

*All versions*

# ***Folland Gnat Parkjet***

Photograph of actual aircraft.

Photograph - 14/11/2019 By Richard Darling



2nd Generation Jet Fighter

**Construction Guide**

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## Gnat History

The Folland Gnat (pronounced 'nat') is a British compact swept-wing subsonic fighter aircraft that was developed and produced by Folland Aircraft in Hamble-le-ric. Envisioned as an affordable light fighter in contrast to the rising cost and size of typical combat aircraft.

Designed by W. E. W. Petter, the Gnat's design allowed for its construction and maintenance tasks to be carried out without specialised tools, making it suitable for use in countries that had not yet become highly industrialised.

The Gnat T.1 jet trainer variant was adopted and operated by the RAF. In the United Kingdom and became well known due to its prominent use as the display aircraft of the RAF's Red Arrows aerobatic team.

The Gnat F.1 was exported to Finland, Yugoslavia and India. The Indian Air Force became the largest operator and eventually manufactured the aircraft under licence. Impressed by its performance during combat, India proceeded to develop the improved HAL Ajeet, a modified variant of the Gnat Nicknamed 'The Sabre Killer' after achieving a high amount of kills against the aging F86 Sabre of the Pakistani air force.

## Designers Notes

The Gnat makes a great parkjet!

High mounted wings and round underbelly makes easier landings.

Lots of bright colour schemes to choose from to improve visibility.

Simple single motor installation.

This understated little jet is one of the all time favourites, amongst pilots who fly in her. Agile and sweetly balanced, it is like a thoroughbred sports car.

This model allows a 64mm EDF or a single pusher powerplant, with **or** without 3d printed parts.





# 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.

## Cutting parts

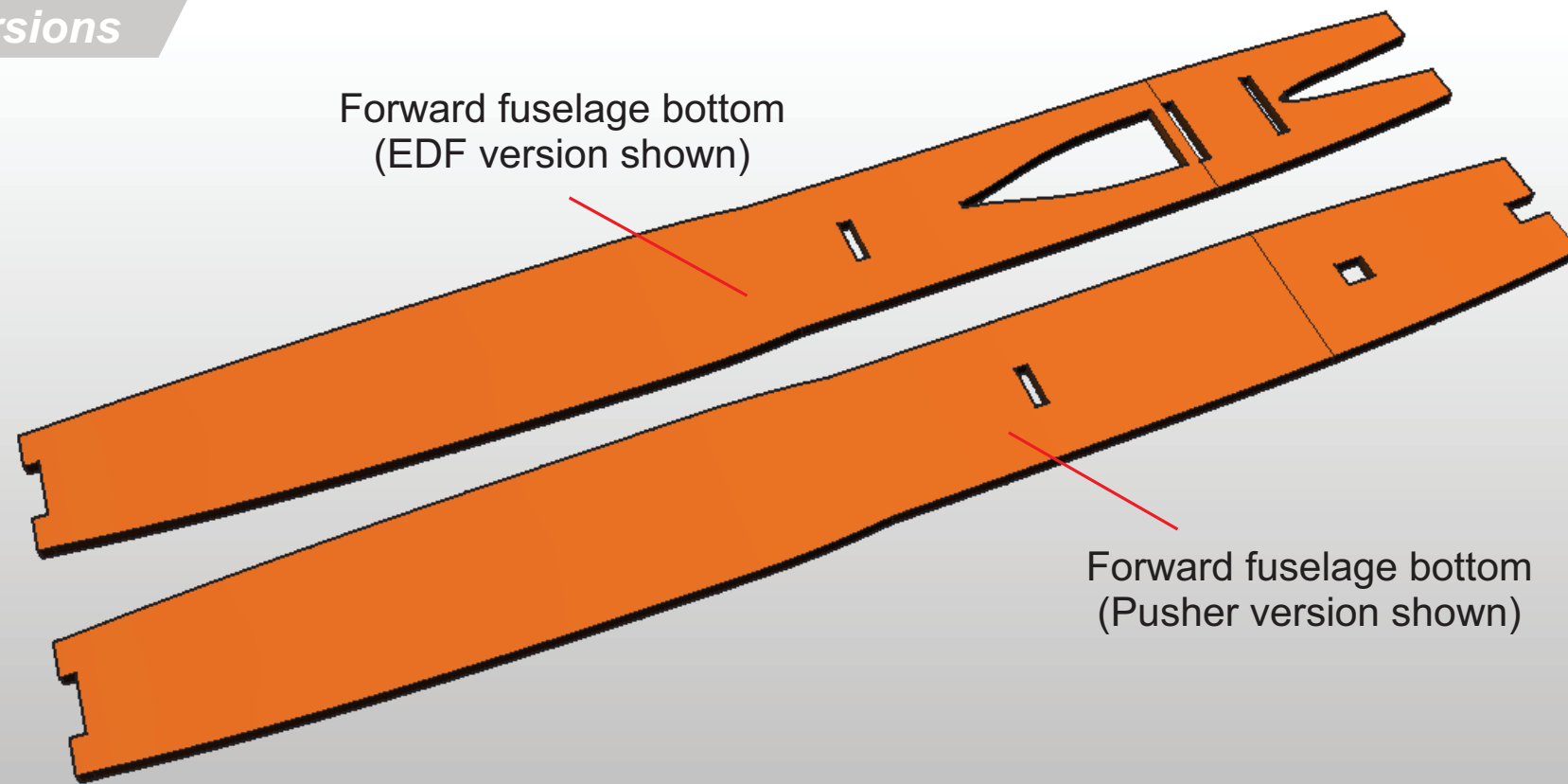
1. Print the plans,
  2. Cut around each part using scissors - allow a border of approx (1/4") 6mm
  3. Use either 3M spray mount or a very light coat of 3M 77 to the back of the parts and stick in an economical layout on the Depron foam.
  4. Using a safety rule and craft knife over a cutting mat - 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 tempates 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 gluing the carbon rod spars into the wings.

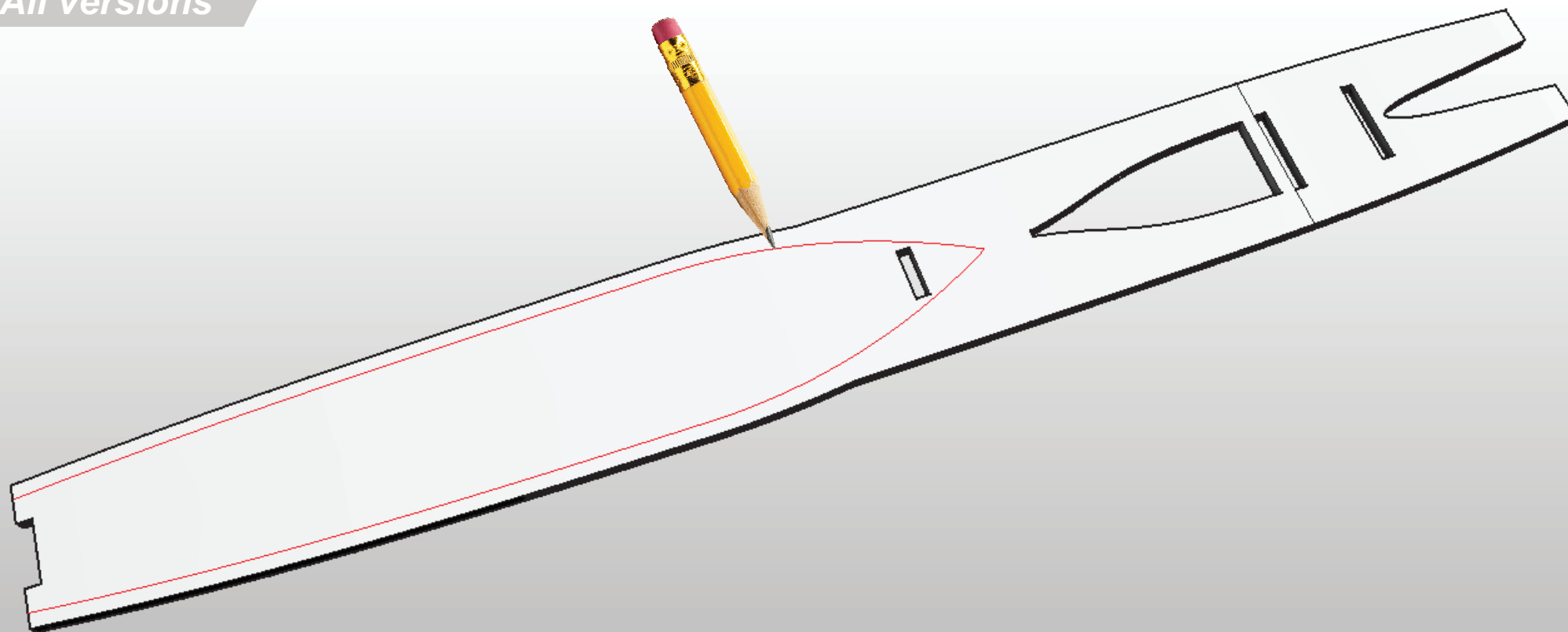


*All versions*



Choose which powerplant you will use in your Gnat and cut the **Forward fuselage bottom** accordingly - EDF or Pusher

*All versions*

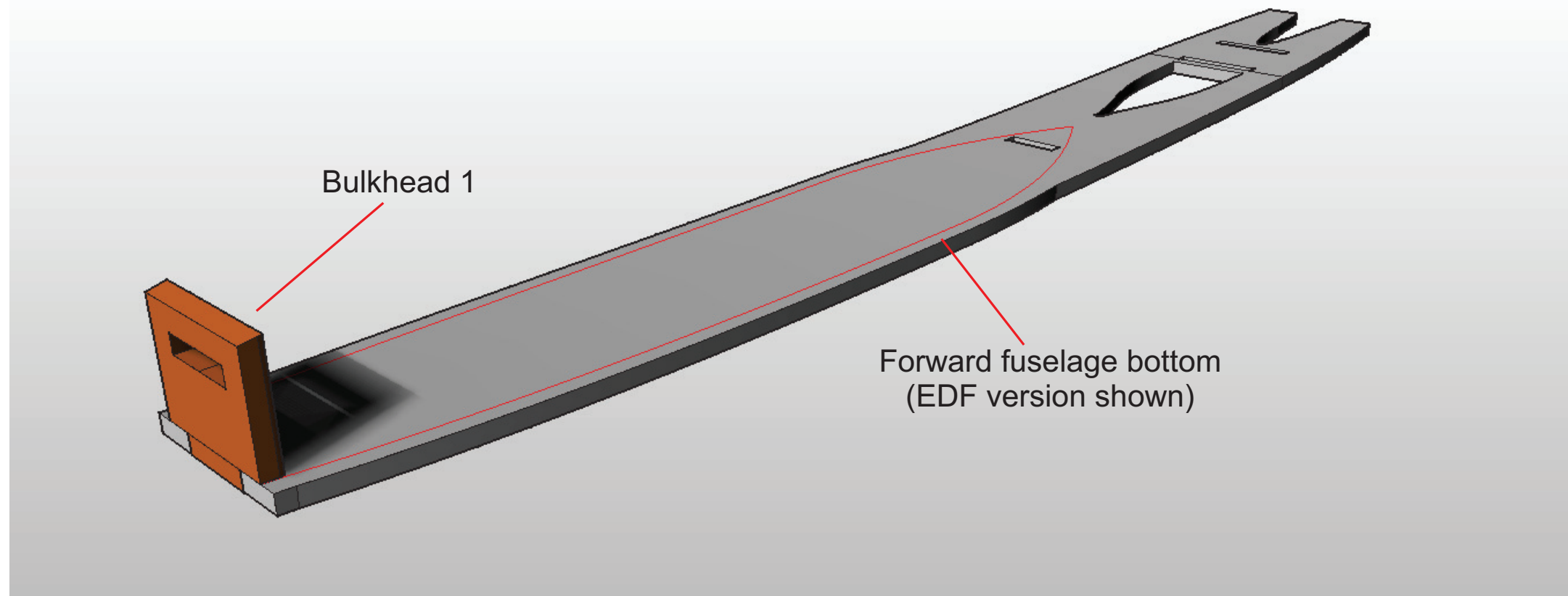


Mark the alignment line as shown in the plans.





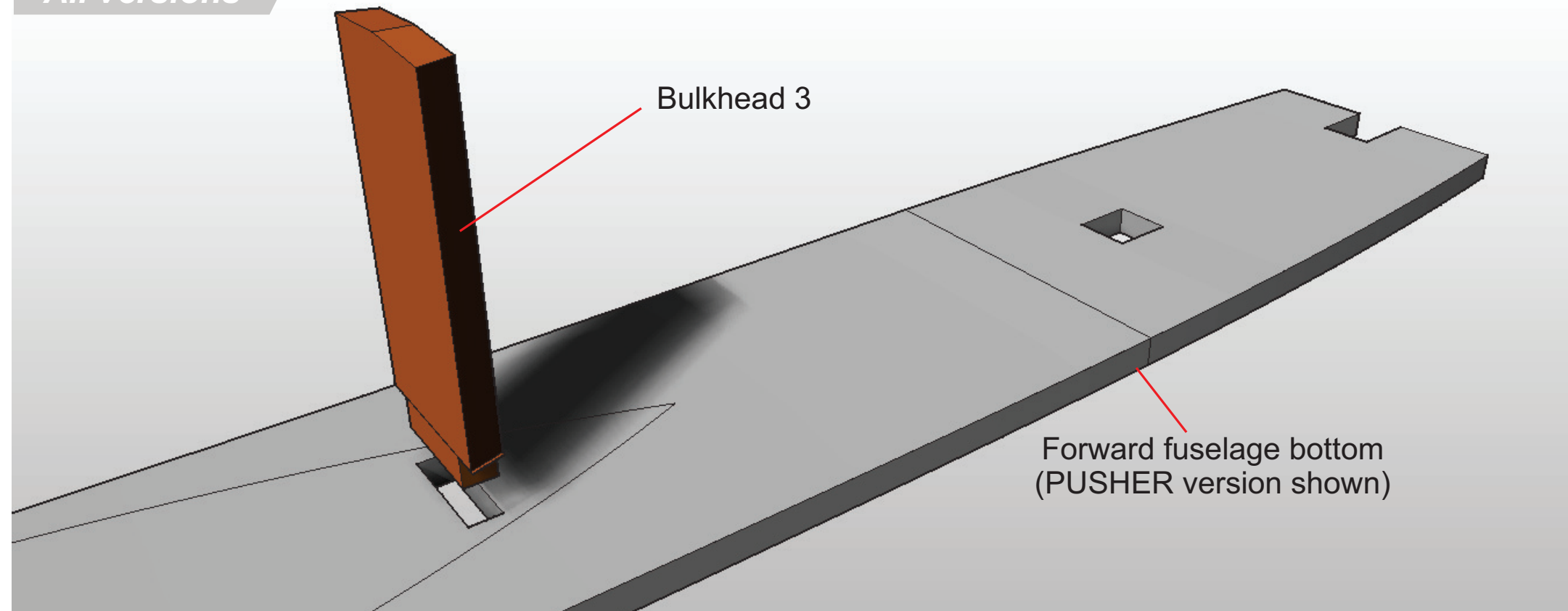
All versions



Glue **Bulkhead 1** in place.



All versions

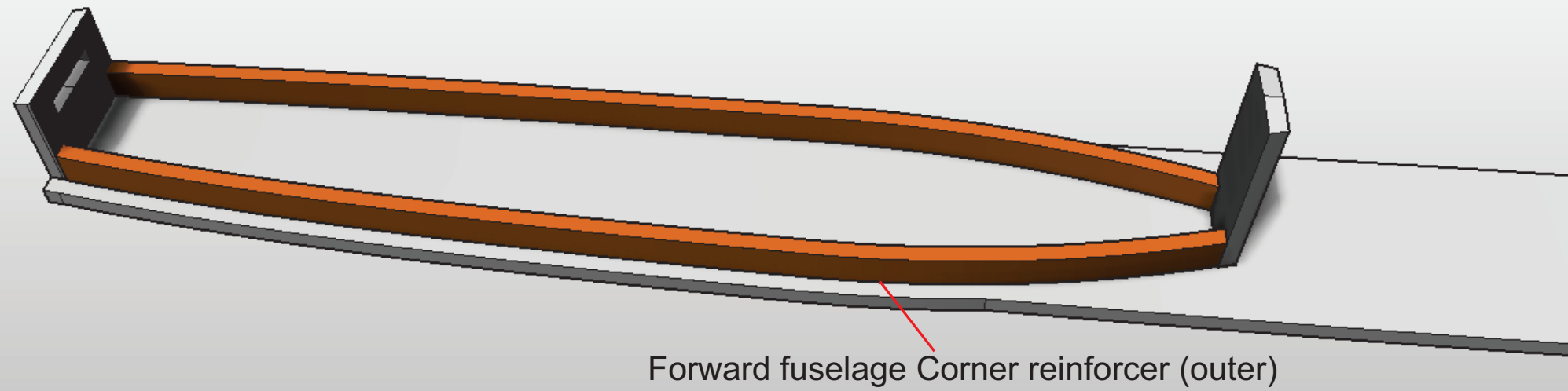


Glue **Bulkhead 3** in place.





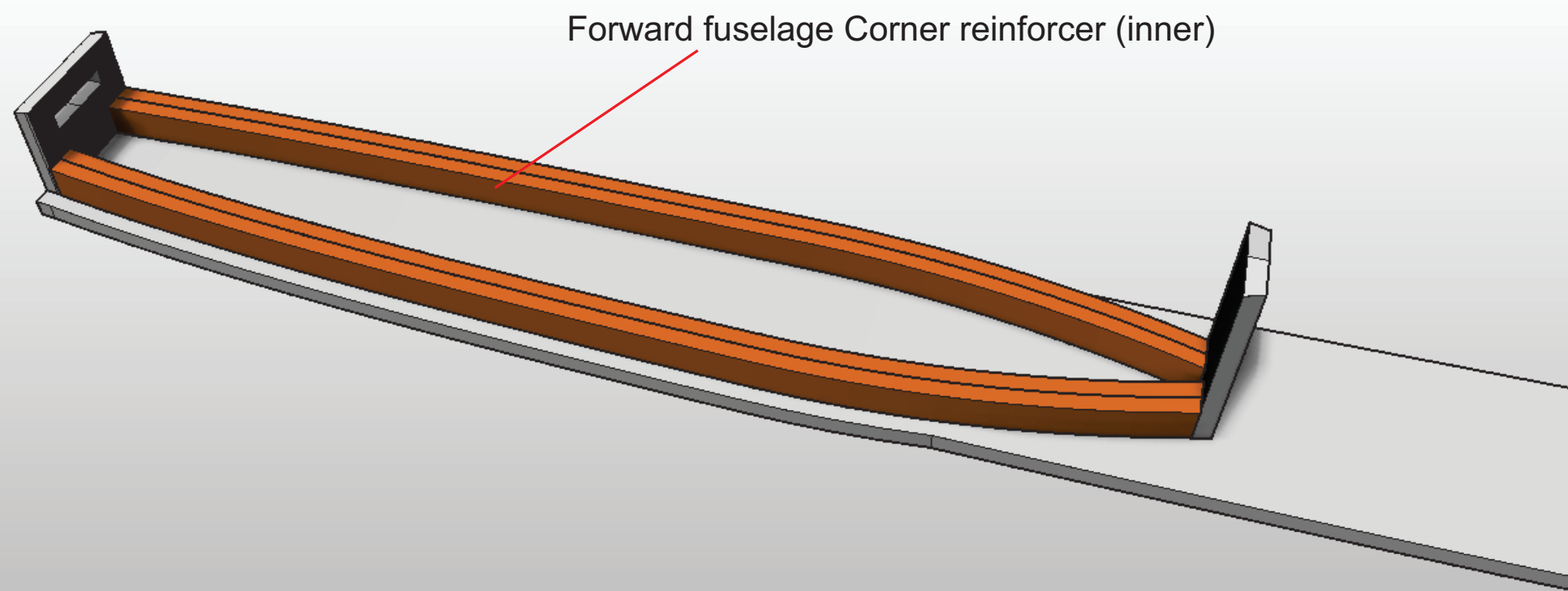
All versions



Follow the marked position from the plans and glue the outer **Forward fuselage corner reinforcer** in place.



All versions

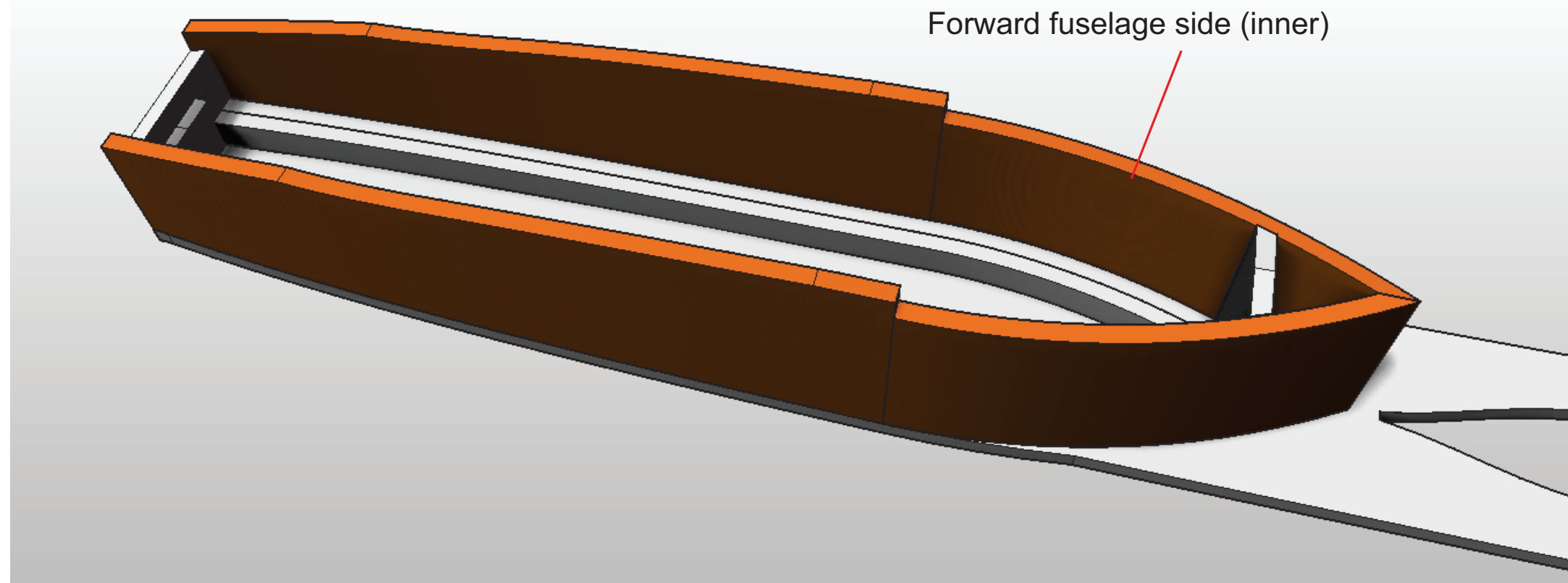


Glue the **inner Forward fuselage corner reinforcer** in place.

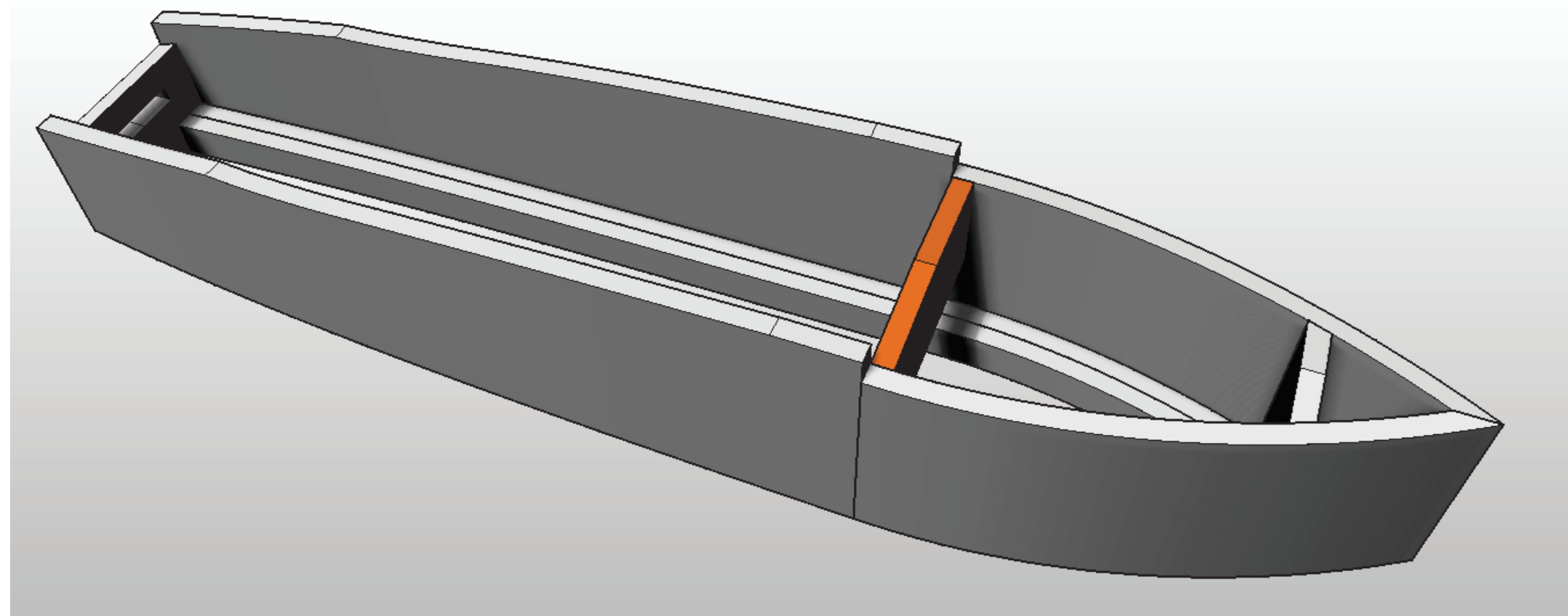




All versions



Curve the **Forward Fuselage Side (inner)** using the table edge bending technique. Glue in place to match the line drawn on the **Fuselage belly**.



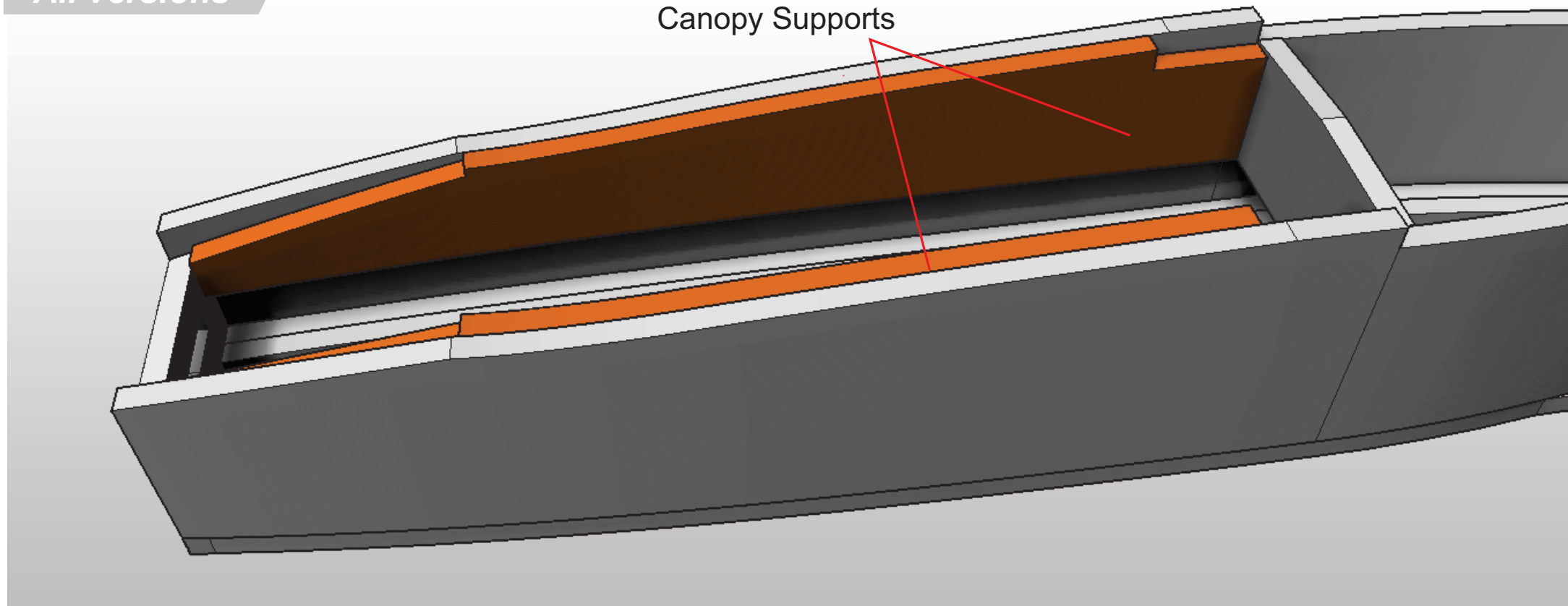
Glue **Bulkhead 2** in place so that the forward face is aligned to the step in the **fuselage sides (inner)**





All versions

Canopy Supports

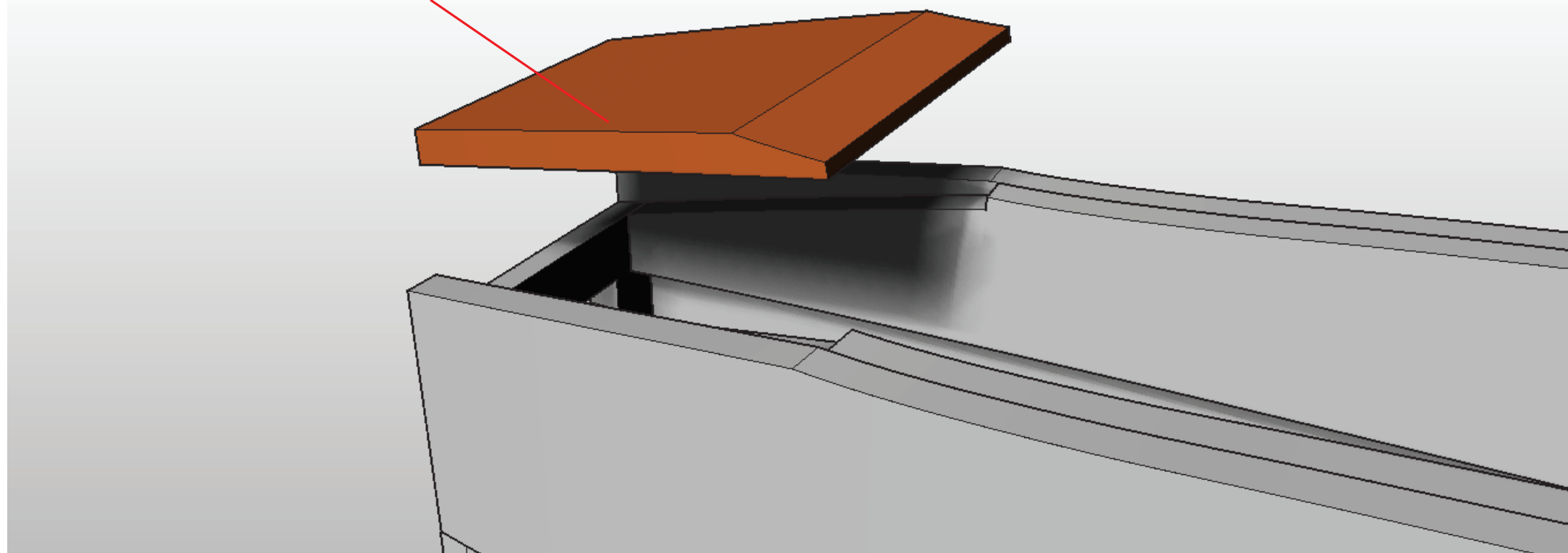


Glue the **Canopy supports** to the assembly



All versions

Forward upper fuselage inner



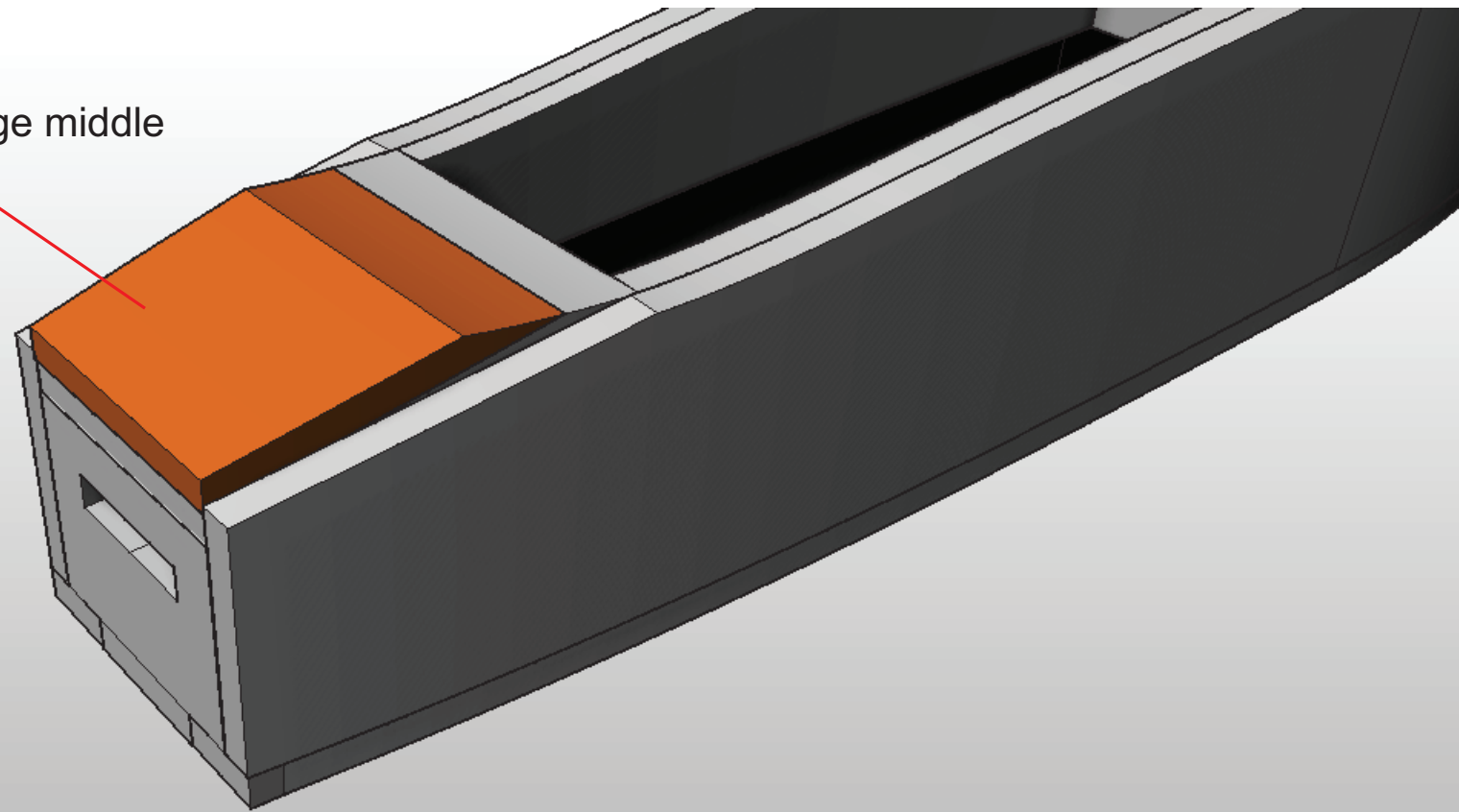
Glue the **Forward upper fuselage inner** in place





All versions

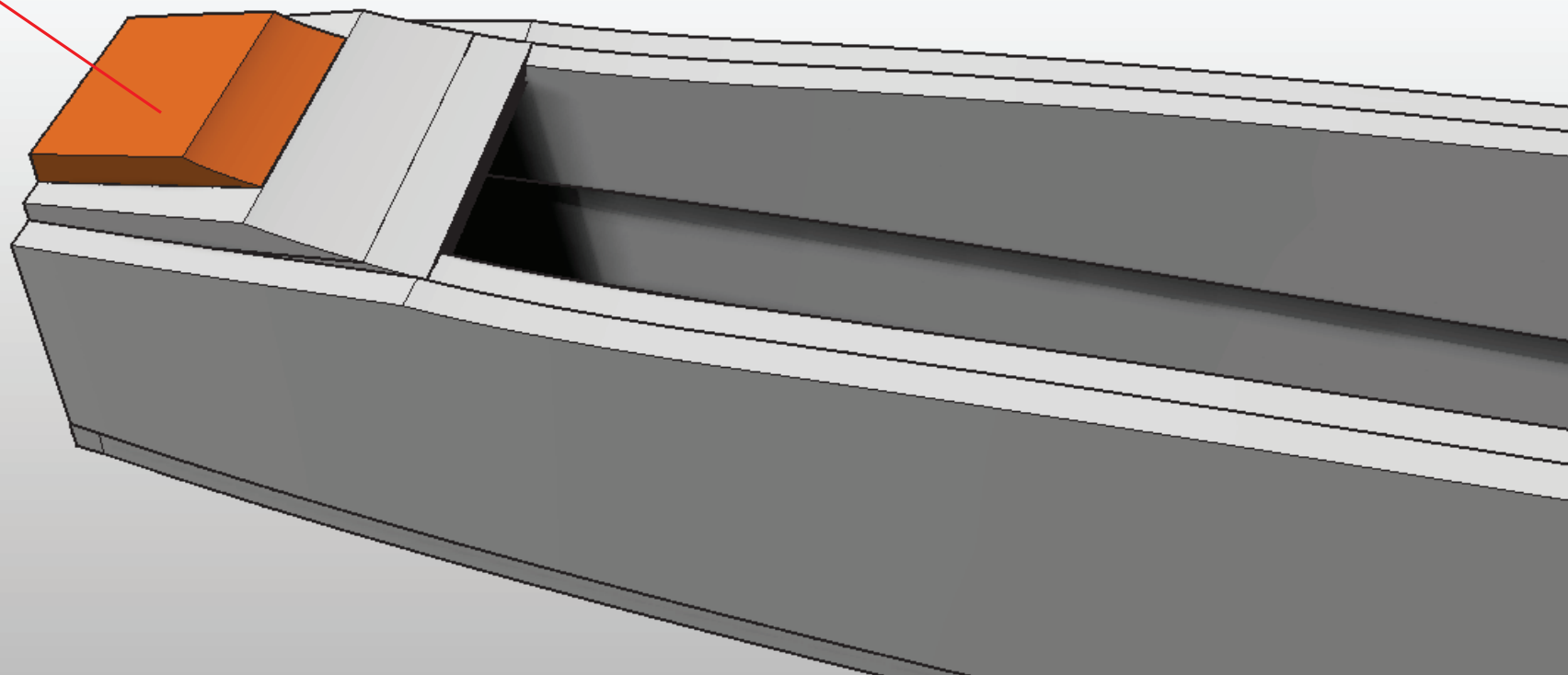
Forward upper fuselage middle



Glue the **Forward upper fuselage Middle** in place



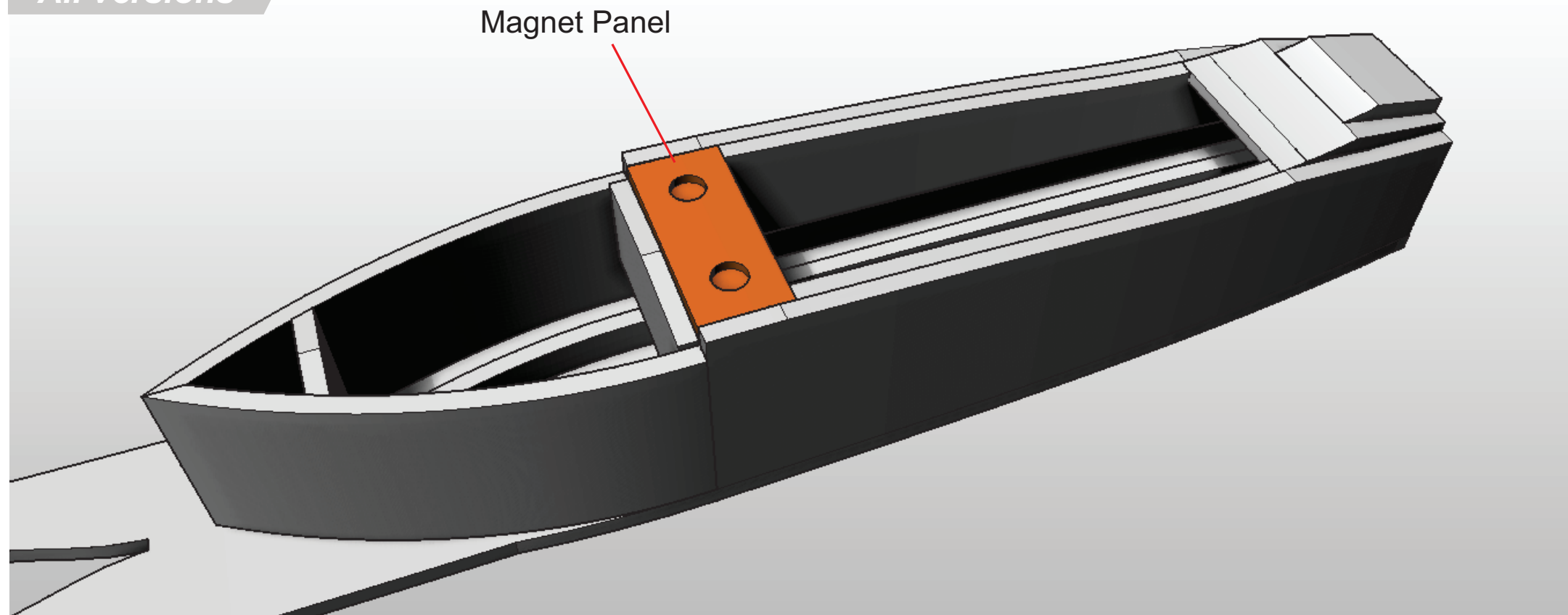
Forward upper fuselage top



Glue the **Forward upper fuselage Top** in place



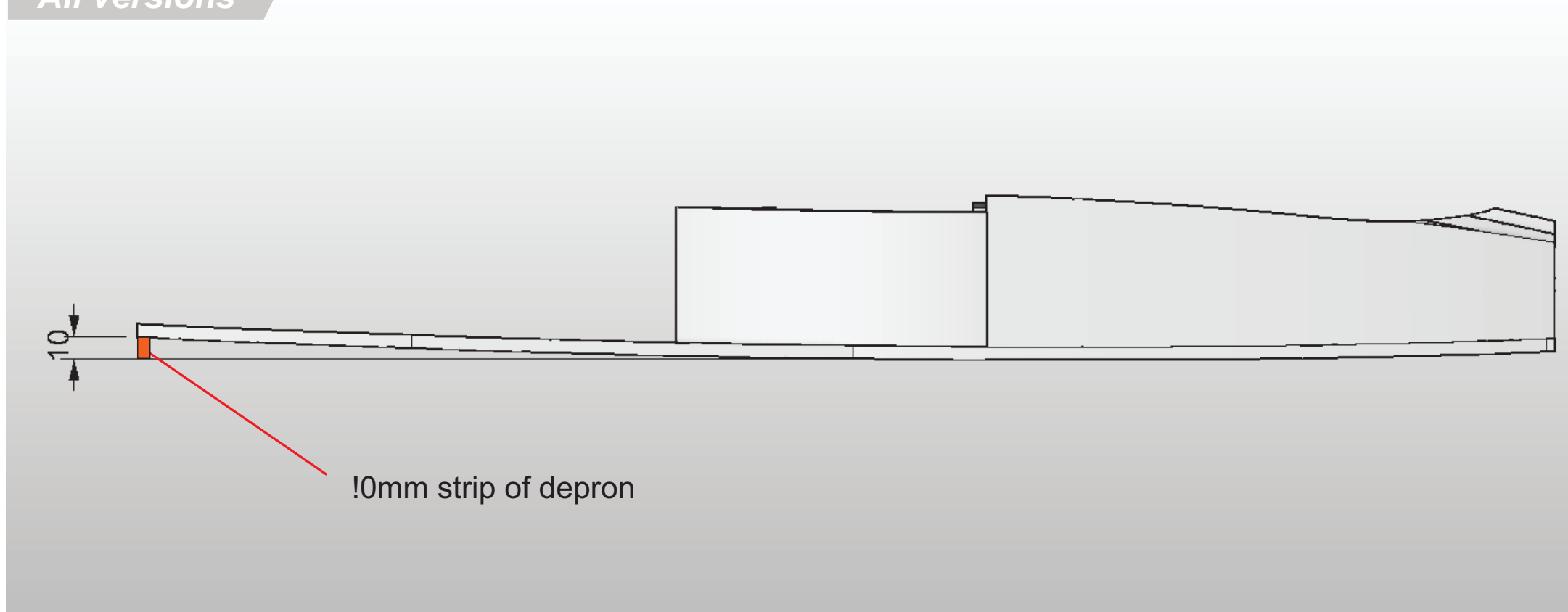
All versions



Glue the **Magnet panel** in place



All versions

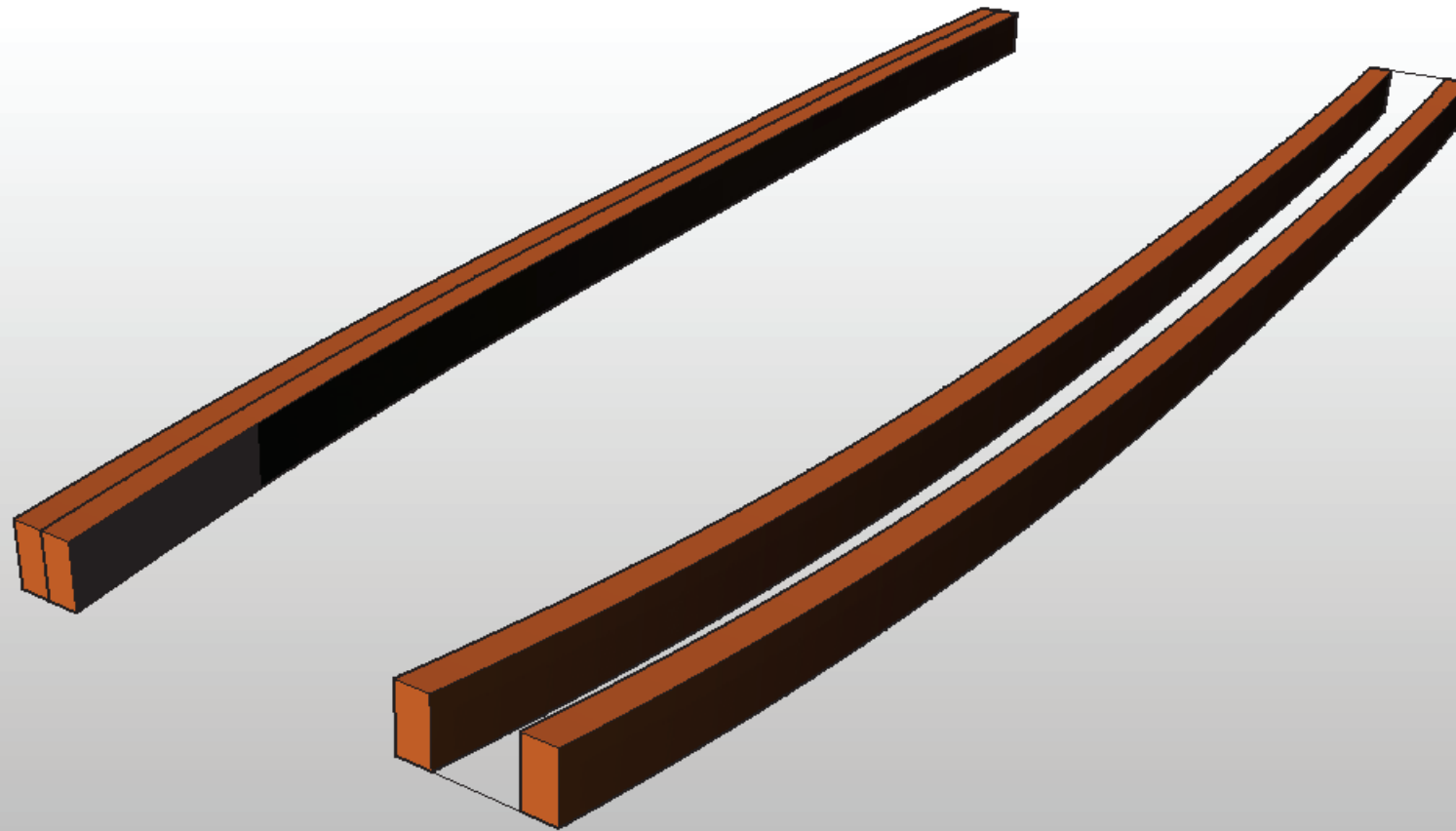


Gently curve the belly panel so that it rests on a 10mm wide strip of scrap depron as shown.



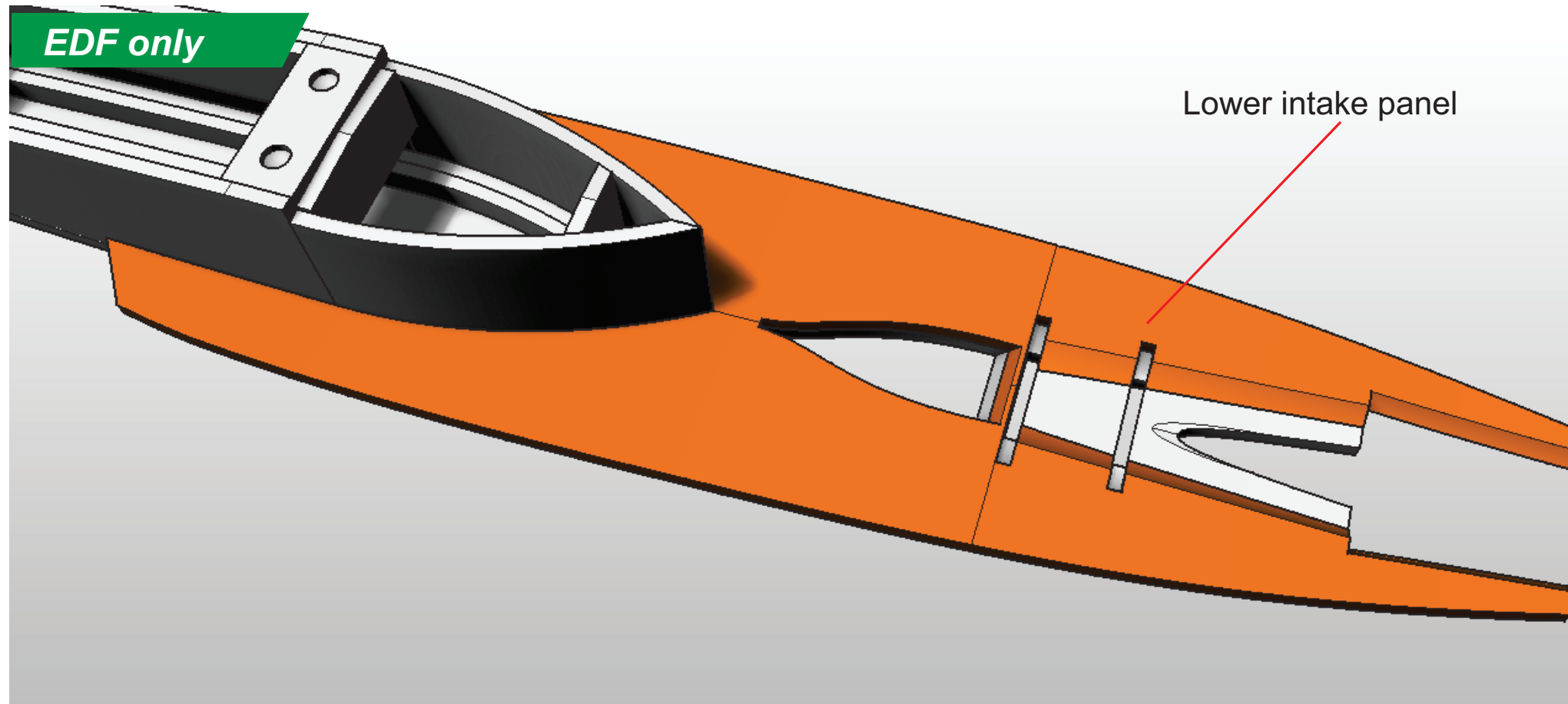


All versions



Glue the 4 **Lower corner reinforcers** together to make two pairs.

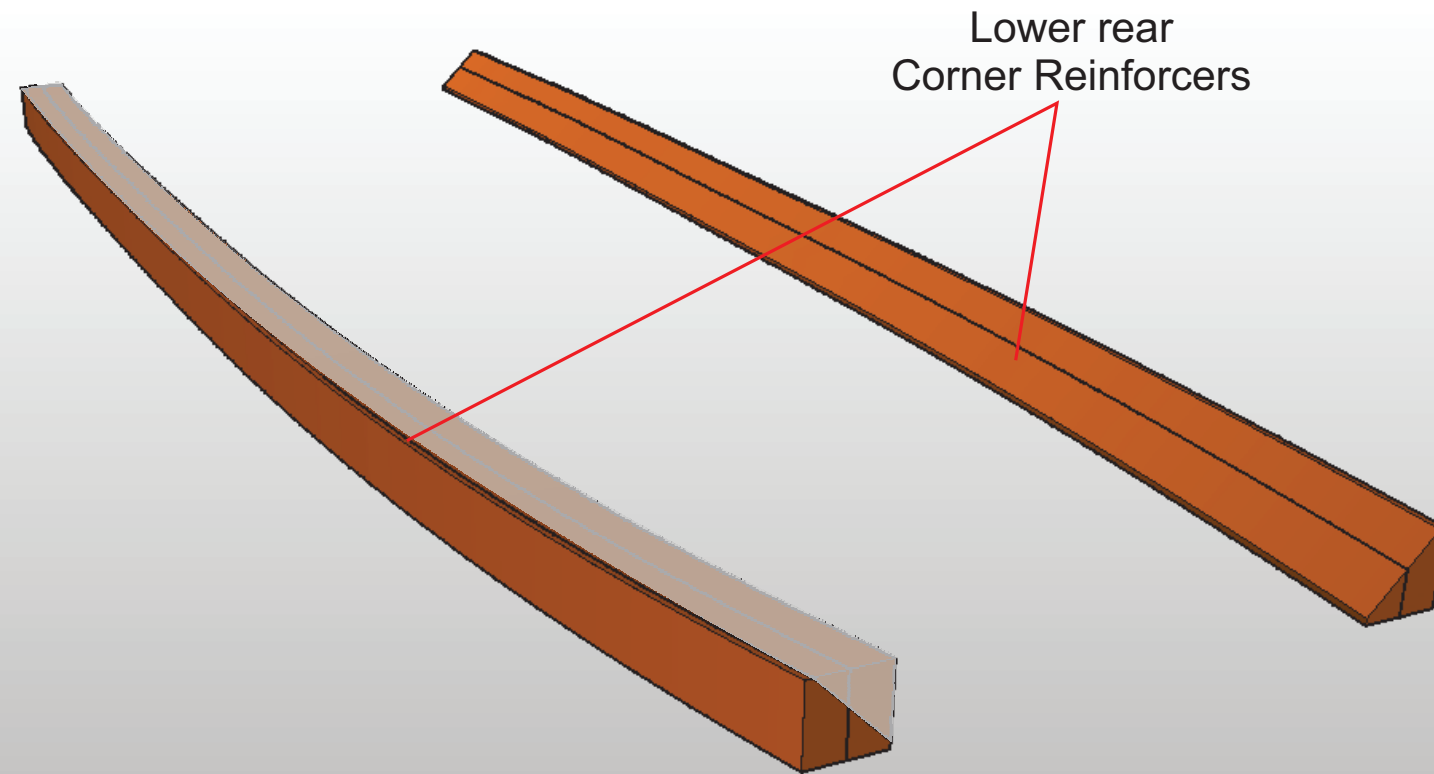
EDF only



Whilst maintaining the gentle curved belly panel, gently curve the **Lower air intake panel** and glue in place.



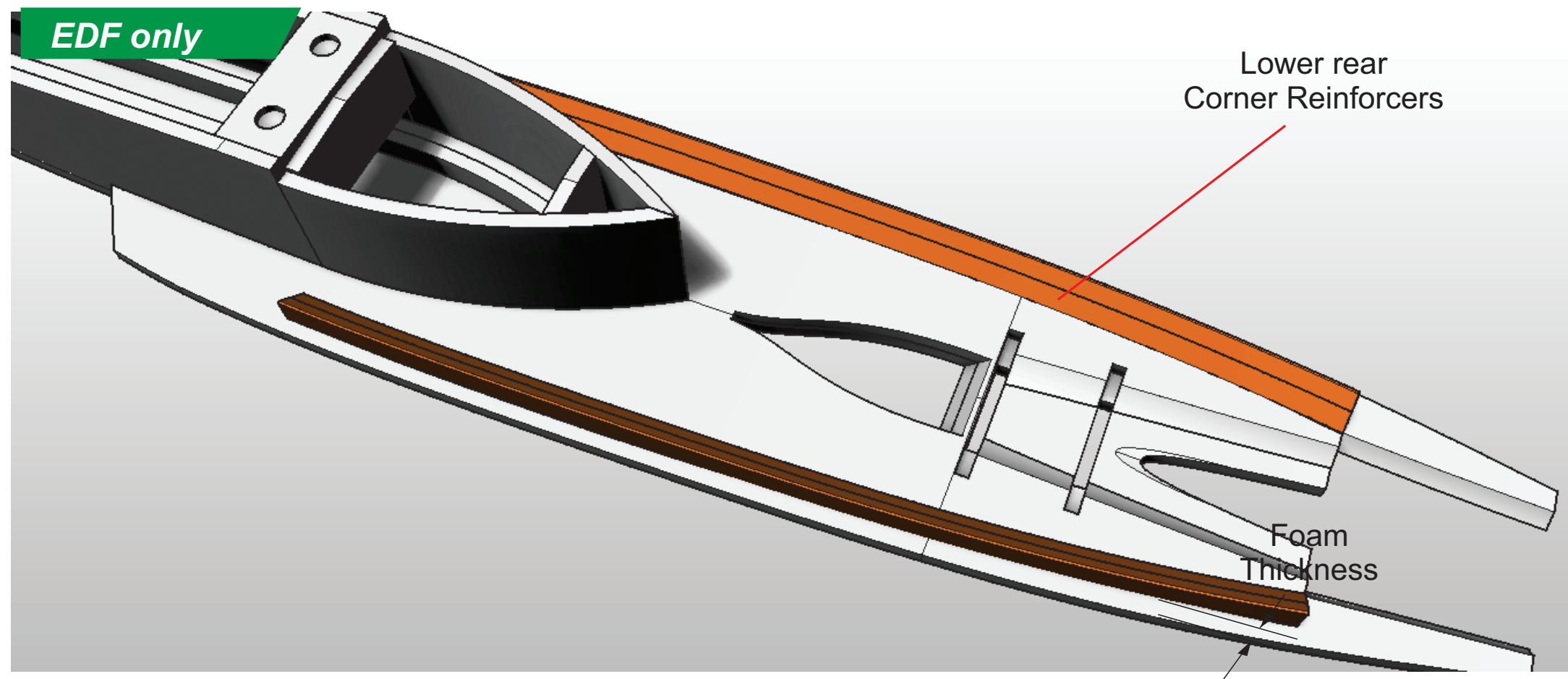
EDF only



For the EDF version, trim away the corner of the **Lower rear Corner reinforcements** as shown, first with a knife then smooth with sandpaper.



EDF only



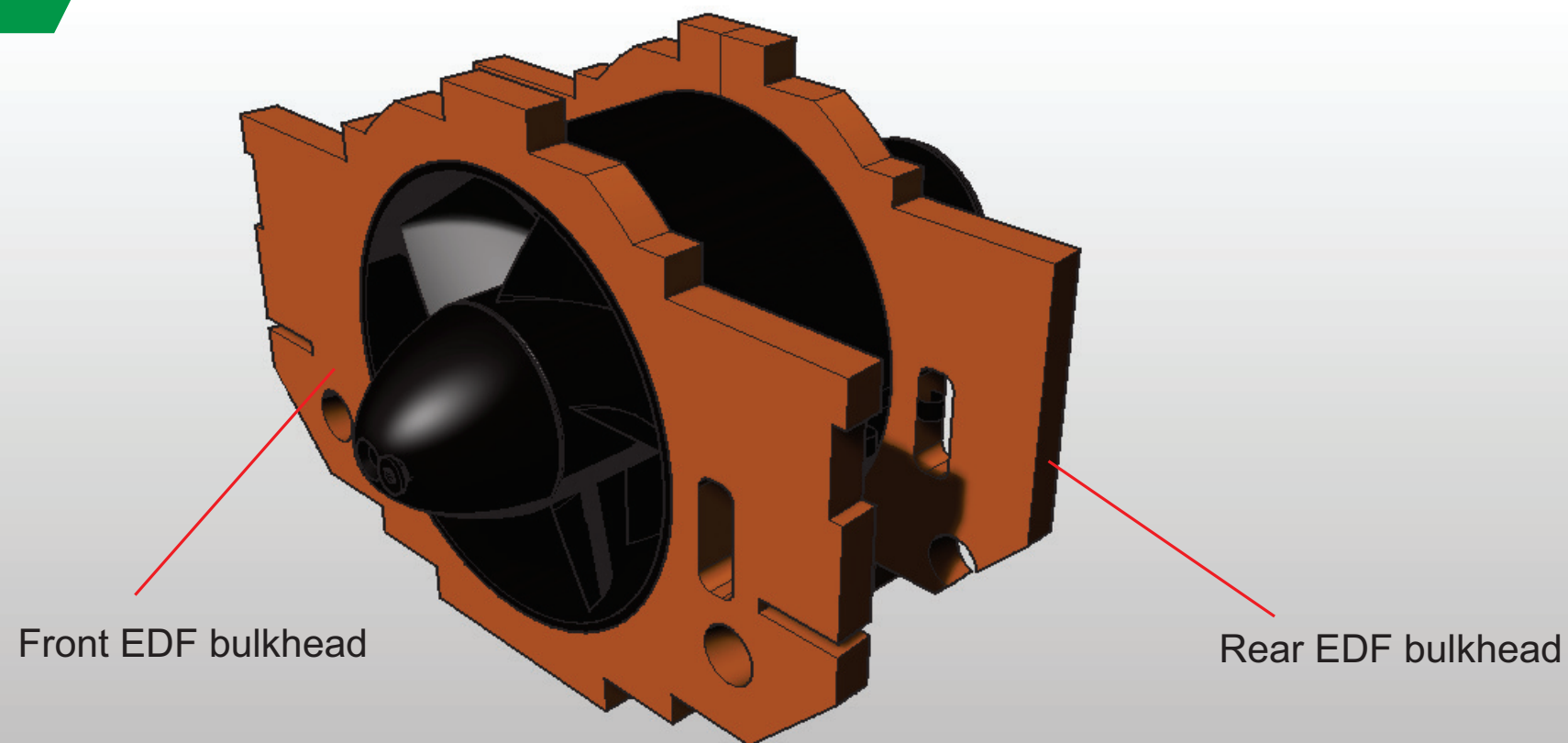
Glue the lower rear corner reinforcements to the assembly.

Position them 6mm away from the edge (the thickness of the foam)





**EDF only**

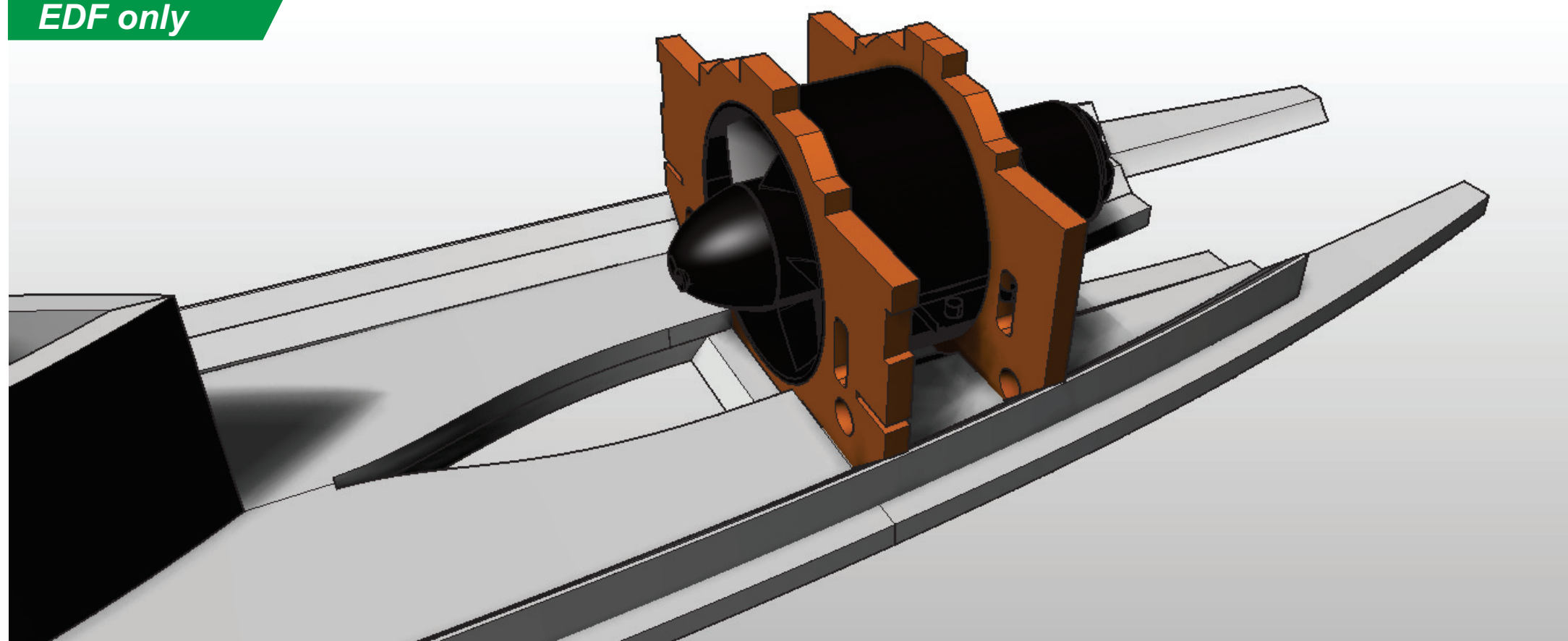


Dry fit the EDF bulkheads to your EDF unit. Adjust to suit your particular choice.

You may find it easier to make the forward bulkhead from 2 x 3mm liteply.

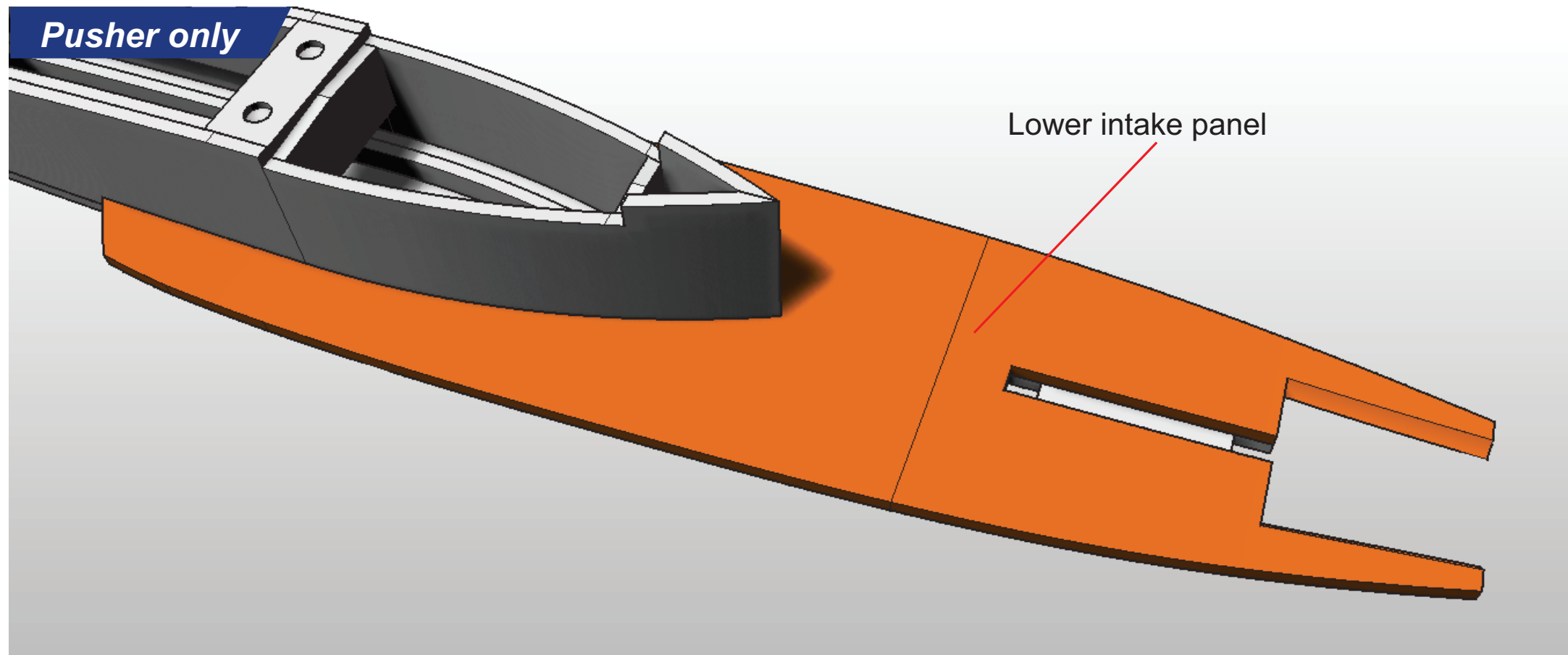


**EDF only**

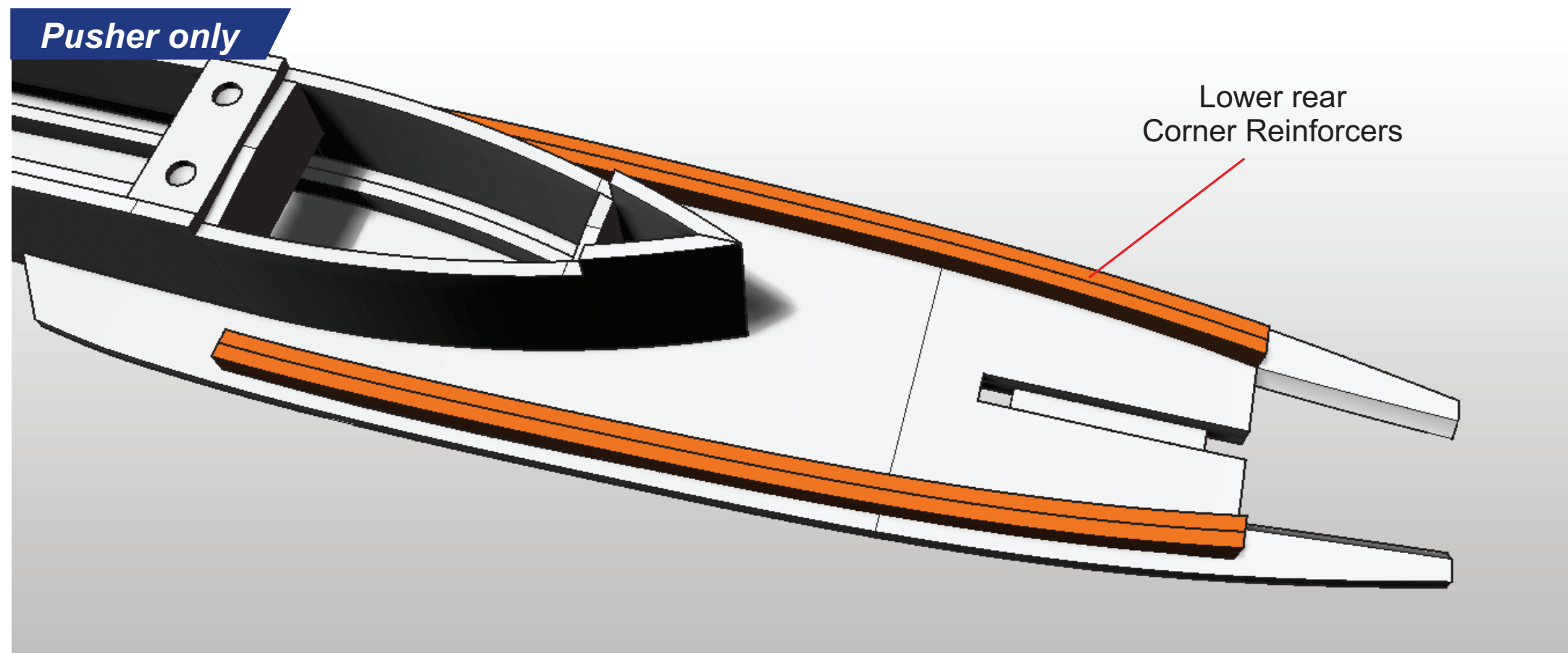


Glue the EDF bulkheads into the fuselage.





Whilst maintaining the gentle curved belly panel, gently curve the **Lower air intake panel** and glue in place.



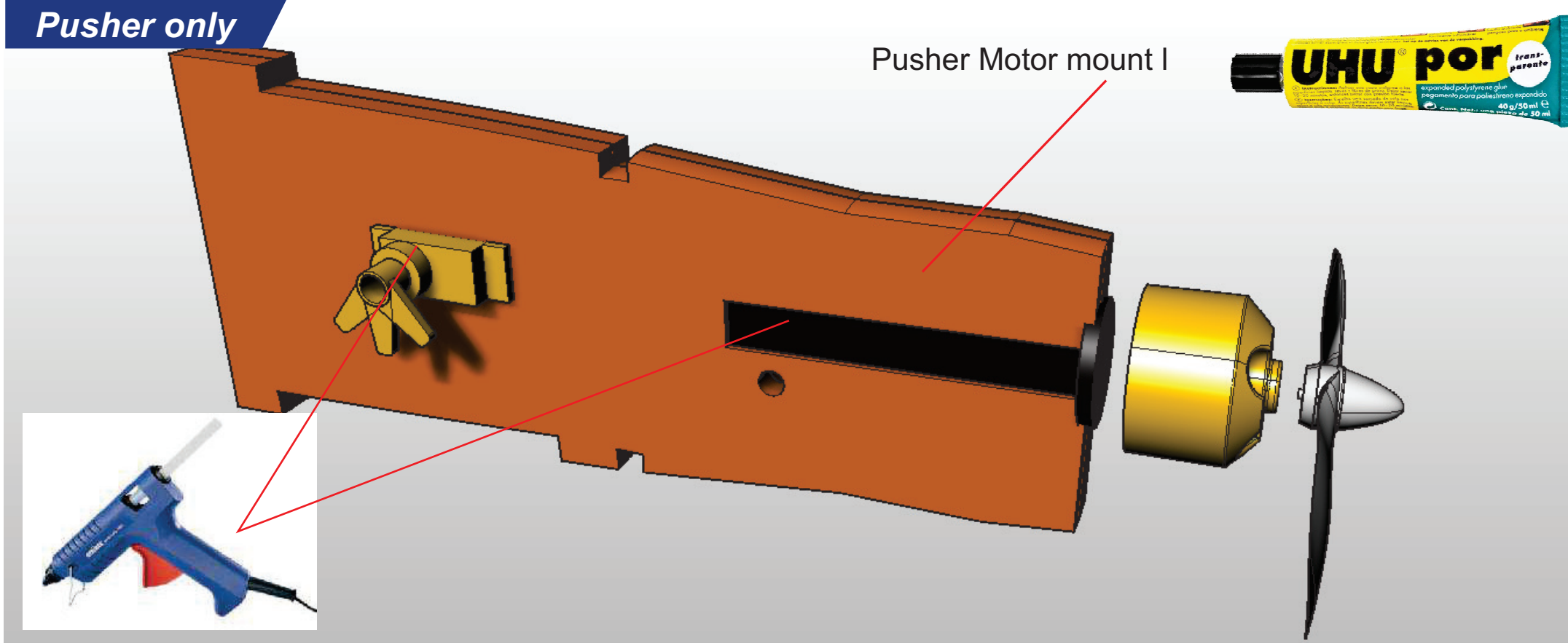
Glue the lower rear corner reinforcers to the assembly.

Position them 6mm away from the edge (the thickness of the foam)





## Pusher only



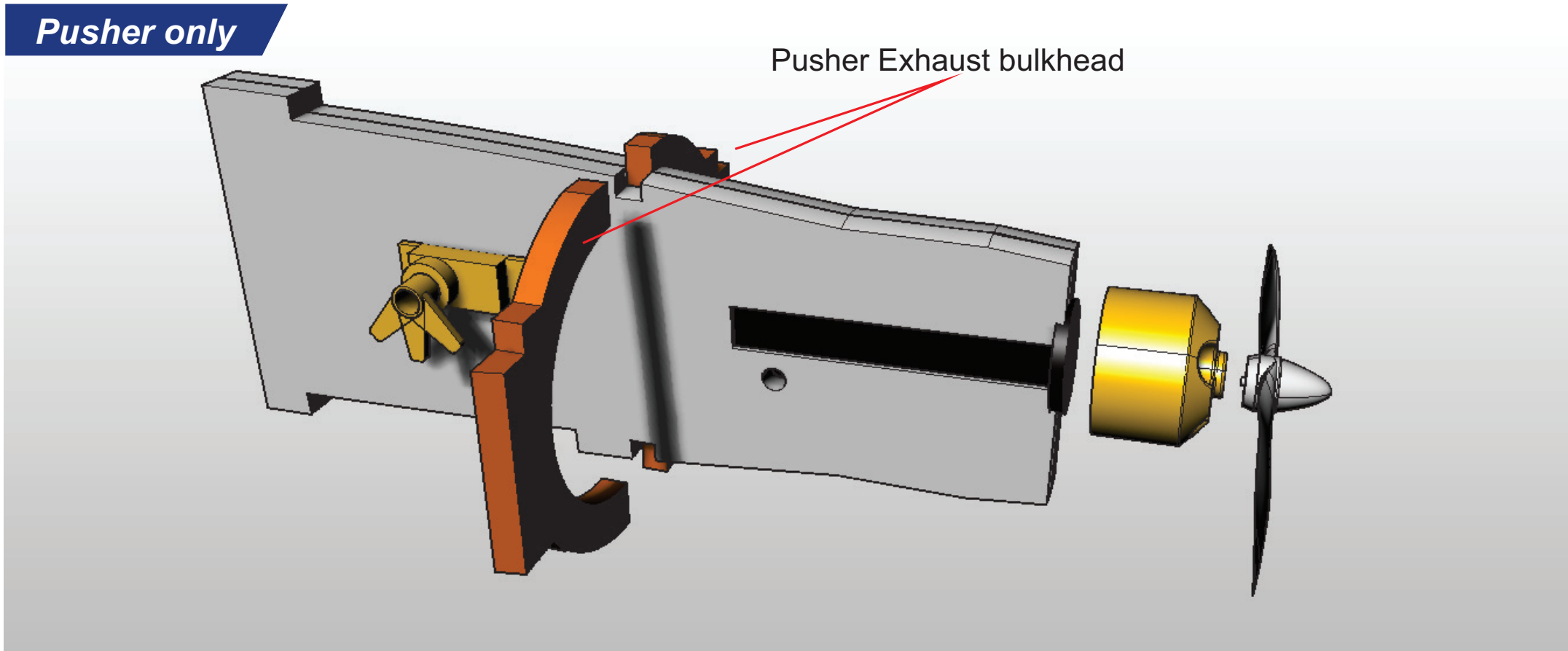
Glue the two **Pusher Motor mount** pieces together using UHU Por.

Glue the motor mount plastic stick mount into the assembly using hot melt glue.

Attach the motor.

Glue the servo in place.

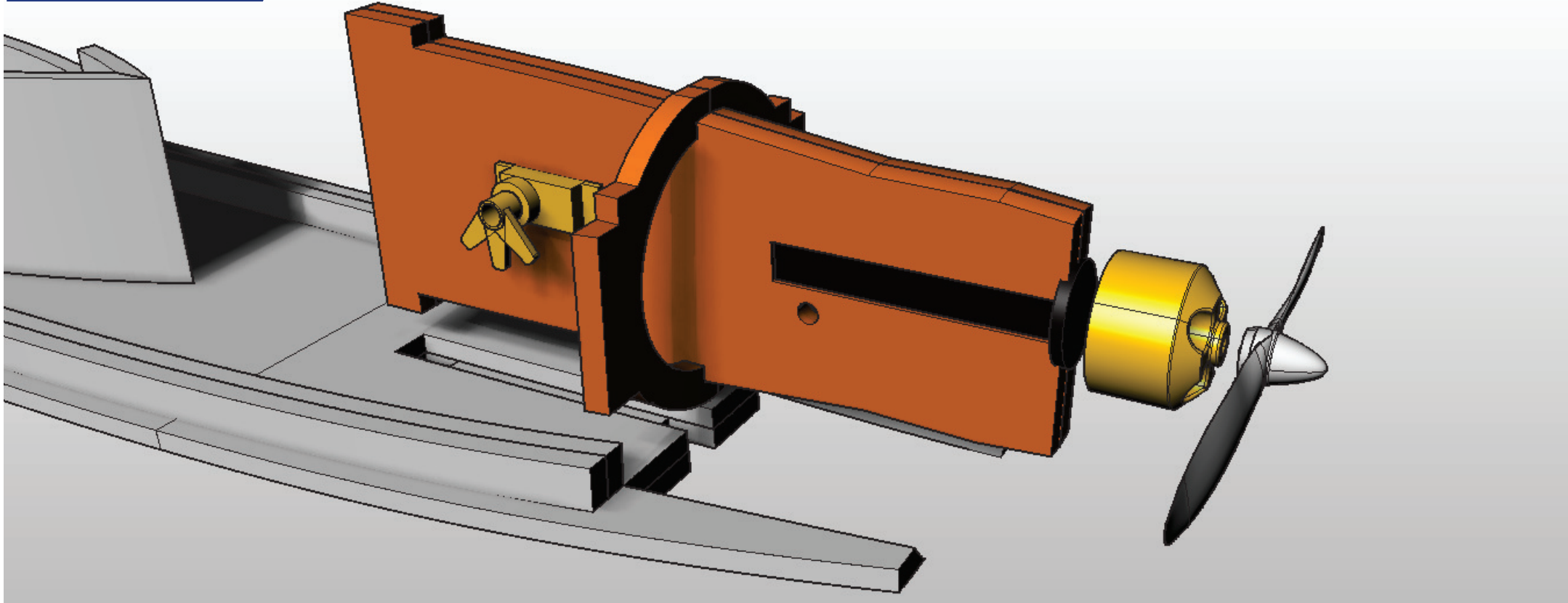
## Pusher only



Glue the two **Pusher exhaust bulkhead** pieces together around the pusher motor mount.



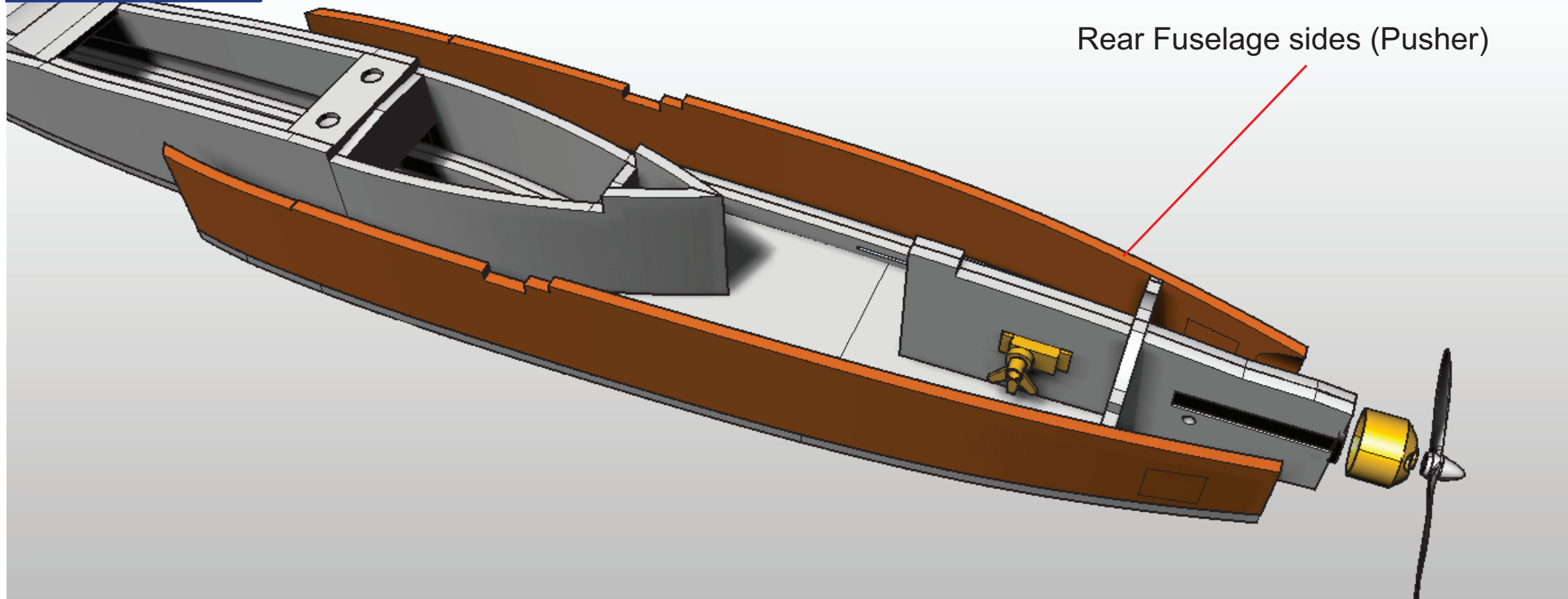
**Pusher only**



Glue the Pusher motor assembly into the fuselage.



**Pusher only**



Rear Fuselage sides (Pusher)

Glue the **Rear Fuselage sides** to the assembly.

Note that the EDF and Pusher versions are different.





EDF only

Rear Fuselage sides (EDF)

Glue the **Rear Fuselage sides** to the assembly.

Note that the EDF and Pusher versions are different.



EDF only

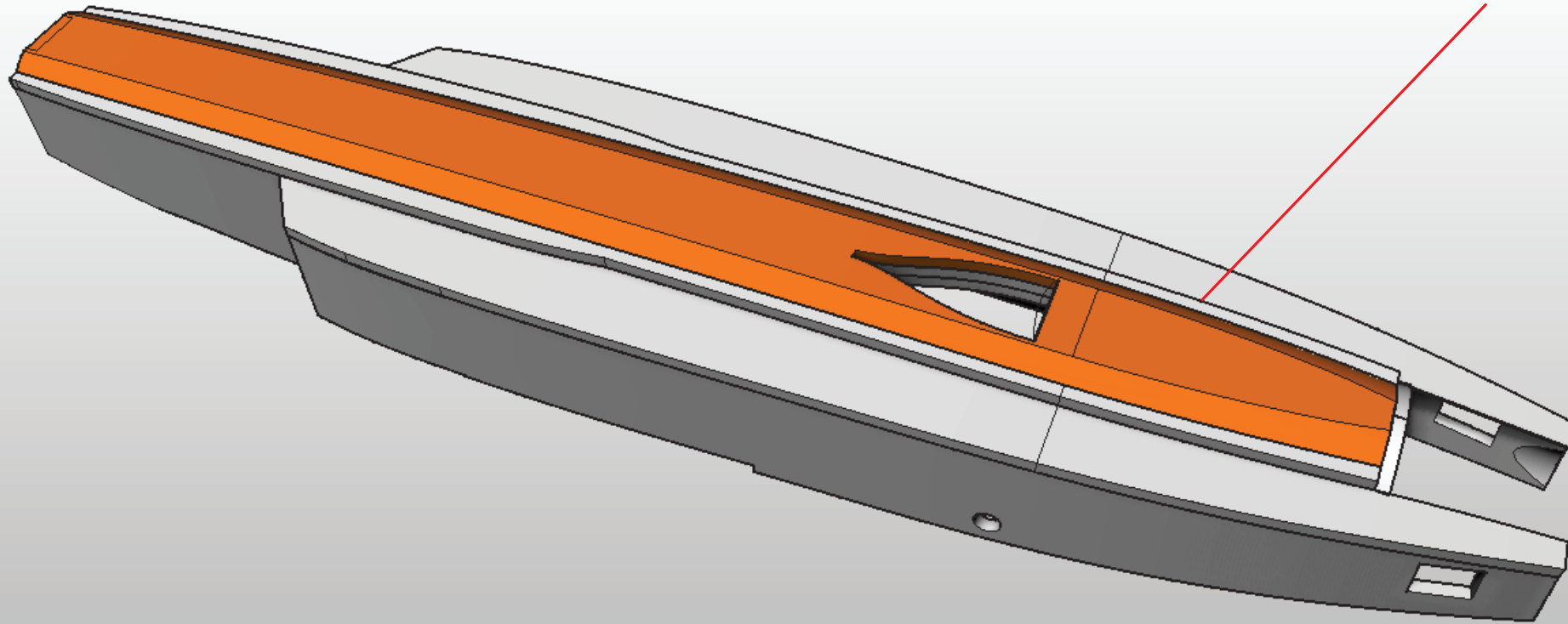
EDF Exhaust Bulkhead

Glue the **EDF exhaust bulkhead** onto the assembly as shown



All versions

Belly Panel (Middle)

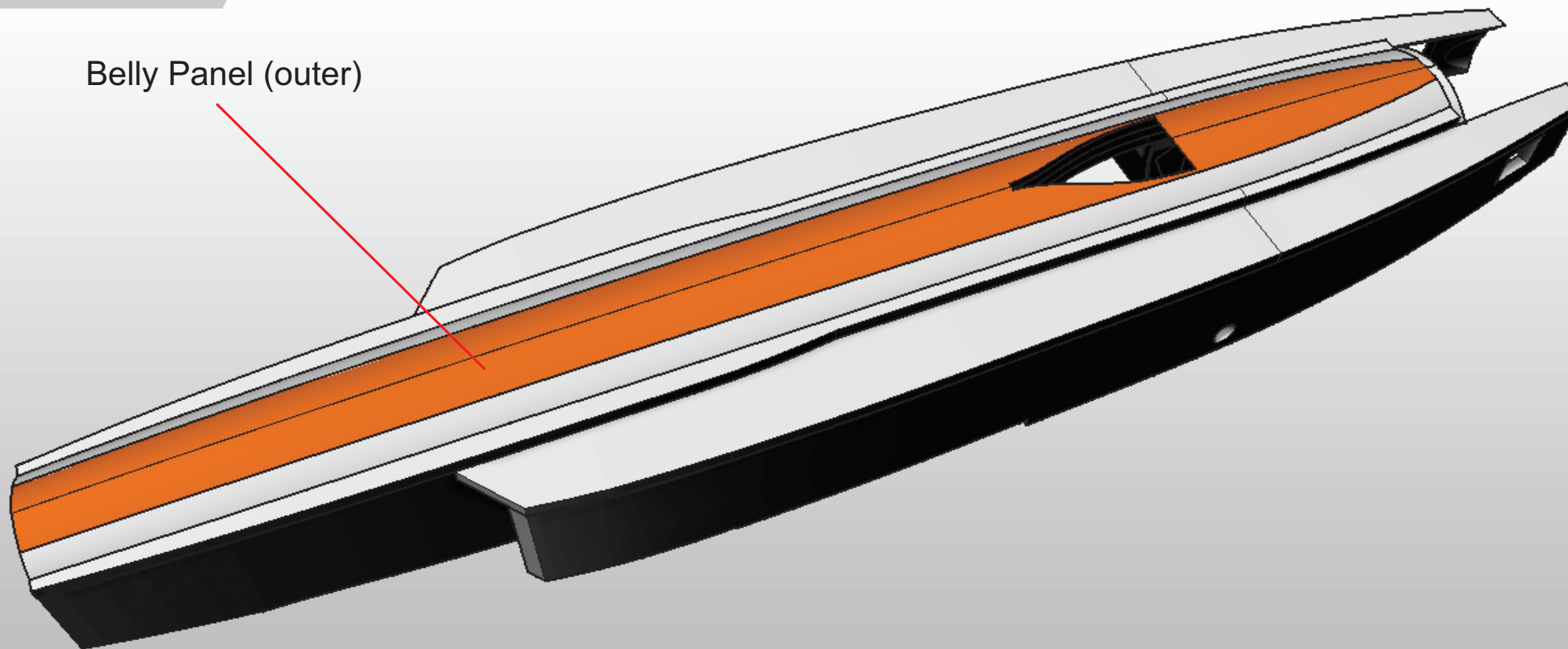


Glue the **Belly panel (middle)** to the assembly.



All versions

Belly Panel (outer)

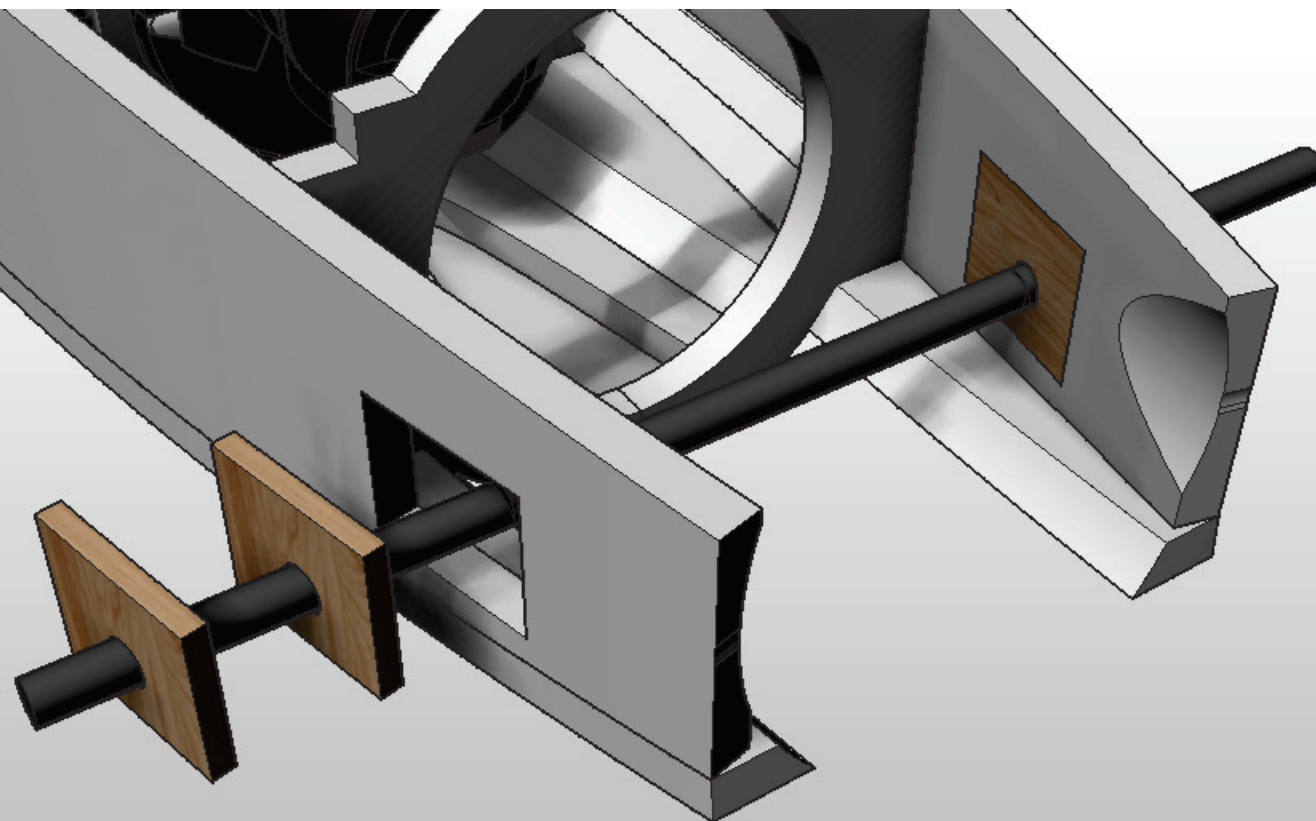


Glue the **Belly panel (Outer)** to the assembly.





All versions

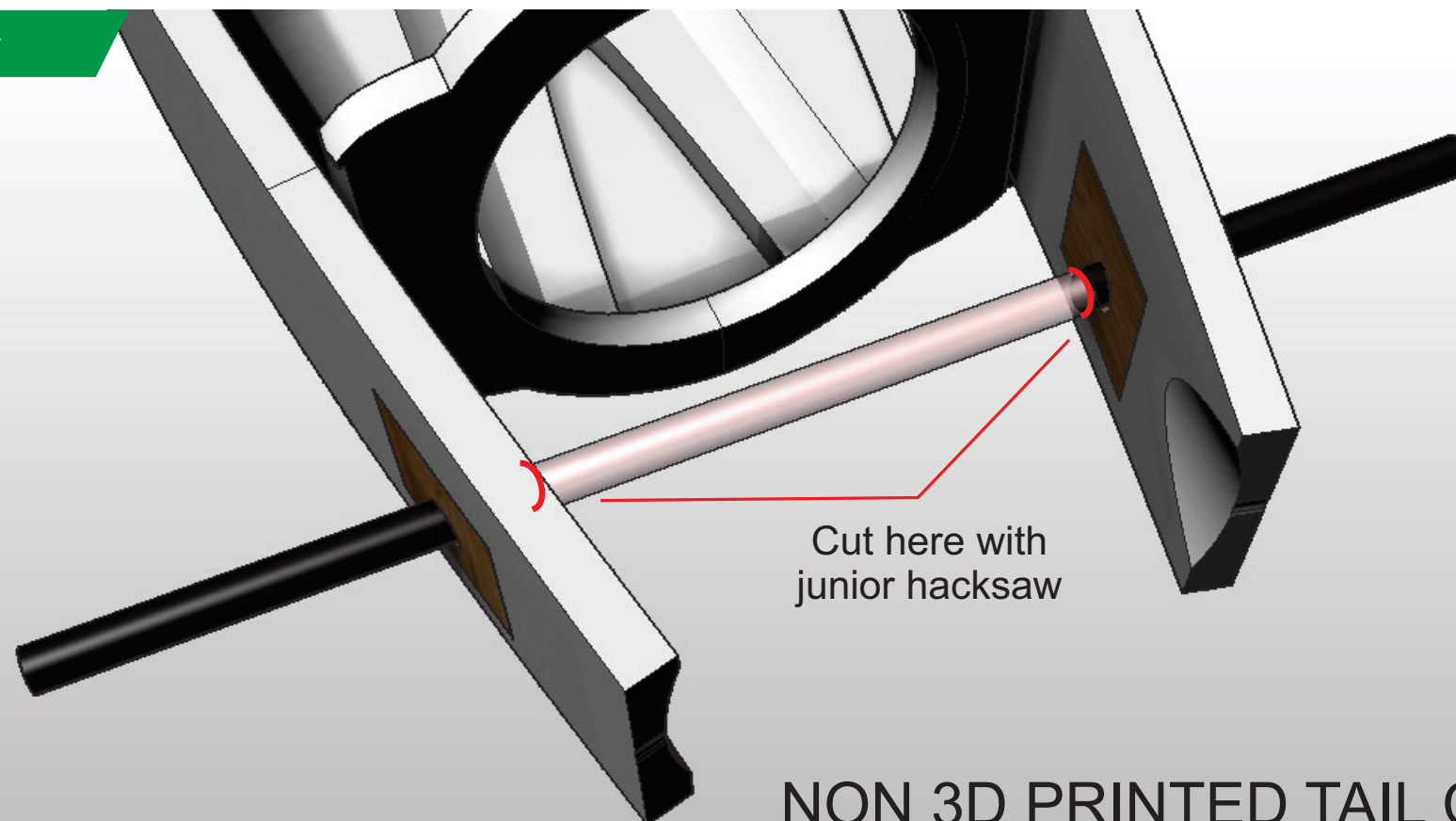


NON 3D PRINTED TAIL CONE ONLY

Glue the 3mm liteply pieces into the assembly, then drill out the holes so that the 6mm carbon tube will slide through.



EDF only



NON 3D PRINTED TAIL CONE ONLY

EDF VERSION ONLY

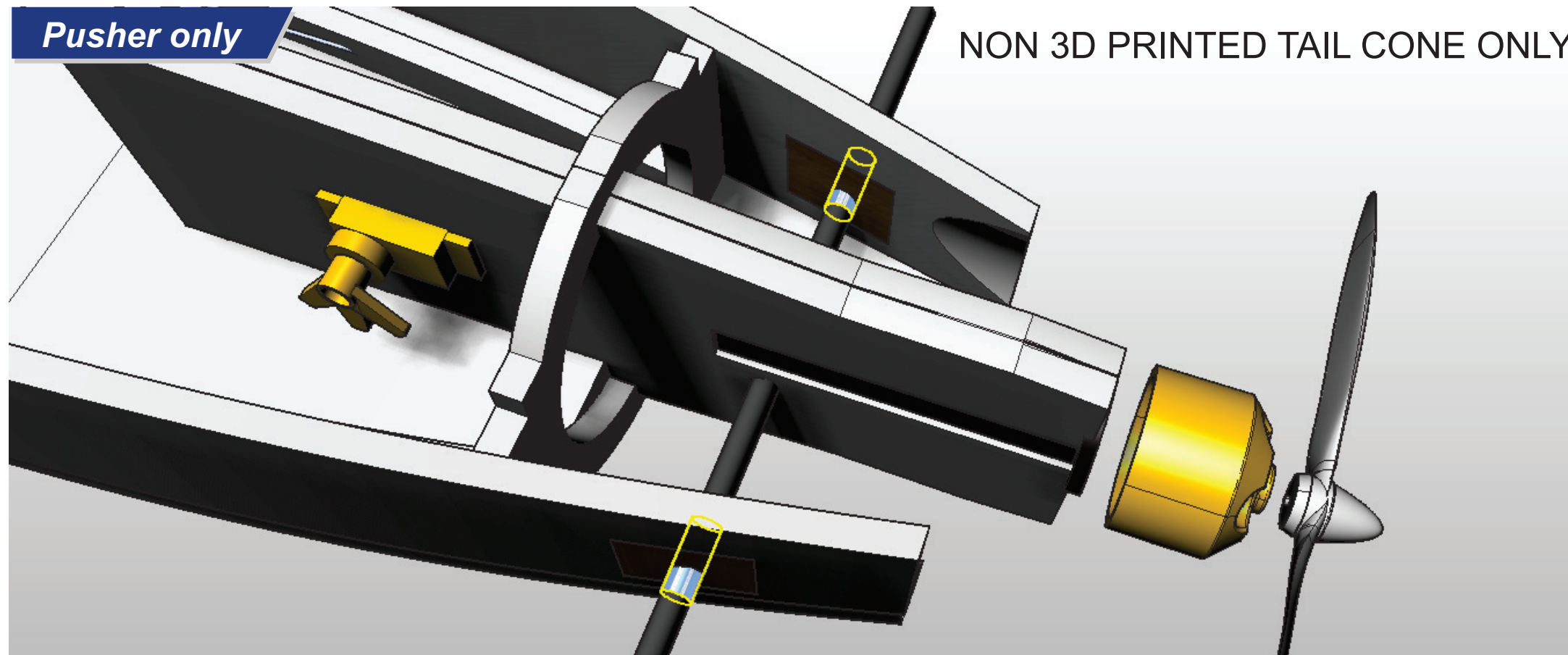
Glue the 6mm carbon tube in the correct position as shown using epoxy. Ensure it has a good bond.

Then using a junior hacksaw or trim away the centre section.



**Pusher only**

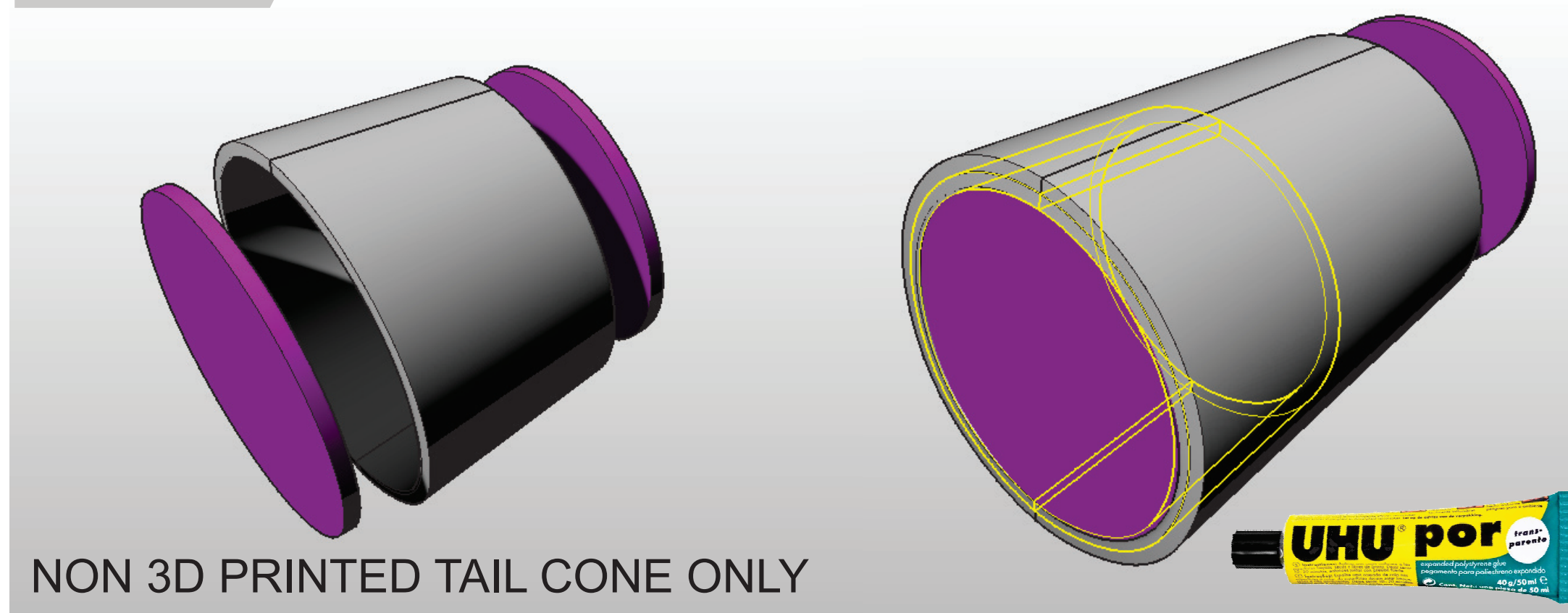
NON 3D PRINTED TAIL CONE ONLY



Using a circular needle-file, enlarge the hole in the liteply elevator supports to fit 7.14 x .355 (9/32 x .014") aluminium tube. Use Epoxy to glue in place.

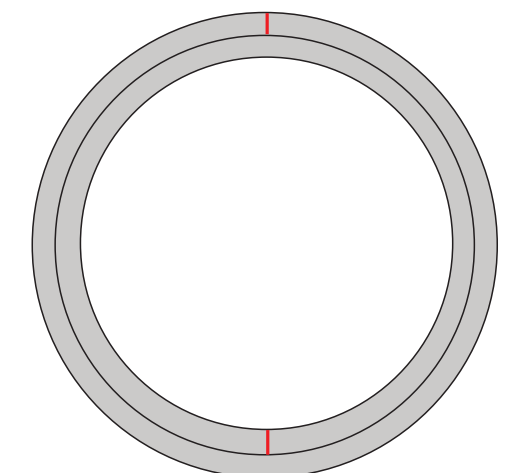


**All versions**



NON 3D PRINTED TAIL CONE ONLY

Using the three circular jigs, make the two cones using 3mm depron and then glue together. Ensure that the splits are at the opposite sides (Pic below). You may want to wrap / glue the exterior with paper to help maintain the shape.





**Pusher only**

## NON 3D PRINTED TAIL CONE ONLY

Cut 10mm dia holes in cone  
**before** gluing to the fuselage



Slide the tail cone into the assembly. Ensure a good fit.

Trim away two holes for the carbon spar and prop-spacers to go through unhindered. (see next step)

Glue into place. Due to the various connecting pieces of foam I suggest you use epoxy (sparingly) to make the bonding easier.

**Pusher only**

## CUT AWAY VIEW

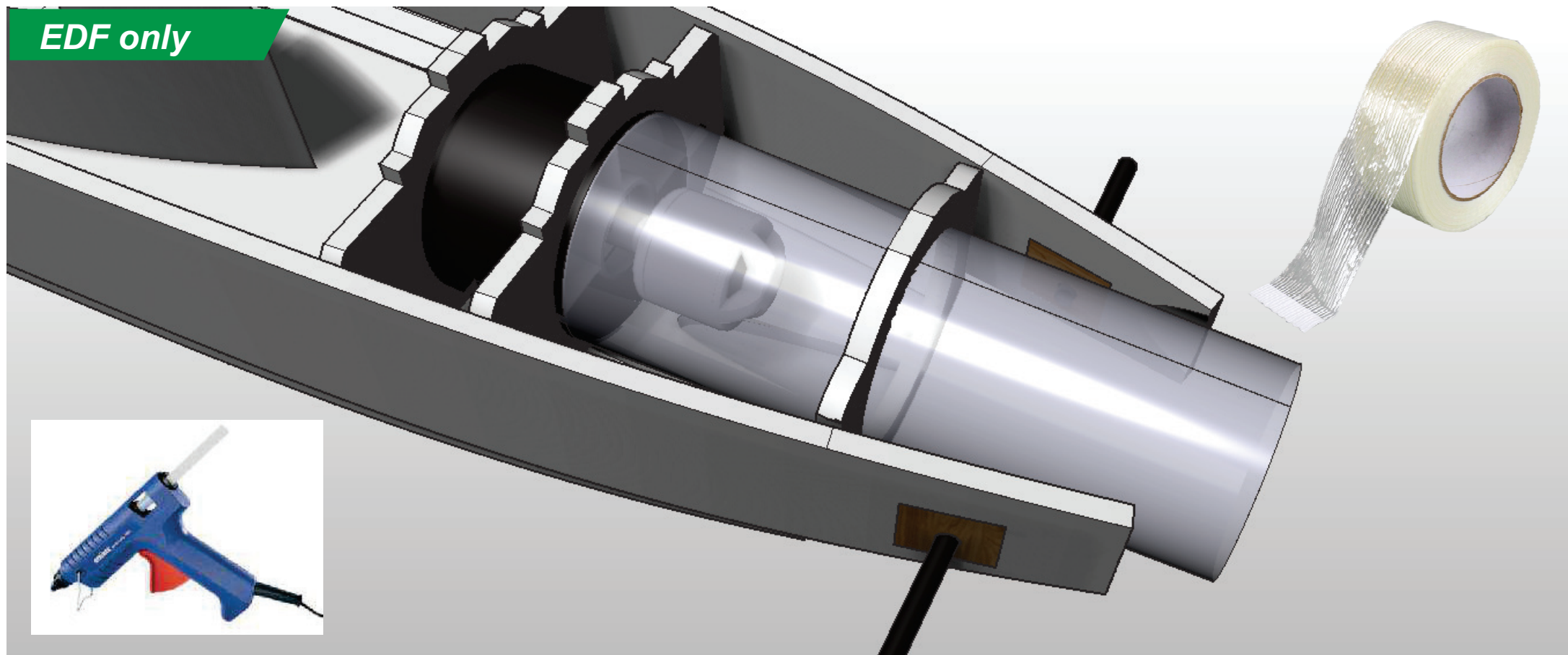
NON 3D PRINTED TAIL CONE ONLY

Slide the Horizontal stabiliser spar through the aluminium tubes, passing through drilled out prop adaptors (to prevent the shaft sliding), and a drilled out standard servo horn.

Connect a piano wire connection rod between the two horns, and ensure that it operates smoothly.



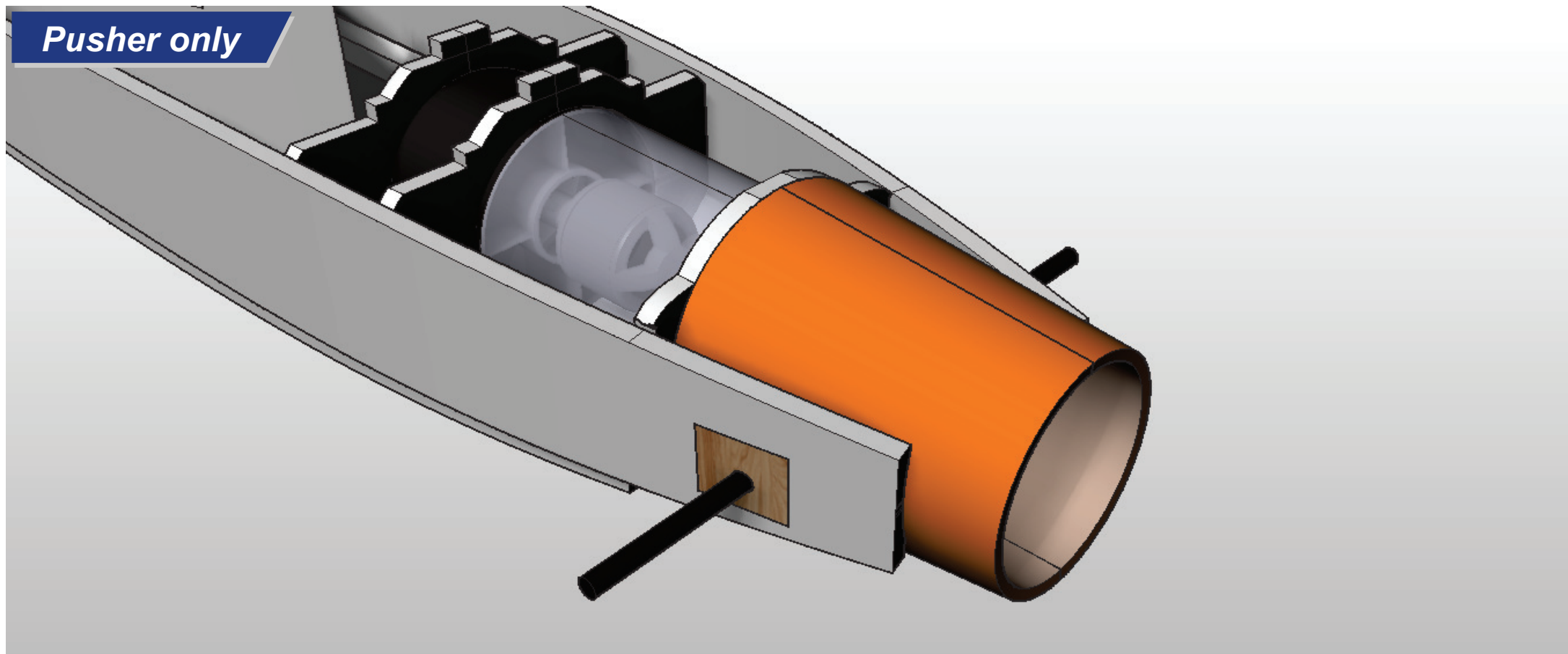
**EDF only**



Make a thrust tube according to the drawing, tape the joint with nylon reinforced tape.

Make the tube lip over the edge of the EDF unit. if there isn't the space to do that, use depron blocks glued to the bulkhead to make a glueing flange.

**Pusher only**



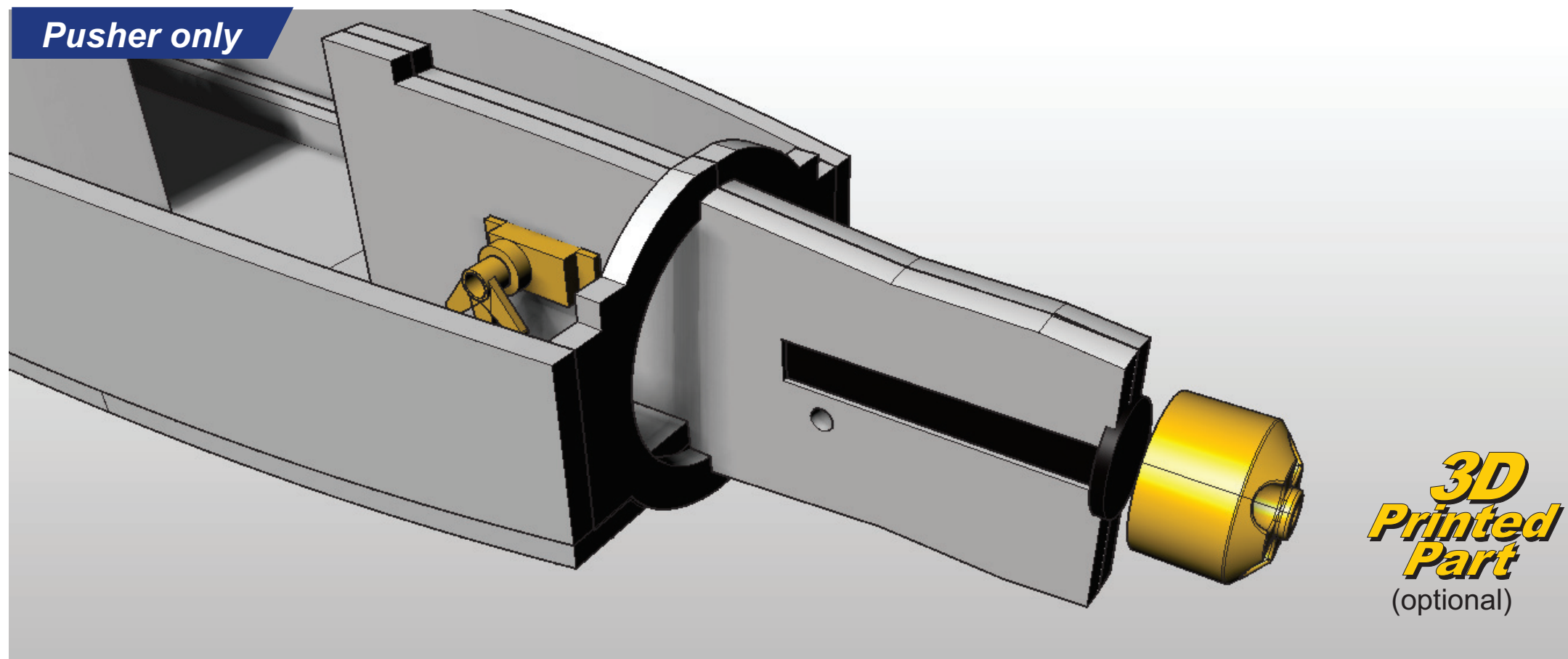
Slide the tail cone into the assembly. Ensure a good fit.

Glue into place. Due to the various connecting pieces of foam I suggest you use epoxy (sparingly) to make the bonding easier.



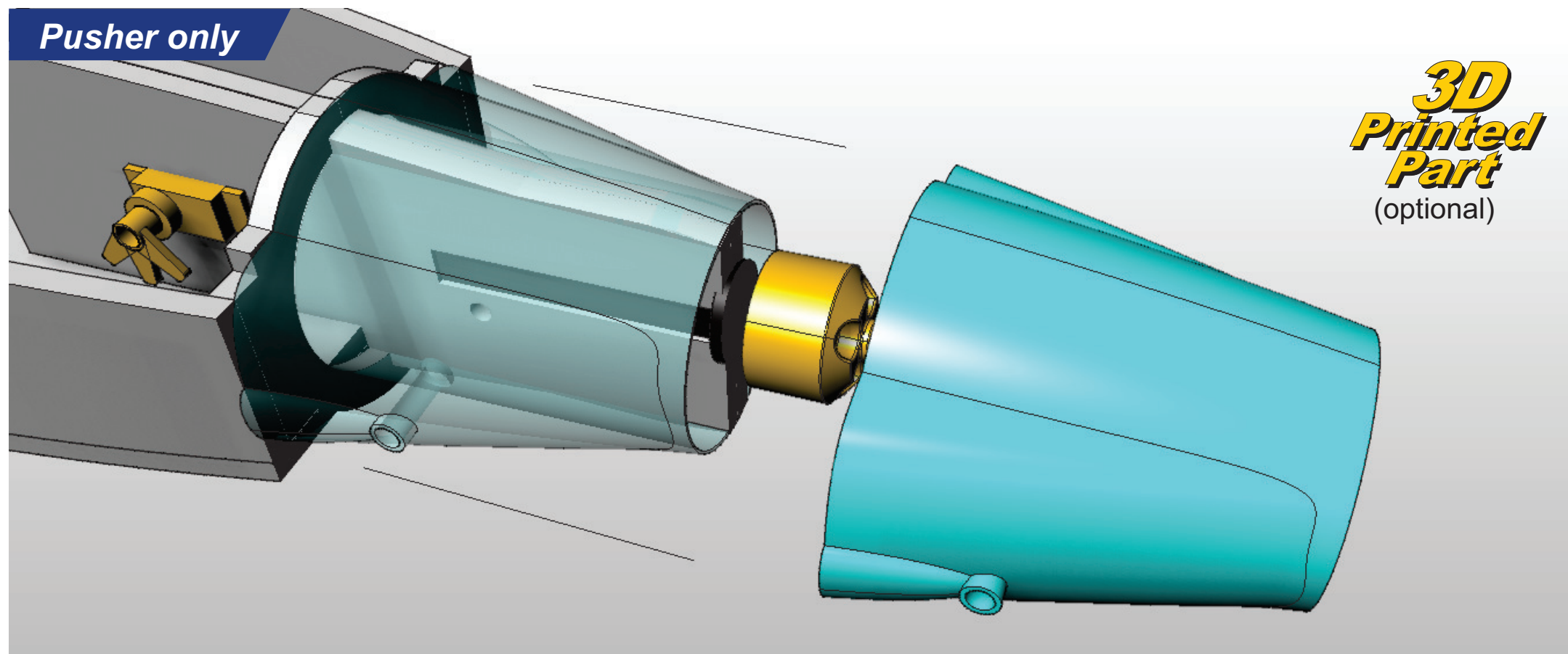


Pusher only



Remove the prop.

Pusher only

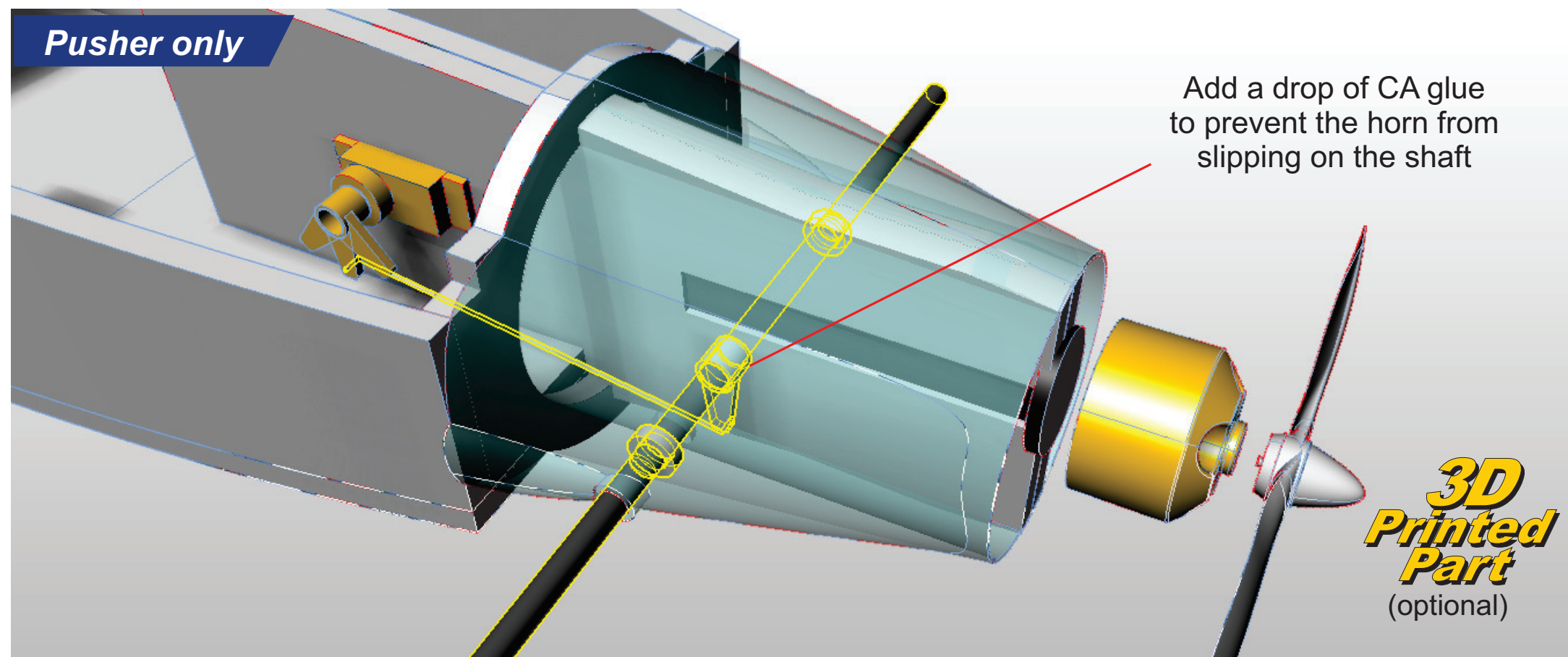


Check that the carbon elevator spar can travel freely through the guide holes in the **3d printed pusher tail cone**. If not, carefully file the hole using circular needle file until it can turn freely.

Glue the tail cone to the assembly.



## Pusher only

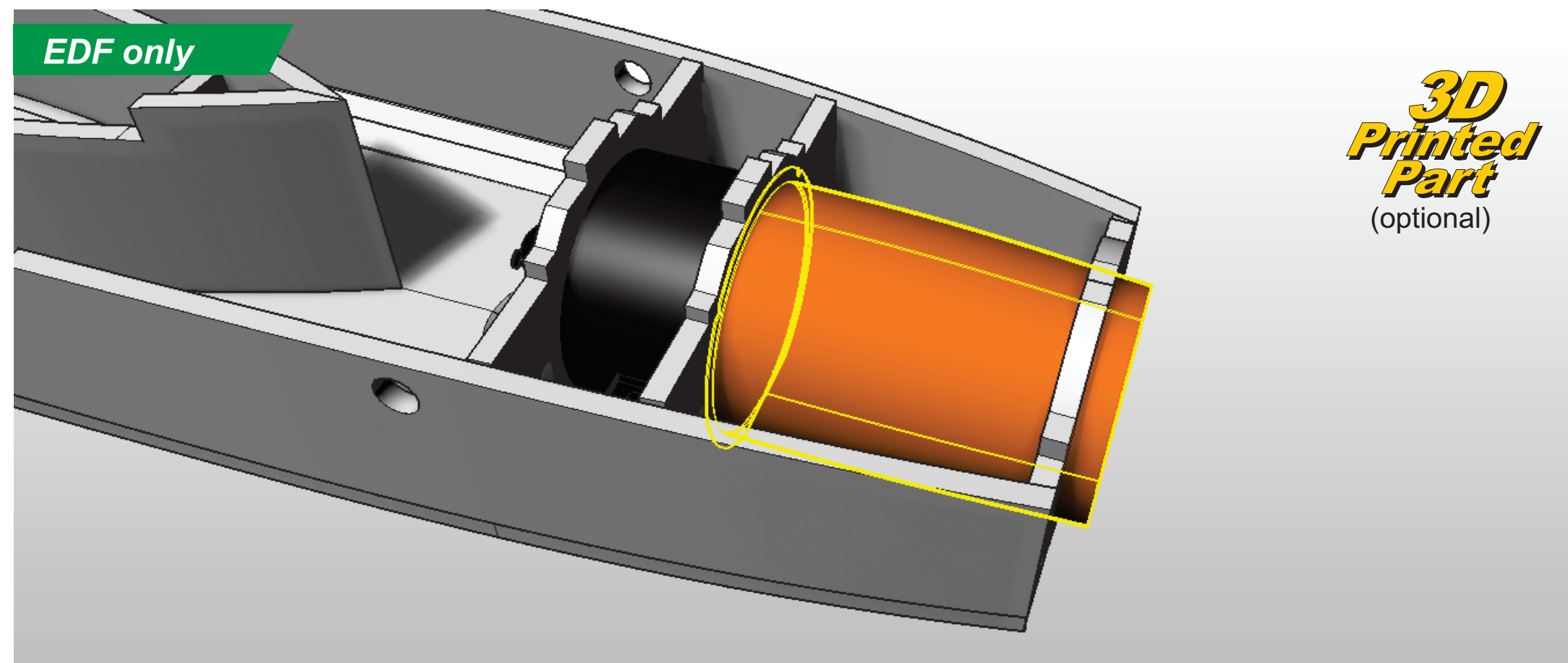


Make the elevator horn by drilling out a standard size servo horn using a 6mm drill bit. Put a Z-bend in the piano pushrod and thread into the elevator control horn.

Slide the carbon tube through the print adding prop adaptor + Elevator horn + prop adaptor to the inside as shown. The prop adaptors act as end stops to prevent the tube from sliding out.

Connect to the servo and test.

## EDF only

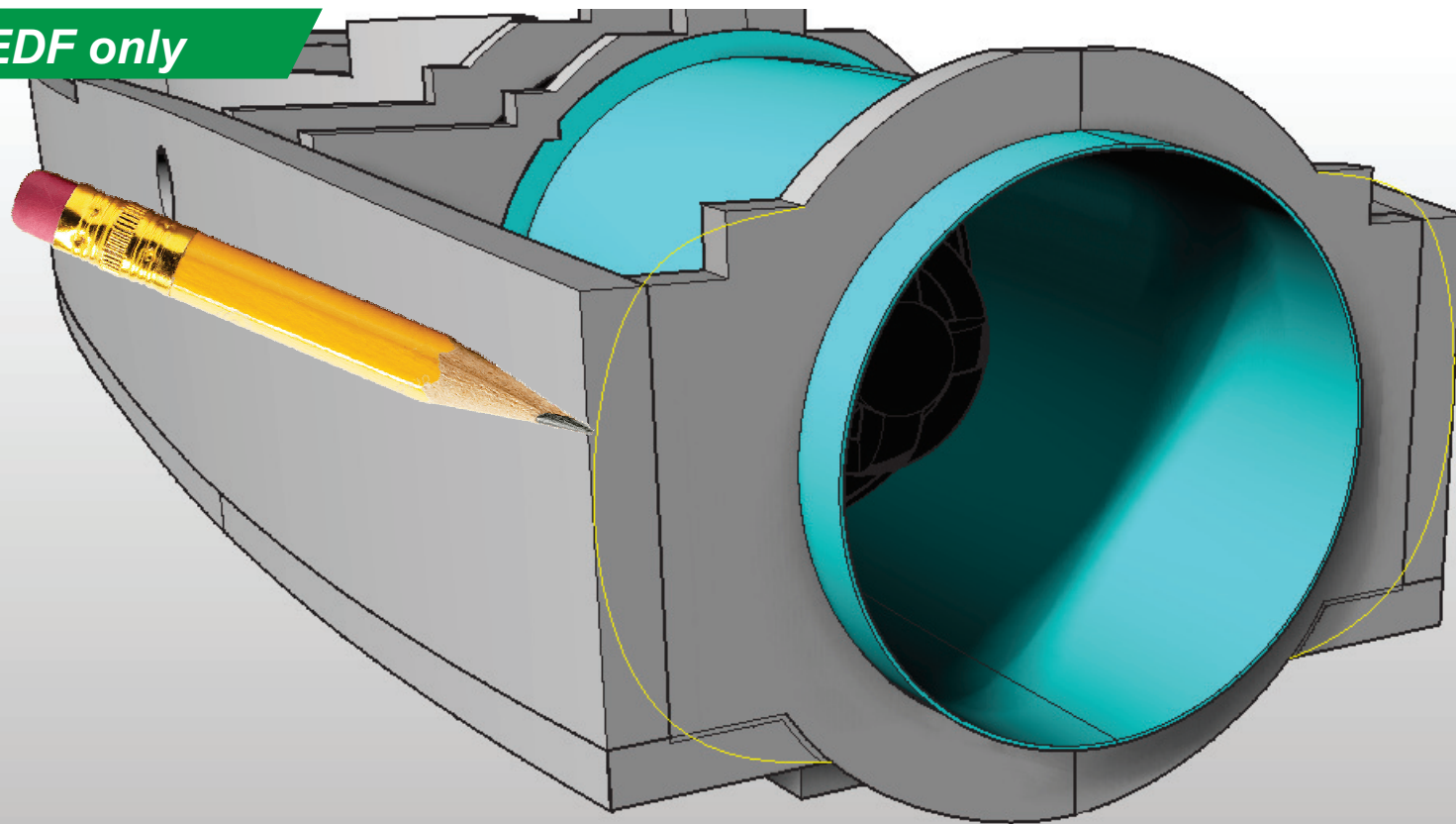


Glue the thrust tube to the assembly making sure it has the flat edge against the belly panels.





EDF only



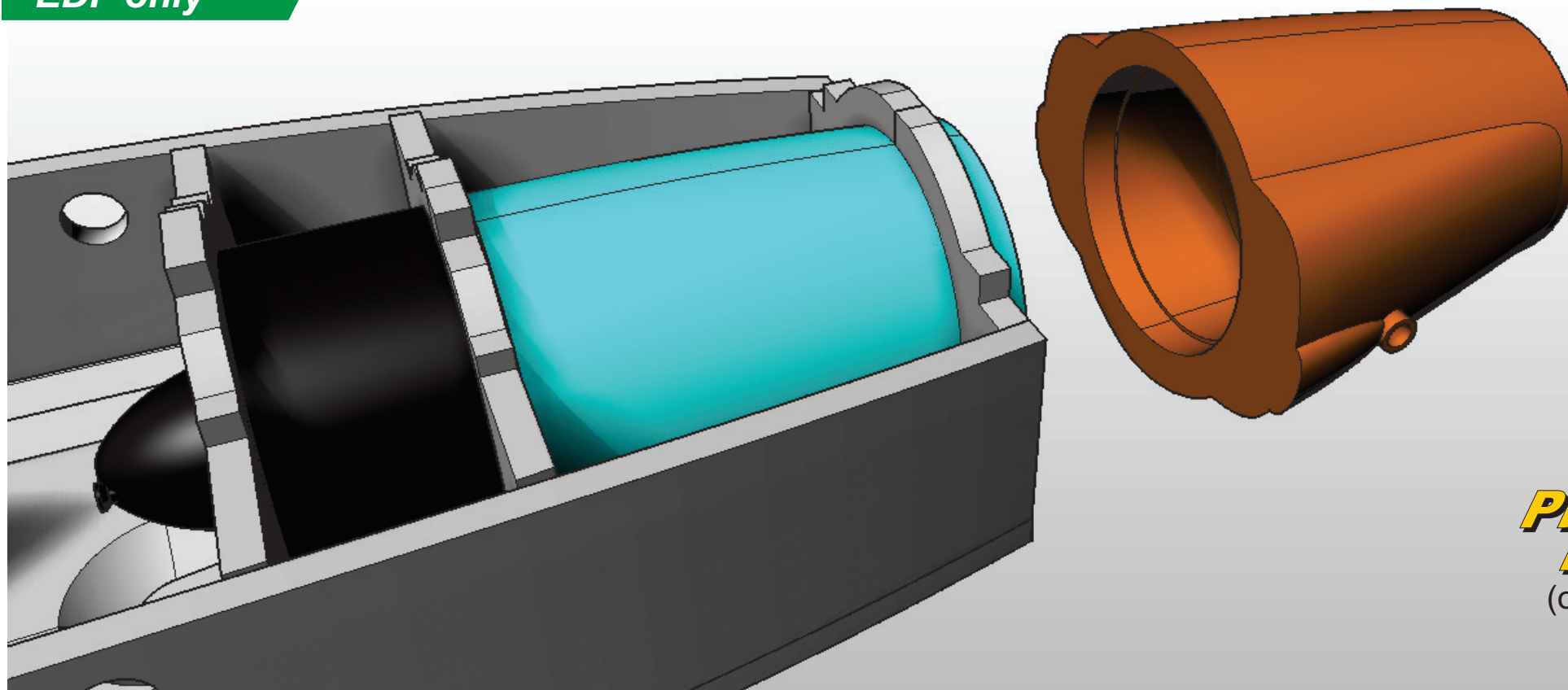
**3D  
Printed  
Part**  
(optional)

Dry-fit the tail cone and draw around the shape.

Sand the depron to shape.



EDF only



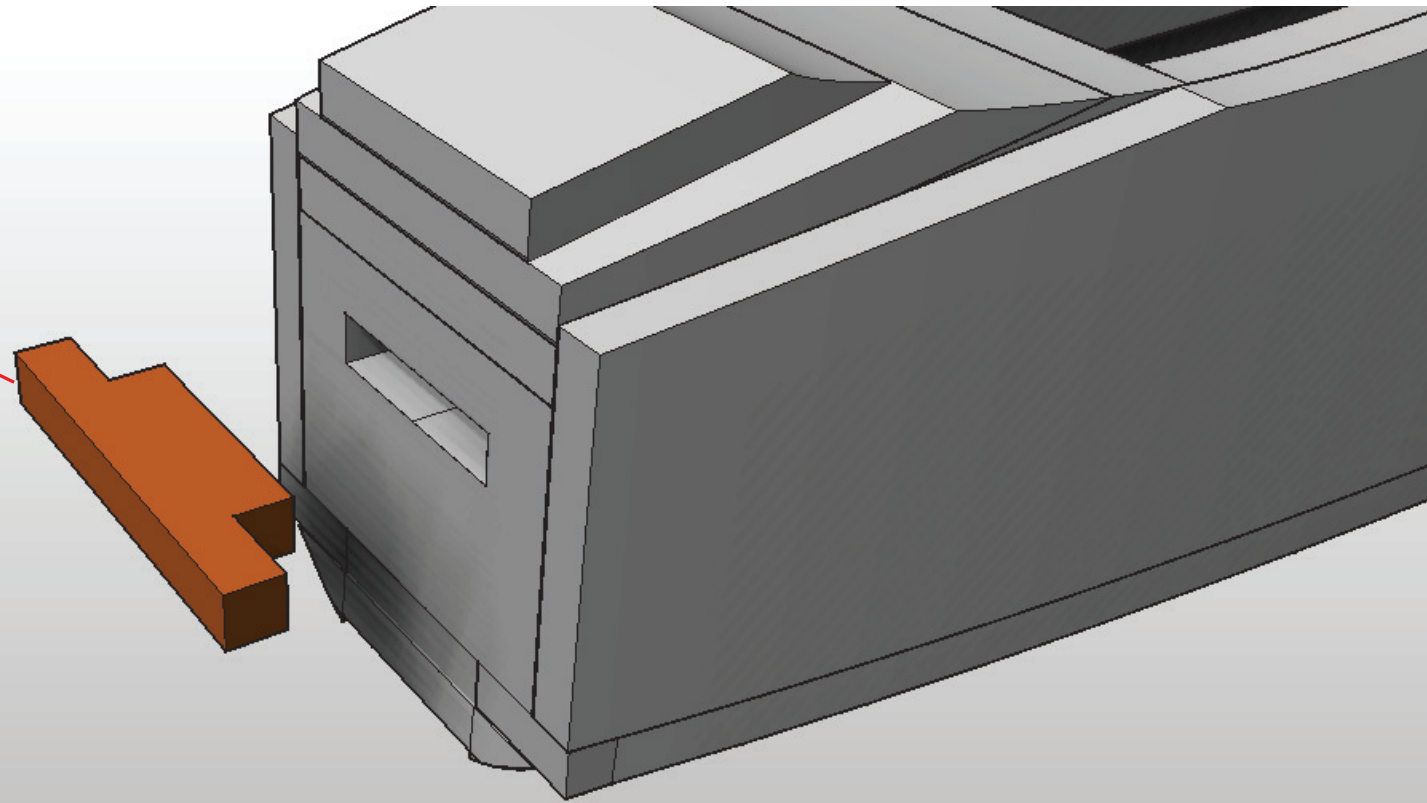
**3D  
Printed  
Part**  
(optional)

Once the depron is sanded (not shown) glue the tailcone onto the assembly.

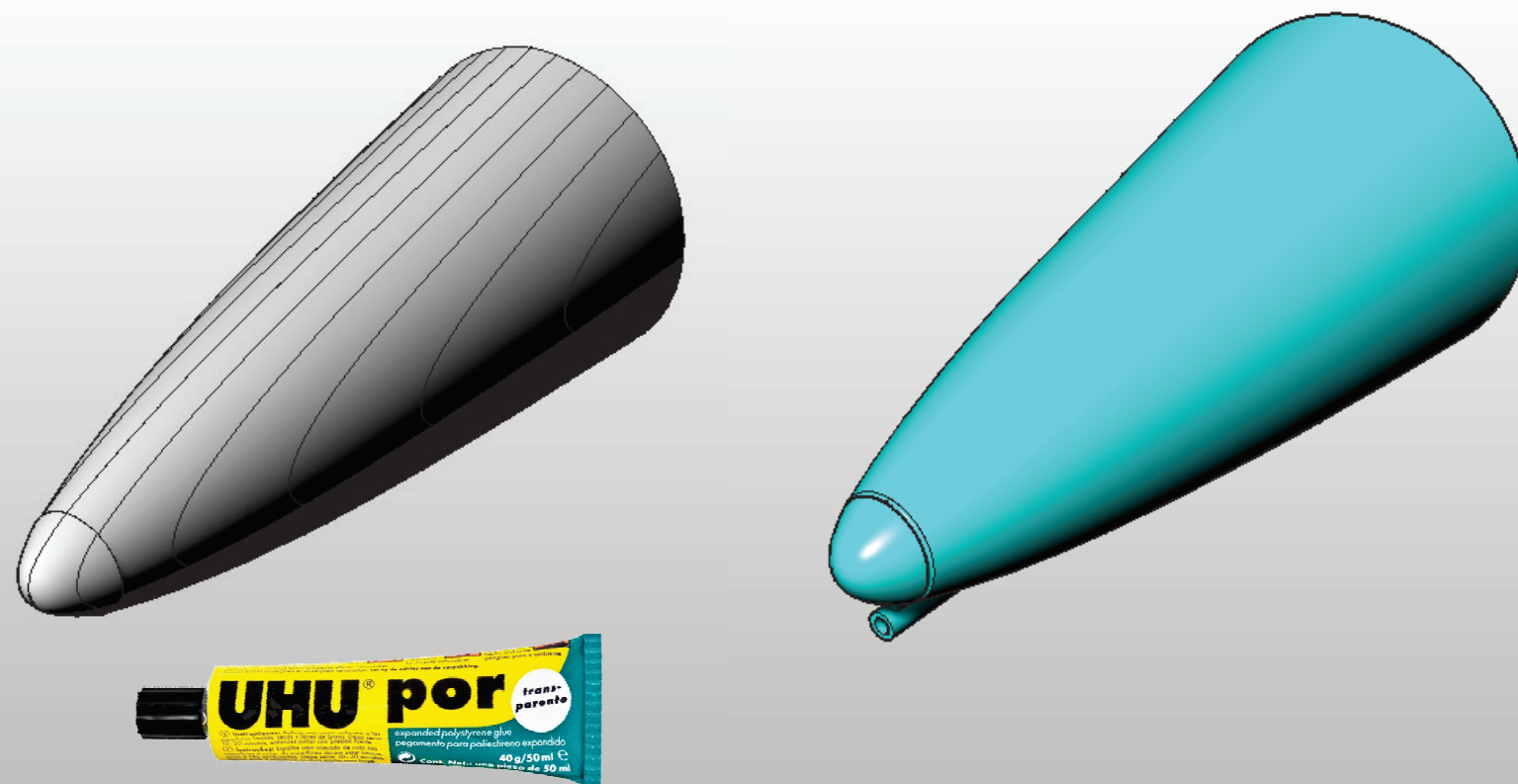


All versions

Nosecone Aligner

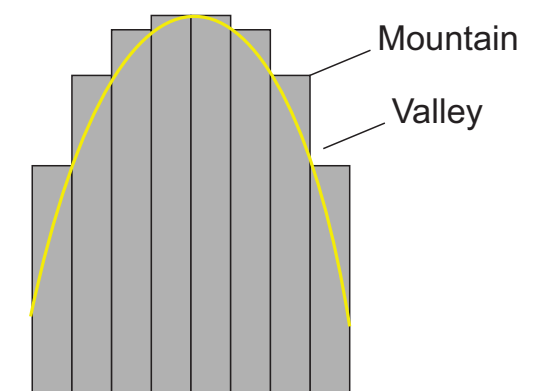


Glue the **Nosecone aligner** to the assembly.

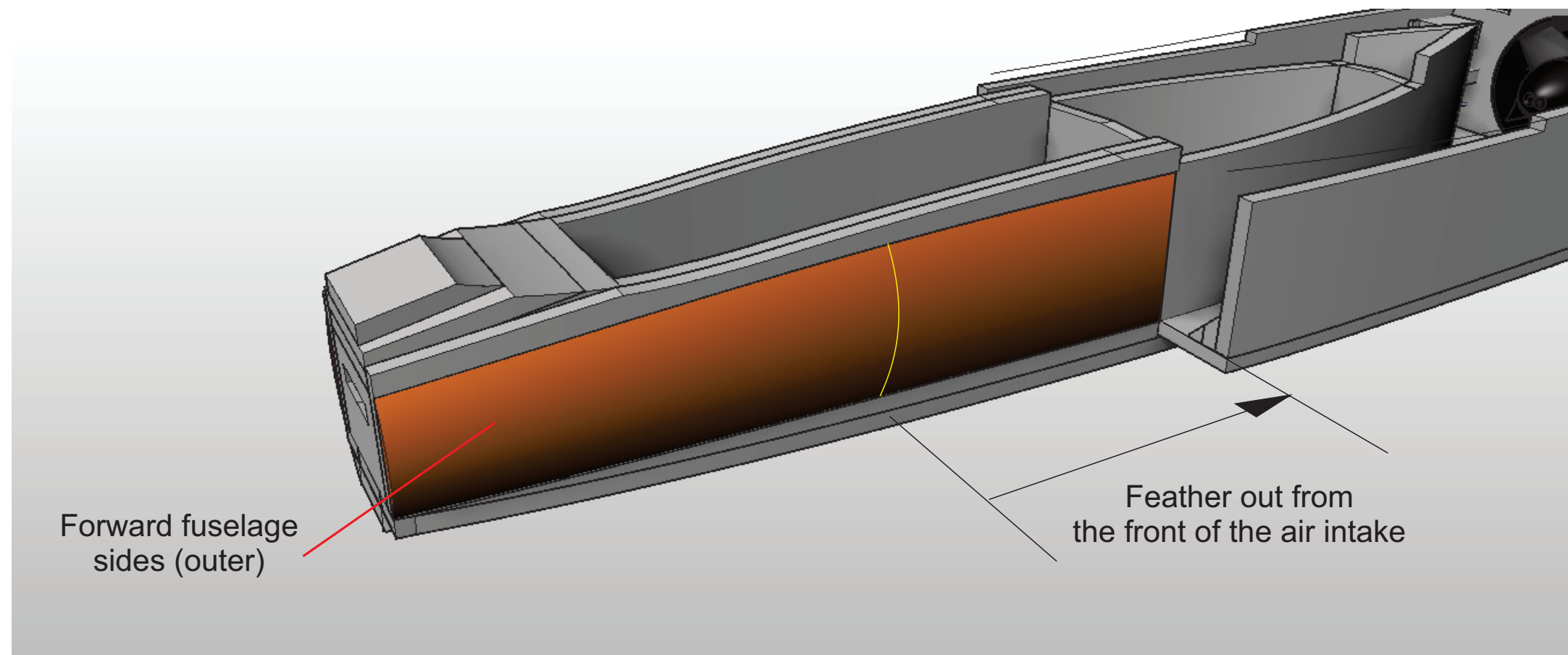


**3D  
Printed  
Part**  
(optional)

Create either a 3d printed Nosecone or a nosecone consisting of layers of foam sanded to get the right shape, by removing the 'mountains' until the 'valleys' are no more.



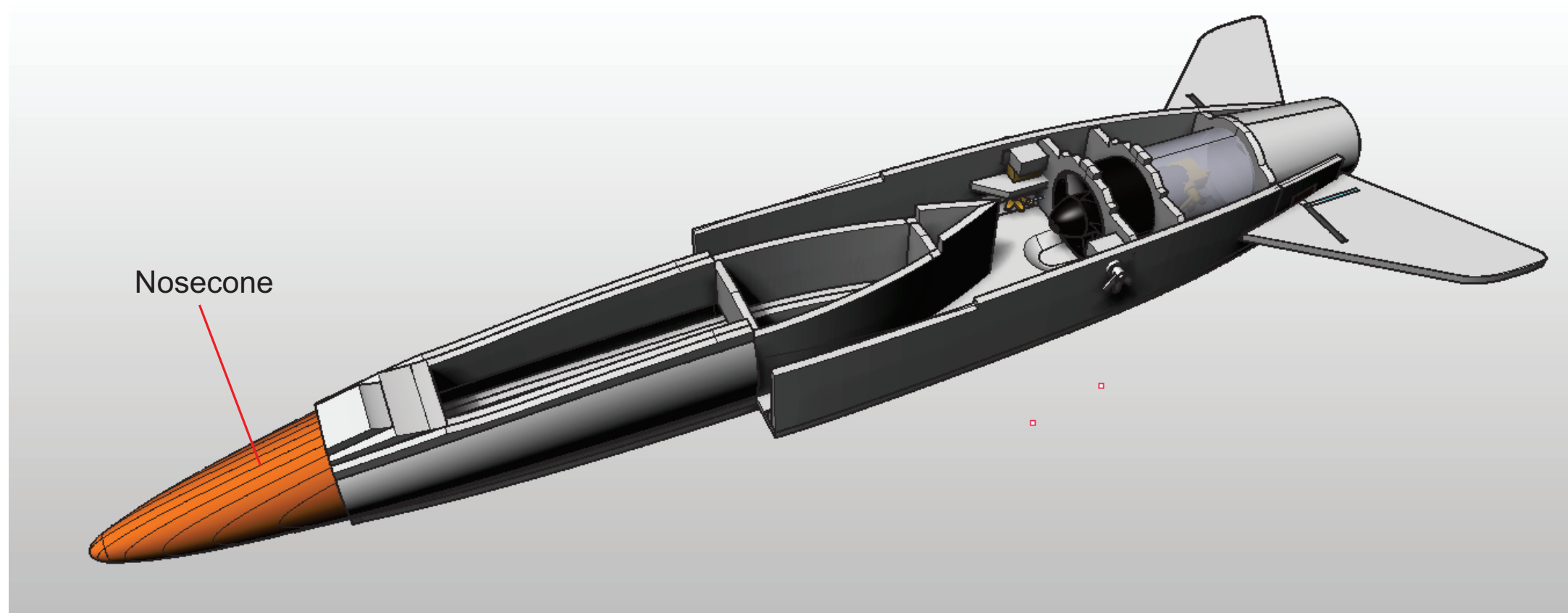




Shape the **Forward fuselage sides (outer)** to feather out as soon as the panel meets the air intake.

This image shows the fuselage prepared for 3d printed air intakes.

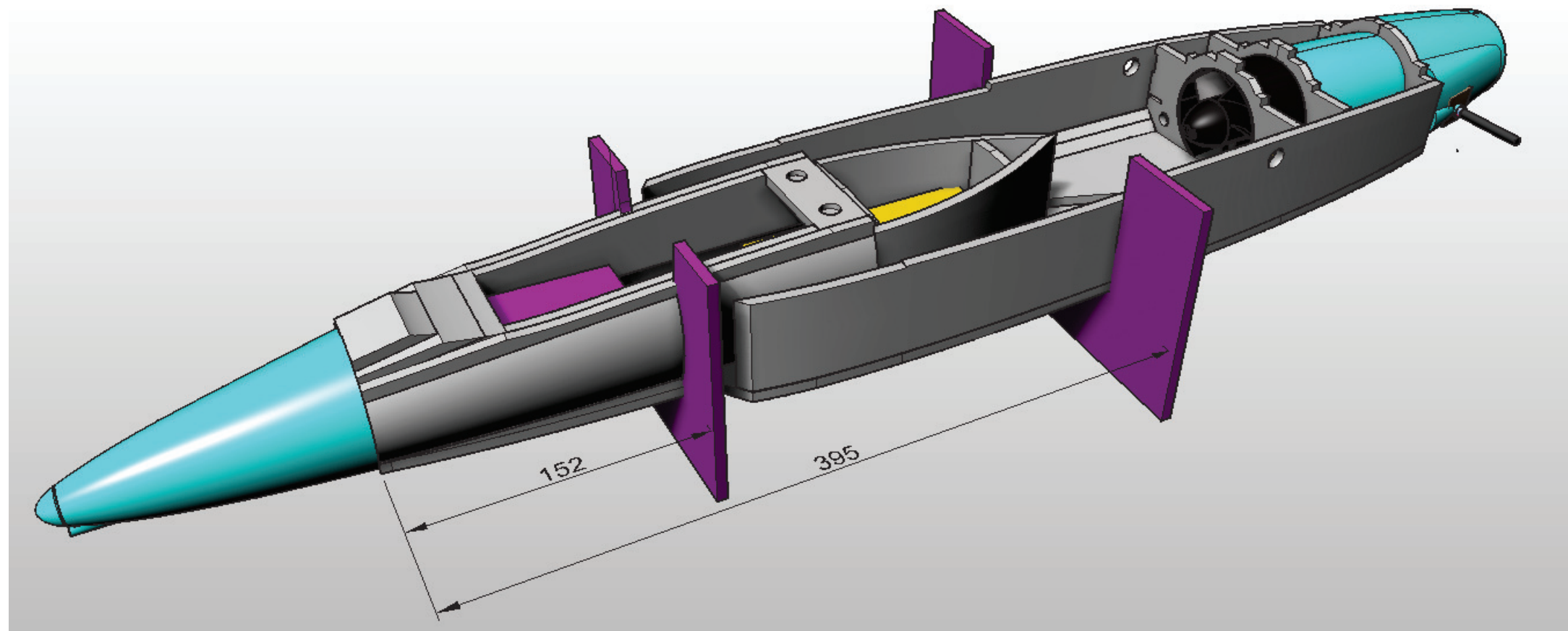
Glue in place.



Glue the Nosecone to the assembly.

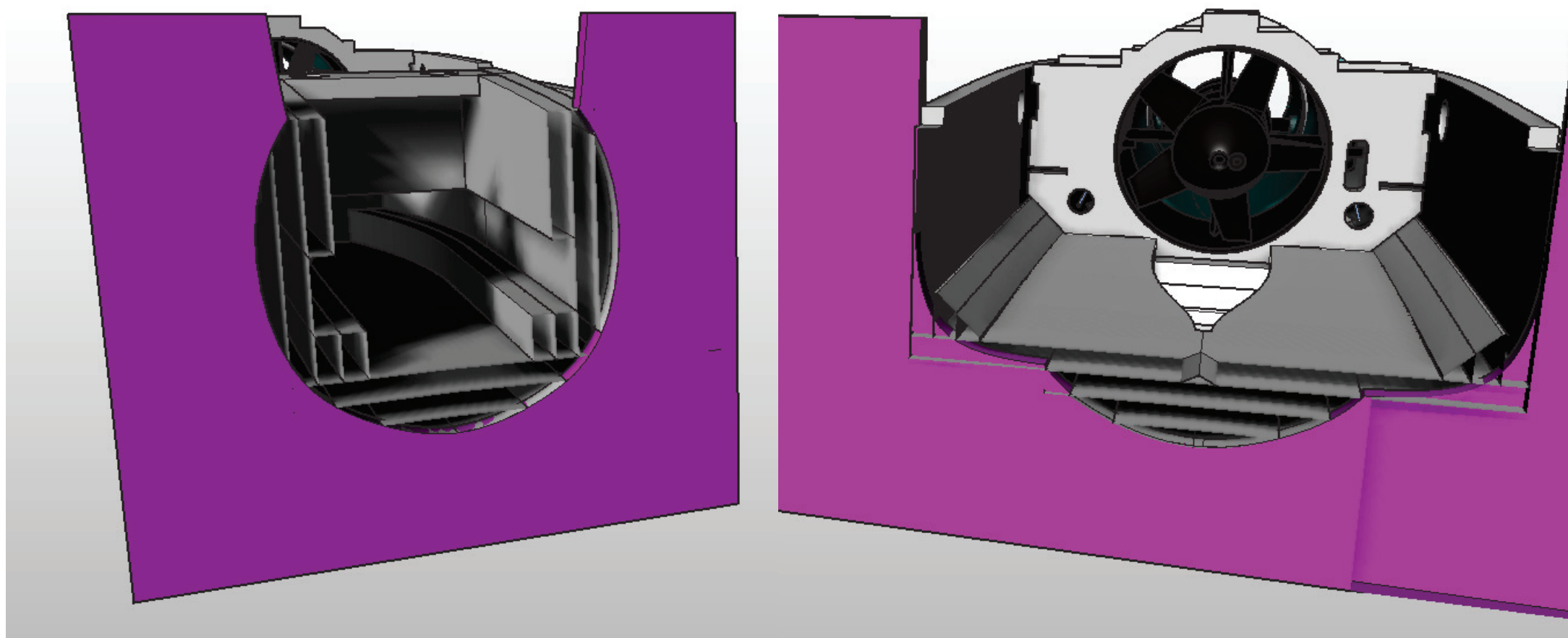




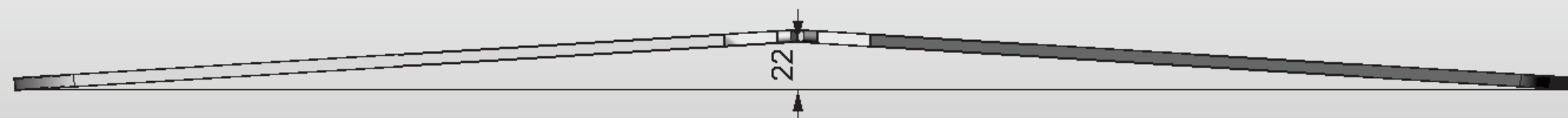


Use the sanding jigs to shape the fuselage as shown.

Use sandpaper and block with various grades of sandpaper to get a smooth finish,



*All versions*



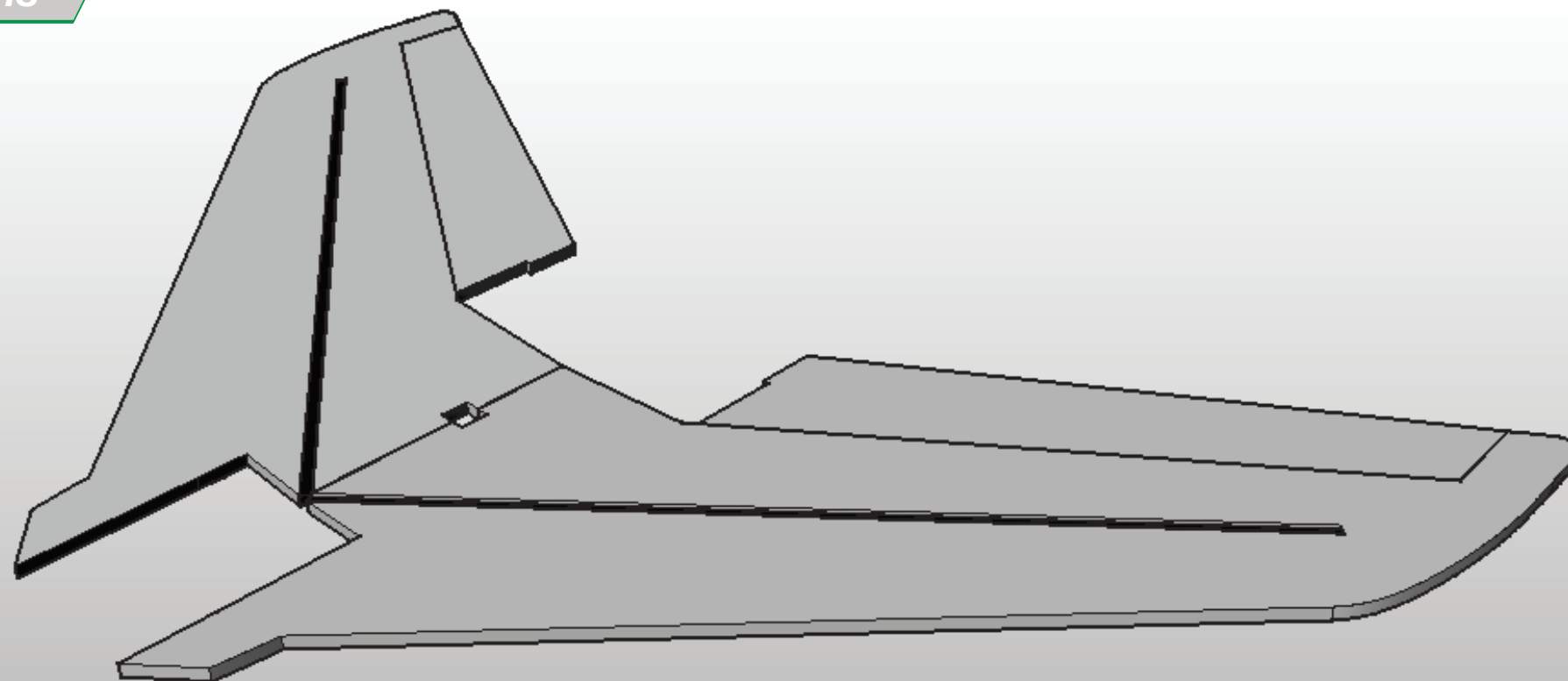
Cut two pieces of carbon tube to length to fit into the slots in each wing. Ensure then ends are 'mitred' together to make a good fit. Using masking tape on the top and bottom of the spars until the epoxy sets.

Make a 22mm depron strip to raise the centre of the two wings to create the anhedral shape.

Use masking tape top and bottom and epoxy in place.

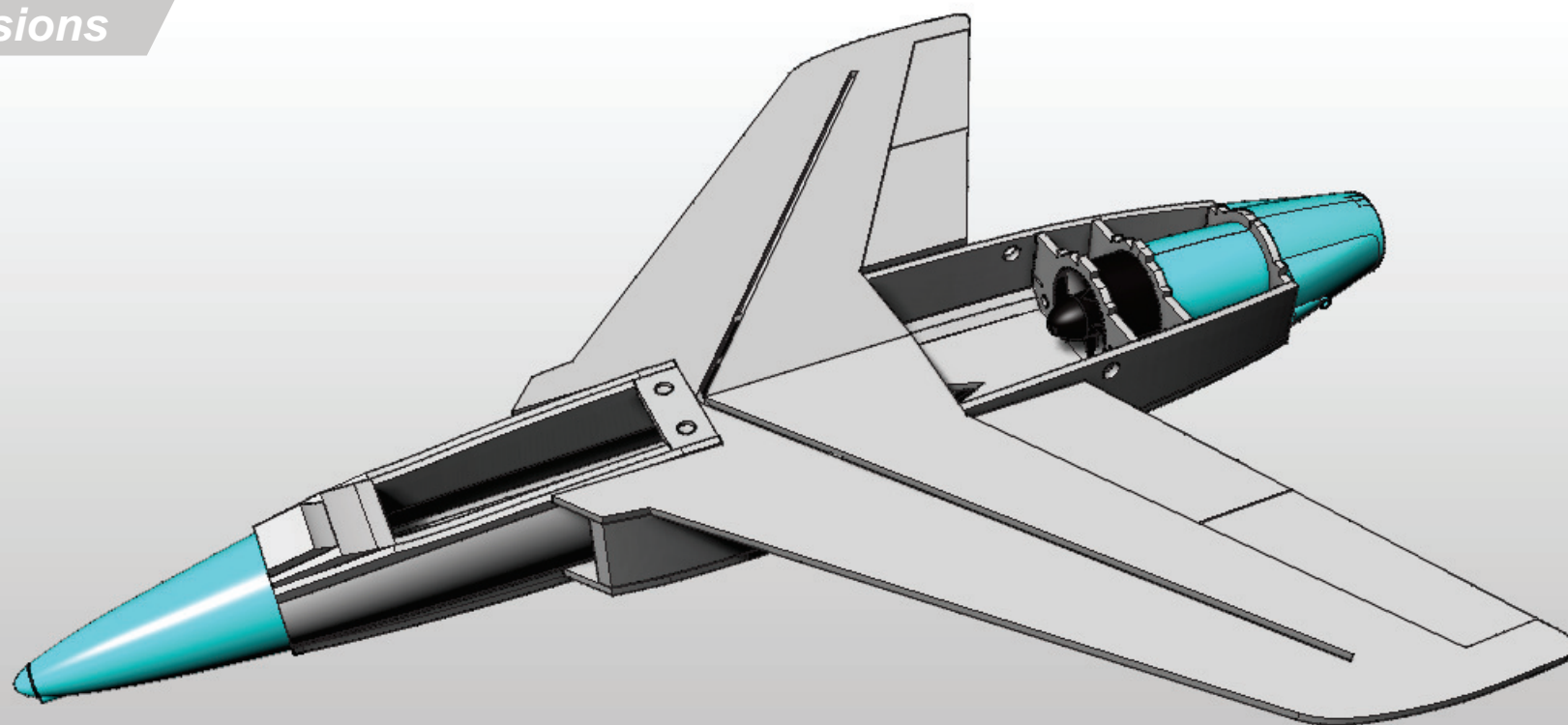
Leave until completely set

*All versions*





All versions

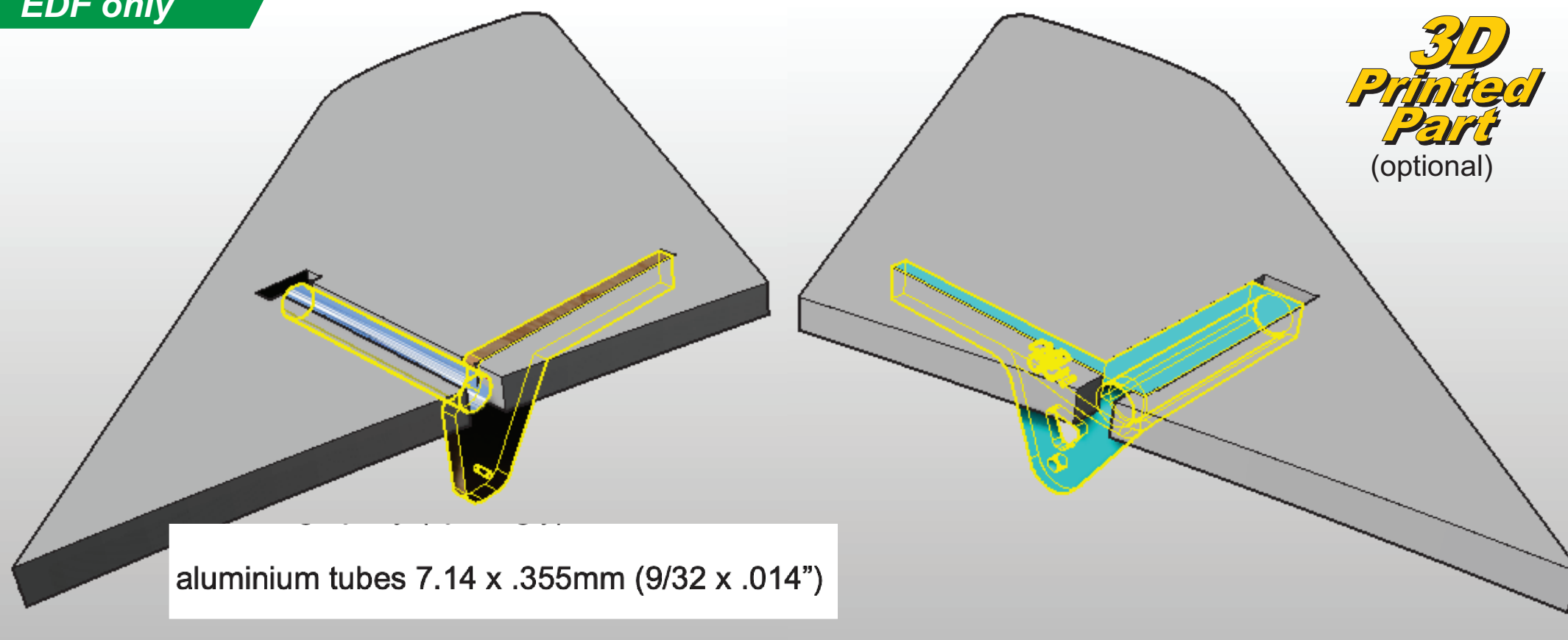


Sand the mating surfaces to ensure a good fit.

Carefully align the wing with the Centreline of the fuselage then glue in place.



EDF only

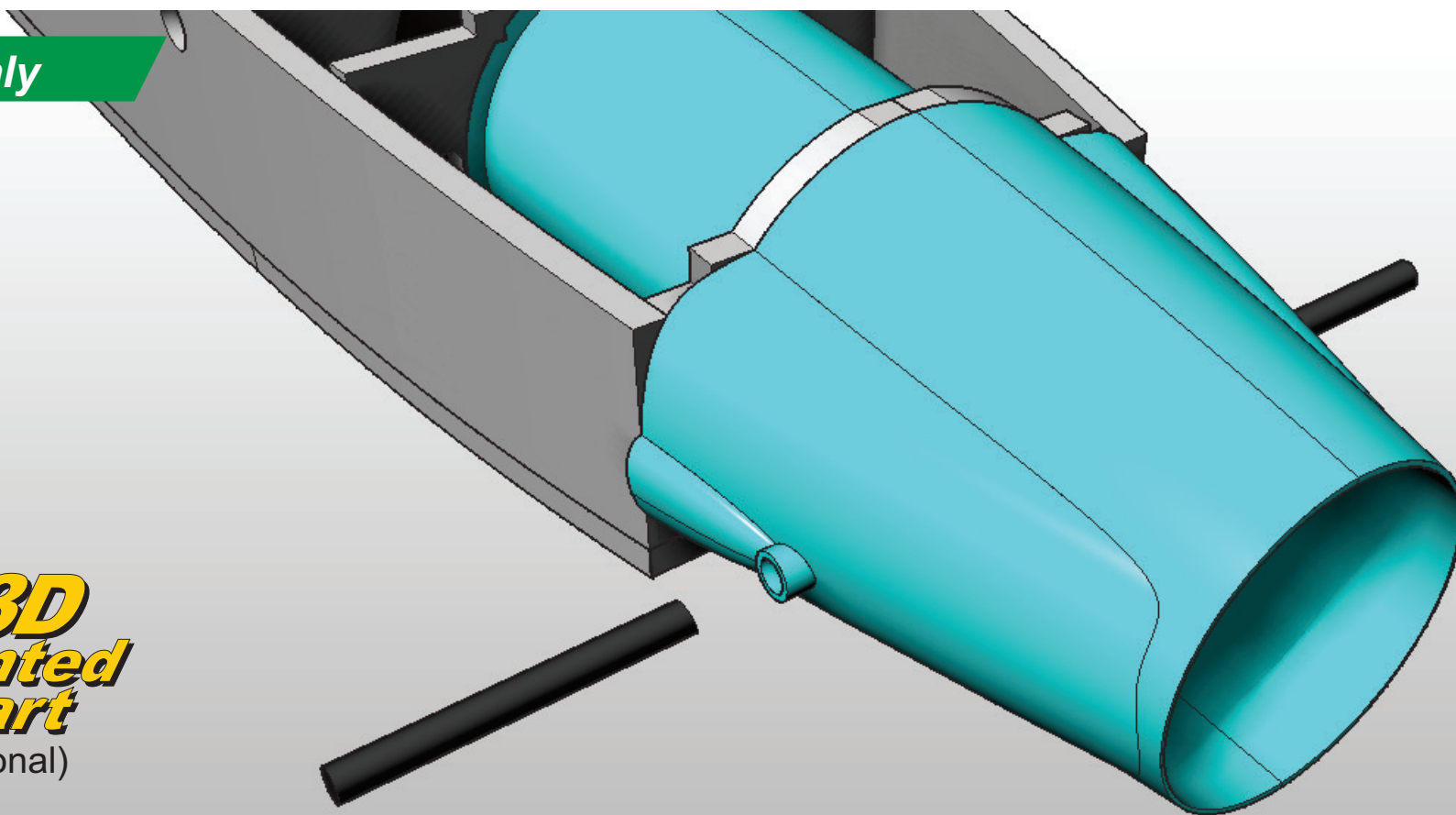


Either using the aluminium tube / 3mm plywood construction or 3D printed parts, assemble the EDF elevator pivot/horn and glue in place using epoxy.



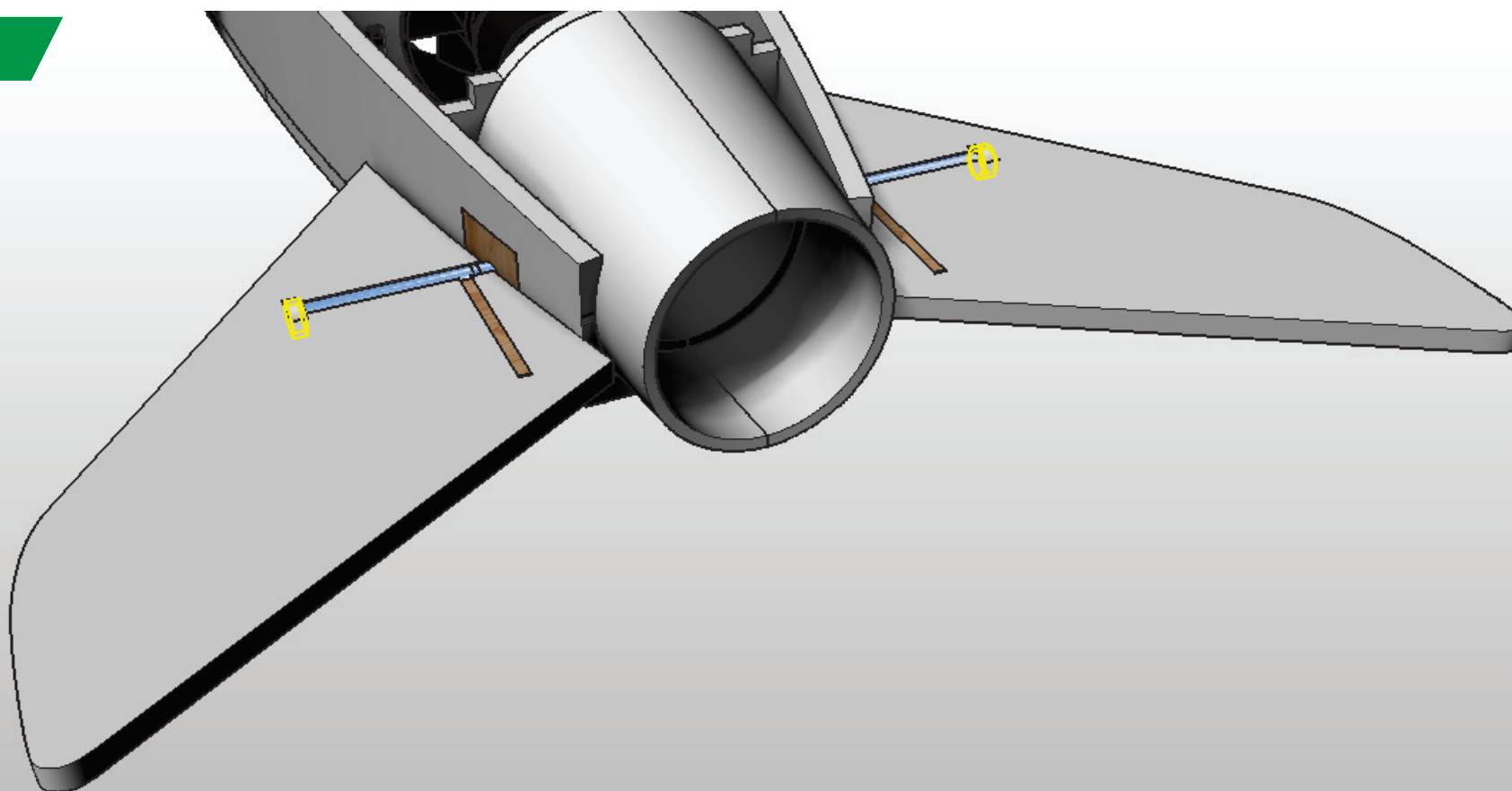
EDF only

**3D  
Printed  
Part**  
(optional)



Glue the horizontal stabiliser shafts into the 3d printed exhaust duct using Epoxy.

EDF only



All EDF versions -

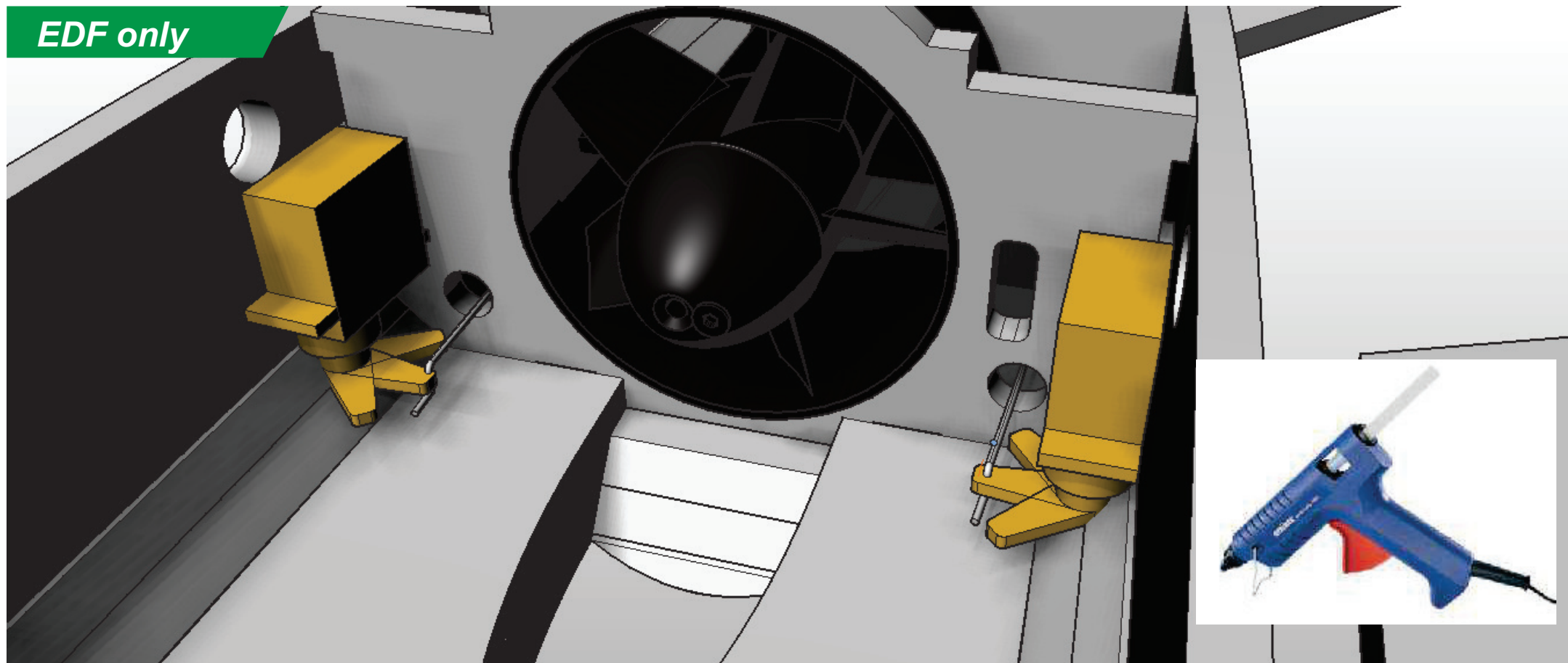
Slide the elevators onto the shafts, along with the two endstops. Carefully glue the end stops onto the shaft using CA.

Alternatively, drill and put a small screw through the endstop into the carbon shaft.





EDF only

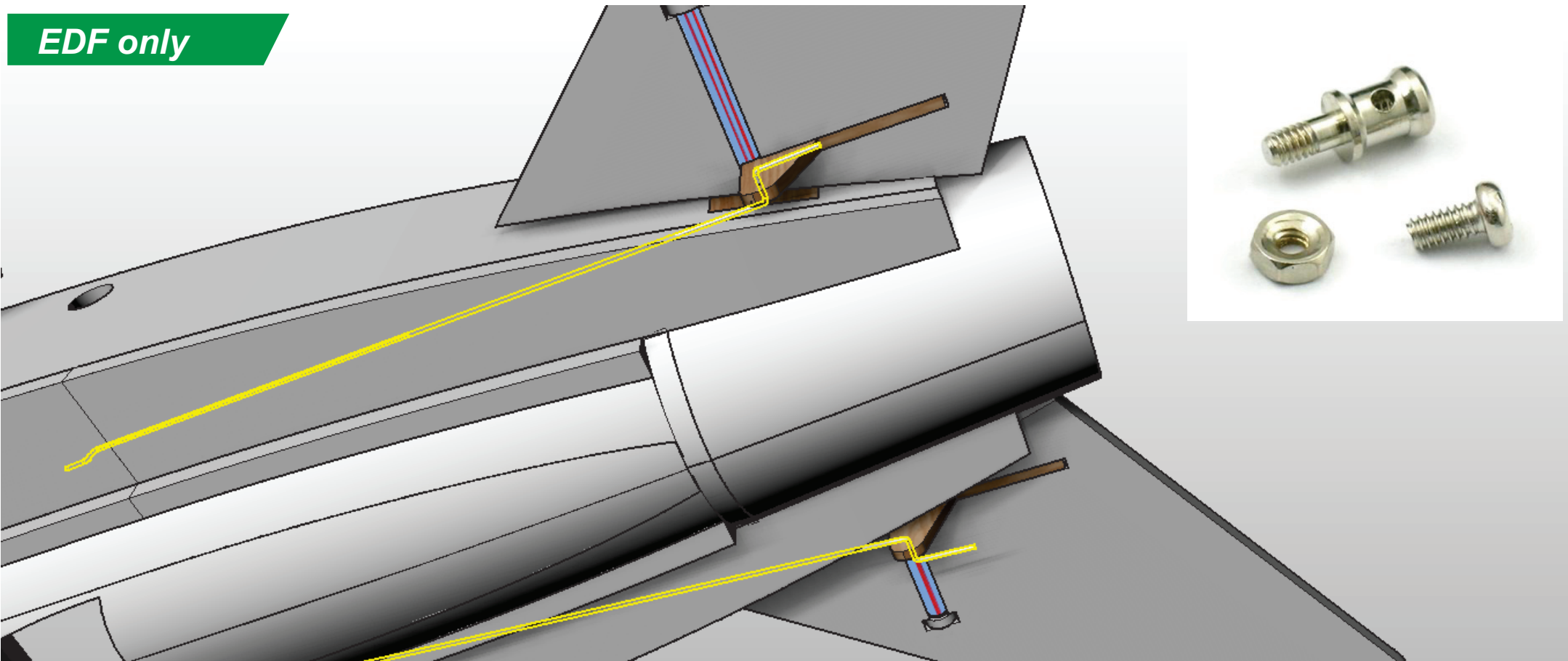


The elevators are controlled by two servos.

Using a drill and piece of piano wire, carefully create a passage through the underside of the fuselage right past the control horns and through the holes in both EDF bulkheads. Enlarge and thread a plastic pushrod sheath through, and glue in place.

Put a Z bend in the end of your push rods, and thread through your servo horn.

EDF only

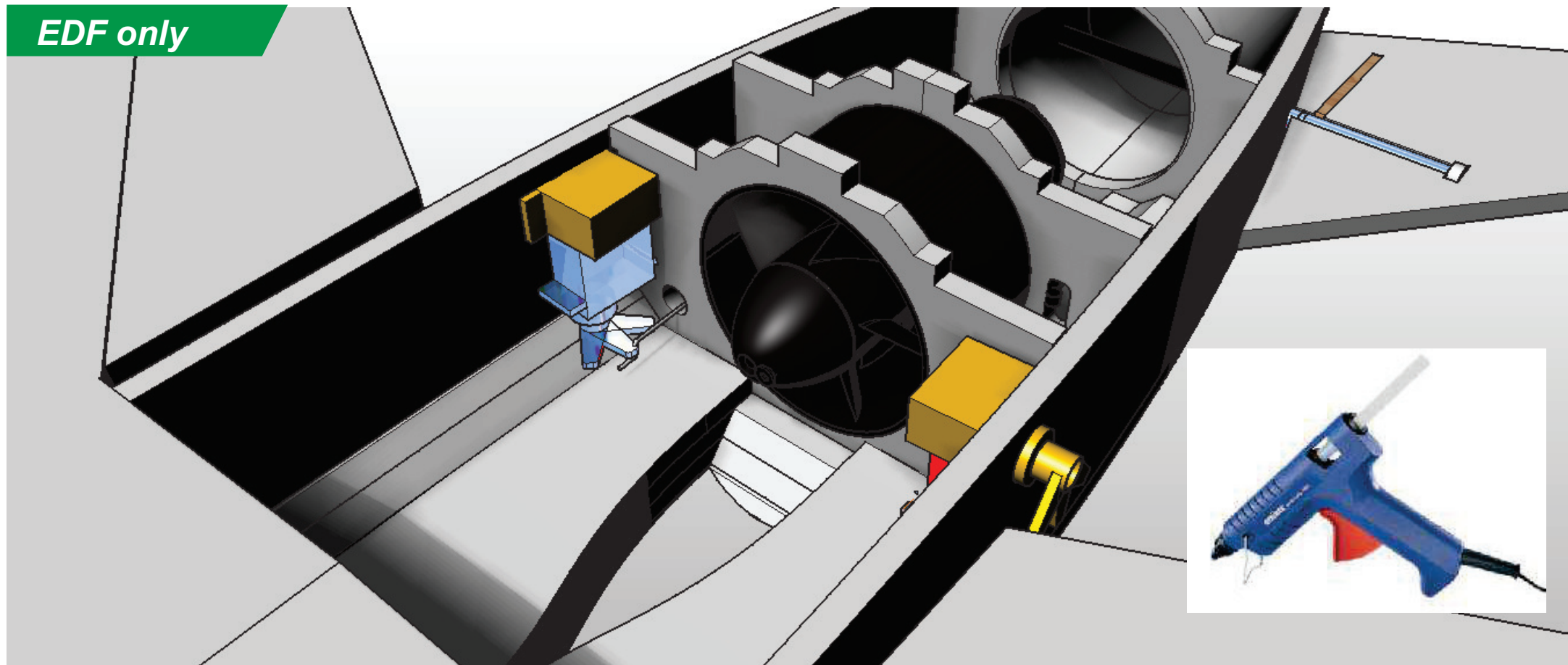


Glue your servos in place as shown using hot melt glue, to ensure a good adhesion to both the outer wall and bulkhead.

On the elevators, fit Linkage stoppers and adjust to suit.



EDF only

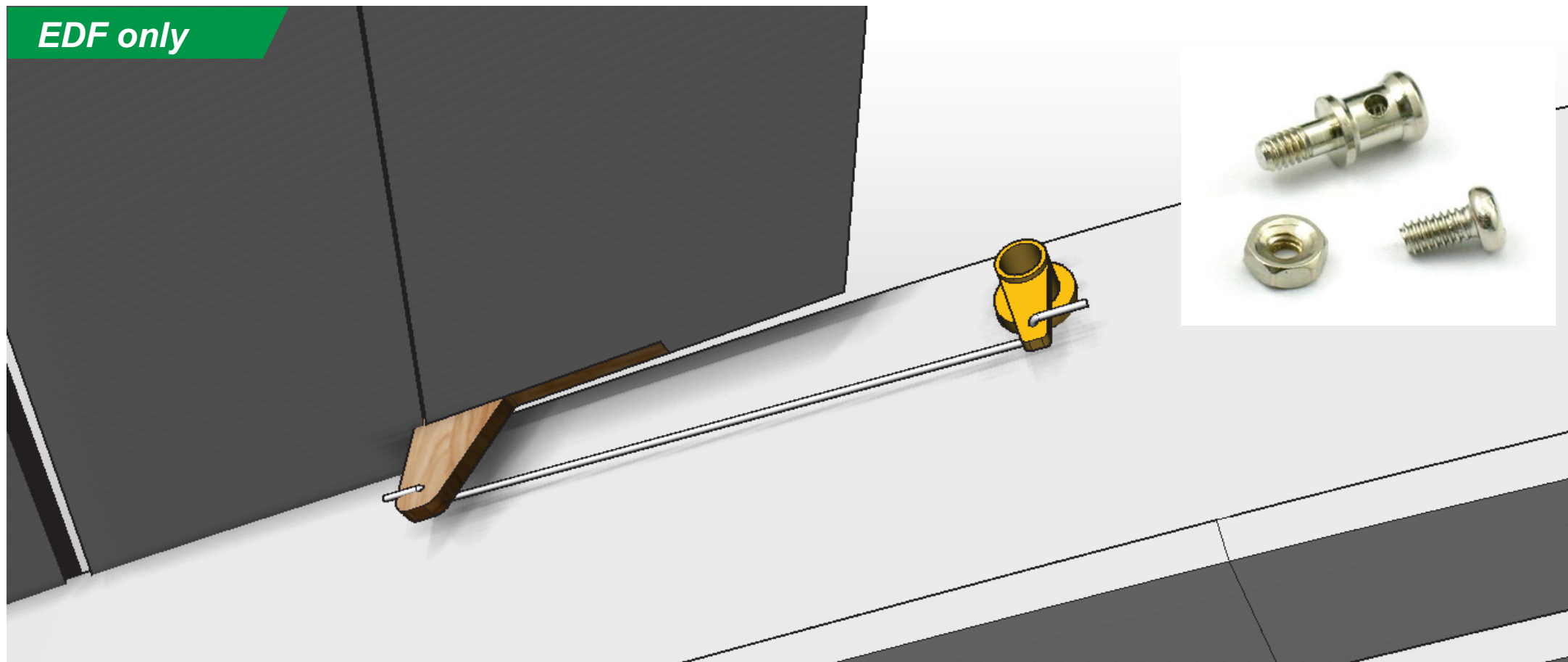


In order to minimise intrusion into the EDF air intakes, I positioned the Aileron servos rearward of the wing.

Carefully run the Piano wire forward as shown using linkage stoppers on the Servo control horn to give adjustability. You may need to slightly bend your pushrod to avoid the ailerons.

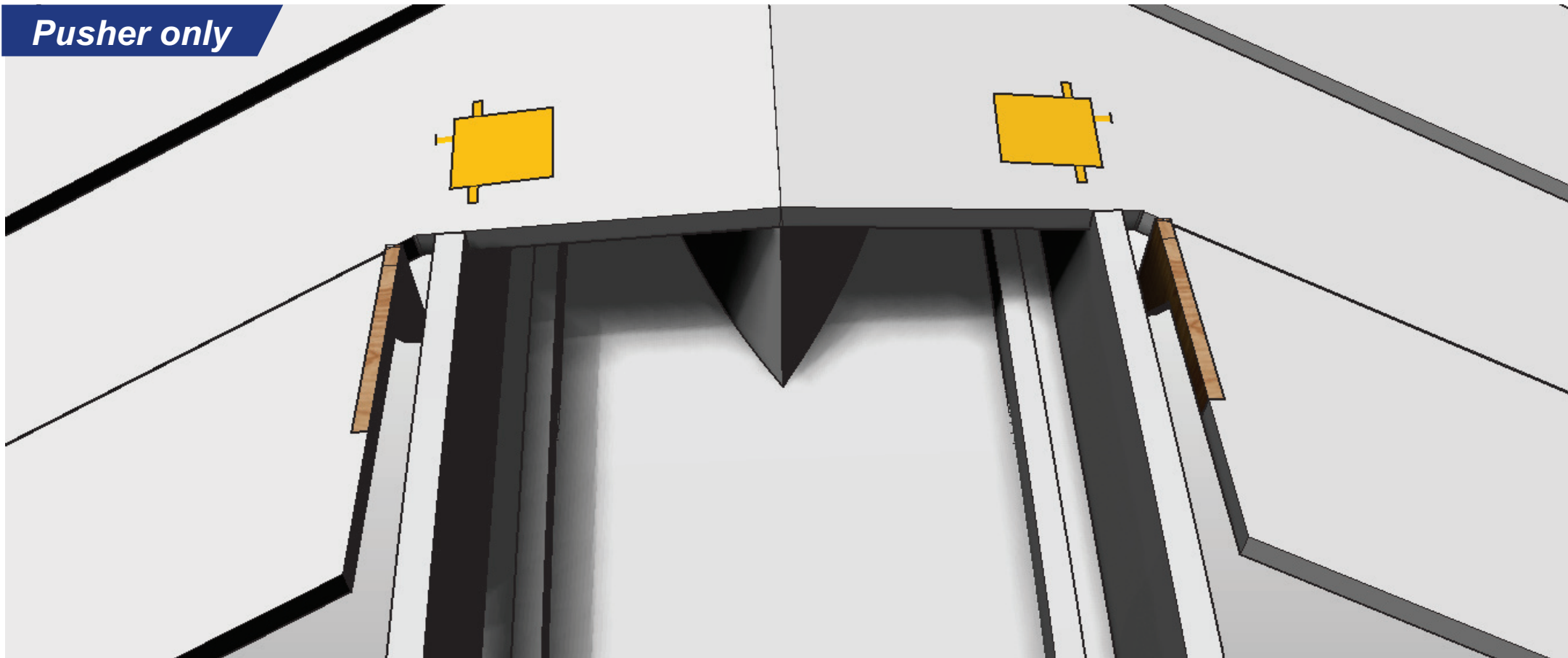
Glue the servos to the previous servos/bulkhead and fuselage using hot melt glue.

EDF only





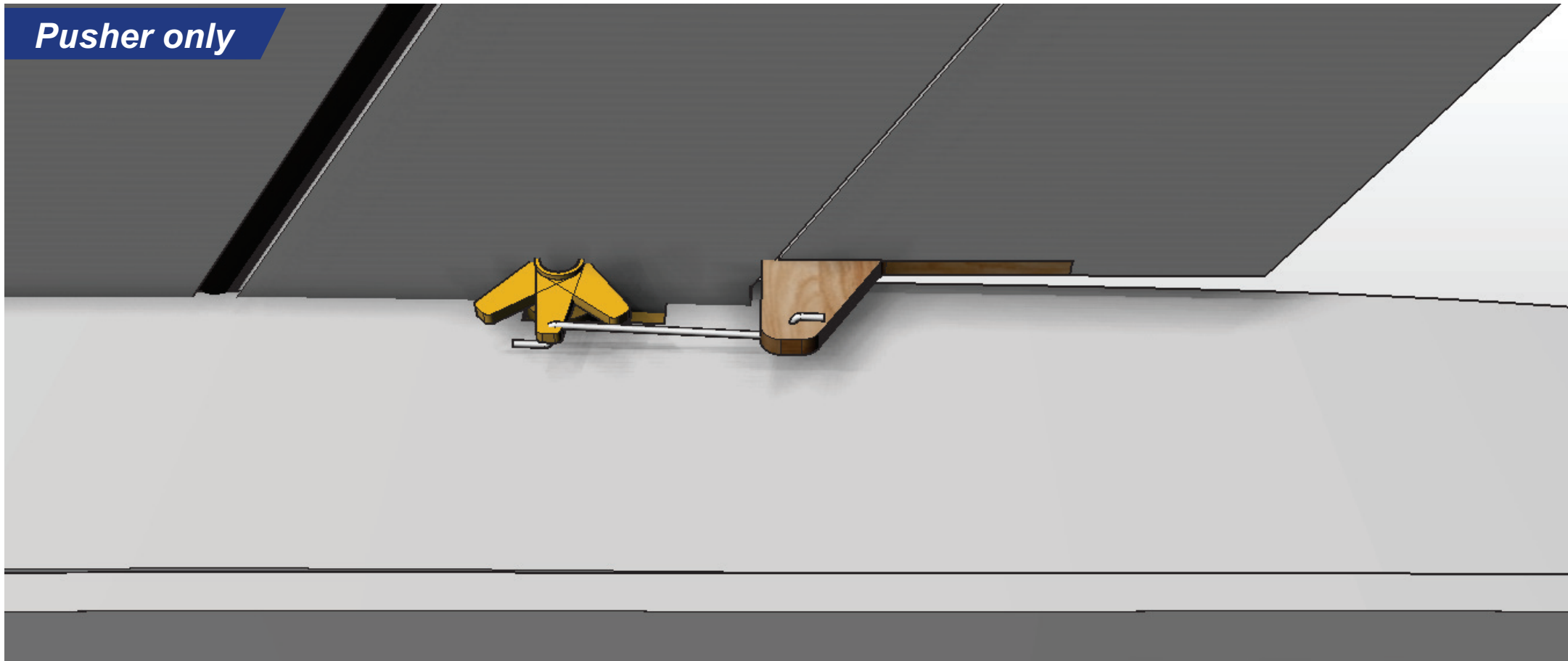
**Pusher only**



For the Pusher version, Glue the servos into the wing using hot melt glue and connect the pushrod to the control horn.



**Pusher only**

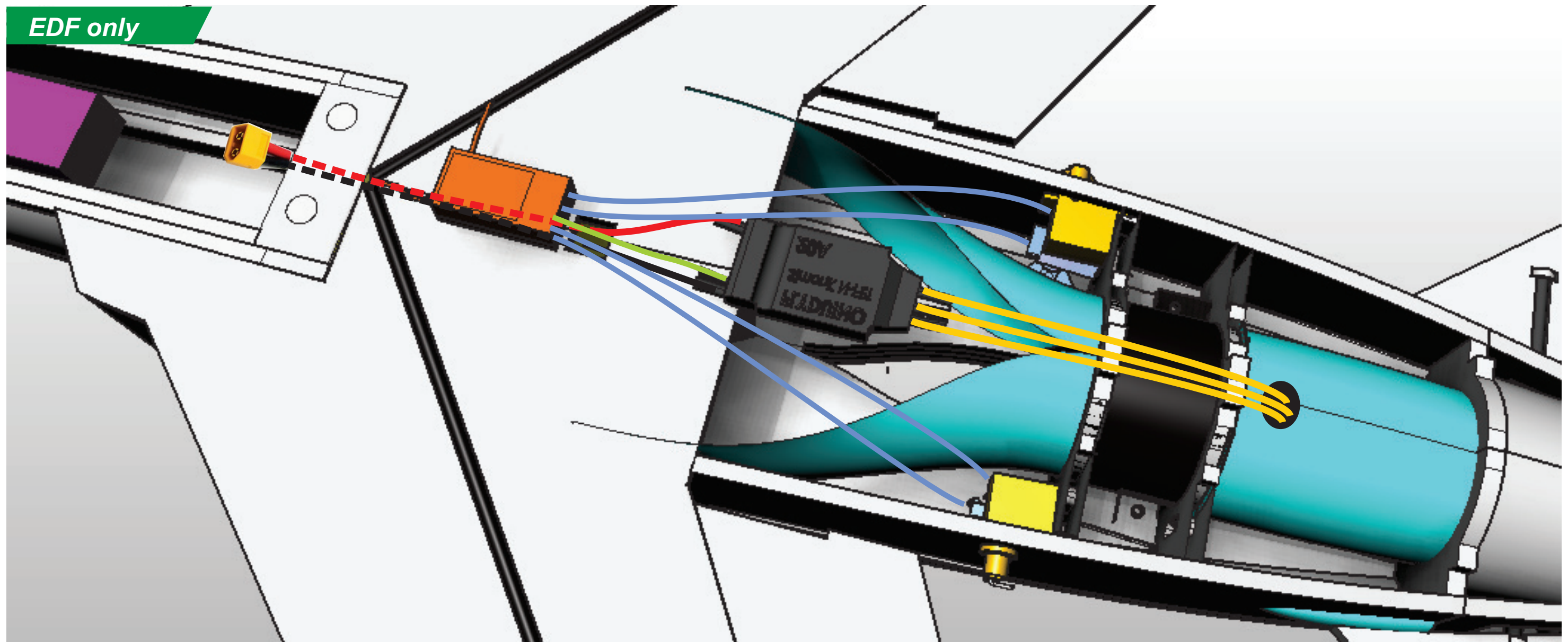


Fit a linkage stopper to the control horn to allow adjustment.



Then connect all your servos to the Receiver. Set all controls to +/- 30 degrees with 40% Expo programmed into your transmitter.





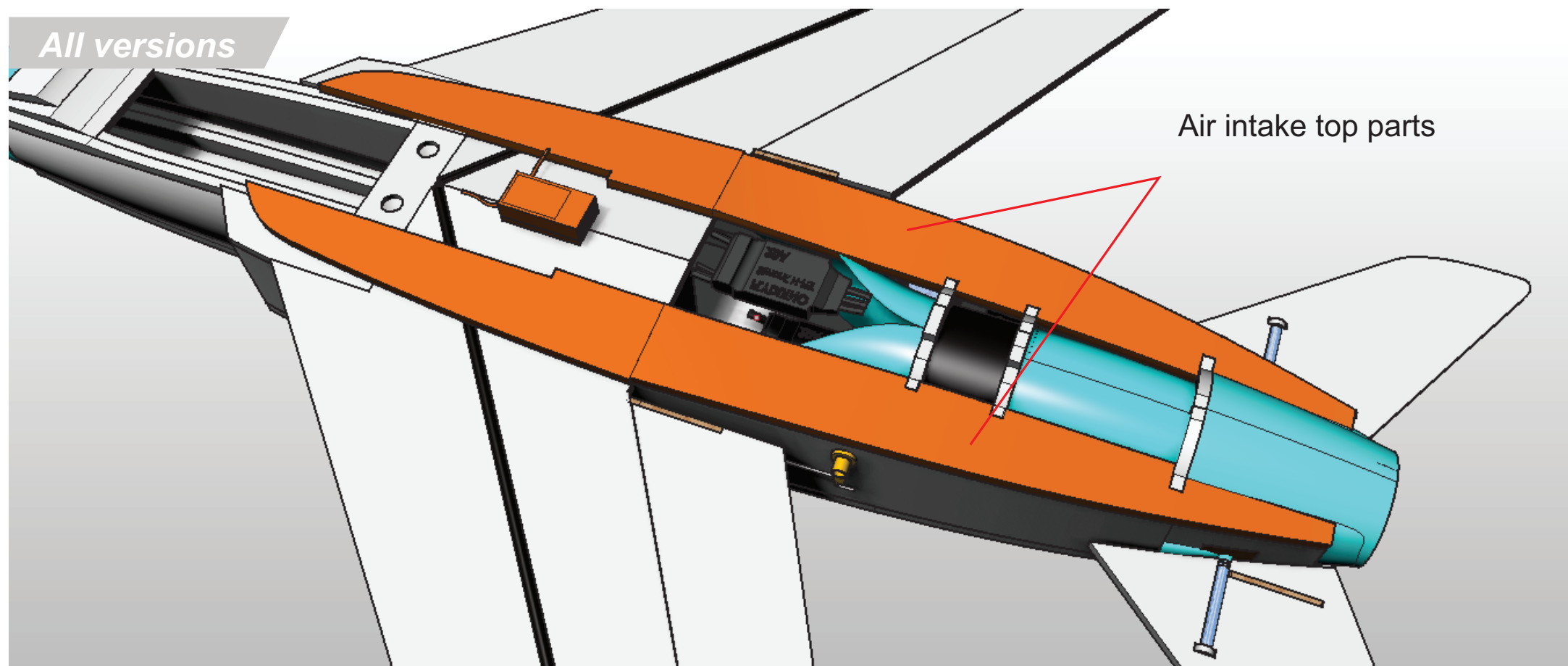
Using a soldering iron, burn a hole into the thrust tube and thread the 3 motor wires through. Extend them to reach the ESC as shown. Run the power cables from the ESC to the battery via the square hole already cut into the wing then solder your battery connector on the end.

Run the ESC servo cable to the receiver and then test out your throttle channel. Check it runs the correct way around - if not swap two of the wires over.

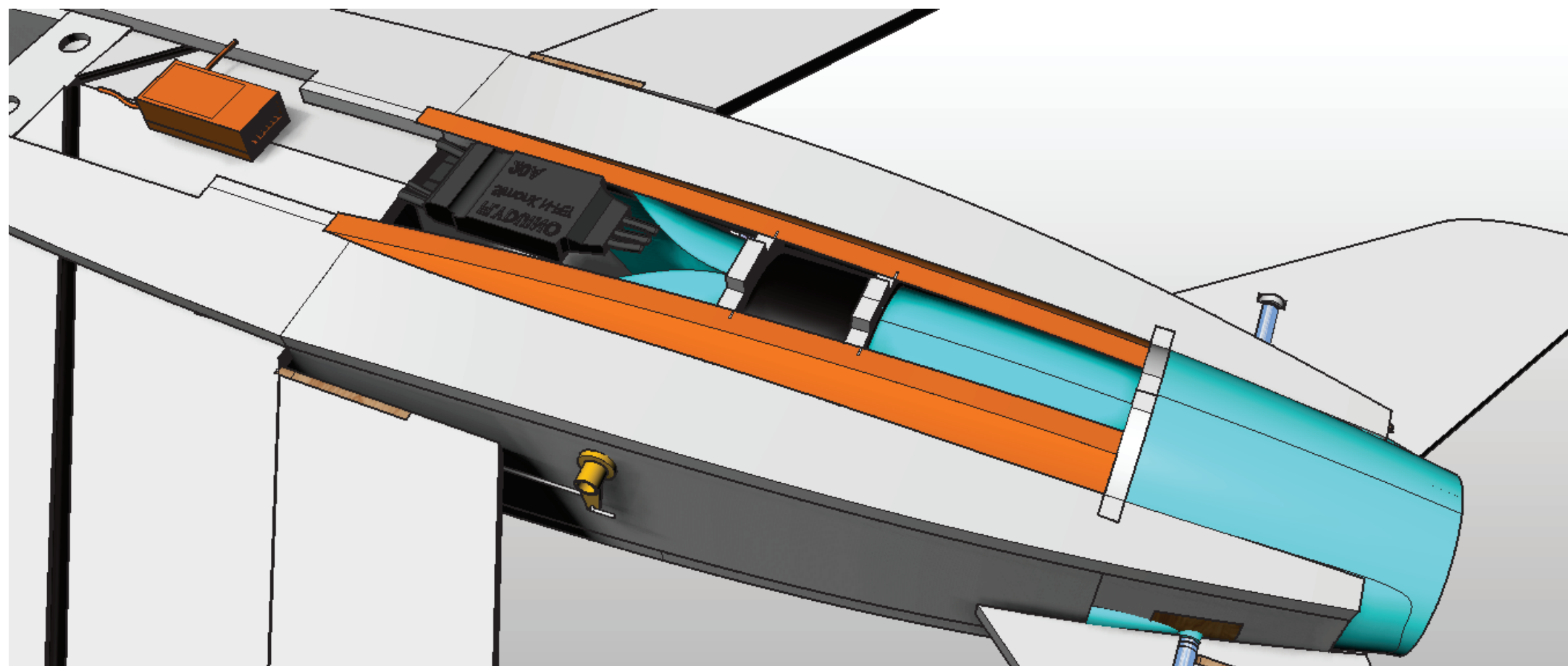
Then connect all your servos to the Receiver. Set all controls to +/- 30 degrees with 40% Expo programmed into your transmitter.



All versions



Glue the **Air intake top parts** onto the assembly.

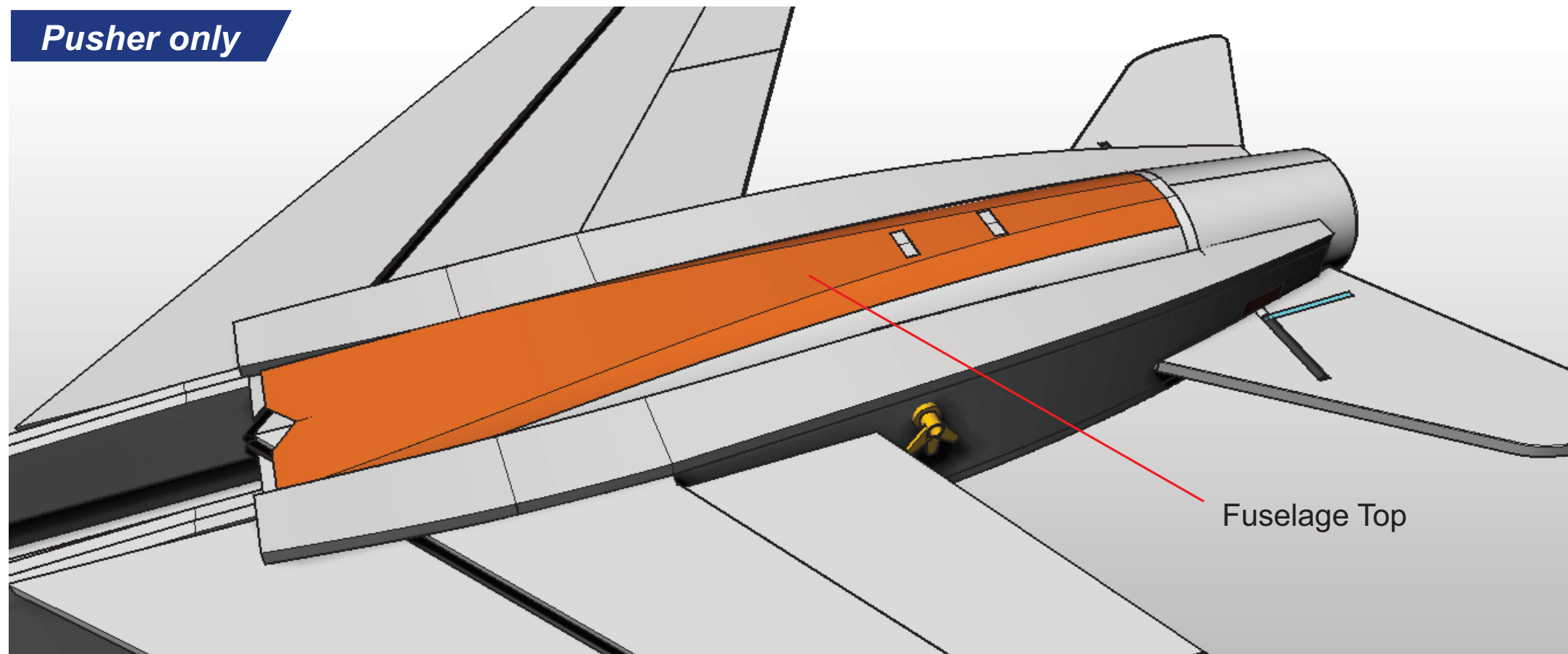


Glue the Upper fuselage shaper pieces onto the assembly, then sand both top edges flat using sandpaper and a block in preparation for the fuselage top to sit on it.





### Pusher only



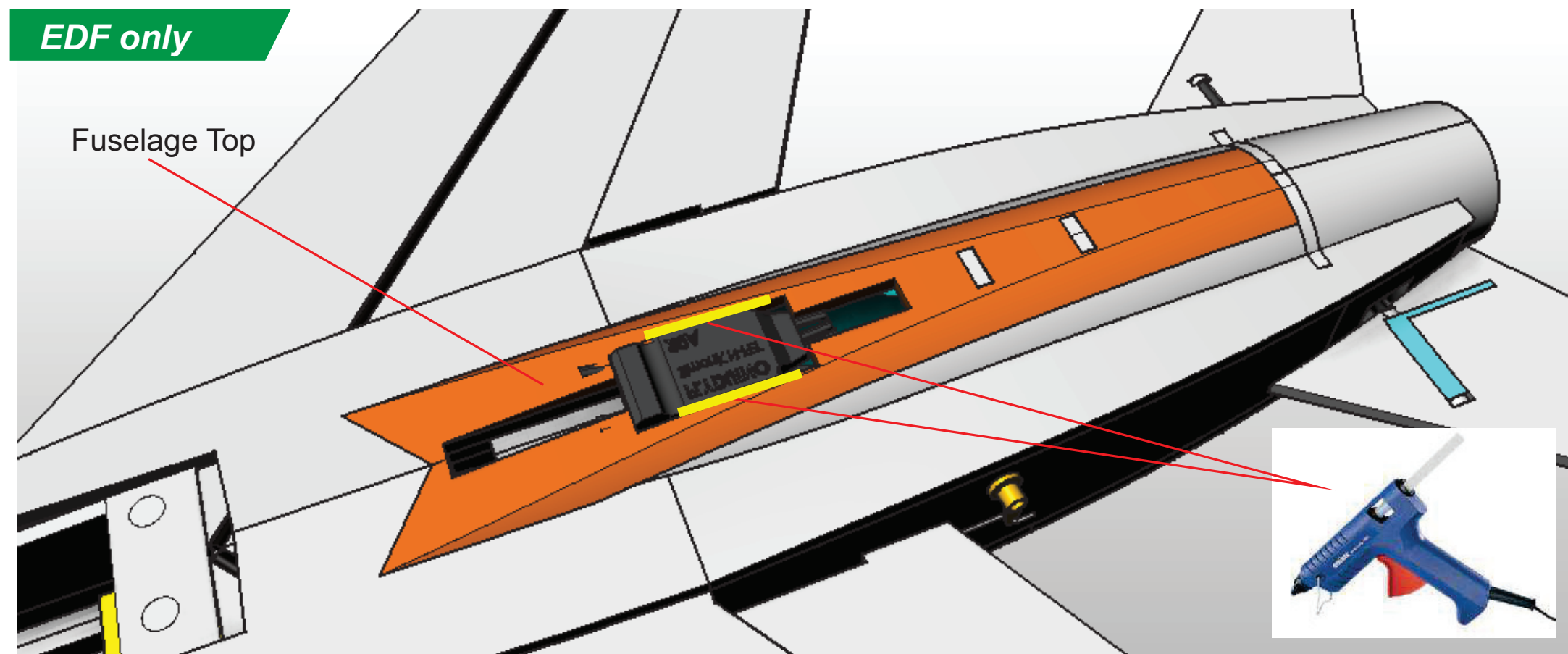
Sand to shape then glue the **Fuselage top** in place.

For the EDF version, cut a slot in the top for the ESC and inlet / outlet wires as shown.

Glue the ESC to the **Fuselage top** along the edges using hot melt glue.



### EDF only



Turtledeck forward bulkhead

Turtledeck end piece

Turtledeck sides

Glue together the Turtledeck pieces as shown



All versions

Glue the Turtledeck assembly to the fuselage ensuring that the slot at the rear is not too narrow or wide to receive the vertical stabiliser.

Ensure this assembly is mounted on centreline as it is easy for this to be misaligned.





Turtledeck forward bulkhead

Turtledeck end piece

Turtledeck sides

Glue together the Turtledeck pieces as shown



All versions

Radio Receiver

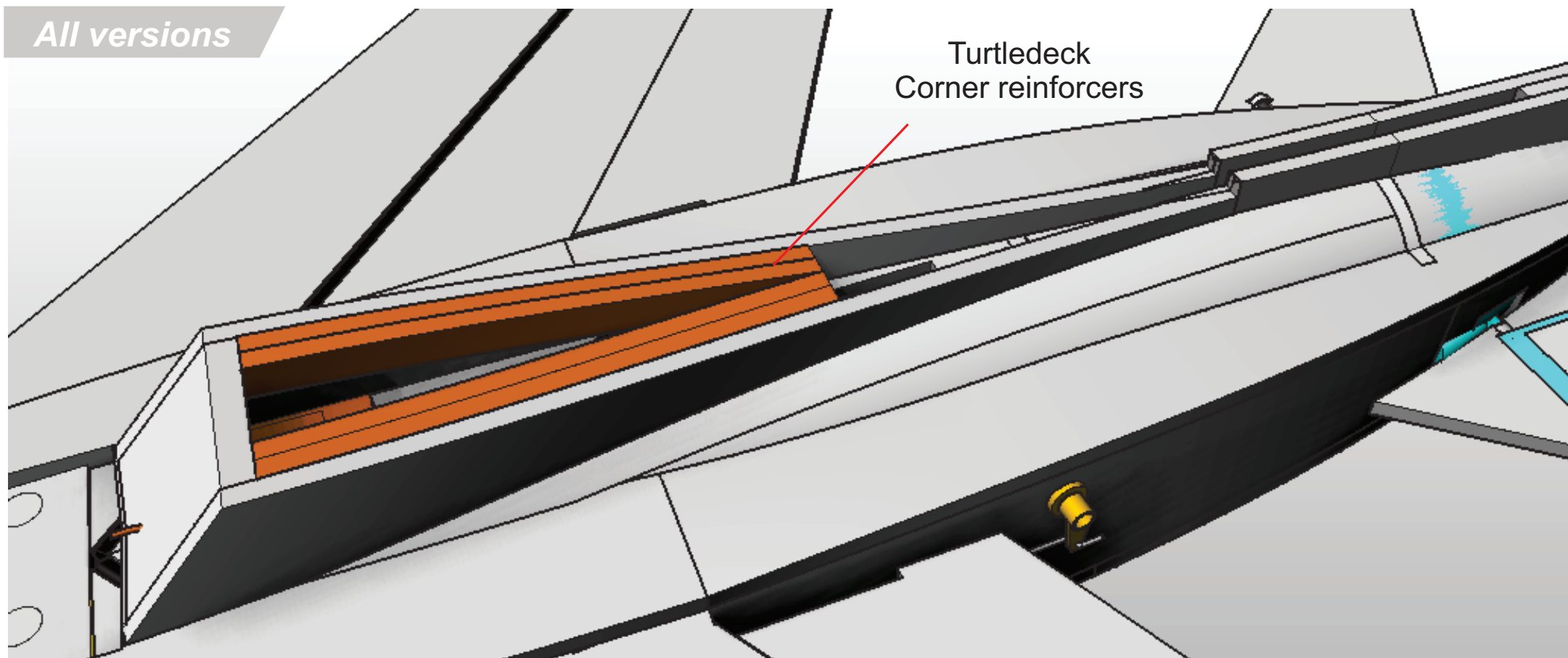
Glue the Turtledeck assembly to the fuselage ensuring that the slot at the rear is not too narrow or wide to receive the vertical stabiliser.

Ensure this assembly is mounted on centreline as it is easy for this to be misaligned.

Fit the Receiver as shown



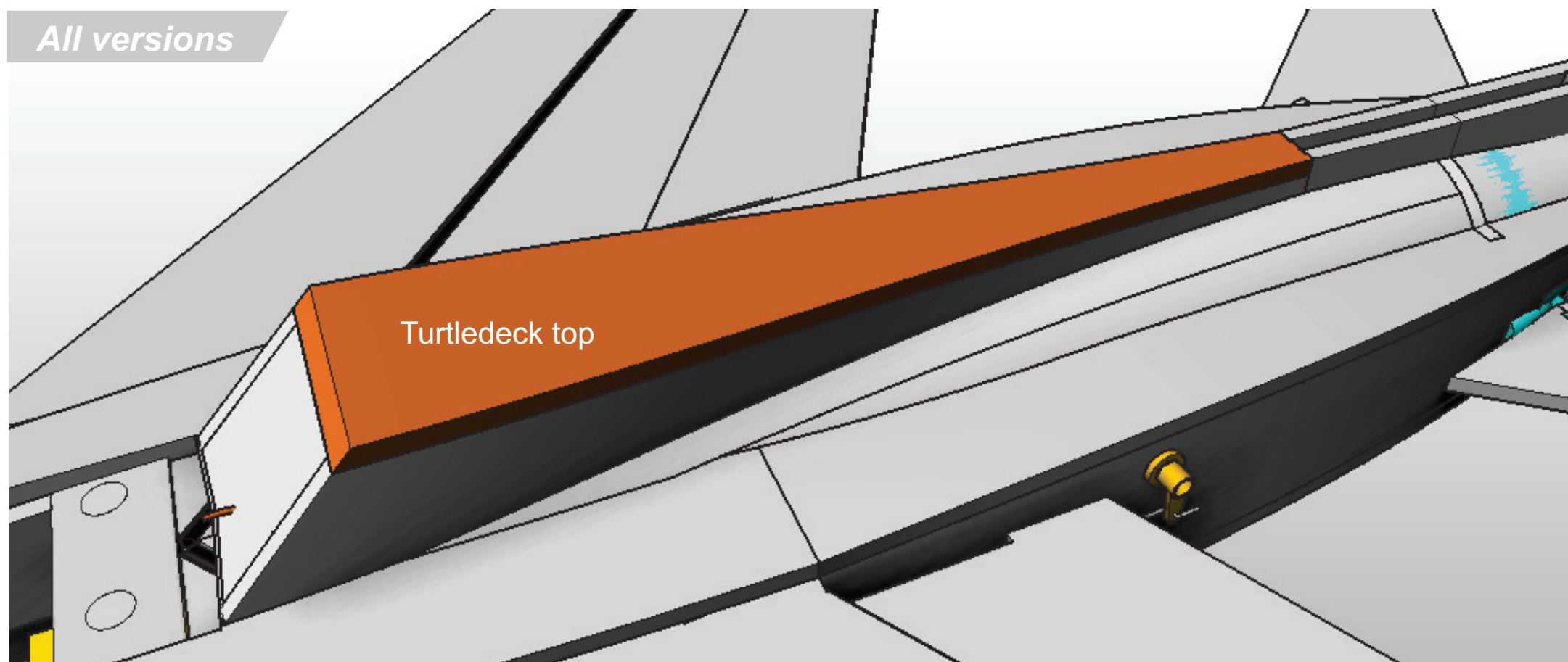
All versions



Glue together the **Turtledeck Corner Reinforcer** pieces as shown then into the turtledeck assembly.



All versions



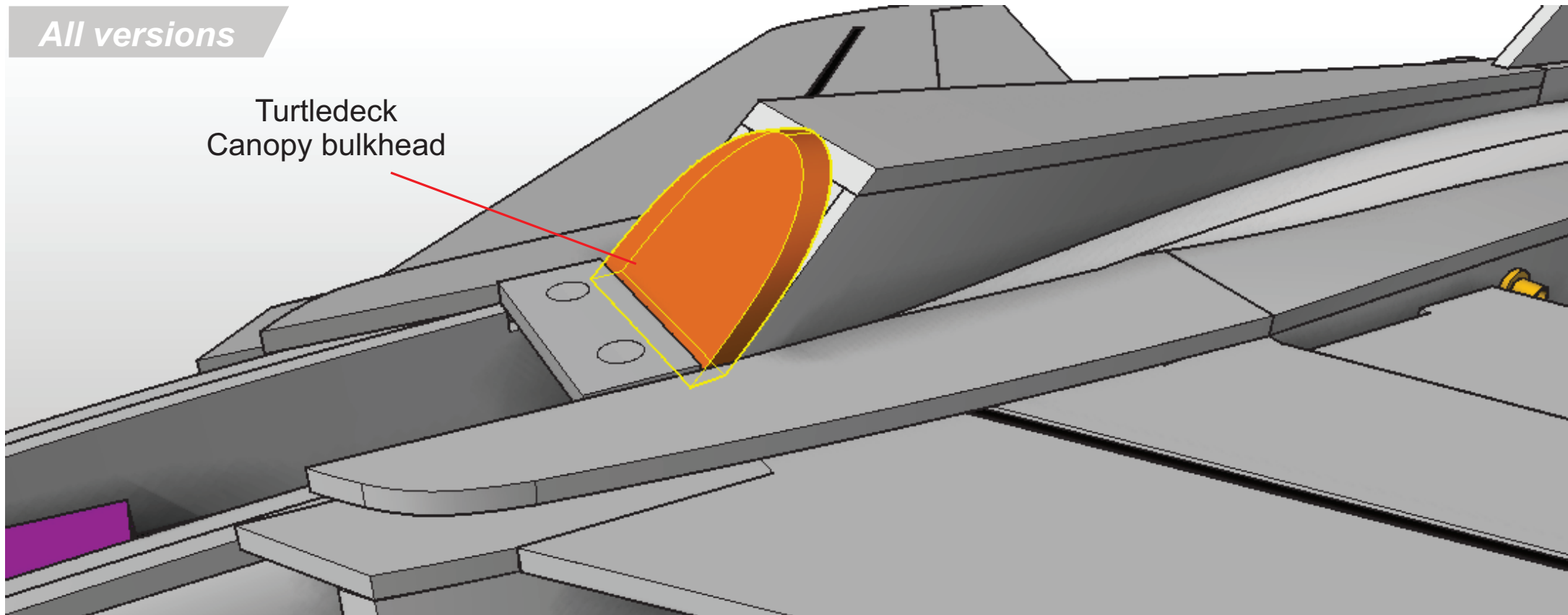
Glue the **Turtledeck Top** to the assembly.





All versions

Turtledeck  
Canopy bulkhead

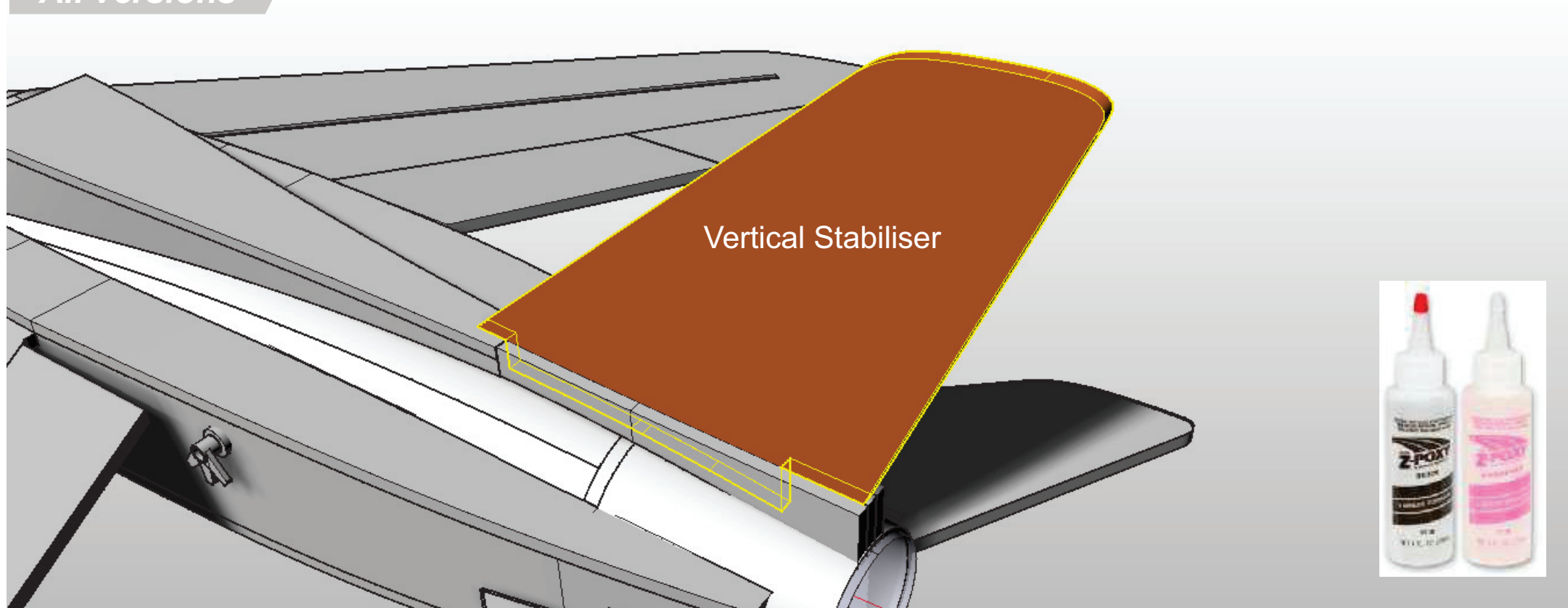


Glue together the **Turtledeck Canopy bulkhead** to the turtledeck assembly.



All versions

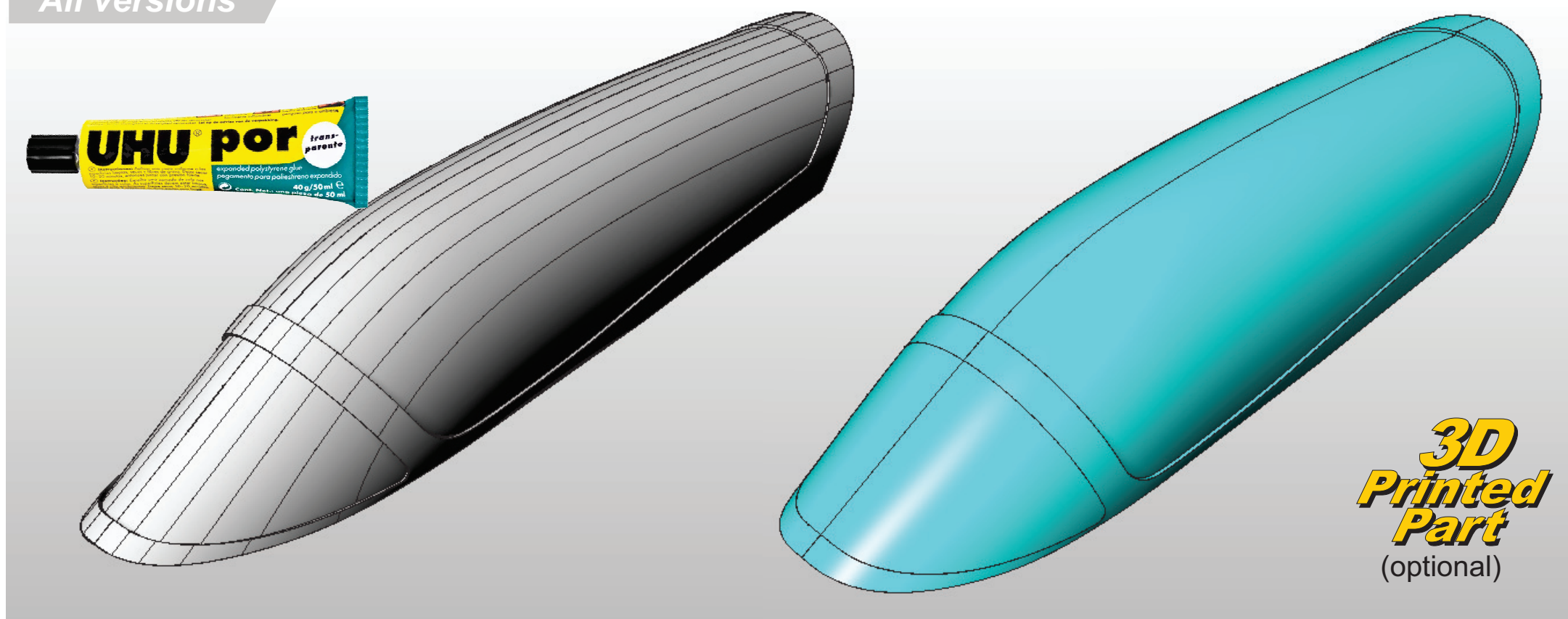
Vertical Stabiliser



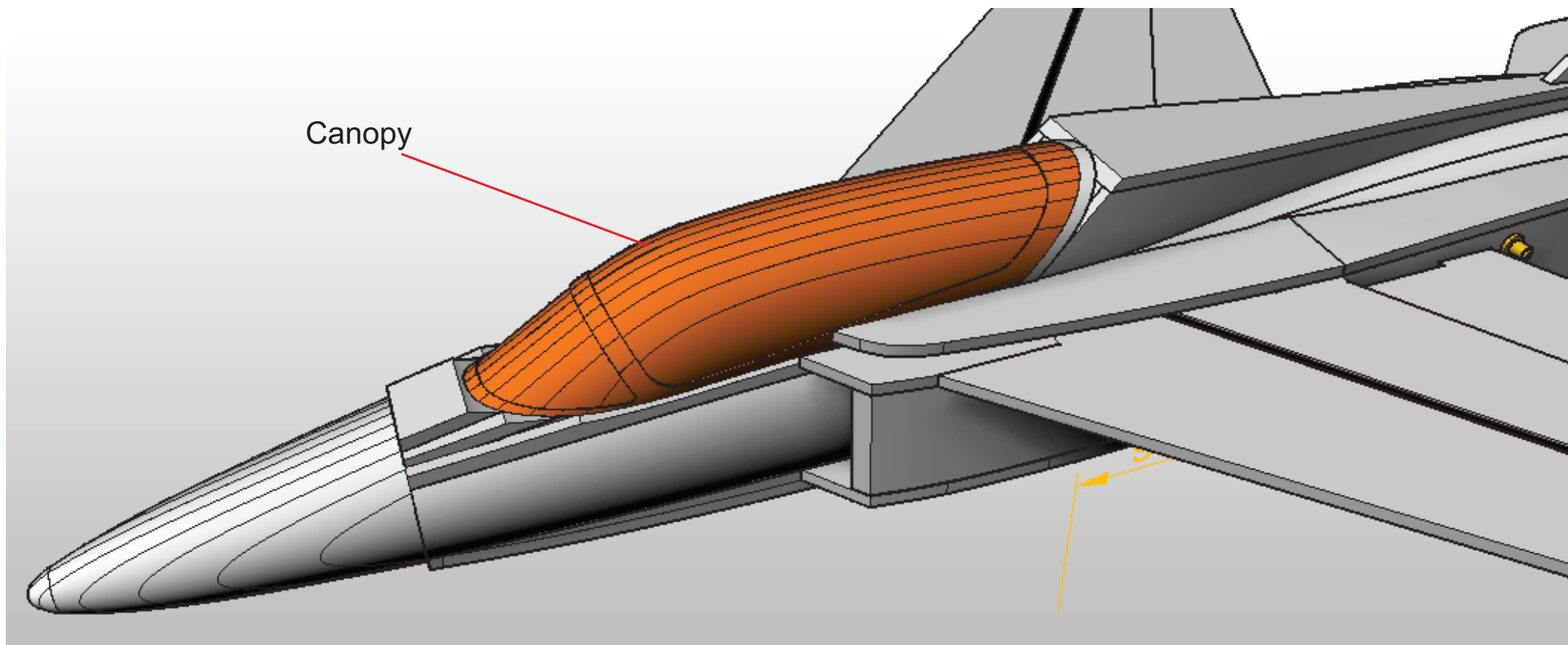
Glue the **Vertical Stabiliser** into the turtledeck assembly.



All versions



Either fabricate a **Canopy** from laminated pieces of foam sheet, or 3d print one.

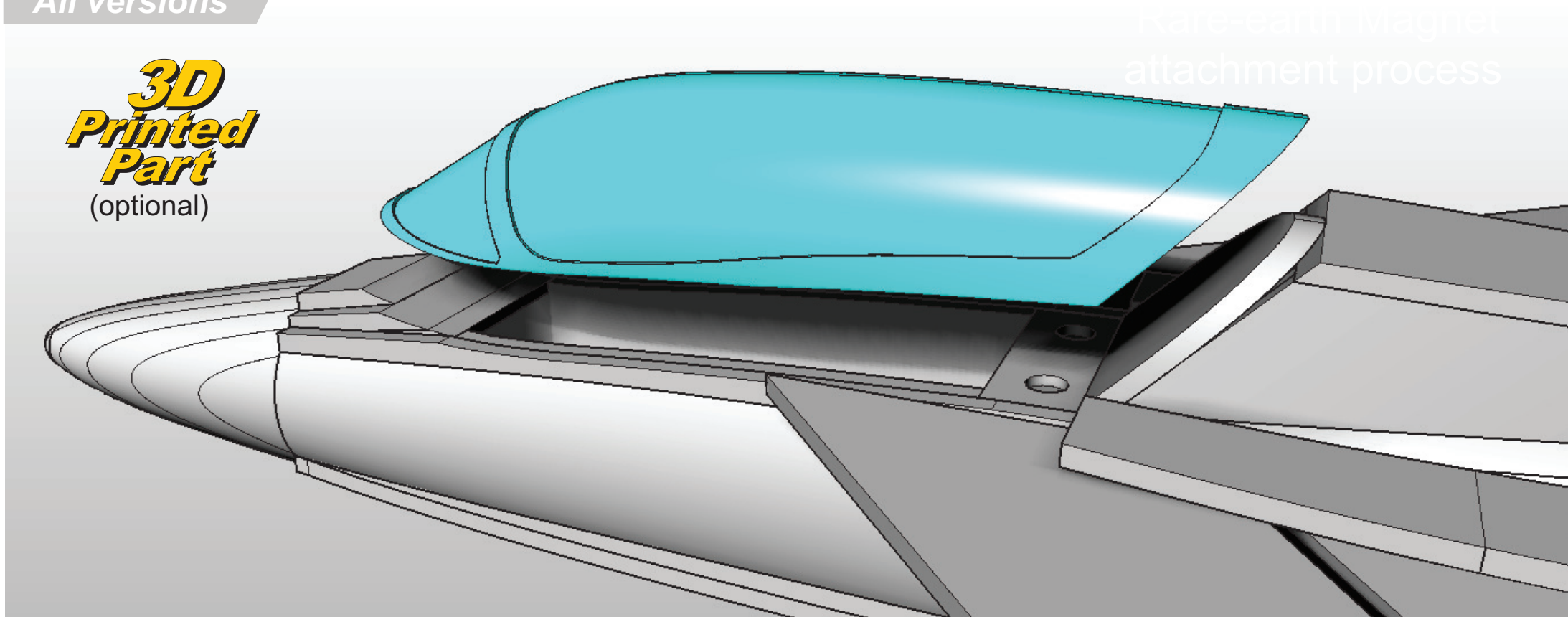


Rest the **Canopy** onto the aircraft and use as reference for sanding the forward fuselage upper and the turtledeck.

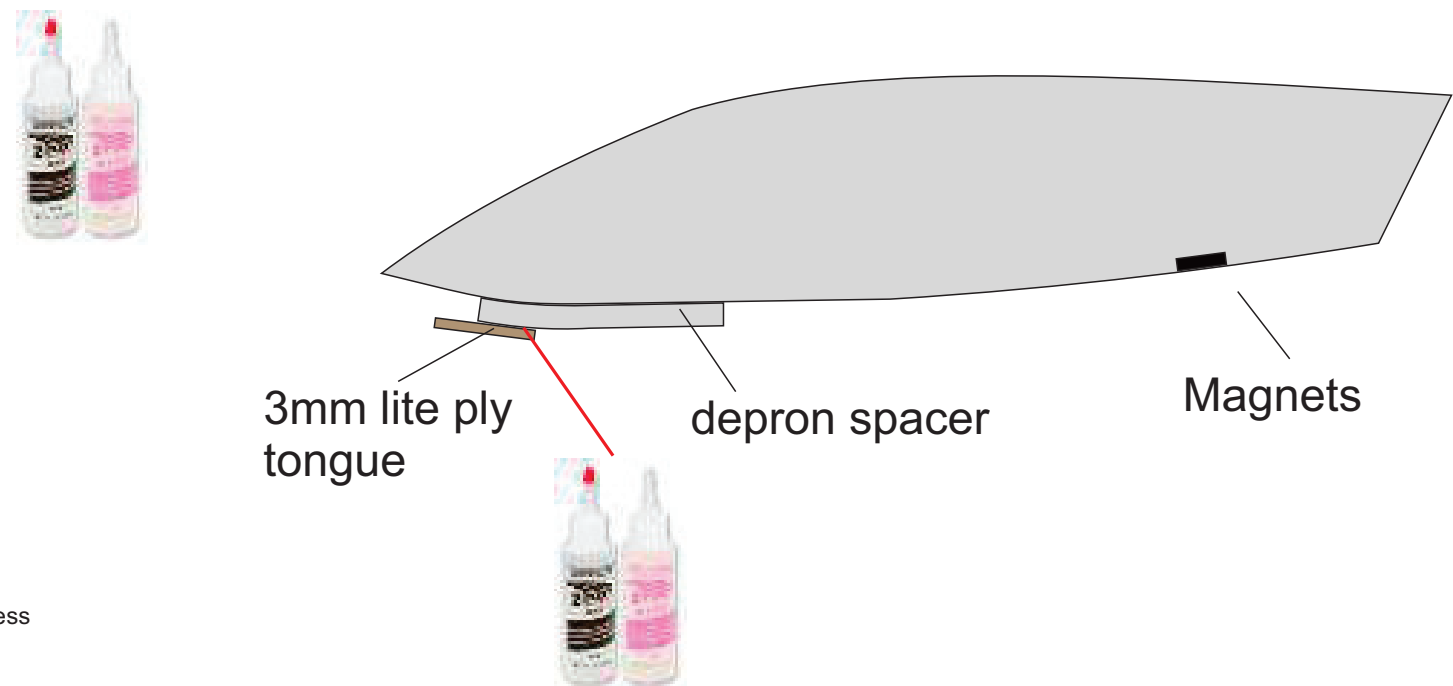
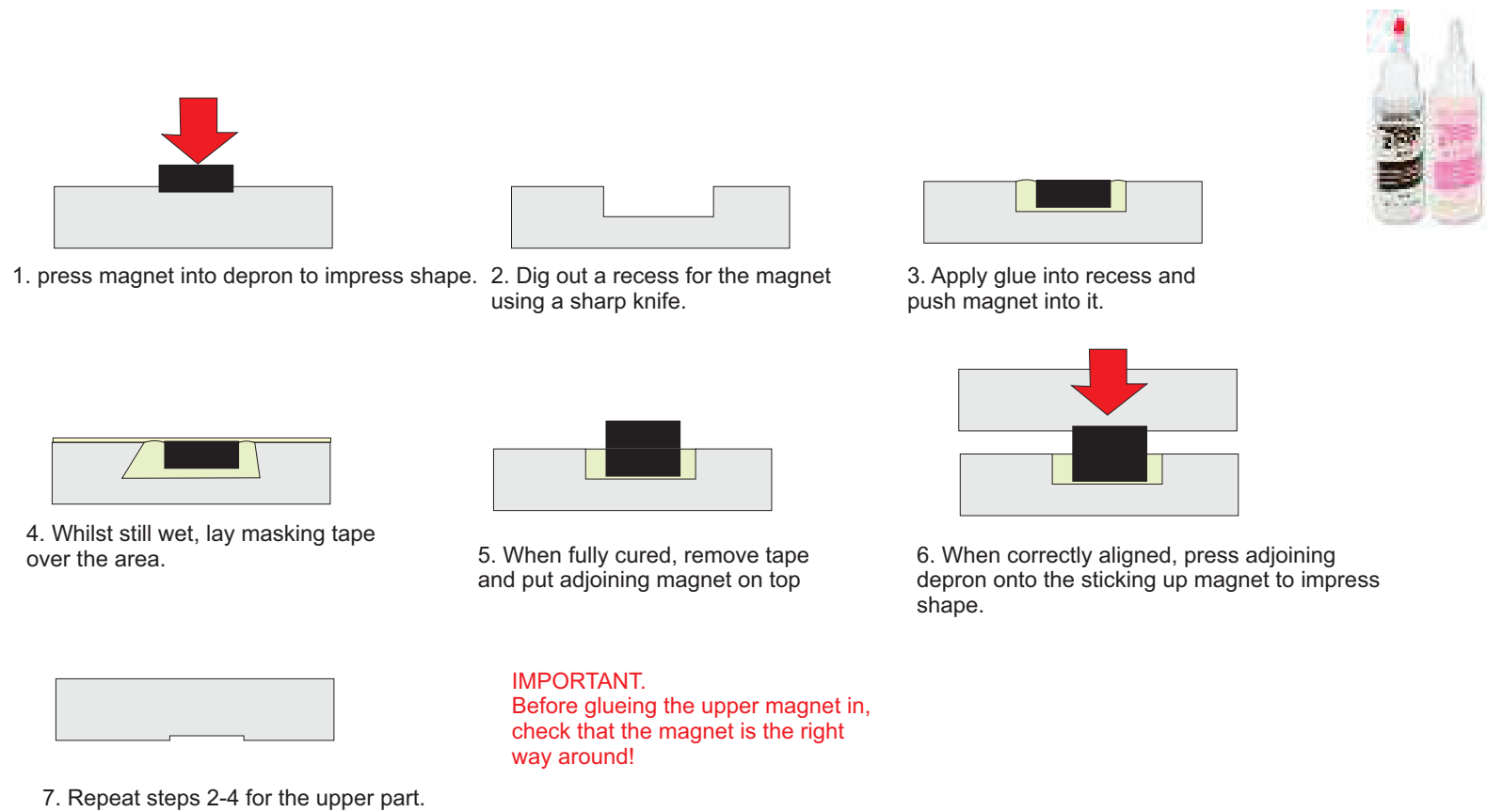


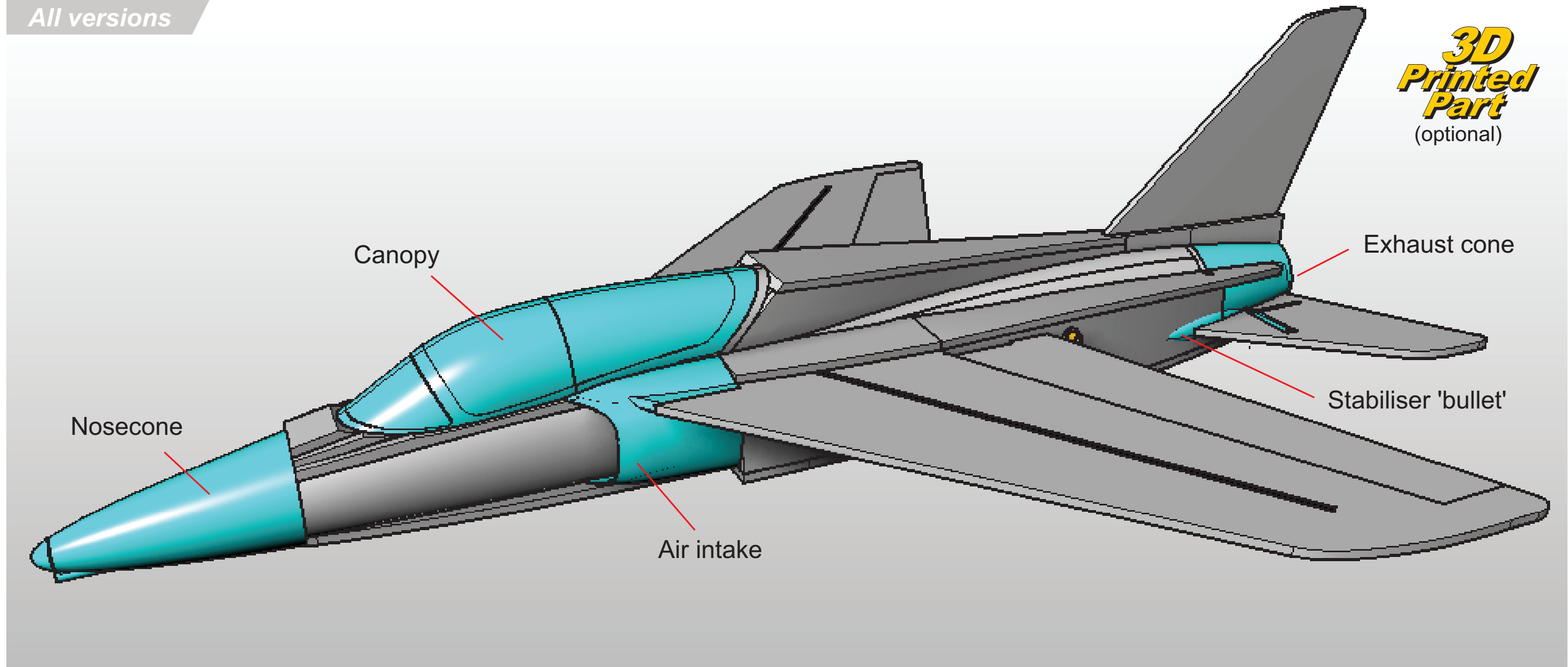


**3D  
Printed  
Part**  
(optional)



Add a tongue and magnets to the canopy as shown.





Finish the sanding to shape using a small sanding block, and add scale features such as the 3d printed air intake and Horizontal stabiliser bullets as shown.

Congratulations your model is now complete!







Image Copyright (c) Nigel Paine, Airplane pictures.

Use images from the internet as reference and finish your model in your favourite scheme.

