).
You will notice that both the new models are powered by brushless 'in-runner' motors and Li-Poly batteries. The key benefits these bring, is the awesome efficiency and power to weight these now provide and the longer flight times we can now expect. One key factor that always seems to lead to confusion is the motor, battery and prop set-up. Something your local model shop may struggle to provide, unless they are an electric flight specialist. The understanding gained in electric flight circles is now filtering out to the masses but I think a point of help should always be on the 'plan' itself. You will notice on the plan there is a power train set-up specified. This set-up was suggested by a new supplier of the electric goodies, called 4-Max, which distribute their own brand of equipment under the banner of Purple Power. The man behind 4-Max is a guy called George Worley. George is very knowledgeable with all aspects of electric flight. The set-up suggested by George, was absolutely spot on! A 230 Watt motor gives ample power for a model designed to come out at just over a pound in weight. So even if you build heavy there is every chance you won't be disappointed with the performances of either model.

The construction of both models is simplicity itself. The slab sided box type fuselage does require a bit shaping but there's no rolling or fighting the wood grain with these two. The wings use my tried and tested sheet balsa method which requires the builder to razor

plane and sand a 6mm (1/4”) thick wing outline to shape. I first used this method some 20-years ago and I still think it’s a superb way of making a simple & quick wing.

Ok, so that’s enough background, it’s on with the build. As both models share similarities in construction I shall generalise the build sequence but expand in detail on each model where necessary.

WINGS

Cut out the wing parts from 6mm (¼”) medium density balsa sheet to form a pair of wings and the 4mm birch ply wing spar for the Lightning. Weigh the individual parts and interchange them in order to achieve an equal balance wing. Now glue the wing parts together. Where indicated on the plan, highlight using a pen, the location of the area of balsa to be profiled. An indicative guide to shaping the wing is shown on the plan. With the wing panels flat on the building board use a razor plane to profile the wing panels to the first stage of completion as shown on the plan. Now either continue with a plane or with a sanding block begin the second stage of profiling. Use one of the fuselage sides on the Lightning to achieve the correct profile at the wing root. When happy, use a medium to fine grade abrasive paper to finish both wings panels to a smooth flowing profile. Now cut out the ailerons. Next channel out a slot (using the threaded end of a push rod as a file) in the underside of the wing for the MiG for the aileron torque rods to fit 'flush' into.

Bend the torque rods to shape. Prior to fitting, coat the bearing surface of the rod with thin oil or grease. Fit the rod into the channel with the control arm passing through the wing. To secure the aileron in place Cyano a thin strip of 0.8mm ply or plastic over the top of the channel. When the glue is dry, the torque rod can be worked free to produce a perfect bearing surface. Make the necessary holes and slots in each aileron and locate them into position and check for free movement.

For the Lightning, the aileron control is done via control cables buried in the underside of the wings. To make the slot for the control cable to fit in to, again use a threaded end pushrod to file out a slot. The type of control cable I used on the prototype was the Sullivan gold type which is approximately 2mm in diameter. Try and keep the bends between the control horn and the servo as smooth as possible.

To finish use fine abrasive paper to round off the leading edge and the wing tips.

FUSELAGE

Make up a pair of fuselage sides from the plan. To make life a little easier, a full size outline is shown of the front and rear sides on the Mig-25 plan. You will also notice on the plan an indicative ‘pictorial’ parts list to help you identify the shape of the parts and numbers required to be cut out.

Now cut out all the remaining parts that are shown in the pictorial parts list. Mark the positions of the formers on both fuselage sides. Now line the edges with 9mm triangular balsa as indicated on the plan. Where the curve is tight, make some saw cuts in the triangle to aid the bending. On fuselage former 10 (MiG) & 11 (Lightning), glue it in to

position with the 6mm ply doubler that gives additional support to the motor mounting dowels and drill the two hole ready for the motor mounts dowels to be installed.

For the MiG, glue all the formers into position on one fuselage side only. Using a set square to check the formers are square. In the case of the MiG, make up the forward and rear fuselages as separate sections. For the Lightning, only fit formers 8, 9 & 10 for now. Now fit the opposing fuselage side and again check alignment. Gently pull the fuselage sides of the Lightning together at the front and at the rear. Secure formers 7 & 11, checking alignment as you proceed.

Now join the front and rear sections of the MiG fuselage together.

The top and bottom sheeting can now be applied, noting that 'cross grain' balsa is used predominately here. Once this is complete, begin to shape the fuselage to a 'round' smooth flowing radius, as shown on the plans and photographs. Use a razor plane to carry out the rough shaping to begin with. Cut deeply into the 9mm triangle to achieve the radius. Don't be tempted to just square off the edges. The razor planning is crucial to give the models, especially the Lightning that lovely rounded fuselage shape.

Ok so now you have shaped the fuselage, you're almost there. For the MiG, fit the servo rails in the fuselage, and use pieces of 6mm sq balsa to add extra security if you wish.

At the rear of the MiG fuselage, position and drill two holes in the fuselage sides to accept the tailplane torque rod outer tube, which is made from 3mm plastic tube.

Still with the MiG, fit former 11 into position on the front top decking. From block balsa or laminated pieces of 12mm sheet balsa, cut the noise block to shape. Glue this to the front of the model and then 'blend' it into the fuselage using a razor plane and then sandpaper.

Now cut out the battery access hatch in the Lightning and the radio access hatches in the underside rear of the fuselage for both MiG and Lightning.

Now position the wings in/on to the fuselage and when happy use thin Cyano to secure I would suggest running a bead of PVA glue along the wing/fuselage joint to strengthen the joint. For the Lightning, glue into the slots made earlier, the aileron control cable

Now make up the 'razor back' from a 'sandwich' of sheet balsa for both models. Shape and trim this before fitting.

TAILPLANE AND FIN

For the MiG, you will need to cut out four tailplane pieces. The reason behind this is you will need to 'sandwich' two pieces together with the torque rod in-between. Make up the torque rod but only bend it at one end. Place it through the outer tube and slide both rod and outer tube through the fuselage. Centralise the outer tube leaving approximately 3mm overhanging the fuselage on both sides. Now carefully bend to a right-angle the other end of the torque rod. Centrally locate the torque rod and mark the 'bend' position on to one of the four tailplane pieces. Carefully channel out where the torque rod sits using a small round file or a threaded pushrod end. When this is done offer the 'channelled' tailplane to

the torque rod, locate a second tailplane piece over, and sandwich the torque rod together. By squeezing the pieces between finger and thumb, you should be able to compress the two together ready for gluing. Now glue them together using medium Cyano. When done, do the same to the other side but leave a small tolerance between the tailplane and the tube for free movement.

For the MiG fins, these are made from 3mm sheet balsa with a 9mm triangular strengthen glued along the bottom edge. This is then just butt glued on to the fuselage; however you may wish to leave these off for the moment until these and the rest of the model is covered.

The Lightning tailplane is a little more simpler to make. Simply cut the tailplane pieces out of sheet balsa, glue them together and glue them into the tailplane slot cut in the side of the fuselage. Remember to bend and fit the elevator torque rod BEFORE fitting the tailplane.

The lightning fin is recessed into the top of the fuselage so a slot will need to be cut. The fin should now be glued into position and aligned against the razor back. Add two pieces of balsa, one to each side of the fin at the base so the razor back 'feathers' smoothly into the fin.

FITTING OUT & COVERING

Fitting the motor and radio control can be done quite easily after the model is completed. The motor, being and 'inrunner' type is simply tie-wrapped to two 6mm diameter dowels which are fitted and glued into rear most former.

Before covering I personally like to fit the canopy and do any cockpit detailing.
It's worth fitting a pilot and J Perkins do a small NATO jet pilot, which is just the right era and is pretty well the right scale too.

On both the prototypes, the canopies were made removable to allow for the battery packs to be located in the nose. Consequently there should be no need to add any ballast weight to achieve the balance point. In both cases the canopy needs to be trimmed and in the case of the Lightning, glued to the hatch. Note on the plan how the hatch is retained.

Both prototypes were covered in silver Easycoat (Solarfilm). Once covered, the fins can be fitted to the MiG making sure there is good wood to wood glue contact. Fit all the control surfaces with mylar hinge and secured with glue and pins. Fit the servos and elevator control horn and make the elevator and aileron control rods. You will note that the Lightning has all the servos mounted externally. Servo holes will need to be carefully cut into the fuselage and securing plates fitted to help retain the servo screws. Once all servos are connected, it's time to fit the motor, speed controller and receiver and check the control movement to the deflections suggested on the plan.

Fortunately both the full-size aircraft used silver as their base colour so all you really need to do is apply some colour trim and decals. The decals always make a model and a good friend, Stuart Gilbert who's a bit of a wiz kid when it comes to MS PowerPoint, has designed a set of decals which I then printed out on to self adhesive white paper. If any

one wishes to do the same, the decals are available as a free download from my web site www.TonyNijhuiDesigns.co.uk.

The last item to fit (part of the vac form canopy pack), is the dummy nose cone to the Lightning. Simply trim this to the perimeter edge of the former No.7, glue into position and then paint accordingly. I used a Humbrol enamel, slate green for the cone part and matt black for round the perimeter part.

FLYING TIPS

Now it would be easy for me to say that both models have similar performances but that just isn't the case….they're like chalk and Cheese…..and strangely enough I'm now in a position the answer the question we started with "If they meet in the theatre of war which would come out on top". Well after test flying them both one straight after the other I can conclusively say, in my opinion that the Lightning is the out and out winner.

Now designing and building these models in January should have meant a long wait before I could test fly in sensible conditions. But I don't do sensible when it come to test flying and the only thing that stops me test flying is the dark. So unperturbed by gale force wind conditions and in-between rain showers I hot footed it to the Hastings Club field. With aid of a trusted helper the lightning was first to be launched in to the teeth of 30 knot gale. Well I can only describe the next two minutes as a 'blur'. The model immediately rolled onto it back but continued to climb! So I flicked the model back the right way and the climb continued. At this point I soon realised the aileron movement was just too savage for the conditions, even on low-rates. So I throttled back, slowed every thing down and got her trimmed out…well of sorts anyway! Enough was enough and a landing was called and model was 'hovered' to a dam near perfect landing.

Next up was MiG. This time no dramas with the launch, she just climbed away with all the controls movements being pretty well spot on…well from what I could tell! Again no more than a couple of minutes proved this and the Lightning can put up with most things the weather can throw at them, although I would not recommend trying to fly in these conditions…… its not much fun.

So having been severely tried in these extreme conditions and thankfully survived, it was time to call it a day and wait for better conditions.

The next outing was far more pleasant, light winds and the Lightning was first to go again. This time the aileron rates had been reduced to a fraction of the initial setting and the C of G moved forward a little. The hand launch was uneventful and within seconds the model was climbing at pace. So much so the throttle was reduced to slow the rate of climb. Even though the aileron rates were reduced to a sensible level, the model was still very lively. Its rate of travel is quite frightening if you are not use to small fast models and if you're not careful, it will be out of sight before you know it. The model will do most aileron/elevator manoeuvres but this is a jet so keep them big and smooth.

When the MiG was tried in these calmer conditions it required a little more coxing into the air, something wasn't quite right and all the 'fingers' were pointing towards a rearwards C of G position. So the batteries were repositioned which moved the position forward by

15mm and bingo… problem solved. Feeling a little more confident I decided to hand launch this one myself and without any input from me, she shot away like a love sick angel. The MiG is definitely more forgiving and docile and I have to say (from my point of view) that it was far more relaxing to fly. Loops and roll generally require a little more coaxing and the turn of speed and manoeuvrability just wasn't a patch on the Lightning .

Both models can safely be slowed to almost a 'three point' landing .... well it would be if an undercarriage was fitted.

You can expect around 7-minute flight times from a 2200mah 20C LiPo's which I think is plenty long enough especially when flying the Lightning!

So given the choice, which one would I pick? Well if I want excitement the Lightning wins hands down but it should come with a health warning, especial prior to trimming out! So you need to be prepared!
The MiG is far less stressful and edges toward the pilot who wants and needs a little more time to think.

Data File for both models

Weight	16oz-25oz (0.45kg-0.71g)
Wing Span	MiG-25 - 24" (610mm)
	Lightning - 23.5" (597m)
Length	MiG-25 - 32.5" (825mm)
	Lightning - 29.5" (749mm)
Wing Loading	20oz/sq inch (5.2kg/sqm)
Radio	3-function micro
Motor	Brushless inrunner motor PPI-2837-2700
Prop Adapter	PP-PDRV32-50
Battery	3 Cell, 20C, 2200mAh Lithium Polymer PPL-20C3S-2200
ESC	33A PP-DESC33AU
Prop	APCE 4.7"x4.25"