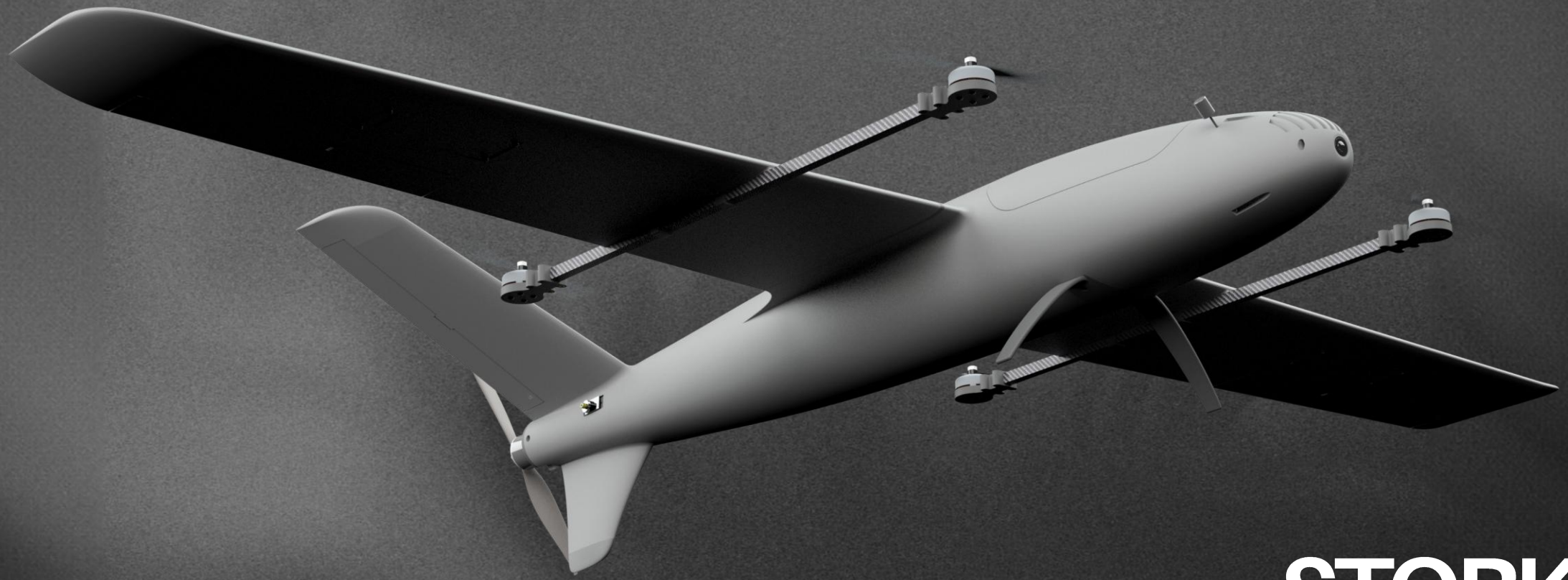
FLIGHTORY



STORK VTOL

USER MANUAL

V.2

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

Join our Discord server, where the discussions are organized by topics, and the interaction between users is lively.
https://discord.gg/GPMgDZ3Cxv

Follow us on Instagram for regular updates and fresh content
www.instagram.com/flightory_

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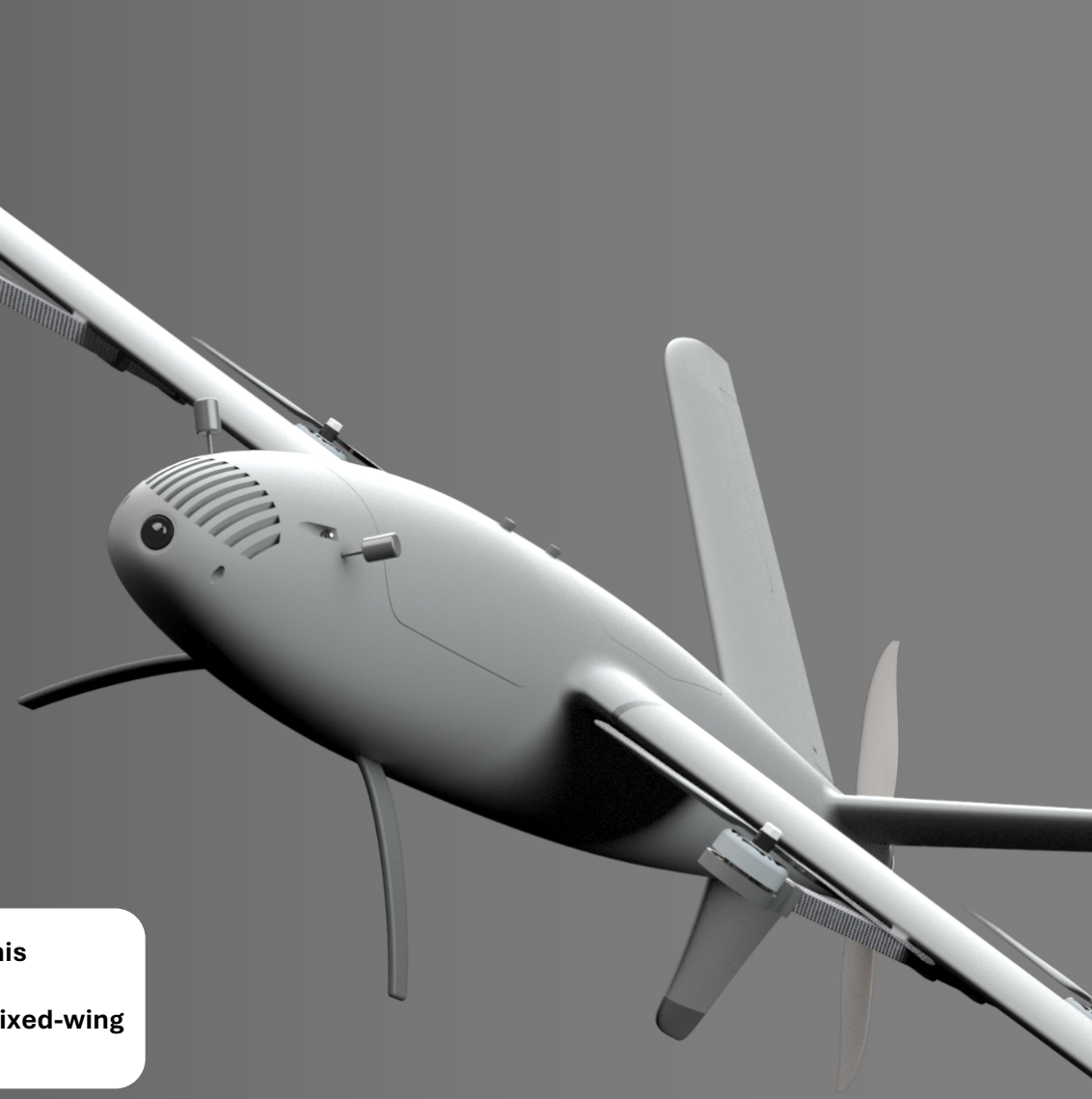
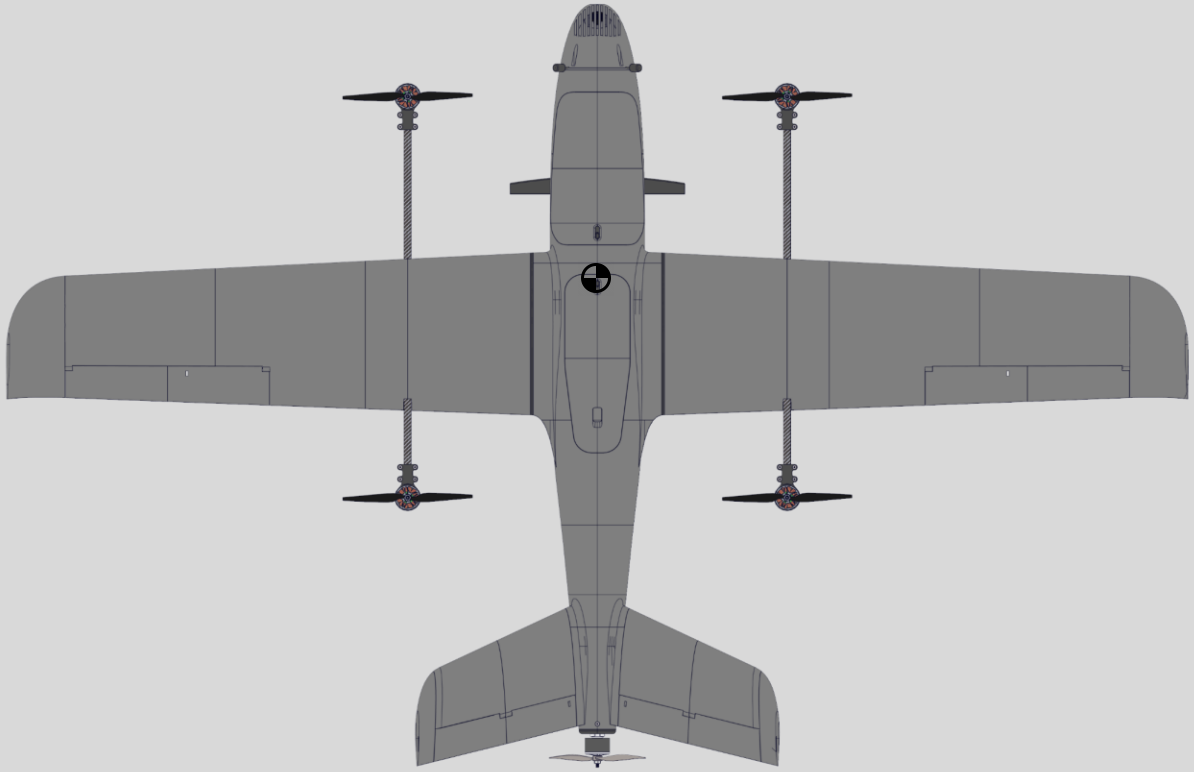
STORK VTOL



The VTOL Pack converts the Stork platform into a 4+1 quadplane configuration, enabling vertical takeoff and landing while preserving the efficiency of fixed-wing flight. Four lift motors mounted on lightweight carbon tube arms work alongside the existing pusher motor. The design integrates seamlessly with the original airframe, maintaining the wing geometry and overall flight characteristics of the fixed-wing version. Dedicated landing skids are introduced to support vertical operations, representing the only modification to the fuselage. This expansion significantly increases operational flexibility, enabling deployment in confined areas without runway access and making the platform well-suited for missions in complex or remote environments.

Building the aircraft in the VTOL configuration requires the base fixed-wing version. This documentation covers only the additional aspects related to the VTOL conversion.
For complete information about the design and detailed instructions for building the fixed-wing version, refer to the base manual.

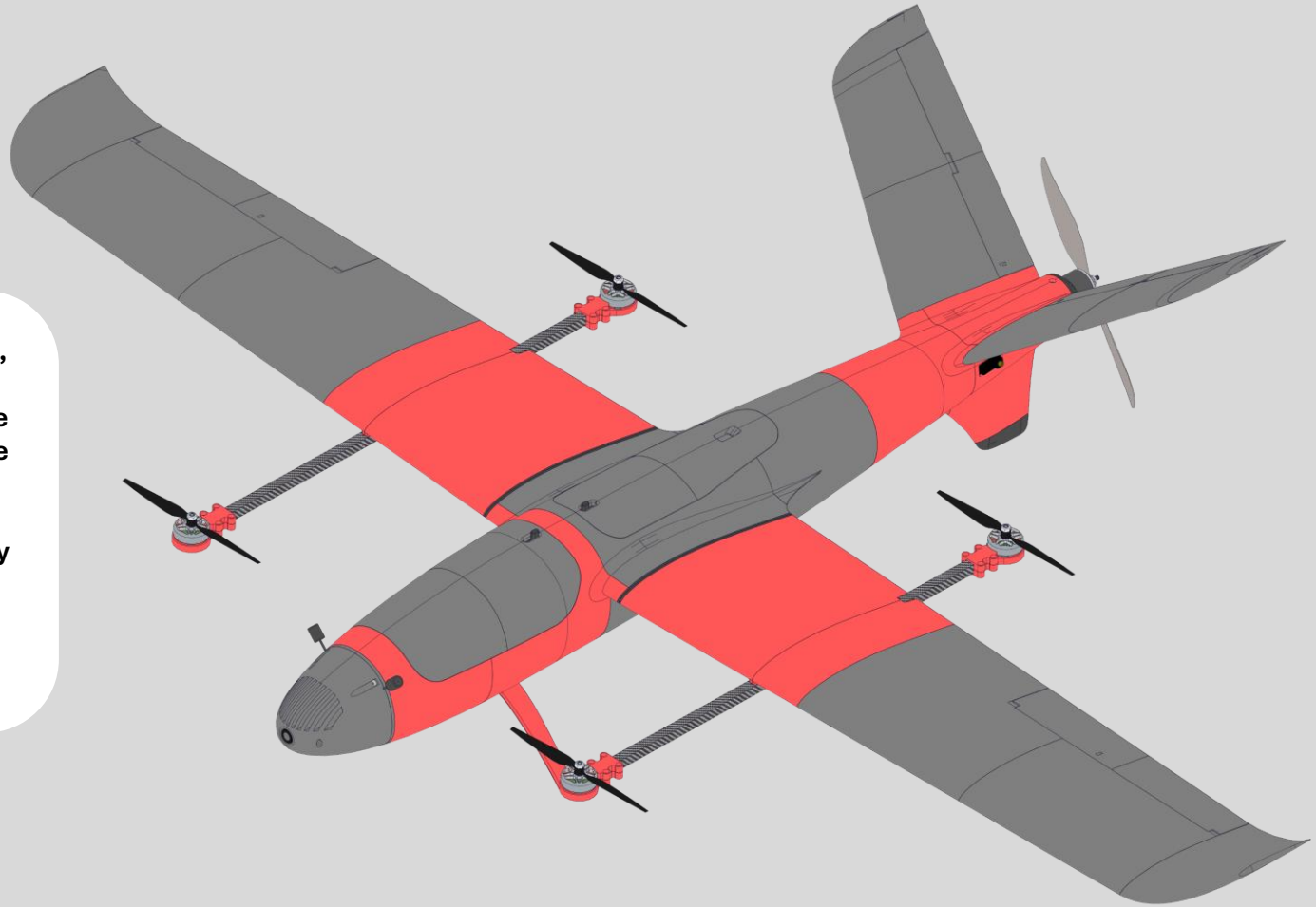
GENERAL AIRCRAFT DATA

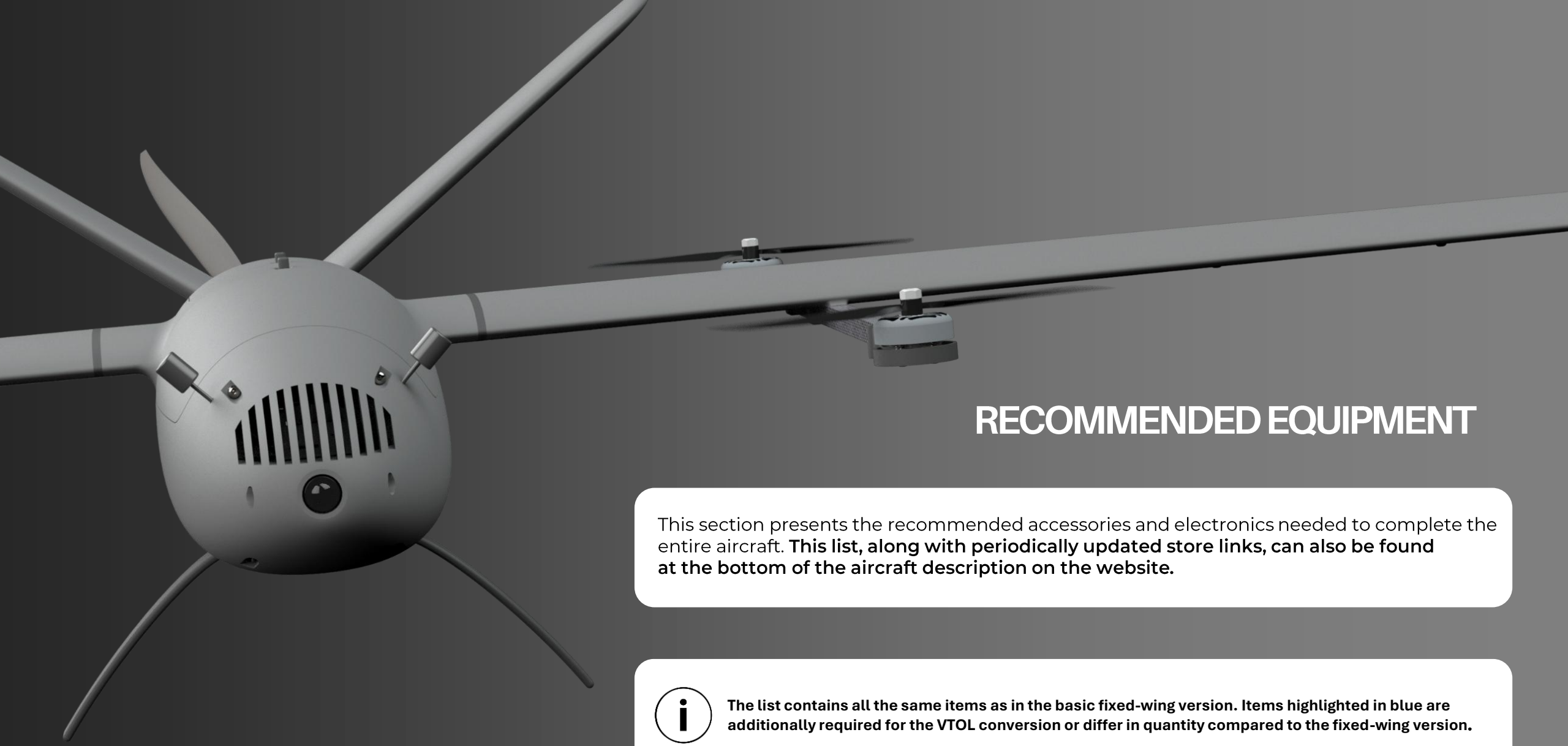


Wingspan	1620mm
Wing area	31 dm^2
Lenght	1000mm
Center of Gravity	47mm from leading edge (at wing root)
AUW	1400-3100g
Optimal Cruise Speed	50-70 km/h
Airfoil	S3021
Root Chord	230mm
MAC	195mm
Aspect Ratio	8,3
Wing load	45 - 100 g / dm^2

VTOL CONVERSION OVERVIEW

The VTOL configuration requires a set of additional printed components, along with the replacement of selected parts from the base fixed-wing version. Elements included in the VTOL Pack are highlighted in red in the diagram. The first wing segment is replaced with a redesigned two-piece structure that provides a mounting interface for the lift motor arms. Selected fuselage segments can also be replaced to integrate landing skids; however, this modification is optional. The standard fuselage may be retained, allowing for conventional belly landings. Despite these modifications, the overall geometry of the aircraft remains unchanged, preserving the original flight characteristics of the platform.





RECOMMENDED EQUIPMENT

This section presents the recommended accessories and electronics needed to complete the entire aircraft. **This list, along with periodically updated store links, can also be found at the bottom of the aircraft description on the website.**

The list contains all the same items as in the basic fixed-wing version. Items highlighted in blue are additionally required for the VTOL conversion or differ in quantity compared to the fixed-wing version.

RECOMMENDED ELECTRONICS

COMPONENT	MODEL / SPECIFICATION
Motors VTOL / Motor Pusher	T-Motor F90 1300 KV / 28XX Motor e.g. BrotherHobby Avenger 2812 V5 910KV
Propellers VTOL / Propeller Pusher	7 inch Propeller / 9-10 inch Propeller
Flight Controller	Speedybee F405 Wing or any other Mavlink FC
GPS	Matek M10Q or similar GPS with compass
Servos	4x EMAX ES08 MAII Metal Gear or similar
ESCs	4in1 ESC e.g. Velox V50A + Separate ESC e.g. Lumenier 51A BLHeli32
Battery	4S-6S Li-Ion / Li-Po
Receiver	Matek R24-D ELRS or similar
FPV Camera + VTX	Walksnail Avatar or any Digital or Analog VTX
FPV Goggles	Walksnail Goggles X or any other matching the chosen VTX

RECOMMENDED ACCESSORIES

ITEM	QUANTITY
10x1000mm Carbon Tube	2
8x1000mm Carbon Tube	1
6x500mm Carbon Tube (WING SPAR)	2
3x500mm Carbon Tube (AILERON HINGE)	2
8x155mm Carbon Tube (V TAIL SPAR)	2
6x265mm Carbon Tube(V TAIL SPAR)	2
3x265mm Carbon Tube (RUDDER HINGE)	2
10x10x500mm Square Carbon Tube (BOOMS)	2
4x95mm Carbon Tube (FIN REINFORCEMENT)	1
Thick CA Glue	1-2 Tubes
CA Activator	1
M3 Threaded Insert (Outer Ø5mm, height 5mm)	35

ITEM	QUANTITY
Hot Glue (optional)	Small amount
Epoxy Glue (optional)	Small amount
LW-PLA / LW-ASA	1 roll
PC / PETG / other rigid material	Small amount
Velcro Strap	2
Servo Extension Cable	4
Control Horn	4
Pushrod	4
M3x6mm Screw	12
M3x10mm Screw	7
M3x8mm Screw	20

RECOMMENDED ACCESSORIES

When selecting square-profile tubes for the booms, it is strongly recommended to choose ones with a circular inner profile, if available. Avoid using the thinnest tubes with a fully square cross-section, particularly those with wall thicknesses of 1 mm or less.

POWERTRAIN SELECTION

There are multiple options for selecting the powertrain configuration, including the motor, propeller, and battery. Recommended motors are in the 28XX class, with propellers ranging from 9 to 10 inches, and batteries rated from 4S to 6S. The motor mount is available in two variants with bolt spacing of 19×19 mm and 16×19 mm, which corresponds to most motors in this class on the market. This component is also provided in STEP format for easy modification if a different bolt pattern is required.

EXAMPLE MOTOR AND PROP SETUP

A suggested motor for this aircraft is the BrotherHobby Avenger 2812 V5 910KV, which performs optimally with 9453 tri-blade or two-blade propellers and a 6S battery. According to the manufacturer's specifications, this setup delivers up to approximately 3800 g of thrust per motor at a maximum power of 1280W with a current draw of around 50A. This requires using an ESC rated at 60A (6S capable).
This setup fully utilizes the motor's performance potential and offers maximum available thrust for demanding applications.

It is worth noting that in recent years, brushless motor technology has significantly improved. Modern motors in the 28XX class are capable of delivering over 1200W of power and exceptionally high thrust, which was not achievable with this motor size just a few years ago. This is a result of advancements in materials, winding efficiency, cooling design, and overall manufacturing quality.

As a result, the market trend has shifted towards motors optimized for higher voltage systems, particularly 6S setups, which now dominate availability in this size class. However, this does not limit the possibility of operating these motors effectively on 4S systems, depending on user preferences and mission requirements.

POWERTRAIN SELECTION

FLEXIBLE OPERATION WITH 4S

While the 6S configuration allows the motors to deliver maximum thrust and performance, the same setup can be operated very effectively with a 4S battery, offering a more efficient and lighter alternative without compromising flight capabilities. In this case, it is recommended to use a slightly larger propeller, such as a 10x6 two-blade, to compensate for the lower RPM resulting from the reduced voltage. This results in proportionally lower motor speed and a significantly reduced current draw, which allows for the use of smaller and lighter ESCs rated at 35–40A for 4S. At the same time, the overall system weight decreases, providing the option to use larger capacity 4S batteries. Despite the lower voltage, the total thrust generated by motor remains around 2000 grams, which is fully sufficient for this aircraft's design and operational requirements.

Prototype testing confirmed that during cruise flight with a 4S battery and 10x6 propellers, the required throttle setting was below 50%, demonstrating efficient power utilization and good endurance potential.

The main reason for choosing 4S operation is the current state of the market, which is heavily saturated with high-performance motors optimized for 6S in this size class. Finding lighter motors designed specifically for 4S that could match or exceed this performance is challenging. For this reason, using a motor like the BrotherHobby 2812 V5 910KV, even when operating on 4S remains a practical and efficient solution. Although this setup does not fully utilize the maximum power capabilities of the motor, it offers several important advantages, including improved efficiency during cruise flight, a lower total system weight, the use of smaller and more cost-efficient ESCs, and the ability to select 4S batteries with higher capacity while maintaining similar weight compared to smaller 6S packs.

This flexible approach allows users to tailor the system to their needs. Whenever the mission demands higher thrust, greater payload, or higher airspeed, the same airframe can be seamlessly scaled by switching to 6S batteries and appropriate ESCs, immediately unlocking the full performance potential of the motors without requiring any changes to the mechanical setup.

POWERTRAIN SELECTION

VTOL LIFT MOTOR CONFIGURATION

The selection of lift motors follows a similar approach to the pusher motor system, balancing thrust, efficiency, and system weight depending on the chosen power setup. The recommended configuration uses T-Motor F90 1300KV motors paired with 7-inch two-blade propellers.

The motor mounts use a 19×19 mm bolt pattern, which is compatible with many motors in this size class. This allows alternative motors to be used without requiring changes to the mechanical design, provided similar specifications are maintained.

The system was primarily tested on a 4S power setup, where it provides stable and efficient hover performance with sufficient thrust for safe vertical takeoff and landing. At the same time, the same hardware can be operated on higher voltage systems up to 6S, following the same principle as described for the pusher motor. This allows to increase available thrust when required, without any modifications.

PRINT SETTINGS

PRINT SETTINGS

This aircraft is designed with optimization for LW-PLA / LW-ASA filaments, reinforced with additional components printed from PC, PETG, or other rigid materials. All parts are designed to fit within a print volume of 220x220x220 mm. The entire design is tailored for printers equipped with 0.4 mm nozzles.

GENERAL GUIDLINES

- All airframe components should be printed using lightweight filaments (LW-PLA, LW-ASA) with single-wall construction.

- Fuselage sections: Recommended to print with gyroid infill between 3% and 6%.

- Wings: Use Lateral Lattice infill, or optionally Cubic Subdivision, with an infill density between 2% and 4%.This approach ensures an optimal balance between strength and low weight while allowing flexibility for tuning print settings.

- For reinforcement parts that require higher strength, it is essential to use rigid and durable materials such as PETG, PC, ABS, or others . These components should be printed using the default print settings for the selected material and the standard strength profiles available in your slicer, ensuring reliable performance without the need for extra configurations.

SUPPORTS AND WALL SETTINGS

- All airframe parts are designed to be printed without supports and with a single wall. (This applies to LW components; reinforcement parts can have a higher wall count.) Some files include pre-designed supports, which is indicated in the file name.

- Some components may benefit from adding supports touching the build plate, or increased wall count for improved strength in specific areas. These exceptions are clearly marked and explained in the *Parts Orientation* section of this manual.

PRINT SETTINGS

PART LIST AND MATERIAL ASSIGNMENT

- The **PART LIST** section contains a complete list of all files required for assembly.

- Each file is accompanied by a clear recommendation regarding: The type of material it should be printed with (e.g. LW-PLA, LW-ASA, PETG, PC, etc.).

PRINT SETTINGS AND PROFILES

- Complete print settings, including filament breakdown and settings for Active Foaming and Prefoamed filaments, are available on our website under the **“PRINT SETTINGS”** tab.

- You will find: Pre-configured profiles for PLA Aero and ASA Aero for Bambulab printers - ready to use out of the box and general configuration templates for Active Foaming and Prefoamed LW-PLA for Cura, providing a reliable starting point for further tuning.

- Currently, we primarily focus on testing and validating settings in Orca Slicer, Bambu Studio and Cura.

PRINTING VARIABLES AND TUNING

Printing results may vary depending on several factors, such as the printer model, filament brand, filament moisture levels, ambient conditions like temperature and humidity, as well as whether the printer is equipped with an enclosed chamber. These variables can influence print quality, strength, and weight. Because of this, achieving optimal results often requires fine-tuning key parameters, particularly printing temperature, flow rate, and retraction settings. In most cases, only minor adjustments are necessary to reach excellent quality. It is strongly recommended to perform test prints when changing filaments, switching printers, or printing in different environmental conditions, in order to refine the settings for the best possible outcome.

PRINT SETTINGS

FINAL NOTES

Achieving optimal results is feasible on the majority of modern 3D printers, provided that appropriate calibration and parameter tuning are performed. Variability in printer hardware, filament manufacturers, material properties, and operating conditions such as ambient temperature, humidity levels, and the presence or absence of an enclosed build chamber, can all have a measurable impact on print quality. As a result, full standardization of print settings across all equipment and environments is not possible.

The provided print profiles and configuration guidelines serve as a reliable baseline; however, minor adjustments to parameters such as temperature, flow rate, or retraction may be required to achieve the intended balance of strength, weight, and surface quality specific to each user's setup.

To facilitate consistency and knowledge sharing across different hardware configurations, an online user community is maintained via Discord. This platform serves as a technical resource where users can exchange verified print profiles, discuss material-specific settings, share build results, and troubleshoot technical challenges related to the printing process.

MOFIDIERS

USING FILES WITH MODIFIERS

The package includes several elements in STEP format, featuring additional solid volumes in critical areas such as the motor mounts, servo sections, the fuselage around the main landing skids, and the wing attachment points for the lift motor arms. These files can be imported directly into a slicer and used as modifier meshes by assigning the additional solids accordingly. This allows for localized adjustment of print settings, such as increasing the number of walls to 2–3 and the infill density to 5–10%, affecting only the overlapping regions of the model. This approach significantly reinforces high-load areas, particularly around the motor mounts. You can also create your own modifiers directly in the slicer or in any CAD software and plan additional reinforcements if needed for your specific use case. The included solutions are ready to use and are the recommended method for printing these components.

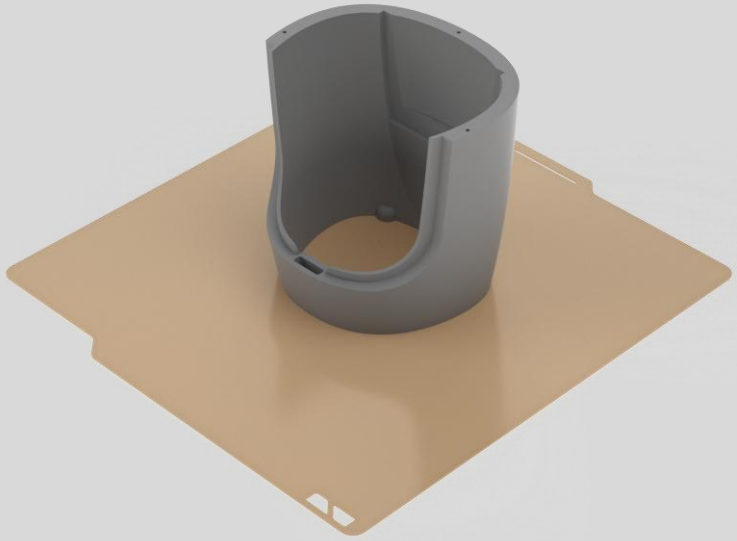
PARTS LIST - VTOL

PART	MATERIAL
FUS 1 VTOL	LW-PLA/ASA
FUS 2 VTOL	LW-PLA/ASA
FUS 5 VTOL	LW-PLA/ASA
FUS 6 VTOL	LW-PLA/ASA
WING 1.1 L / R VTOL	LW-PLA/ASA
WING 1.2 L / R VTOL	LW-PLA/ASA
MAIN SKIDS VTOL	PC

PART	MATERIAL
MOTOR MOUNT 1 VTOL (PRINT 4x)	PC
MOTOR MOUNT 2 VTOL (PRINT 4x)	PC
BOOM MOUNT 1 VTOL (PRINT 4x)	PC
BOOM MOUNT 2 VTOL (PRINT 4x)	PC
BATTERY PAD VTOL	PC / PETG
FIN TIP VTOL	PC / PETG / TPU
BOOM MOUNT GUIDE	PC / PETG / PLA

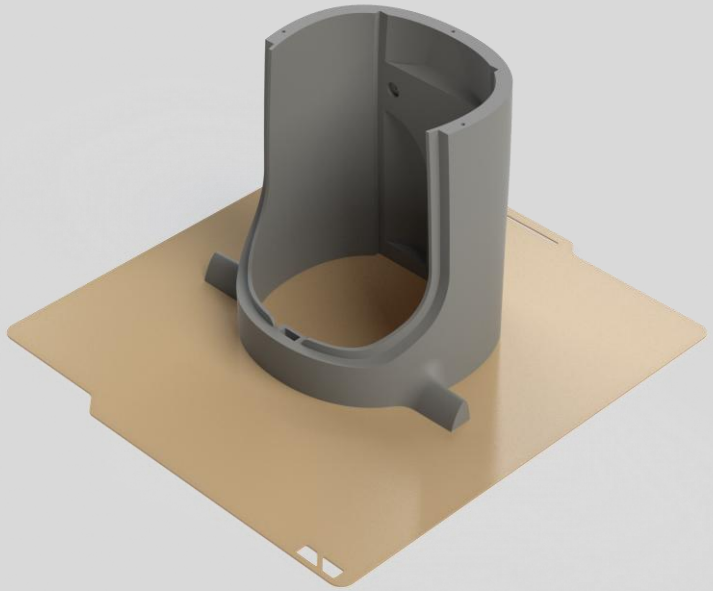
All files in VTOL PACK are available in STL and STEP format

PARTS ORIENTATION



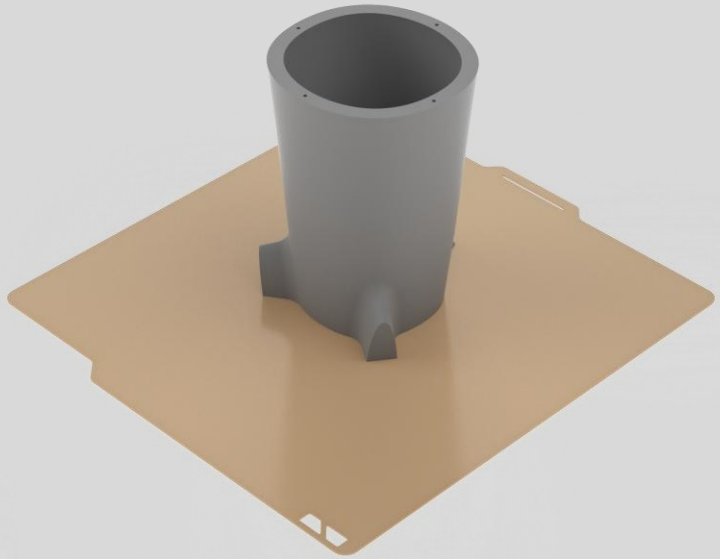
FUS1VTOL

3%-6% GYROID INFILL



FUS2VTOL

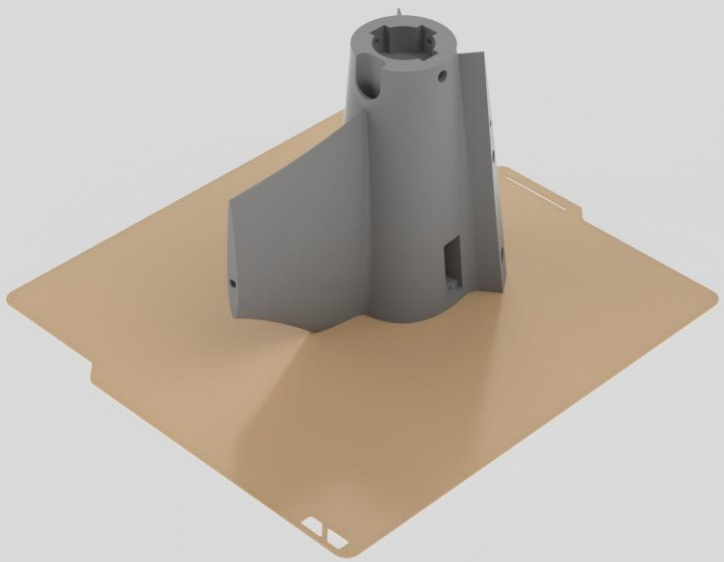
3%-6% GYROID INFILL



FUS5VTOL

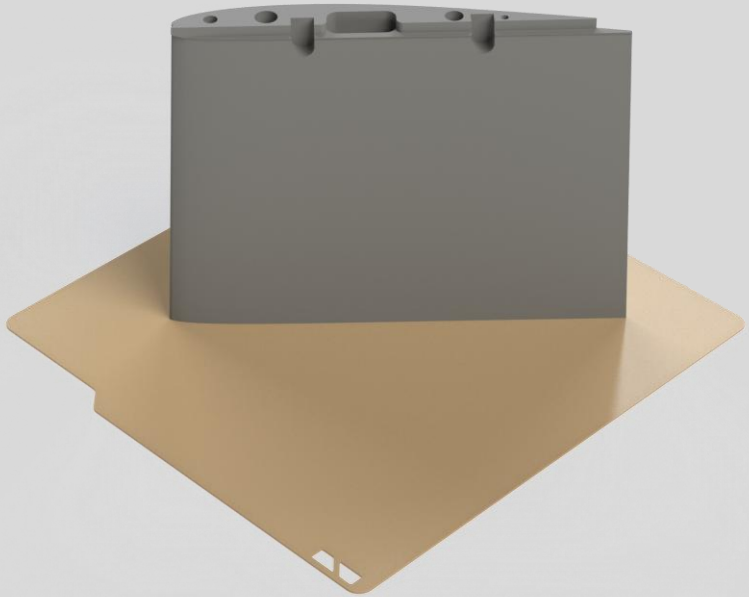
3%-6% GYROID INFILL

PARTS ORIENTATION



FUS 6 VTOL

3%-6% GYROID INFILL



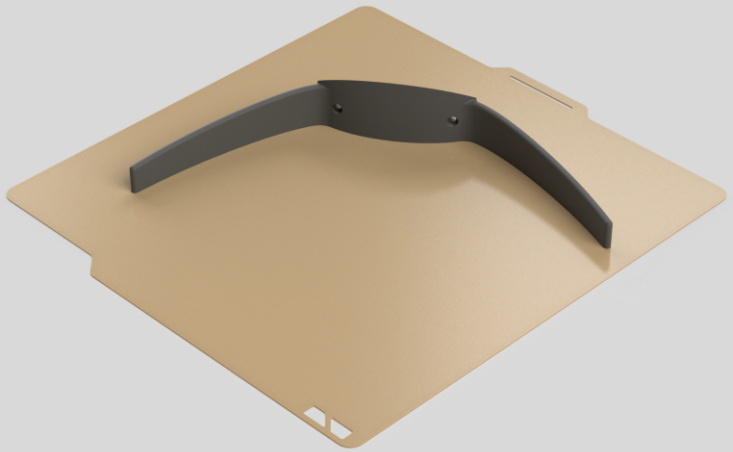
WING 1.1 L/R VTOL

3%-6% LATERAL LATTICE INFILL

WING 1.2 L/R VTOL

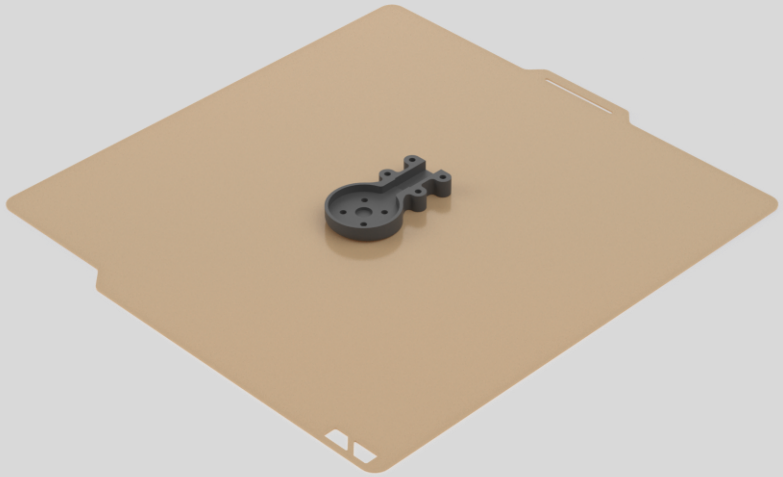
3%-6% LATERAL LATTICE INFILL

PARTS ORIENTATION



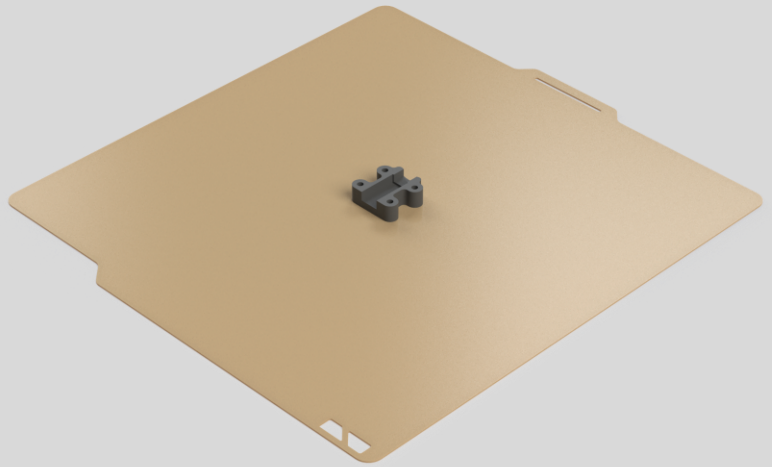
MAIN SKIDS VTOL

80%-100% GRID INFILL



MOTOR MOUNT 1 VTOL

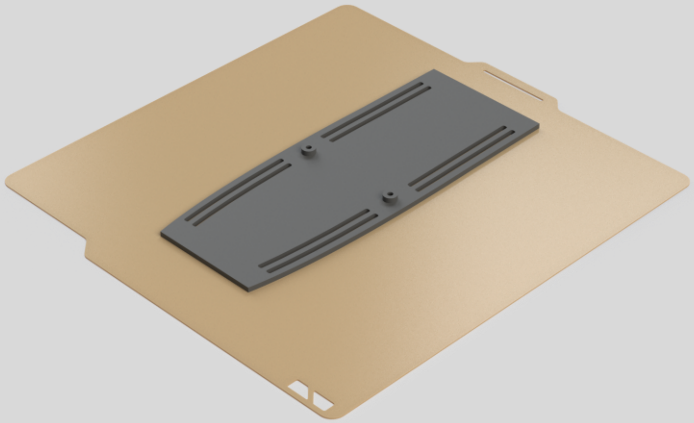
80%-100% GRID INFILL



MOTOR MOUNT 2 VTOL

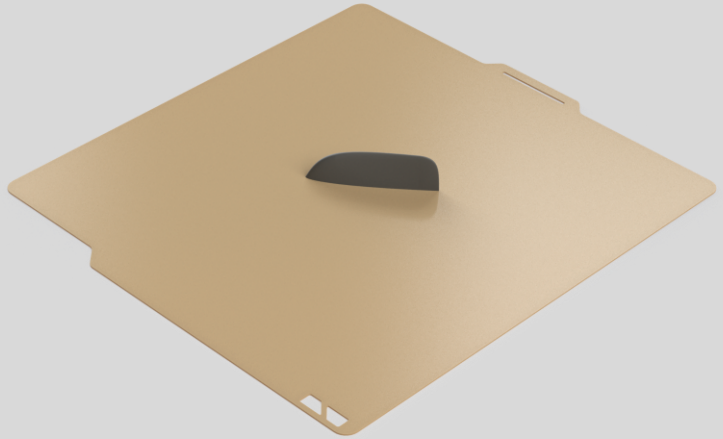
80%-100% GRID INFILL

PARTS ORIENTATION



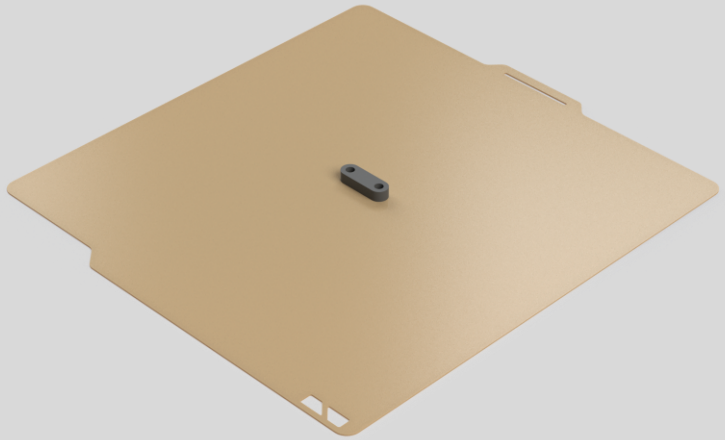
BATTERY PAD VTOL

20%-100% GRID INFILL



FIN TIP VTOL

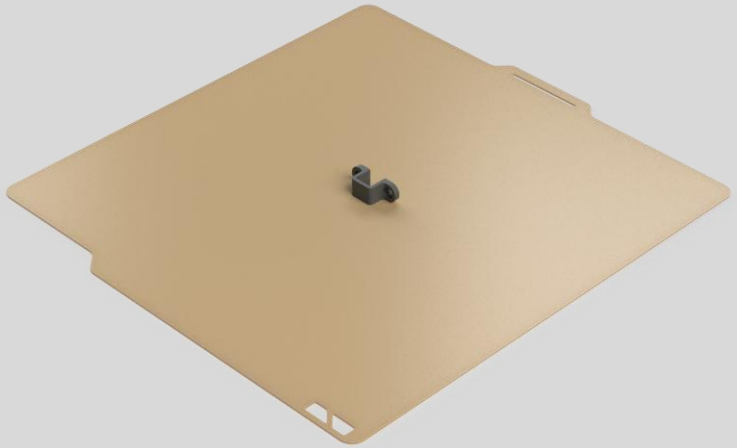
3%-10% GYROID INFILL



BOOM MOUNT1 VTOL

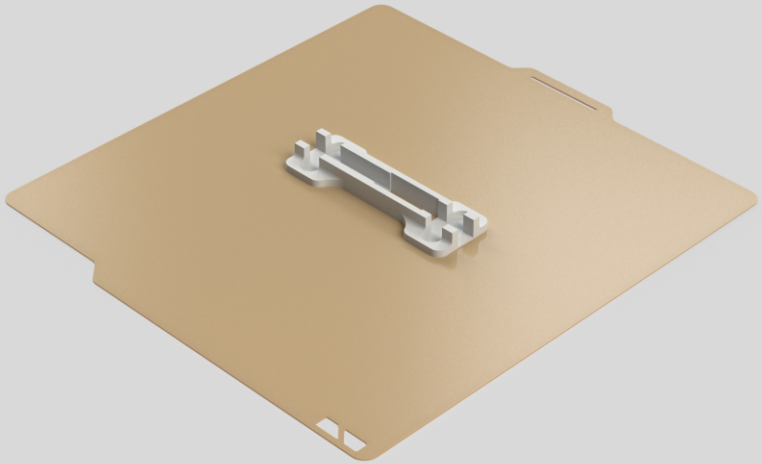
80%-100% GRID INFILL

PARTS ORIENTATION



BOOM MOUNT 2 VTOL

80%-100% GRID INFILL



BOOM MOUNT GUIDE

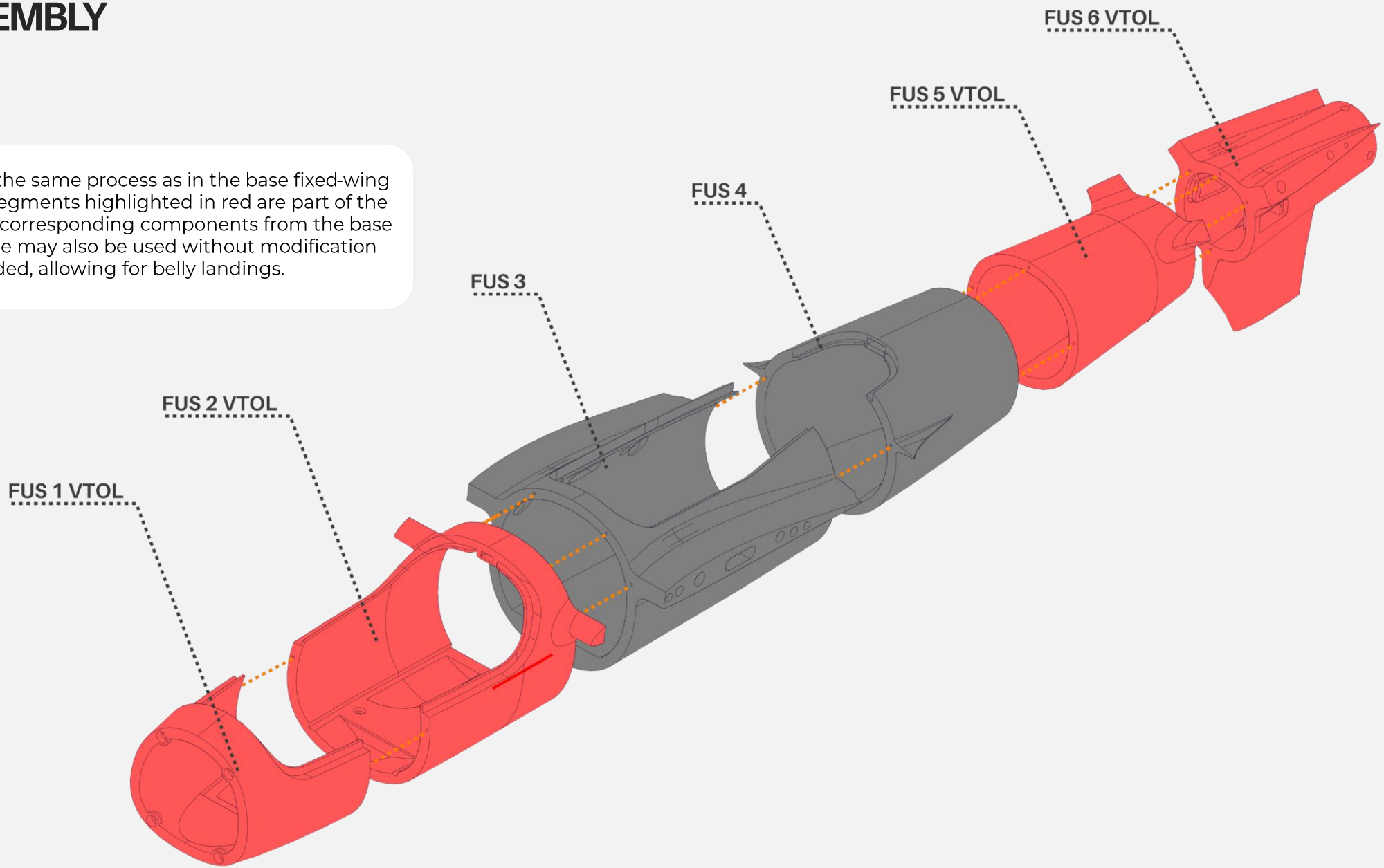
20%-100% GRID INFILL

ASSEMBLY GUIDE

FUSELAGE ASSEMBLY

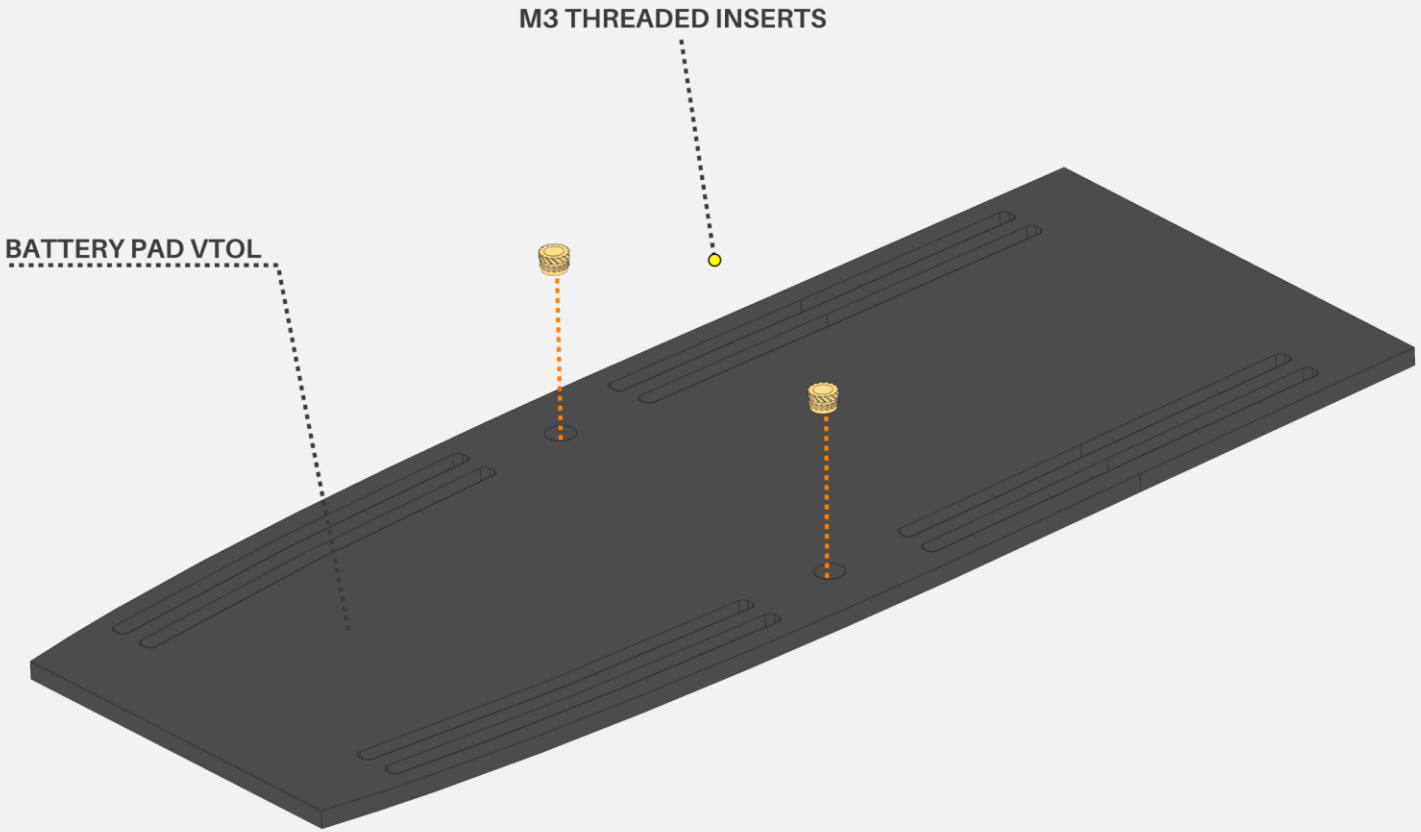
Fuselage assembly follows the same process as in the base fixed-wing version of the aircraft. The segments highlighted in red are part of the VTOL Pack and replace the corresponding components from the base version. The original fuselage may also be used without modification if landing skids are not needed, allowing for belly landings.

CA GLUE



FUSELAGE ASSEMBLY

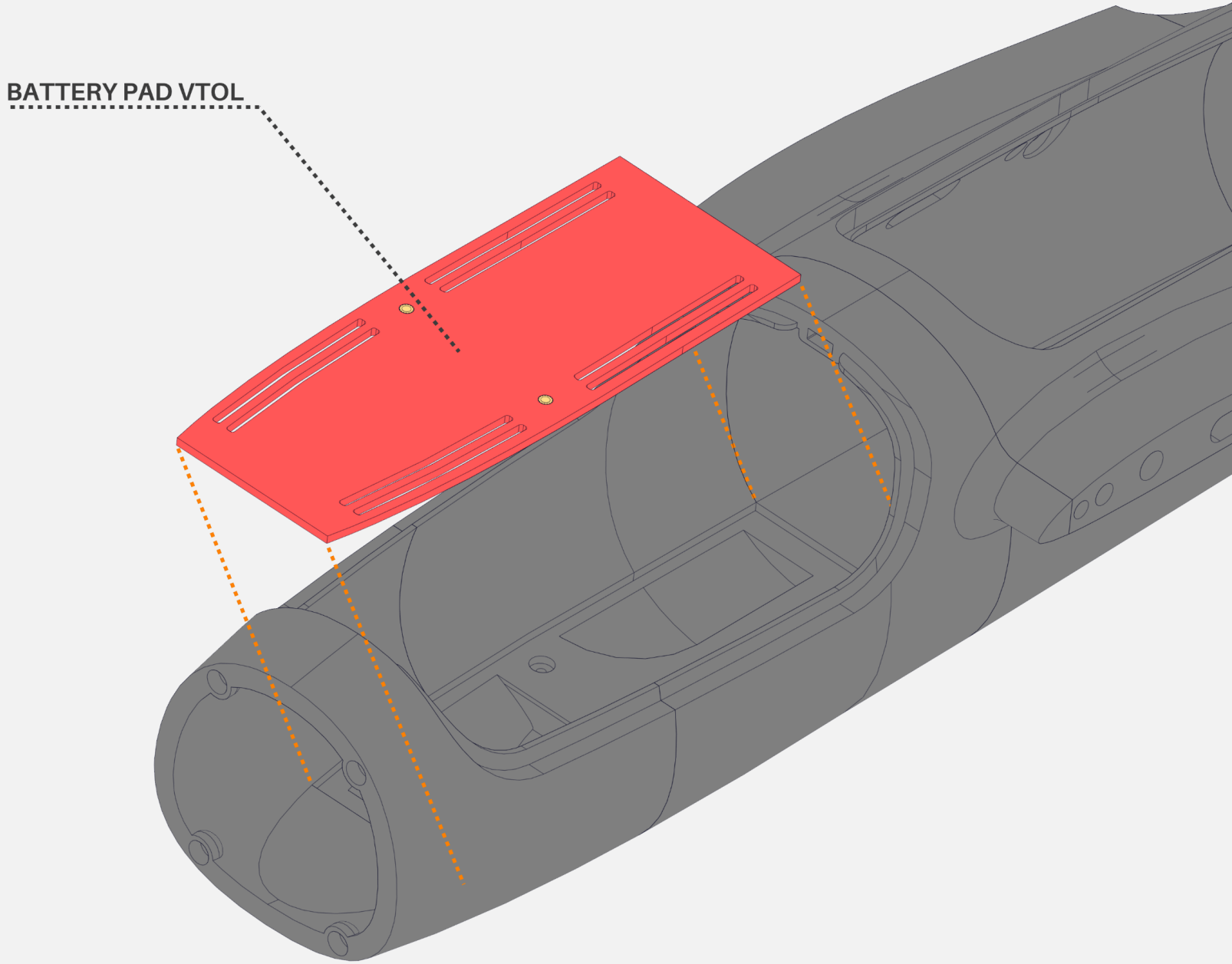
Prepare the BATTERY PAD and press M3 THREADED INSERTS into the designated locations using a slightly heated soldering iron. Compared to the base version, this part is reinforced; in addition to the battery mounting platform, it also includes mounting points for the main landing skids



FUSELAGE ASSEMBLY

Glue the prepared component into the designated location at the front of the fuselage.

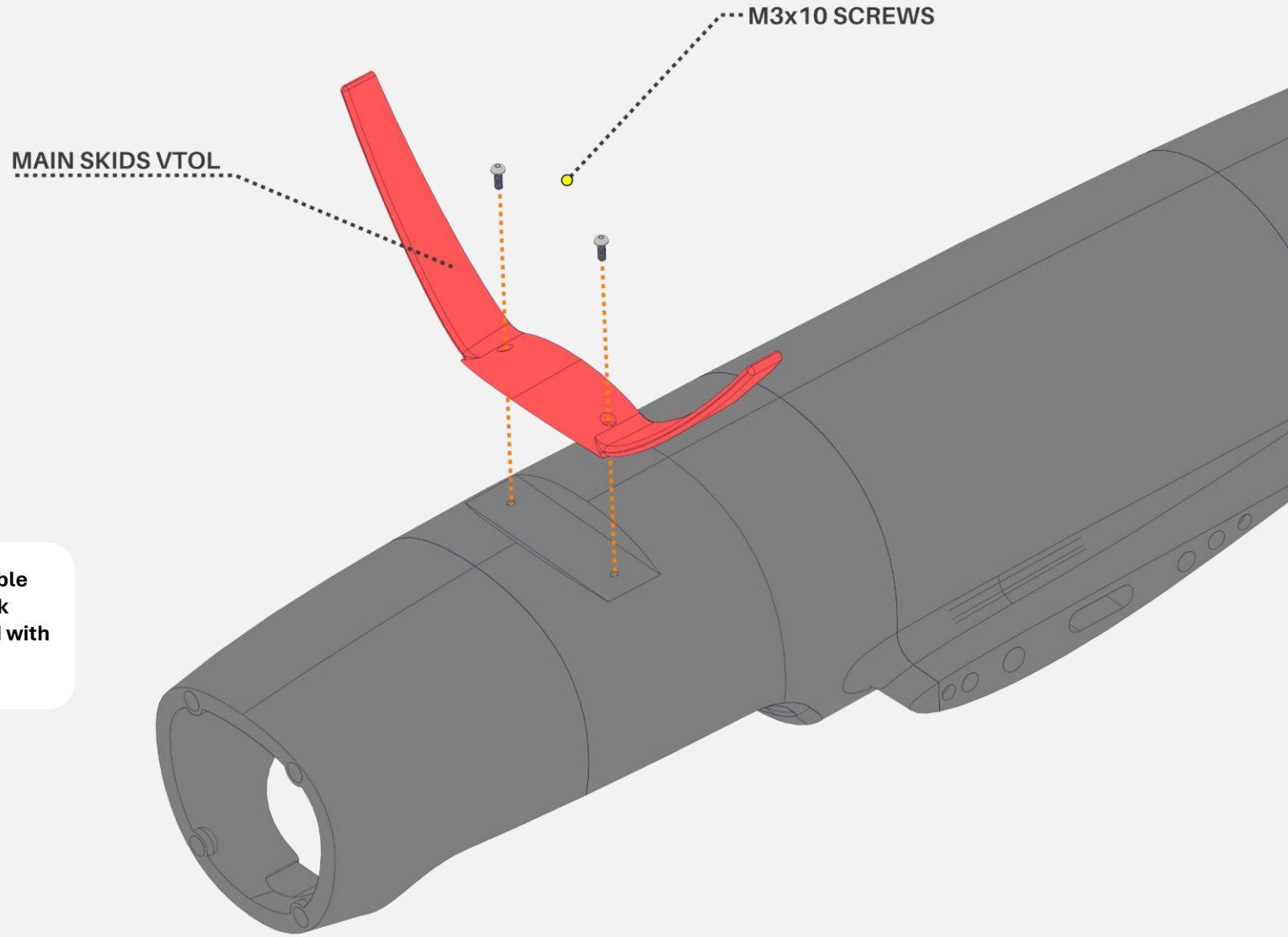
CA GLUE



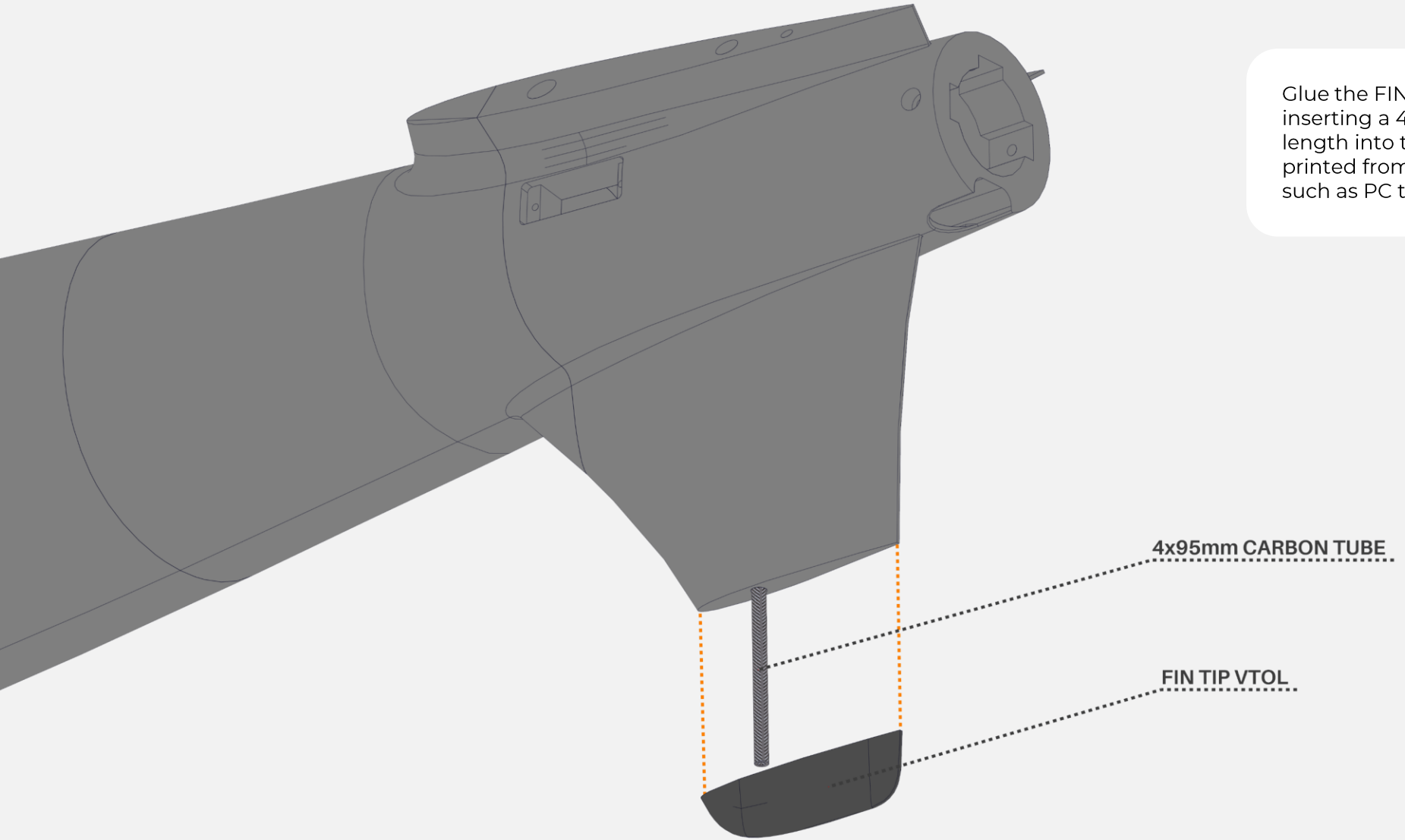
FUSELAGE ASSEMBLY

Prepare the MAIN SKIDS VTOL and mount them to the underside of the fuselage using M3x10 screws.
The landing skids supported by a reinforced fuselage structure created using modifier volumes provided in the STEP files.

When printed according to the recommended settings using a durable material such as PC, the skids provide sufficient strength and shock absorption for proper operation. This configuration has been tested with a takeoff weight of up to 3000 g.



FUSELAGE ASSEMBLY



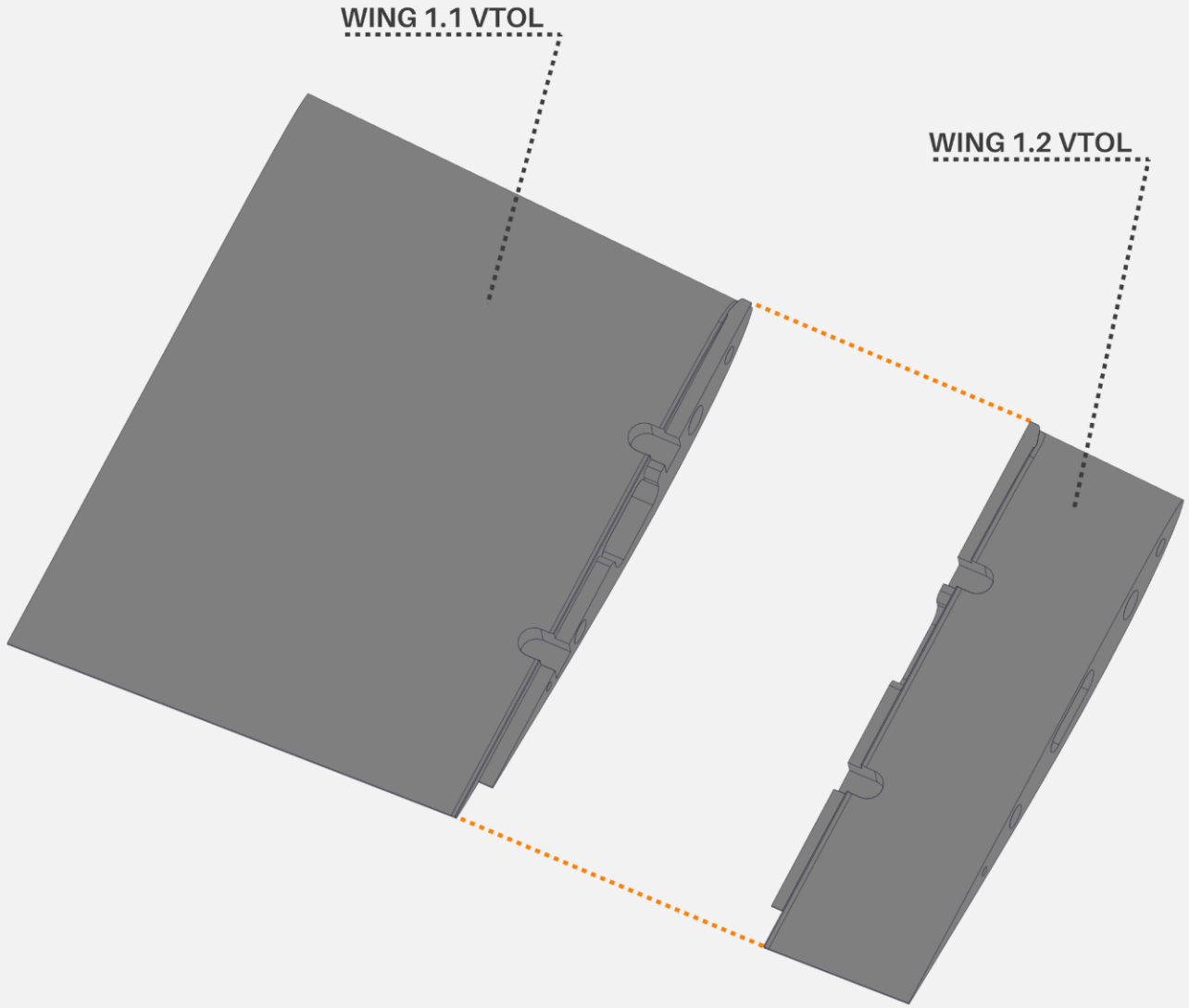
Glue the FIN TIP VTOL at the rear of the fuselage, inserting a 4 mm carbon tube cut to the appropriate length into the designated slot. The component can be printed from a range of materials, from rigid options such as PC to more flexible ones like TPU.

CA GLUE

WING ASSEMBLY

Wing modification is required for the VTOL configuration. If a fixed-wing version has already been built, all wing components must be reprinted.
In the VTOL version, the first wing segment (WING 1) is replaced with two modified parts, WING 1.1 and WING 1.2. The remaining wing components remain unchanged compared to the base version. The use of modifier meshes is also recommended in this case to reinforce the lift motor arm mounting area.

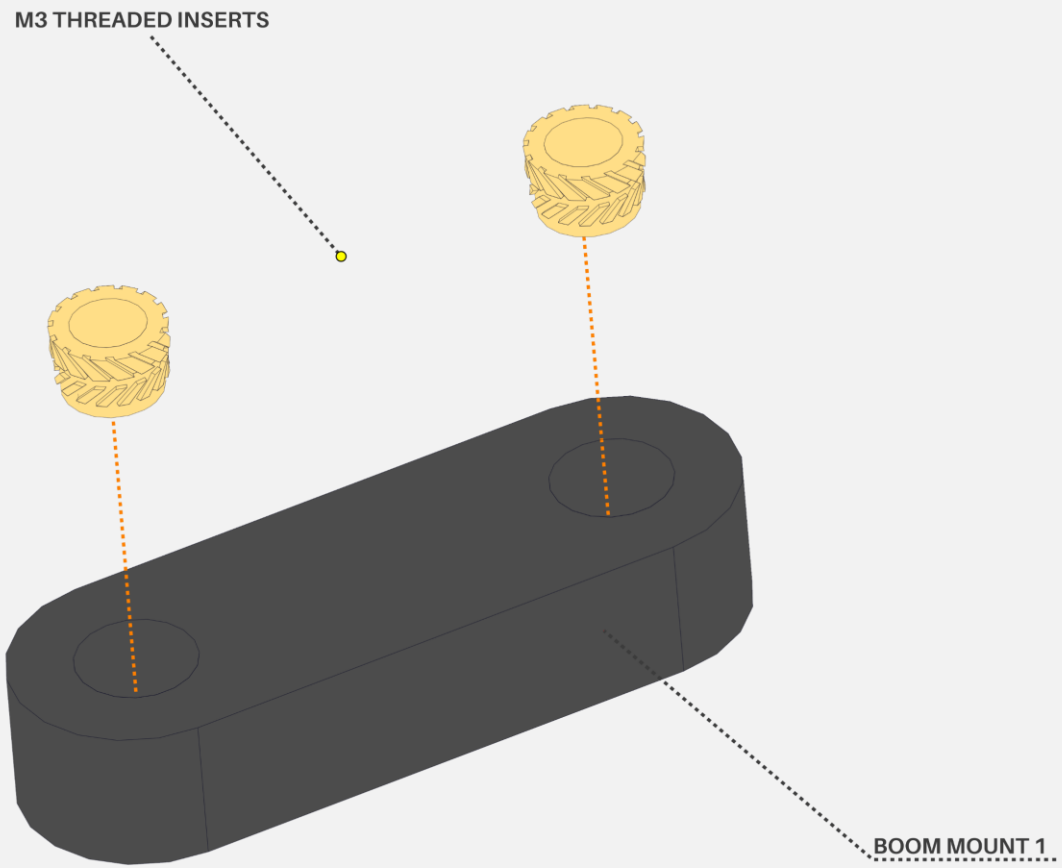
Begin by bonding these two segments into a single assembly, following the same process as in the base version. Inserting the carbon tubes into the designated slots during gluing helps ensure proper alignment of the components.



CA GLUE

WING ASSEMBLY

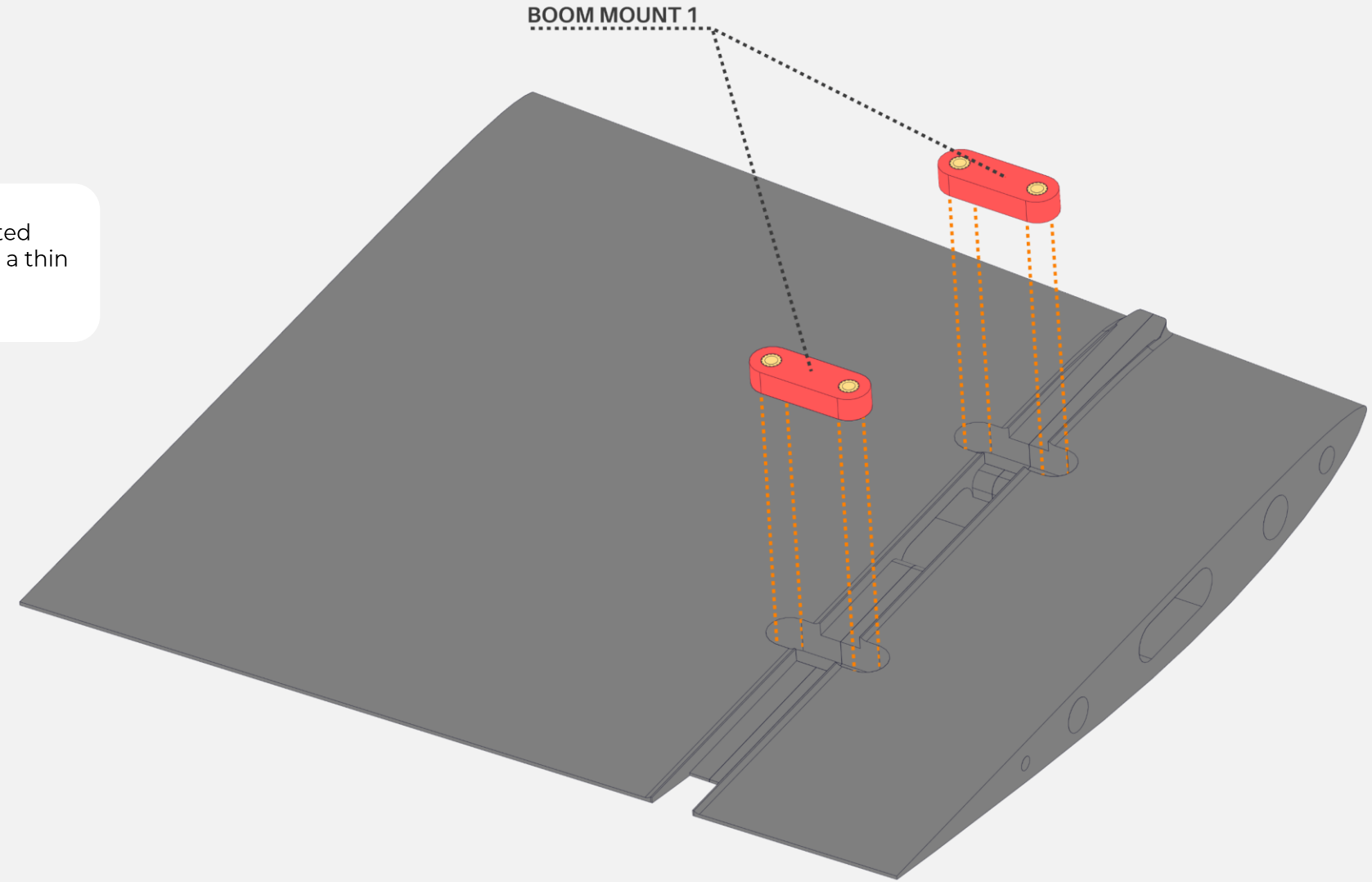
Take the BOOM MOUNT 1 and press M3 threaded inserts into the designated locations, following the same method as for the previous mounts of this type. This component is printed in four units, with two used per wing.



WING ASSEMBLY

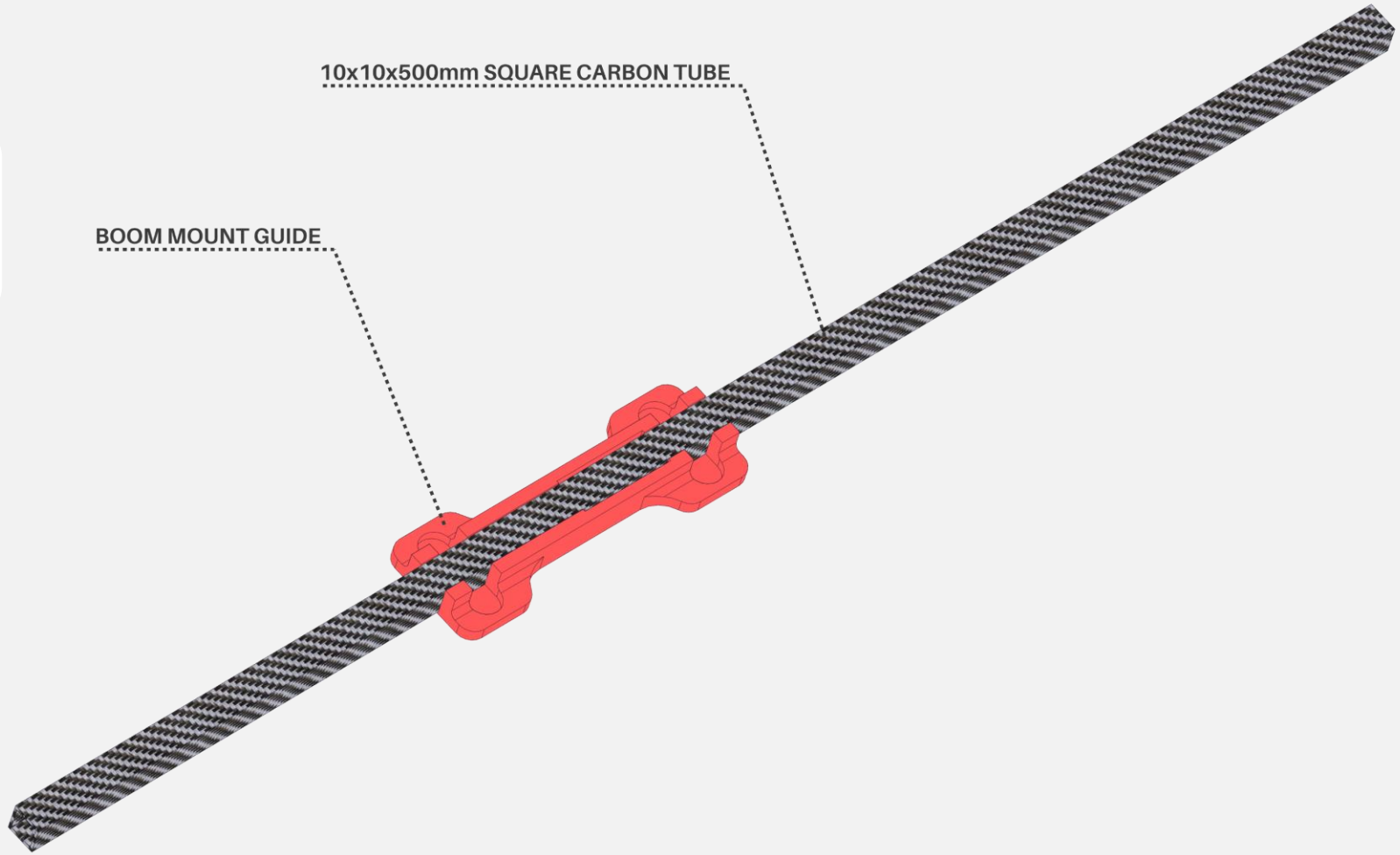
Install the prepared components into the designated locations in the wing. Apply the adhesive evenly in a thin layer across the entire bonding surface..

CA GLUE

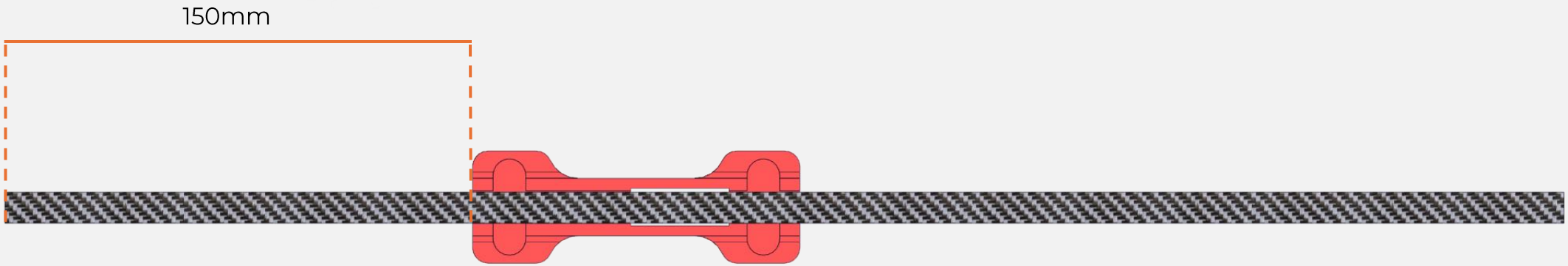


WING ASSEMBLY

Prepare the BOOM MOUNT GUIDE, which serves as a template for the boom. Insert a 10×10 mm square carbon tube, 500 mm in length, into the guide slot and proceed to the next step..



WING ASSEMBLY

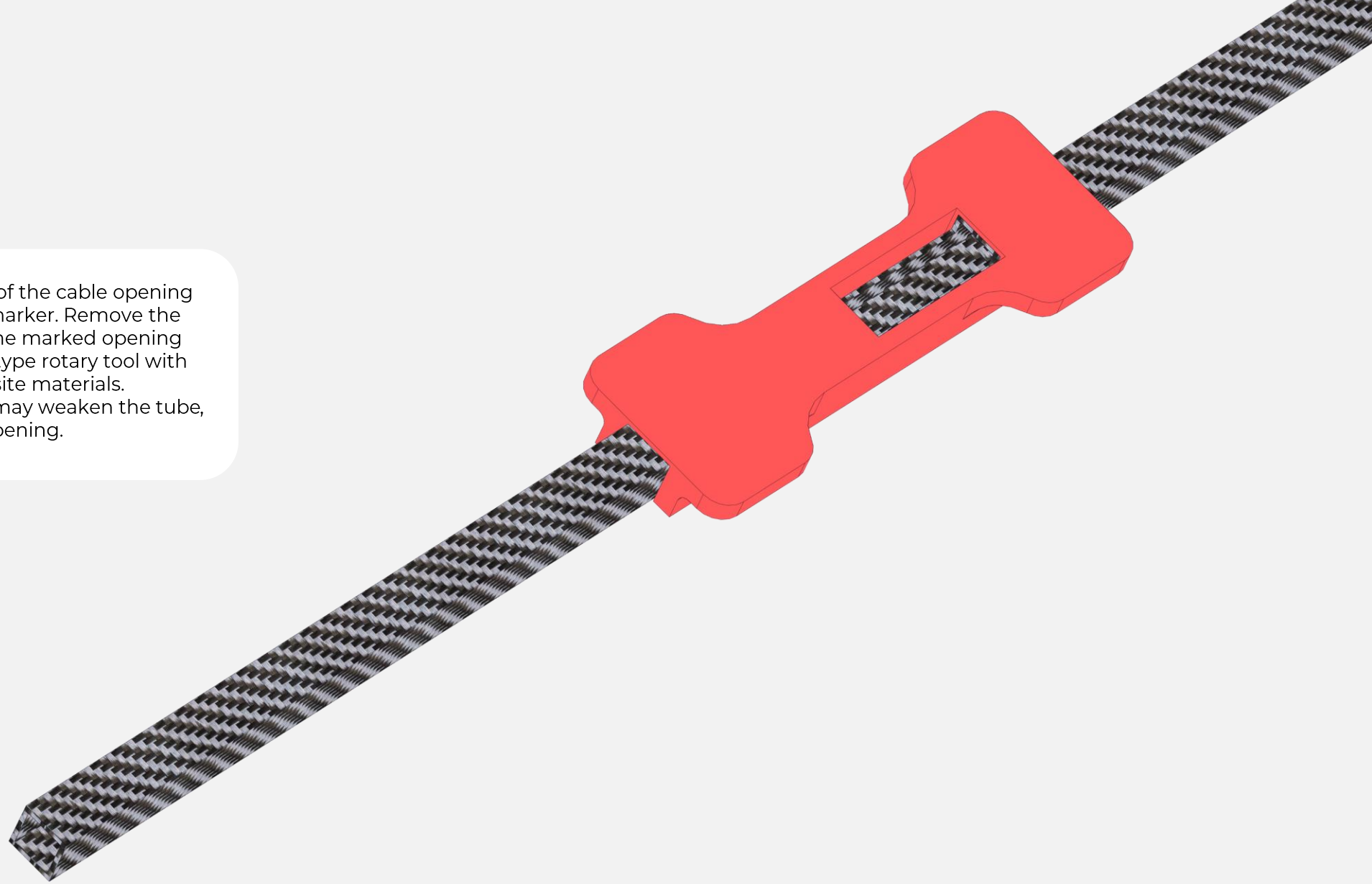


The guide is used to accurately position the boom mounts and to create an opening for the motor cables. To ensure proper alignment, measure 150 mm from one end of the tube to the point of contact with one side of the guide, following the diagram.

For ease of assembly, once the measurement is set, you may temporarily secure the tube with tape at the contact points with the guide. This helps prevent any unintended movement within the slot during the process.

WING ASSEMBLY

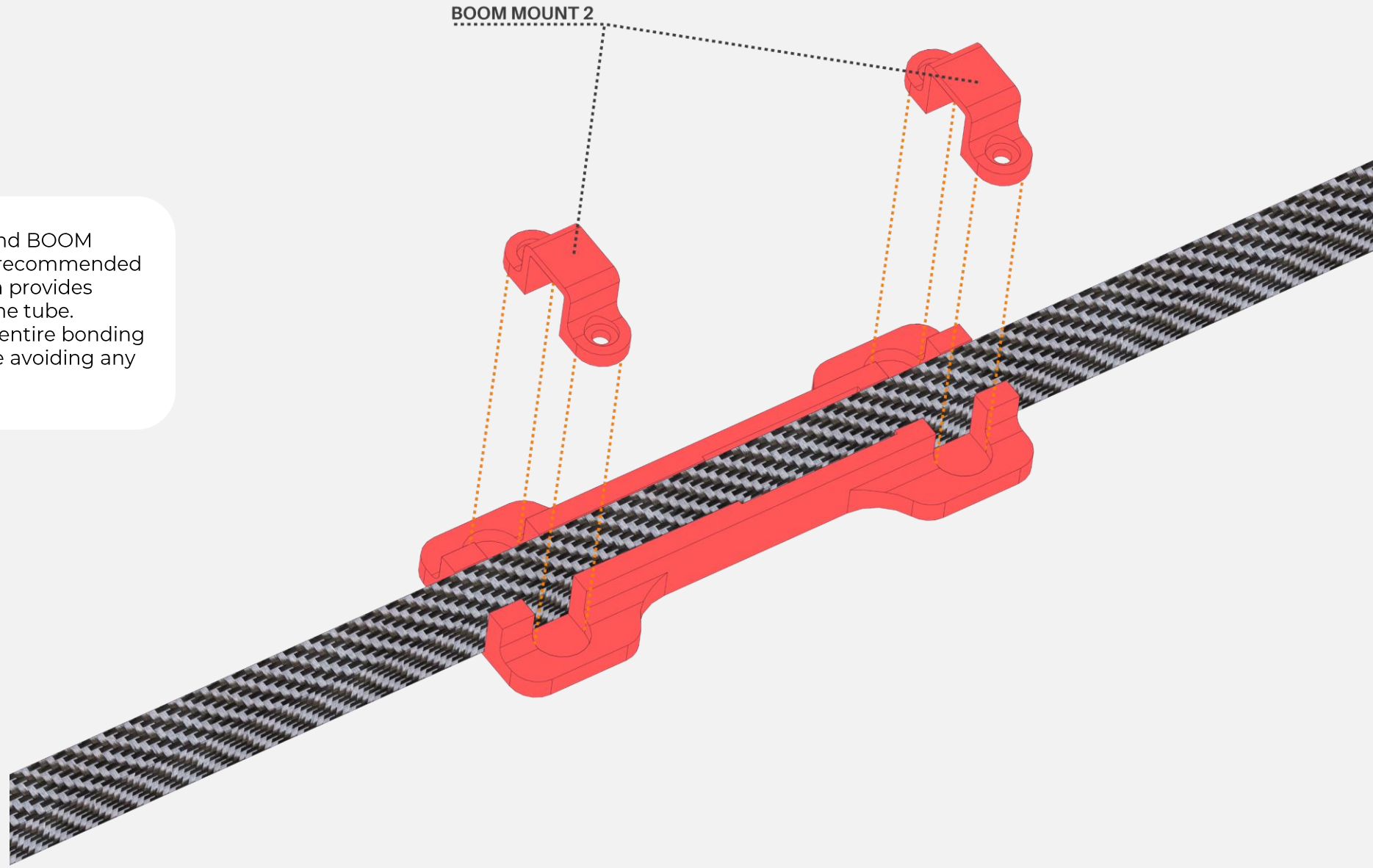
From the underside, mark the location of the cable opening on the tube using a white permanent marker. Remove the tube from the guide and carefully cut the marked opening using a suitable tool, such as a Dremel-type rotary tool with a thin cutting disc designed for composite materials.
Take care not to cut too deeply, as this may weaken the tube, only remove a single wall to form the opening.



WING ASSEMBLY

Place the tube back into the guide and bond BOOM MOUNT 2 in the designated positions. It is recommended to use a slow-curing epoxy adhesive, which provides a strong bond with the carbon surface of the tube. Apply an even layer of adhesive across the entire bonding surface, ensuring it is well distributed while avoiding any excess spilling outside the joint area.

EPOXY GLUE

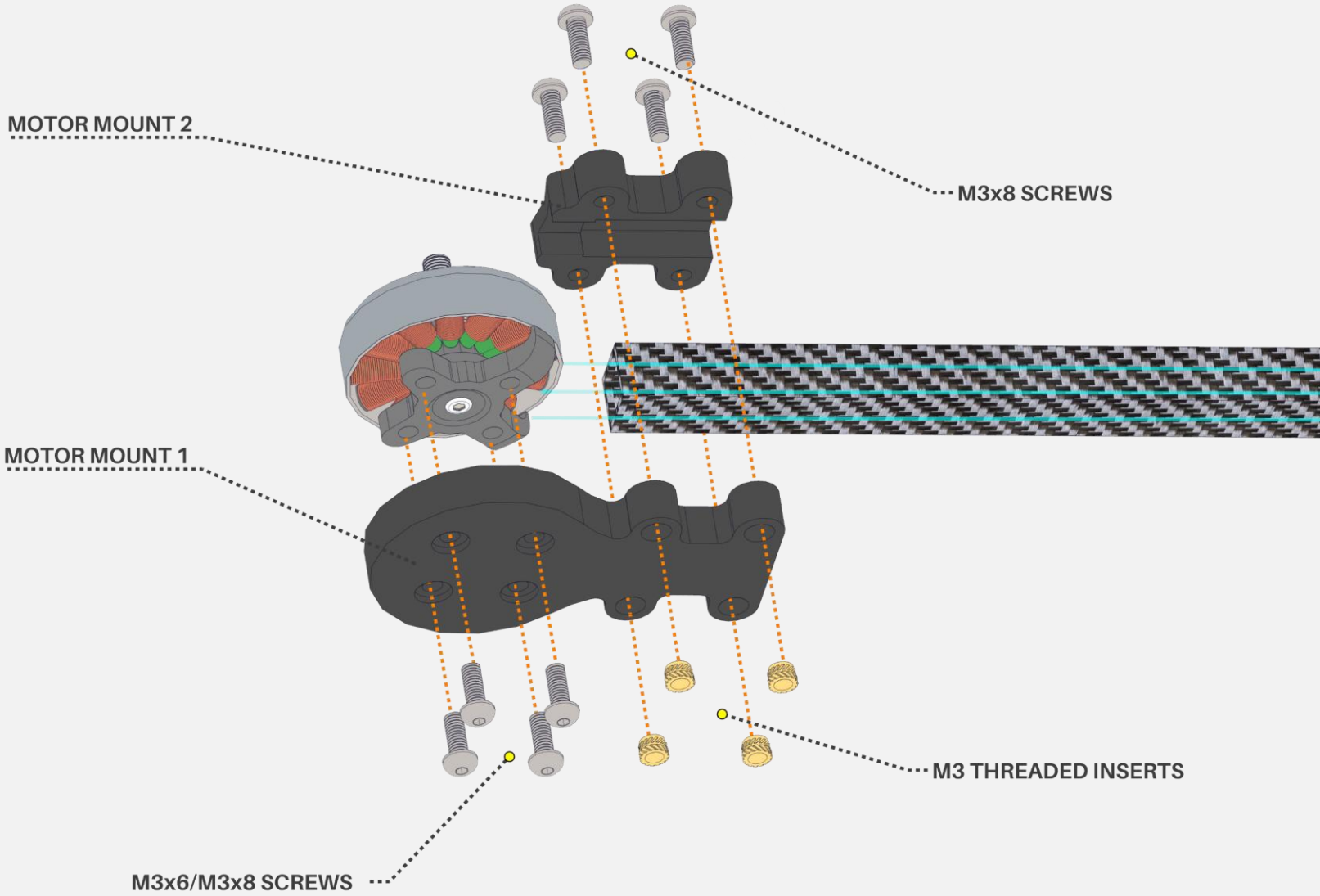


WING ASSEMBLY

Prepare MOTOR MOUNT 1 and MOTOR MOUNT 2 by first pressing the M3 threaded inserts into the designated locations. Attach the motor using M3 screws, preferably those included with the motor.

Route the cables through the tube. Ensure they are long enough to extend at least beyond the previously prepared opening in the tube, or longer if you intend to route them directly into the fuselage in the following steps.

Then align and secure the two motor mount components using M3×8 screws, as shown in the diagram. If you find that the motor mount does not fit tightly enough on the tube, you can wrap the tube at the joint area with strong duct tape. This will reduce the tolerance and result in a more secure, snug fit. Repeat the same procedure for all four motor arm ends.

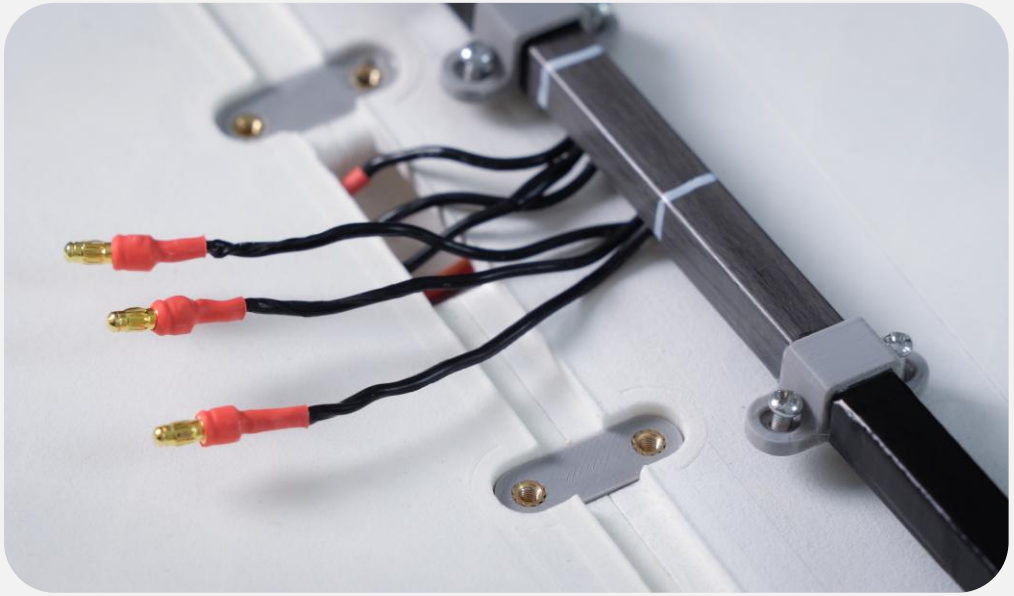


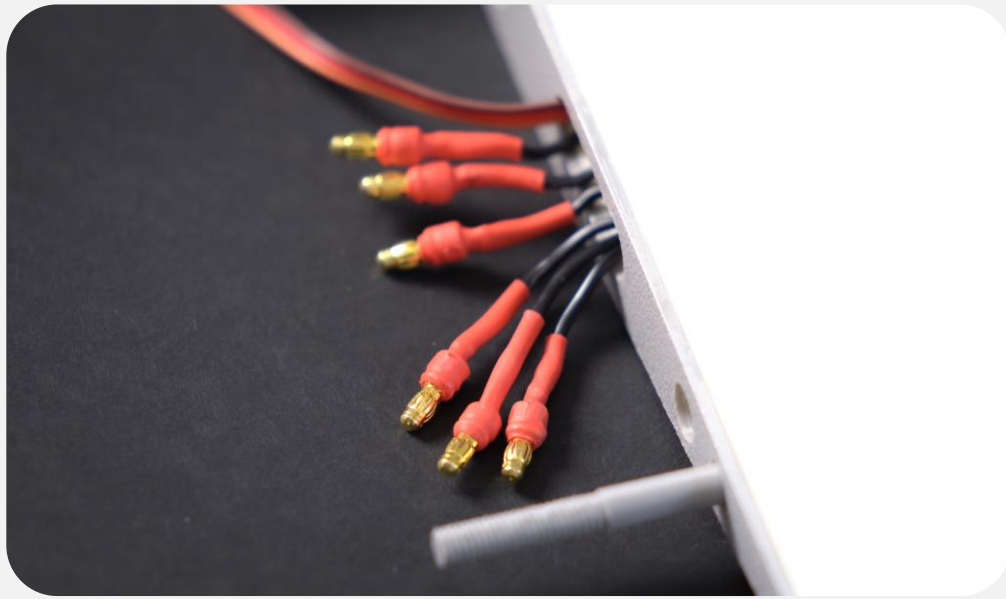
WING ASSEMBLY

At this stage, you should have a completed arm with the motor installed and the cables routed through the tube and exiting via the prepared opening. It is recommended to solder 3.5 mm gold (bullet/banana) connectors to each motor wire.

These can then be connected to extension leads made with matching wires and connectors, which are routed through the wing and exit at the wing root. At the wing root, you may use another set of connectors (e.g. gold connectors or an alternative of your choice) to interface with the final set of wires leading to the ESC. These wires should be pre-soldered to the ESC on one end, and terminated with compatible connectors on the other.

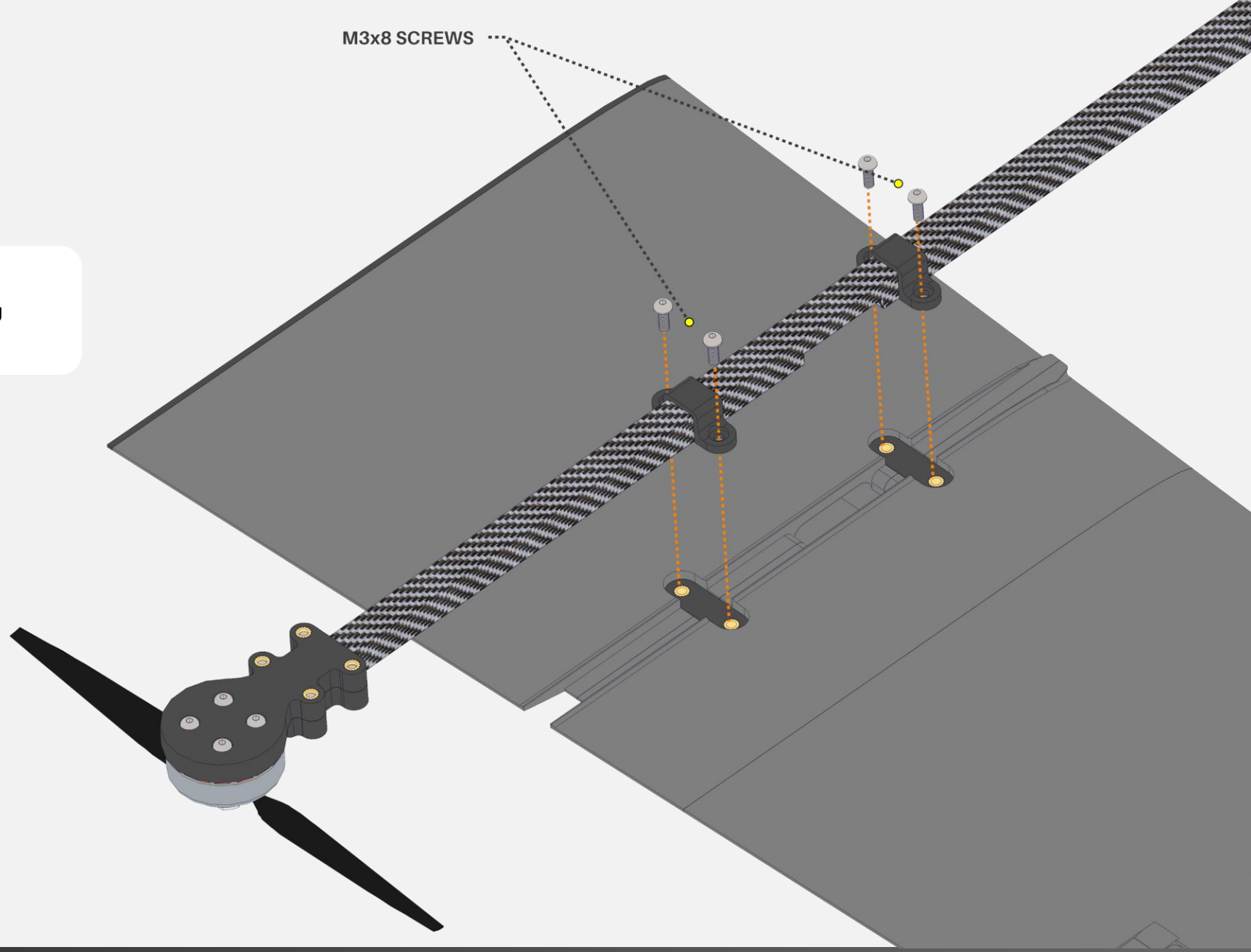
The images provided illustrate how this setup should look in practice. This approach ensures a modular and easily serviceable wiring setup.





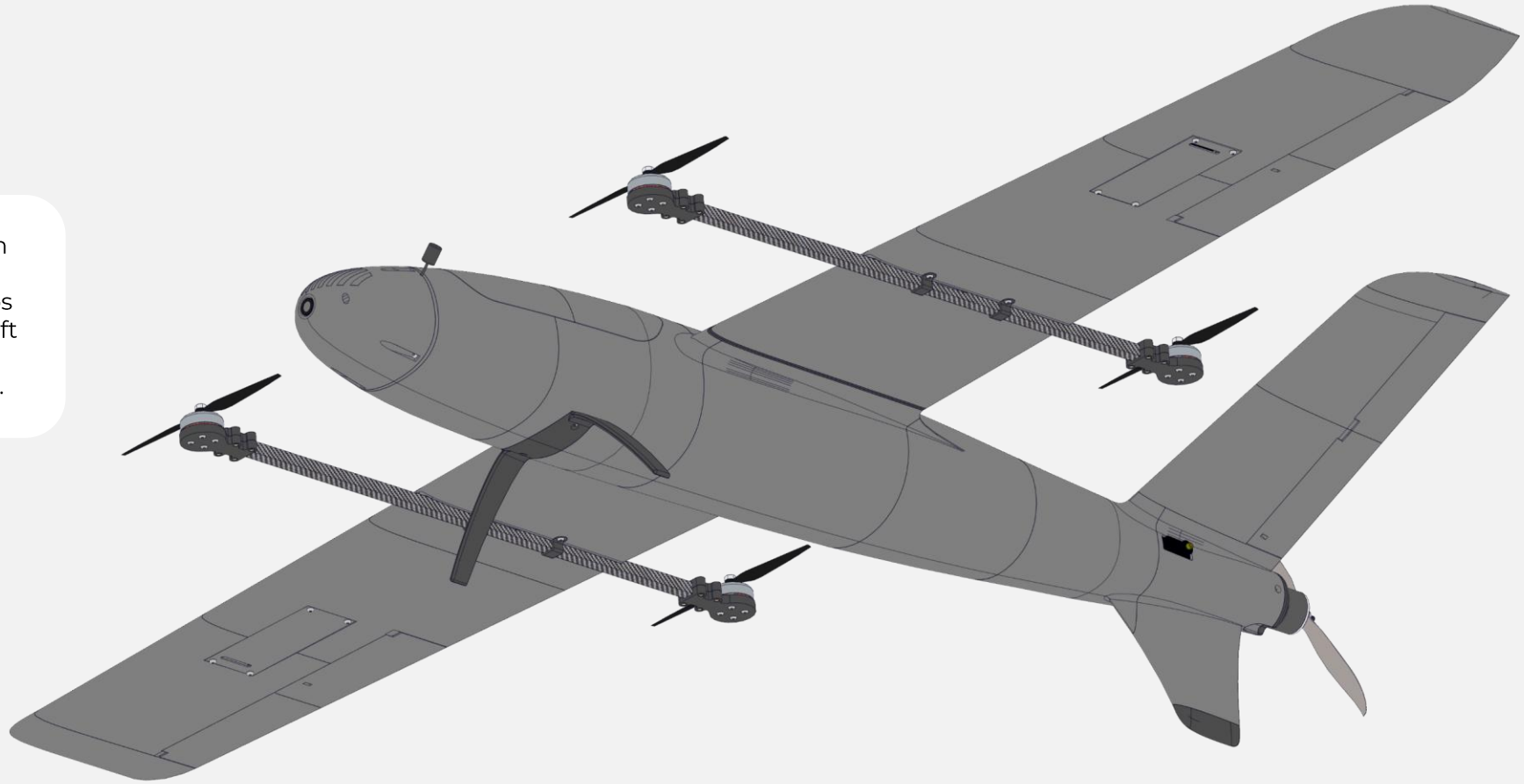
WING ASSEMBLY

Once the cables have been prepared and routed, install the arm with the motors and secure it using M3×8 screws, as shown in the diagram.

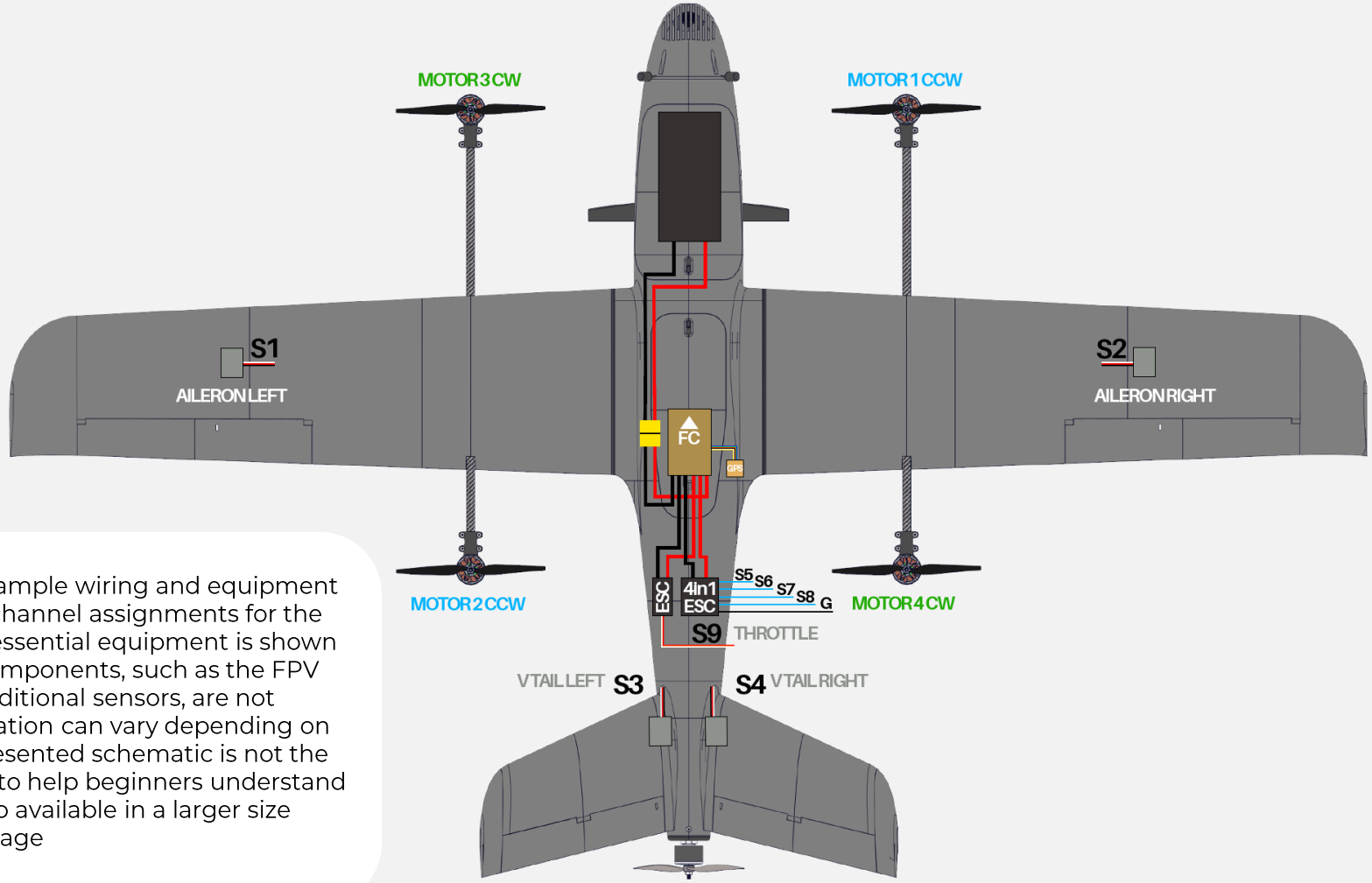


FINISHING BUILD

The remaining stages of the build process remain unchanged from the base version and should be completed in the same manner. Once these steps are finalized, the VTOL configuration of the aircraft will be structurally complete and ready for the installation of the remaining onboard electronics.



WIRING DIAGRAM



The diagram illustrates an example wiring and equipment layout, including suggested channel assignments for the servos and motors. Only the essential equipment is shown in the schematic. Optional components, such as the FPV camera, VTX, receiver, and additional sensors, are not included, as their implementation can vary depending on the chosen hardware. The presented schematic is not the only solution but is intended to help beginners understand the setup. This diagram is also available in a larger size in PDF format in the file package

ARDUPILOT CONFIGURATION

For beginners, a document with a preconfigured parameter (.param) file is also available. The document outlines the key parameter settings for a QuadPlane 4+1 VTOL configuration in ArduPilot. It is intended to serve as a reference and a solid starting point for further configuration and tuning of this type of aircraft.

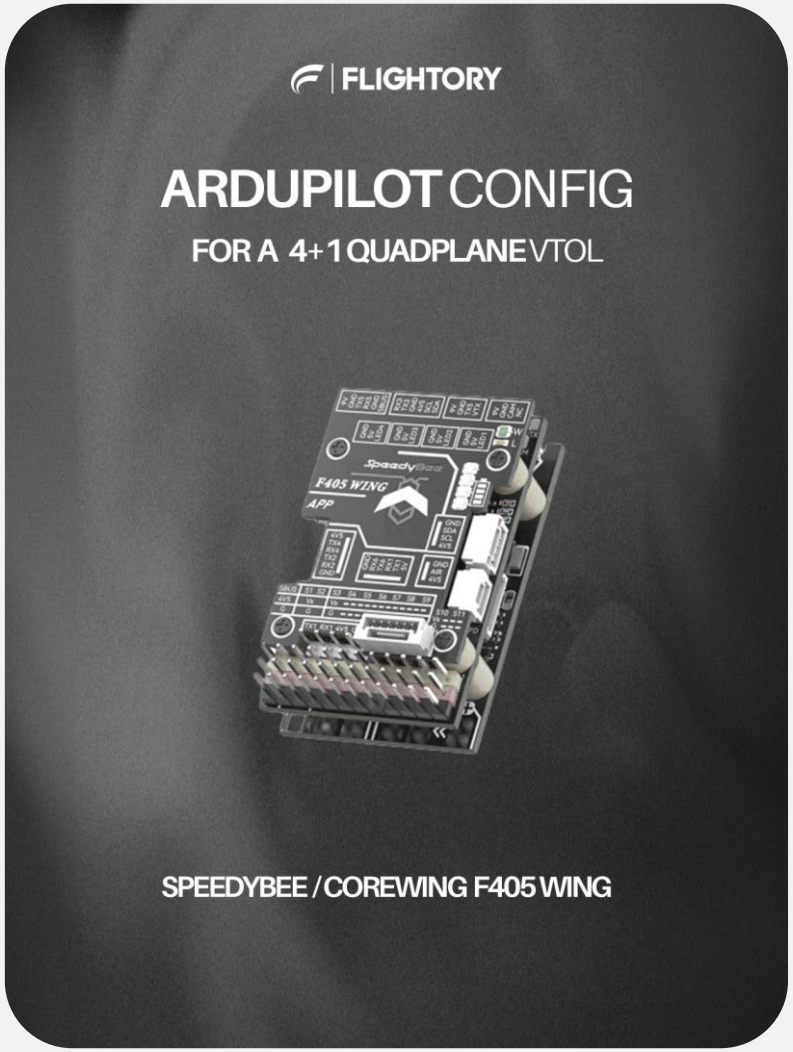
The file is prepared for the Speedybee/Corewing F405 Wing used with an ELRS receiver, GPS, Walksnail FPV system, and the Yaapu telemetry script option.

This is not a ready-to-use configuration and must not be applied without proper verification. Before flight, you are required to configure the correct servo outputs according to your airframe setup and perform all necessary calibrations, including compass and accelerometer. The following sections of the document present the main parameters along with explanations of their functionality.

All information, as well as the firmware, is available onthe ArduPilot website. It is also recommended to review the user manual of the flight controller for configuration.

https://ardupilot.org/plane/docs/common-speedybeef405wing.html

The document is available for free download from the Flightory Discord server in the #free-files channel.



FLIGHTORY

STORK VTOL