



YF-23 Parkjet

By Craig Clarkstone

MK 5

Construction Guide

© 2013 Craig Clarkstone. All rights reserved

YF-23 History

The Northrop–McDonnell Douglas YF-23 was an American single-seat, twin-engine fighter aircraft designed for the United States Air Force (USAF).

The design was a finalist in the USAF's Advanced Tactical Fighter (ATF) competition, battling the Lockheed YF-22 for a production contract. Two YF-23 prototypes were built with the nicknames "Black Widow II" and "Gray Ghost".

Several companies submitted design proposals; the USAF selected proposals from Northrop and Lockheed. Northrop teamed with McDonnell Douglas to develop the YF-23, while Lockheed, Boeing and General Dynamics developed the YF-22.

The YF-23 was stealthier and faster, but less agile than the competition (both exceeded the design brief). After a four-year development and evaluation process, the YF-22 was announced the winner in 1991 and entered production as the Lockheed Martin F-22 Raptor. The two YF-23 prototypes are now museum exhibits.

Recently I discovered that there are two versions (and two sets of plans in circulation on the internet), the YF-23A, and the YF-23 EMD - a revised version with a longer nose and larger weapons bay. This design follows the YF-23A - the version that actually flew.

Grateful thanks to my wife and family for putting up with me on the many hours I spent on this project. Thanks also to Fernando Gamboa, John Woodfield, Steve Shumate, Oliver Scheiber, Phil 901901, Vicente Lerum and everyone else who have all helped me on this journey to launch my first RC aircraft design.

Designers Notes

The black widow completely captured my imagination as a young man. It's shape is something from science-fiction. Arguably one of the most iconic shapes that ever took to the air. Having built several of Steve Shumate parkjet designs, I became hooked on the concept of scratchbuilt parkjets - Fun and fast to fly, cheap to fix and run.

I looked all over the internet and struggled to find plans for a full fuselage YF-23 parkjet so I decided to take the plunge and attempt to make my own. This is my first design - hopefully I have found the balance between scale looks and ease of build.

I've been on an educational journey into the world of model aircraft design and I have scoured books, countless websites, computer programs and asked for help from numerous people along the way.

The EDF version needs more speed than a hand launch in order to get sufficient lift, hence I've designed a launch dolly to help.

The pusher version has the conventional parkjet setup and hand launches ok - when you follow the launch instructions (at the rear of this guide)

If you enjoy this design please help me to fund my next project and send a donation for \$10 to Paypal address :-

c.clarkstone@btinternet.com

Thank you! and happy flying.

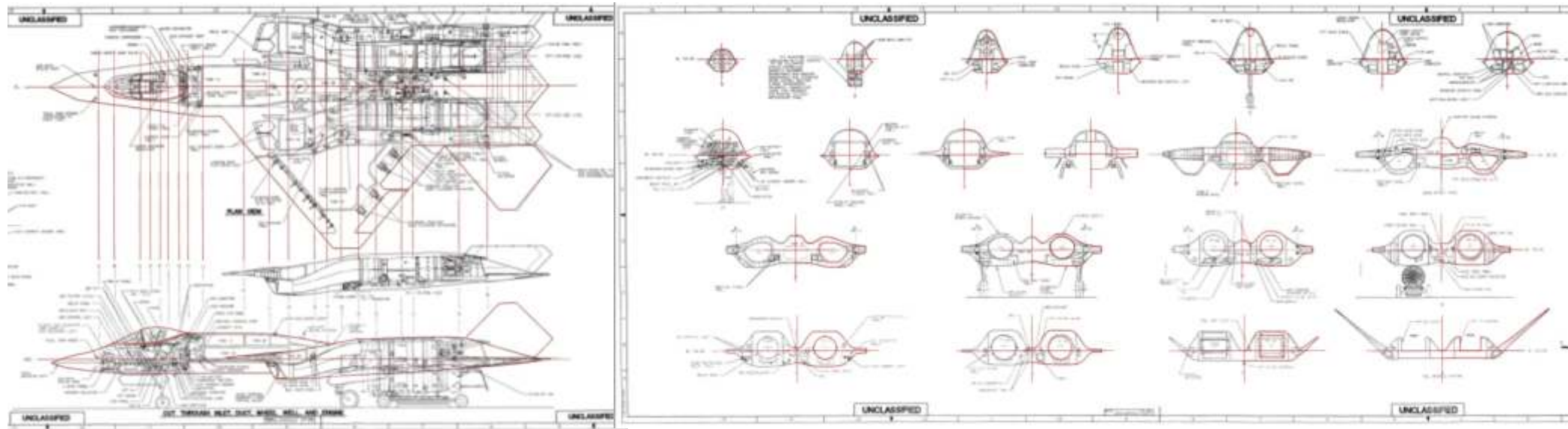
Craig :)



(c) 2013 Craig Clarkstone. All rights reserved. The design is free for non-commercial use only.

YF-23 RC Model development

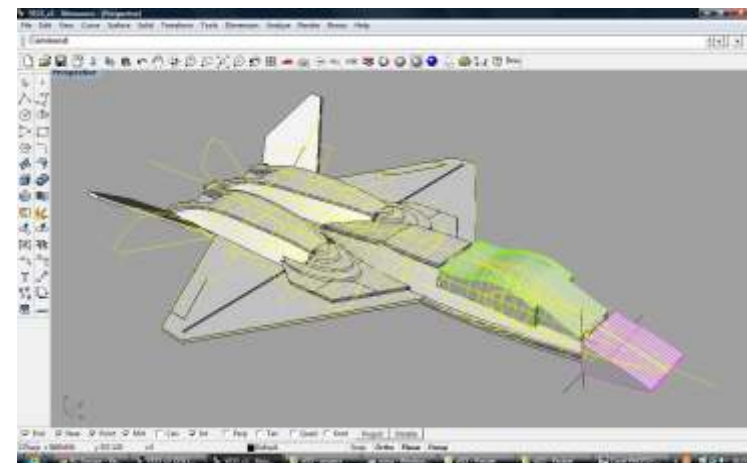
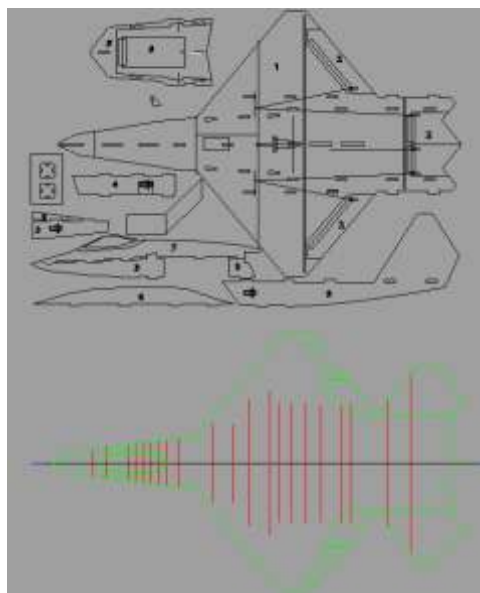
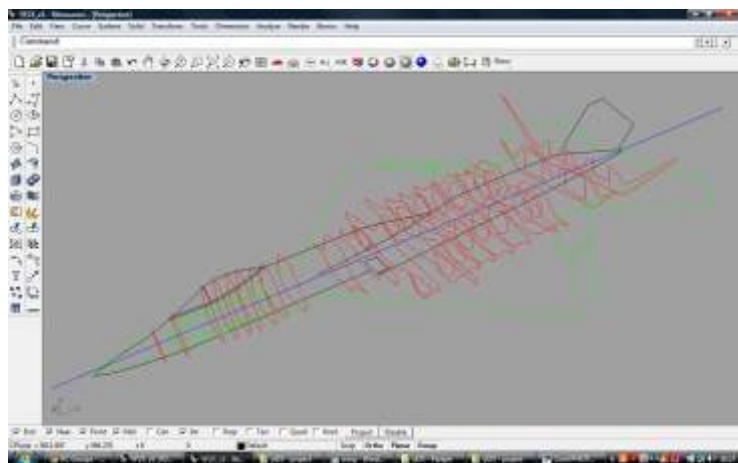
1. I started by downloading plans off the internet from Scott Lowther (up-ship.com) . I traced them in Coreldraw to get the main profiles



2. I imported the vector lines from Coreldraw into Rhino (a 3d CAD program) where I assembled them.

3. I re-scaled the 3d lines to match the same scale as Nic Cara's - downloaded from Parkjets.com

4. I set about creating the closest I could to the original shape with simple bits of 6mm and 3mm depron.

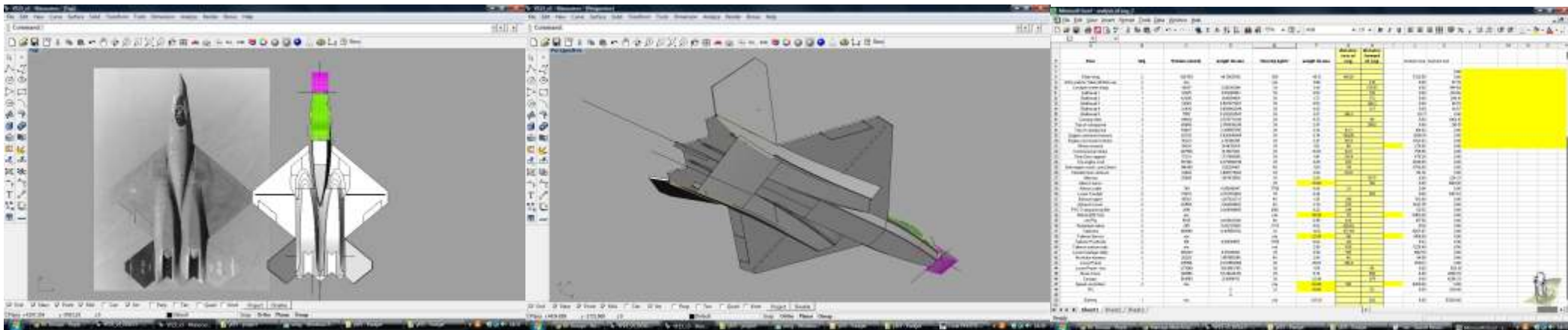


YF-23 RC Model development

5. I studied photo's extensively to try and make it as scale as possible, yet as simple as possible to build.

6. I started to create a simple pusher version to minimise extra risks for the maiden flight.

7. I used the Rhino to give me volumes of the foam parts, so I made a spreadsheet in excel to work out the moments about the fulcrum. I had based the given centre of gravity based on two designs I found on RC groups.com.



8. I then thought I might as well design the EDF version first as it would be easier to make a pusher later based on the EDF variant.

9. With a corrected CofG (Thanks Vicente) my prototype was beautifully balanced and flew without any trim adjustment on a windy April 2013 in Hamble, UK.

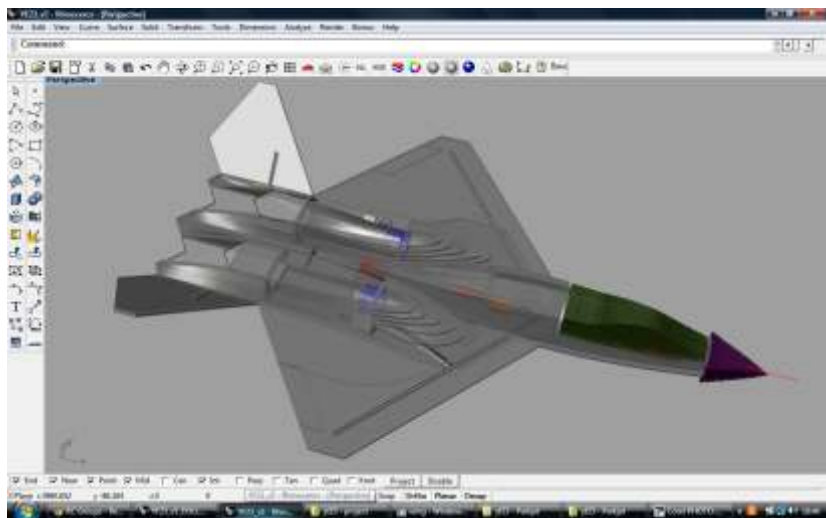
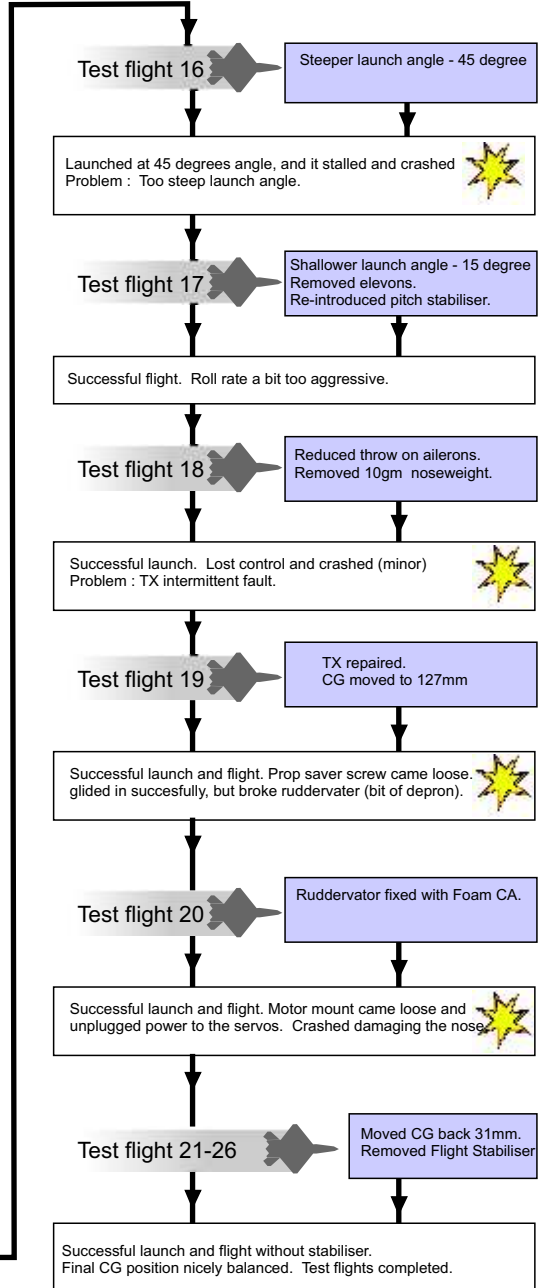
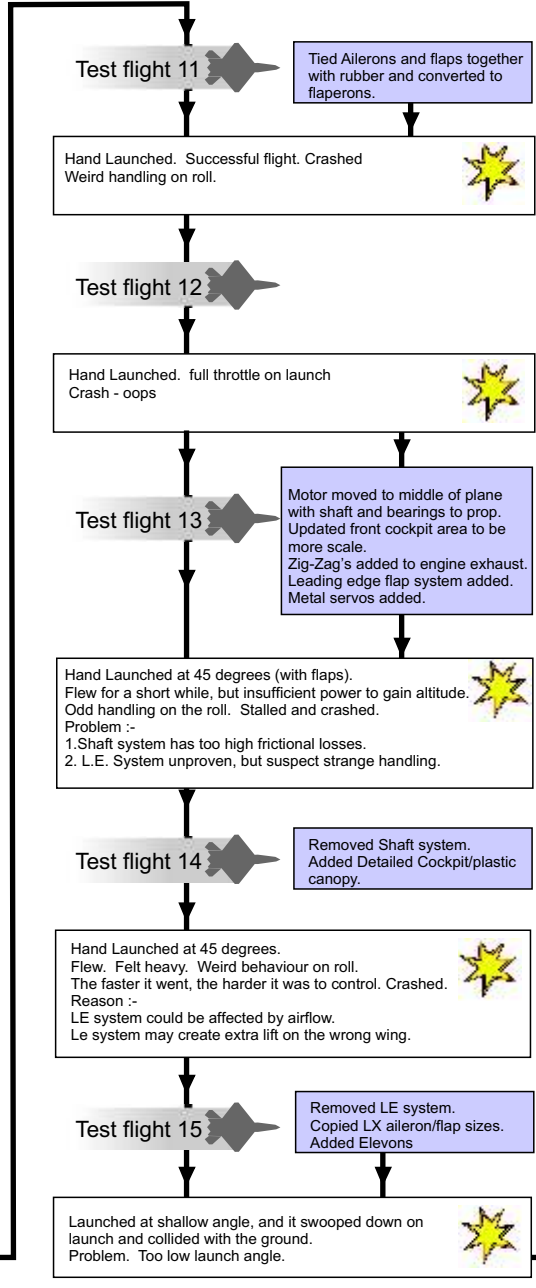
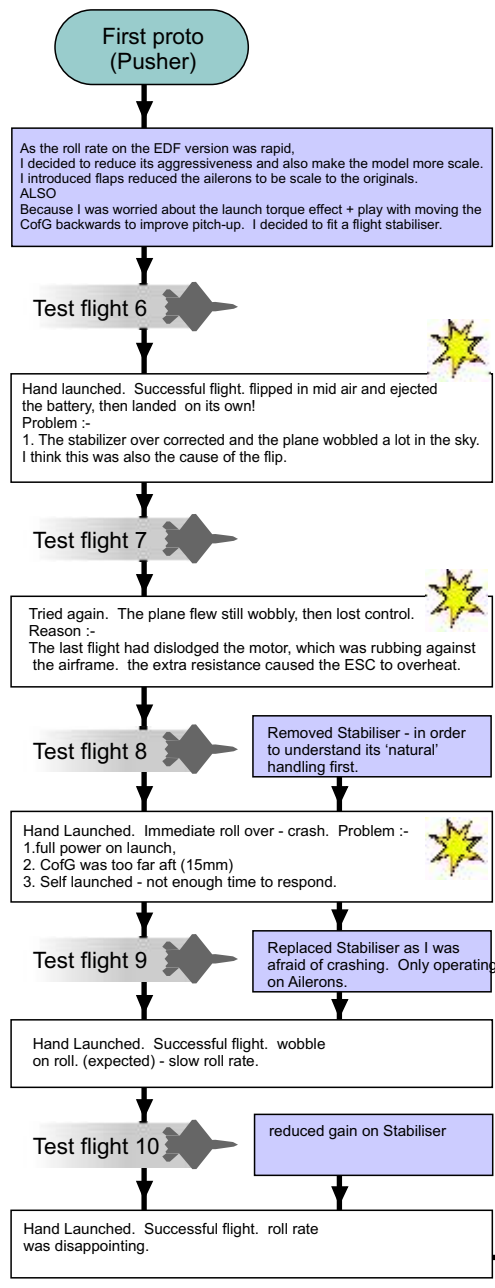
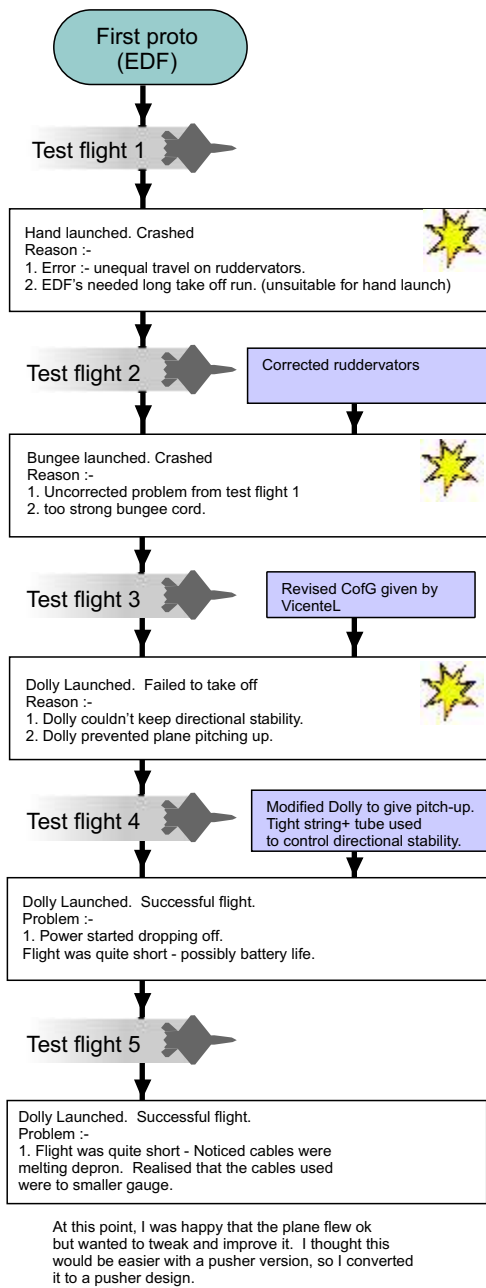
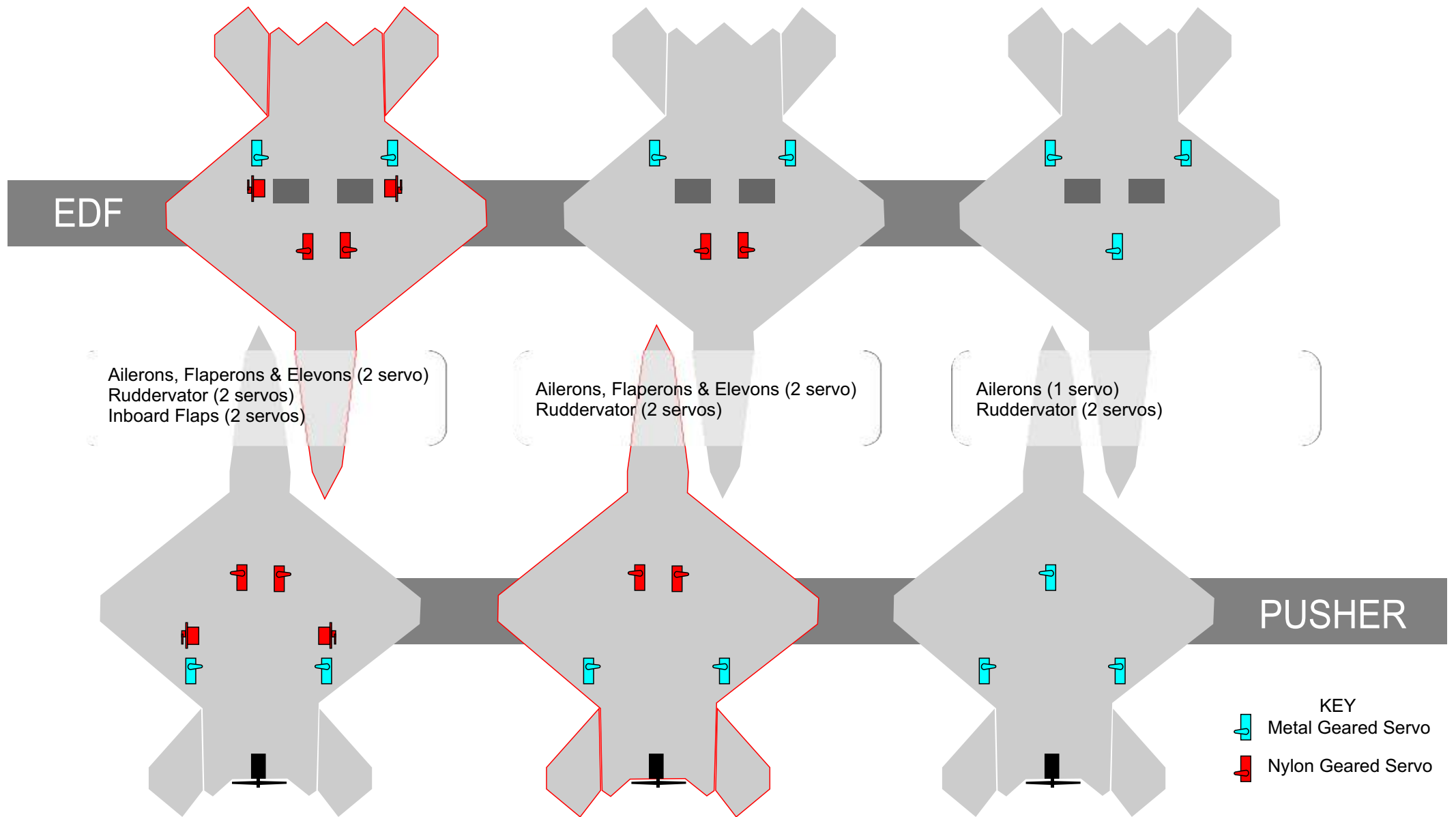


Photo by John Woodfield



Configuration options

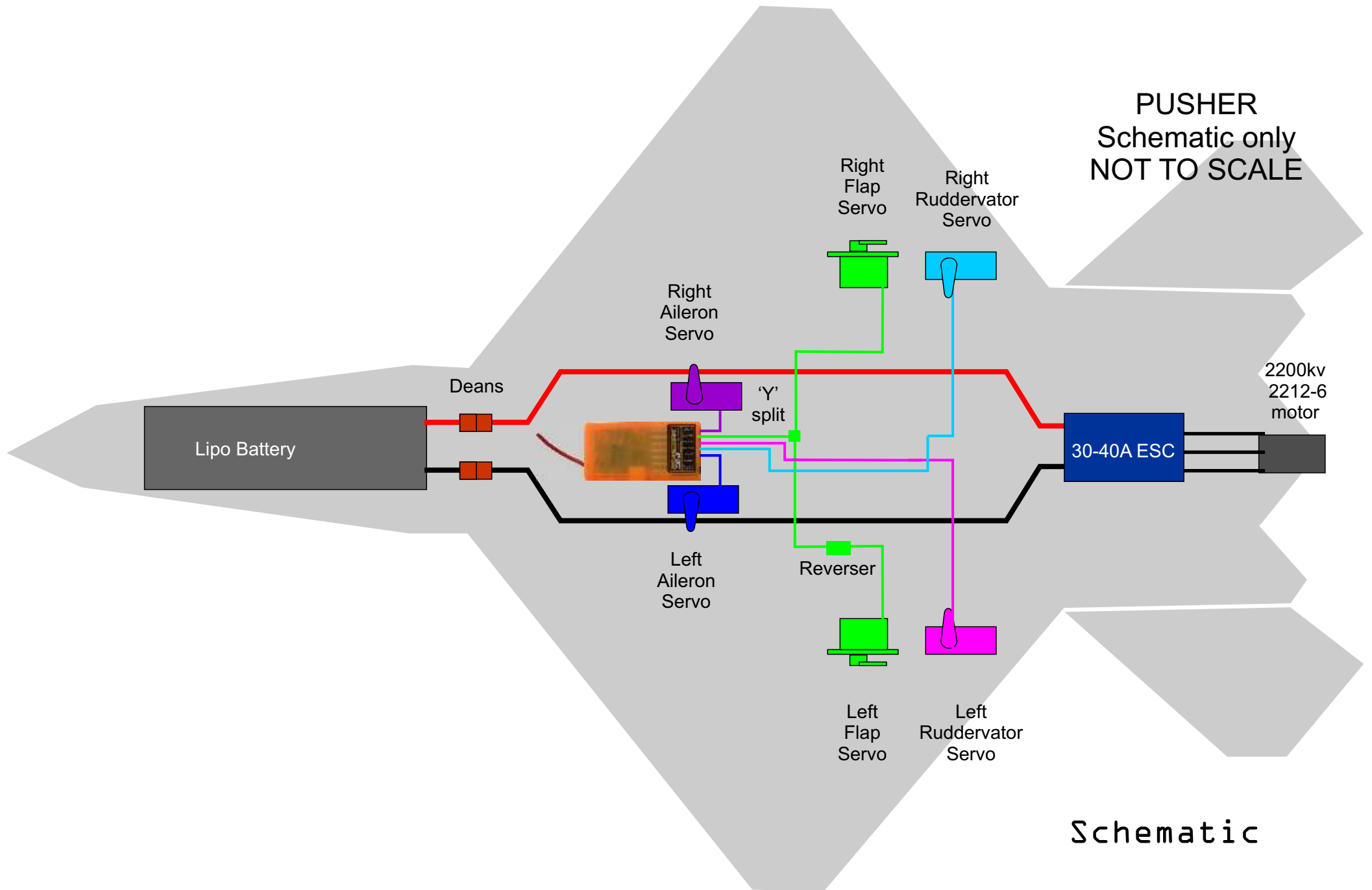


There are numerous layouts and options within this design to tailor it to your preferred way of flying, not limited to these shown above. Please remember that the more servos you use, the heavier your model will be.

My preferences are outlined in red :- The pusher version doesn't really require flaps, but can benefit from them when doing high alpha, and elevons for improved pitch control. The EDF, version is quite a fast flying model so I would recommend the extra flaps to help you land gently.

Servo / Motor Configuration

PUSHER
Schematic only
NOT TO SCALE



Schematic

Construction

Before you start .



Adhesives

- > For the majority of construction :
 - UHU Creativ for Styrofoam (also called UHU POR)
 - 3M 77 Spray adhesive.
- > For wing spars and motor mounts :
 - Epoxy. (5 and 15mins cure times are the most convenient)
 - micro-balloons can be added to reduce weight.
- > For servo's / and quick grab :
 - Hot melt glue gun - Caution if the glue gets too hot it will melt foam - test first!

Tapes

- > For holding parts tightly together whilst glue sets
 - Low tack masking tapes
- > For leading edges, hinges, general strengthening
 - 3M Gift tape (Purple - not green one!) - I prefer lightweight plastic hinges.
- > For decals
 - Coloured parcel tapes (strips taped to waxed paper & cut out)

Cutting parts

1. Print the plans,
2. Cut around each part using scissors - allow a border of approx (1/4") 6mm
3. Use either 3M spray mount or a very light coat of 3M 77 to the back of the parts and stick in an economical layout on the Depron foam.
4. Using a safety rule and craft knife over a cutting mat - important! use a fresh blade otherwise it will drag and spoil the foam. (I find the stanley knife perfect) make the straight edge cuts, then the curved parts freehand.
5. Once the parts are cut-out, keep the template stuck to the part until just before needed to help identify the parts.
6. After use, I find it helpful to keep all the used templates in case replacement parts need making. (the glue eventually dries and they don't stick together!)

IMPORTANT Wherever the plans call for marking guidelines onto the depron, please ensure that you do otherwise it can cause problems later on. I suggest you use a Sharpie Fineliner to transfer the lines.

Glueing parts together.

1. Ensure a really good fit - this will reduce the amount of adhesive used. The Bar Sander is a great tool for this.
2. Follow the adhesive instructions closely.
3. Use ordinary steel head pins to help keep the parts located whilst epoxy sets.
4. Use objects as weights such as paperweights to apply pressure whilst adhesive sets.
5. Use masking tape to apply pressure whilst adhesive sets. Also use masking tape to along the slots for the wing spars whilst glueing the carbon rod spars into the wings. This prevents the glue protruding and gives a nice finish.



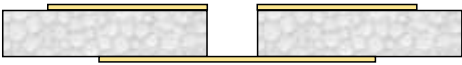







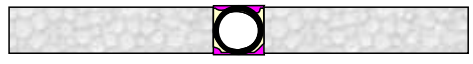
1. Start with the wing spars. Glue 6mm Carbon rod into the Main Wing Panel (Part 1) Using Epoxy mixed with Micro Balloons.

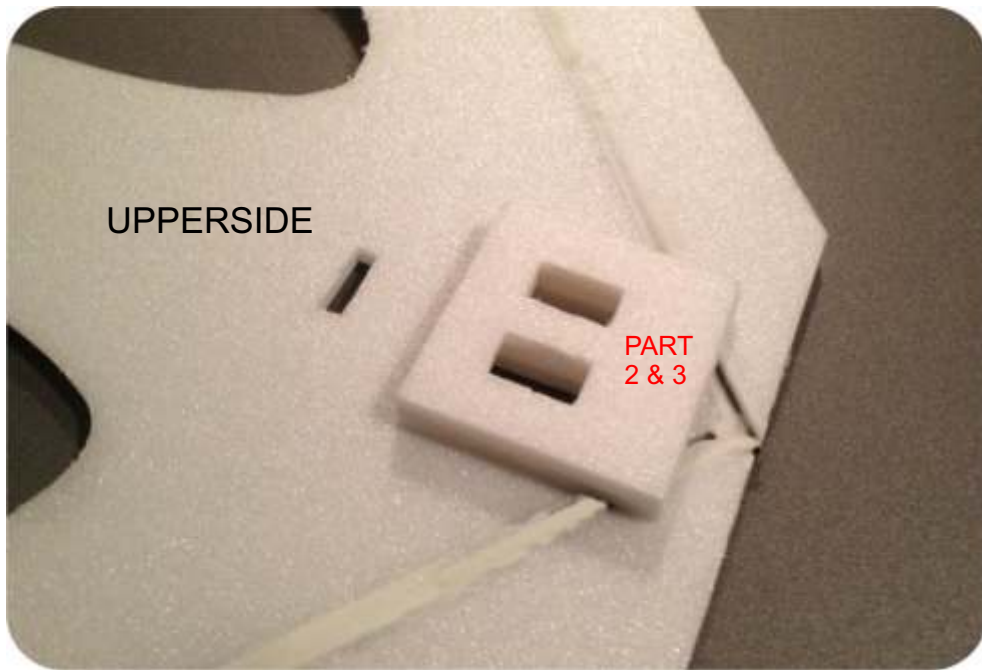
For extra protection to the leading edges, pre-shaped balsa could be glued on at this stage.

NOTE : if using 5 minute epoxy, do not attempt to do both spars same time - (learned from experience!)

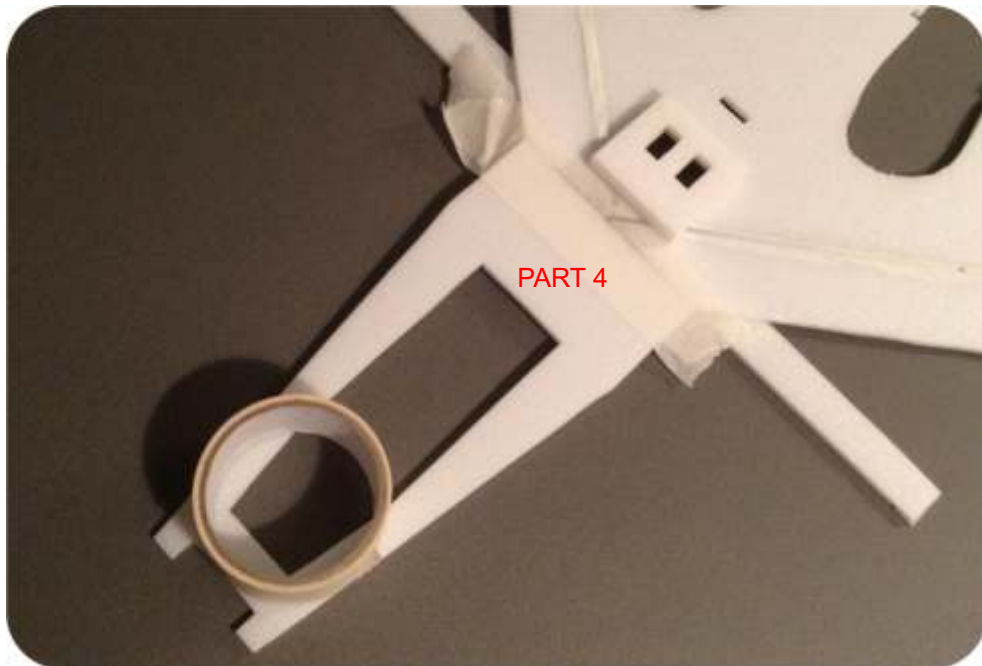
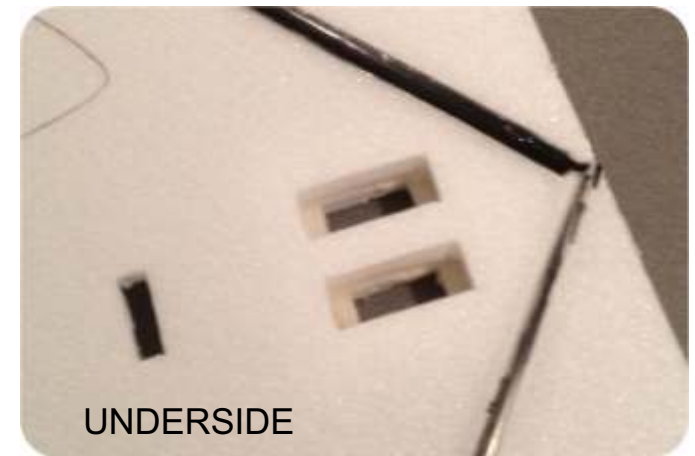


Gluing Carbon rod into depron.

<p>1. Apply masking tape as shown.</p> 	<p>2. Mix Epoxy with micro-balloons and apply to carbon rod.</p> 	<p>3. Spread epoxy mix evenly all over the rod.</p> 
<p>4. Slide rod into position. Take care not to detach lower masking tape. Do this on a flat surface.</p> 	<p>5. Whilst the mix is still fluid, Scrape excess epoxy away.</p> 	<p>6. Apply masking tape to help smooth-out bumps. Place on flat surface with large books on top and leave to set (fully)</p> 
<p>7. Remove all tape and apply fresh tape as shown.</p> 	<p>8. Fill using lightweight filler, gently using spatula to achieve a near-flat surface.</p>  <p>When the filler has set, gently sand flat using a purpose made sanding block - be careful not to sand through the masking tape.</p>	<p>9. Remove masking tape to leave a near-perfect finish.</p> 

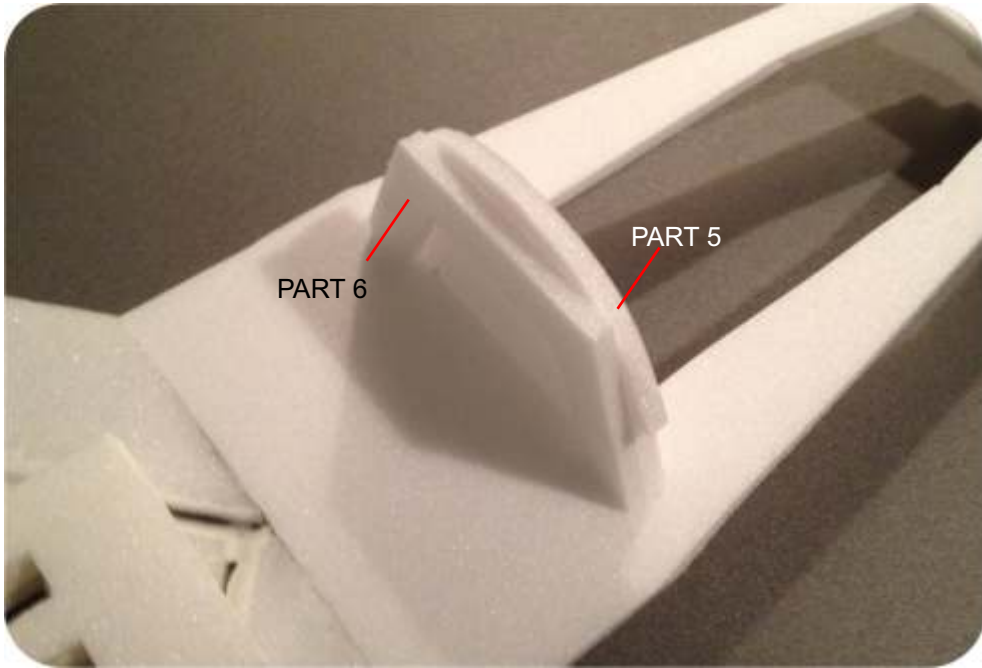


Stick the two servo tray pieces (Parts 2 & 3) onto the upper side of the wing panel - glue using 3m 77 spray glue - Locate using servo holes.

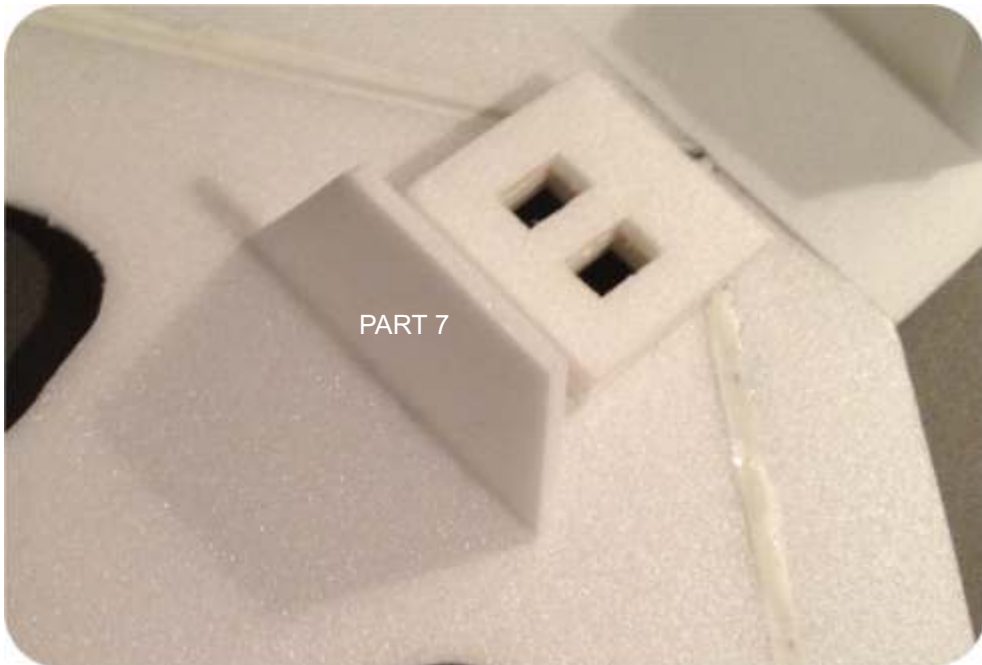


Raise the wing panel 6mm and glue the fuselage former (Part 4) to the wing panel using UHU Por so that the fuselage former is angled slightly down. Secure using tape until the glue has fully cured.



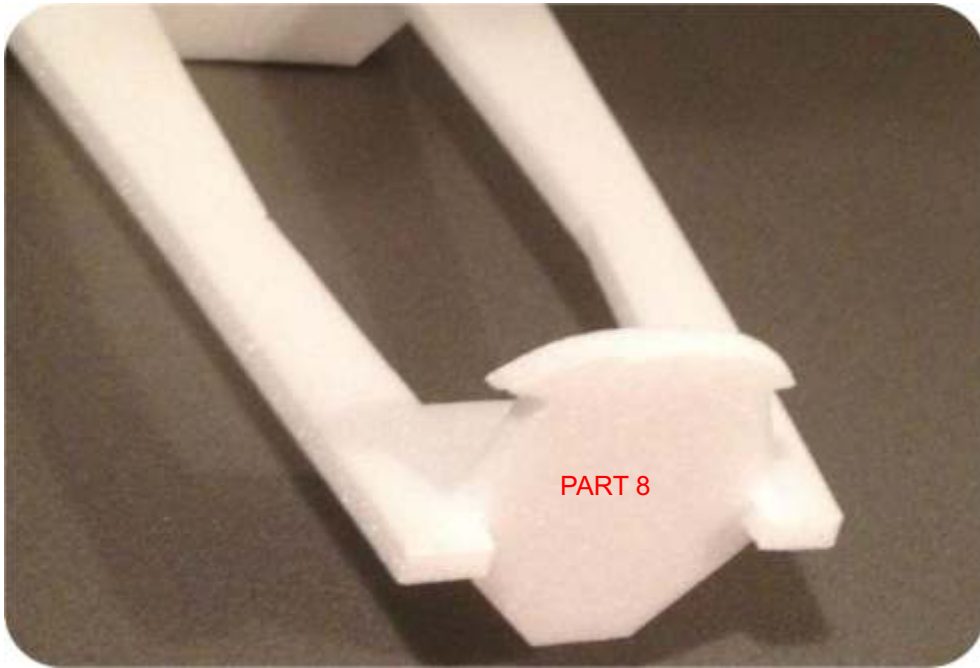


Glue the two bulkhead parts together (Parts 5 & 6) using UHU por and locate via the slot. - don't glue the area where the two parts slide otherwise it will get stuck on the contact adhesive.

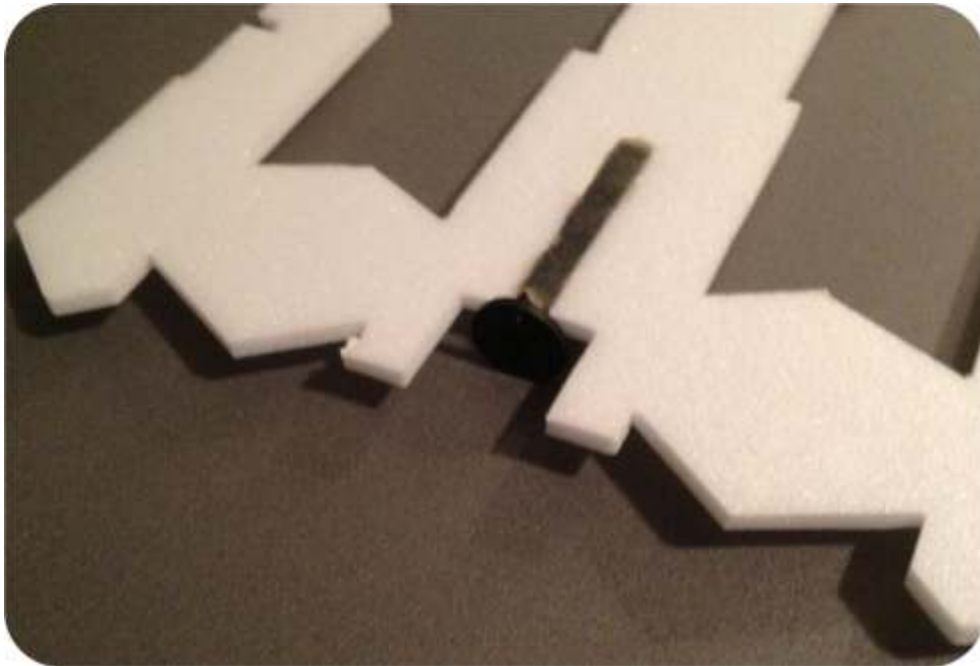


Glue the turtledeck bulkhead (Part 7) onto the wing panel using the lug and hole to position it.



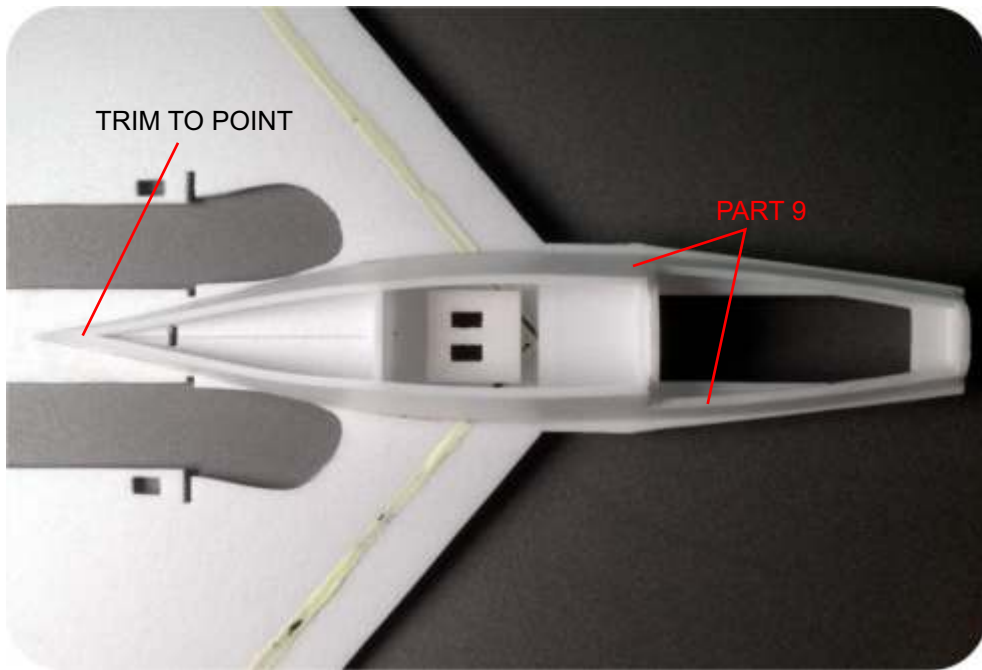


Glue the front former (Part 8) to the fuselage former using UHU por.
Again, don't get glue on the parts where the depron slides.



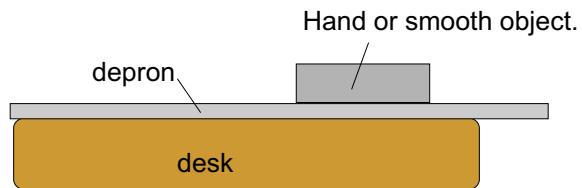
Glue the motor mount into the depron, aligned to the upper side of the depron, Use masking tape to help keep a flat upper surface. Use hot melt glue for a plastic motor mount. Be careful not to over heat the glue which can melt the depron. If using a balsa mount then I suggest epoxy instead.



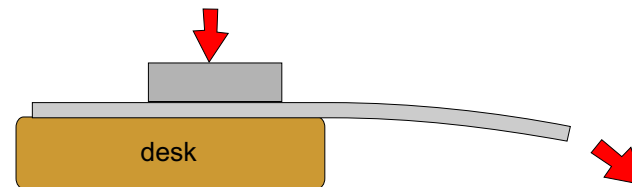


Glue on the fuselage upper sides (Part 9) with UHU por.

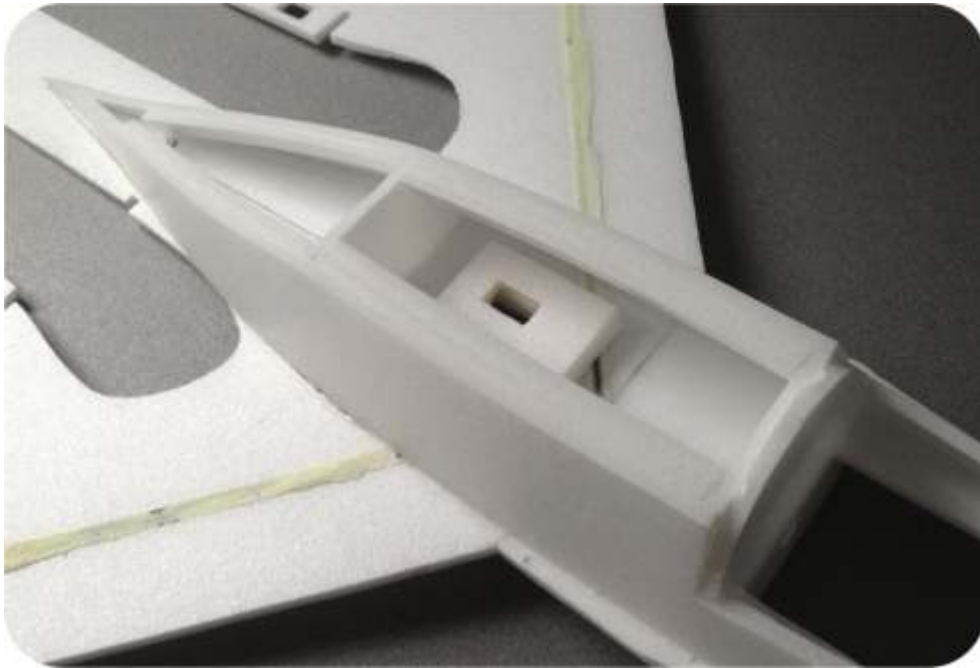
I discovered that the easiest way to gently curve depron, is the a similar way you curl paper. See diagram below. Practice on scrap depron first!



1. Place over edge of desk.
firmly press down on the depron
75mm (3") from the edge of the desk.

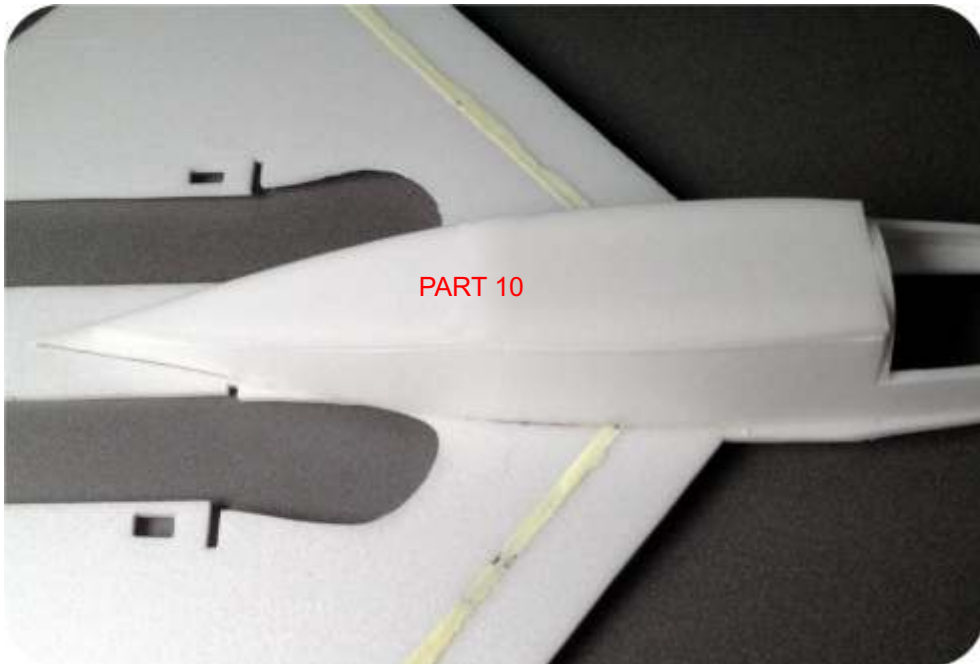
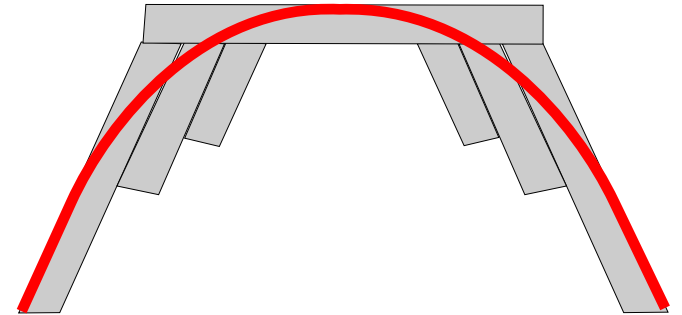


2. Whilst still pressing down, Drag the depron
over the edge of the desk, pulling down as you go.
This motion will put a nice curl in the depron.



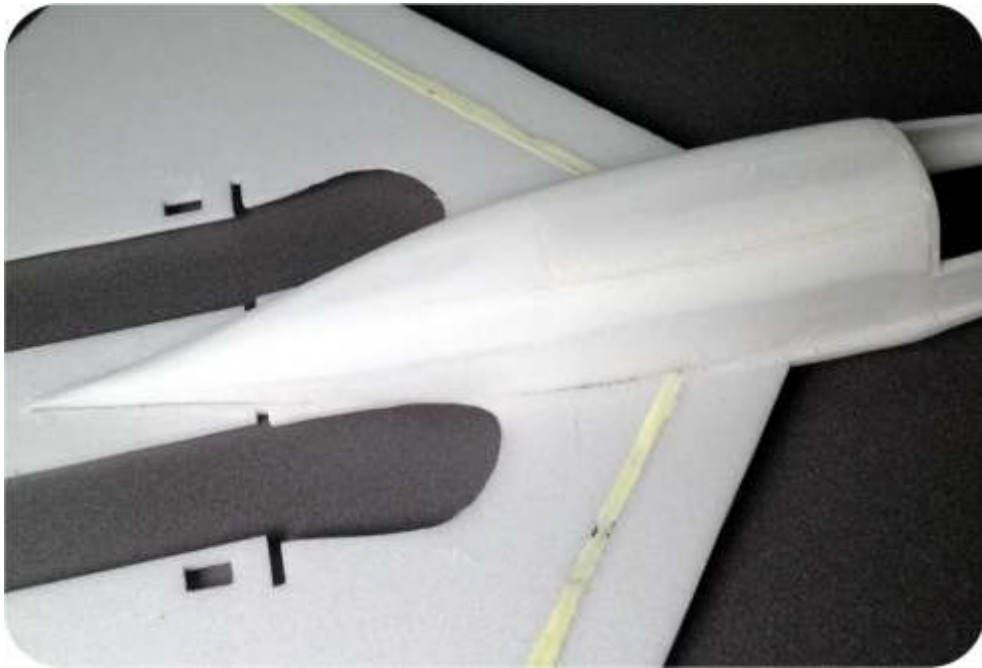
Glue 6mm depron reinforcement strips into the turtledeck sides. In front of the turtledeck bulkhead use 20mm and then on top of that a 10mm strip (see illustration below) behind the bulkhead use 10mm wide only.

Sand the top flat using a sanding block in preparation for the top pieces.



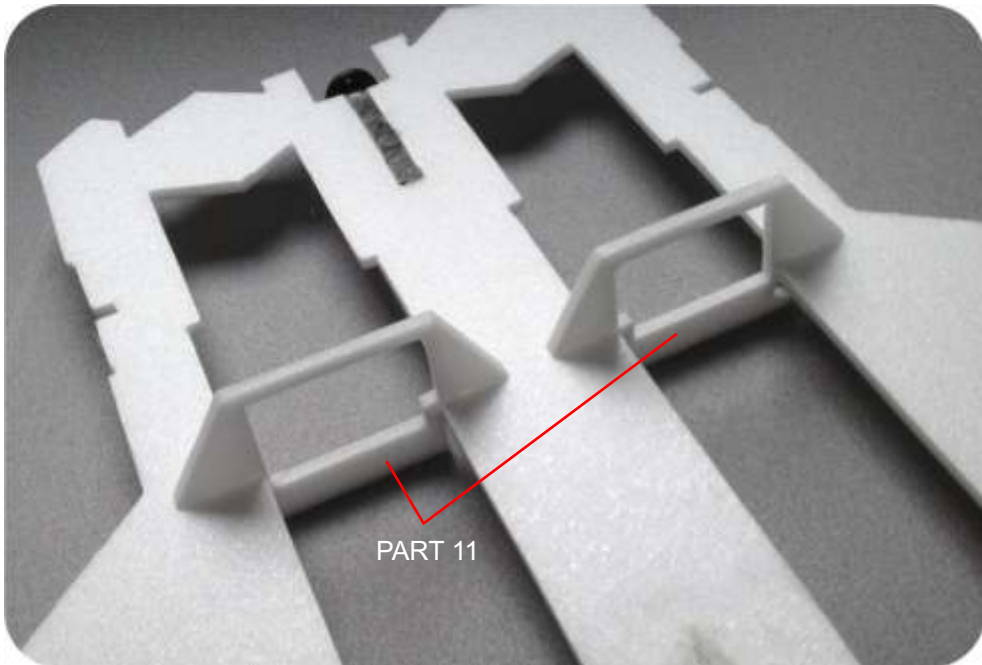
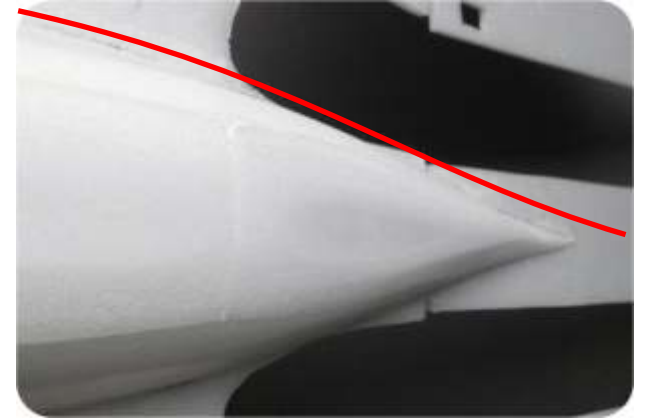
Shape then glue the turtledeck top piece on (Part 10).





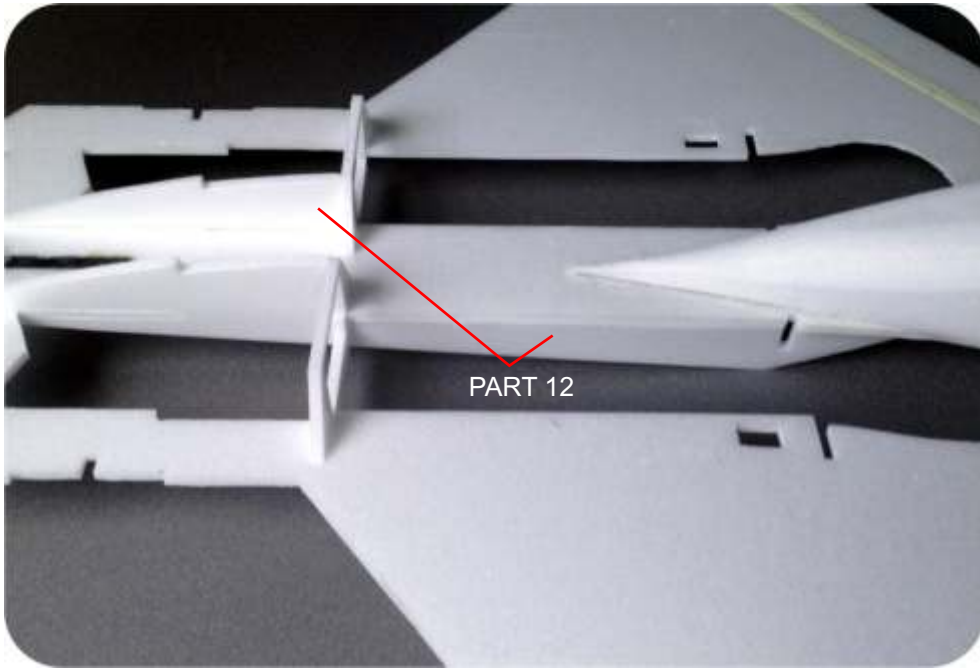
Use a long sharp knife to slice off large chunks of depron to get to rough shape then sand to shape using a sanding block. Get the nice 'S' shape in the turtledeck.

Finish the 'point' of this part well, using lightweight filler if needed, as when the nacelles are built, it will be difficult to finish this well.

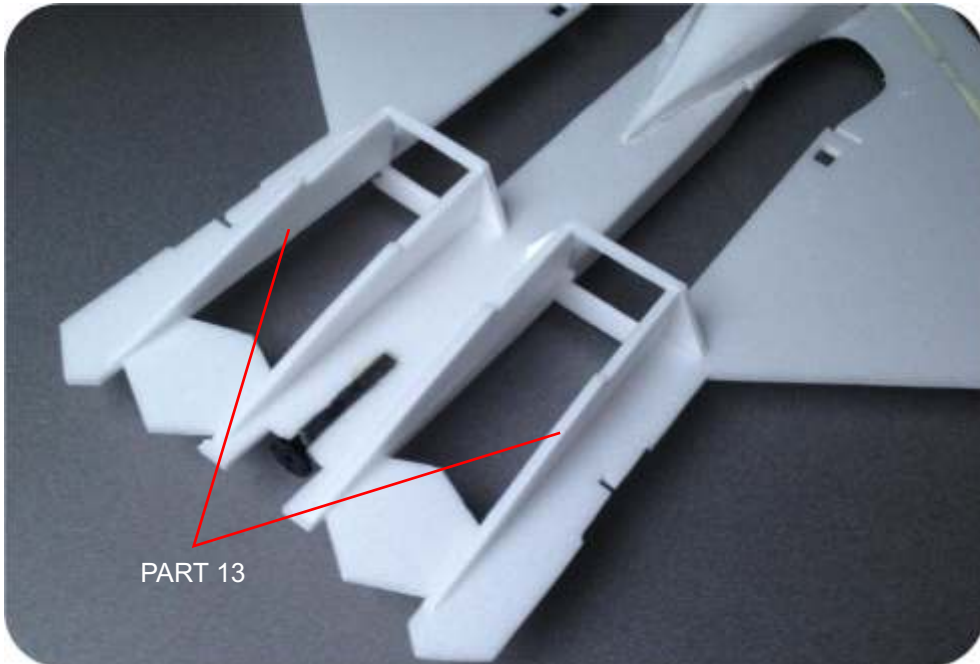


Glue in the rear nacelle formers (Part 11) using UHU por



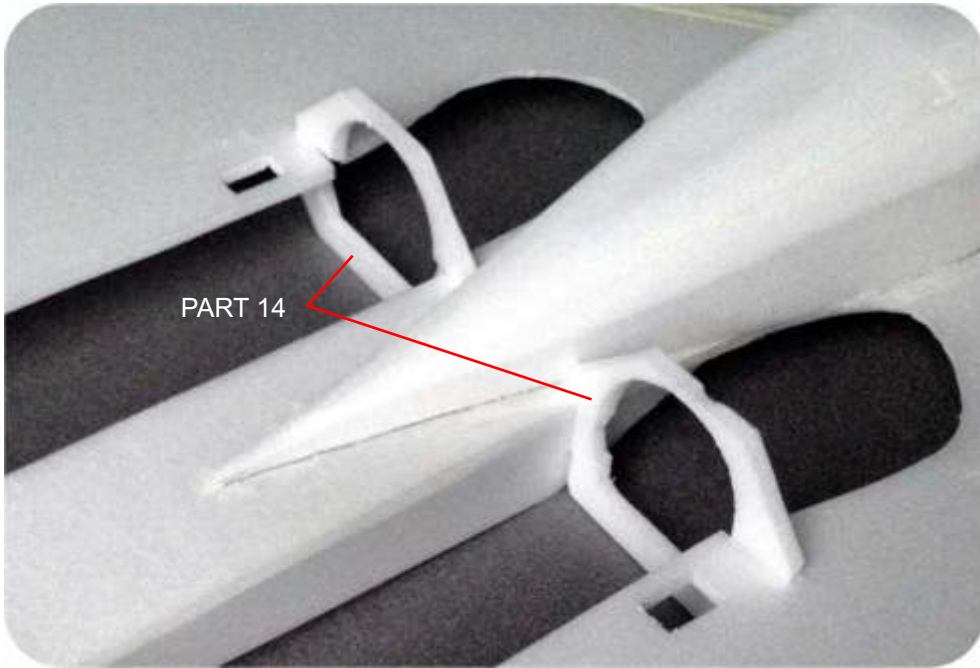


Using a non-contact adhesive (epoxy sparingly) to fit the inner exhaust panels in (Part 12). This is because UHU Por is a contact adhesive and this part of the design requires slotting into place.

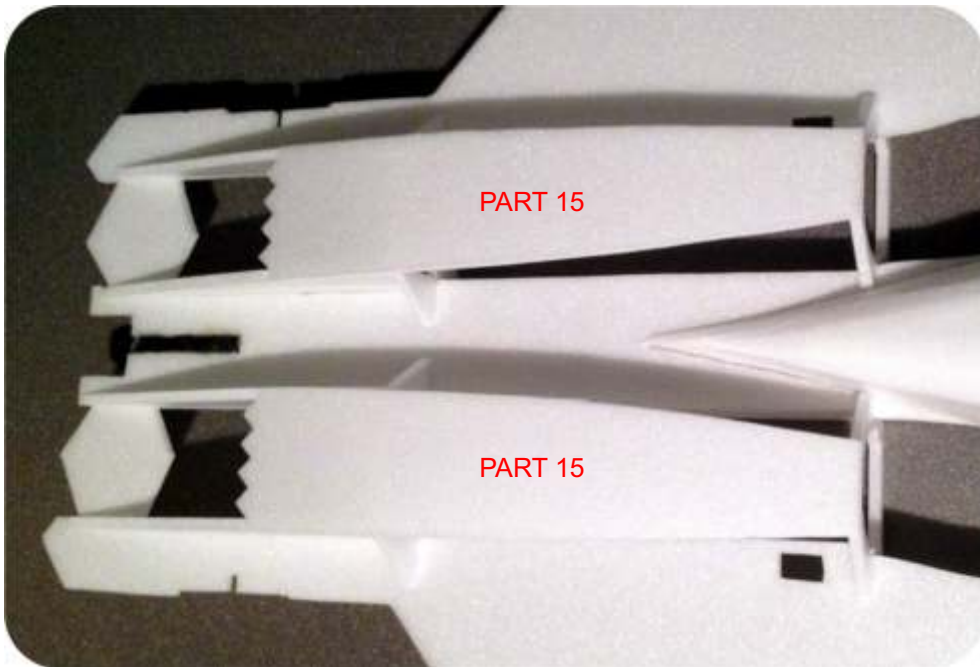


Fit the outer exhaust panels (Part 13) in using UHU por.





Glue in the forward nacelle bulkheads (part 14) using a non-contact adhesive (epoxy sparingly)



Using UHU por, gently shape and the glue the upper nacelle parts (part 15) on.

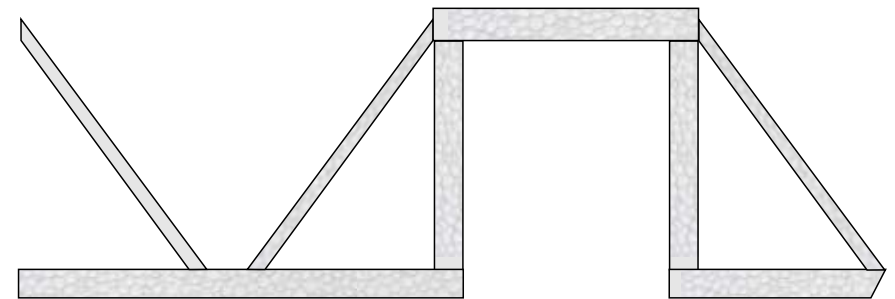




Add the 3mm inner depron nacelle sides(Part 16) using UHU por. The 3mm Depron edges are sanded to shape (see diagram below). Glue on the ruddervator support pieces (part 26) - area shown in red, sanded to fit the nacelle outboard sides.



Gently curve the 3mm outer depron nacelle sides (Part 17) to shape and carefully sand the edges to make a perfect fit. Feather out the rear edge to come to a seamless join. Attach Using UHU por,

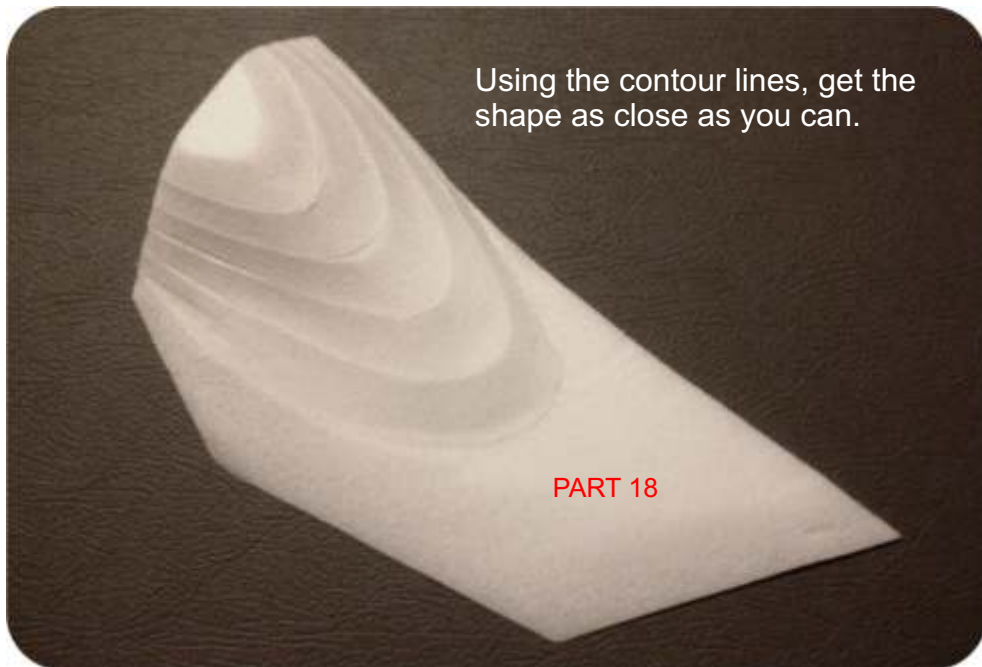
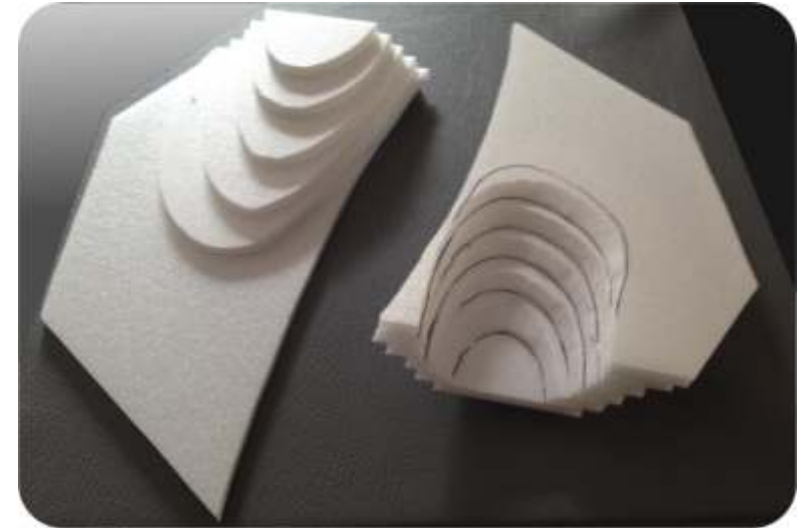


Note that the 6mm upper nacelle part should be proud - this is to facilitate final shaping without sanding away the bonded faces.



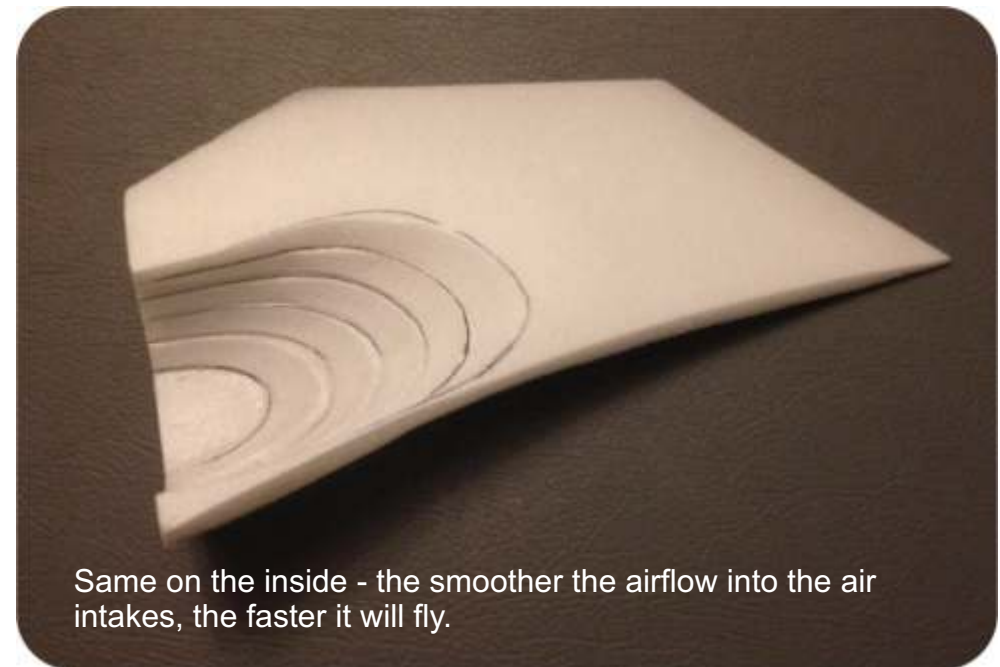
Using a sharpie fine liner to draw on the chamfer. below : Slightly trimmed, and glued together with uhu POR.

Construct the forward engine nacelles (Part 18). Start by bevelling the edges on each layer as per the plans. Each layer should align with the next until you have a complete assembly.



Using the contour lines, get the shape as close as you can.

PART 18

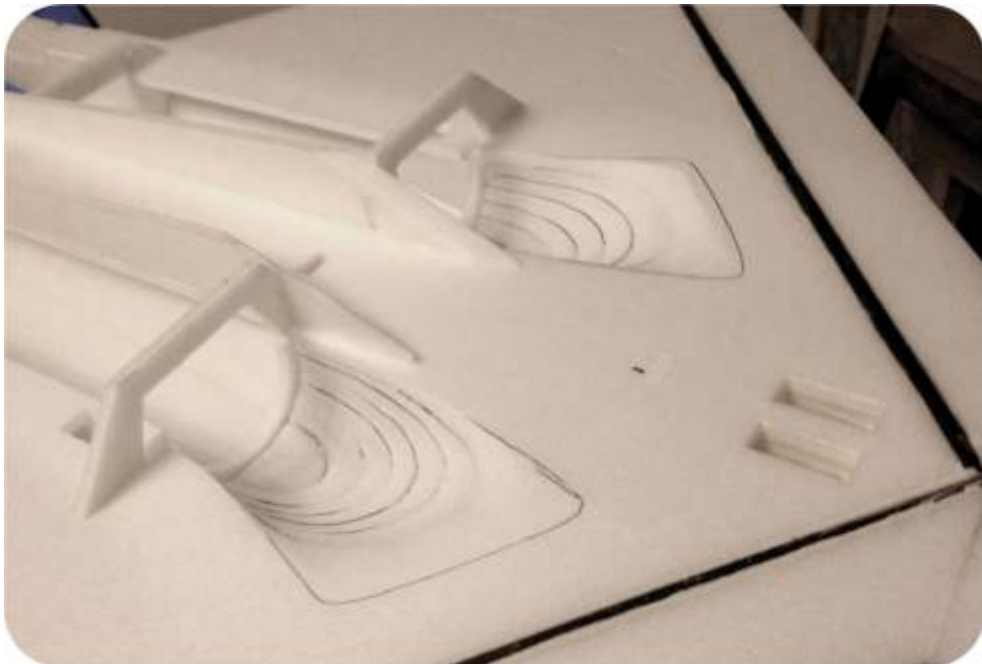


Same on the inside - the smoother the airflow into the air intakes, the faster it will fly.



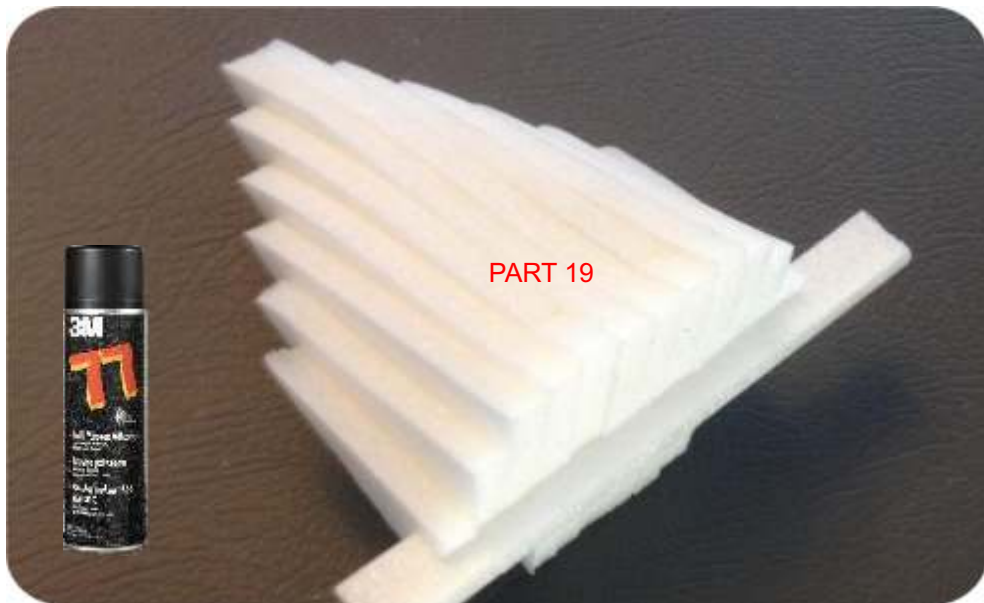
EDF VERSION ONLY - DON'T GLUE THEM ONTO THE WING ASSEMBLY UNTIL AFTER THE EDF UNIT IS MOUNTED! The 4mm lip is for supporting the bell-mouth of the EDF units.

PUSHER VERSION ONLY : Glued these parts on using UHU por. - it will need further sanding to blend into the main fuselage.

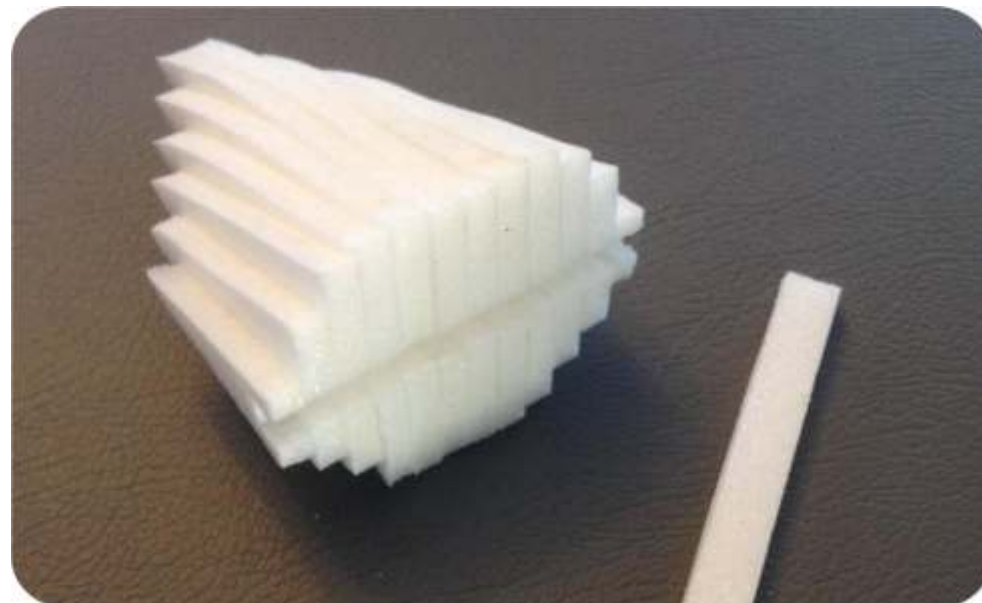


The underside shows the gradual transition between flat surface to the air intake. Using sandpaper, shape the transition to be a smooth and aerodynamic as possible

Note - see the EDF unit mounting flange to the rear of the contoured air intake area. If you are building a pusher, then this can be cut away and sanded flat to reduce drag.



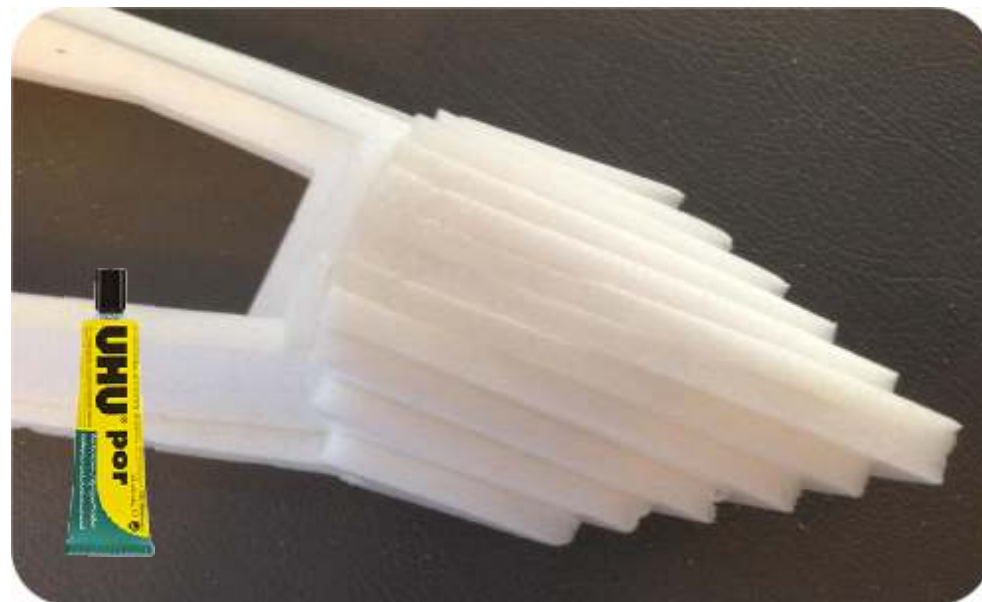
Assemble the nose cone (Part 19). Use a straight scrap piece of depron to align all the pieces (do not glue onto assembly!)



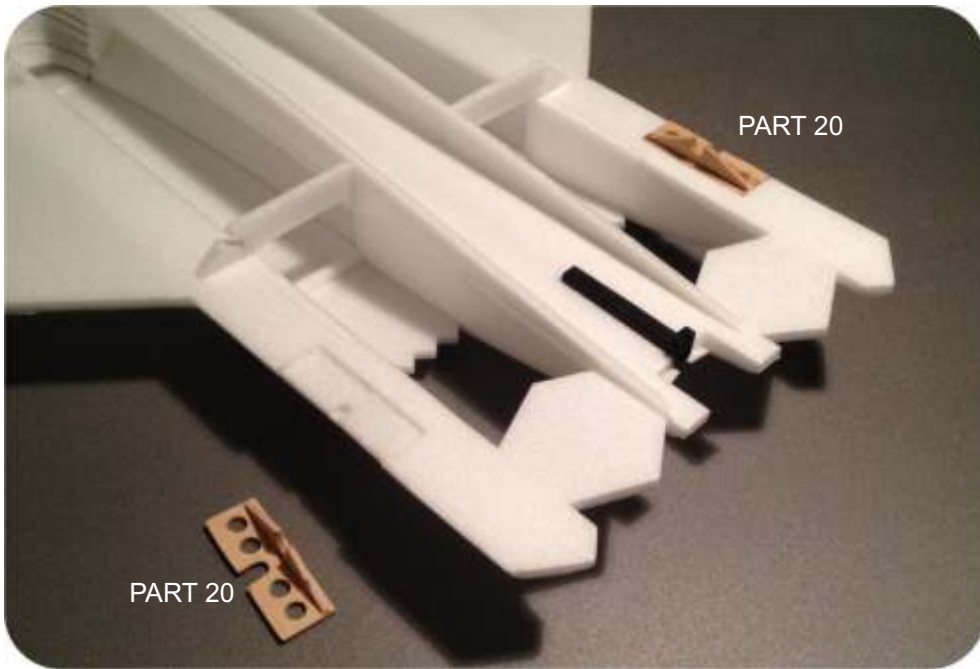
This leaves a keyway to locate the nose in the right place.



Locate into the fuselage on the centerline.



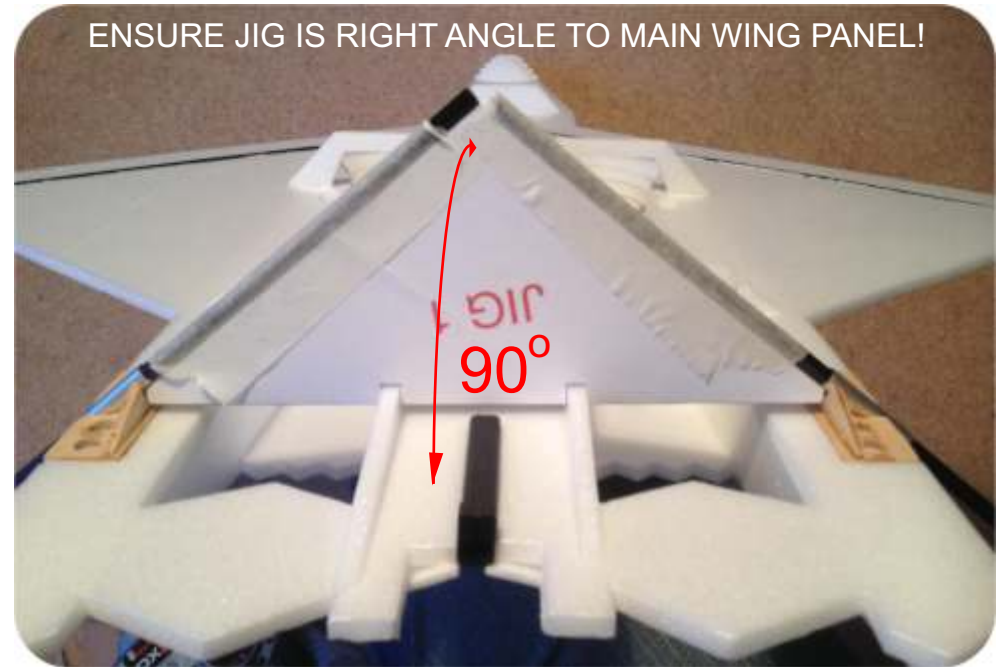
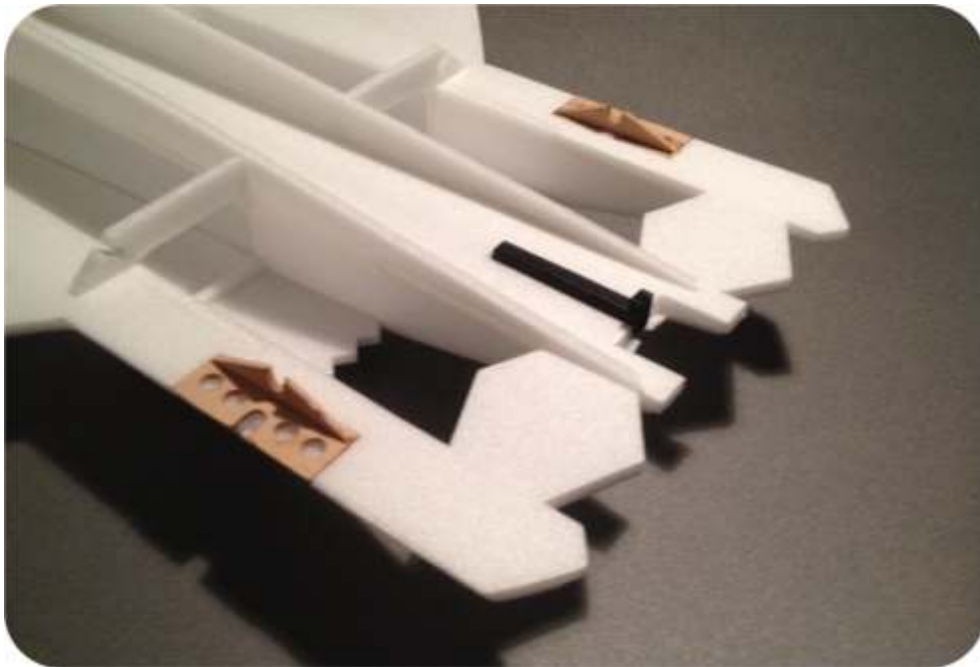
Bond using uhu POR

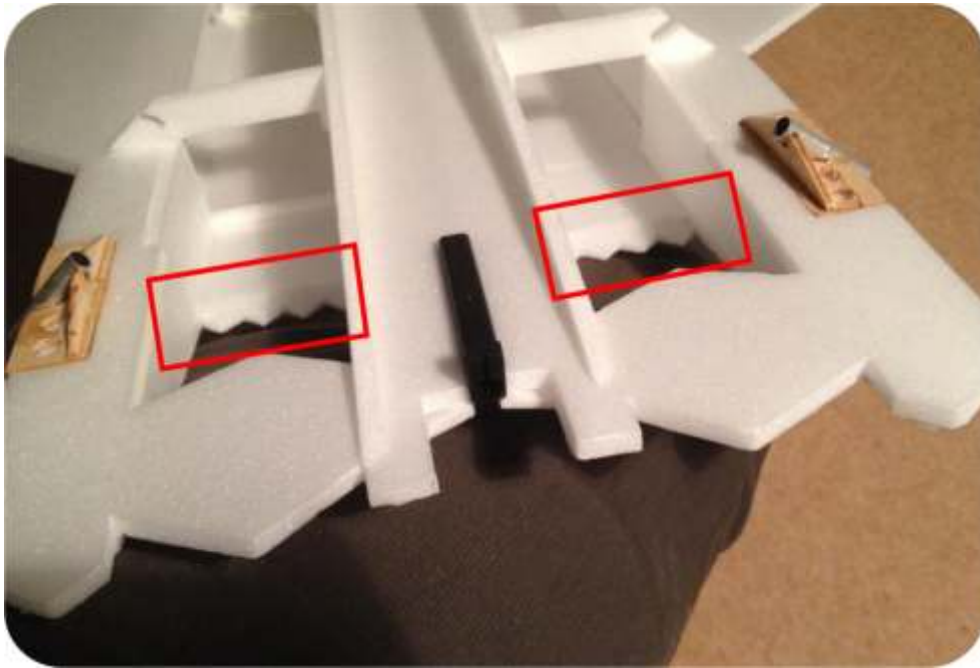


Assemble the plywood ruddervator support cradles (Part 20). Glue together and in-place using epoxy (sparingly).

Cut 2 off 40mm aluminium tubes 7.14 x .355mm (9/32 x .014")

Align using the jig shown below - glue the tubes as per this image :-

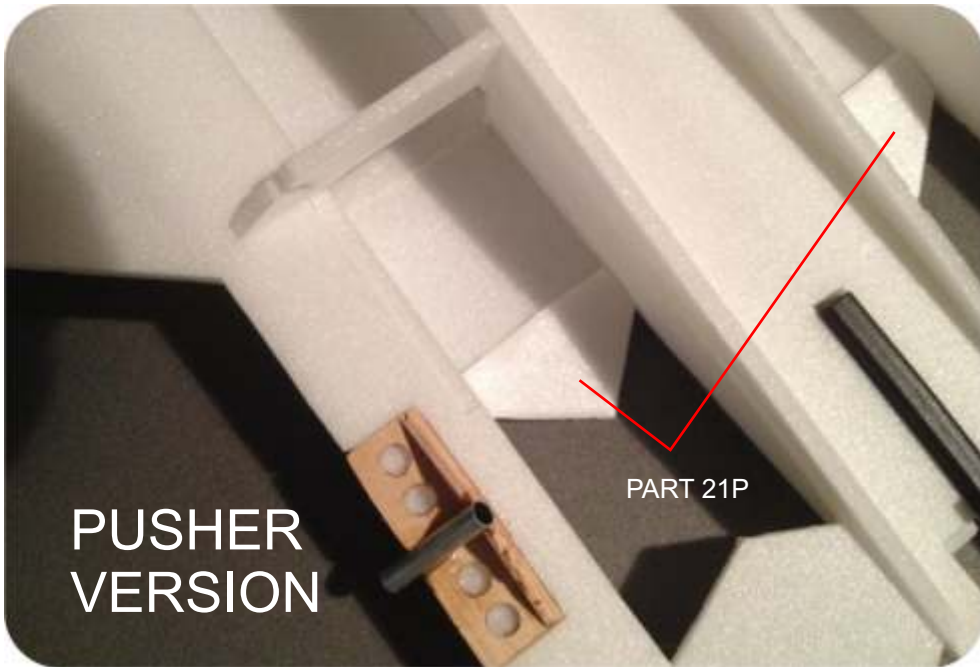




14. Sand away the underside of the trailing edge upper nacelle. Align sanding board horizontal to former bulkheads, then carefully pull away part of the former as shown.

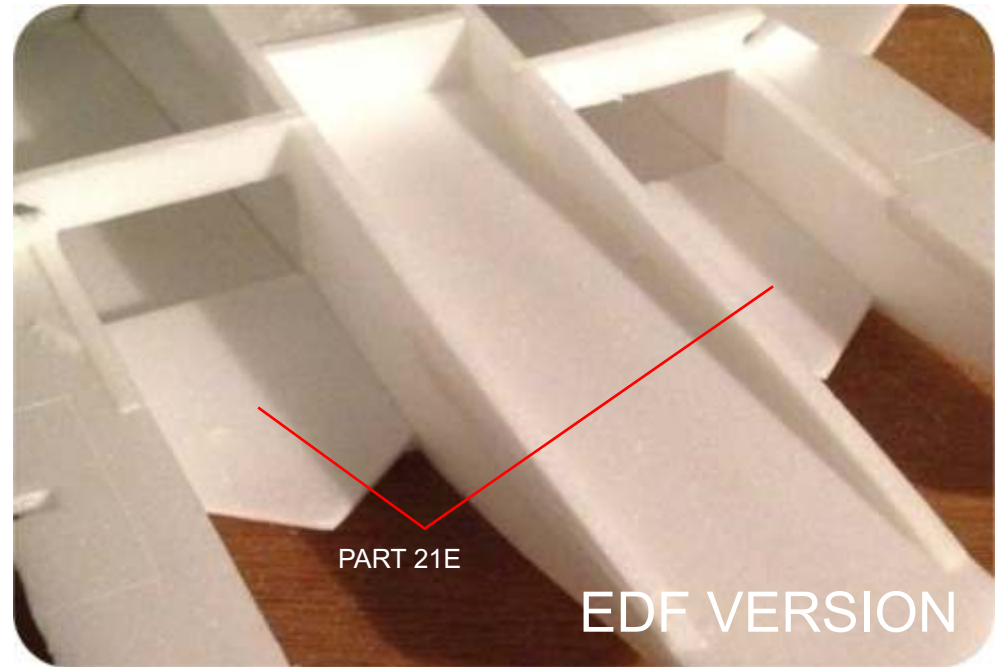
EDF Version. Fit the 3mm upper engine part (Part 21e) onto the bulkhead (this aligns the exhaust flow to neutral)

PUSHER. Fit the smaller 3mm upper engine parts (Part 21p). sand the leading edge to aid airflow. Trim away the lower part of the bulkhead as per picture.



PUSHER
VERSION

PART 21P



PART 21E

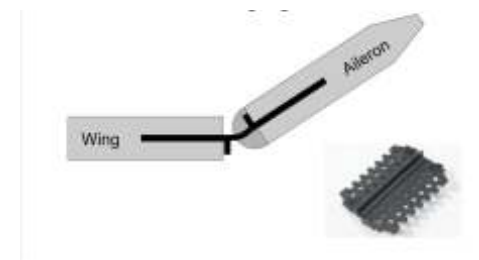
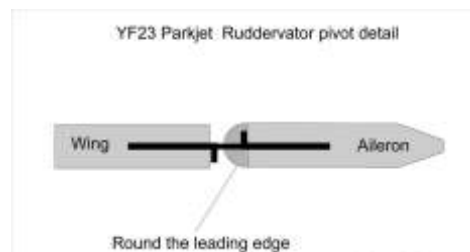
EDF VERSION



Apply lightweight filler / spackling to inside of the air intake, then sand smooth. (EDF version to remain separate)

Cut the channel for the aileron pushrods. I found that a small flat headed screwdriver works well to dig out the channels.

Prepare the hinges as shown, Cut two aileron horns from 1mm plastic sheet (Part 22). Hole drilled using pushrod for slop free fit



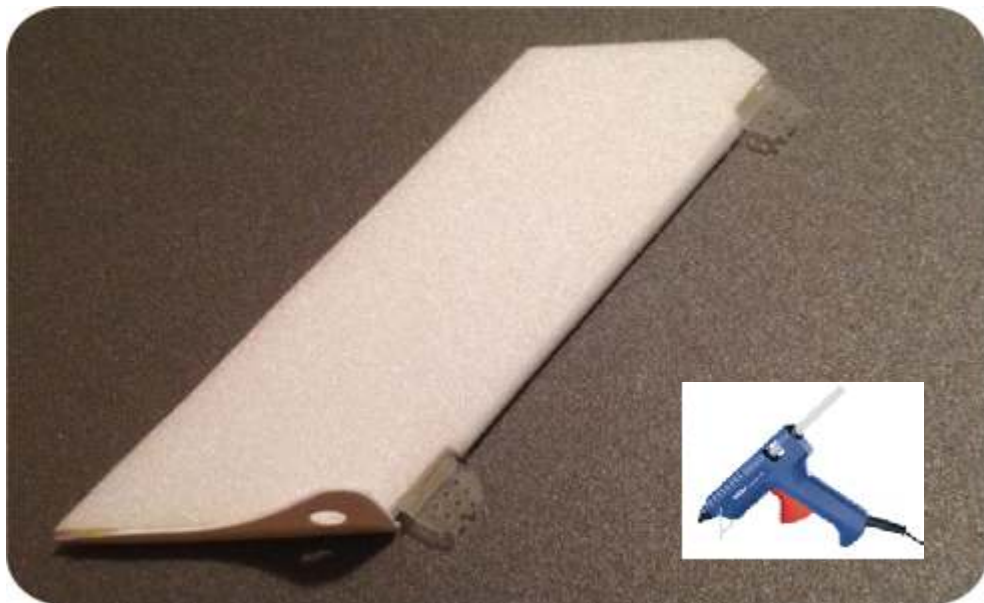
My preferred hinge



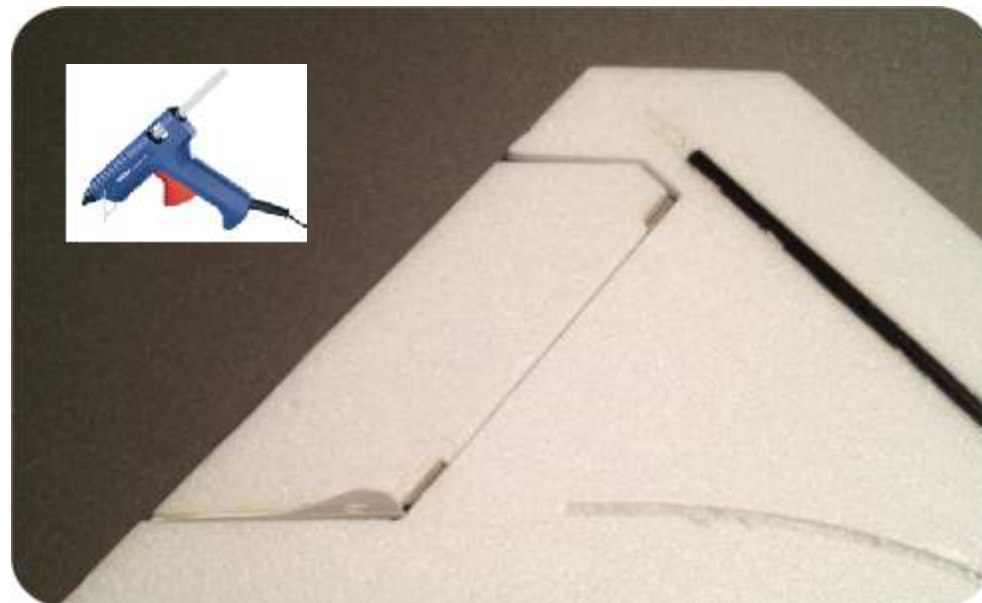
Cut in two



PART 22



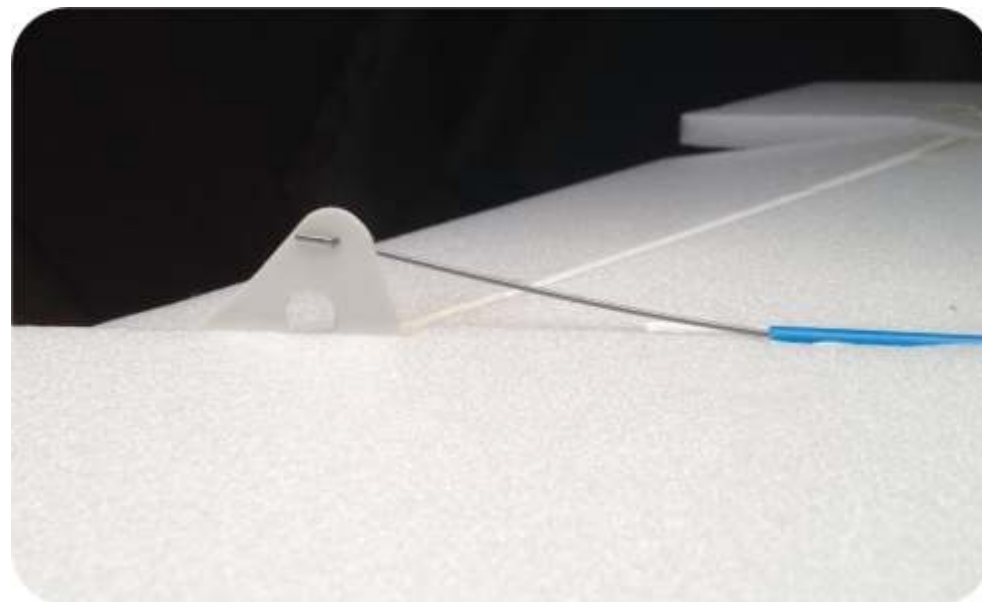
Aileron trimmed to allow clearance. Hinges recessed. Glued on using hot melt glue sparingly.



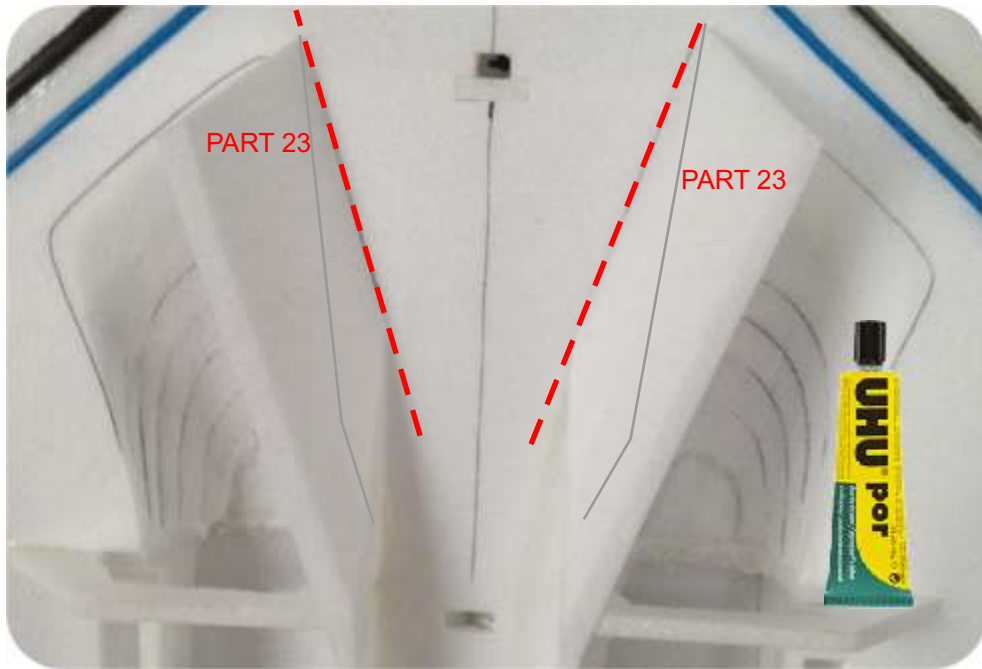
Glued into wing the same way



Pushrods made with z bends and sheathes glued using uhu POR (before fully set) - Also Foam safe CA may work (untested)



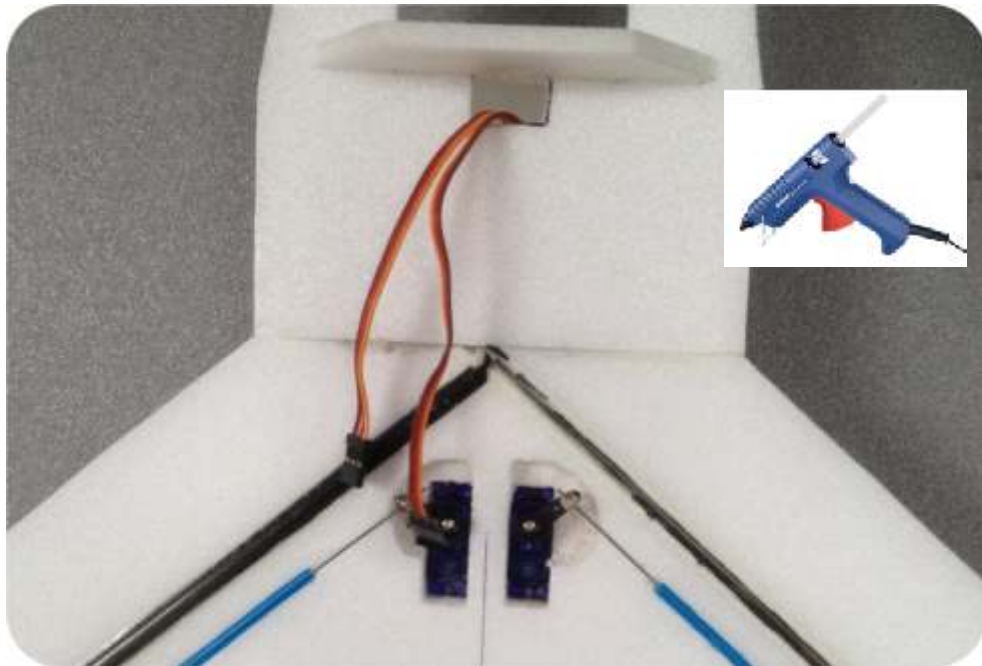
Z bend in horn

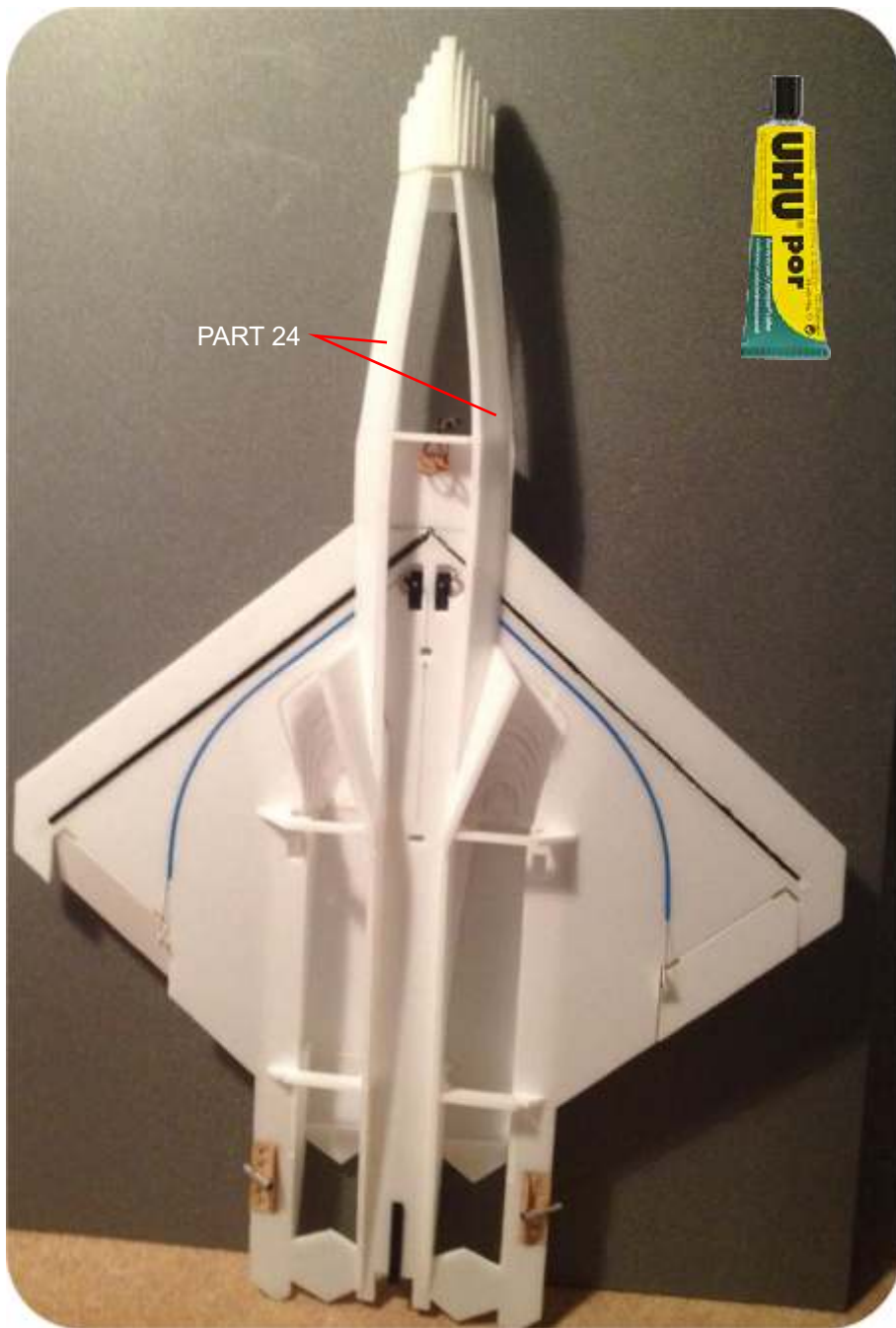


Stick on the air intake sides(Part 23) using uhu por following the lines you transferred from the main wing panel plan.

Cut away the depron to allow the servo horn to travel.

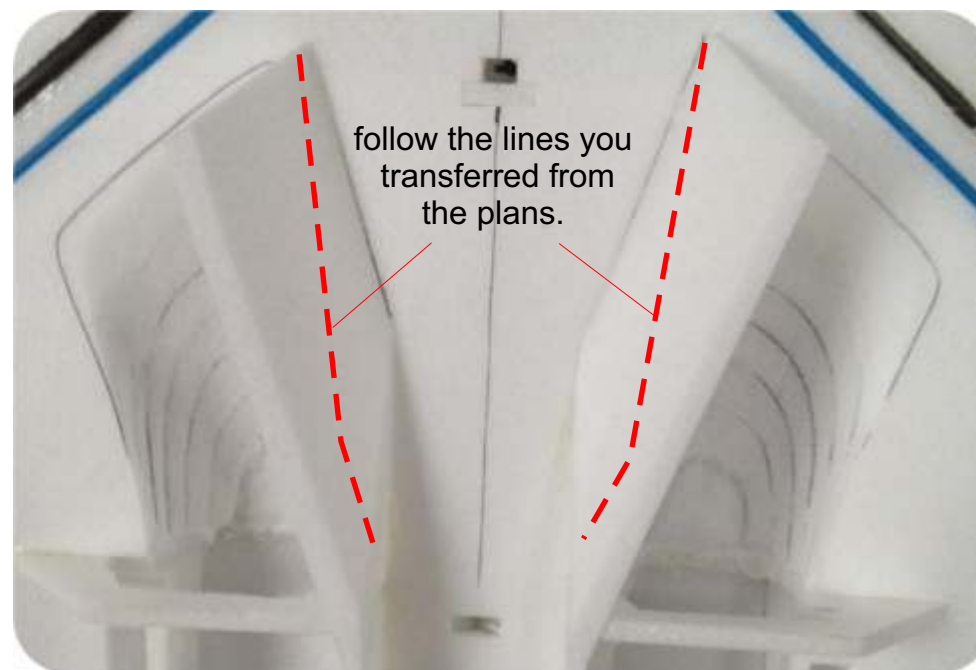
Thread the cables through the turtledeck as shown. Glue servos in using hot melt glue(sparingly). Use analogue, nylon servos to keep weight down.





Test fit the front lower fuselage parts (Part 24). These are drawn slightly oversize in order for you to sand down to get a precise fit into the assembly.

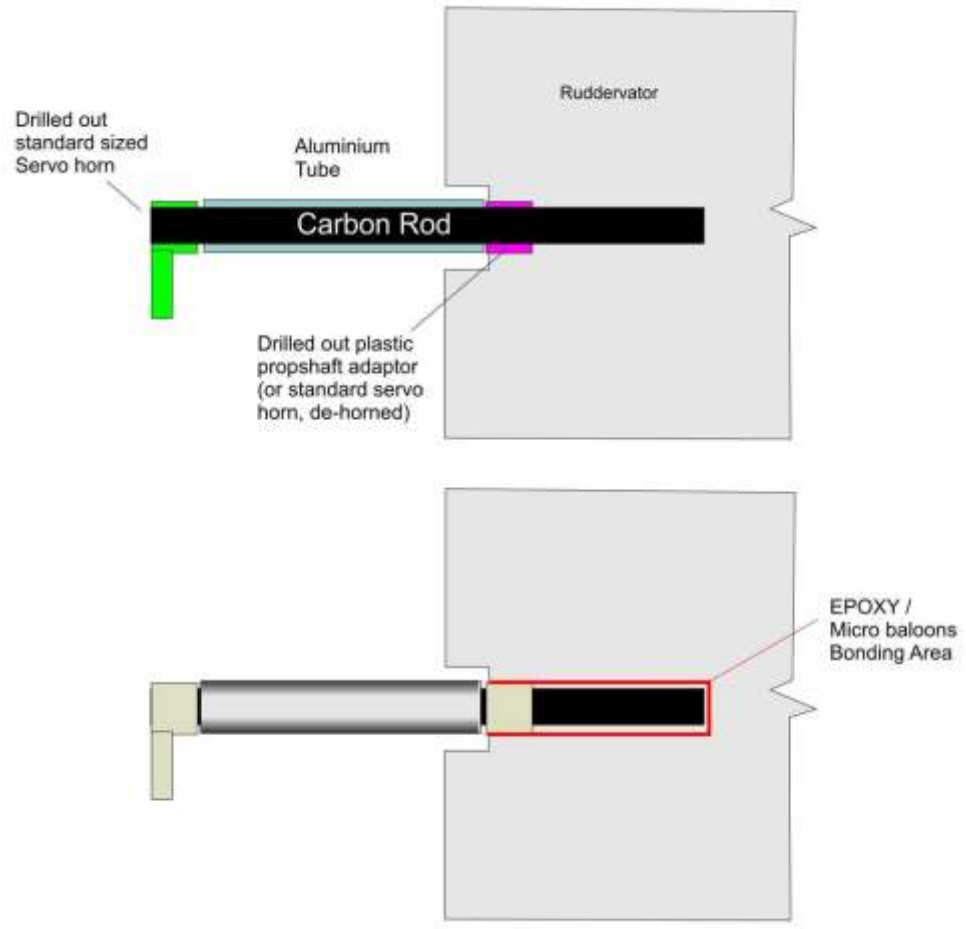
Use the **lower fuselage base** along with the lines drawn on the inboard intake sides, to get correct alignment. This can be a little tricky getting it right, so I suggest extra care at this stage.

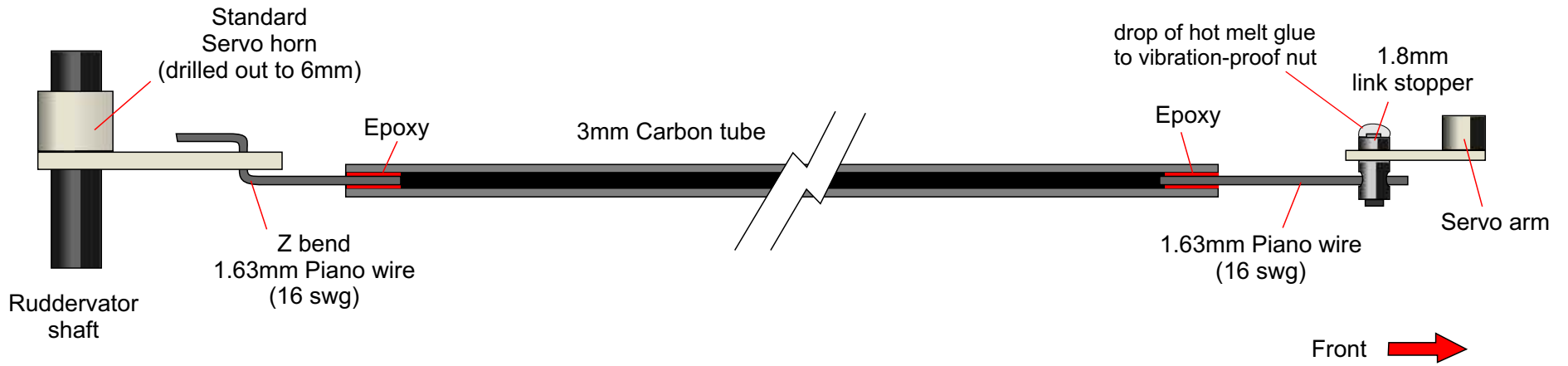




The diagram below shows the ruddervator (Part 25) pivot method.

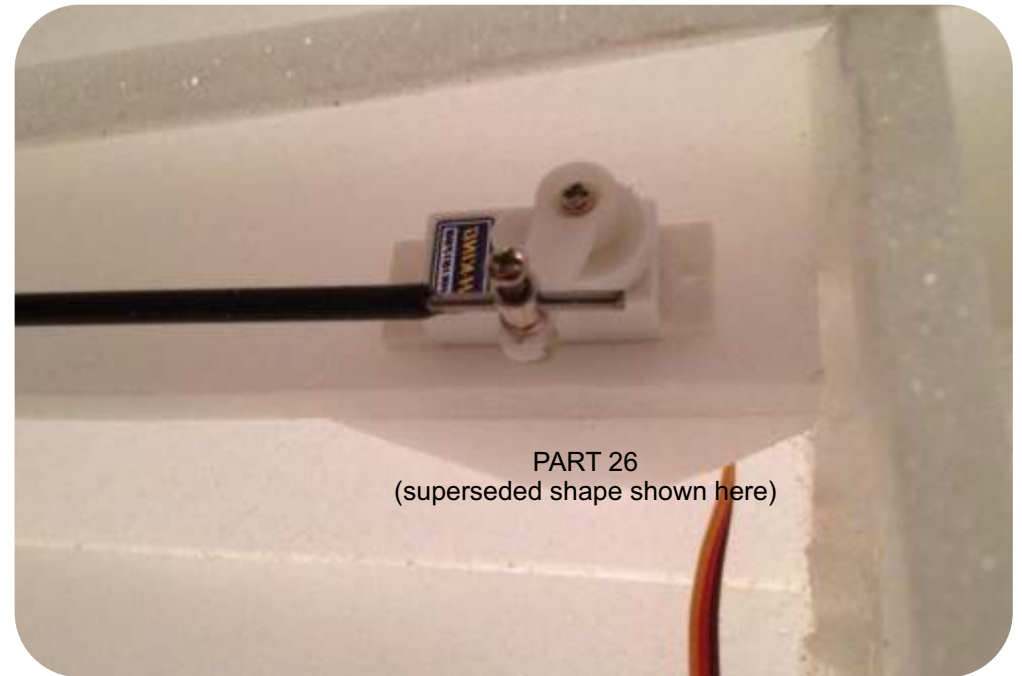
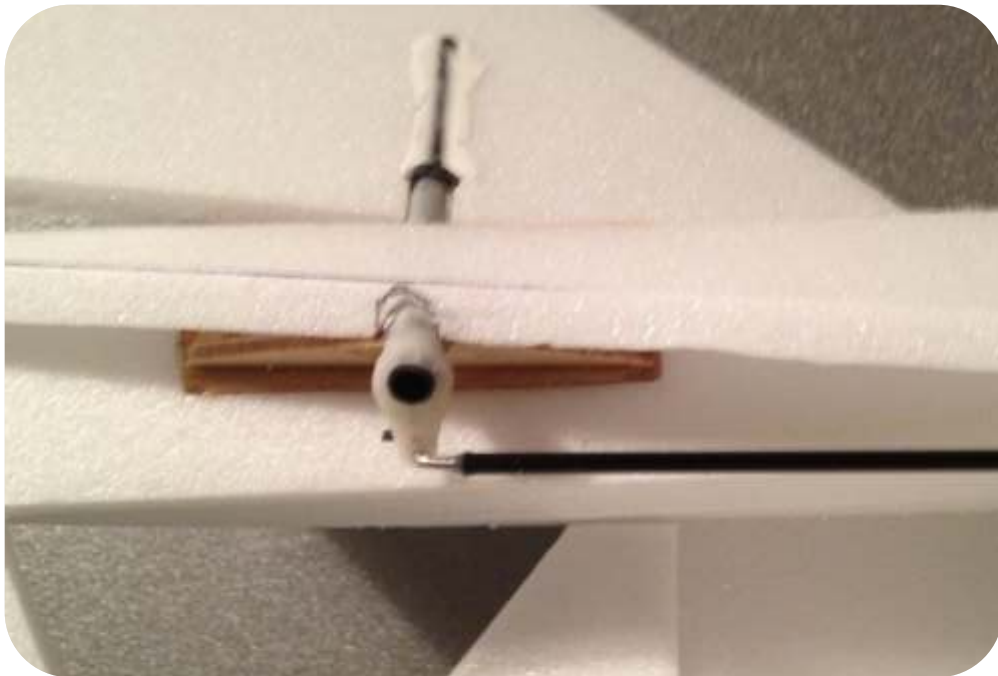
Use 3m scotchtape (approx 70mm) tightly wrapped around the carbon tube to reduce slop in the pivot.

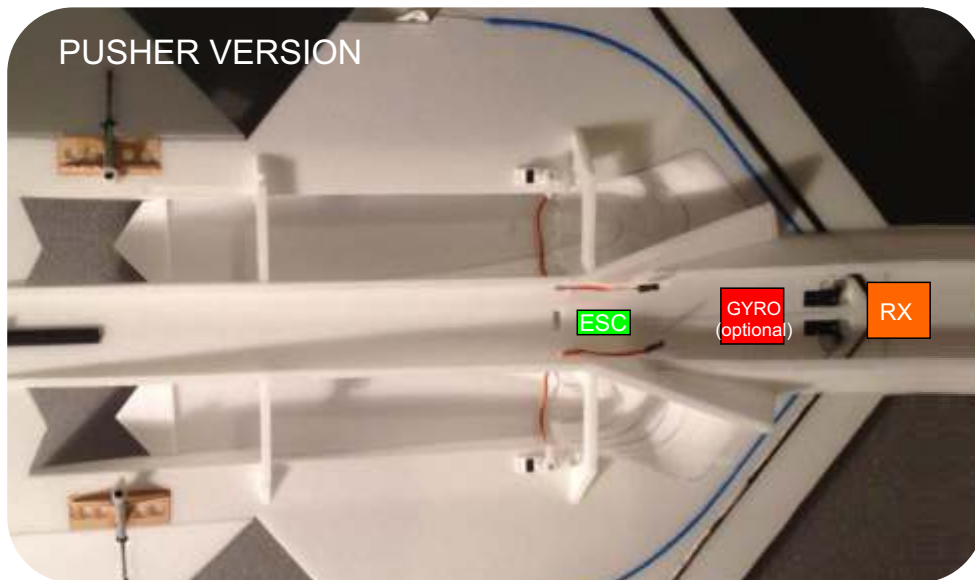
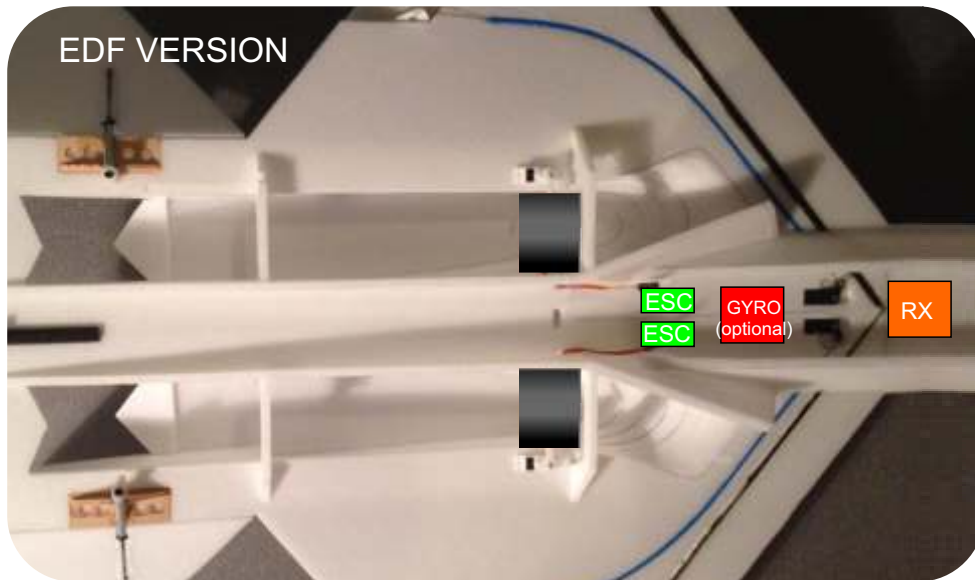




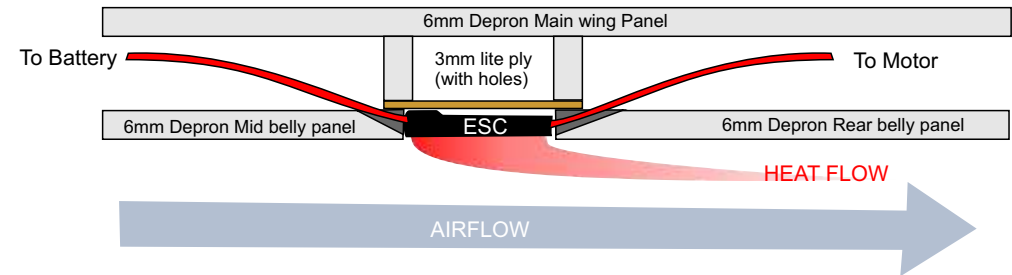
10mm Axis to Axis

13mm Axis to Axis





Speed Controller



The Speed controller is mounted on a specially designed 'bridge' that holds the flat heat dissipative surface outside the aeroplane, whilst not disrupting the aerodynamics.

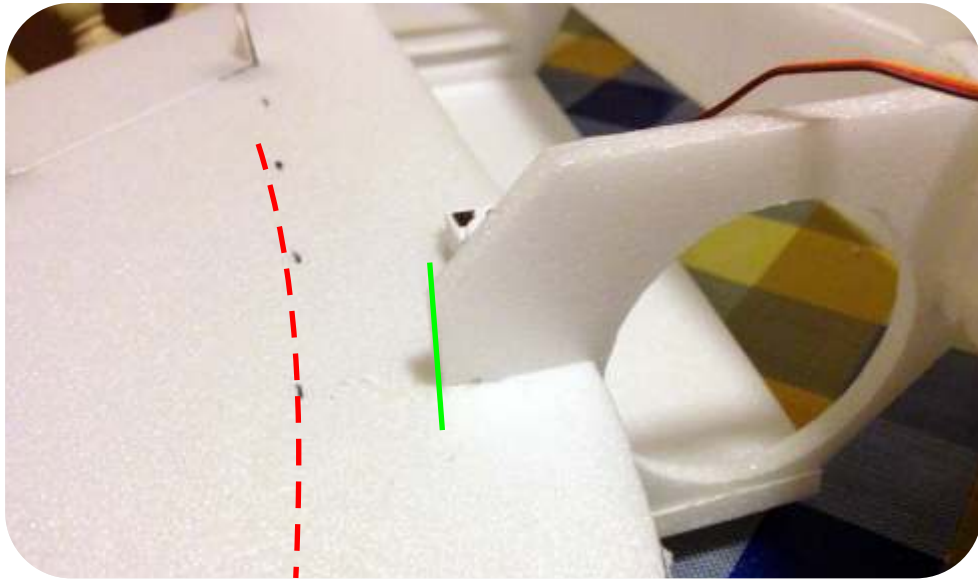
Gyro / Stabiliser

The Gyro / Stabiliser works best if it is as close to the aerodynamic centre as possible.

Receiver

I suggest you mount the receiver forward as it is cleaner to wire, as wires can pass through the turtledeck and come out in front of it. As it is away from the EDF units particularly, perhaps there will be less Electromagnetic interference. Its position also helps to keep as much weight forward as possible.

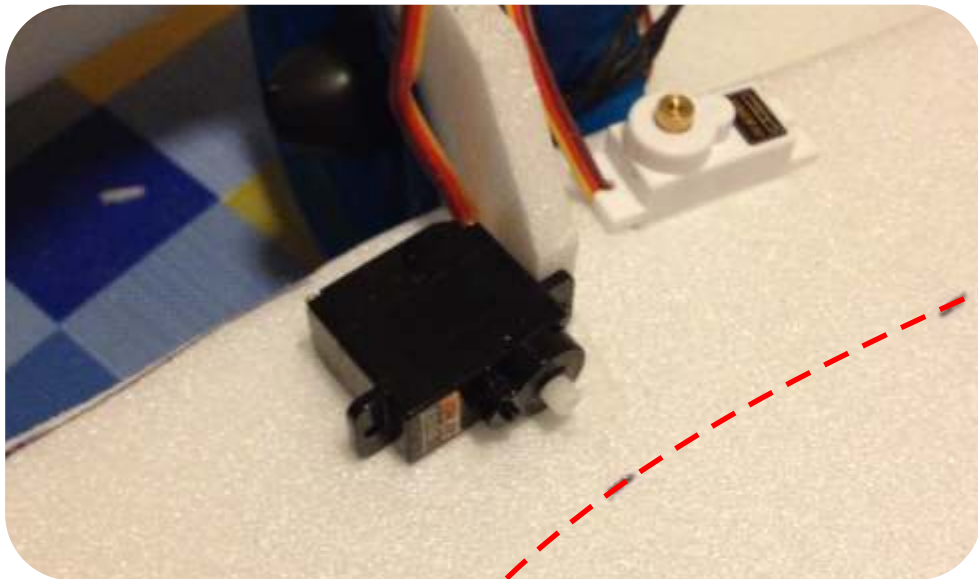
Electronic locations



Inboard Flaps (optional)

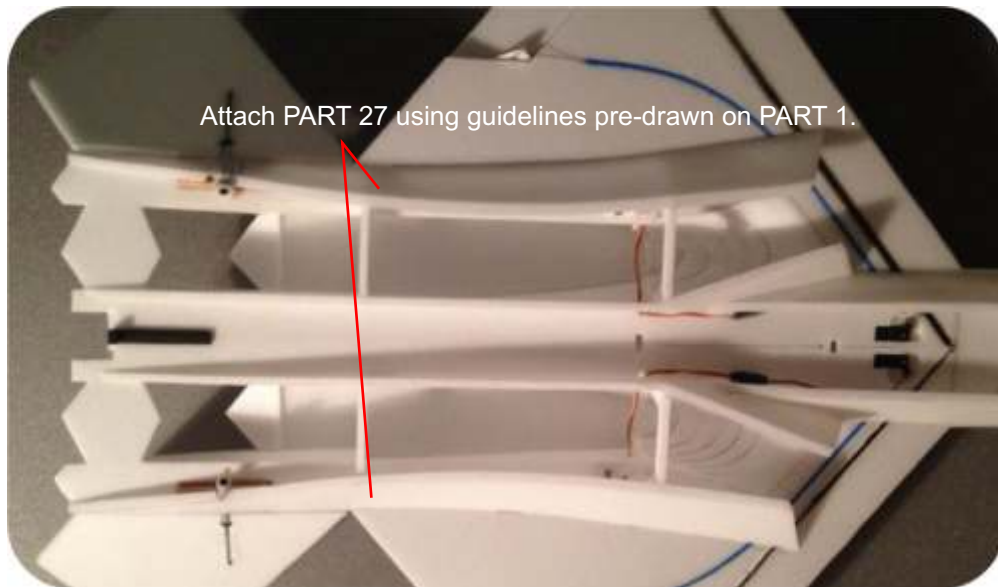
To mount the servos for the inboard flaps, firstly trim the bulkhead as shown (green line) as identified on the plans.

The red line denotes the outboard edge of the lower fuselage.

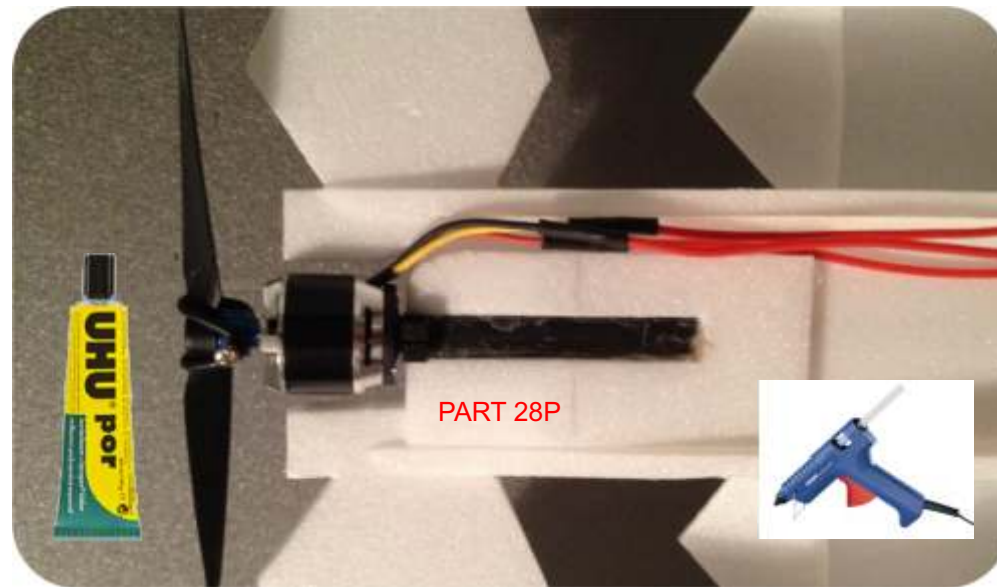


Position the servo mounting flange onto the edge of the bulkhead. Align the servo to run parallel with the outboard edge of the lower fuselage side pieces (Part 27). Glue in place using either UHU Por or Hot Melt glue.

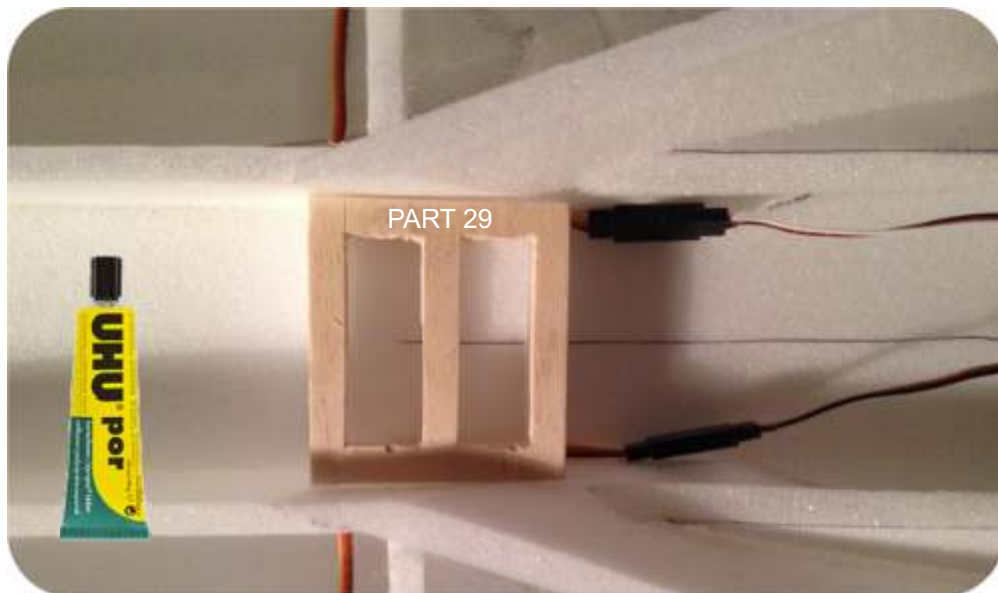
When attaching the lower fuselage side pieces (Part 27), press them into place, with the servo in place. This will indent the depron with the position of the servo arm. Use the indent as a guide to cut away a hole for the servo arm to pass through.



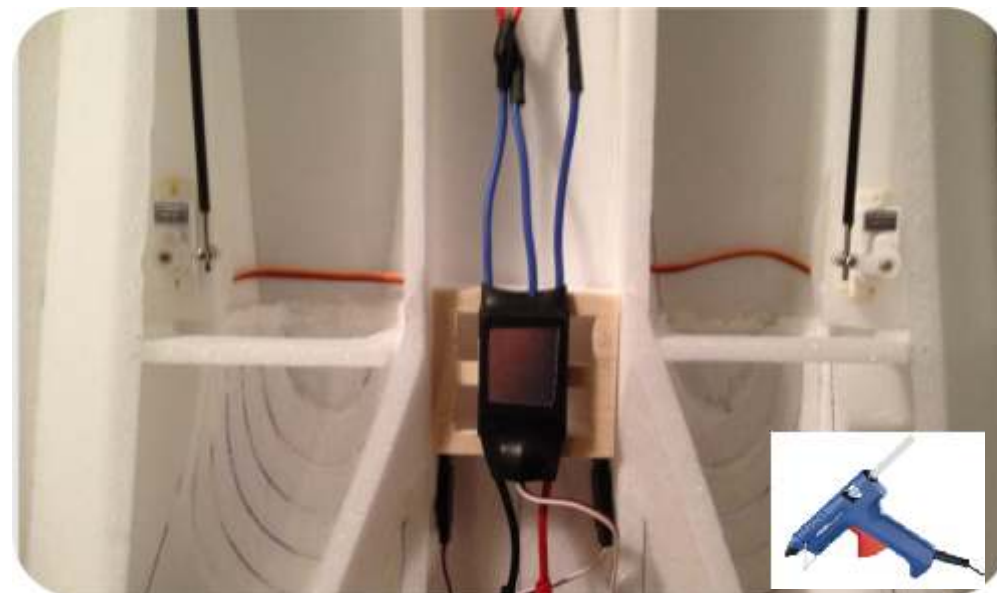
Glue the ruddervator servos into place, and thread the servo cable around the underside of the upper nacelle, Cut holes in the main wing panel and thread the cable through as shown.



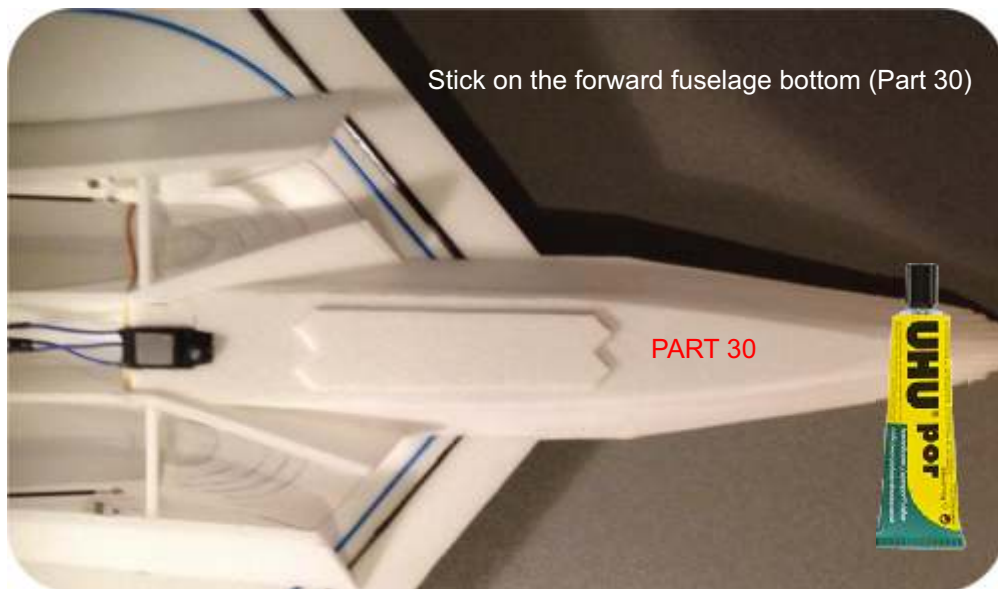
Using UHU Por for the depron, and Hot melt for the stick mount, fit the stick mount support panel in (Part 28p). Solder the motor cables and mount the motor as shown.



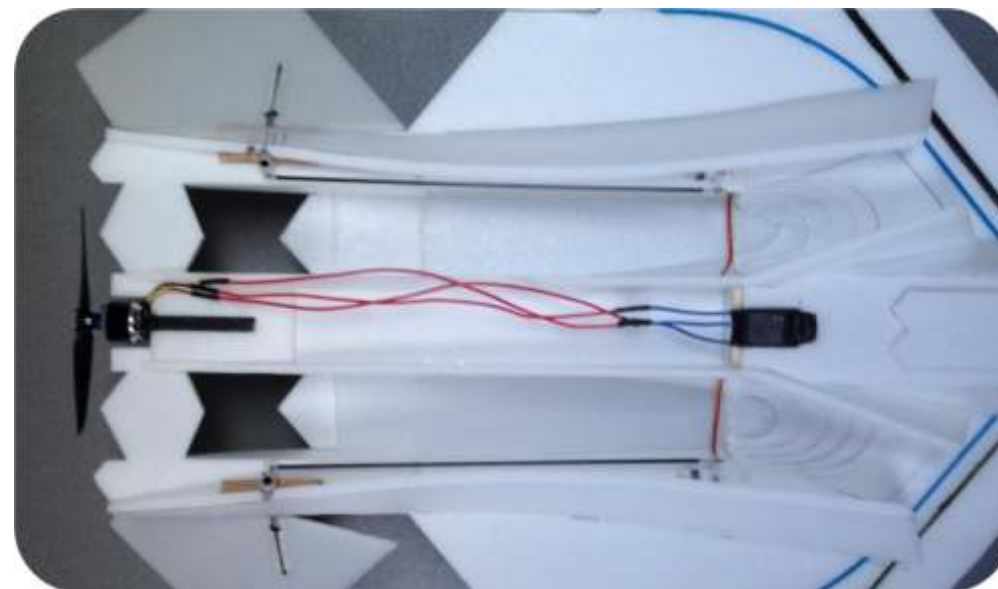
Build the ESC bridge as shown using UHU Por.



Mount the ESC centrally on the bridge as shown using Hot melt. Cut the heat shrink away on the cooling surface as shown.



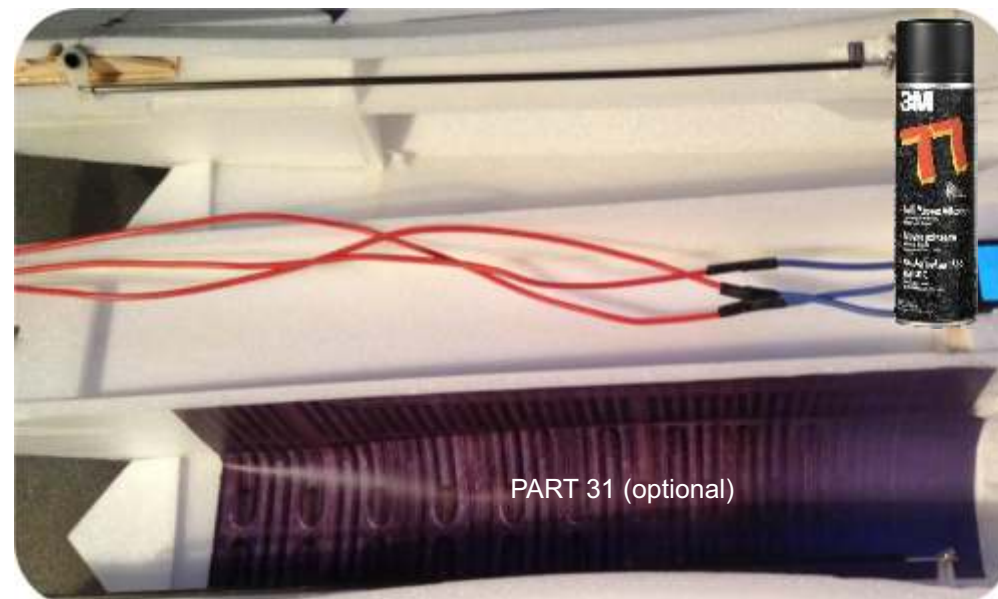
Construct the electronics access hatch and supports as per the plan. Use a single rare-earth magnet to keep it closed. Create a plastic 'antenna' as a finger grip (not shown) - fix with hot melt.



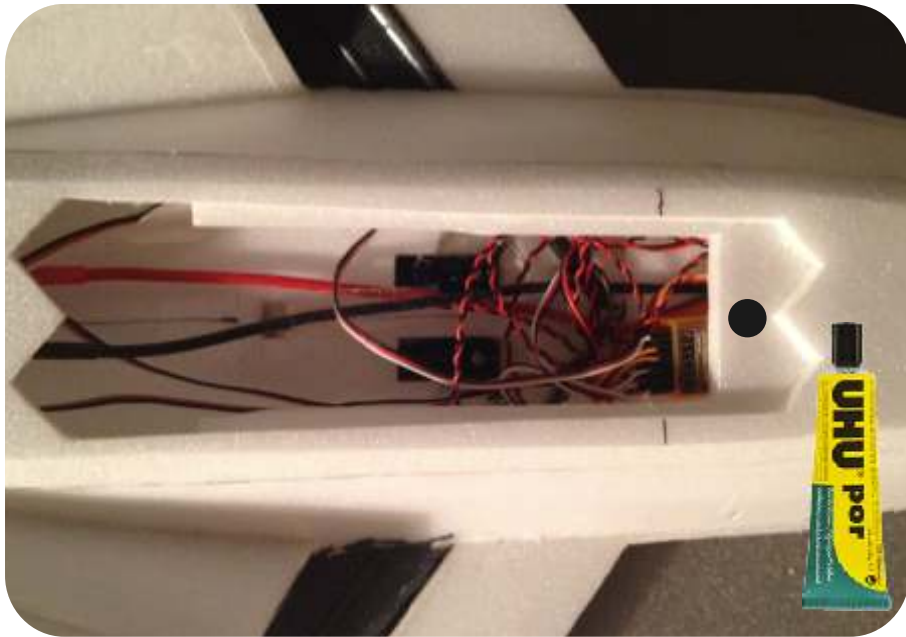
PUSHER ONLY : Cut away the front and rear bulkheads to reduce aerodynamic drag using a sharp knife.



Stick the servo cables to the nacelle using UHU Por.



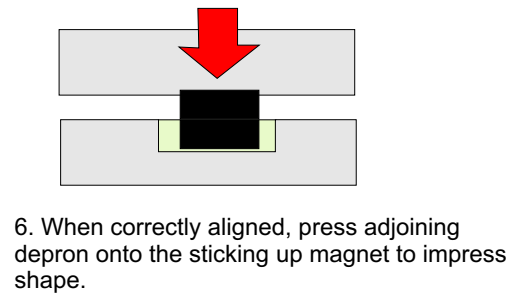
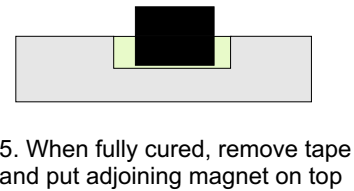
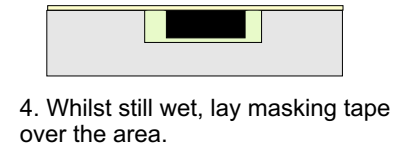
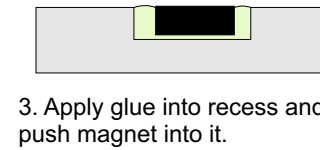
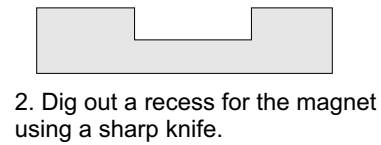
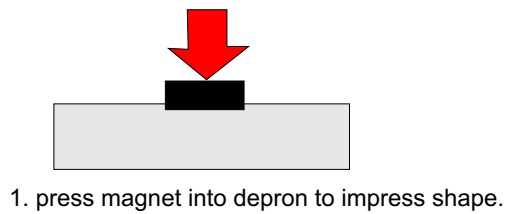
PUSHER ONLY : Cut and glue the paper ducting into place using 3m77 spray glue. Ensure good bond around the edges.



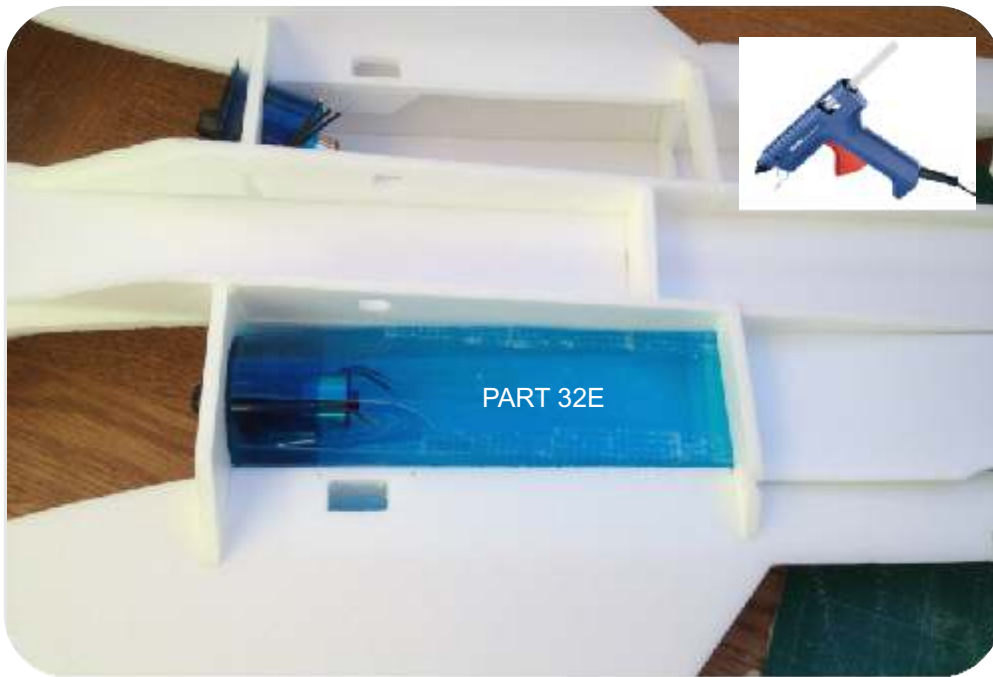
Attach the electronic access panel hatch flange using uhu Por.
 Attach the flange to the hatch. along with an 'antenna' style handle.
 Secure the hatch using a rare-earth magnet using epoxy.



Rare-earth Magnet attachment process



IMPORTANT.
 Before glueing the upper magnet in, check that the magnet is the right way around!

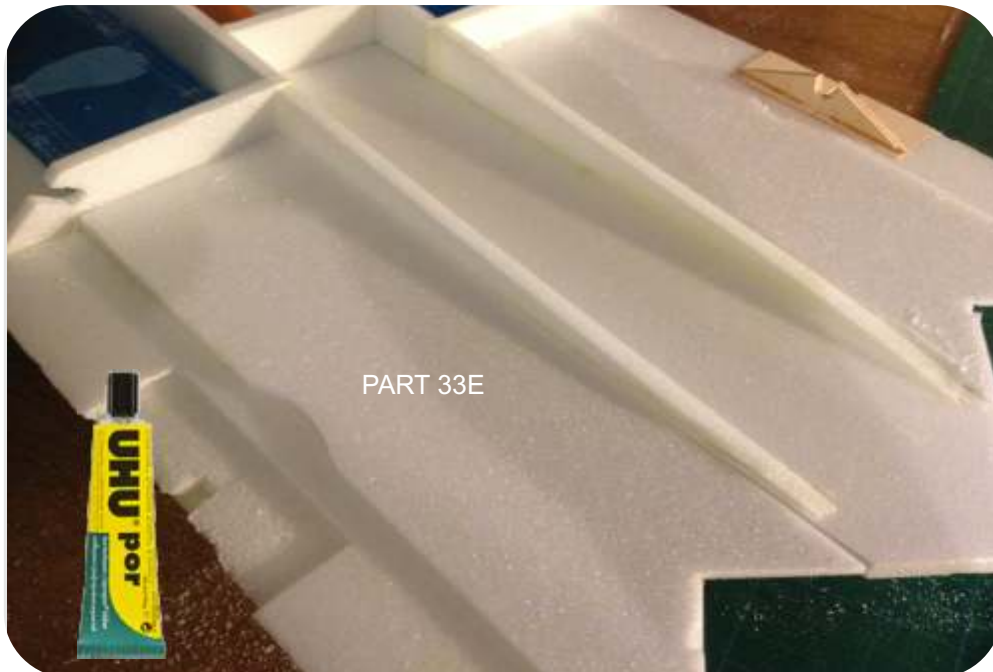


EDF only. Construct the Circular-to-rectangular ducting from Plastic sheet (Part 32E) carefully taped with nylon reinforced tape. The ducting has a slight 's' wave in it as it goes to the rear to help airflow.

The ducting is designed to sit within the rear bulkhead along with the 3mm lower exhaust panels. TRIAL FIT - see instruction below.

After this fix in the ducting carefully using hot melt glue. Use sparingly to keep weight down, and to avoid melting the depron or ducting.

(please note this image is from an earlier design - the surrounding details & build stages are different)

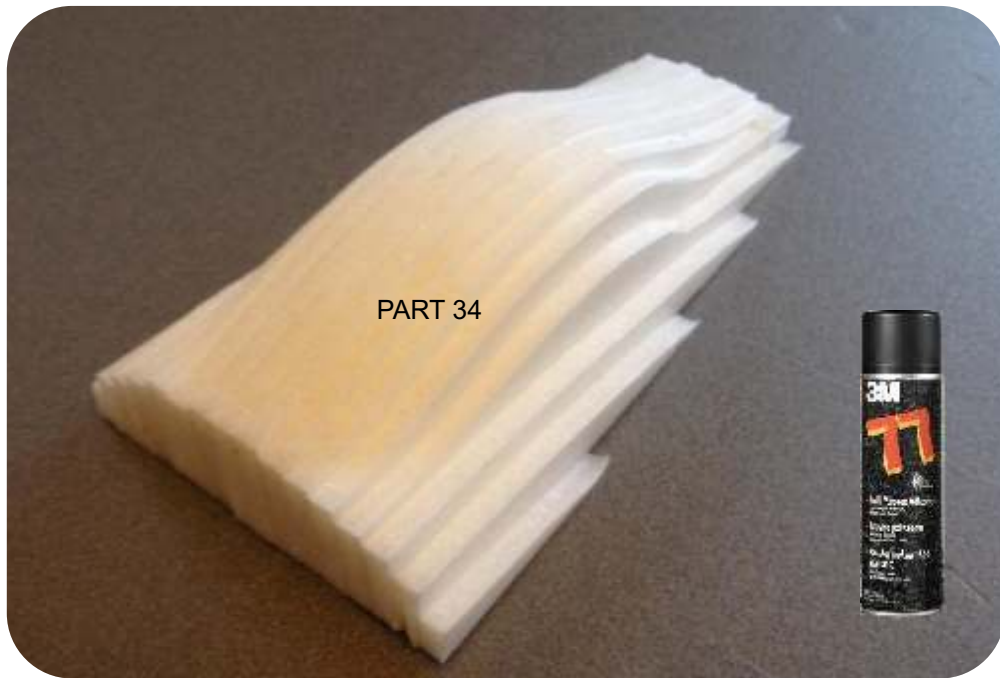


EDF only.

Cut away the main wing panel support pieces (that hold the tail together)

Glue the 3mm exhaust panels (Part 33E) using UHU Por. The exhaust panels sit against the inner vertical exhaust pieces, and lay flat on the wing assembly at the other side.

(please note this image is from an earlier design - the surrounding details & build stages are different)



Using 3M 77 glue, laminate the canopy parts and assemble (Part 34). If you are building the clear plastic canopy version, this is detailed later in the manual. Keep the parts 90 degrees from a flat surface - pressed up against another vertical surface such as a book end to improve alignment.

Sanding and Shaping will be done at a later stage.

Use rare-earth magnets at the rear of the canopy to attach the canopy to the aircraft. Glue a depron strip into the cockpit using epoxy to receive them.

(please note this image shown below is based on a clear plastic canopy & detailed cockpit version demonstrated in the finishing guide)





29. EDF ONLY - Cut the Air intake ducts out of 3mm depron (Part 35) and use a heat gun/ hairdryer to shape the rear edge to a semi-circular shape. Using sandpaper on a flat surface, taper the leading edge as shown.

30. Using 3m Gift tape (purple one) tape the slits together and carefully glue into place. Try to make the airflow into the EDF units as smooth as possible.

(please note these images are from an earlier design - the surrounding details & build stages are different)





EDF version : (please note this image is from an earlier design - the surrounding details & build stages are

EDF - smooth and paint (if required) the inside of the air intake's with a little spackling filler (lightweight filler). Glue both air intake nacelles in place with UHU por.

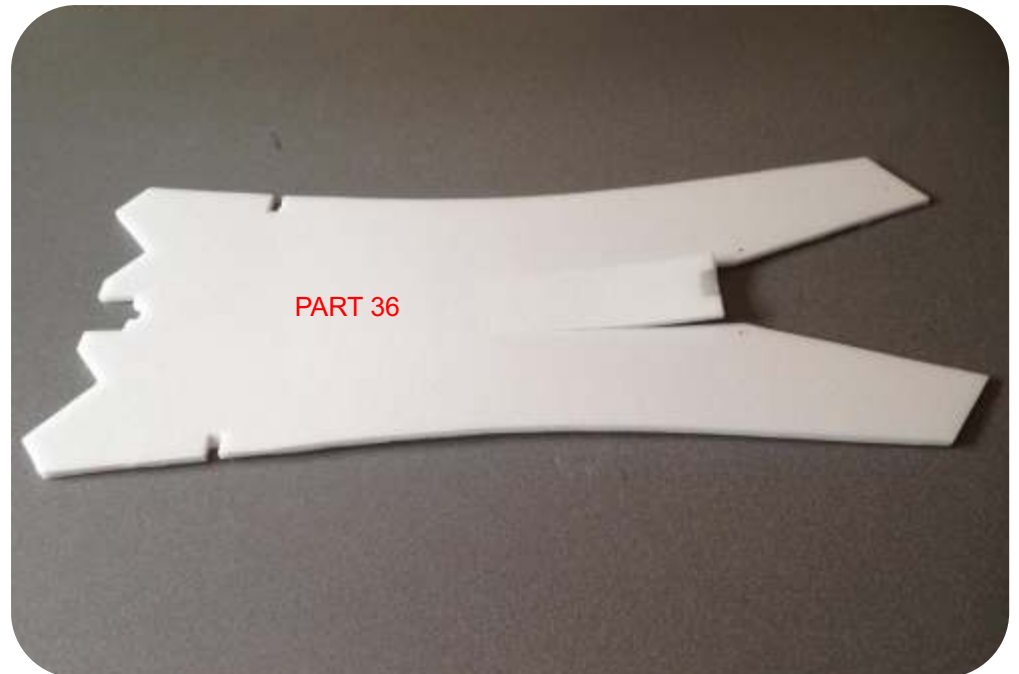
PUSHER - Paint the inside of the air intakes (if required). Secure the paper ducting if neccesary.

Both. Using the inner engine exhaust as a guide, trim the lower rear fuselage pieces so they are completely in line.

Trim the underbelly (Part 36) to fit around the ruddervator pivots and esc wires. curve the panel to give a good fit all around and glue into place.



Pusher version

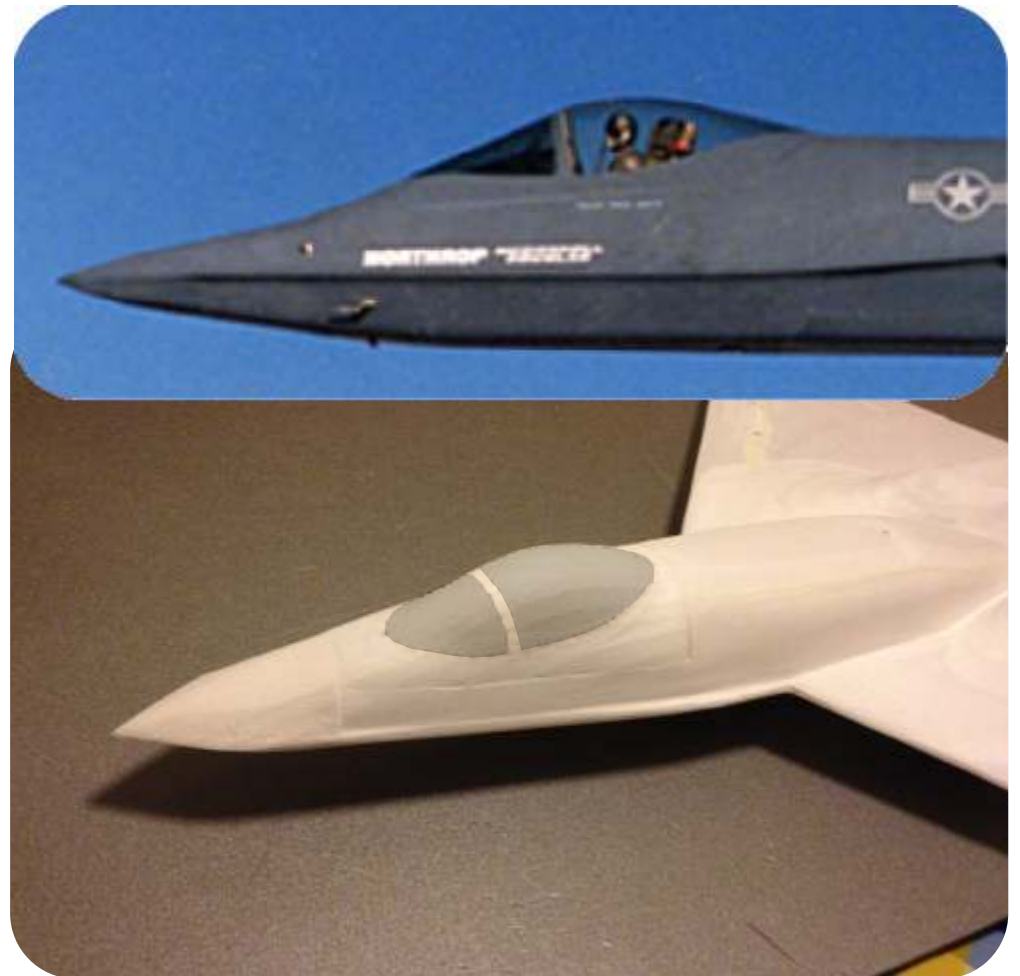
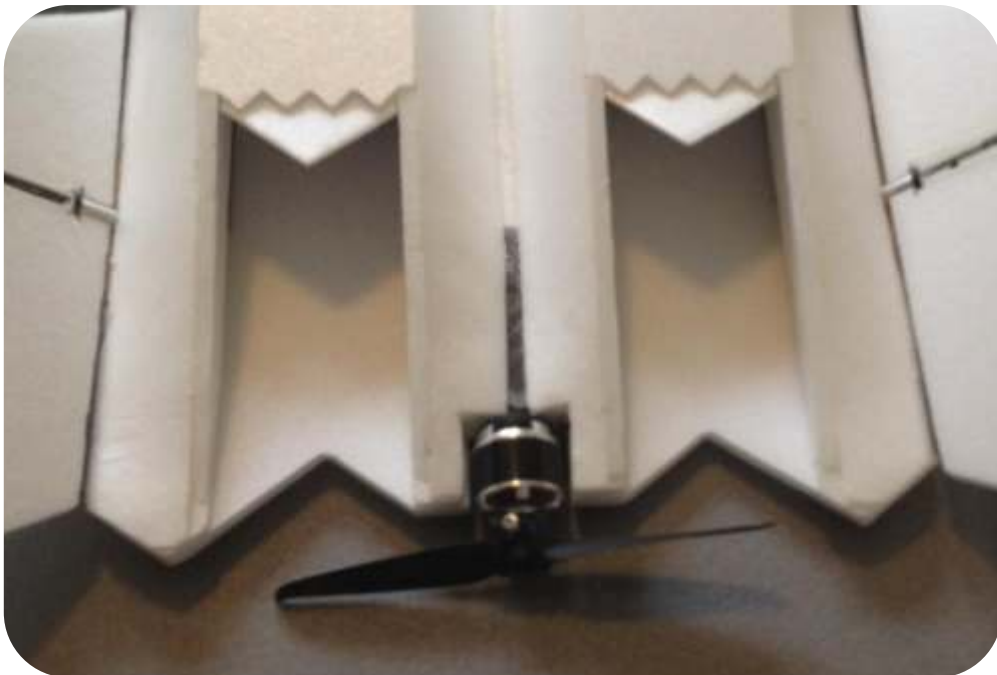


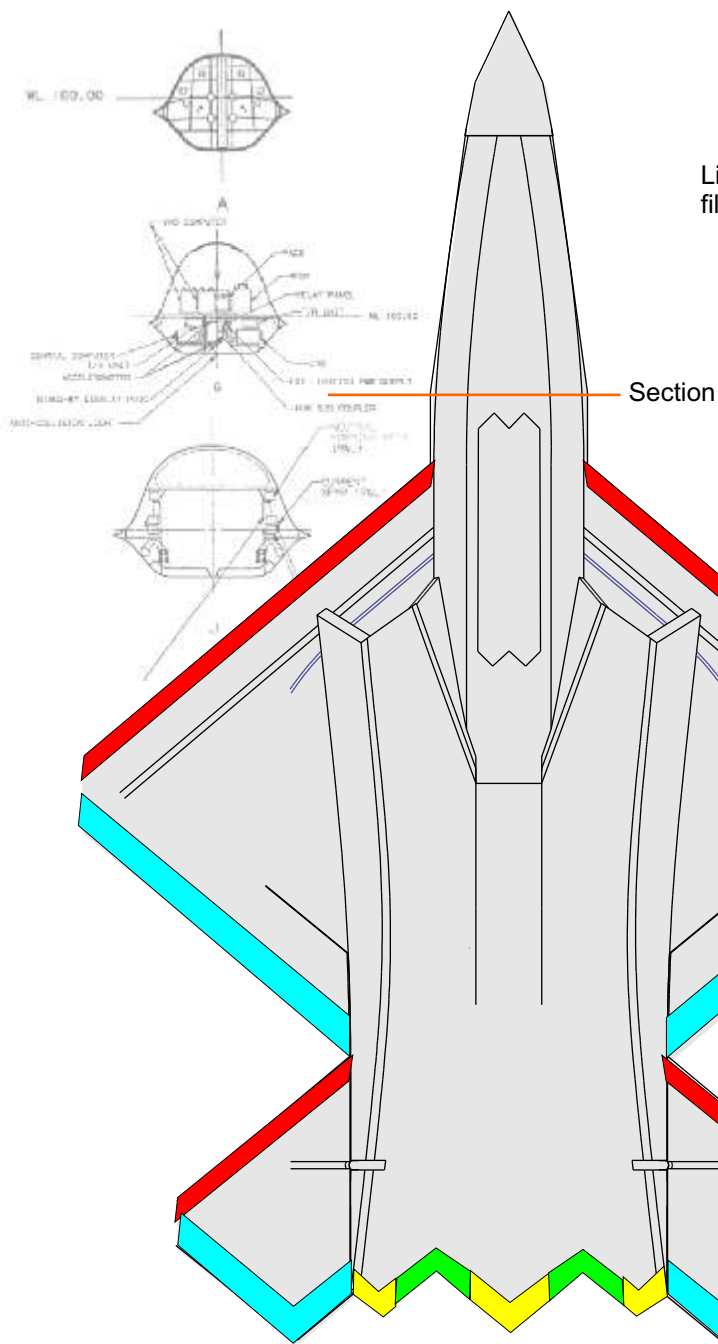


Glue the underbelly on, and carefully check the travel of the ruddervators to ensure free movement. Use a narrow sharp knife to trim away excess depron if required.

Turn the model over and trim away the retaining support pieces to reveal the full engine exhaust.

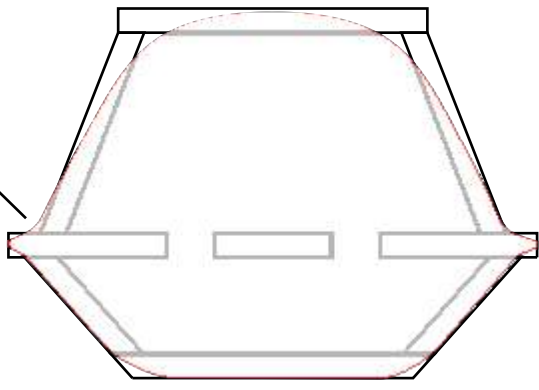
Sand the nose and cockpit to shape using photos of the real plane and the contours as your guide.





Section (Not to Scale)

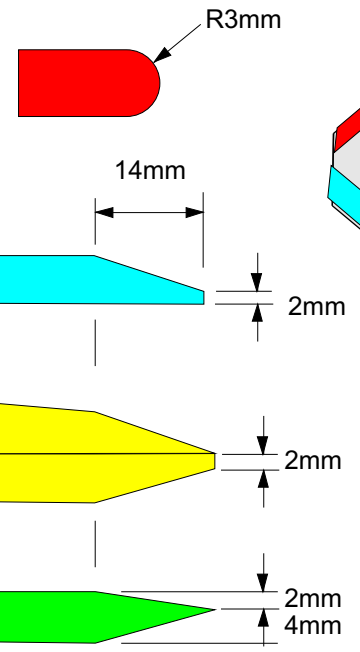
Lightweight filler in edge



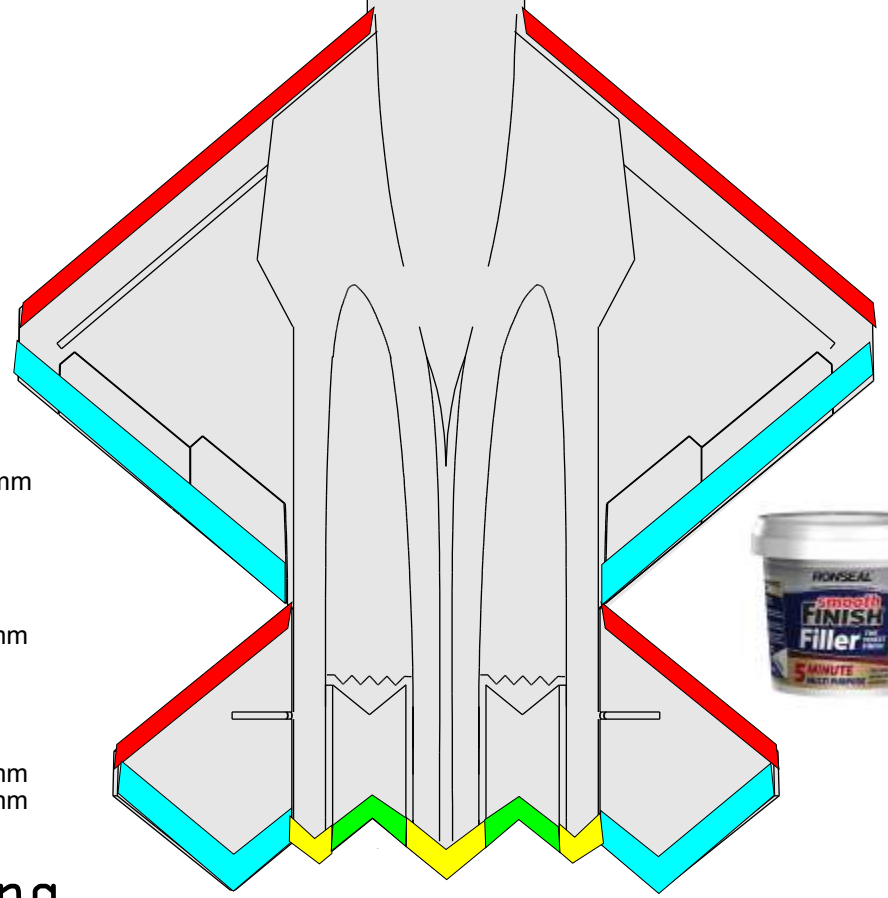
Section

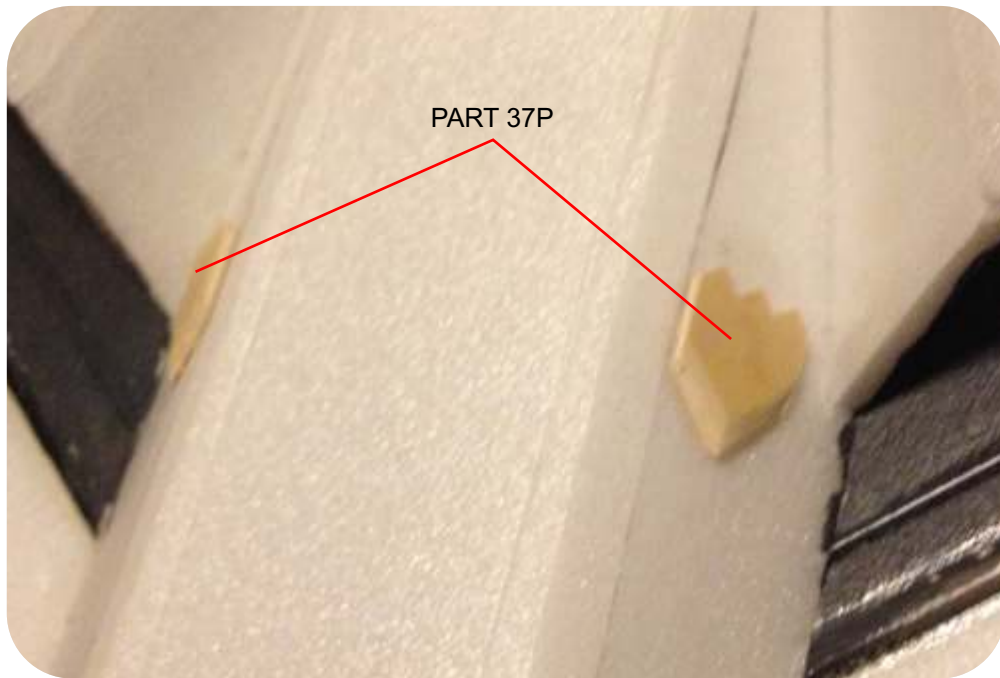
Carefully sand the edges as per the coloured key. Sand the forward fuselage as shown in the section drawing - around the edges are sections from the original plans of the real aircraft to help you.

Rub a diluted (with water) spackling/lightweight filler into the sanded edges to give strength and smoothness to them. Alternatively, balsa profiles can be used here.



Edge Finishing





PUSHER : Stick on the launch grips (Part 37P) as indicated in the plans.

Congratulations! Your model construction is complete! You can simply fly it as it is or take it to the next stage of finishing and painting. Refer to the Finishing Guide for painting tips and decals etc.

If throughout the build you have any ideas on how to improve this guide or model. please email your ideas to c.clarkstone@btinternet.com

If you have enjoyed this model please consider sending \$10 via paypal to c.clarkstone@btinternet.com.



