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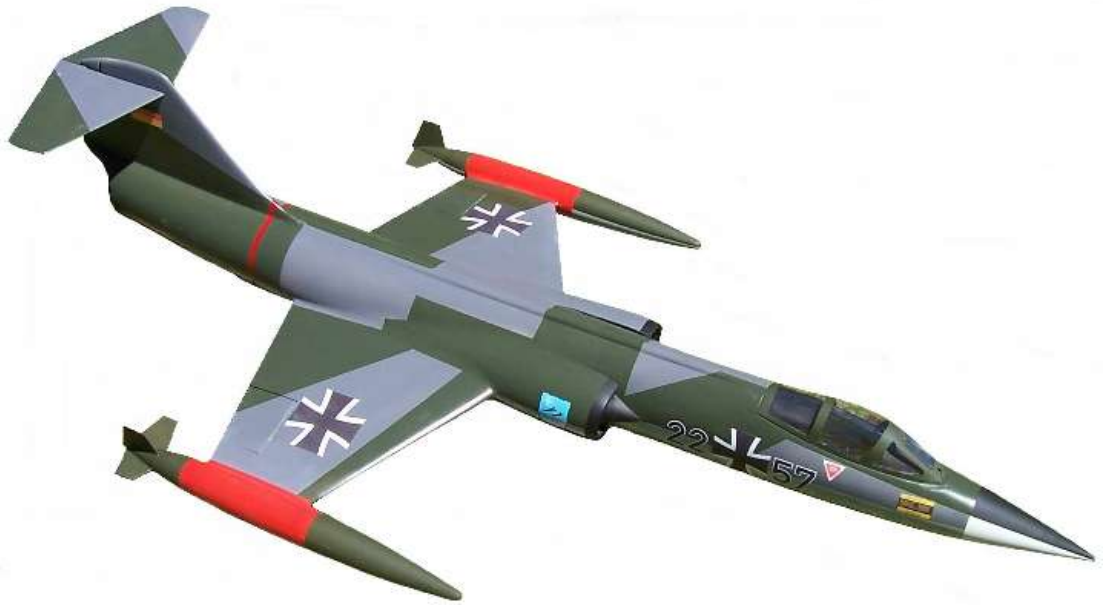


EDF F104
Instruction Manual

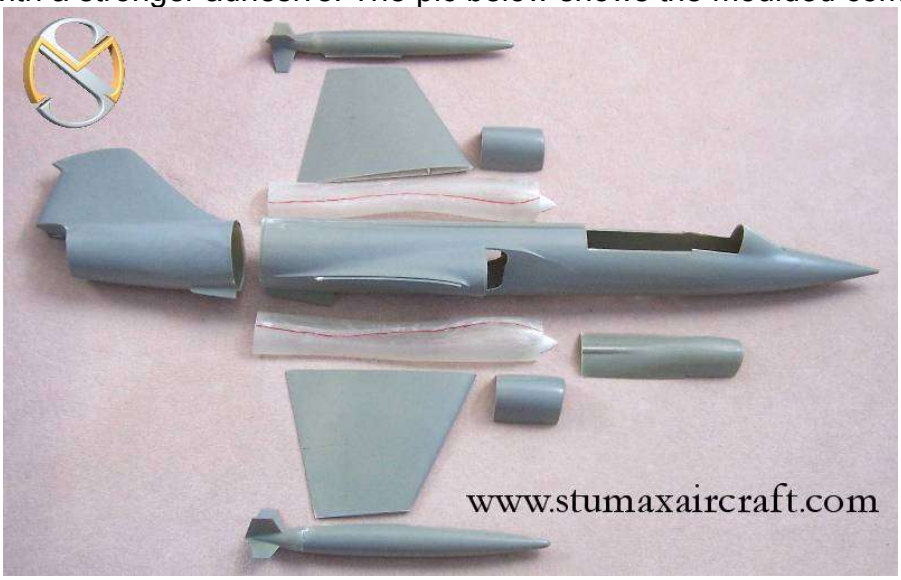
1.Introduction

Please allow me to introduce myself. I'm Stumax, and I'll be taking you through the construction of your new EDF F104 kit. Please take the time to read though these instructions carefully and familiarise yourself with the methods and techniques used in moulded composite aircraft construction. This aircraft is all moulded, except for the tailplane, and unless you've got extensive experience with all moulded kits, you may just save a few headaches by not skipping this part.

Take a look at the moulded parts. With the exception of the intake ducting, they are all grey. This is grey automotive primer and is applied to the mould surface before laying up the epoxy/glass matrix. This is done for two reasons: it saves you time in rubbing back the shiny surface of epoxy before painting and it provides a much better adhesion between the paint and the epoxy. As the primer is slightly porous, the epoxy makes a very good bond with it, far better than spraying primer over roughened epoxy.

The wings are moulded using sandwich construction skins, which are made from a sandwich of glassfibre/ high density foam/ glassfibre. The foam used is a high density extruded polystyrene foam, similar to blue foam, but denser, harder and more impact resistant (BTW, it's not Depron). As it's a polystyrene type foam, it will be melted by hydrocarbon based solvents such as acetone and lacquer thinners. The wings are also primed in the mould, and it shouldn't be necessary for another coat of primer, except around the wing/fuselage joint. Be careful if using auto lacquer, as if there are any exposed foam edges they will quickly disappear. Be sure that any edges are sealed with epoxy before spraying with solvent based paints. If in doubt, use a water based paint.

As with all glass/epoxy mouldings, before you glue anything to the surface you must roughen with coarse sandpaper and wipe clean with acetone. This is to remove the polyamine blush which appears on the surface of epoxy as it cures (like an oily film). For gluing to epoxy, use epoxy (slow setting for higher strength areas, 5 minute for low stress stuff), high strength silicone RTV (for joints that don't need high rigidity) or possibly some of the newer polyurethane foaming type adhesives (Probond, Gorilla Glue, Purbond). Only use CA type adhesives for tack gluing then follow up with a stronger adhesive. The pic below shows the moulded components.



Fuselage Construction

The fuselage construction begins with gluing the wing attachment bulkhead into the fuselage. Look at the wing root section of the fuselage and you'll notice some parallel scratch marks about 100mm from the LE. This is where the bulkhead will be located. Cut a slot in this part of the fuselage, making it 10mm wide, enough to fit the 3mm plywood bulkhead and the 6mm plywood wing joiner. The wing joiner goes to the rear of the bulkhead. Trial fit the bulkheads one at a time, noting that there is a “P” port (left) and “S” starboard (right) mark on them. The centre edges of the bulkheads align with the seam of the fuselage. When you're satisfied they fit OK, tack them in place with some CA then run a nice epoxy fillet on both sides. Oh, you did remember to sand and clean the area prior to gluing, didn't you? See the pic below.

While that joint is curing, let's move onto the rear section. The inside front lip of the rear section may need to be sanded to match the protruding lip of the front section. It doesn't need to be a perfect fit as it's rigid enough that when the screws are in place the sides won’t flex out of alignment. The rear section is removable and is attached via 3x3mm countersunk head screws. The nuts are glued to fibreglass tabs which extend from the end of the front section of the fuselage. Countersunk screws are used to help disguise them better, however, their heads need a larger area to distribute the stresses. To accomplish this, you will need to epoxy some 8x15mm strips of 1.5mm fibreglass (printed circuit board material) inside the fuselage where the three lower screws will pass. You will need to file the inside lip of the front edge to allow the strips to be flush with the inside of the fuselage skin, as the front edge of the strips will be flush with the front edge of the rear fuselage section. These strips allow the heads of the screws to disappear flush with the outside of the fuselage (the screw heads may be painted to match). Now drill 3mm

holes through these strips, 6mm from the front edge. Countersink the holes using either a proper countersink or a drill sharpened with a 90 degree included angle. The screw heads should fit flush with the fuselage sides. BTW, the positioning of the two lower screws isn't super critical, but imagine that the fuselage is round and the three screws are equispaced around it's periphery. Just make sure they're symmetrical. Now take three 10x25mm strips of 1.5mm fibreglass and drill 3.5mm holes 6mm from each end and epoxy some 3mm nuts over one of the holes. In the other end the hole will act like a key when it's epoxied into the front section of the fuselage. Using the 3mm countersunk screws, screw these strips into the rear section of the fuselage, so that they're protruding. The lip on the rear edge of the fuselage will need to be relieved where these strips pass. Once that is done, trial fit the rear section to the front section, making sure that nothing is causing the fuselage to distort out of shape (the sides should be perfectly flush). Mix some epoxy and microballoons (just thick enough not to run) and tack glue the 3 protruding strips into the front section of the fuselage. Tape the joint to keep everything lined up nicely until set (leave it nose down). When cured, unscrew the three screws and remove the rear section. It may need a little tap as some epoxy may have crept into the joint. Now mix up some more epoxy/microballoons and secure the 3 strips into the front section. Don't skimp on this joint!

The fan mount bulkhead now needs to be epoxied in place. It locates about 5mm in from the rear edge of the fuselage (not the lip, the step before the lip). It will need to be relieved to clear the three joiner strips. Don't cut too much out as the joint between the strips and this bulkhead is important. When it fits nicely epoxy it in place, forming nice fillets around the joining strips.

That's it for the fuselage for now, it's time to get the wings ready to attach before we can install the ducting.

Wing Construction

The wings are pre-moulded with a sandwich skin and ply spar with carbon fibre caps. The ailerons are hinged using the top skin as the hinge material, with a small width of the foam core being removed to allow the skin to flex. Some people like to score the top skin which allows the hinge to flex more. This is not a good idea as it concentrates the stress over the scored line and the hinge will ultimately fail there one day. The movement required for flight is very small, so leave the hinge as it is, and it will last as long as the model does. You will notice as you deflect the aileron, that there are exposed foam edges. As mentioned earlier, this foam will dissolve in contact with hydrocarbon based solvents. If you intend to use them it's a good idea to widen the saw cut at each end of the aileron and face the ends with some 0.4mm plywood. Similarly, on the underside of the wing at the LE of the aileron there is an exposed edge which would benefit from application of some 5 minute epoxy – just open the hinge up, wipe the epoxy along the edges, place some sandwich wrap in the gap then relax the hinge. BTW, some of the pics following are of the original prototype which didn't use live skin hinging so don't be confused by the balsa edges on the ailerons or the aileron being cut free from the wing.

The wing planform has been stretched slightly from scale to give enough wing area for heavy builders. If you like, you can cut 20mm span off each panel from the root section. Now the wing will be very close to scale. The fillets on the fuselage actually match this version. Note that if you do this you may need to sand the stub spar a little to prevent it from bulging the wing when inserted.

The first step in constructing the wing is to cut a hole for mounting the aileron servo. As shown in the pic below, I used a 45mm diameter hole, 157mm from the TE and 100mm from the root. This places the hole centre inboard of the edge of the aileron, which is important from a stress concentration point of view. Use thin wing servos preferably, as there's not a lot of thickness to play with. Don't use anything weaker than an HS81 or equivalent, as the ailerons are quite wide and the loads are reasonably high as a result. Don't go putting 6gram servos here, please! The aileron horn is cut from some printed circuit board fibreglass. Remember that the aileron deflection is only small, so you need a reasonably long aileron horn – have the hole about 5mm from the lower surface of the wing and centred over the hinge line.

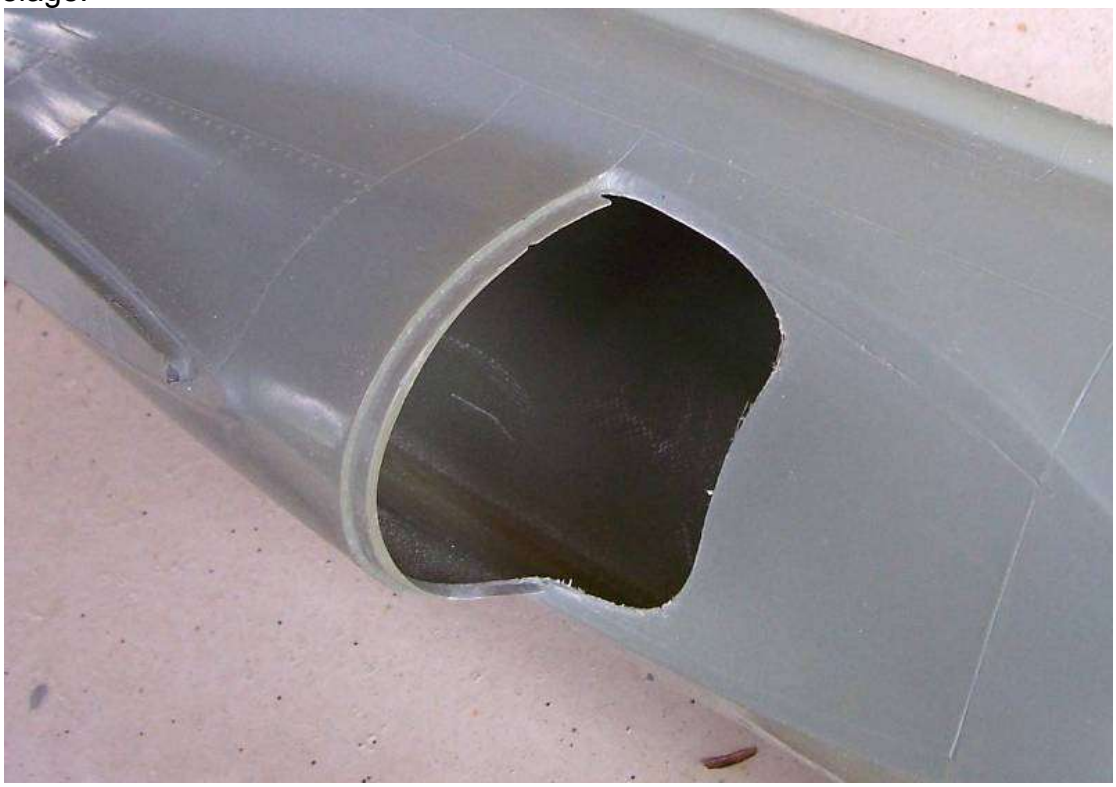
The wing attaches to the fuselage via a 6mm ply stub spar which is glued to the bulkhead inside the fuselage. The location of the stub spar in the wing is dictated by the location of the bulkhead in the fuselage. Put some epoxy on the top and bottom edges of the stub spar and insert it into the wing close to where it will go, but slightly aft. Now slide the wing panel onto the fuselage and align the root with the fillet. Tape the wing in place temporarily. Using a long dowel or similar, poke through the fuselage opening and push the stub spar onto the wing attachment bulkhead. You'll feel it stop and align itself as you push it. Now carefully remove the tape and slide the wing off, being careful not to budge the stub spar. It's important that the stub spar be closely aligned like this to minimise the amount of epoxy required to get a strong joint in this area. There are stronger ways of attaching the wing, but this method will withstand the flight loads and more, but in an accidental arrival the stub spar or bulkhead will fail, leaving the wing and fuselage intact (yes, it works, I've proven it!) to survive another day. Get some string and run it through the servo cutouts and through the wing panel. Make it long enough so that when the model is assembled you can tie the servo leads to the string and use the string to pull the leads through and up into the nose of the fuselage.

Now it's time to glue the wings on. The wing attachment bulkhead has stubs which will help considerably in setting the anhedral correctly, and the fuselage has fillets moulded in which are quite accurate. The fillets on the fuselage also have a stepped face, which provides and edge onto which to glue the wing skins, eliminating the need for a root rib. You may need to sand the wing root at an angle to match the anhedral angle of the stub spar. You'll need a large flat surface on which to set up the model with the fin vertical. A good way to hold the fuselage is to clamp the sub fin in a drill vice (see the pic) and shim the drill vice so that the main fin is vertical. Leave the fuselage free for now. Put some epoxy on the face of the wing attachment bulkhead, and the full face of the stub spar. Also put some epoxy along the edge of the step on the wing fillets. Slide the wing panels on, and make sure that there is enough epoxy forming a nice fillet between the stub spar and the bulkhead. A few spots of masking tape can help here, holding it all together temporarily if you're not an octopus. Now screw the rear section of the fuselage on and place the assembly onto the workbench and clamp it up so that it won't move. Get a fair distance away and look at the model from the rear. Are the wings at the correct anhedral angle with respect to the fin? The actual angle isn't that critical, but they do need to be symmetrical. They should be close, the bulkhead's stubs take care of that, and you need to measure and check until they are symmetrical. It goes without saying that you need to use slow setting epoxy for this operation. Now check the wing incidence angles. They should be symmetrical as well. Measure, check and correct until it is perfect. Then go and have a lie down – it is quite stressful as there's no second chance if you get it wrong.

Here's a pic showing it all setup and with the wings glued on. BTW, it's a good idea not to have things in the background (like window frames, for instance) which will confuse your eye when checking squareness like this. When it's all fully cured, run a small fillet of epoxy/microballoons along the joints.

Inlet Ducting

The inlet ducting comprises of two moulded ducts. You'll notice there is a left and right duct. To distinguish between left and right, look at them side-on. The front edge should angle downwards a bit – the inlet covers are similarly oriented. To install the ducts you'll need to open up the hole in the fuselage a bit. The ducts will just touch the fuselage at the opening when inserted, but shouldn't be pushed in by the fuselage.



The ducts have the shock cones moulded into them. The shock cone only touches the fuselage at the point. You'll notice the fuselage has a matching section moulded in to show where the shock cone should be. It's not super critical, but both sides should be the same. Trial fit the inlet covers with the duct taped in place and make sure the duct is in the correct place. If the duct is a little high or low the inlet cover will lose it's curvature continuity with the fuselage. Insert the ducts one at a time through the opening and pass the end back through the rear fuselage bulkhead. When both ducts are in place, glue the front of the shock cone to the fuselage with a spot of epoxy. It's probably a good idea to sand through the primer with coarse sandpaper (only the area to be glued, mask off around it with tape before sanding) to achieve a good bond. Also glue the rear of the duct to the bulkhead, and glue the faces of the ducts together at the end where they meet (a couple of clothespegs will do nicely to clamp them together), thick CA will do here.

The inlet covers are next. The inside rear edge has a bead of filler which you'll need to sand so that they fit flush with the fuselage. A little patience here can make the difference between the covers fitting flush or not. The top and bottom edges of the covers do not touch the fuselage sides. This is to give the appearance of the boundary layer splitter on the fullsize aircraft. The inside edges here should be left open for air to enter the fuselage for battery cooling.

The covers are epoxied on along the lip moulded into the fuselage, and at the front of the duct. Thicken the epoxy with microballoons to aid blending the duct with the radiussed edge of the inlet cover. After the epoxy has cured, sand the edges of the duct so they blend with the cover's radius nicely.

The fan mount is next. This is precut from 3mm lietply. There are six pieces in all – 2 gussets and 4 mounting rails. The 4 mounting rails are glued together to make 2 mounting rails which are glued onto the gussets. The fan is screwed onto the rails, trial fit it all to the rear bulkhead to make sure the fan clears the duct by about 1mm. Trim the rear edge of the duct if necessary. Epoxy the fan mounts to the bulkhead while they are screwed to the fan – this way you can be sure not to distort the fan shroud when screwing the fan on later.

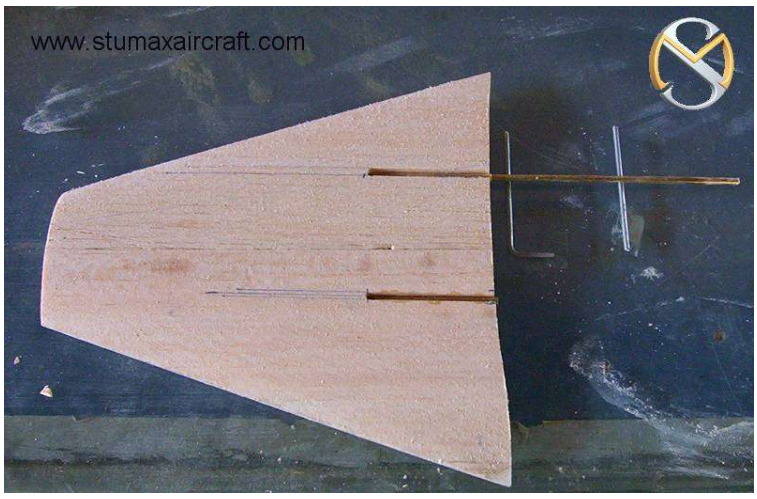
Canopy Hatch

The canopy hatch is made form a fibreglass moulding into which is glued the clear canopy. If you desire a clear canopy, cut the canopy sections out of the hatch, as well as the front canopy section and glue the clear canopy from the inside. The canopy is moulded from PETG (Coke bottle material), and the best adhesive for it is silicone RTV adhesive. The front edge of the canopy has a lip which locates inside the rear edge of the front canopy section. You'll need to sand inside the front canopy section to get a nice neat fit here. It actually needs only to locate in three points – top and each side – to keep it located securely.

You'll notice a couple of strips of 3mm square spruce glued on the underside of the canopy frames. These are to help keep the frame located within the lines of the fuselage. The other end of the hatch may be secured using a commercially available hatch pin or a screw into a strip of plywood – whatever is your preference.

Tailplane

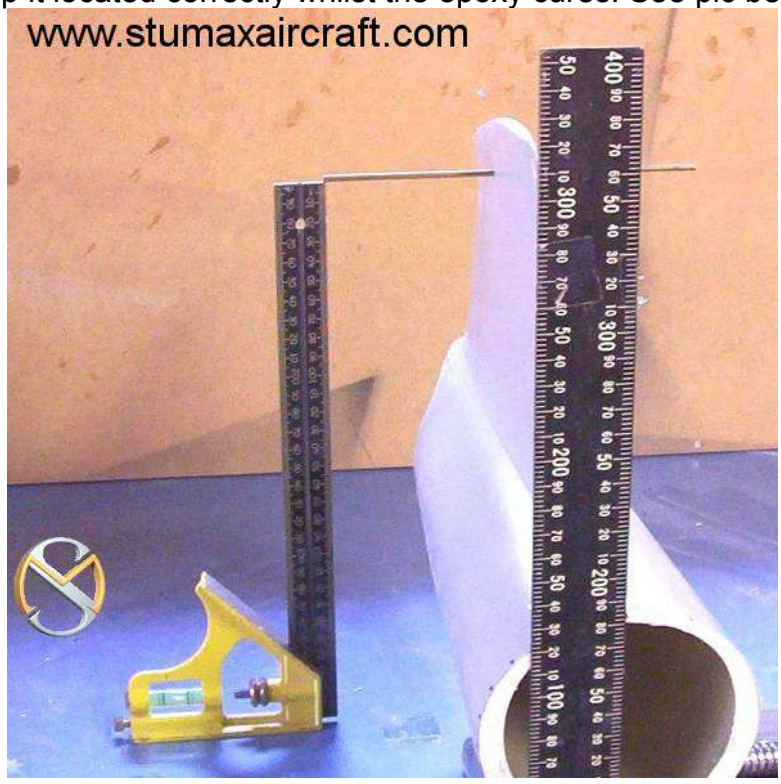
The tailplane is made by gluing the two pieces together to form the left and right halves. The halves are joined by 2.5mm music wire joiners which locate in aluminium tubes glued into each tailplane half. Cut 3.5mm wide slots in each tailplane half to accept the aluminium tubes. The front slot should be 35mm from the LE, the second slot is 50mm behind the first slot. Keep the bits you cut out and split them in two and glue them on each side of the tubes to fill the gap. Now shape a nice symmetrical airfoil. If you're no good at shaping airfoils, just round off the LE and taper the TE to about 1.5mm over the last 25mm or so. Don't put a sharp LE or rounded TE on the tailplane – both mistakes are very bad. Finish the tailplane with your favourite lightweight method. I prefer 3/4oz glass using water based polyurethane (WBP). If you choose this method, seal the balsa with several coats of dope first to stop it absorbing too much and warping. It's also a good idea when using WBP to do both sides at the same time to prevent warping. It's very important that the tailplane is flat.



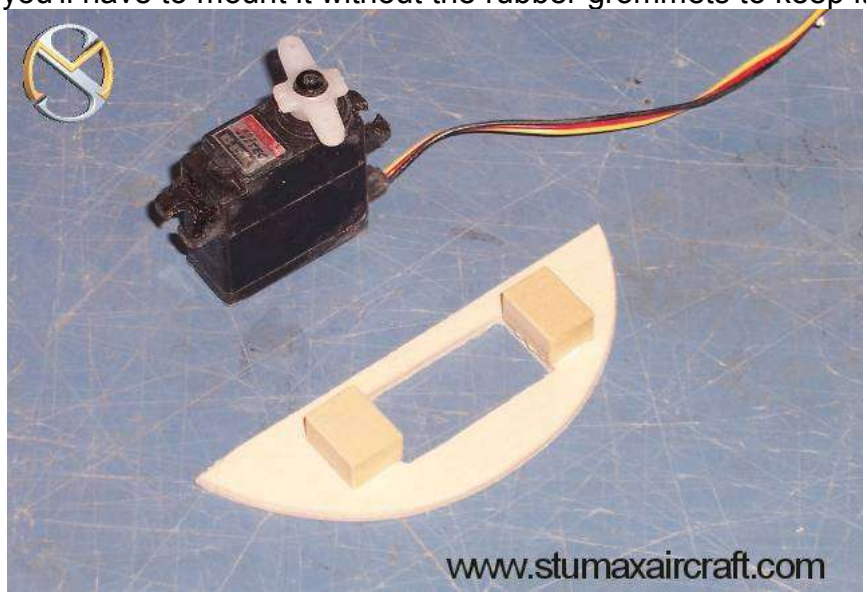
Fitting Tailplane to Fuselage

The joiner wire may be either glued into the fin or you may glue a suitable piece of brass tube into the fin and slide the joiner through it. If you choose this method, make sure the brass tube is a precise fit to prevent the tailplane from flopping around. The actual position of the joiner in the fin isn't super critical, about halfway along a horizontal line drawn from the point on the TE of the fin will do.

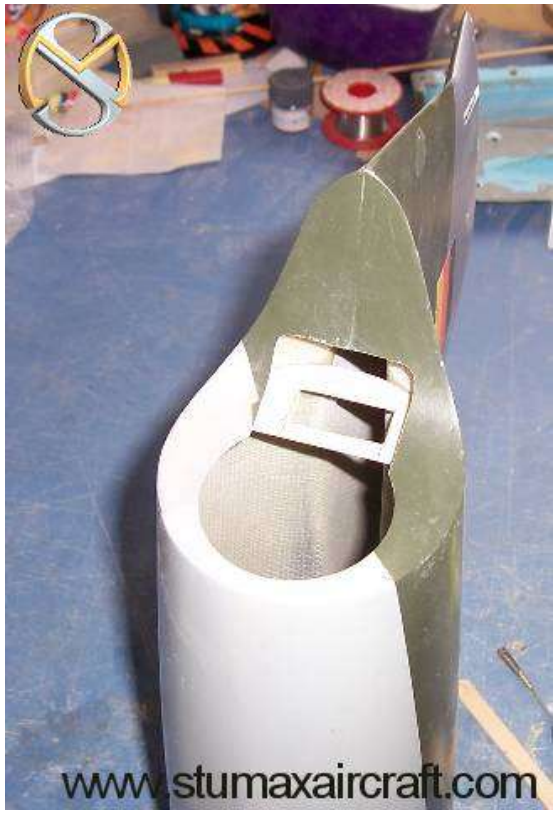
Drill a hole to accept the joiner. On one side make the hole a precise fit, on the other side make it a bit loose to allow you to set the joiner square. Pass the joiner wire through the hole in the fin and tack it with CA on the side with the smaller hole. Mix up some epoxy and microballoons and using a long stick, put some all around the joiner wire inside the fin. Now put the rear section into a drill vice as per the front section when you were gluing the wings on. Set it up with the fin vertical and measure the joiner and set it square to the fin. Put some tape around the joiner at the joint to keep it located correctly whilst the epoxy cures. See pic below.



The tailplane servo mounts on a small bulkhead which is glued inside the rear of the fuselage. Use a decent servo here, I use an HS85MG, the loads can be quite high. If you like, you may wish to add some hardwood blocks behind to allow the screws to be screwed in and out without wearing out the holes. Note that the servo body is perpendicular to the pushrod. This will have the tendency to rock the servo on it's mounts, so you'll have to mount it without the rubber grommets to keep it firm.



The hole in the rear of the fuselage will need to be opened out to about 52-54mm diameter, depending on your preferred tailpipe size. You will also need to cut the opening for the servo mount.



The servo mount is epoxied in place at an angle which allows a straight run for the pushrod to the rear tailplane joiner wire. The tailplane is actuated using a pushrod

from the servo which pushes on the rear joiner wire via a ball socket (the type with a brass ball with a hole in). You'll need to drill out the hole in the ball to match the joiner wire – it pops out of the ball socket easy enough for this. Be careful not to distort or scratch it or it won't move freely in it's socket. To allow the rear joiner wire to move up and down with the tailplane, an arcuate slot needs to be cut into the fin as shown below.

As mentioned, the servo pushrod is just a 1/16” threaded rod with a ball socket on one end and a clevis on the other. Here's how it looks.

Use a piece of tape under the tailplane halves at the rear to join them.

Wingtanks

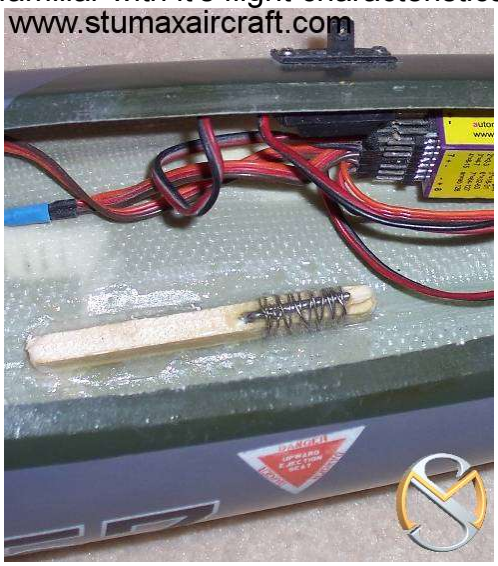
The wingtanks are moulded in one piece and are a necessary addition to the model. They enhance the wing's lifting ability and make the model easier to see in the air. They also add a degree of roll damping which is desirable to stop the wings wobbling in flight due to the low inertia. They may be epoxied onto the wings or made removable. If you are making them removable, use 2 short lengths of 3mm brass tube glued into the wingtank which locate in holes in a 3mm ply tip rib epoxied onto the end of the wing panel. Keep them about 50mm apart, and use a 3mm allen head screw to screw the tank onto the rib (drill and tap a hole in the ply rib, & add a small extra piece of ply for more thread depth). Have the screw head pass through the body of the tiptank and locate on the filleted section which blends with the wing. BTW, a small piece of heatshrink shrunk over the head of the screw with the allen key attached is a good way to keep it on the allen key when inserting and removing it. They should be held on firmly as there is quite a bit of load on them in flight and if one of them comes off the model is history.

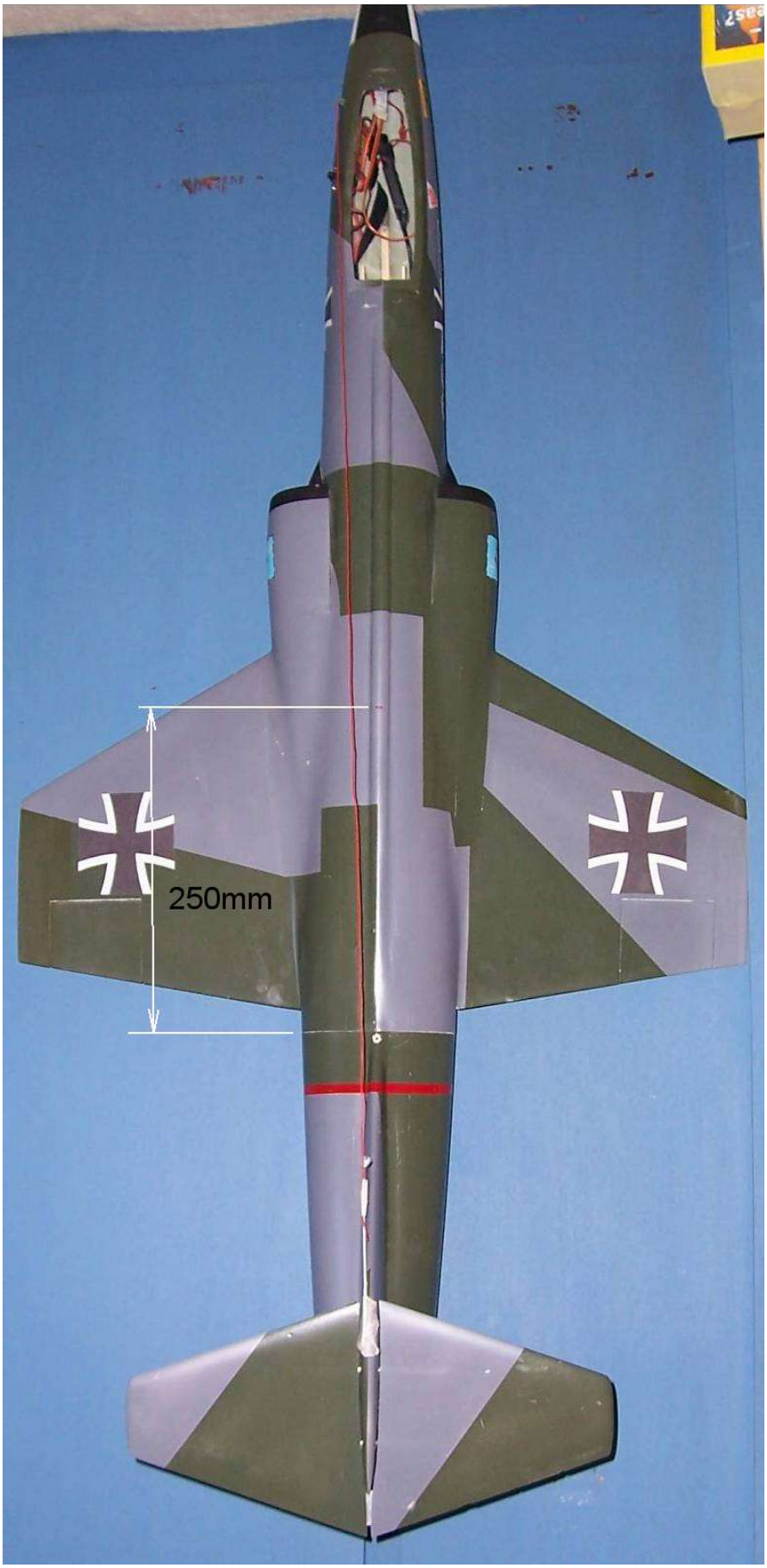
Finishing

There's not a lot to do as far as surface preparation goes. Give the primer a very light sand with no coarser than 800 wet and dry paper, used dry. The fuselage seam may need a little spot filling and sanding. The tail will need sanding and priming. Keep the finishing light, remember there's not a lot of wing area to carry any extra weight, and you don't want to fill up all the surface detail! Water based acrylics for plastic models are great as they come in all the authentic colours for military aircraft. If you choose one of the more decorative schemes, remember what was mentioned earlier about the foam in the wing.

Radio Installation

The tailplane servo installation has already been covered. Plug the servo into the Rx and check the movement. You need about the amount of movement that is shown in the pic above. The aileron servos may be glued in place or screwed in, depending on what type of servo you choose. Use 1/16" threaded rod to make the aileron pusrods. Aileron movement should be about +-6mm for first flights. The Rx is located in the nose, so you'll need some long extensions for all three servos. The battery needs to be located between the canopy and the fan. Just where it goes depends on how heavy your motor is, how heavy your battery is etc so that the model balances correctly. Because of all the options available here, the battery mounting is best left up to the individual. Be sure that it is securely mounted as the model accelerates pretty hard on launch. The esc should go somewhere between the battery and the fan. It's always a good idea to arrange for some cooling holes in the underside of the fuselage. The model should balance 250mm forward of the the fuselage joint between front and rear. The balance point is marked on the pic following. Wing/ tailplane incidence is zero/zero for first flights. The bungee hook is made from 2.5mm music wire glued & wrapped with wire to a 50mm strip of 6mm square spruce which is glued into the fuselage. The hook should be located 310mm from the tip of the nose. The tailpipe should be rolled from thin plastic sheet, such as overhead transparency film, or from cardstock. The outlet diameter should be between 52mm and 54mm – the optimum size will depend on factors such as model weight, power available, flying style etc, so do a little experimentation after you're familiar with it's flight characteristics.




250mm

Flying at last!

With the battery all charged up, do a range check at home with the motor off, then on at various throttle settings. Make sure the model balances as per pic above. Yes, it is along way forward, but the model has a very long nose with a bulbous canopy which creates a lot of lift to bring the aerodynamic centre of the model well forward of the the aerodynamic centre of the wing alone. You'll need a bungee capable of about 9kg pull, and a launch ramp with a pedal release. The model launches very smoothly, so don't be afraid of the dreaded bungee death roll. Don't apply any elevator or power until it is clear of the bungee. Climb out gently at first, until you're familiar with it's handling. Make all turns fairly wide and gentle until you have a few flights to get to know the flight characteristics. With such a high wing loading, speed and smoothness are your best friends, you can't throw this model around the sky like a trainer. You will find that it rolls very axially, and is capable of very big loops, but keep them high and a bit tighter until you get familiar. Low speed flight is surprisingly good for such a heavily loaded aircraft. It does glide quite flat until you get too slow. The stall isn't sudden, but rather mushy, probably because of the fuselage lift. Keep your first flight short – a few minutes should be enough to get the first flight nerves out of the way – as you'll probably need a few goes at setting up the landing approach. Don't push a bad approach, apply power and go around and try again. Overall, it's a most exhilarating model to fly. It has the most awesome presence in the air and is bound to turn heads wherever you fly it.

Final Comments

I hope you've enjoyed building and flying your EDF F104. If you have any problems feel free to email me at stumax@optusnet.com.au .It's my goal to make sure that every kit sold actually makes it into the air, so I'll do what I can to help you out. If you have any criticisms, suggestions or just comments in general, please feel free to pass them on as well. Oh, and I'd love to see some pics of your finished model, and hear about how it flies. Happy flying!

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