LAYERWINGS · ASSEMBLY MANUAL

Cheel 1800

3D-printable mapping and survey flying wing
1800 mm span · plug-and-play gimbal up to 1 kg ·
34 printed parts · Bambu Lab ready



Version 1.0 · November 2026
Questions: info@layerwings.com · layerwings.com

INSIDE THIS MANUAL

Contents

1. Key numbers
2. What you need
3. Parts map and print list
4. Assembly: wing pieces and body
5. Assembly: wings
6. Assembly: motor and wings on
7. Gimbal module and cover plate
8. Electronics and wiring
9. Setup, CG and first flight

Read this first. Dry-fit every step before you glue. The parts only fit one way: spar holes and pin holes line up only with the right neighbour. The file name of every part is its code in this manual: **`WING-L2F`** = Wing, Left side, section 2 (counted from the body), Front piece. **`A`** = rear piece.

Safety. A new design: weigh your parts, check the CG and test-glide before the first full flight. Remove the propellers whenever you work on the plane with a battery connected. Fly at your own risk and follow your local drone rules.

Key numbers

	Value
Wingspan	1800 mm
Length	849 mm (body)
Wing area	63.9 dm²
All-up weight	≈ 4.1 kg (gimbal + 6S2P) · ≈ 4.6 kg (gimbal + 6S3P)
CG	**462 mm behind the nose tip**
Static margin	8 %
Stall speed	≈ 39–41 km/h
Cruise	≈ 65 km/h
Flight time	≈ 63 min (gimbal, 6S2P) · ≈ 90 min (gimbal, 6S3P) · ≈ 116 min (no gimbal, 6S3P), estimates
Battery	6S2P or 6S3P 21700 Li-ion
Launch / landing	Hand or bungee launch · belly landing on the skids

What you need

Carbon and hardware

Qty	Part	Length	Where
2	Carbon tube 14 x 12 mm	1064 mm	Main spars (they cross inside the body)
2	Carbon tube 8 x 6 mm	562 mm	Rear spars
2	Carbon rod 6 mm	170 mm	Rear pins (wing to body)
2	Carbon rod 3 mm	60 mm	Elevon joiners
4	Carbon rod 3 mm	25 mm	Winglet pins
2 + 2	M5 nylon bolt 30 mm + M5 heat-set insert		Wing lock
6 + 6	M4 thumb screw 12 mm + M4 heat-set insert		Gimbal module / cover plate
≈ 40	1.75 mm filament pieces	20 mm	Alignment pins (wing pieces + body)
16	Neodymium magnets 6 x 3 mm		Hatches (8 in the body, 8 in the hatches)
4	M3 screws (from the motor kit)		Pusher motor

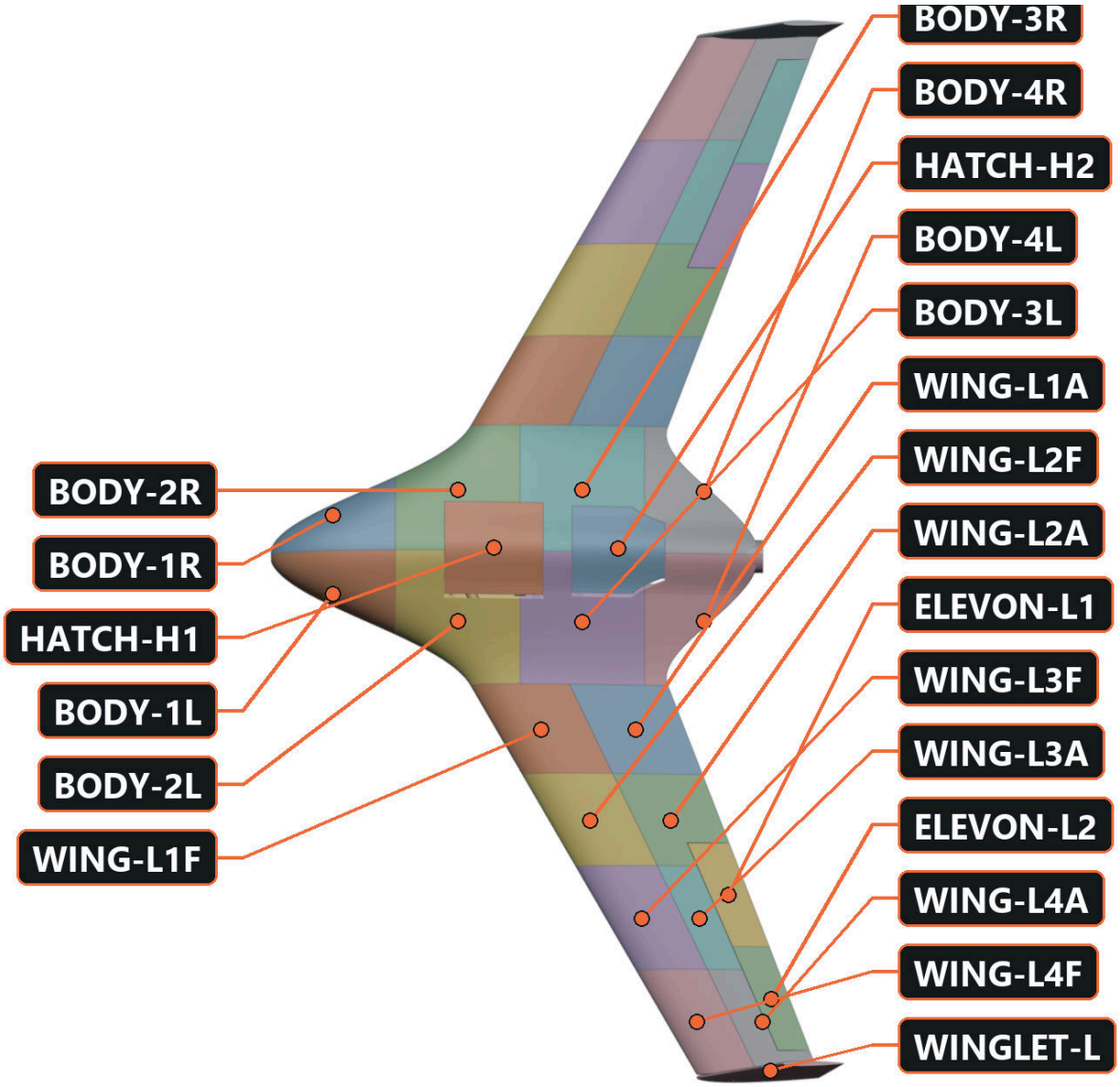
Electronics (suggested)

	Suggestion
Pusher motor	4120 / 3520 class ~450 KV + 14 x 8 folding prop
Pusher ESC	80 A, with separate 5–6 V BEC (servos + gimbal)
Servos	2 x metal-gear wing servo, 12 mm thick class
Battery	6S2P (10 Ah) or 6S3P (15 Ah) 21700 Li-ion
Autopilot	ArduPilot: Pixhawk / Matek H743 + GPS (PPK / RTK for mapping)
Payload	Zoom + day/night gimbal ≤ 1 kg, ball ≤ 120 mm, or a mapping camera

Tools and glue

- Soldering iron with a heat-set insert tip
- Thin + medium CA glue, CA activator
- 30-min epoxy + microballoons (spars)
- 5-min epoxy (pins, winglets, legs)
- Hobby knife, sandpaper 120 / 240
- Hacksaw or Dremel cutting disc for carbon (wear a mask)
- Ruler, marker, masking tape, small spirit level
- Hinge tape or CA hinges
- Velcro straps, double-sided foam tape, zip ties, hot glue

Parts map



Seen from above, nose to the left. Each colour is one print; the code is its file name. The right side (R) is the mirror of the left side (L). Wing sections are printed as a Front (F) and a rear (A) piece.

Every part, how it prints

Part	Filament	How it prints	Supports	≈
BODY-1L	LW-PLA	2 walls, 0 % infill, standing on the rear joint face, nose up	none	25 g
BODY-1R	LW-PLA	2 walls, 0 % infill, standing on the rear joint face, nose up	none	25 g
BODY-2L	LW-PLA	2 walls, 0 % infill, lying on the flat centre split face (tail block: 3 walls)	none	58 g
BODY-2R	LW-PLA	2 walls, 0 % infill, lying on the flat centre split face (tail block: 3 walls)	none	58 g
BODY-3L	LW-PLA	2 walls, 0 % infill, lying on the flat centre split face (tail block: 3 walls)	none	53 g
BODY-3R	LW-PLA	2 walls, 0 % infill, lying on the flat centre split face (tail block: 3 walls)	none	53 g
BODY-4L	LW-PLA	2 walls, 0 % infill, lying on the flat centre split face (tail block: 3 walls)	none	33 g
BODY-4R	LW-PLA	2 walls, 0 % infill, lying on the flat centre split face (tail block: 3 walls)	none	33 g
COVER-PLATE	PETG	3 walls, 20 % infill, outer face down	tree supports (build plate only)	44 g
ELEVON-L1	LW-PLA	2 walls, 0 % infill, 0.6 mm skin, standing on the inboard face	none	15 g
ELEVON-L2	LW-PLA	2 walls, 0 % infill, 0.6 mm skin, standing on the inboard face	none	13 g
ELEVON-R1	LW-PLA	2 walls, 0 % infill, 0.6 mm skin, standing on the inboard face	none	15 g
ELEVON-R2	LW-PLA	2 walls, 0 % infill, 0.6 mm skin, standing on the inboard face	none	13 g
GIMBAL-MODULE	PETG	4 walls, 25 % gyroid, deck face down (upside down)	tree supports under the plate + skids	125 g
HATCH-H1	LW-PLA	2 walls, 0 % infill, standing on its front edge	none	19 g
HATCH-H2	LW-PLA	2 walls, 0 % infill, standing on its front edge	none	12 g
WING-L1A	LW-PLA	2 walls, 0 % infill, 0.6 mm skin, standing on the inboard face	none	43 g
WING-L1F	LW-PLA	2 walls, 0 % infill, 0.6 mm skin, standing on the inboard face	none	60 g
WING-L2A	LW-PLA	2 walls, 0 % infill, 0.6 mm skin, standing on the inboard face	none	36 g
WING-L2F	LW-PLA	2 walls, 0 % infill, 0.6 mm skin, standing on the inboard face	none	51 g
WING-L3A	LW-PLA	2 walls, 0 % infill, 0.6 mm skin, standing on the inboard face	none	25 g
WING-L3F	LW-PLA	2 walls, 0 % infill, 0.6 mm skin, standing on the inboard face	none	46 g
WING-L4A	LW-PLA	2 walls, 0 % infill, 0.6 mm skin, standing on the inboard face	none	23 g
WING-L4F	LW-PLA	2 walls, 0 % infill, 0.6 mm skin, standing on the inboard face	none	38 g
WING-R1A	LW-PLA	2 walls, 0 % infill, 0.6 mm skin, standing on the inboard face	none	43 g
WING-R1F	LW-PLA	2 walls, 0 % infill, 0.6 mm skin, standing on the inboard face	none	60 g
WING-R2A	LW-PLA	2 walls, 0 % infill, 0.6 mm skin, standing on the inboard face	none	36 g
WING-R2F	LW-PLA	2 walls, 0 % infill, 0.6 mm skin, standing on the inboard face	none	51 g

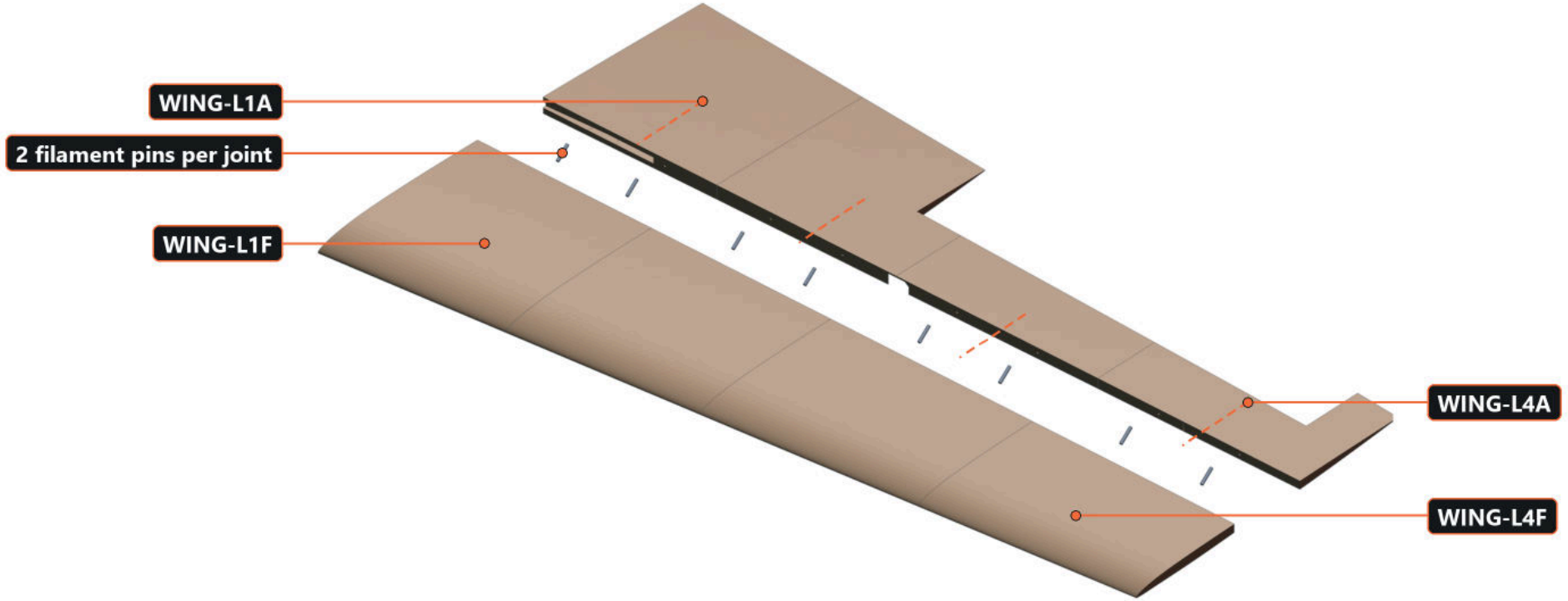
LW-PLA / Bambu PLA Aero ≈ 1143 g. PLA Aero profile, 0.4 mm nozzle, 2 walls, 0 % infill, "Detect thin wall" ON. The files in **1_PRINT_ready_for_Bambu** are already rotated, flat and centred. Gimbal module, cover plate in PETG; feet in TPU. More detail: the Print Guide PDF.

Every part, how it prints

Part	Filament	How it prints	Supports	≈
WING-R3A	LW-PLA	2 walls, 0 % infill, 0.6 mm skin, standing on the inboard face	none	25 g
WING-R3F	LW-PLA	2 walls, 0 % infill, 0.6 mm skin, standing on the inboard face	none	46 g
WING-R4A	LW-PLA	2 walls, 0 % infill, 0.6 mm skin, standing on the inboard face	none	23 g

Part	Filament	How it prints	Supports	≈
WING-R4F	LW-PLA	2 walls, 0 % infill, 0.6 mm skin, standing on the inboard face	none	38 g
WINGLET-L	LW-PLA	2 walls, 0 % infill, standing on the base	none	37 g
WINGLET-R	LW-PLA	2 walls, 0 % infill, standing on the base	none	37 g

01 Wing pieces: front + rear



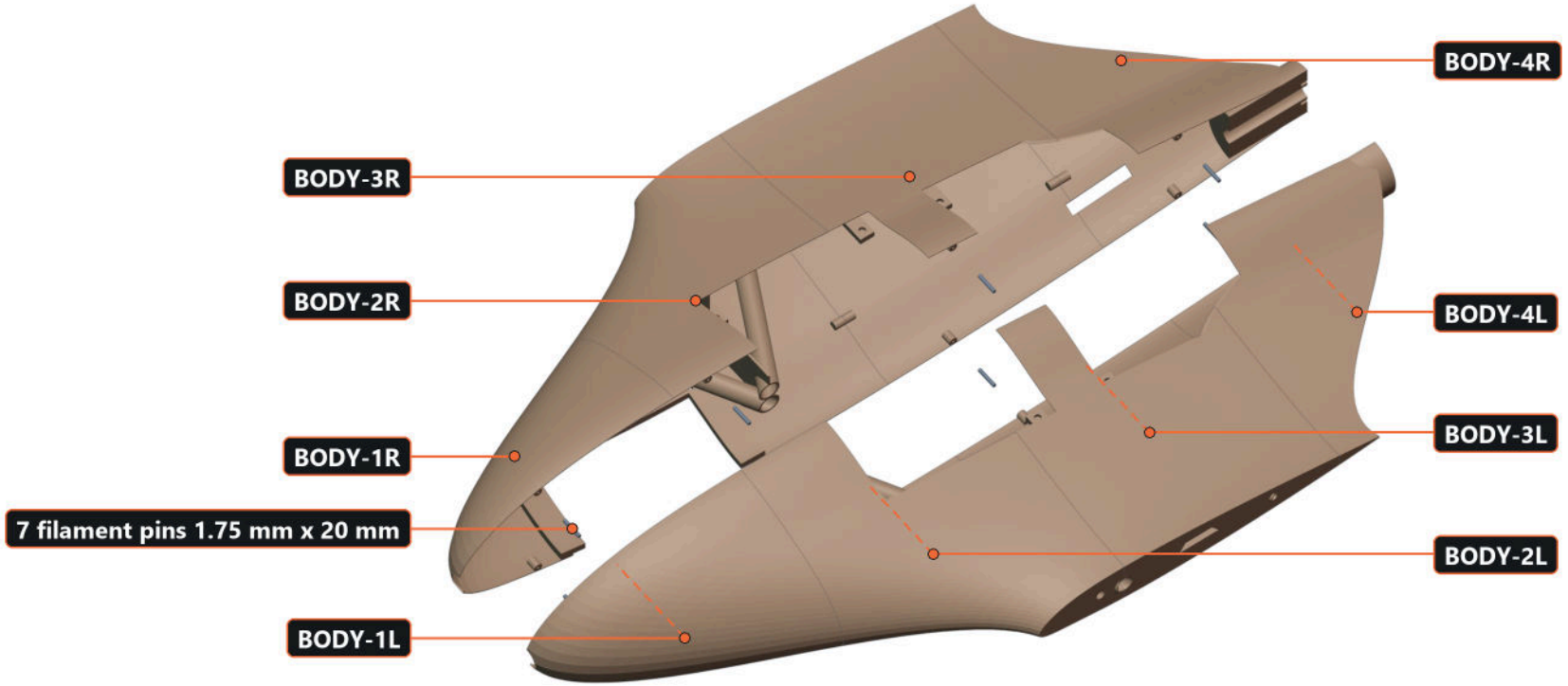
Medium CA | 16 filament pins

1. Each wing section is printed in 2 pieces: front **F** and rear **A**. Lay out all 8 pieces of the left wing in order (section 1 at the body, 4 at the tip).
2. Push two 20 mm pieces of 1.75 mm filament into the pin holes of each glue face.
3. Dry-fit, check the top surface is smooth, then glue with medium CA.
4. Do the same for the right wing (8 pieces).

Tip: Glue F + A on a flat table, top side down, so the section does not twist.

New in this step | Already built | Carbon | Hardware | PETG

02 Body: left and right halves

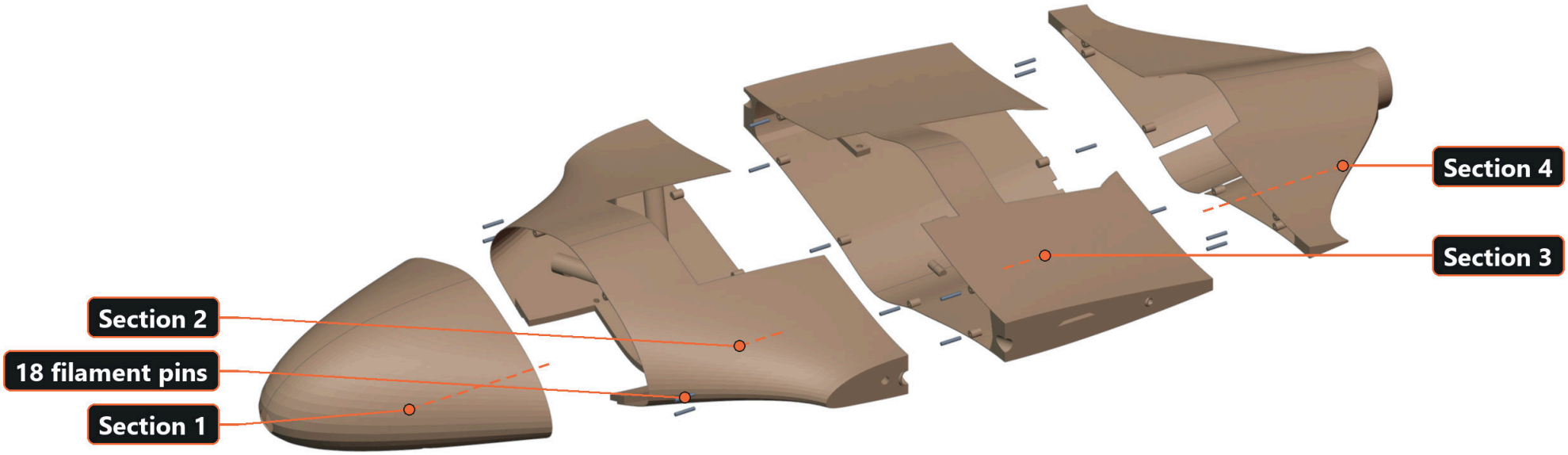


Medium CA | Filament pins

New in this step | Already built | Carbon | Hardware | PETG

1. Sand the joint faces flat.
2. Put filament pins into the pin holes of the centre seam.
3. Dry-fit and glue **BODY-1L + 1R**, **2L + 2R**, **3L + 3R** and **4L + 4R** with medium CA.

03 Body: join the four sections



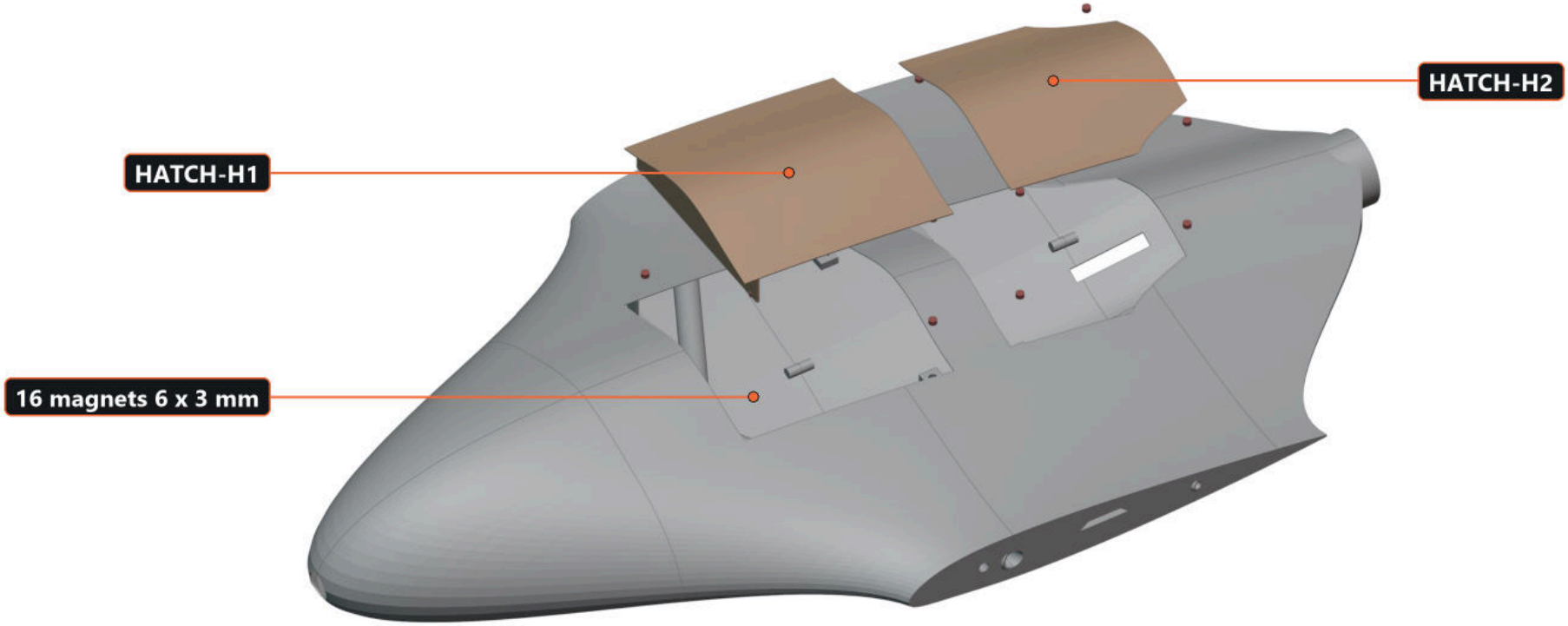
Medium CA | Filament pins

1. Put filament pins in each joint between the sections.
2. Dry-fit sections 1 to 4 on a flat table: the belly must be straight.
3. Glue one joint at a time with medium CA. Sand the seams lightly.

Tip: Lay the body upside down while the glue sets.

New in this step | Already built | Carbon | Hardware | PETG

04 Magnets and hatches



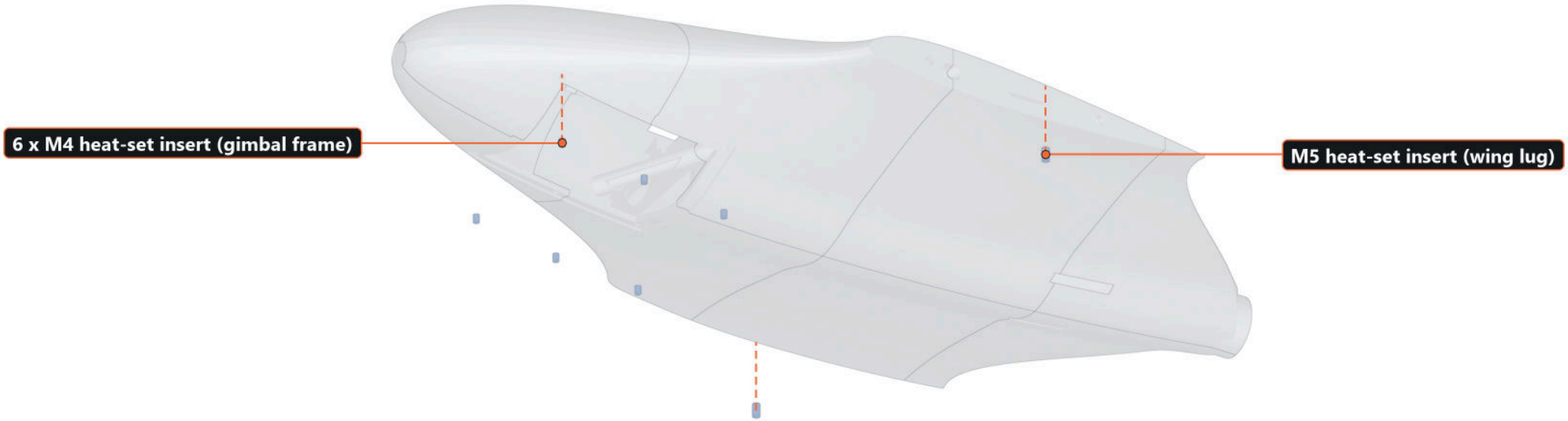
CA | 16 magnets

1. Glue 8 magnets (6 x 3 mm) into the body ledges with a drop of CA.
2. Put a magnet on each body magnet, CA on top, then press the hatch on: the hatch magnets end up in the right place and the right way round.
3. **HATCH-H1** = battery bay, **HATCH-H2** = autopilot + ESC bay. Both must snap on and off.

Important: Check the magnet polarity before the glue sets: the hatch must pull down, not push away.

New in this step | Already built | Carbon | Hardware | PETG

05 Heat-set inserts



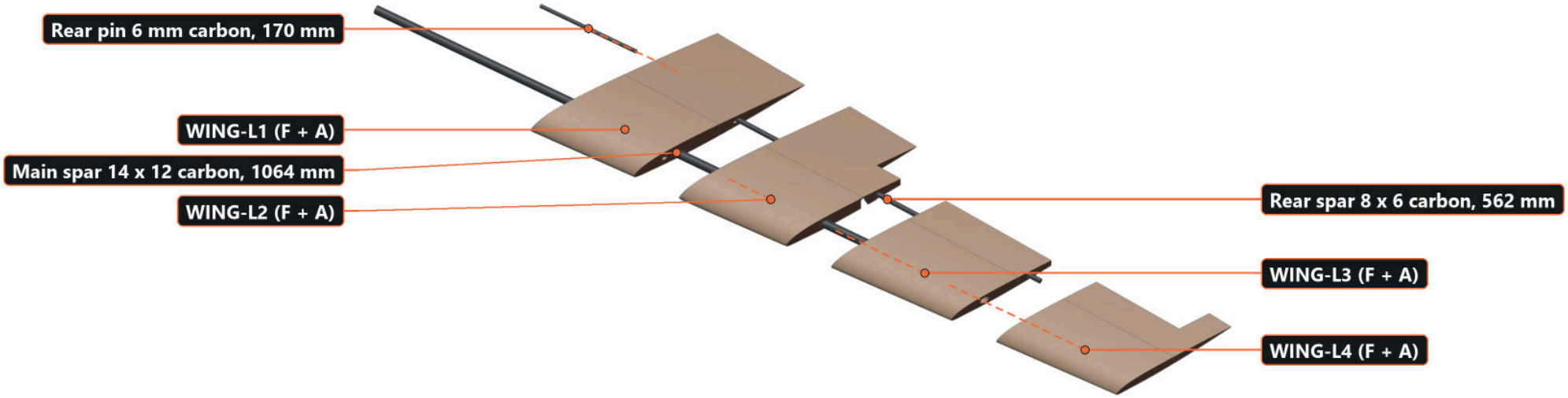
6 x M4 insert | 2 x M5 insert | Soldering iron

1. Melt **6 x M4** heat-set inserts into the gimbal frame around the belly opening (from below).
2. Melt an **M5** insert into each wing lug (2 in total).
3. Keep every insert straight and flush. Let it cool before you test a screw.

Tip: Push the insert in slowly with the iron at about 220 °C; don't push it through the thin skin.

New in this step | Already built | Carbon | Hardware | PETG

06 Wing: four sections on two spars



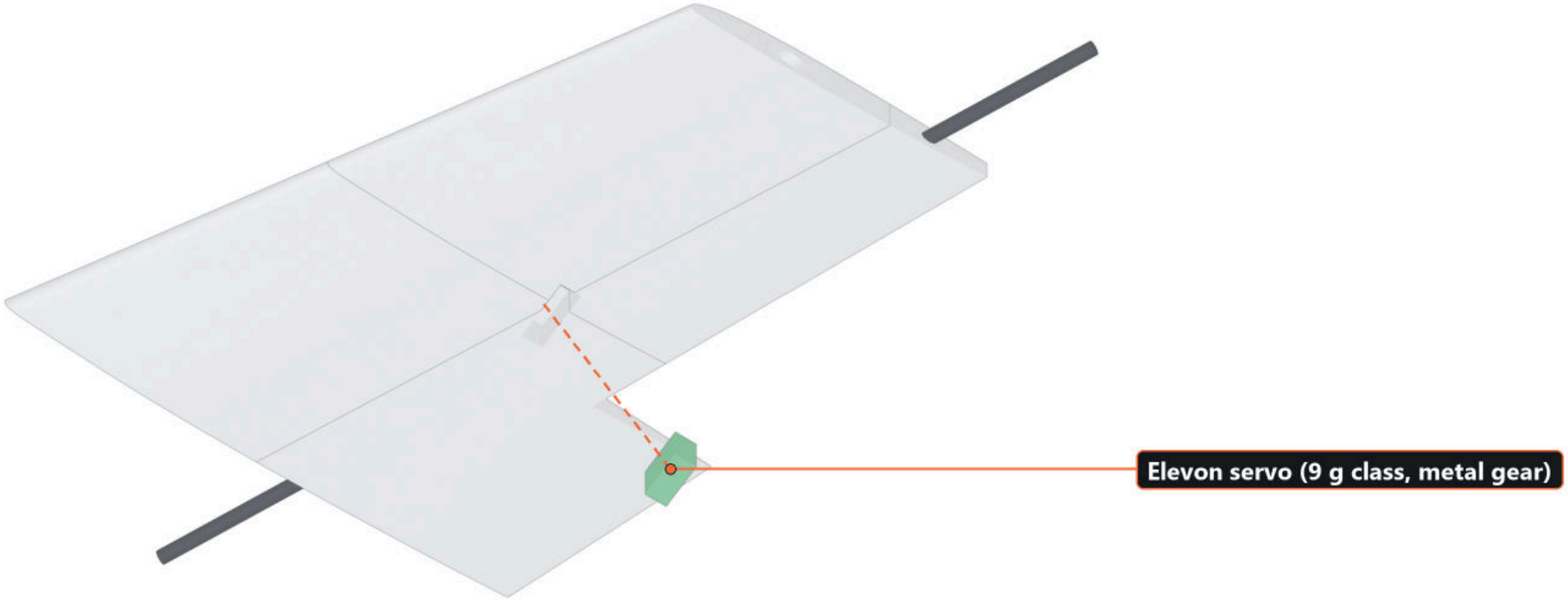
30-min epoxy · CA · Main spar 1064 mm · Rear spar 562 mm · Rear pin 170 mm

1. Cut the carbon: main spar 14 x 12 to **1064 mm**, rear spar 8 x 6 to **562 mm**, rear pin 6 mm to **170 mm**. Sand the ends.
2. Dry-fit sections 1–4 on both spars. The main spar sticks out of the root: it goes into the body later.
3. Fill the spar channels with 30-min epoxy + microballoons, slide the sections home, glue the section faces with CA.
4. Glue the 6 mm rear pin into the root (half of it sticks out). Let it cure flat. Build the right wing the same way.

Tip: Mark the spar where it leaves the root so you can see if it slid while curing.

New in this step · Already built · Carbon · Hardware · PETG

07 Elevon servo



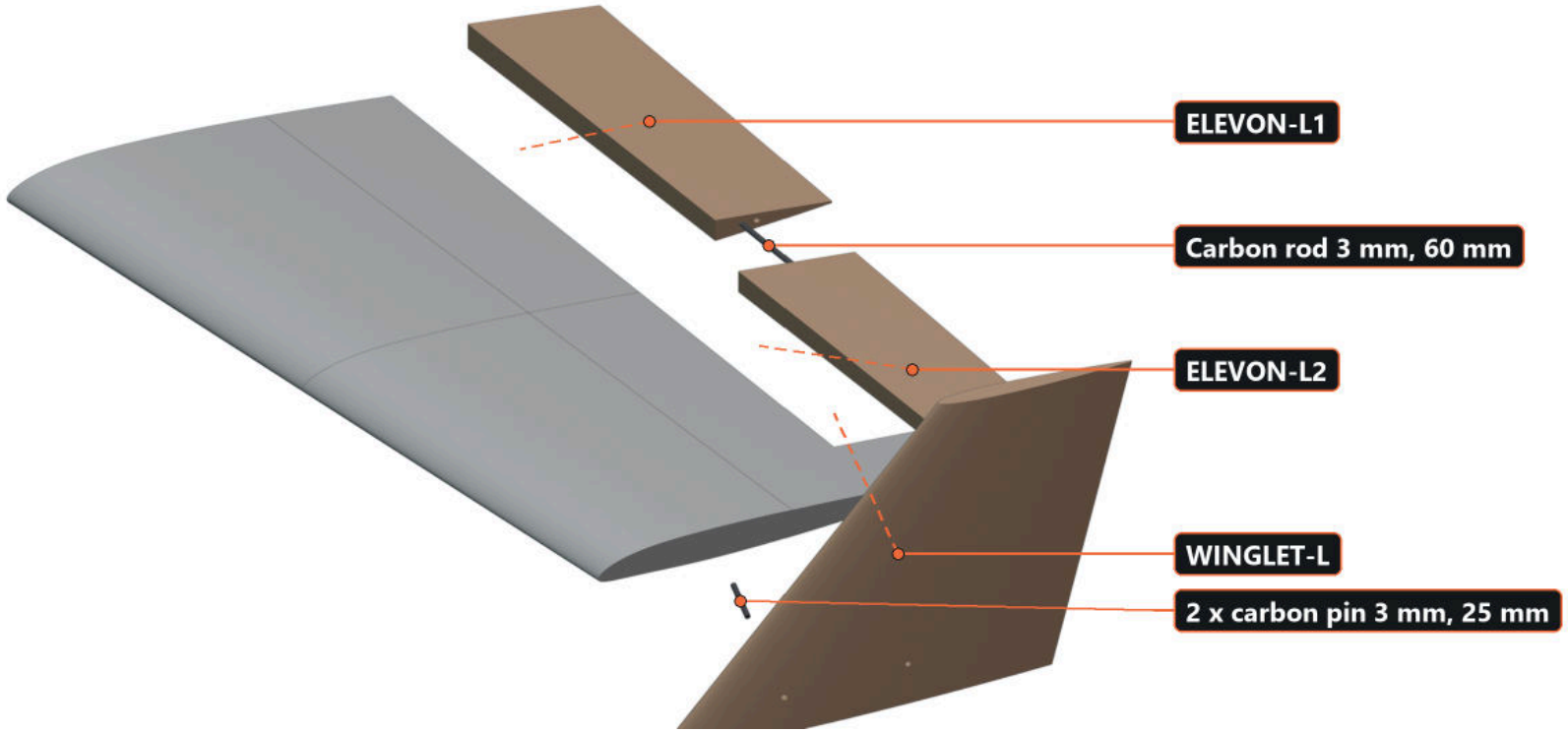
Metal-gear servo | Servo extension

1. Pull the servo wire through the wire channel from the servo pocket to the root (string helps).
2. Centre the servo with your radio, fit the arm, and fix it in the pocket under the wing (hot glue or tape + a drop of CA).
3. Same on the right wing.

Tip: Centre the servo BEFORE you fix it.

New in this step | Already built | Carbon | Hardware | PETG

08 Elevons and winglet

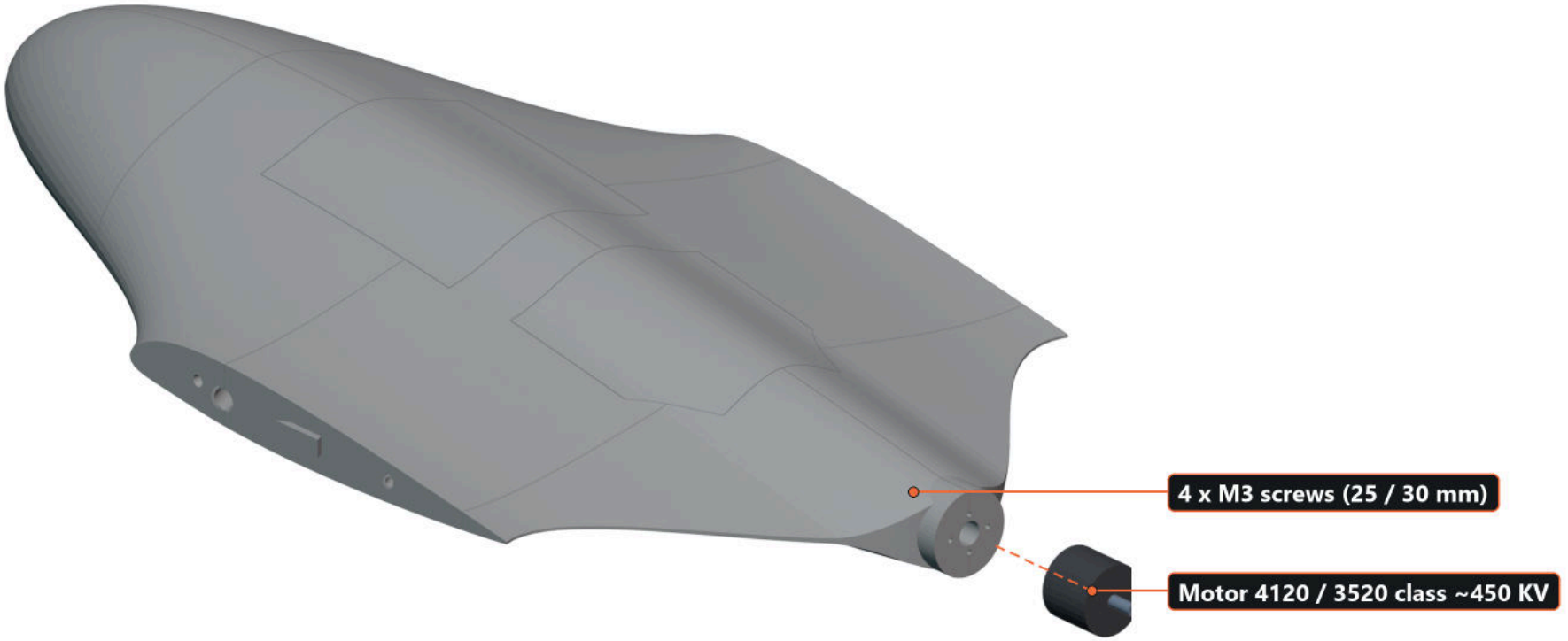


5-min epoxy | Rod 3 mm x 60 | Hinge tape | 2 x 3 mm pin

New in this step | Already built | Carbon | Hardware | PETG

1. Join **ELEVON-L1** and **ELEVON-L2** with the 3 mm carbon rod (**60 mm**) and 5-min epoxy. Check they are straight.
2. Hinge the elevon with hinge tape on top (full length) or 4 CA hinges. It must move freely 20° up and down.
3. Fit the horn in line with the servo arm; connect with a 1.5 mm pushrod.
4. Glue two 3 mm pins (**25 mm**) into the tip and glue **WINGLET-L** on.

09 Pusher motor



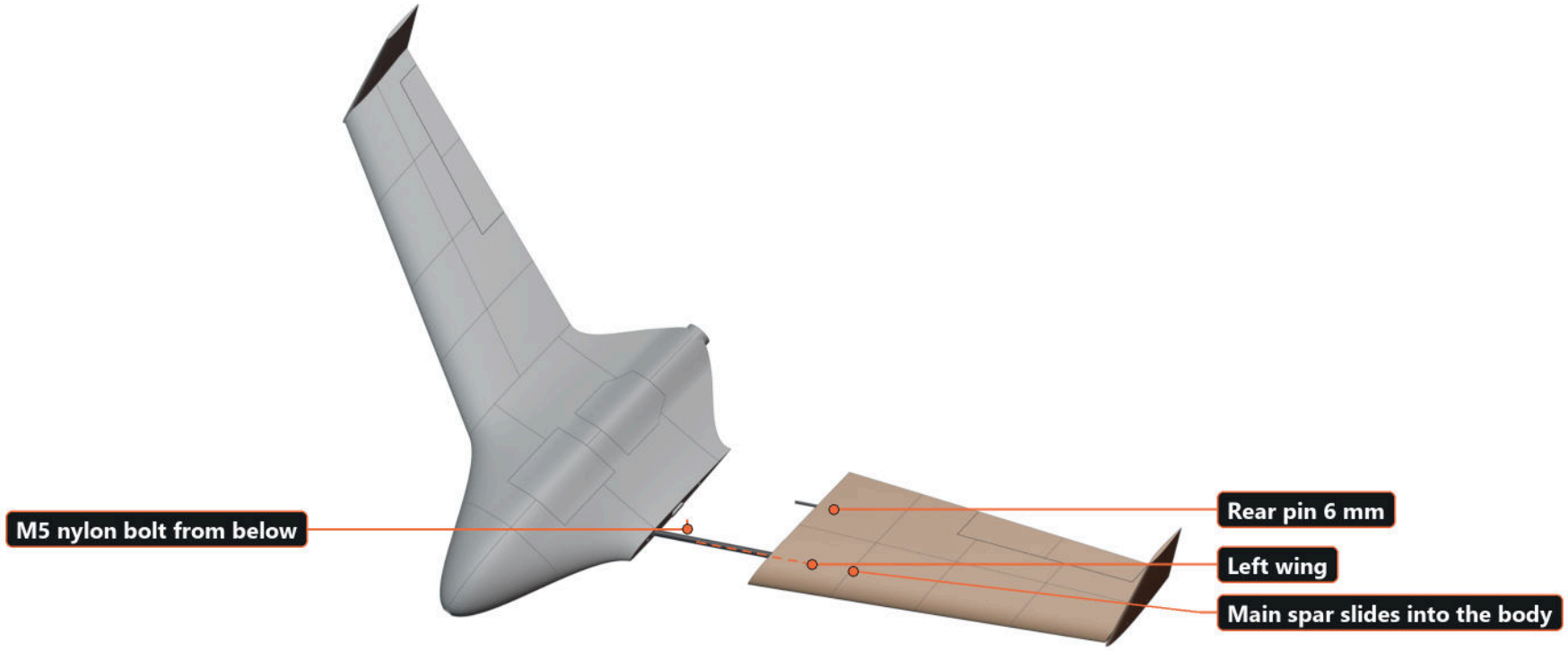
4 x M3 + thread lock | 14 x 8 folding prop

1. Fix the motor to the tail boss with 4 x M3 screws (25 / 30 mm pattern) and thread lock.
2. Run the wires through the boss into the rear bay (under HATCH-H2).
3. Fit the 14 x 8 folding prop; check it clears the body and elevons.

Important: Never fit the propeller while you set up or test on the bench.

New in this step | Already built | Carbon | Hardware | PETG

10 Wings on



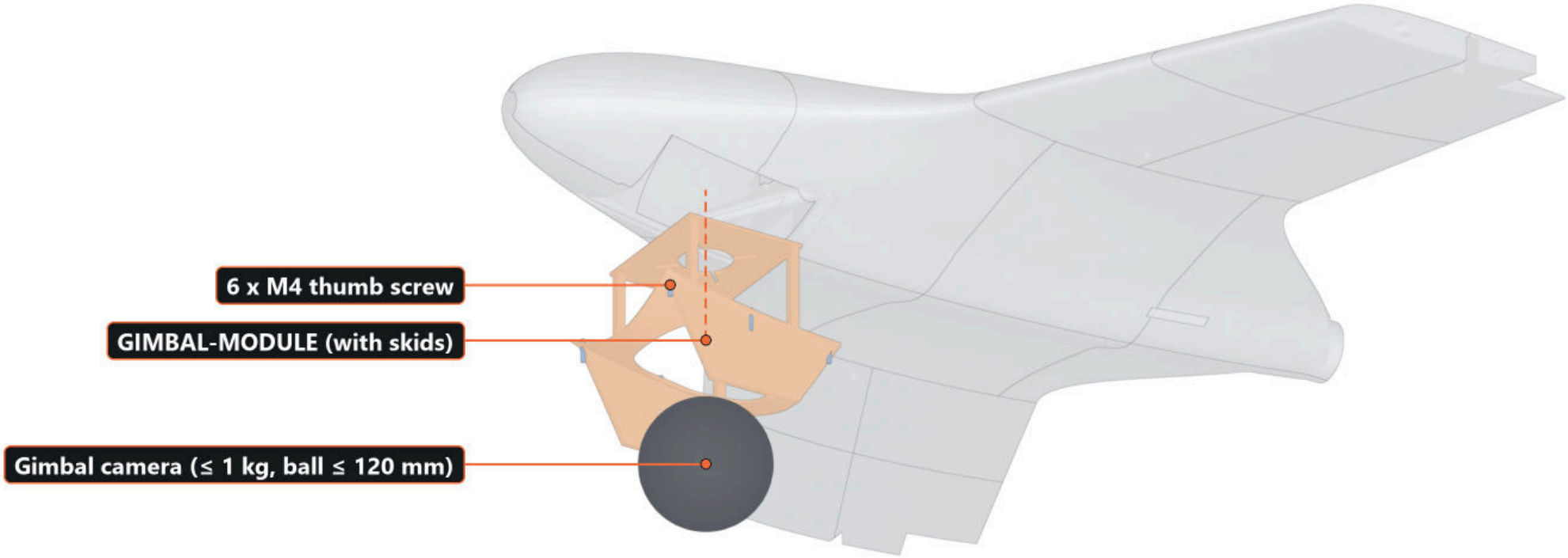
2 x M5 nylon bolt

1. Feed the servo wire into the body.
2. Slide the left wing on: its main spar goes into the sleeve in the body (the two spars cross one above the other).
3. Push until the 6 mm rear pin is home and the root sits flush.
4. Lock with one M5 nylon bolt from below. Same for the right wing.

Tip: For transport: undo one bolt per side and slide the wings off.

New in this step · Already built · Carbon · Hardware · PETG

11 Gimbal module



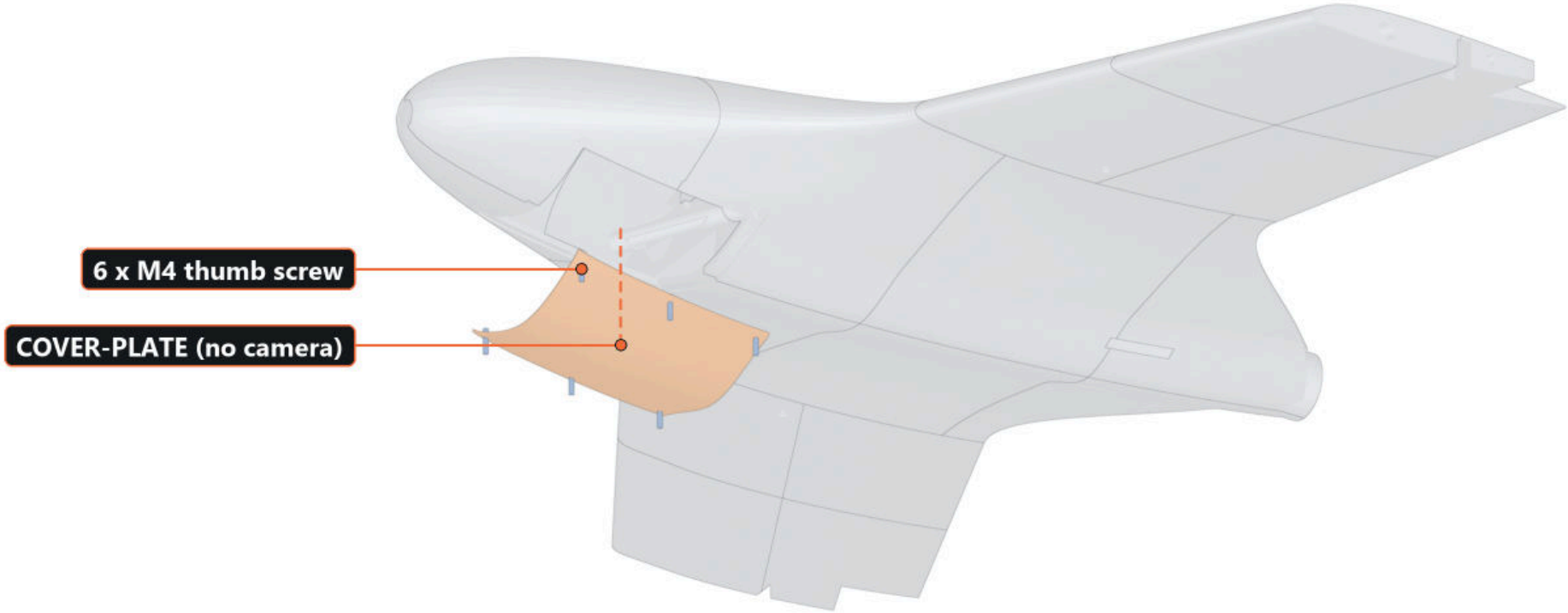
6 x M4 thumb screw | M3 for the damper plate

1. Bolt the gimbal damper plate to the deck of **GIMBAL-MODULE** (4 radial M3 slots fit square patterns of about 32–64 mm; 50 mm cable hole).
2. Plug in the gimbal cable, push the module into the belly opening and fix it with the **6 M4 thumb screws**.
3. The skids are 8 mm lower than the camera ball: the plane lands on them. Set the gimbal to look backwards / up for landing.

Important: Balance again every time you change the payload: CG 462 mm from the nose tip.

New in this step | Already built | Carbon | Hardware | PETG

12 No camera: cover plate



6 x M4 thumb screw

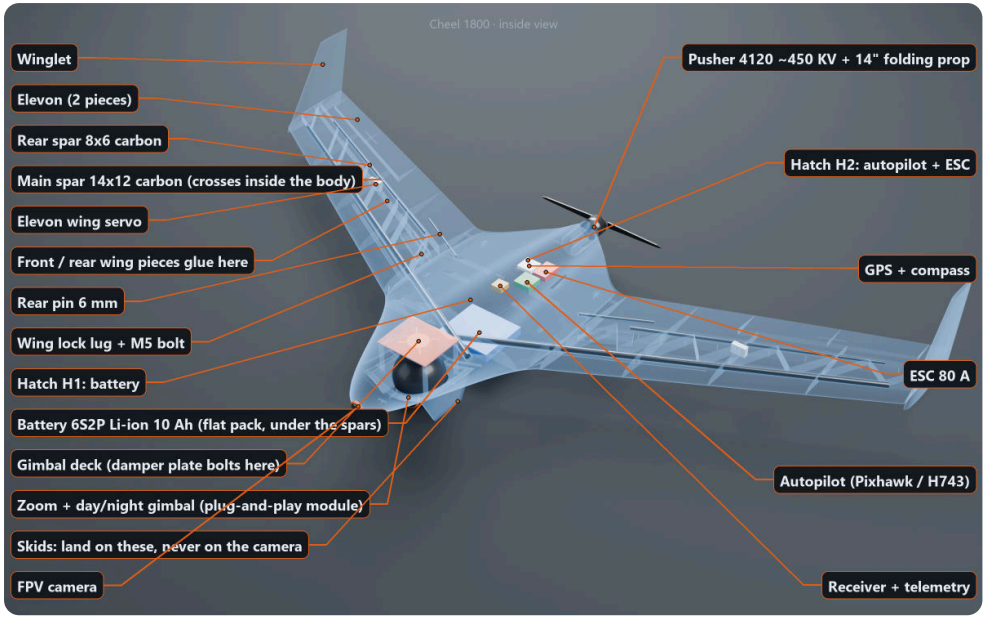
1. Remove the gimbal module (6 thumb screws).
2. Fit **COVER-PLATE** with the same 6 thumb screws.
3. Move the battery forward to bring the CG back to 462 mm (the gimbal weighs about 1 kg ahead of the CG).

Important: Without the gimbal the wing is tail-heavy until the battery moves forward.

New in this step · Already built · Carbon · Hardware · PETG

ELECTRONICS

Where everything goes



Part	Where
Battery	6S Li-ion flat pack under HATCH-H1, below the spar crossing. Velcro strap. Slide it forward / back to set the CG.
Autopilot + GPS	Under HATCH-H2 on foam tape, arrow forward. GPS (PPK / RTK for mapping) on top, away from the ESC.
Pusher ESC	Rear bay, over the cooling slots in the floor.
Elevon servos	Wing pockets; extensions through the wire channel into the body.
Gimbal	In the module; its cable and power go up into the body. Separate 5–6 V or 12 V BEC as your gimbal needs.
FPV camera / radio	Small FPV camera in the nose port; receiver antennas out of the side, 90° apart.

Autopilot outputs (ArduPilot)

Output	Function
SERVO1	77 – Elevon left
SERVO2	78 – Elevon right
SERVO3	70 – Throttle (pusher)
SERVO4	Mount tilt / camera trigger (as needed)

Setup, CG and first flight

	Setting
Elevon throws	Roll ± 12 mm, pitch + 10 / – 8 mm at the elevon root. 30 % expo to start.
Elevon trim	About 1–2° up (1–2 mm) at neutral: the reflex the wing needs.
Directions	Stick back: both elevons UP. Stick right: right elevon UP, left DOWN. Check in MANUAL and in FBWA.
CG	**462 mm behind the nose tip**. Balance with the payload and battery you will fly. Level or slightly nose-down.
ArduPilot basics	Plane firmware, flying wing: SERVO1/2_FUNCTION 77/78, SERVO3_FUNCTION 70. Calibrate accel, compass, radio. Camera trigger: CAM1_TYPE.

First-flight checklist

1. Weigh the plane and check the CG at 462 mm with the payload fitted.
2. Elevons move the right way in MANUAL and FBWA.
3. Failsafe set (RTL) and tested with the radio off.
4. GPS lock, home set, compass calibrated.
5. Gimbal module screws tight; gimbal parked for landing.
6. Hand / bungee launch: full throttle, wings level, slightly nose-up into the wind. Climb, trim, land on grass on the skids.

New design: numbers are calculated from the CAD, not yet flight-proven. Start with gentle flights and adjust the CG in 5 mm steps.

Need help? Email info@layerwings.com with a photo of your build. Free tools: layerwings.com/tools/

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