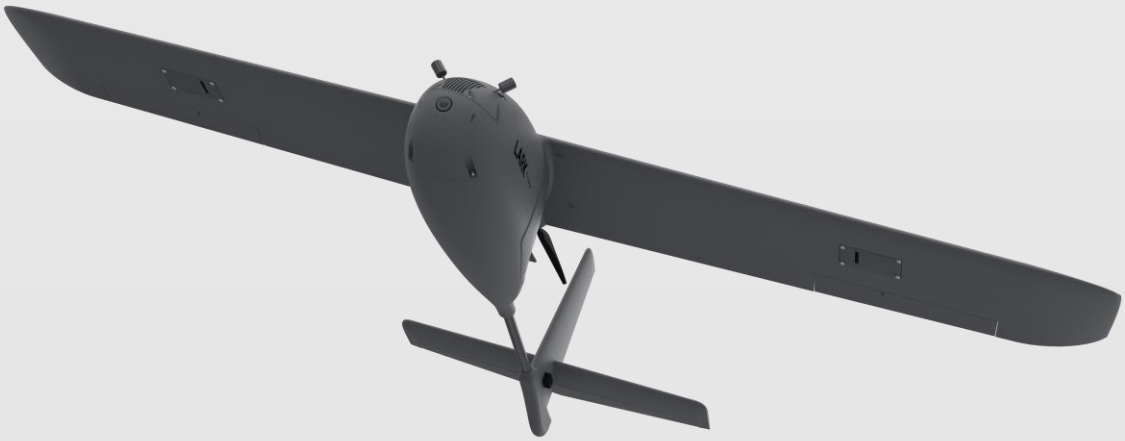
FLIGHTORY

LARK

USER MANUAL

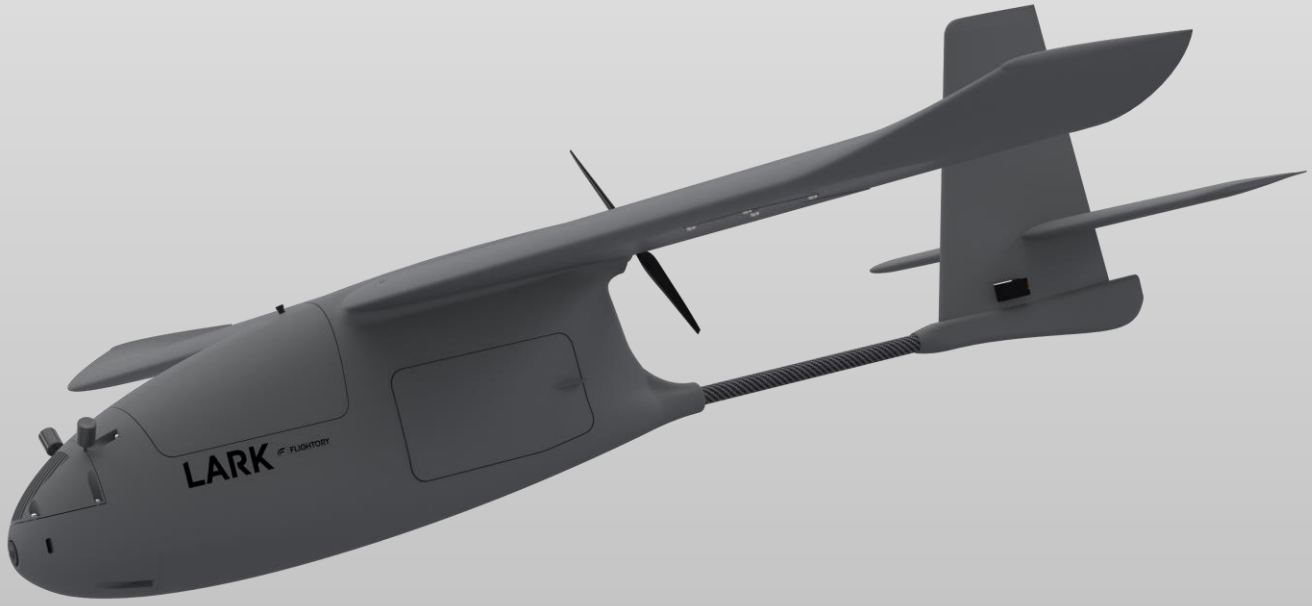
V.1

Socials

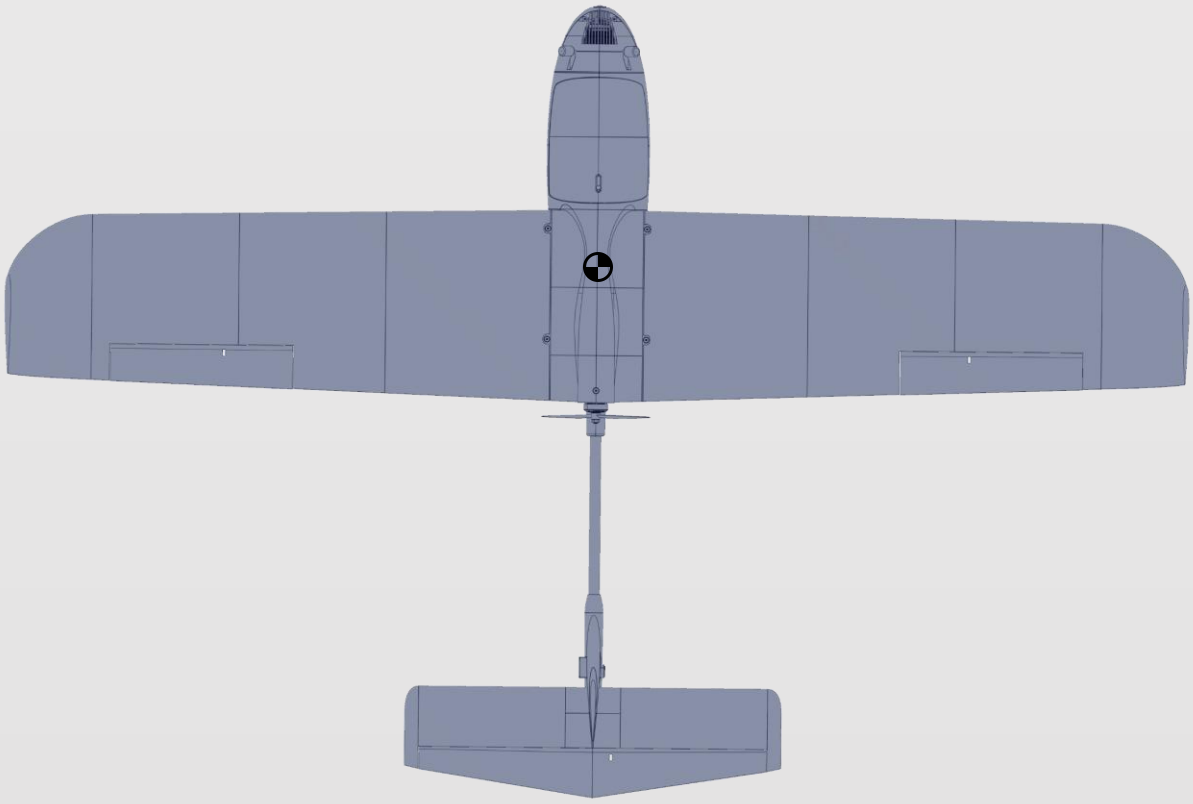


Join Flightory Tech group on Facebook and create community with us. Share progress of your builds. Any suggestions or questions welcome.
www.facebook.com/groups/flightory

Follow Instagram where I share more footage on a regular basis
www.instagram.com/flightory_

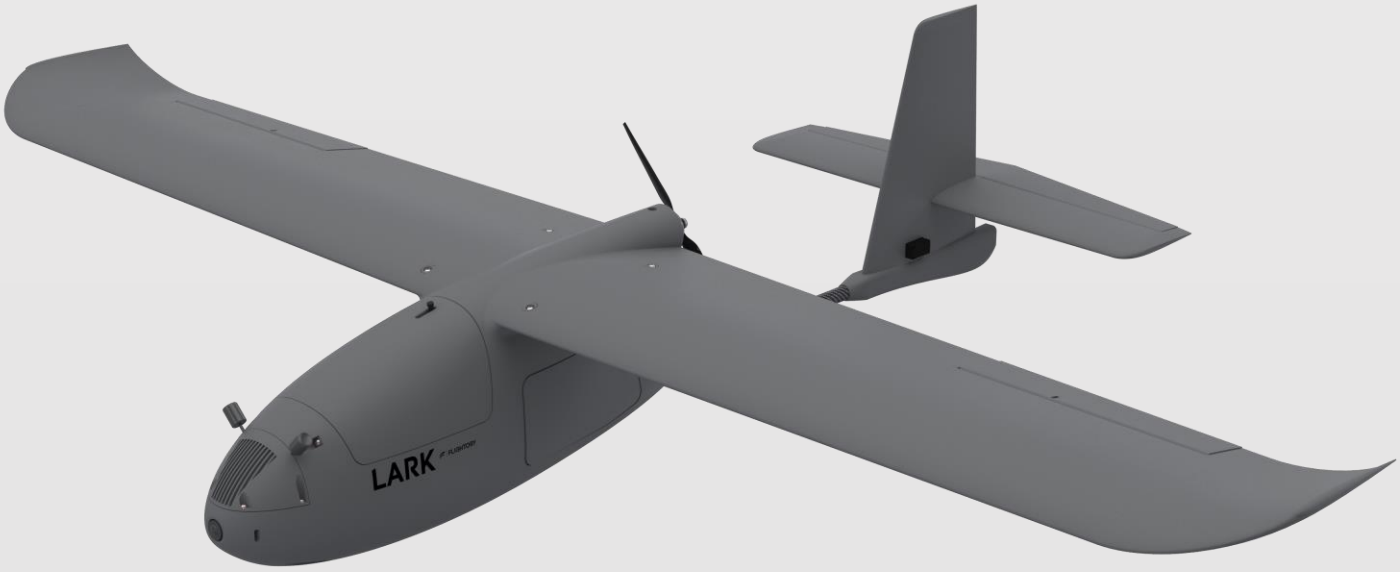


General Aircraft Data



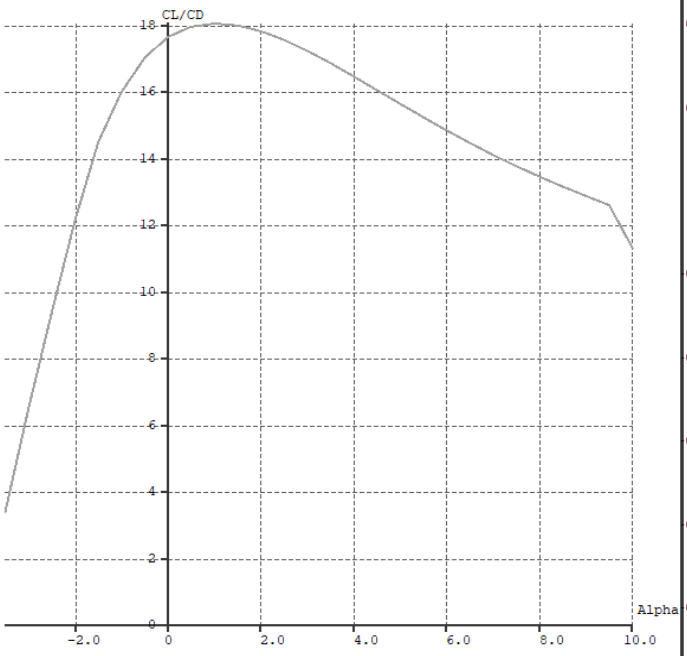
General data	
Wingspan	1290mm
Wing area	24 dm²
Lenght	865mm
Center of Gravity	66mm from leading edge
AUW	1100-3000g
Optimal Cruise Speed	50-60 km/h
Airfoil	Eppler 193
Root Chord	210mm
MAC	195mm
Aspect Ratio	5.8
Wing load	45 - 125 g / dm²

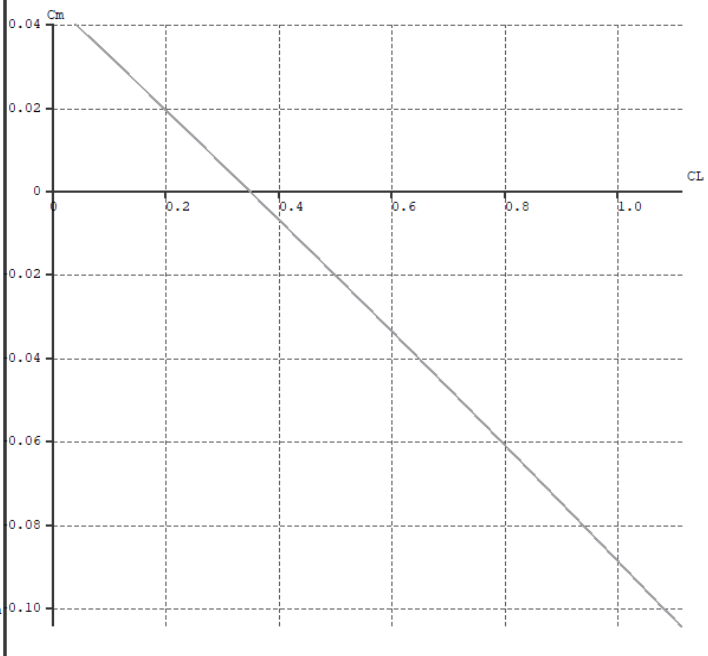
General Aircraft Data

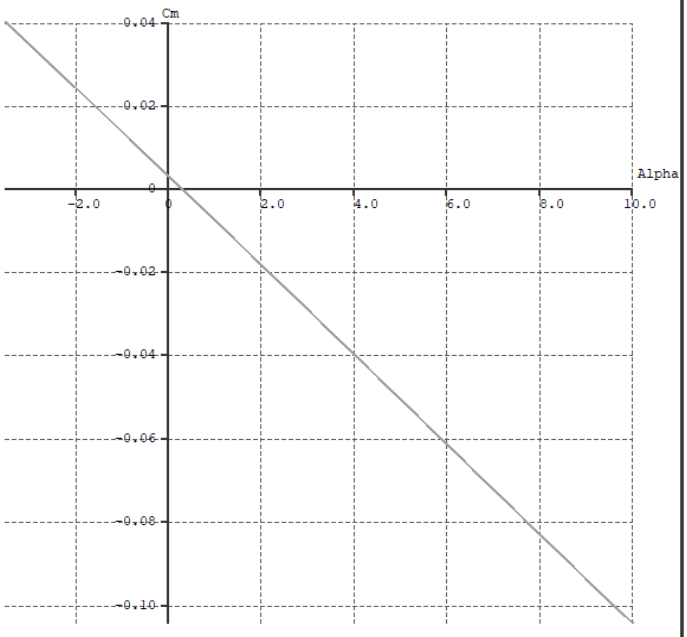


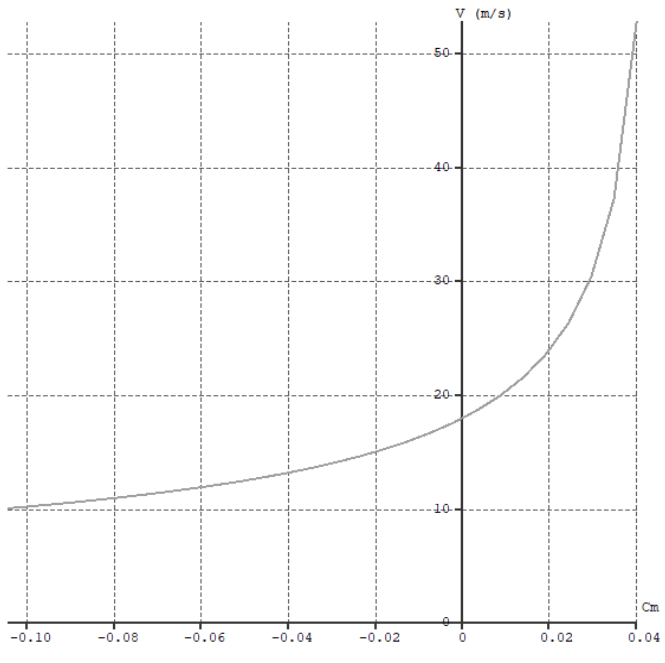
The aircraft is a 3D-printed UAV in a classic configuration with a tail boom and a pusher propeller. It is designed for optimal performance and compactness. The geometry has been carefully examined using CFD and real flight tests.
The platform is designed with accessibility and modularity in mind. The nose of the aircraft is fully detachable, allowing for adaptation to various cameras, sensors, and other types of payloads. By default, it is configured for a standard 19x19 FPV camera and any VTX also located in the nose. All files are available in STL format, and some of them are also provided in STEP to facilitate easy editing and customization for individual needs, such as camera mounts, antennas, and others. With the recommended motor system and a 21AH 4S6P Li-Ion battery, low current consumption can be achieved during stable flight, providing a flight time of over 4 hours. The power reserve is substantial, and flight is possible at around 30% power, allowing for the use of 3S packs as well. Depending on the user's requirements, they can customize the payload, battery, and achieve an aircraft tailored to their needs.

CFD Analysis



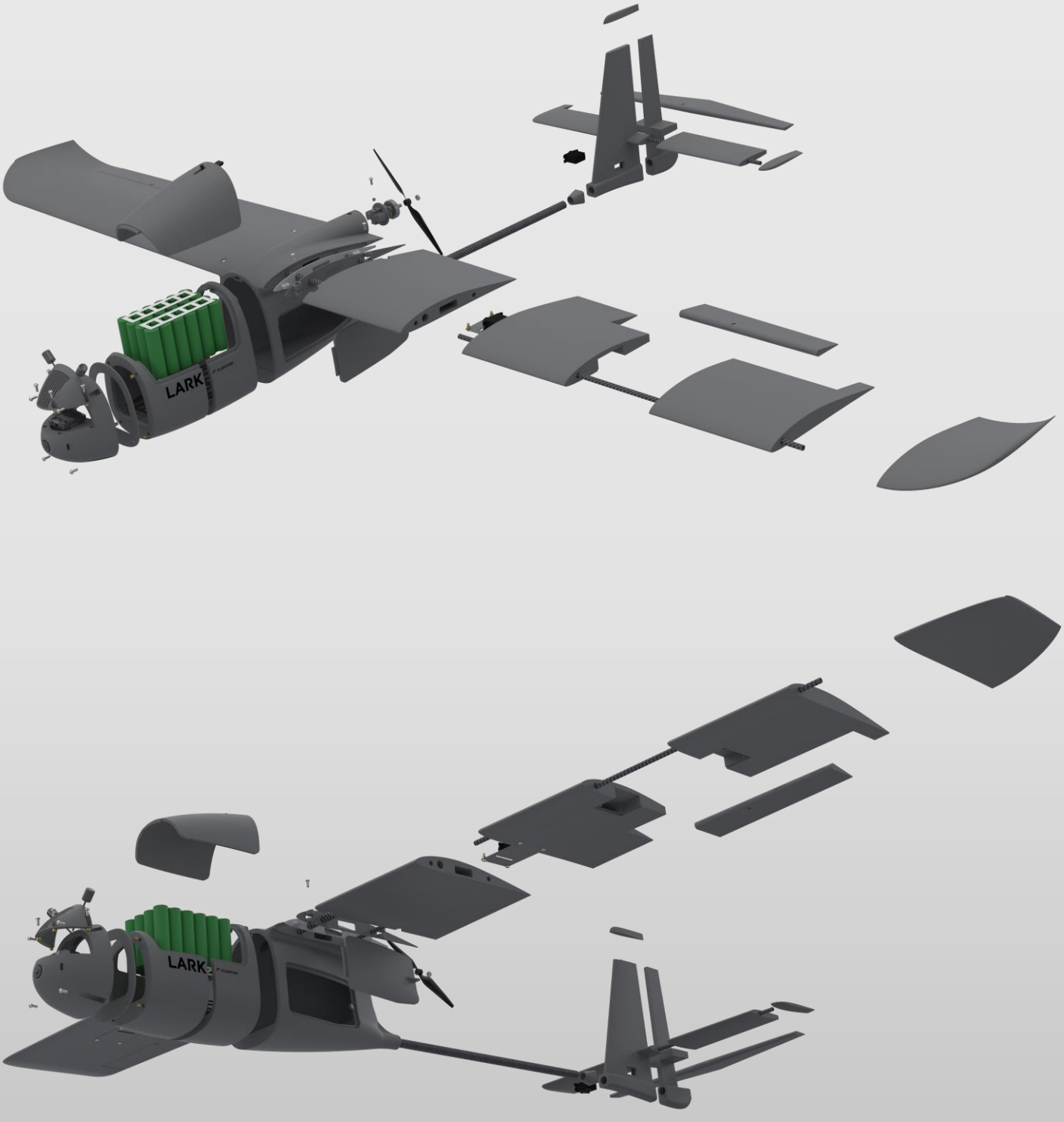






The geometry was designed to provide the best possible aerodynamic characteristics. The Eppler E193 airfoil was selected. With the center of gravity correctly positioned 66mm from the leading edge, the aircraft maintains a substantial margin of longitudinal stability with zero pitching moment at zero angle of attack. Between 0 and 2 degrees of AoA, the aircraft achieves maximum efficiency at speeds ranging from 50 to 60 km/h. With the recommended motor and propeller and 4S battery, the aircraft flies steadily in level flight at approximately 30% power, resulting in an average current draw of 4A and providing over 4 hours of flight time. The power reserve is significant, allowing for the use of a 3S battery with lower voltage. There is considerable flexibility in the choice of motor and battery, depending on user preferences. When properly configured, the aircraft does not require a flight controller and can be flown in both manual and automatic modes.

Exploded view



Reccomended RC Equipment

Reccomended electronics	
Motor	T- Motor F90 1300KV
Propeller	7x4 / 7x5 / 7x6
Flight Controller	Speedybee F405 Wing or any other Mavlink FC
GPS	Matek M10Q or similar GPS with compass
Servos	3x Corona 929MG Metal Gear or similar
ESC	BlHeliS 40A
Battery	4S (max 4S6P 21Ah Li-Ion) or smaller pack / 3S battery also possible
Receiver	Matek R24-D ELRS or similar
VTX	Digital or analog VTX

Required accessories

ITEM	QUANTITY
10x500mm Carbon Tube (MAIN SPAR)	1
6x500mm Carbon Tube	3
12x430mm Carbon Tube (TAIL BOOM)	1
6x200mm Carbon Tube (V STAB SPAR)	1
6x384mm Carbon Tube (H STAB SPAR)	1
Thin CA Glue	20g tube
CA Activator	1 (optional but useful)
M3 Threaded Insert (Outer Ø5mm, height 5mm)	13
M3 screw	17
M3 nut	4
LW-PLA	1 roll
PETG	Small amount
Polyester hinge 20x25mm	11
Pen spring	1
Velcro strap	2
Servo extension cable	3

PARTS LIST - FUSELAGE

PART	MATERIAL
FUS 1	LW-PLA
FUS 2	LW-PLA
FUS 3	LW-PLA
FUS 4	LW-PLA
FUS 5	LW-PLA
HATCH SIDE 1	LW-PLA
HATCH SIDE 2	LW-PLA
HATCH FRONT 1	LW-PLA
HATCH FRONT 2	LW-PLA
NOSE	LW-PLA
NOSE TOP 2 ANTENNAS	LW-PLA
NOSE TOP 1 ANTENNA	LW-PLA
NOSE CLEAN	LW-PLA
FRONT REINFORCEMENT	PETG
BATTERY PAD	PETG
BOOM MOUNT	PETG
MOTOR MOUNT	PETG
LOCK 1	PETG
LOCK 2	PETG
FUS ROOT L/R	PETG

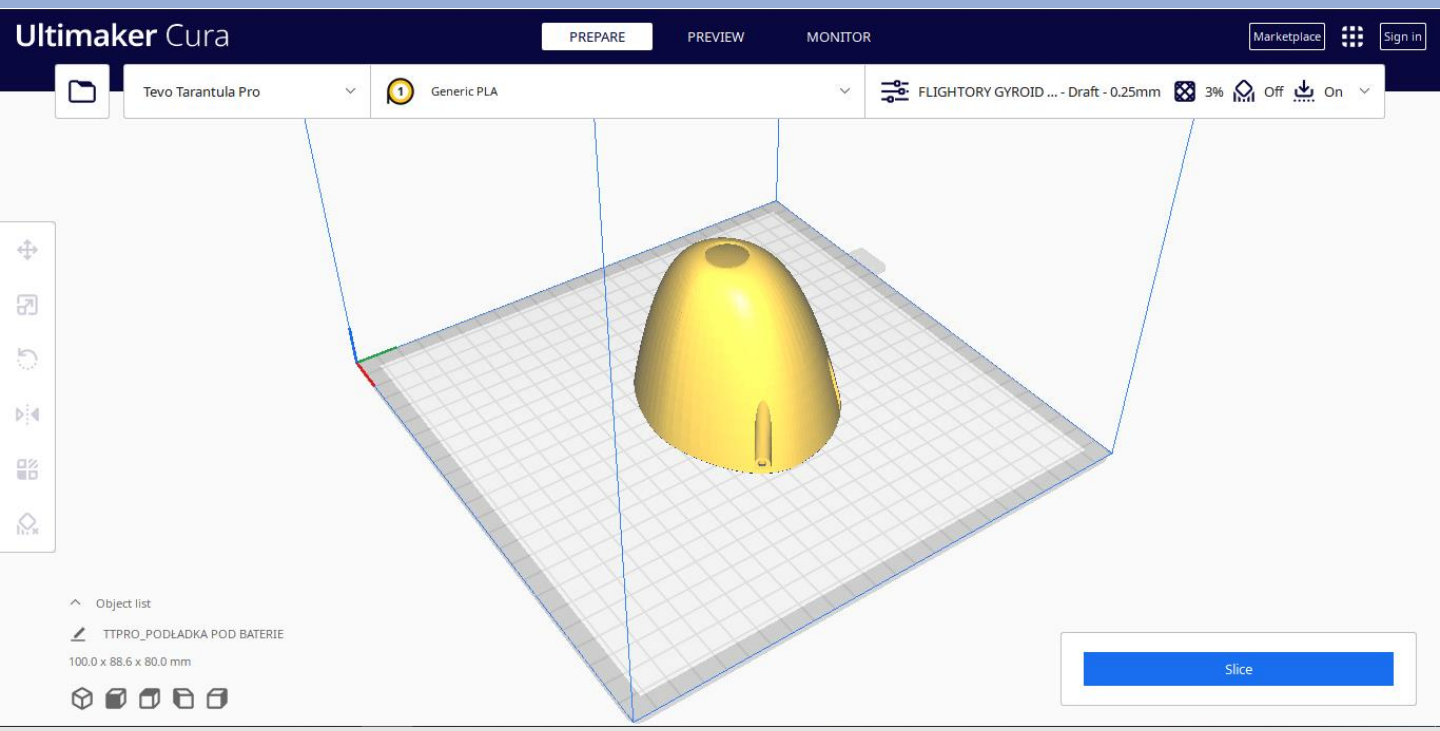
PARTS LIST - WINGS

PART	MATERIAL
WING 1 L /R	LW-PLA
WING 2 L /R	LW-PLA
WING 3 L /R	LW-PLA
WINGLET L /R	LW-PLA
AIL L / R	LW-PLA
SERVO COVER (print 2)	PETG
WING ROOT L /R	PETG

PARTS LIST - TAIL

PART	MATERIAL
TAIL 0	PETG
TAIL 1	LW-PLA
TAIL 2	LW-PLA
ELEVATOR L/R	LW-PLA
HORIZONTAL STABILIZER L/R	LW-PLA
HORIZONTAL STABILIZER TIP (print2)	LW-PLA
VERTICAL STABILIZER TIP	LW-PLA

Print Settings



Slicer software you need to use is Ultimater Cura. All elements from **LW-PLA** are best printed with ready-made settings prepared in a profile that you can download. Settings are prepared a standard 0.4mm nozzle. Download link is available on Flightory Blog. Infill in this profile is set to 6%. For this project I recommend changing it to 3% for most parts. This is sufficient infill

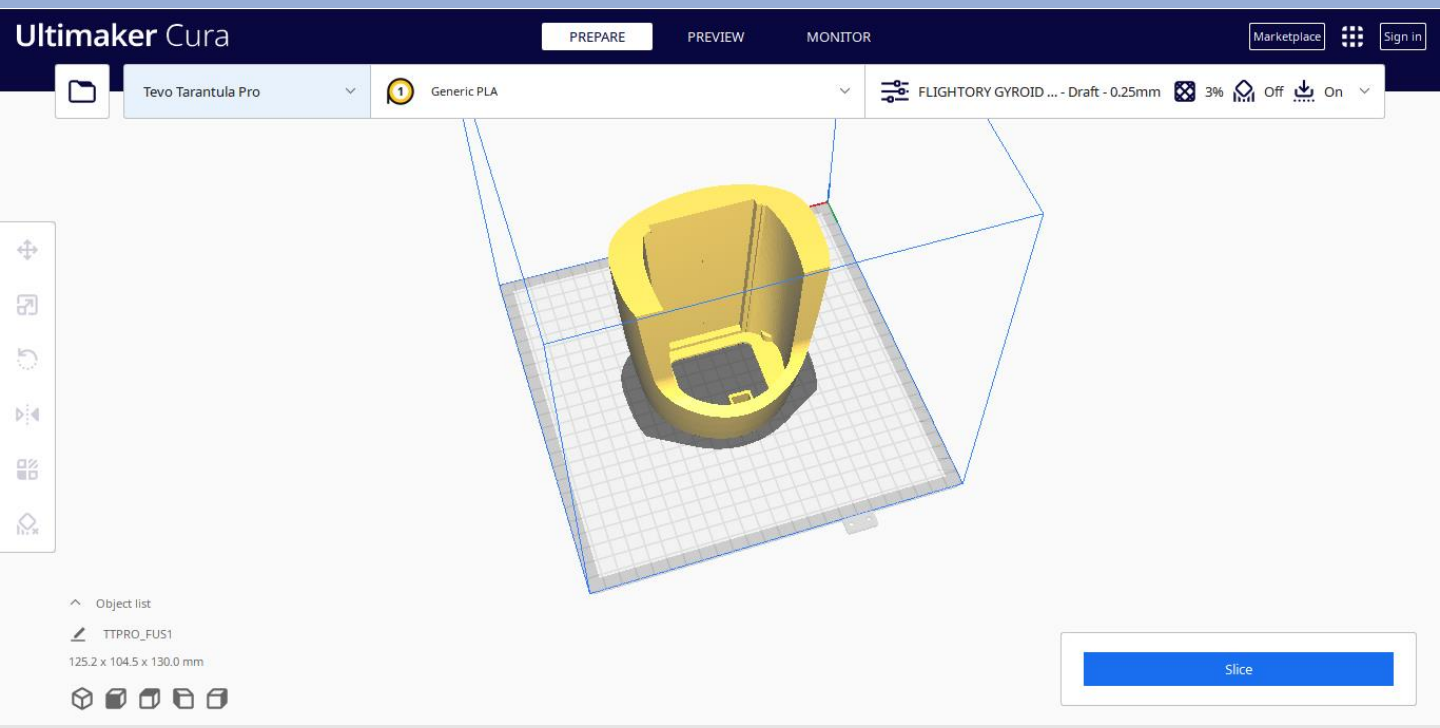
Main features of slicer LW-PLA profile

- layer height: 0,25 mm
- single wall 0,4mm thickness
- 3% Gyroid infill.
- Temperature: 235 degrees,
- flow 60%
- fan speed: 0%

The rest of the detailed settings are saved in the profile.

To print hard **PLA or PET-G** parts, use a default profile in CURA called Draft. **Layer height is 0.2 mm, infill is 20% Grid pattern.** Set the temperature around **220 degrees.** You can fine-tune these parameters to suit your needs and your printer.

Print Settings

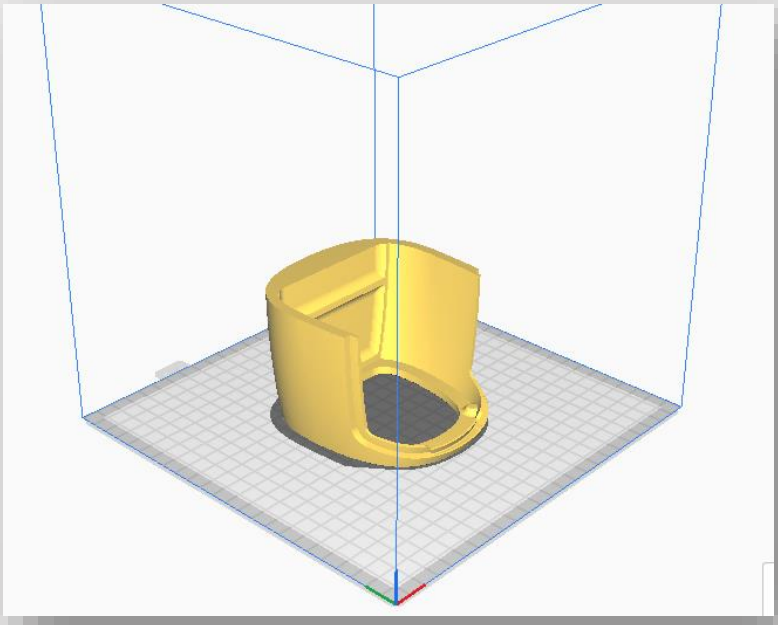


All parts are suitable for printing on any standard printer with a small working area. I printed all parts on a 200 x 200mm area. The settings are just a base that you can change and adjust as needed. The following pages will list my recommended infill settings for each part.

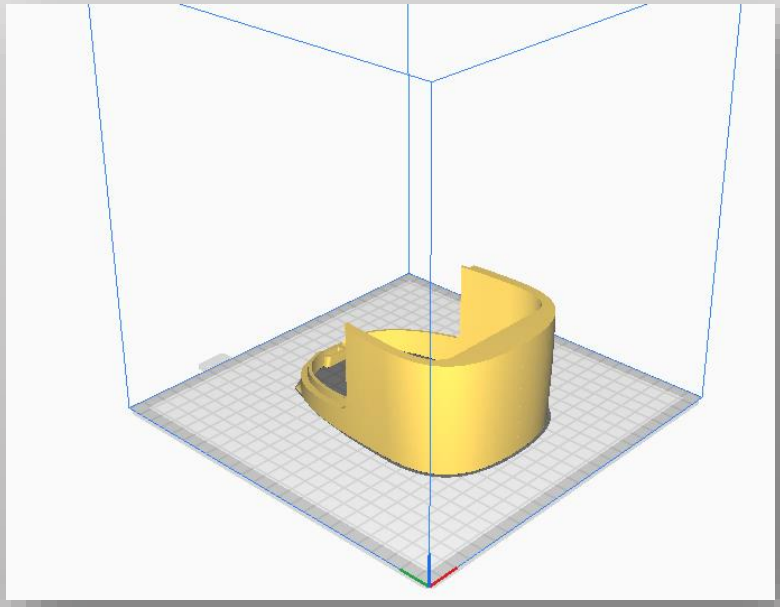
All elements can be printed without supports, but your printer may have a problem with some horizontal surfaces in some places. Depending on the effects, you may then consider turning on supports for these elements and cleaning the printed elements afterwards.

Parts Orientation

Important thing is the correct orientation of the printed parts
to avoid overhangs, and not have to use supports.
Below is the recommended orientation of parts and infill settings.

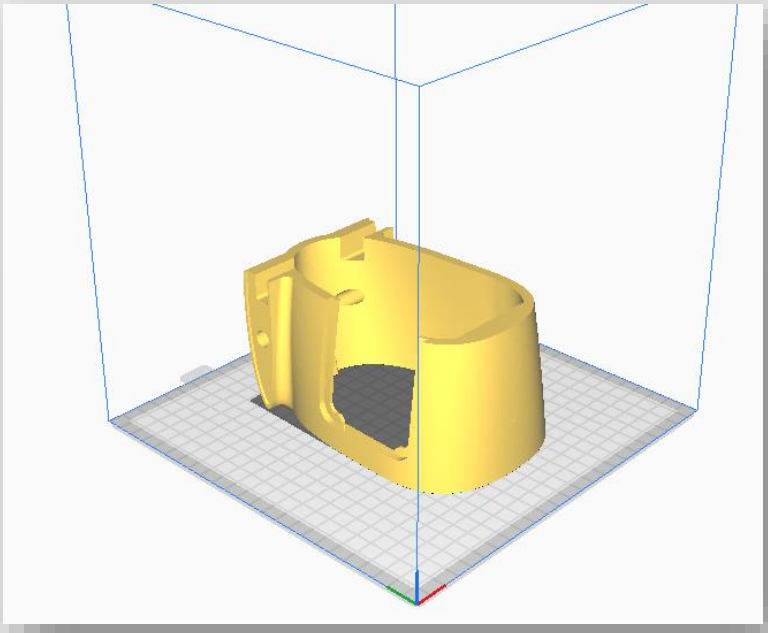


FUS 1 - 3% gyroid infill

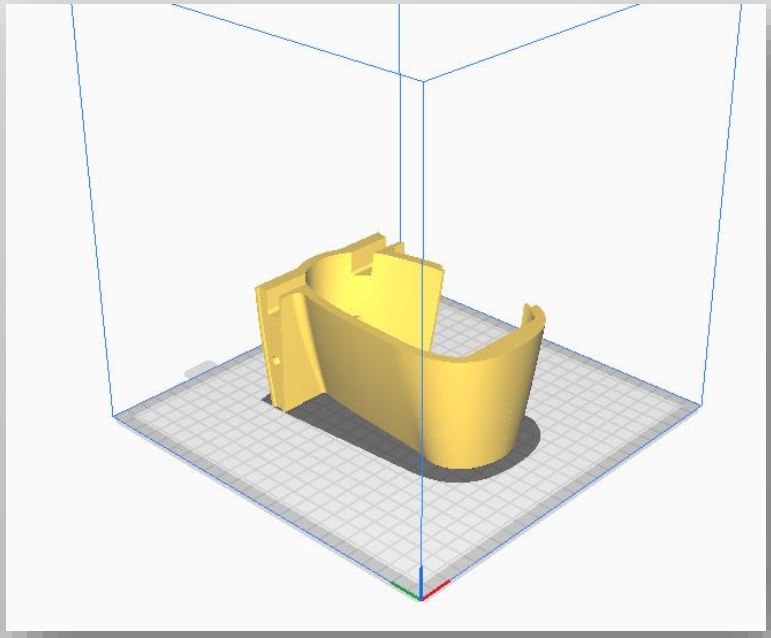


FUS 2 - 3% gyroid infill

Parts Orientation

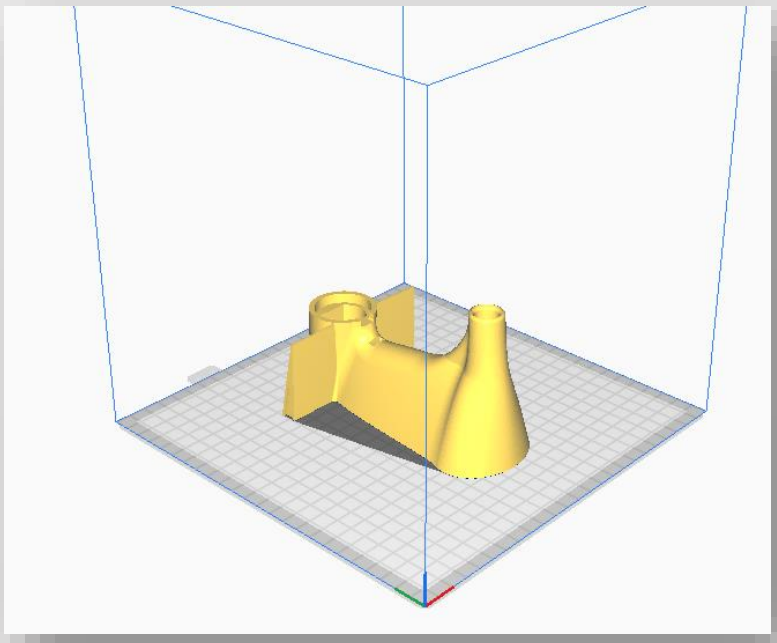


FUS 3 - 3% gyroid infill

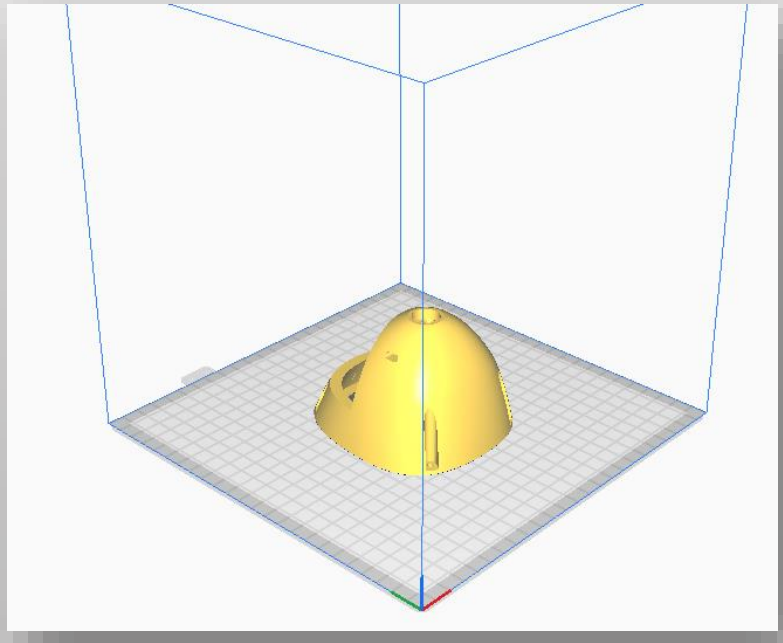


FUS 4 - 3% gyroid infill

Parts Orientation

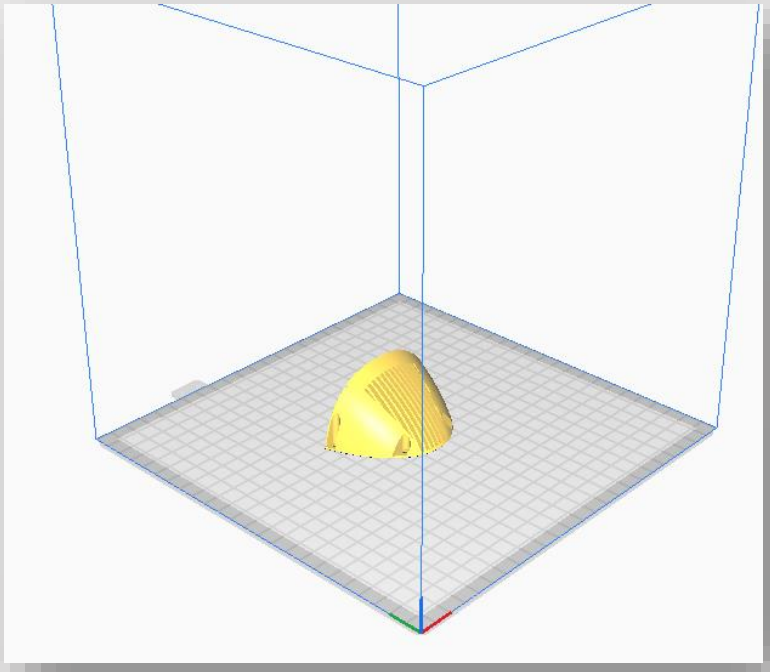


FUS 5 - 6% gyroid infill

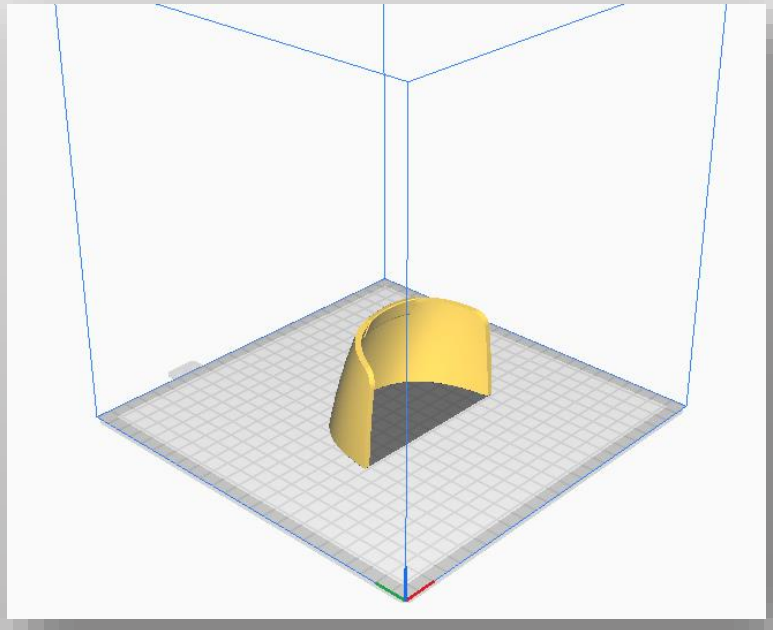


NOSE - 4% gyroid infill + 2 walls

Parts Orientation

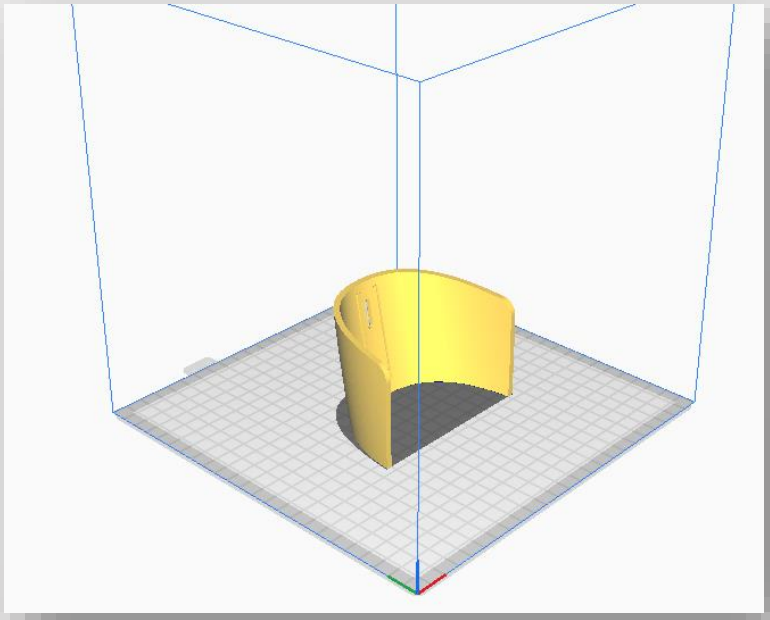


NOSE VTX COVER- 4% gyroid infill + 2 walls

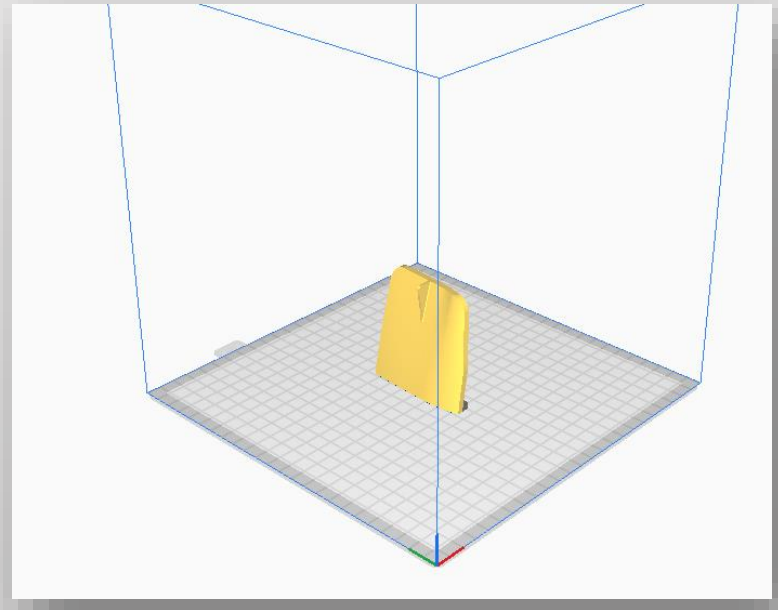


HATCH FRONT 1 - 3% gyroid infill

Parts Orientation

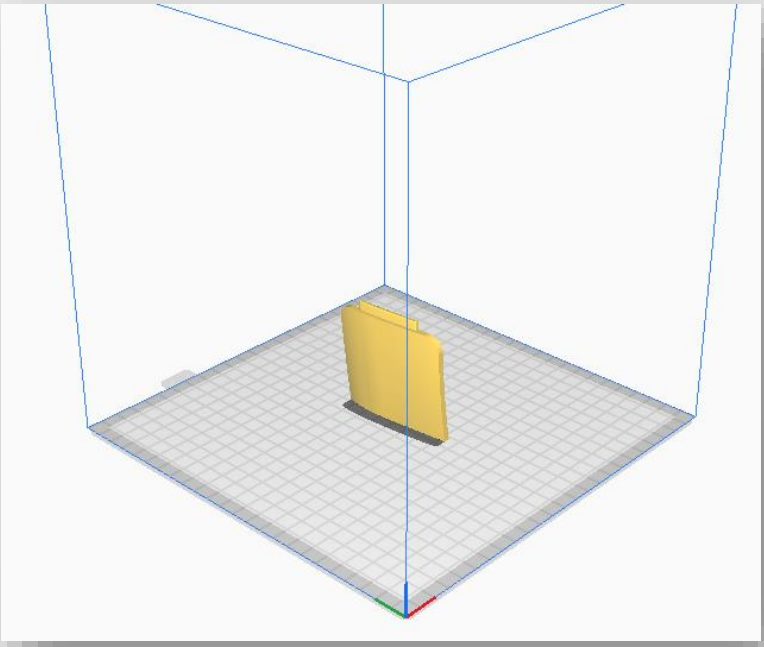


HATCH FRONT 2 - 3% gyroid infill

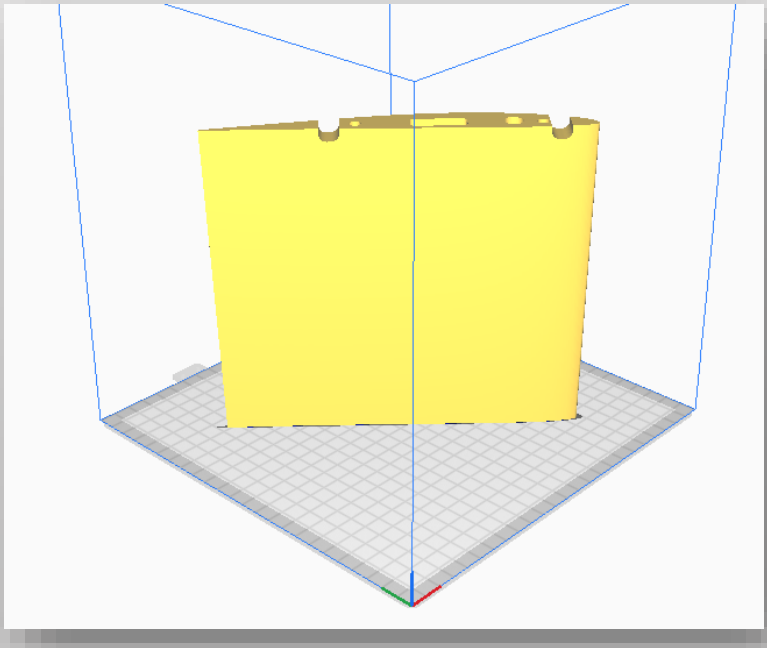


HATCH SIDE 1 - 3% gyroid infill

Parts Orientation

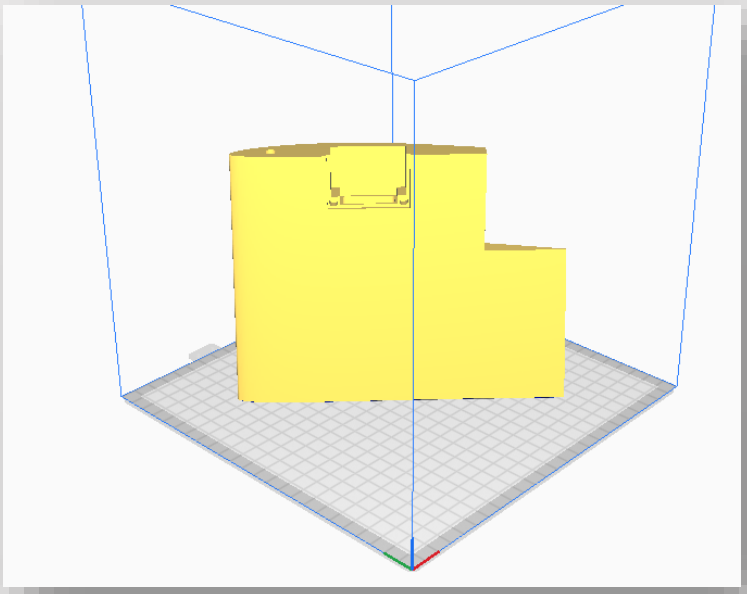


HATCH SIDE 2 - 3% gyroid infill

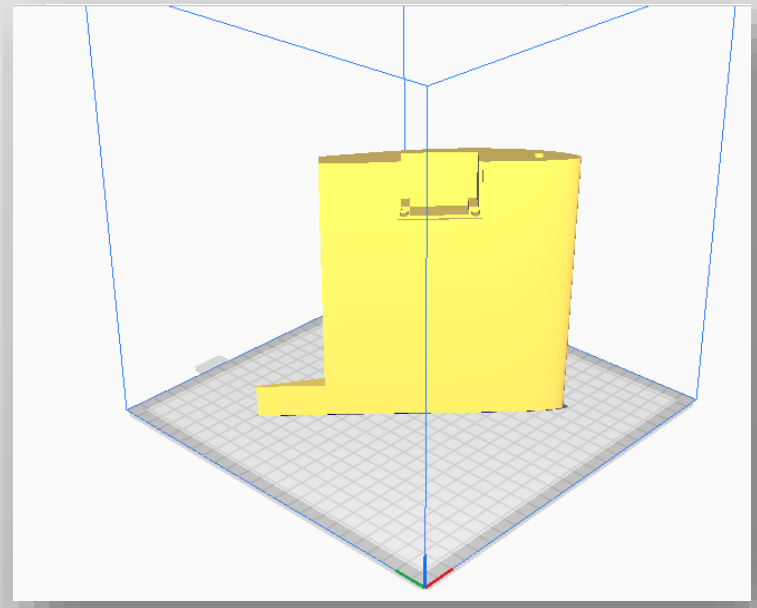


WING 1 - 3% cubic subdivision infill

Parts Orientation

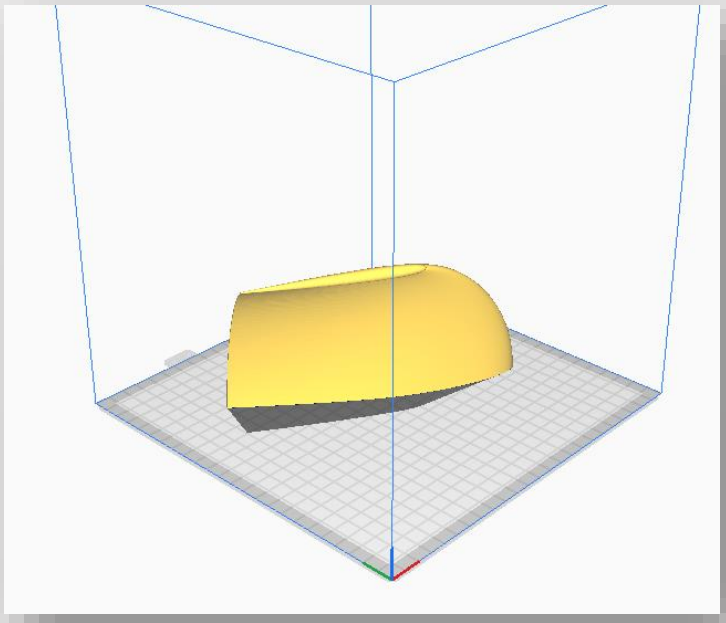


WING 2 - 3% cubic subdivision infill

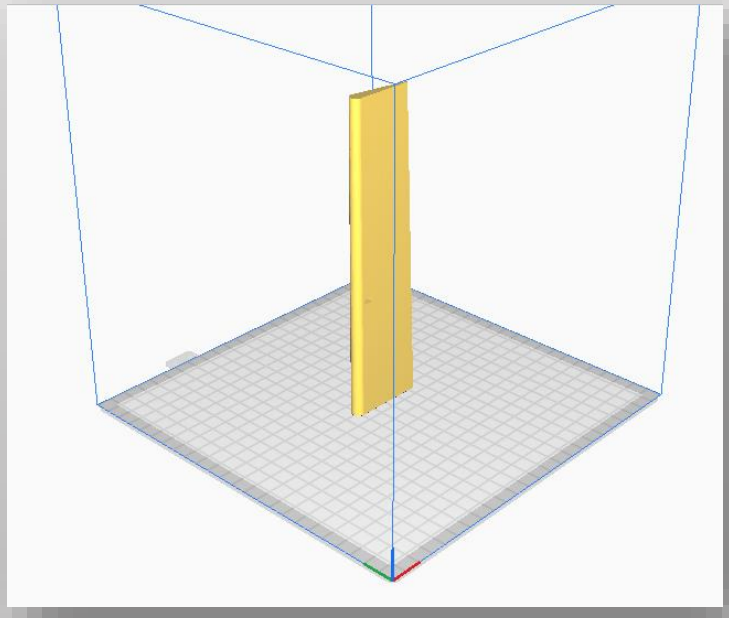


WING 3 - 3% cubic subdivision infill

Parts Orientation

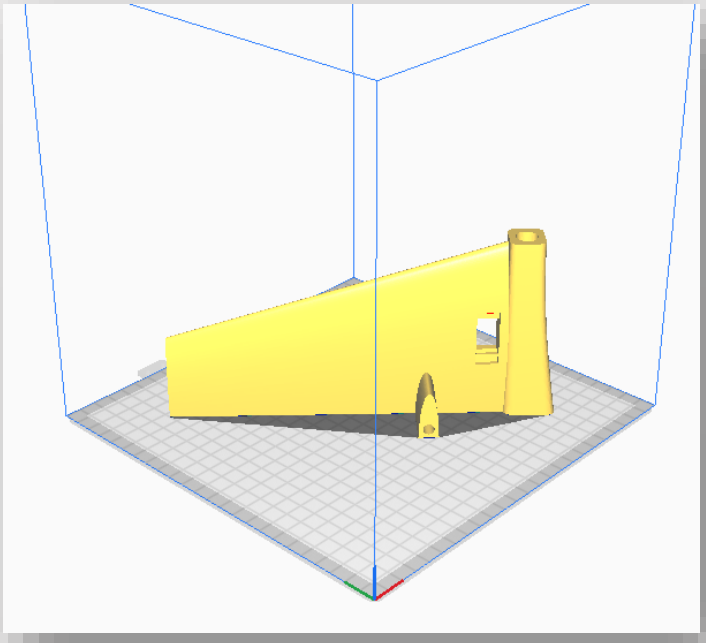


WINGLET- 3% cubic subdivision infill

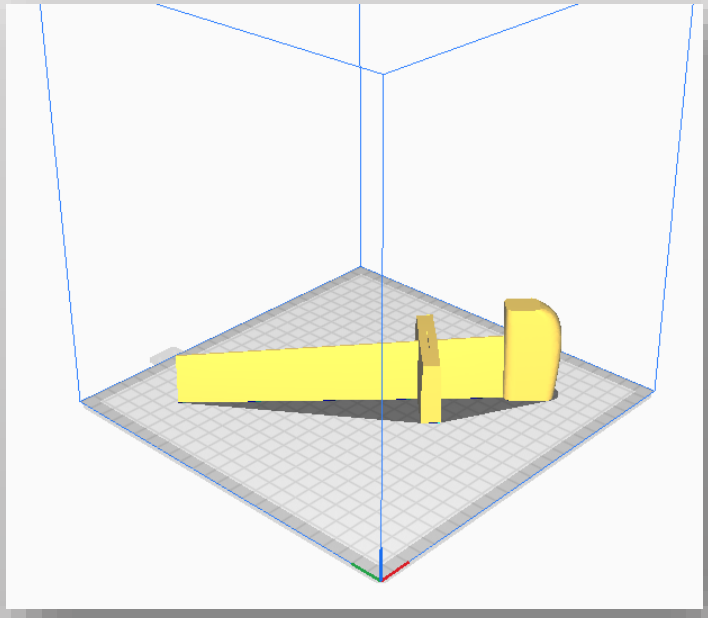


AIL- 4% cubic subdivision infill

Parts Orientation

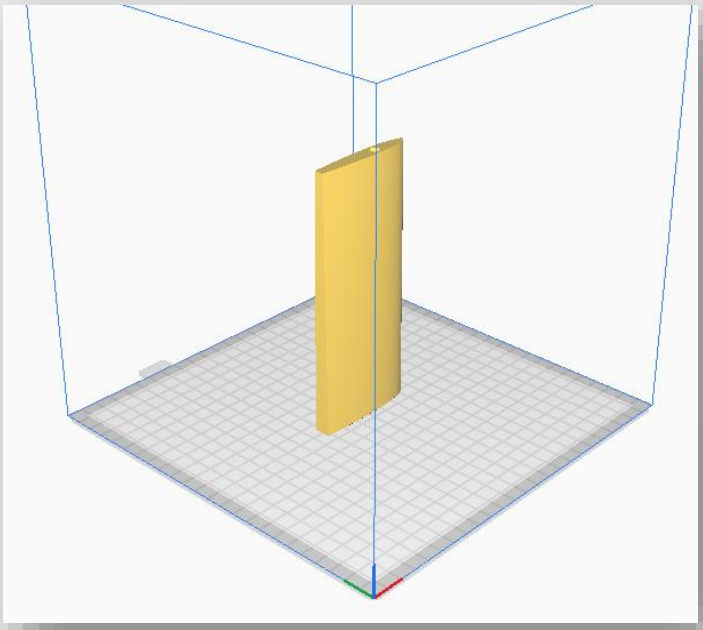


TAIL 1 - 6% gyroid infill

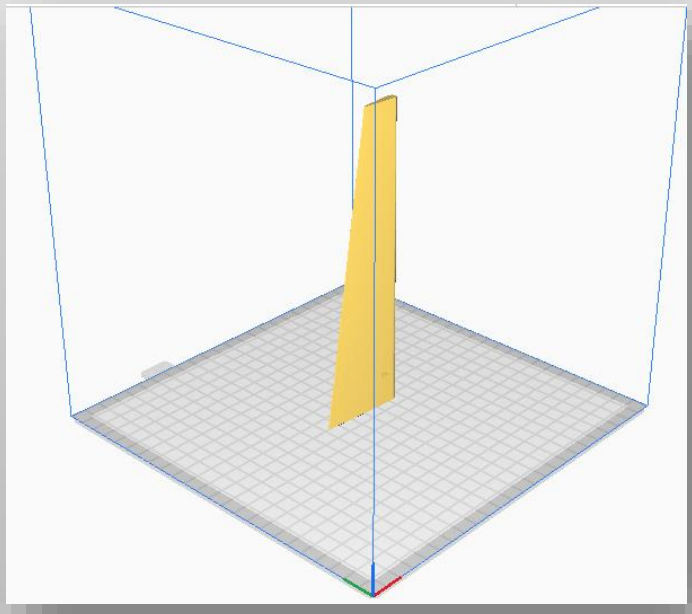


V-TAIL 2 - 3% gyroid infill

Parts Orientation



HORIZONTAL STAB - 3% gyroid infill

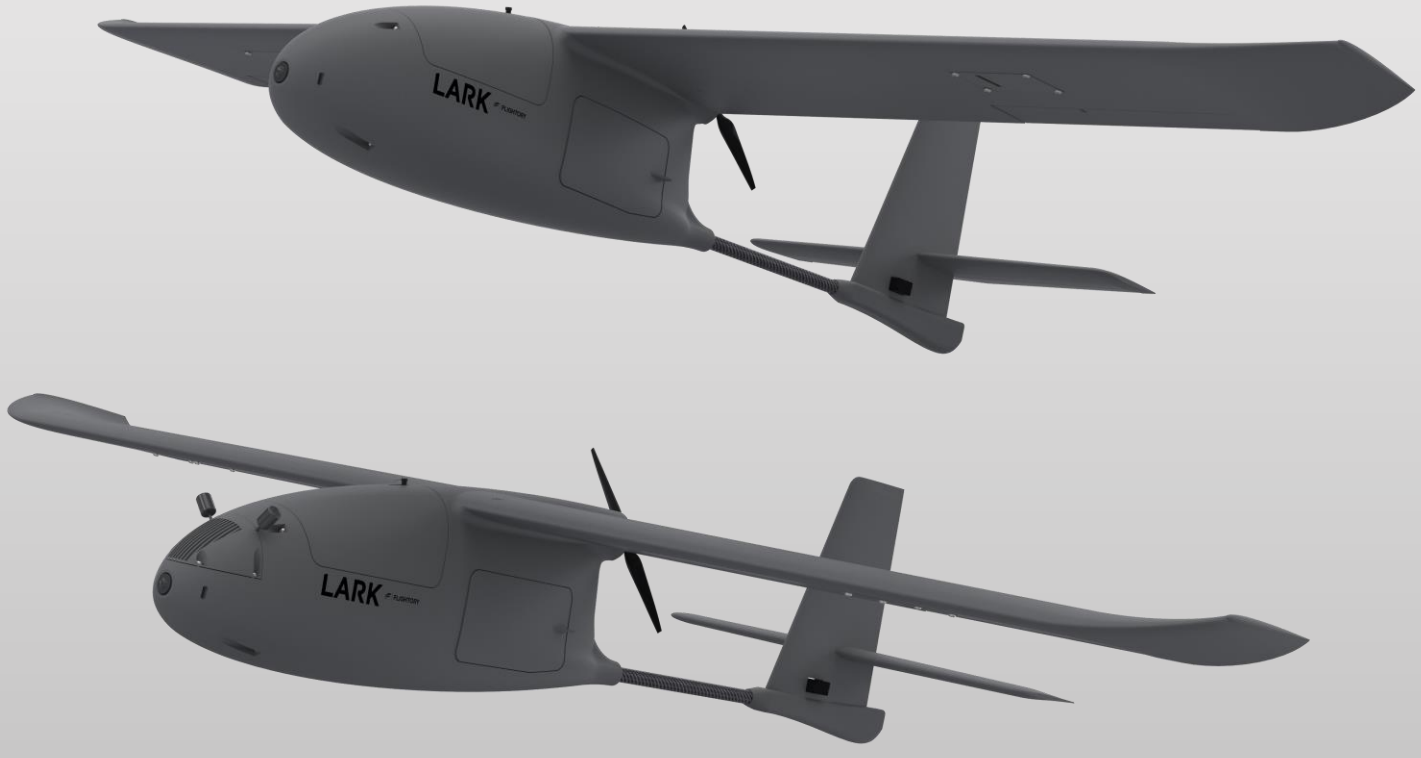


ELEVATOR- 4% gyroid infill

NOSE VARIANTS

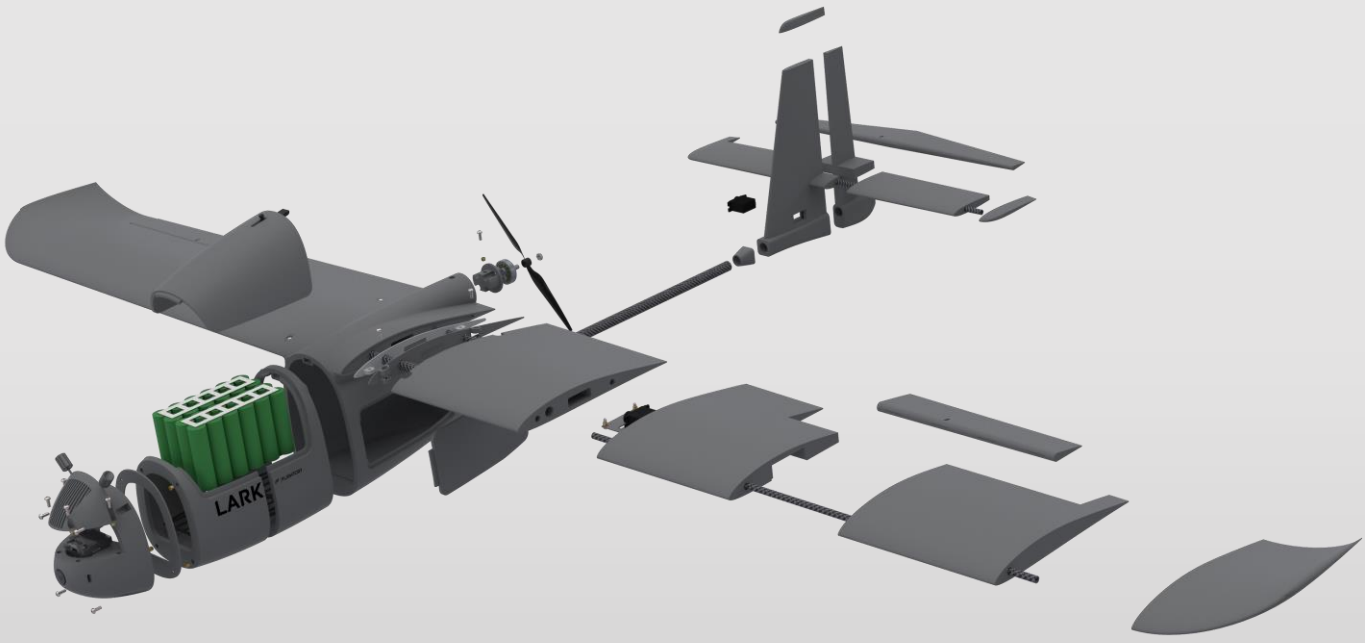
There are 2 variants of the nose. You can choose version with a VTX mounted inside and a 19x19mm FPV camera, or a clean version with just the FPV camera. The VTX mounts on a "shelf" and the available space is sufficient to accommodate any VTX.

The nose is fully removable, mounted on four M3 screws. It is also available in STEP format for easy editing. You can edit this part and adapt it to your own more individual needs and to mount different payload. You can also have several versions of the nose and change them according to the needs of a particular flight.



STEP files

All files are available in STL format. In addition, some important elements are available in STEP format, which allows easier editing and customization.

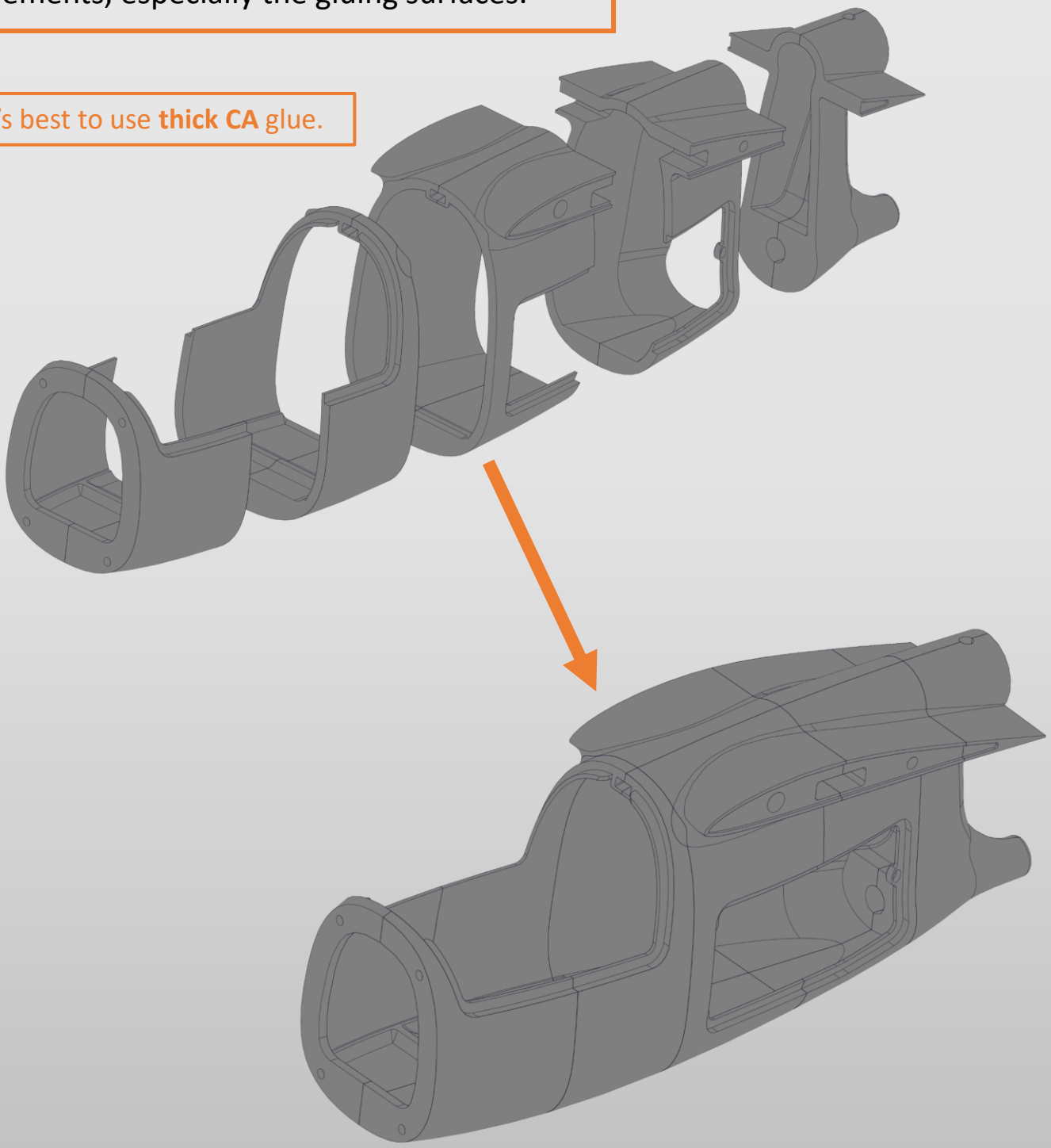


You can find these files in folders labeled STEP

Fuselage assembly

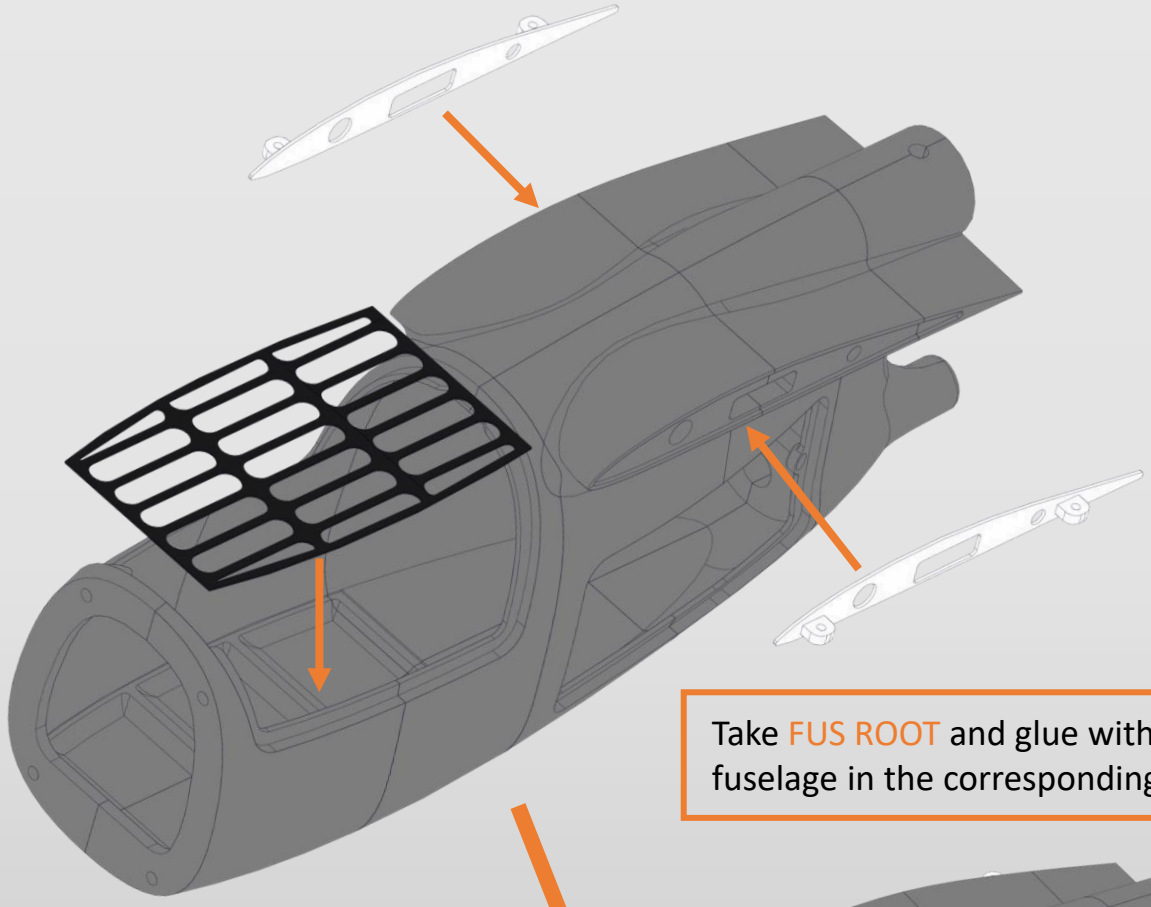
Prepare all fuselage segments. Before gluing, you can gently sand the surface of all elements, especially the gluing surfaces.

It's best to use **thick CA** glue.

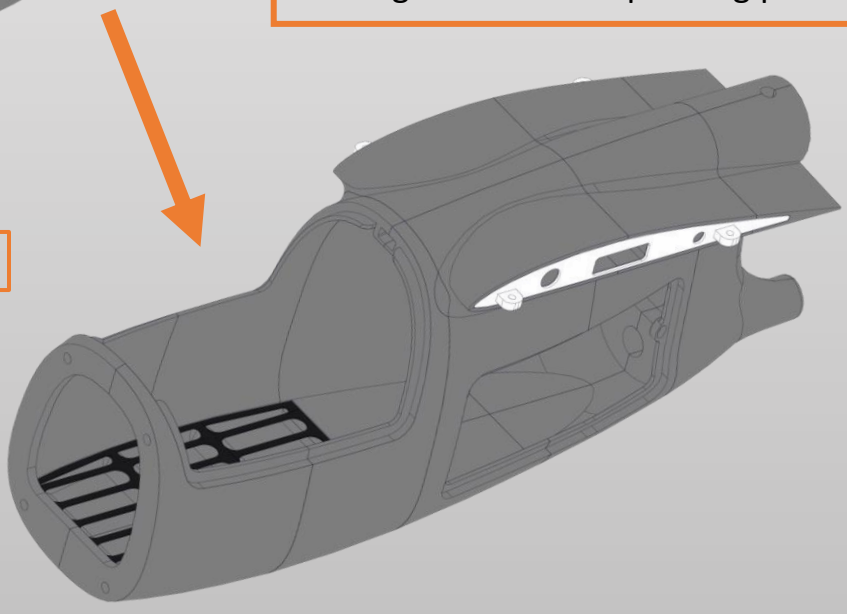


Fuselage assembly

Prepare parts printed from PET-G or other hard material. Take the BATTERY PAD and paste it in the designated place in the front of the fuselage.

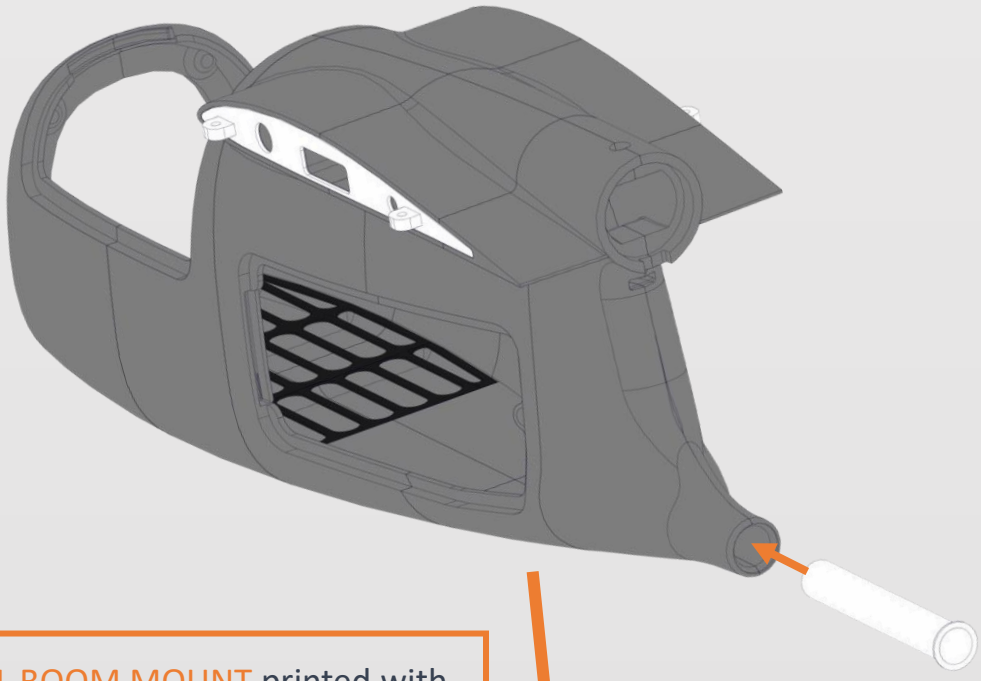


Take FUS ROOT and glue with CA to the fuselage in the corresponding places.



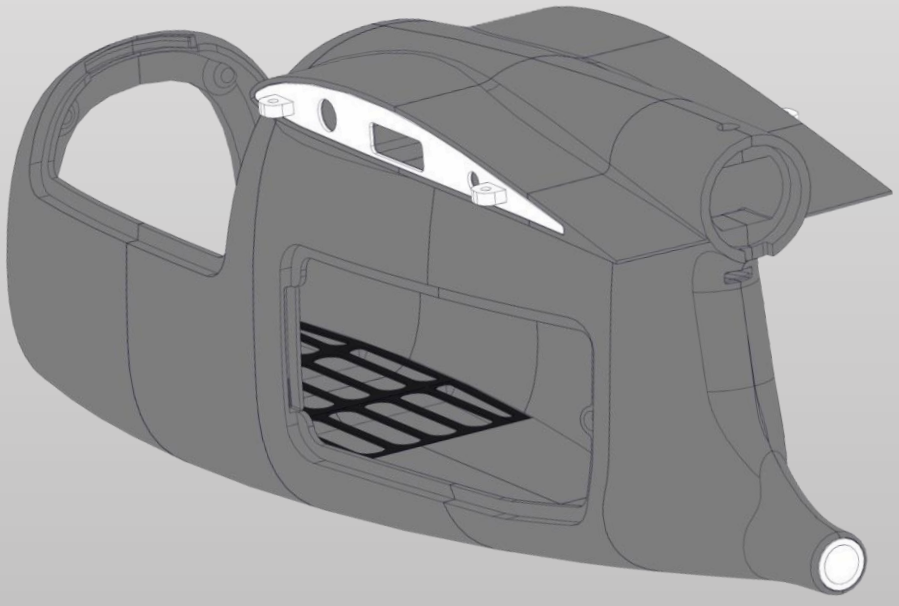
It's best to use **thick CA** glue.

Fuselage assembly



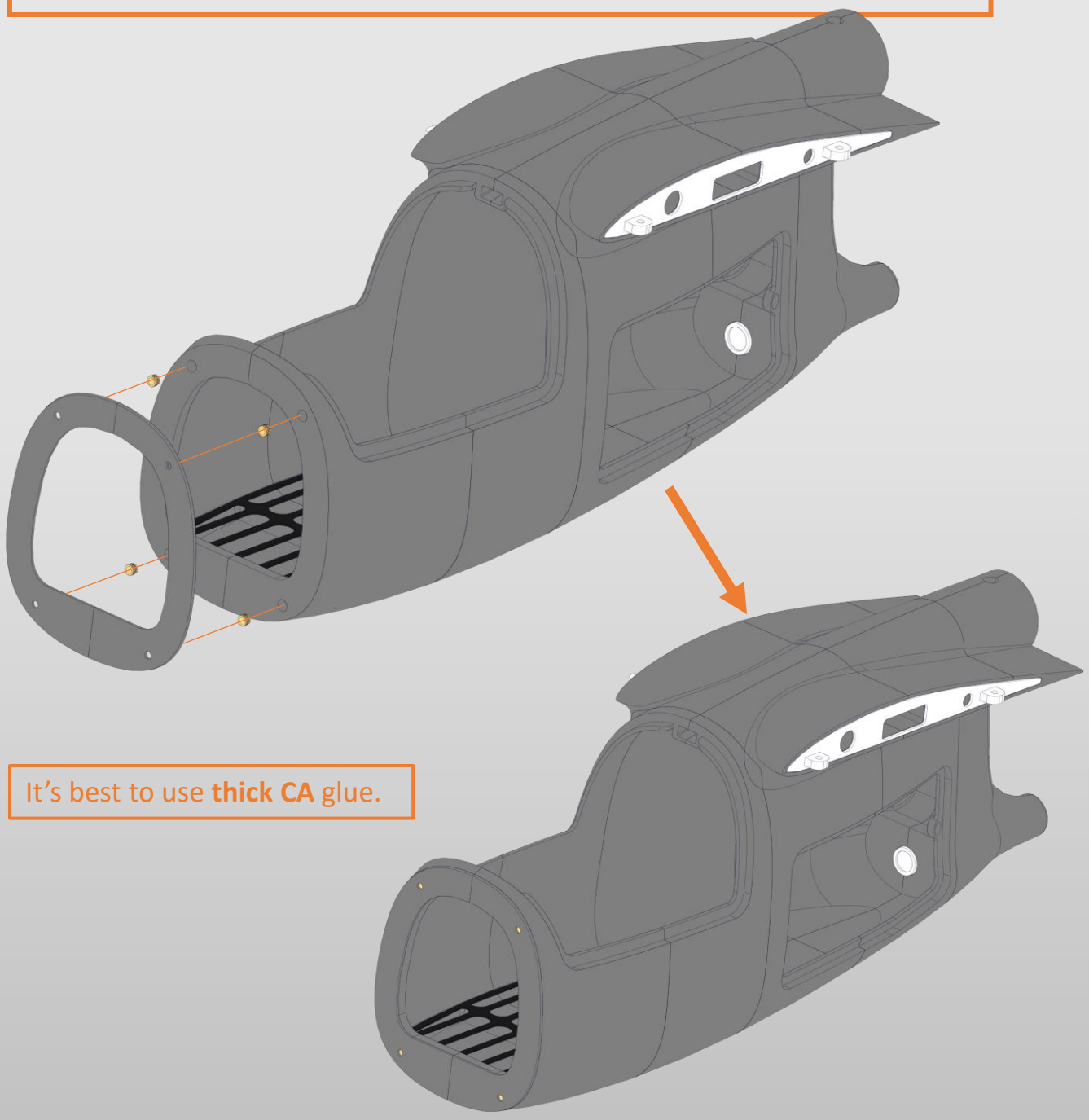
Take the TAIL BOOM MOUNT printed with PETG or another rigid material and paste it into the designated slot. This component reinforces the section of the fuselage to which the tail boom will be attached

It's best to use **thick CA** glue.



Fuselage assembly

Now take M3 threaded inserts with an outer diameter of 5mm.
Glue them into the designated places in the front part of the fuselage.
You can use a slightly heated soldering iron for this. Then glue NOSE REINFORCEMENT printed from PETG or other hard material. This noticeably increases the strength of the nose when it is frequently unscrewed and prevents the threaded inserts from being torn out.

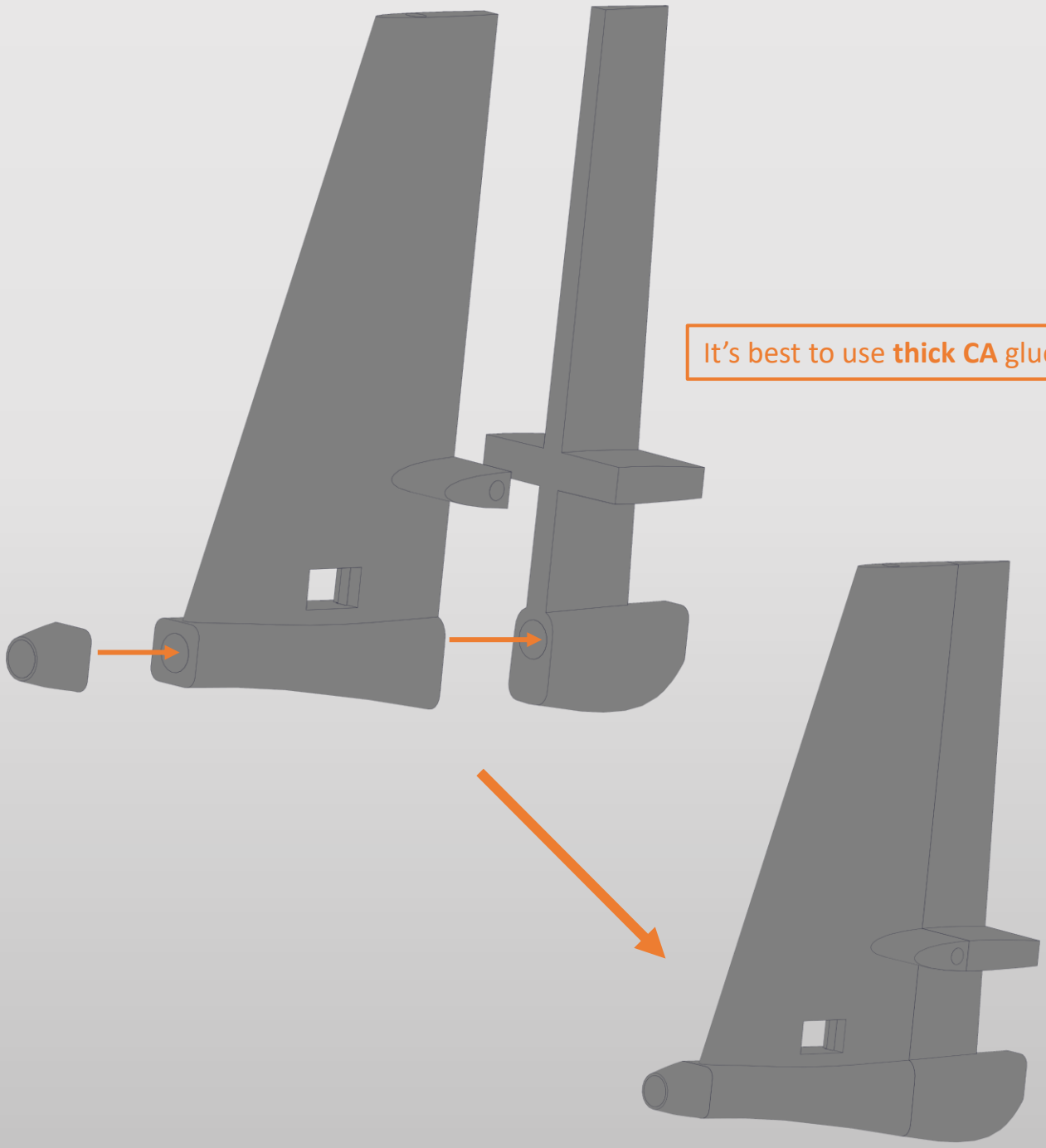


It's best to use **thick CA** glue.

Tail assembly

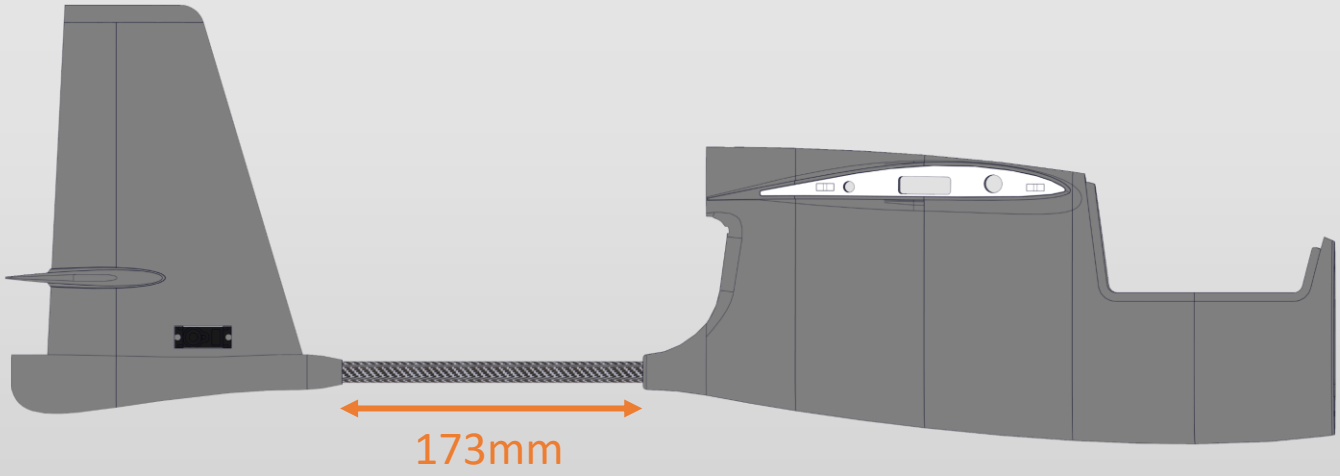
Now, get the tail parts ready and glue them together.

It's best to use **thick CA** glue.



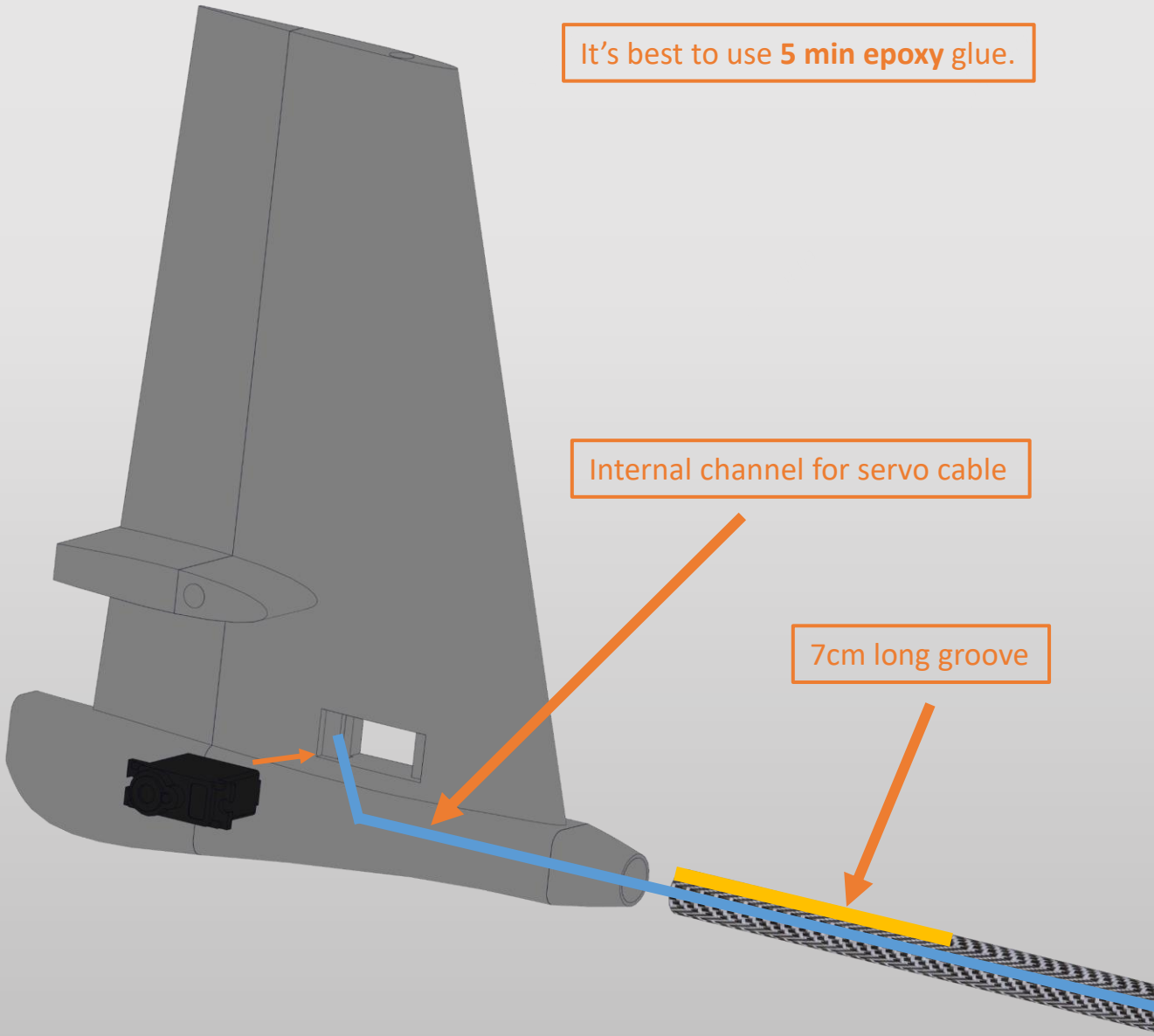
Tail assembly

Prepare the tail boom. Cut a carbon tube with a diameter of 12mm to a length of 430mm. Before gluing the tail, you can make sure that the tail boom has "fully entered" the designated slots. Correctly, the marked distance between the fuselage and the tail should be 173mm.



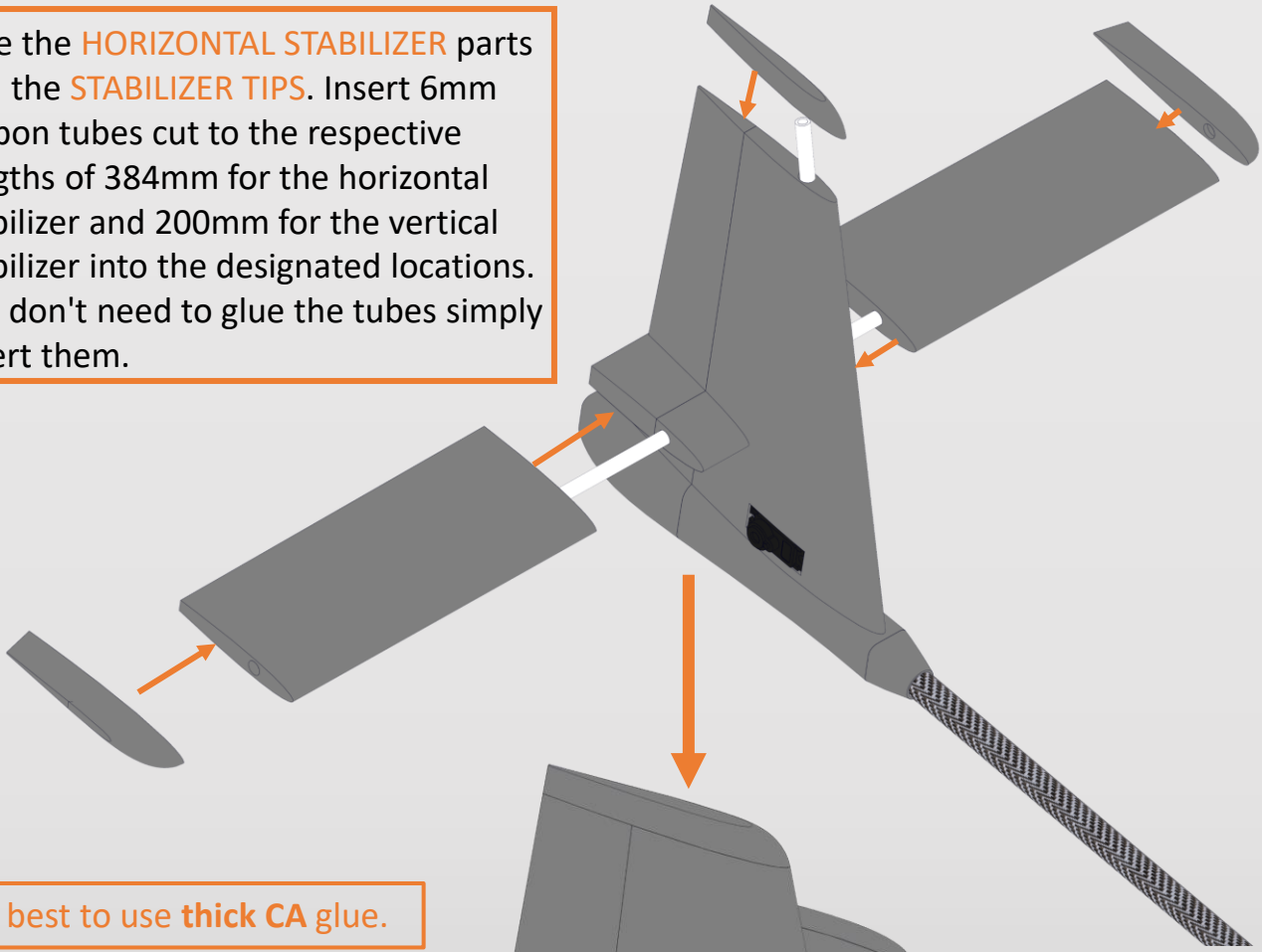
Tail assembly

At this stage, it is necessary to attach the elevator servo and the tail boom. Inside the tail, there is a designed channel for the servo cable. While installing the servo, guide the cable through that channel and into the tail boom. The cable will likely be too short to reach the fuselage, so you may need to use an extension or manually lengthen the cables. To enable the tail boom installation, it is necessary to cut a "groove" approximately 7cm long from the end, so it reaches around the area where the servo is located. This can be done with a Dremel or by carving it with a file. Once the tail boom is prepared in this way, insert it all the way and glue it in place.

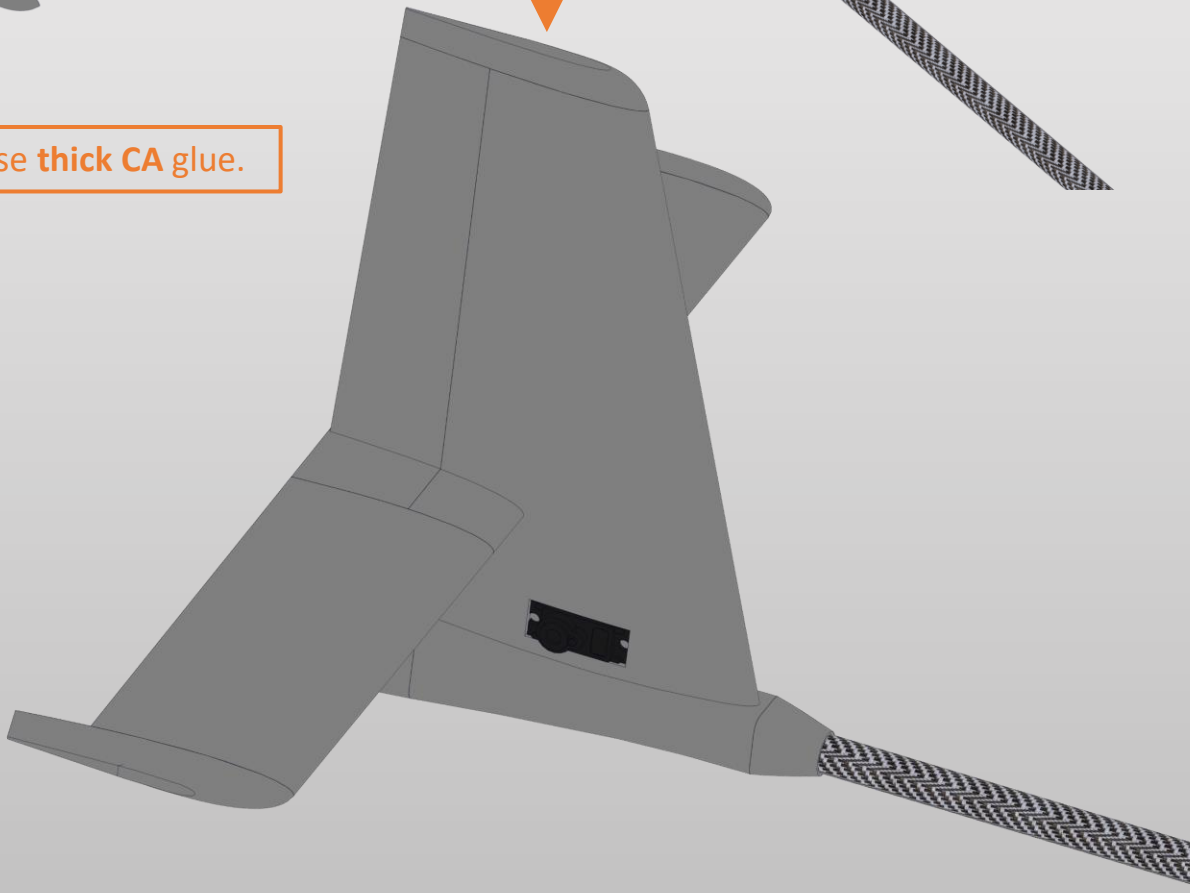


Tail assembly

Take the HORIZONTAL STABILIZER parts and the STABILIZER TIPS. Insert 6mm carbon tubes cut to the respective lengths of 384mm for the horizontal stabilizer and 200mm for the vertical stabilizer into the designated locations. You don't need to glue the tubes simply insert them.

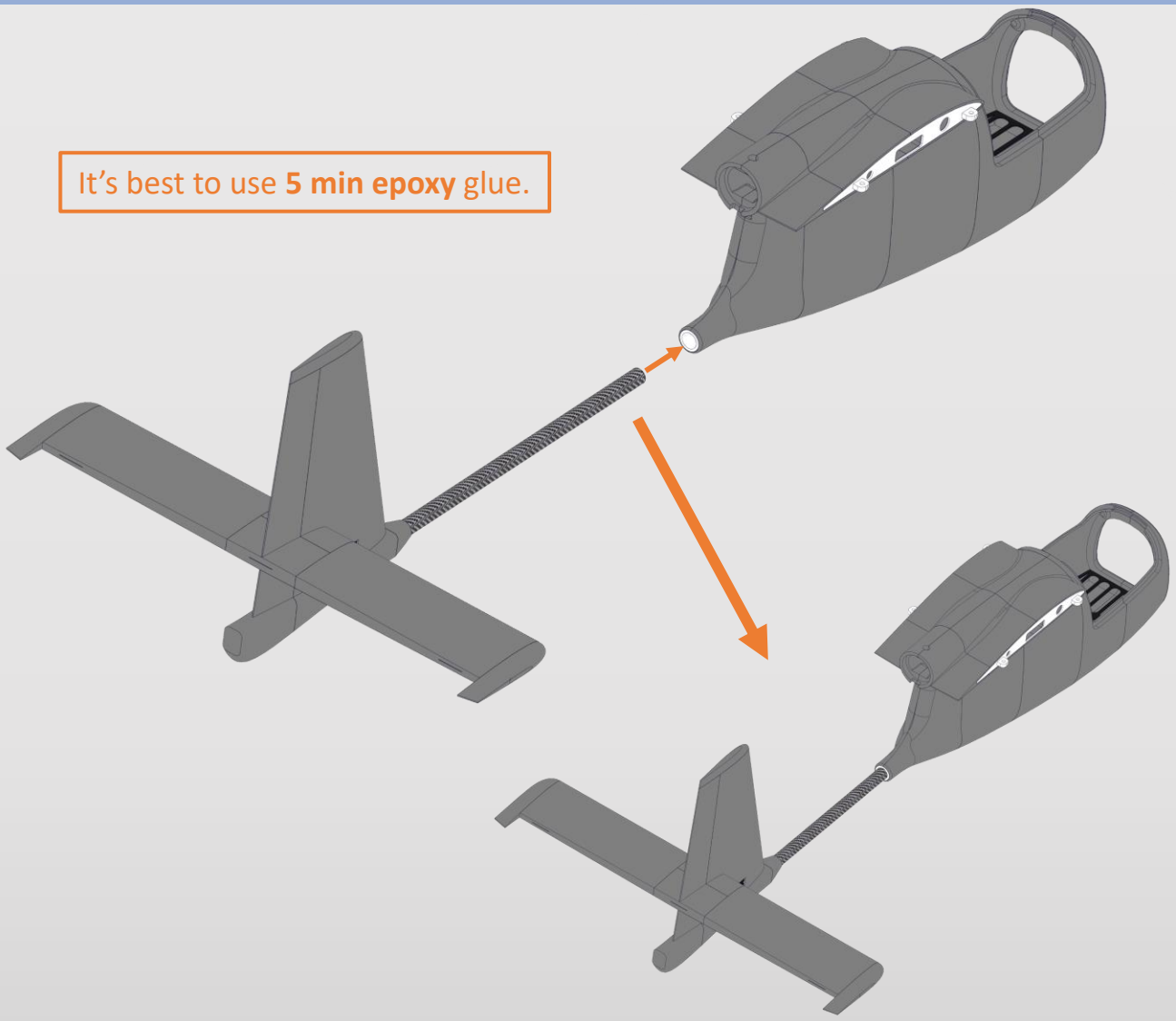


It’s best to use **thick CA** glue.



Tail assembly

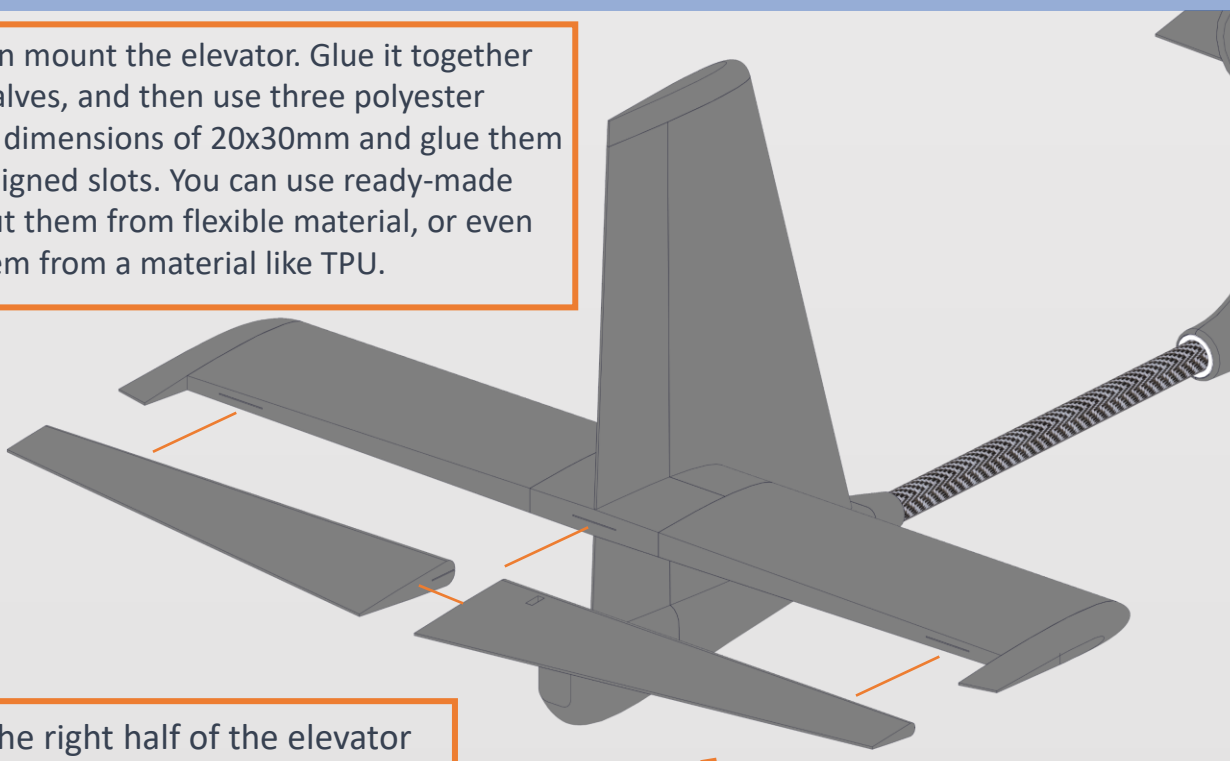
It’s best to use **5 min epoxy** glue.



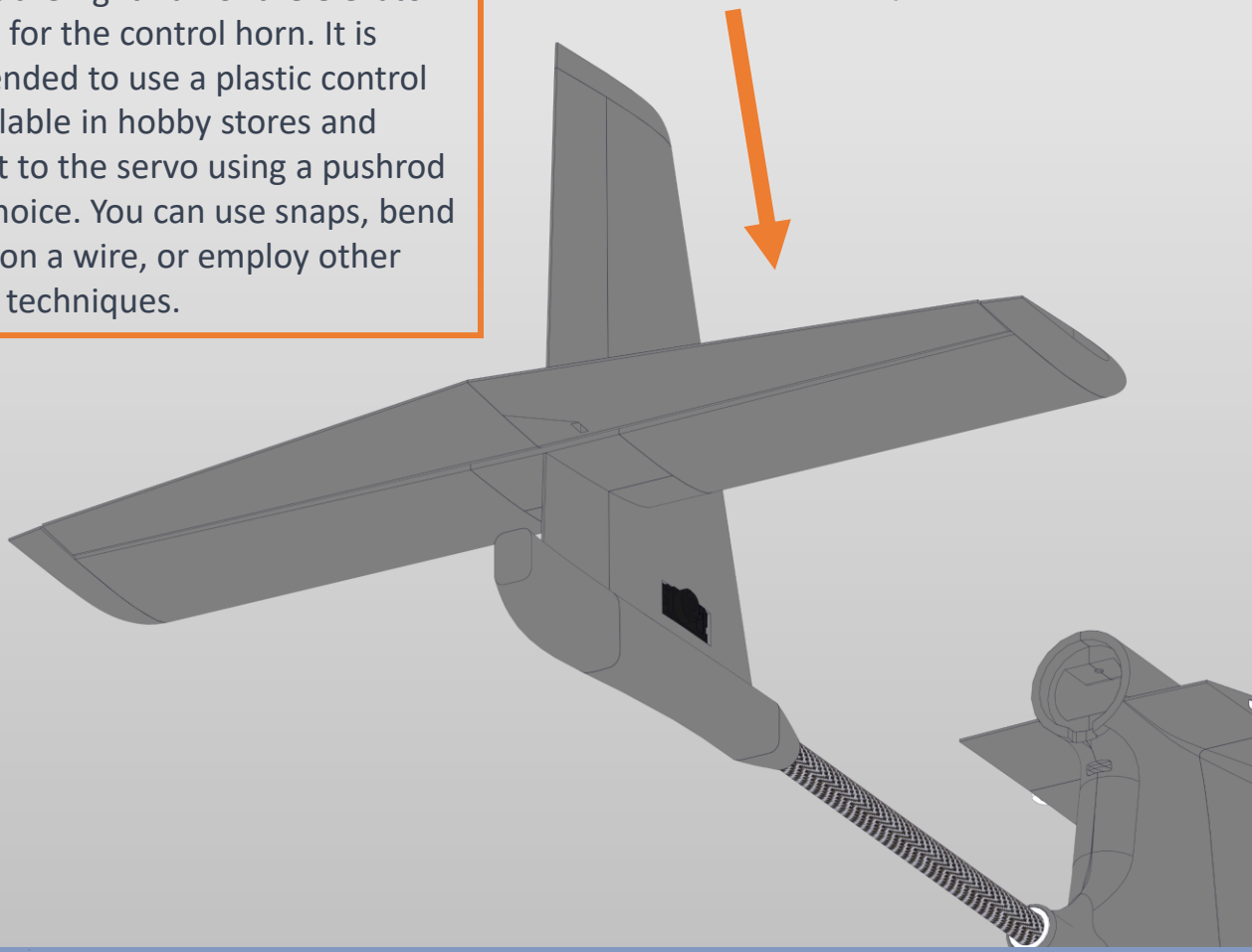
Now, glue the tail boom to the fuselage. Start by routing the elevator servo cable into the fuselage and precisely fit it in place without glue. It is crucial to to align the tail, ensuring that the horizontal stabilizer is perfectly parallel to the wings. To assist in this, you can use something to support all the parts on the table. You can also use small levels to make sure that both the main part of the fuselage and the tail are horizontal. For gluing the tail boom, I recommend using 5-minute epoxy glue to allow time for proper alignment of these elements.

Tail assembly

Now you can mount the elevator. Glue it together from two halves, and then use three polyester hinges with dimensions of 20x30mm and glue them into the designed slots. You can use ready-made hinges or cut them from flexible material, or even 3D print them from a material like TPU.

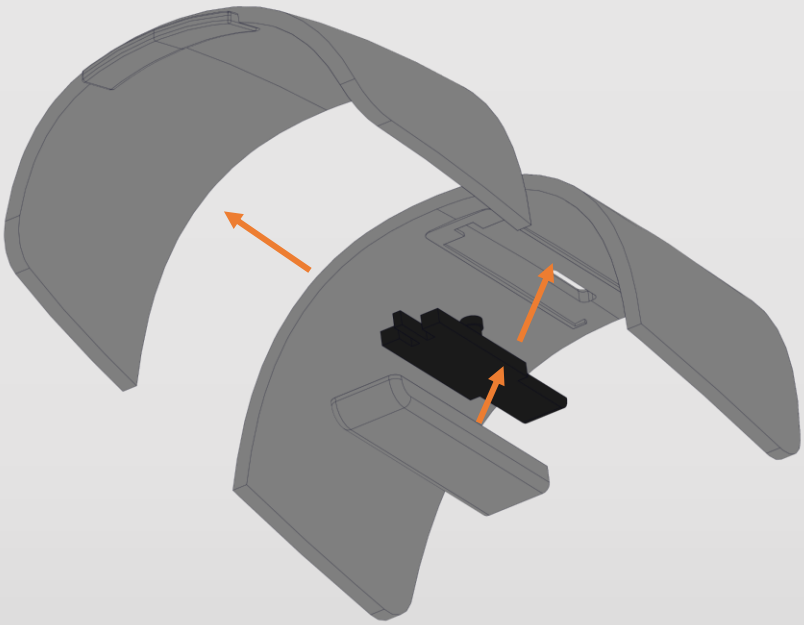


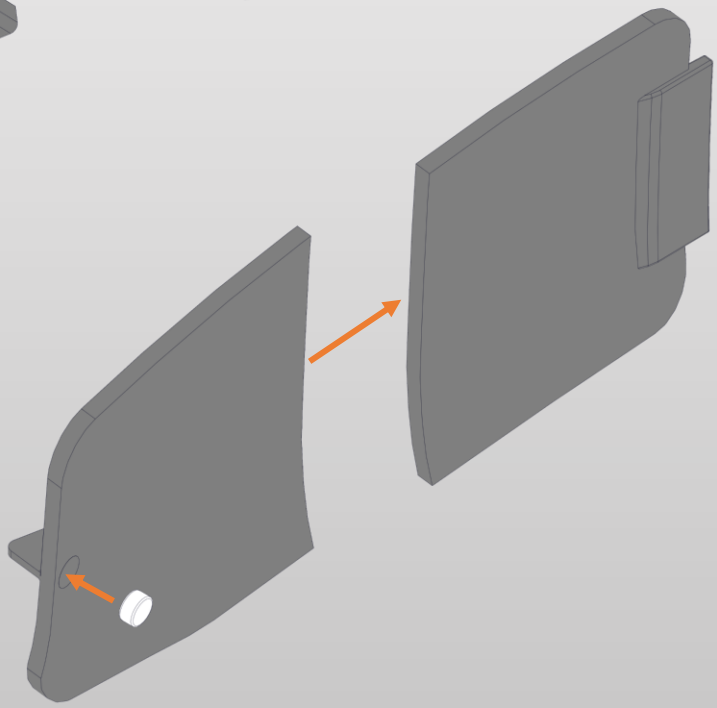
Note that the right half of the elevator has a slot for the control horn. It is recommended to use a plastic control horn available in hobby stores and connect it to the servo using a pushrod of your choice. You can use snaps, bend a Z-bend on a wire, or employ other fastening techniques.



Hatches

Take the hatches parts and assemble them. For the FRONT HATCH, also insert LOCK 1 and LOCK 2. Assemble it, adding a small spring, and glue it in the designated place. Use a small amount of CA glue, but be careful not to spill the glue and block the lock. For the side hatch, paste a 6x3mm magnet into the designed slot.

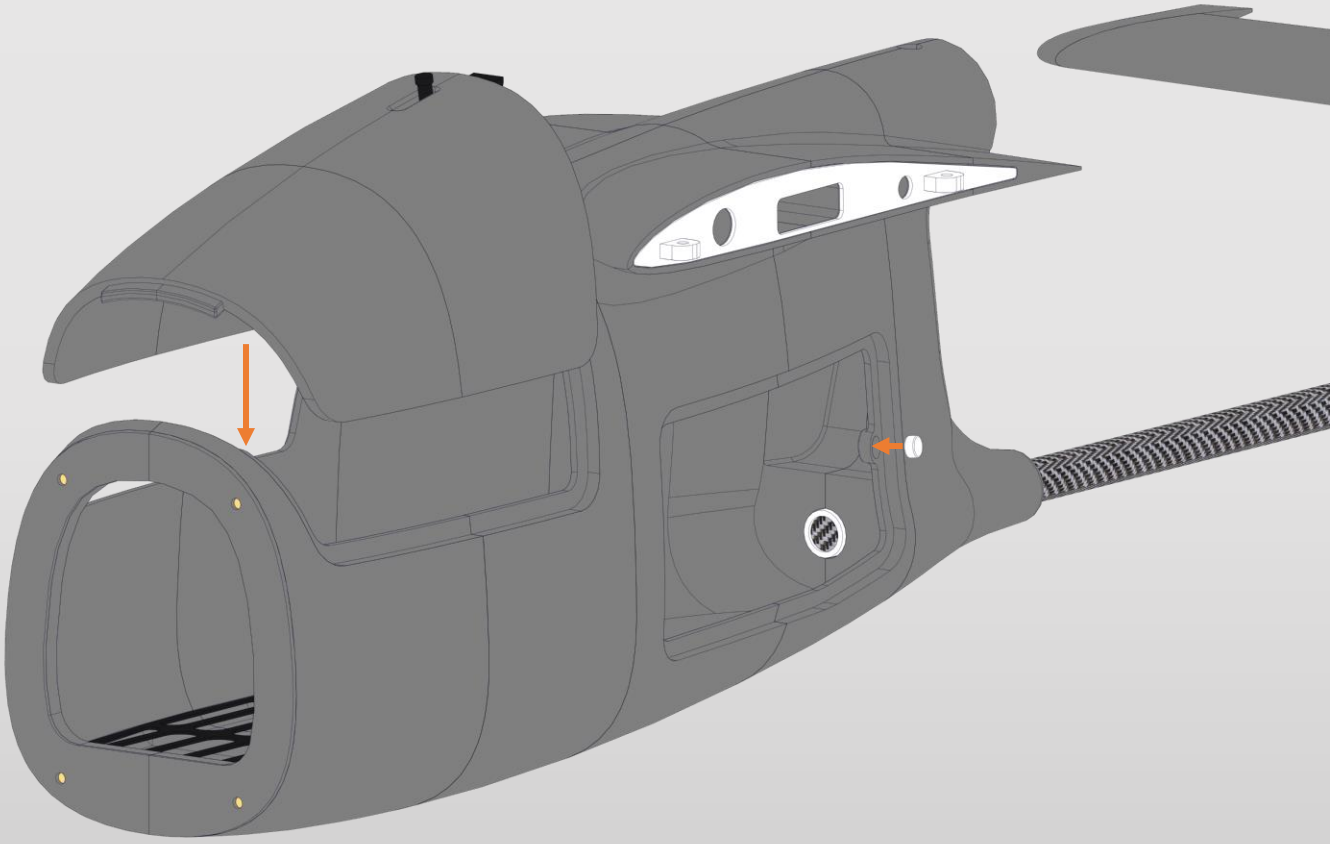




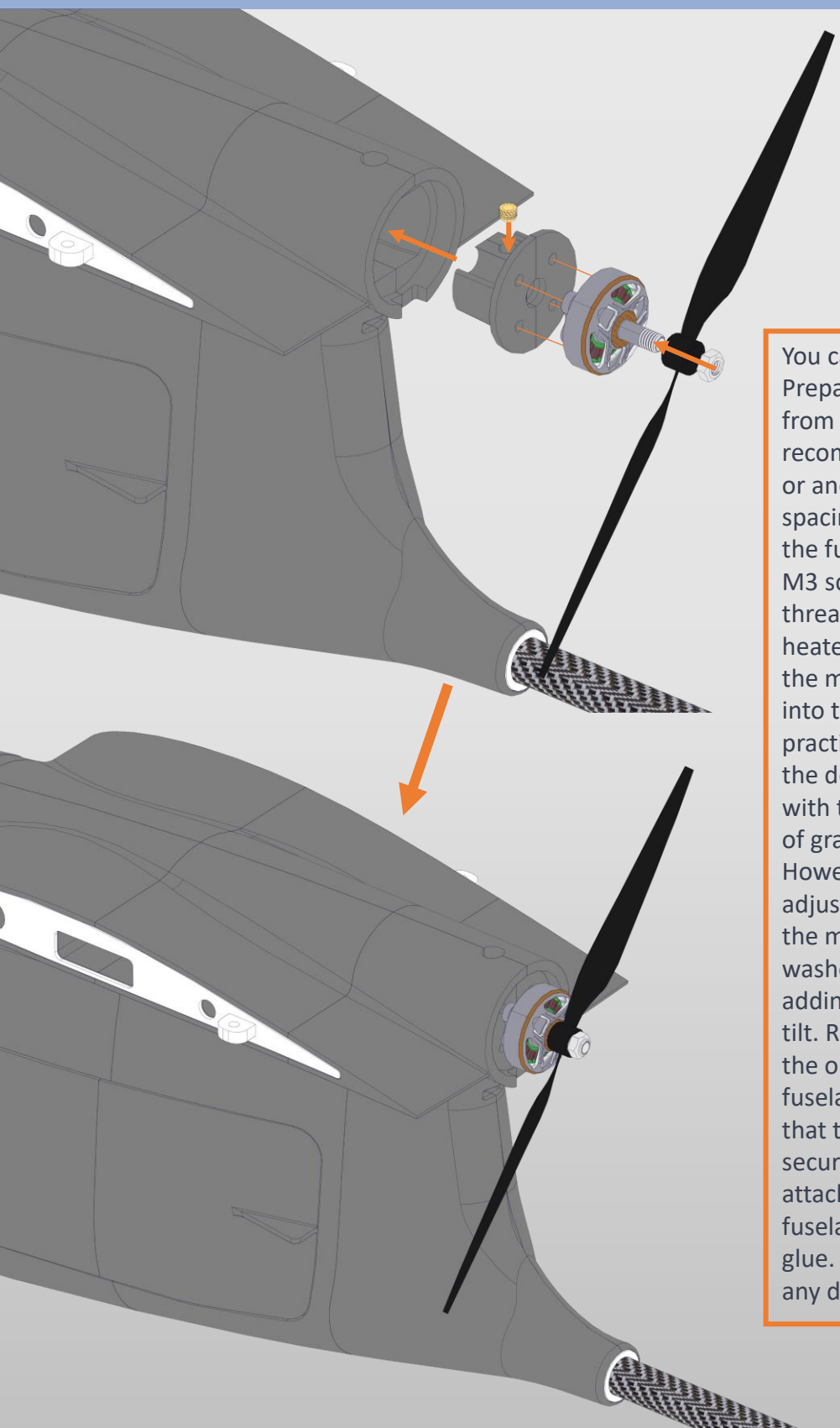
It's best to use **thick CA** glue.

Hatches

Check if the hatches fit well the fuselage. Also, glue the second 6x3mm magnet into the fuselage in the place where the side hatch is inserted.

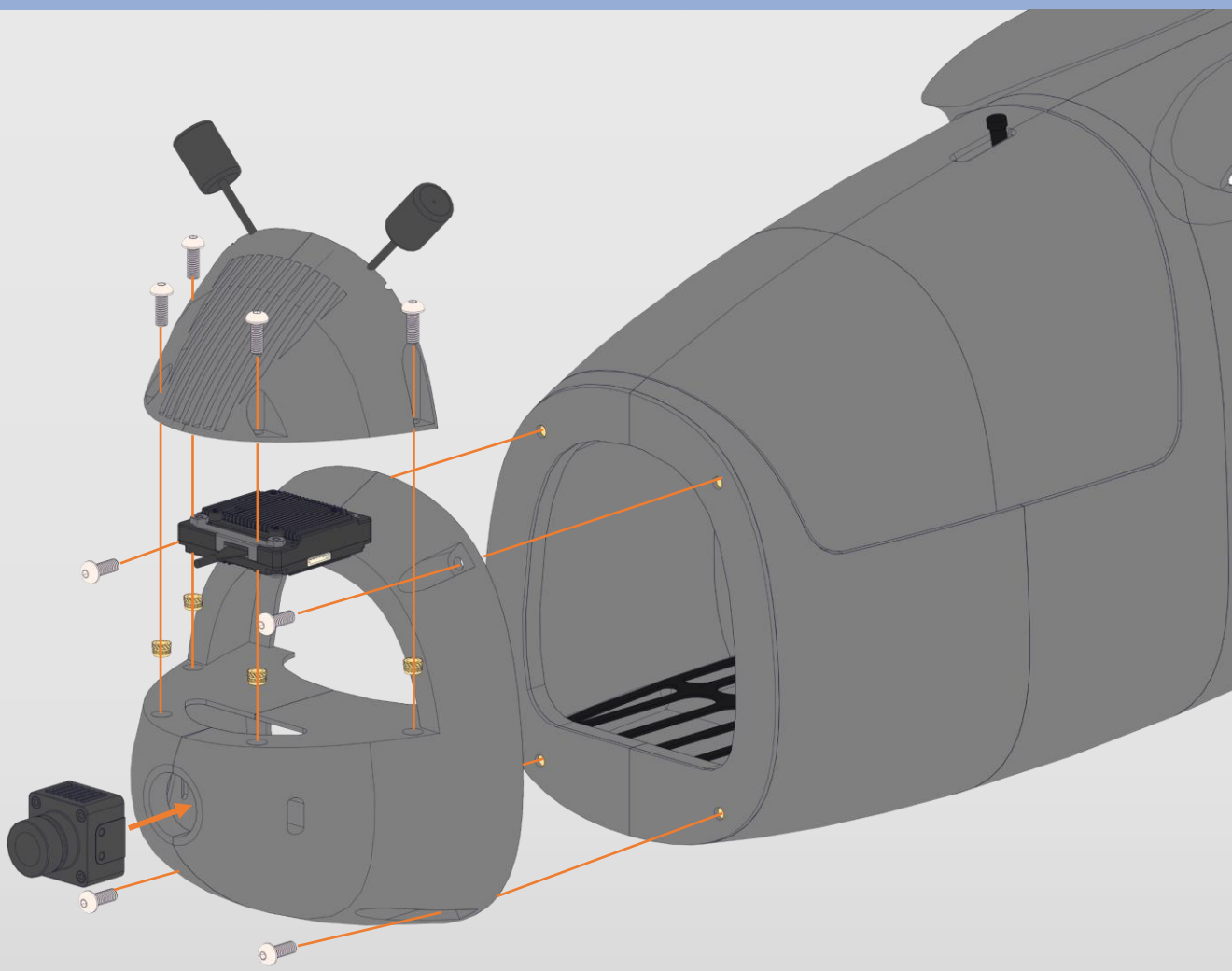


Motor Mount



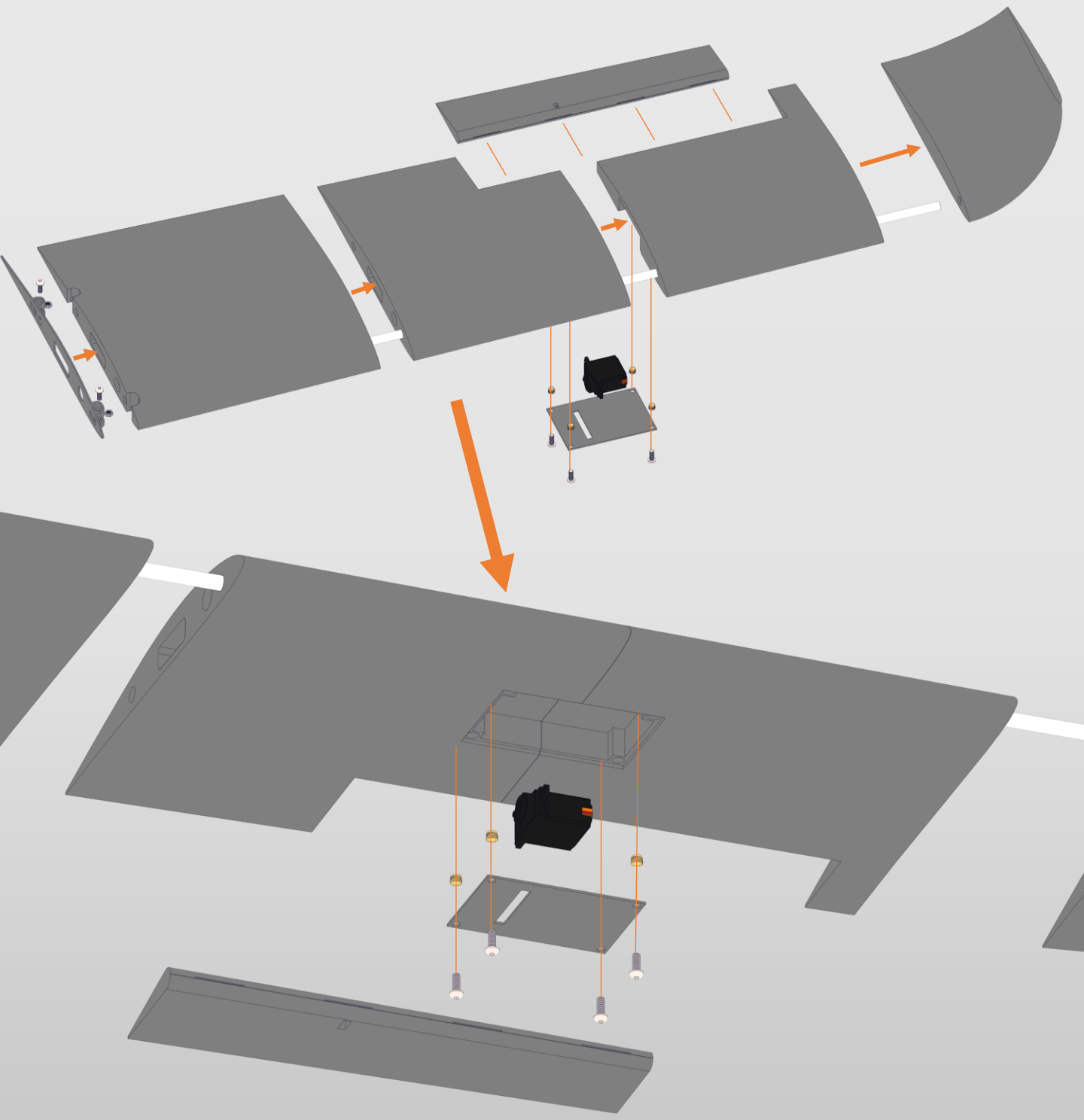
You can now install the motor. Prepare the motor mount printed from PETG. It is designed for the recommended T-Motor F90 motor or another with the same screw spacing. The motor is attached to the fuselage from the outside using M3 screw. To begin, secure the M3 threaded insert using a slightly heated soldering iron. Then, screw the motor to the mount and slide it into the fuselage. The motor is practically level with the wing, and the designed slight tilt, combined with the correctly positioned center of gravity, is appropriate.
However, if you feel the need for adjustment, you can slightly increase the motor's tilt by inserting thin washers under the lower screws, adding approximately one degree of tilt. Route the motor cables through the opening designed in the fuselage, slightly below. If you feel that the motor is not holding securely enough, you can optionally attach the motor mount to the fuselage with a small amount of hot glue. This is optional, but if you have any doubts, you can do it

Nose mount



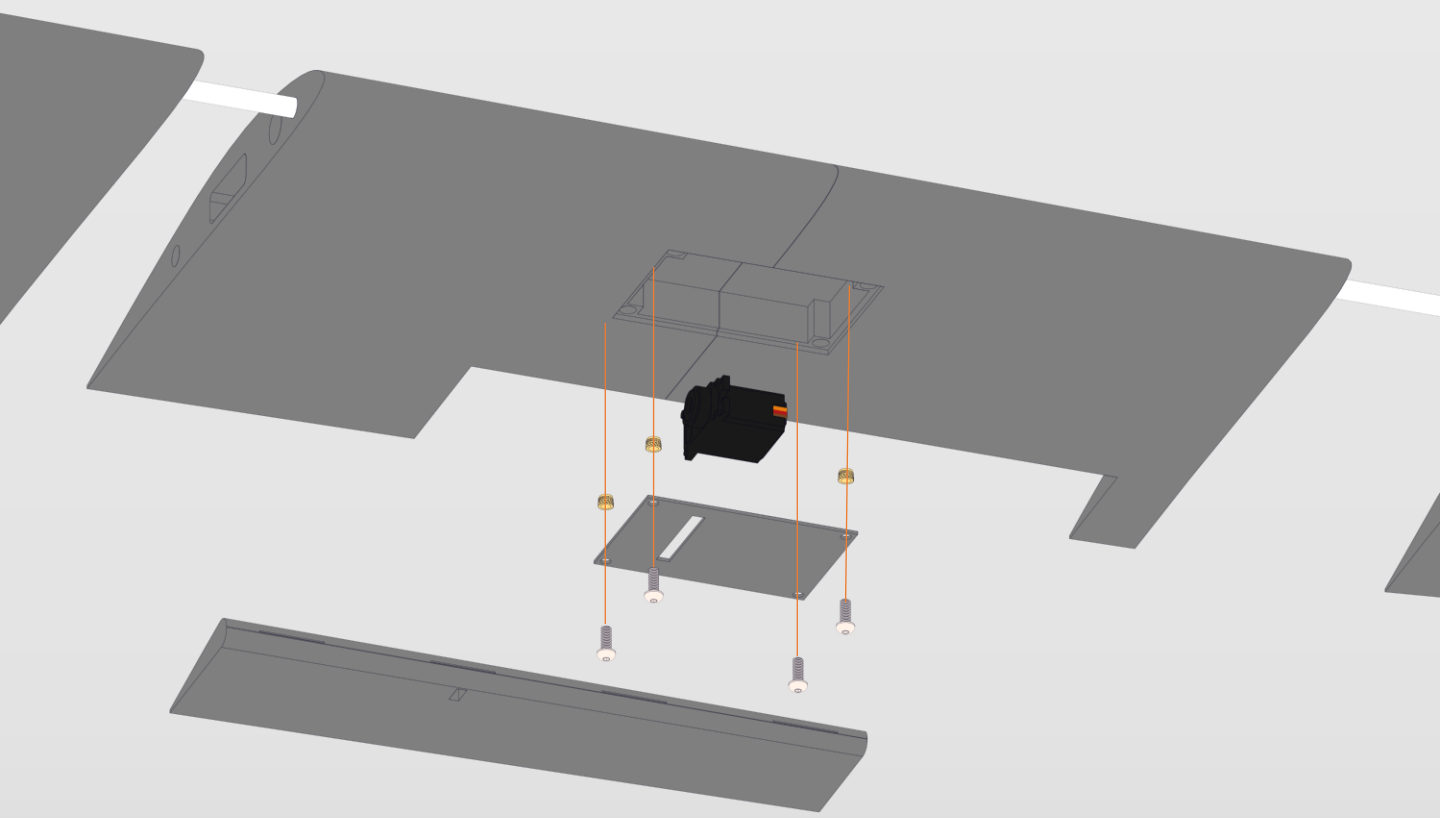
Now you can mount the nose with short M3 screws. If you are using version with VTX, you can put your VTX on the "shelf" and cover it with NOSE VTX COVER and secure the antenna.

Wings assembly



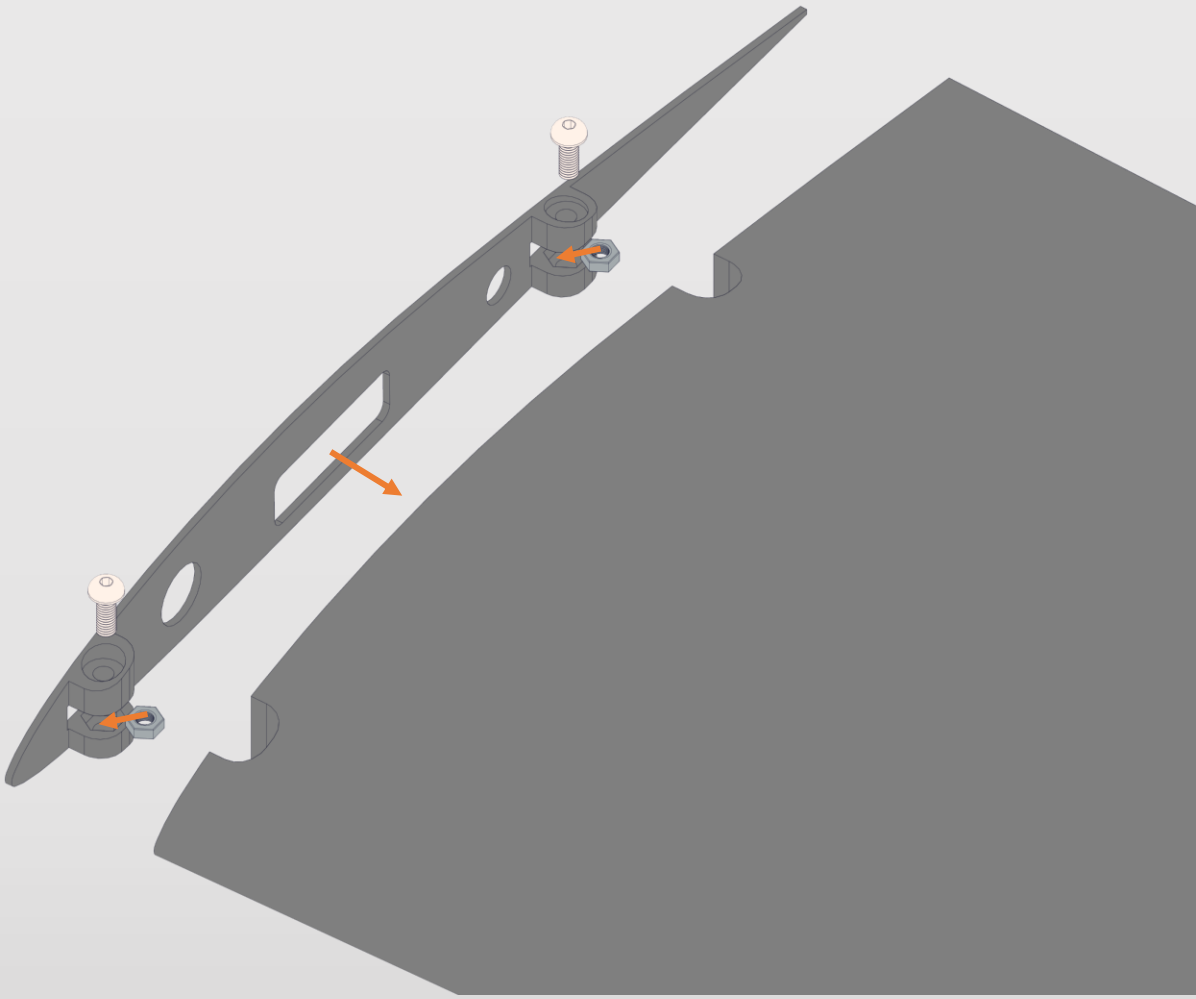
Glue the wing segments together. Insert a 6mm carbon tube cut to a length of 500mm. There is no need to glue the tube, just insert it into the designed slot

Wings assembly



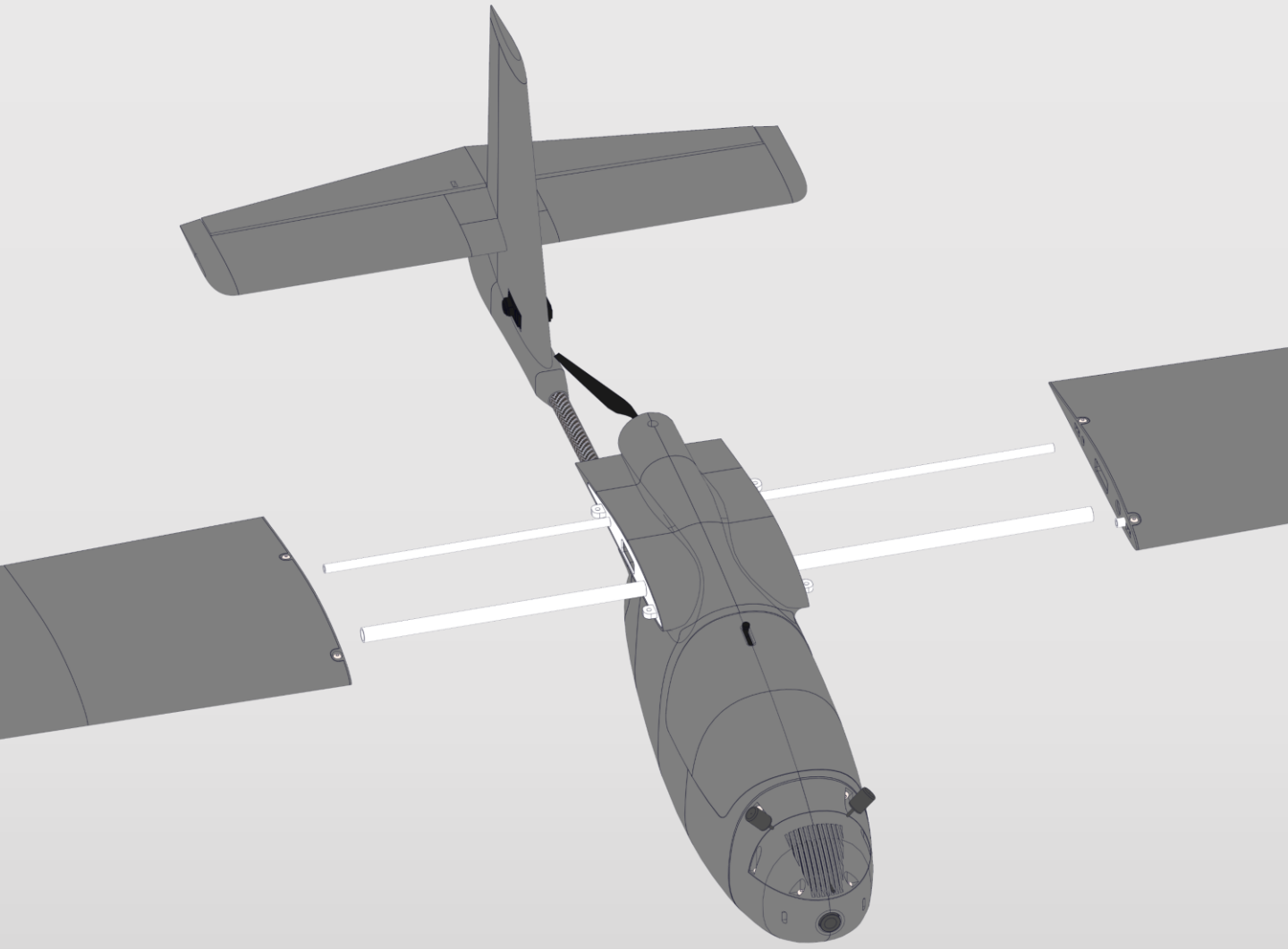
Insert the aileron using 20x30mm polyester hinges or ones made from another material, similar to the elevator. Then, using a slightly heated soldering iron, attach M3 threaded inserts designed for servo cover mounting. Set the servo so that the control horn protrudes through the opening in the servo cover, glue it in place using hot glue, and cover it. Then, connect the servo to the aileron using a pushrod, similar to the elevator.
Note: when gluing the aileron control horn, one of the hinges may be obstructive. You can simply pierce that hinge with a knife when securing the control horn or skip one of the hinges

Wings assembly



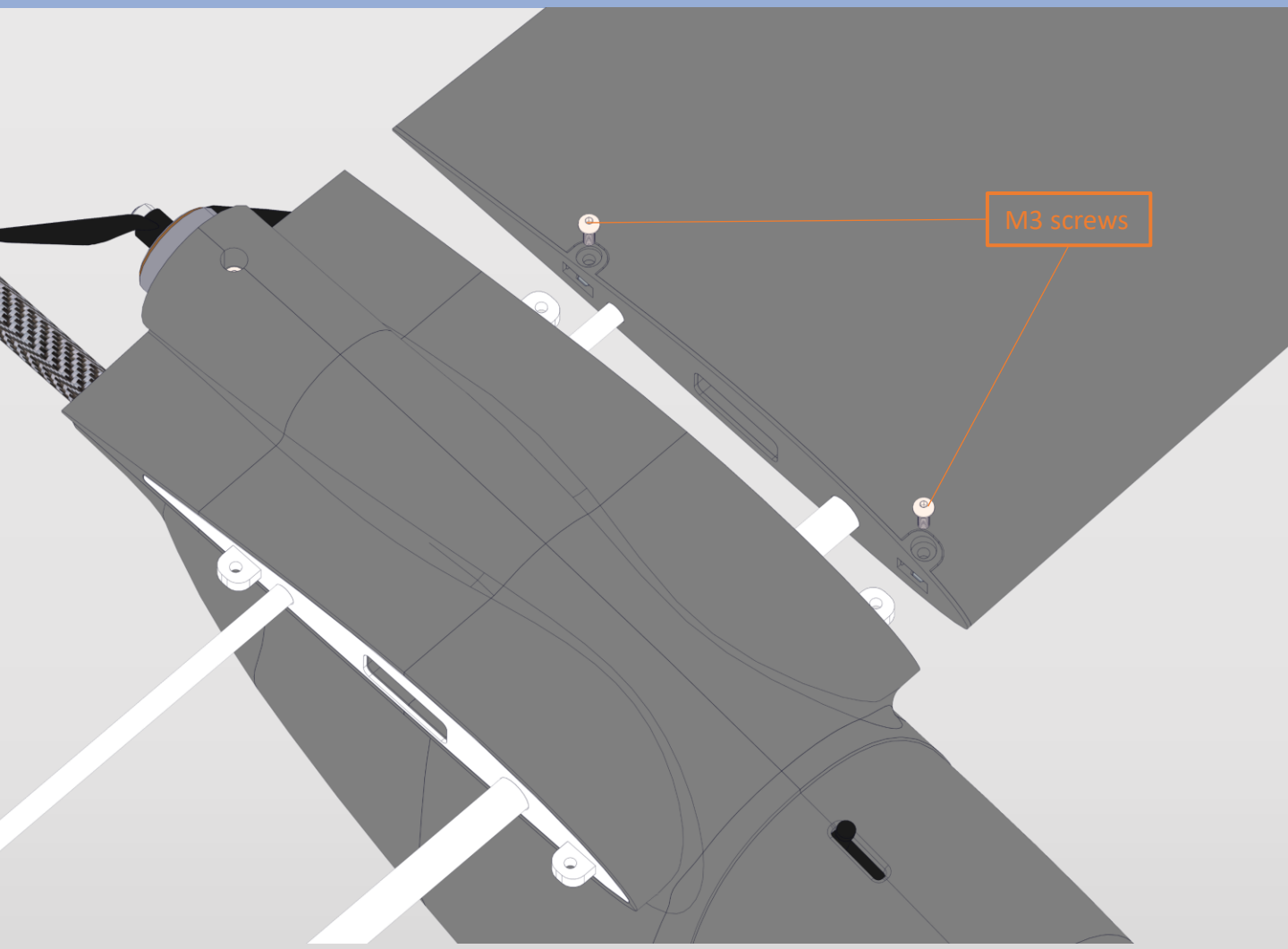
Finally, install the WING ROOT printed from PETG or another rigid material. In the lower part, there are designed slots for regular M3 nuts, which will be responsible for attaching the wings to the fuselage. Insert them there and secure using a few drops of CA glue.
Then, glue the root to the wing.

Wings assembly



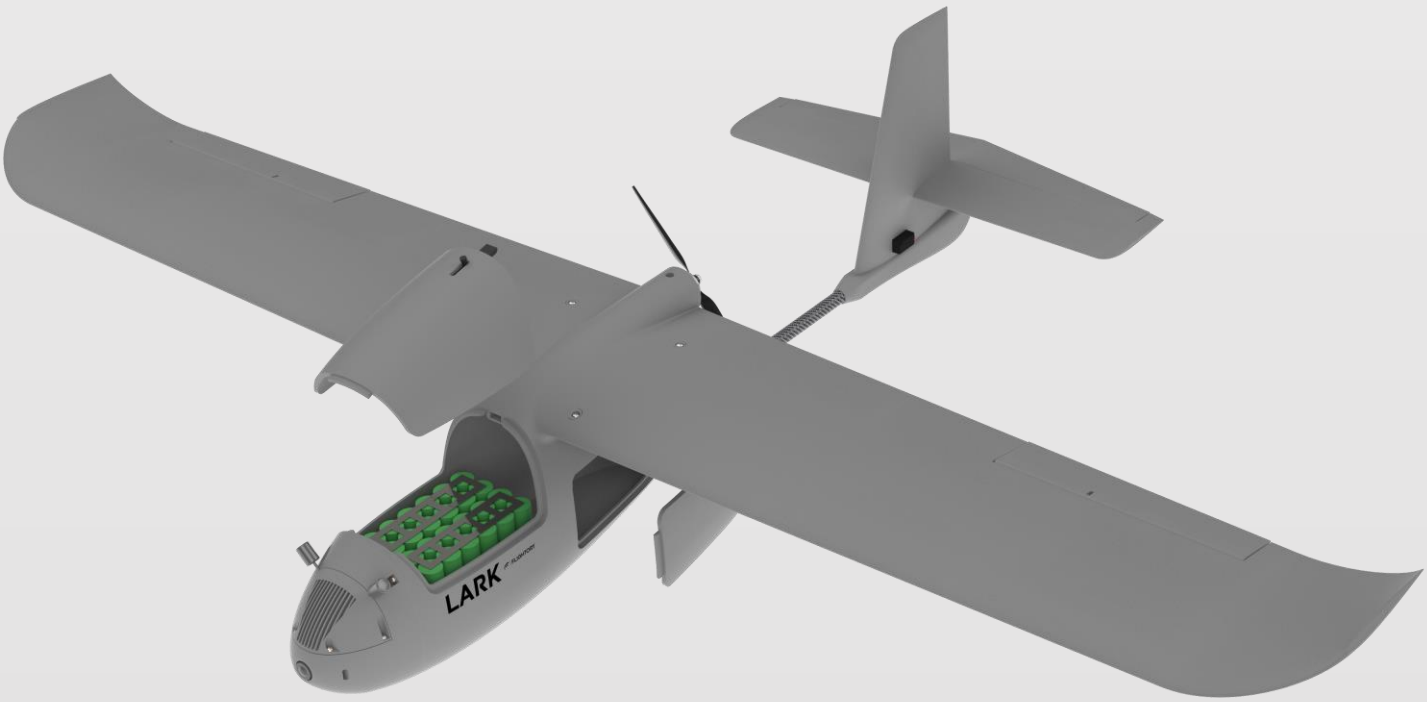
Now, insert carbon tubes with diameters of 10 and 6mm, cut to a length of 500mm. These are the main wing spars. Slide the wings in and push them against the fuselage. Thread the servo cables through the designed channels and lead them into the fuselage.

Wings assembly



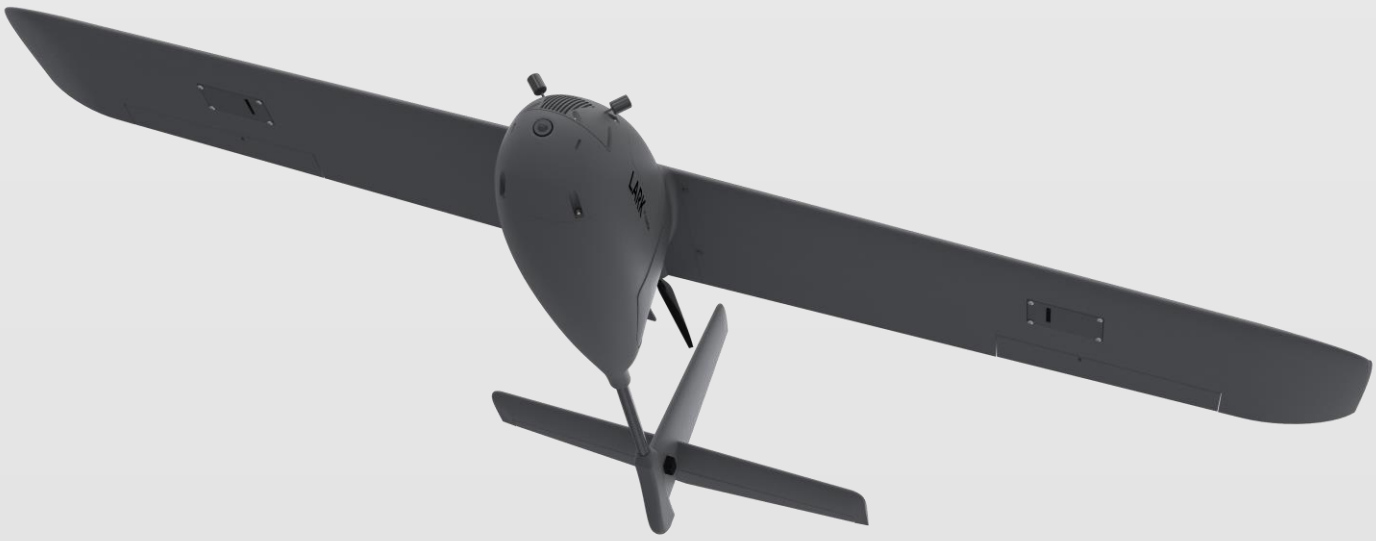
The wing assembly is simple and quick. After pushing the wings against the fuselage, screw in two M3 screws into the designated places. The screws are anchored in PETG-printed material, making the system durable and resistant to repeated wing disassembly

Finishing build



Finally, arrange the rest of the equipment. The battery pad can accommodate a large pack, even a 4S6P Li-Ion battery. In this configuration, the flight time can be maximized. Of course, you can use a smaller pack or Li-Po batteries as well. Additionally, the applied motor configuration is efficient enough that stable flight can be achieved at around 30% throttle or even less. For this reason, the aircraft can be successfully used with 3S batteries. The choice is yours, depending on your preferences. Access to the fuselage section under the wing is provided through the side hatch. There, you can easily fit the flight controller, ESC, receiver, and GPS. If you want to mount the GPS externally, for example on the top of the fuselage, you can manually cut a small hole or slightly modify the provided element in the STEP format.

Before flight



The model is ready to fly. Before flying, take care of the correct balance, which is 66mm from the leading edge. Check the correct operation of the ailerons and rudders and the direction of propeller rotation. The takeoff is done by hand throw. Grab the fuselage under the wings and throw it in a confident motion at a slight angle of attack. Good luck with your flights!

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