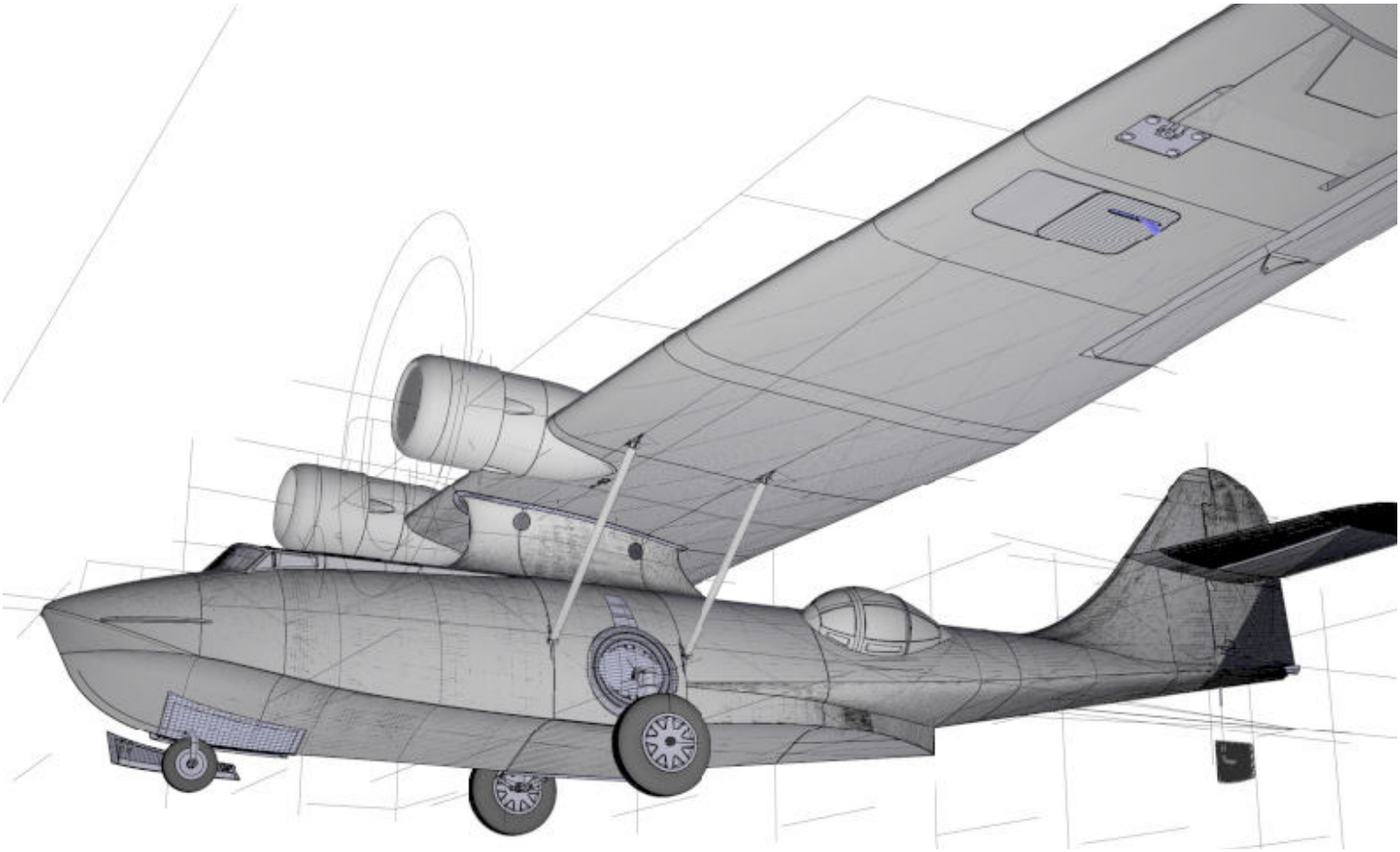


Institute OF THE Flying Arts

PRESENT:

Consolidated PBY Catalina

BY

Martin Klöpfer

Historical

The **Consolidated PBY Catalina**, also known as the **Canso** in Canadian service, is an American flying boat and later an amphibious aircraft of the 1930s and 1940s, produced by Consolidated Aircraft. It was one of the most widely used seaplanes of World War II. Catalinas served in with every branch of the United States Armed Forces and in the air forces and navies of many other nations.
During World War II, PBYs were used in anti-submarine warfare, patrol bombing, convoy escort, search and rescue missions (especially air-sea rescue), and cargo transport. The PBY was the most numerous aircraft of its kind and the last active military PBYs were not retired from service until the 1980s. In 2014, nearly 80 years after its first flight, the aircraft continues to fly as a water-bomber in aerial firefighting operations all over the world.

About the model

This is the semi-scale model of a Consolidated PBY Catalina with about a 1.7 m wingspan. The files include two fuselages, one wheeled and one flying-boat only. Since the water version will still need some servo-less retracts for the floaters, the wheeled version can use a fixed mount but comes with a fully functional landing gear including the fancy nose-gear door mechanics and is pretty much using standard-servos.
Almost any of the gear-parts needed are 3D printed and you 'll have to get not much more than some (okay... many) tiny din-screws, springs, aluminium rod, some steel wires and a brass tube from Jeff or your local hardware store.
As improvement to the former version, I added structured canopies for the rear blisters, making access to the rear section that way and changed the wing-struts to PLA material, which reduces metal works and soldering to a minimum.

Initially, the wheeled fuselage wasn't meant to be used in the water at all, since you have an extra fuselage for this, but switching to Prusa slicer changed a lot and it looks, though untested, as if it might be possible to caulk it and enjoy some beaching manoeuvres.

Parameters

Scale ca.:	18: 1
Wingspan:	1702 mm
Length:	1046 mm
Print weight ca.:	1500 g
Weight fully equipped ca.:	2600 g
Wing profile:	Clark YH modified
Speed:	moderate

Requirements

All parts were printed on a Prusa Mk3.
Minimum print volume : 200×200×180mm.
Recommended nozzle : 0.4 mm for PLA and 0.6 or 0.8 mm for flex
Slicing software : Prusa slic3r 2.7.0

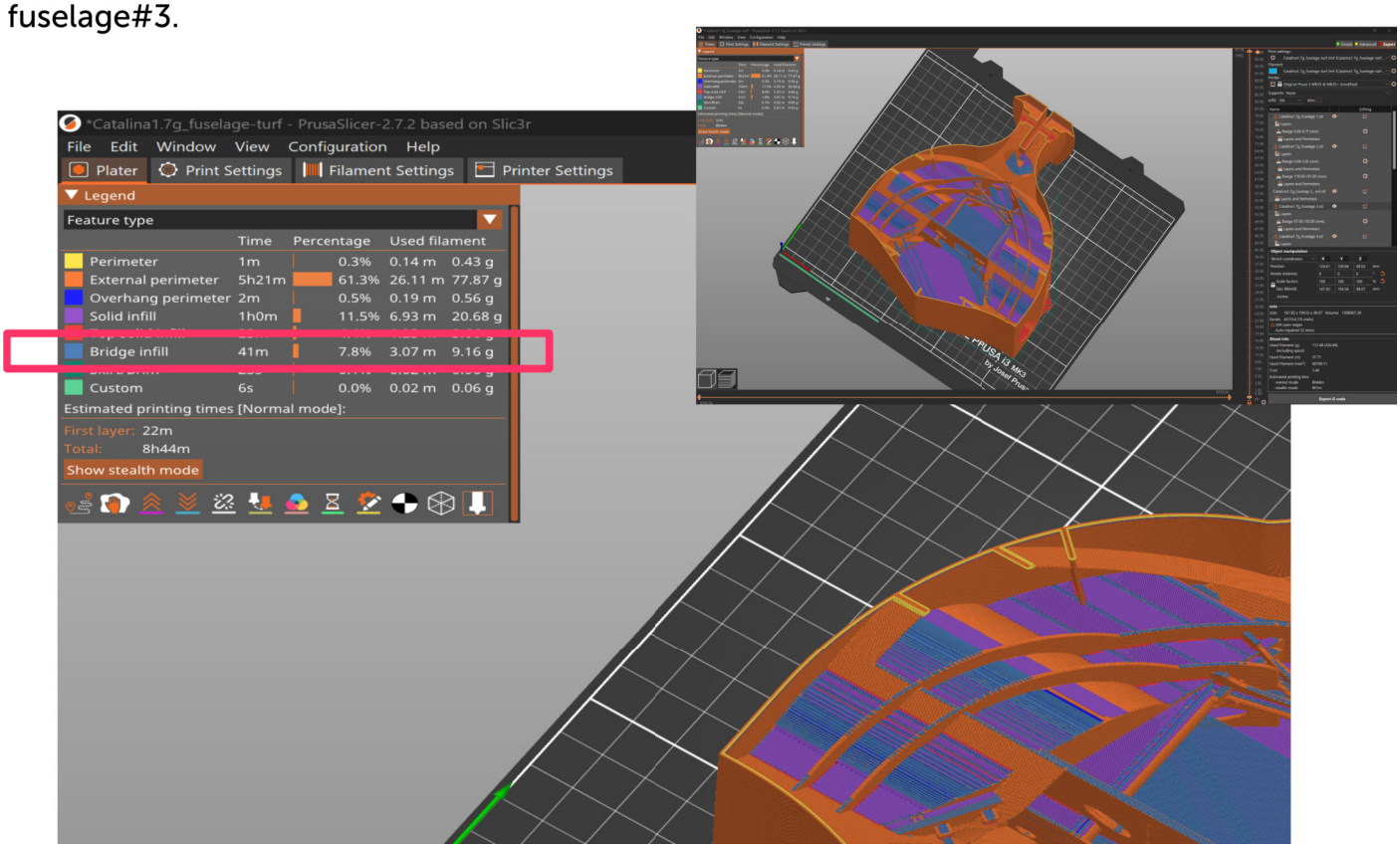
Print settings

- Hull parts: I use the thin wall printing template from the 3DLabprint site. These parts and are fine with any standard or effect PLA you might like.
- Tires: the g code is sliced for flex-foam, or vario-shore TPU, which prints very nicely. But you can use any of the softer flex materials for the tires.
  I've scaled the main tires to 98% to fit easier into the wheel cut-outs.
- Gear parts: Are basically sliced with 0.2mm QUALITY settings, but with an additional 3rd perimeter.
  Here the right choice of the PLA is crucial! PLA properties are changing with the colour and the rule is: The more pigment or glitter-thingy in it, the softer and weaker it gets. Less pigment on the other hand means stiffer and tougher, but also more brittle.
  Clear filaments work, but tend to break early on hard shocks. White, black and the very most uni-colours work good, silver is bad and so is matte material.

  Exception: The four stabilizers of the bumpers work best when printed with PET or XT for flexibility.

Important information on Prusa-slicer settings

As mentioned before, the new Prusa-slicer (PS) brings along some fine features, of which we can take good advantage in thin-wall printing. Those of you, having printed LabPrint models before, will notice some differences in the sliced files, especially in fuselage#3.



The light blue lines, called bridge infill, appear when you turn on top and/or bottom layer in the print-settings. PS uses these as "quick and cheap" supports for unsupported overhanging top or bottom layers, which might cause the print to fail.

When printing standard parts this is often a sign of faulty 3D data, but here we take advantage of it and can now close the planes that are over 45° degrees. Even horizontal planes work! PS spans the bridge infill like washing lines in the layer before. Sometimes this might not get perfect, but its way better than completely leaving the planes open.
In the end most of the stings can easily be removed by hand or tweezers or just stay inside. (In case of fuselage#3 you'll need to remove the middle ones of course.)

Unfortunately I found this not well documented but some old discussion in the forum:
https://forum.prusa3d.com/forum/prusaslicer/turn-off-bridge-infill/

Bill of material

Drive settings:

2x Turnigy D3530/14 1100KV or similar 3530-35 1100kv
2x 30A Electronic Speed Controller or similar 30-40Amps
XT 60 or XT 90 connectors
Turnigy 5000mAh 3S 30C or similar
16AWG wire red and black
Shrink tube
Propellers: You can use a CW/CCW pair of two blade 9/6 or 9/4.5 props or try this 9/5 CW/CCW 3 blades

Servos, RC, etc.:

Radio system, with at least 8 channels or more
7x 9g Servo HXT900, or better 12g servo MG90S
1x MG996R standard size servo, 11kg
2x main landing gear servoless retract (only needed for articulated floaters)
3x Y-servo cable
4x 100cm servo lead extension
2x 20cm servo lead extension
2x 30cm servo lead extension
7x push rod connectors
AC hinge sheet or similar
CA glue - medium or similar medium viscosity CA glue
Activator for CA glue or similar
2x 1.7mm or 2mm threaded pushrods
1x elevator linkage lever In case you don't trust the printed part.
∅ 3mm spring steel wire, approx. 40 cm (from your local dealer)
∅ 3mm silver steel wire, approx. 30 cm
∅ 4mm x 0.5mm Brass tube, approx. 10cm
∅ 6mm Aluminium rod, approx. 10cm
2x compression spring, ∅6mm x 20mm with 0,8mm wire
4x steel pushrod, ∅ 1.0mm, 2pc. with 1m should be good
5x neodymium magnet ∅5mm x 1mm
5x M4 washers
Silicone sealant or my favourite: FixAll CRYSTAL from SOUDAL
Velcro strip for Li-Po battery
Some grease
Masking tape

Screws:

- 4x m2×6mm, countersunk
- 2x m2×10mm, countersunk
- 12x m2×7mm, cylinder
- 8x m2×10mm, cylinder
- 16x ∅1.2-2.2×9mm, self taping
- 28x ∅3×10mm, self taping, countersunk
- 8x ∅3×12mm, self taping, countersunk
- 2x ∅3×20mm, self taping, countersunk
- 2x m3×6mm, pan-head
- 1x m3×20mm, pan-head
- 5x m3×12mm, countersunk
- 1x m3×14mm, countersunk
- 2x m3×16mm, countersunk
- 1x m3×6mm, cylinder
- 2x m3×8mm, cylinder
- 1x m3×10mm, cylinder
- 10x m3×16mm, cylinder
- 1x m3×26mm, cylinder
- 1x m3×30mm, cylinder
- 2x m3×36mm, cylinder
- 2x m3×50mm, DIN912 cylinder
- 2x m5×30mm, nylon screws and nuts

Tools

- Scissors
- Snap knife
- Some screwdrivers and Allen keys
- Pliers (a Z-bending pliers is very helpful)
- Tweezers
- Hammer
- Bench vice
- Rotary-tool (Dremel) or angle-grinder (to cut the spring-steel rods)
- Drill or best a drill-press
- Drills: 1.0mm, 1.5mm (better 1.7mm), 2.0mm, 3.0mm, 4.0mm
- Soldering iron and hot tool (a gas-torch with metal snap-knife works well)
- Tissue for wiping off CA glue
- Print of the wire-pattern PDF. (Print 1:1 on DIN A4 paper.)

Assembly instructions

Please note: The videos linked in this user-guide are from the flying-boat version and going to be updated, but contain helpful information. So use them more as a guideline and refer to this manual in case.

Part 1a: The fuselage with gear

Gear parts in general:

My focus when designing and slicing the gear parts was on more on stability and structure than on printing-speed and convenience. So there are lots of support-structures to be removed and parts to be cleaned. I prefer using a drawing blade better than sanding or filing PLA material. (Try drawing with the snap-knife blade! It works very well for me.)

-All 1mm holes for the push-rods are printed too tight by means to keep the backlash small. They need to be opened with a 1mm drill. → Since this is best done by hand, I advise making a simple tool by glueing a 1mm drill into a piece of wooden 5-10mm rod.

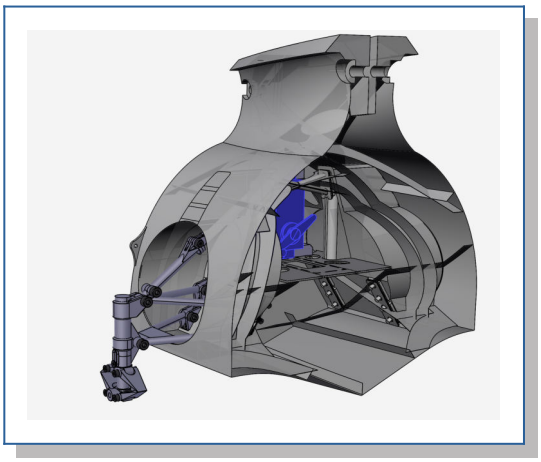
-Give special attention cleaning the axles, but don't overdo! They are meant to have tight fit to the control horns attached. If these connections get too loose, cross piercing with a hot needle helps best, when everything in place. (CA-glue tends to jam the bushings next to and is NOT recommended here!)

-Many of the gear-screws work as connection and axle at the same time. Tighten this screws carefully until the joints start to go hard, then move joints a few times to work in the face-sides and loose the screws again until the joints are running smooth and freely. Secure the screws with a tiny drop of CA glue to the thread, if necessary.

Main Gear

Though it is possible to install servos and mechanics to the fuselage after assembling the sections, it makes things a lot easier to do as much as possible in advance. So we will start with the main-gear in Section #3.

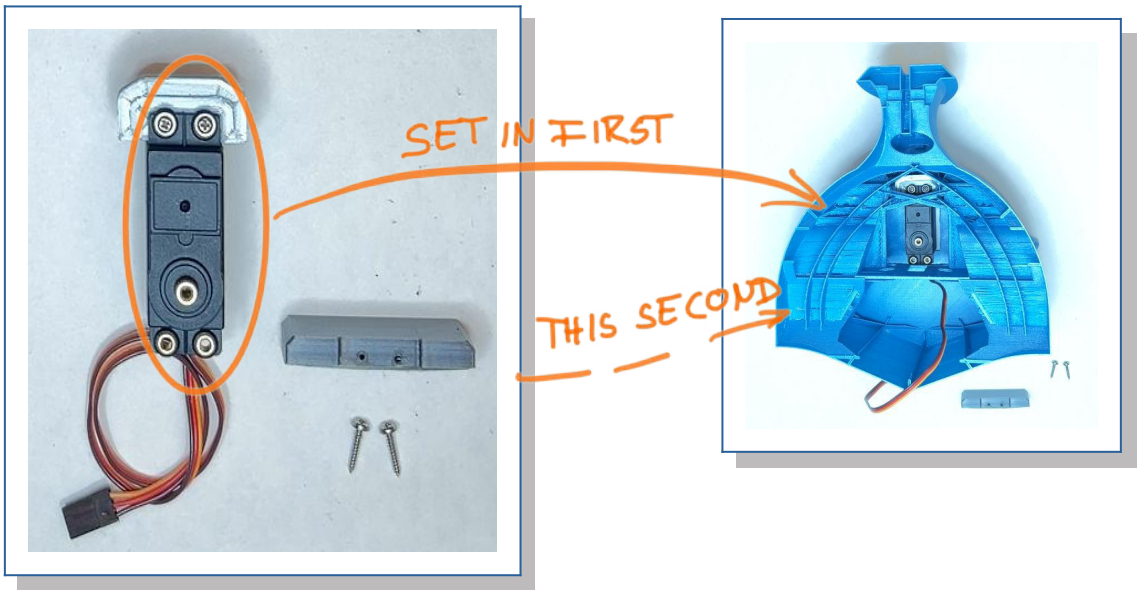
As you'll notice there are more options to mount the servo, but the horizontal ones require ball heads on the servo horn and are not so easy to adjust.



Please prepare:

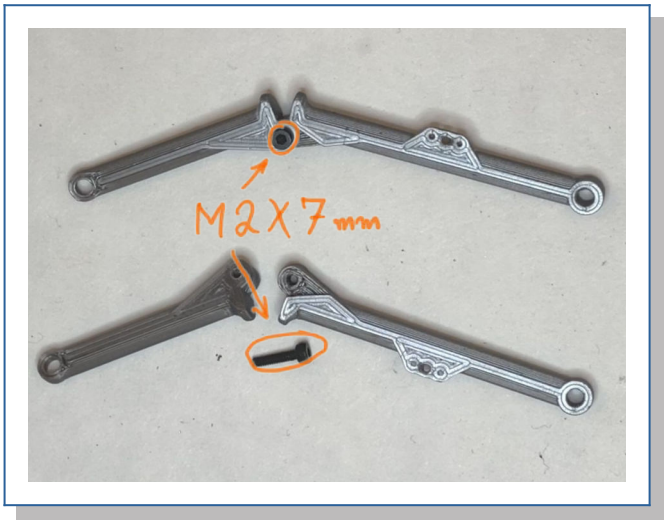
- ✗ fuselage section #3
- ✗ all parts named "_main-gear_", except the rims and tires. (See 3mf-file.)
- ✗ gear-servo mounts #1 and #2
- ✗ MG996 servo with mounting parts
- ✗ ∅6mm aluminium rod
- ✗ 2x compression springs
- ✗ push-rods according to wire-pattern sheet
- ✗ 2x push-rod connectors
- ✗ Screws:
  - 2x m2×6, countersunk
  - 2x m2×7, cylinder
  - 8x m2×10, cylinder
  - 2x m3×8, cylinder
  - 2x m3×16, cylinder
  - 12x m3×10, cylinder
  - 20x ∅3×10, self tapping, countersunk

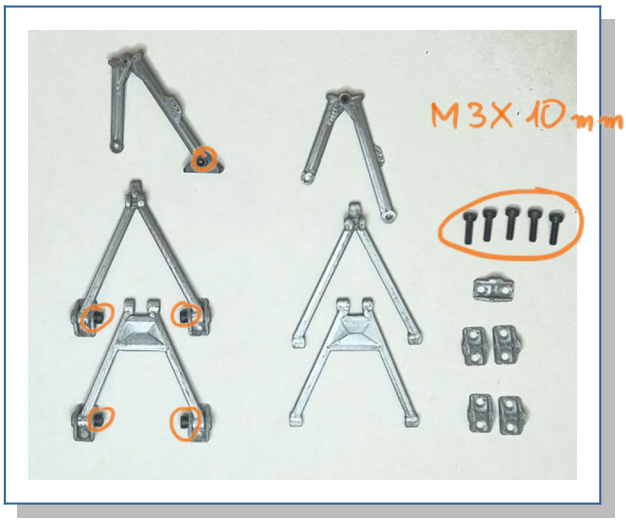
1. Start equipping the servo with its attachment accessories and use a hot needle to make holes for the screws in the servo mounts. Screw the upper (small) servo-mount to the servo and bring it into position in the fuselage.



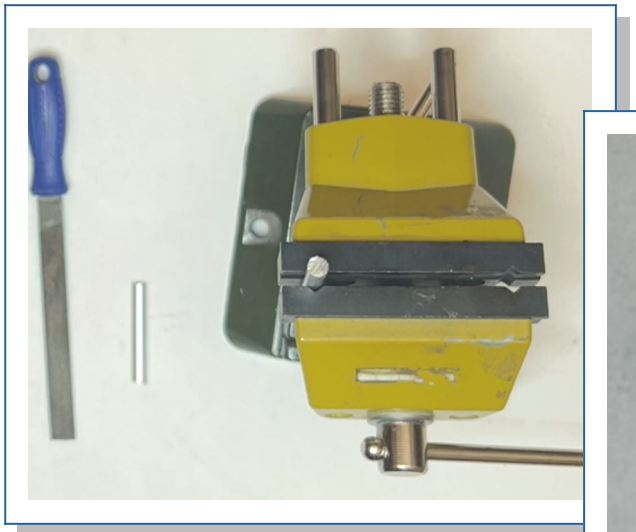
2. If necessary cut an opening into the bulkhead. Then bring the lower servo-mount into position and attach it to the servo as well, check if the servo is aligned correctly with the bulkhead and glue the mounts to the fuselage.

3. Make the two elbow-joints from the upper and lower struts using the m2x7 screws, equip them and the upper and lower arms with the gear-mounts using m3x10 screws and make sure all joints are running freely.





4. Use a saw or rotary-tool to cut the ∅ 6mm aluminium rod to length, according to the wire-sheet. Next even the saw marks, true the face-sides and give a good 1x1mm chamfer to the rod-top with a fine-tooth file.



5. For the 3mm hole use the bumper-shoe to find the correct position and drill slowly and carefully trough. (I have put additional parts to the g-code as they usually break and melt in this procedure.)
   Next mark the position of the 1.7mm hole, drill only around half way trough and deburre the hole with the snap knife.
   Then use a good new m2 screw, preferably with Allen- or "Torx"-drive to work in a thread. Begin slowly with 1-2 turns, care for angle and unscrew again. Then gain more depth each time and remove chips in between. (Of course you can use a 2mm tap for this, if you have one. Just drill trough and cut the 2mm thread then.)

<u>Hints:</u> 1.Use file and make a small plane, where you plan to puncture and drill.
2.Turning in some long m3 screw will help to aim for correct alignment, when drilling without rig.

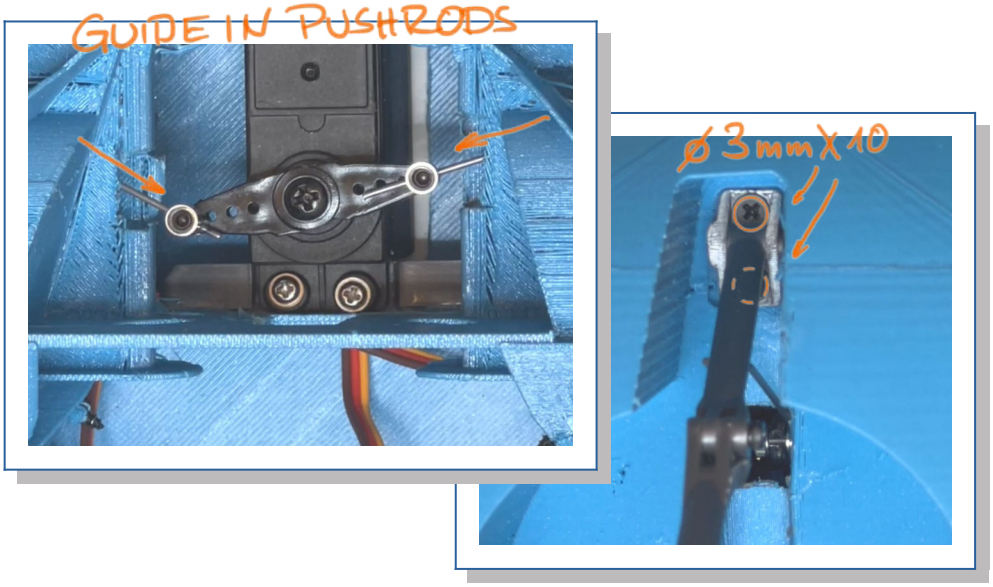
6. Insert the spring into the bumper housing followed by the ALU rod then use a new m2×6 countersunk screw to secure it in place. Check for easy movement.

Congratulations!! You just made the hardest part of the metal work!

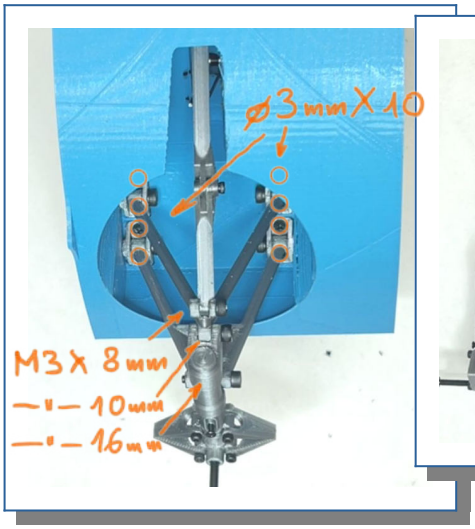
7. Complete bumpers with the stabilizers. Carefully bend in shape, past use m2×10 screws to join. Check for good movement again.

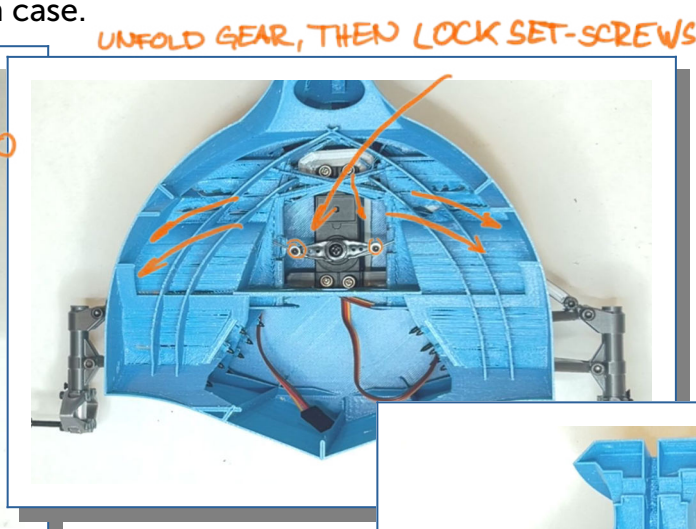
8. Now use the elbow-joints assembled before, to mark the openings for the push rods and cut them out with the hot tool.
   Prepare the elbow joints with the push rods and the servo horn with the push rod connectors.

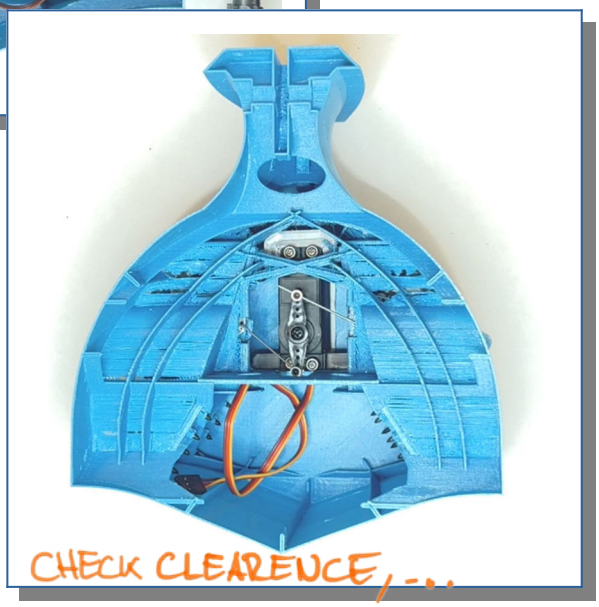
9. Install the servo horn and bring into horizontal position, then guide the push rod into the connector and mount the strut with two ∅3mm×10 self tapping screws.

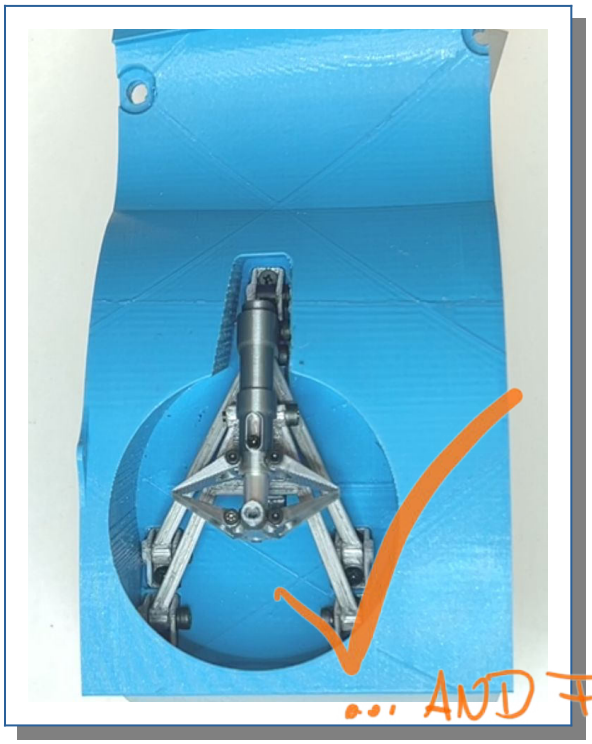


10. Fix the upper and lower arms to the fuselage (∅3mm×10 self tapping) and then connect to the bumpers using m3×8, m3×10 and m3×16 screws.
With the servo horn still in horizontal position unfold both sides of the gear by hand, then lock the push rods with the set screws. Use a servo tester or your RC to check for any collision and remove in case.



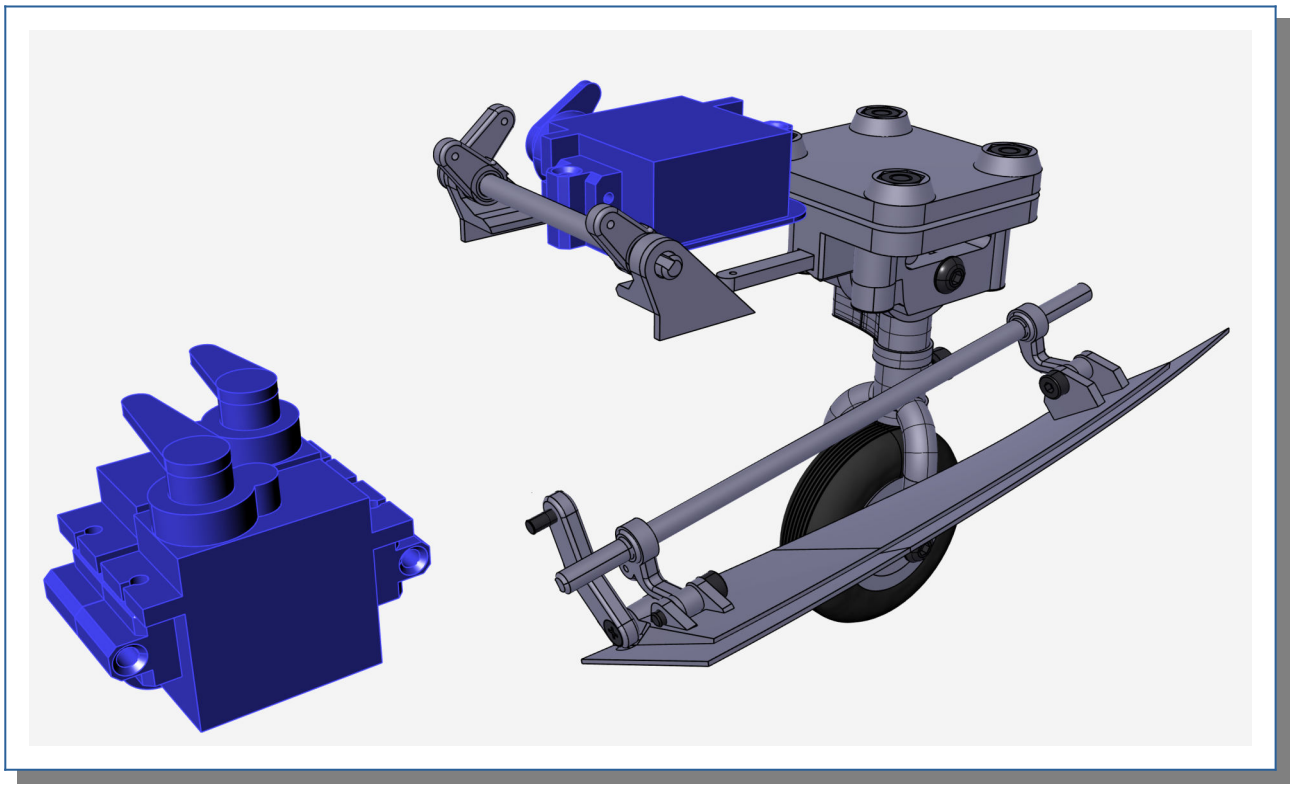






Nose Gear

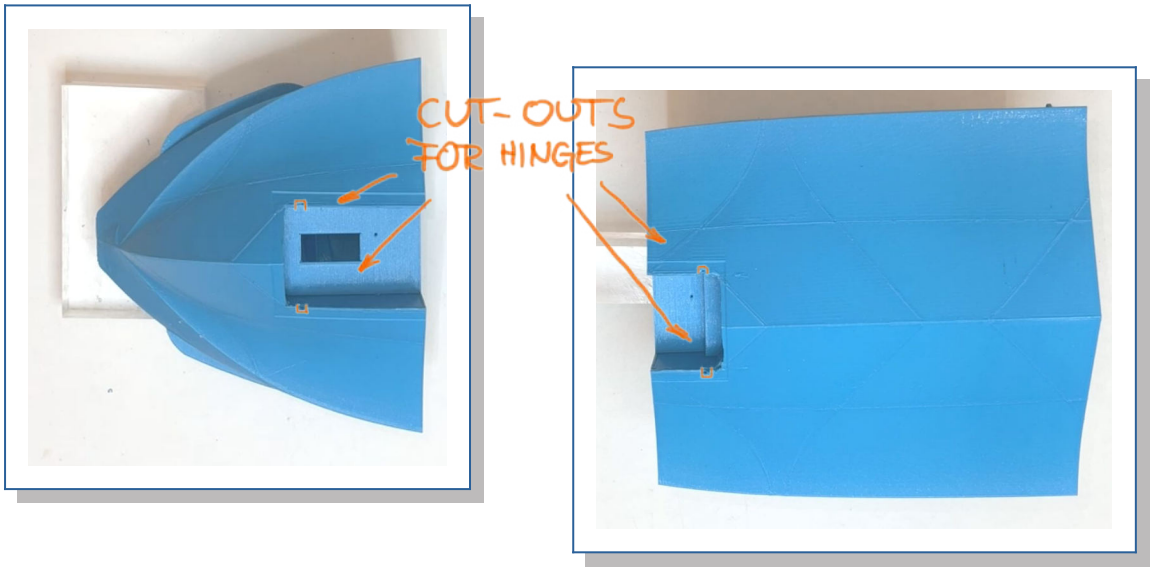
-Pay attention when screwing in the long screws for the first time! The holes are designed to get their threads cut by the screws. This causes a lot of friction and heats the screw over the PLA glass-transition temperature.
DO NOT attempt to tighten the screws when hot! This will spoil the thread.
Screw in nearly all the way down and allow to chill for a few minutes before finally tightening.
-Give extra care for good travel when assembling the nose-gear mechanics, especially to the nose-gear housing and the central piece some filing will be necessary to gain perfect fit and function. When assembled, you should be able to manually operate the gear by the servo-rod without serious resistance.



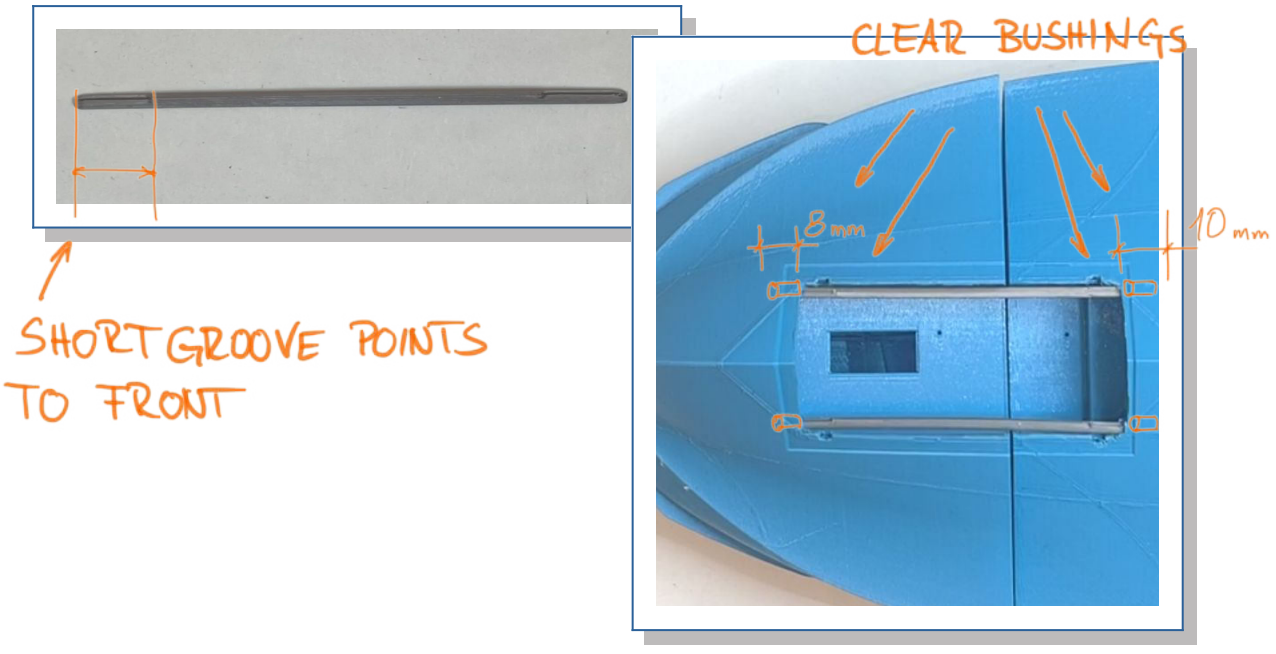
Please prepare:

- ✗ fuselage sections #1 and #2
- ✗ all gear parts having "_nose-gear_" in their names, except rims and tire. (See 3mf-files.)
- ✗ the nose-gear doors
- ✗ 3x servo mount
- ✗ nose-gear pushrods and sliding-rod, according to wire-sheet
- ✗ 2x pushrod connectors
- ✗ 3x MG90S servo
- ✗ Screws:
  - 2x m2×6, countersunk
  - 2x m2×10, countersunk
  - 4x m2×7, cylinder
  - 2x ∅3×10mm, self tapping, countersunk
  - 2x ∅3×20mm, self tapping, countersunk
  - 1x m3×30, cylinder
  - 2 x m3×50, DIN 912
  - 5x m3×12, countersunk
  - 1x m3×14, countersunk
  - 2x m3×16, countersunk
  - 2x m3×6, pan-head

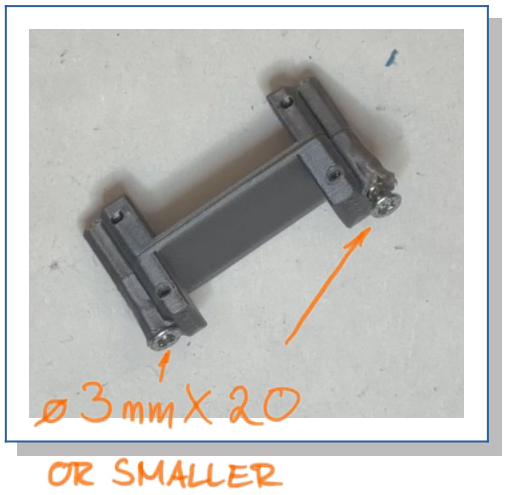
1. Use the hot-tool to cut the opening of the nose-gear bay in section #1 and #2 and clean the edge. Pay attention to the little cut-outs needed for the hinges.

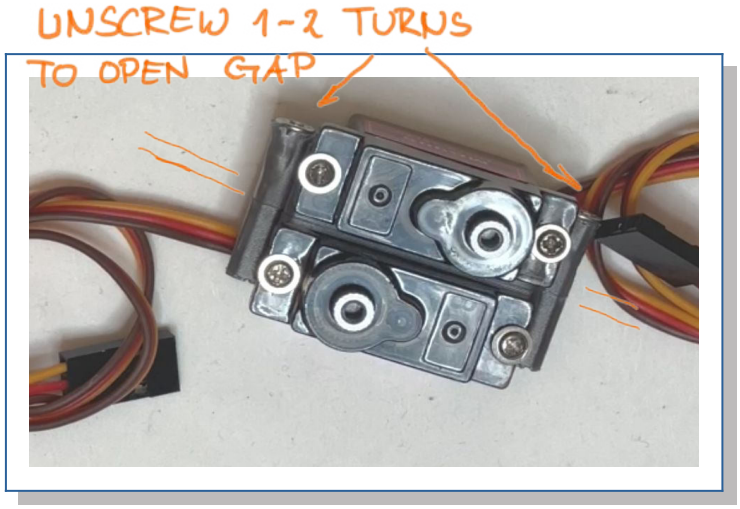


2. Use a long 3mm drill or a round file to carefully clean the door-axle bushings in the fuselage sections #1 and #2 and fit in the door axles. As the axles tend to have a tiny bulge from printing at the tips, start with sanding a little chamfer there and then sand or draw the top and bottom areas, repeatedly checking for fit and depth in the bushings of the fuselage. The axles should turn smooth, without sound and clamping and dive in about 8mm to the front bushings and 10mm into rear ones.

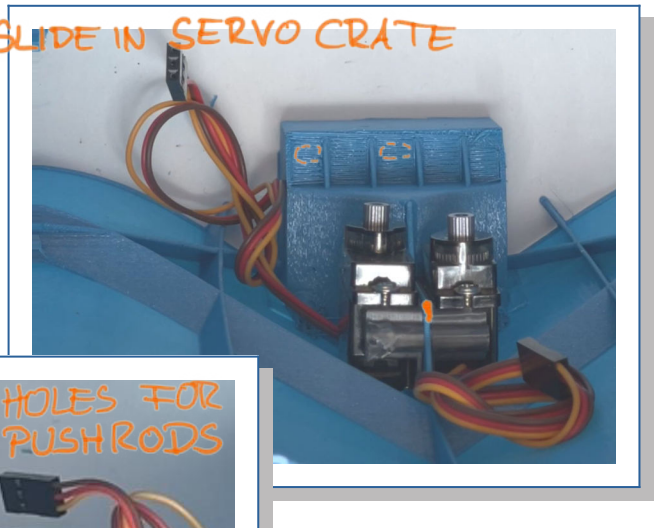


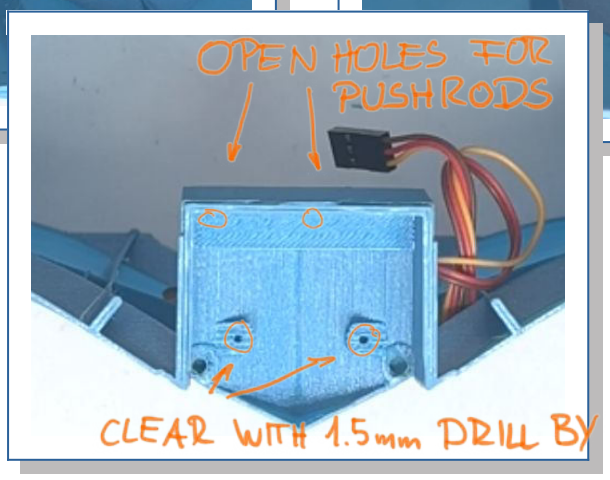
3. Take one of the servo-mounts, widen its bore diameter to 3mm and use two ∅3mm×20 self tapping screws to join it with another servo mount.
   Screw in two MG90S servos facing opposite directions.



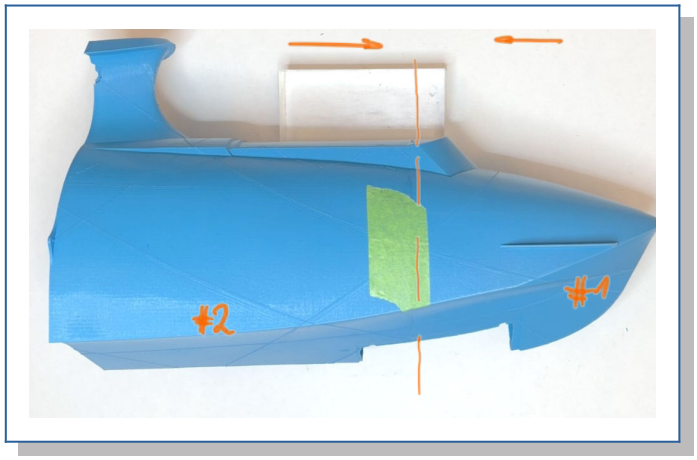


4. Loosen the two 3mm screws a little, so that there is gap of 1-2mm between the servo-mounts. Use hot-tool to open the slots for the servo attachment in the fuselage, slide along in the two connected servos and tighten the screws again.
   Use hot wire to pierce holes for the push rods and finally use a 1.5mm drill to widen the holes for the control-levers.

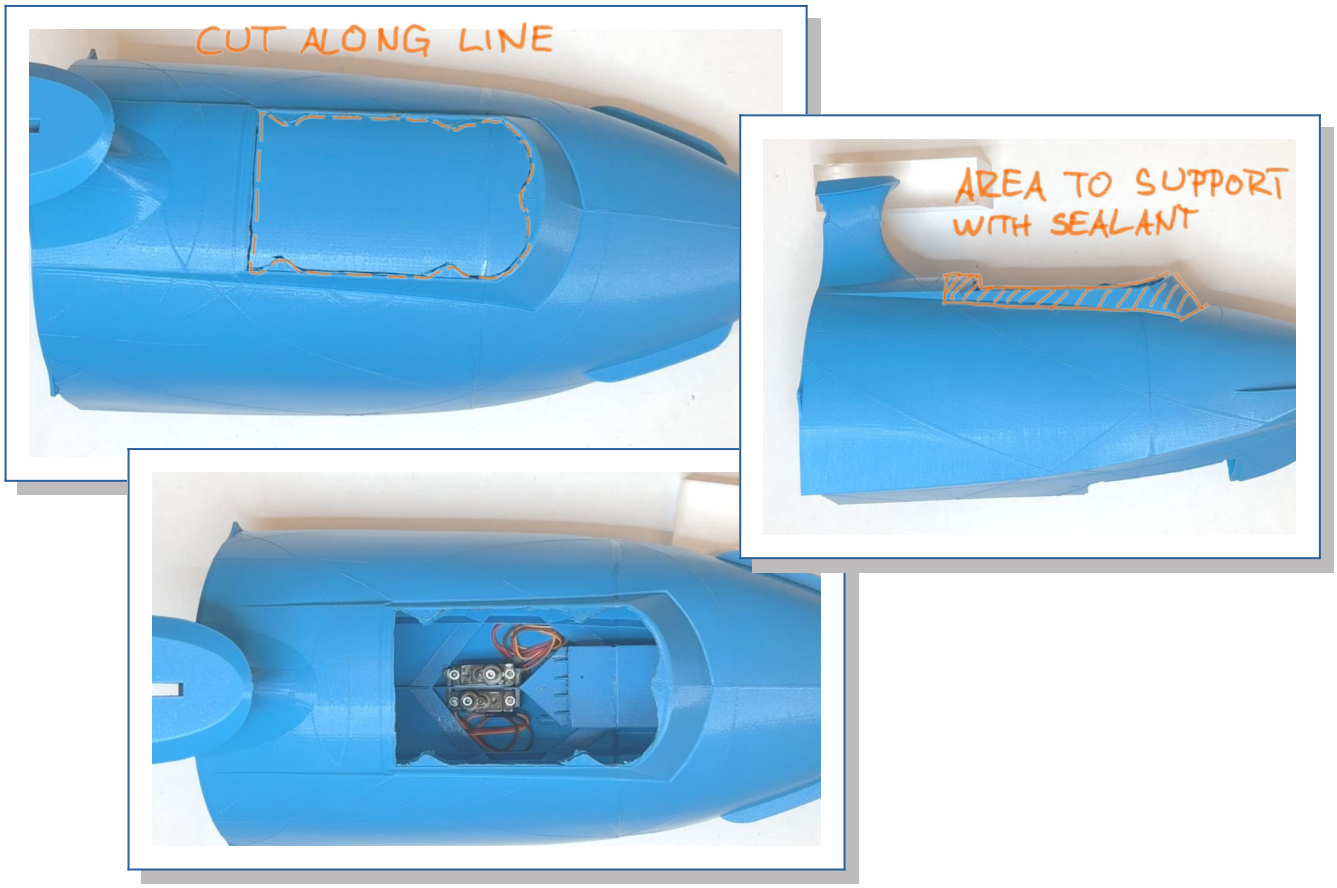




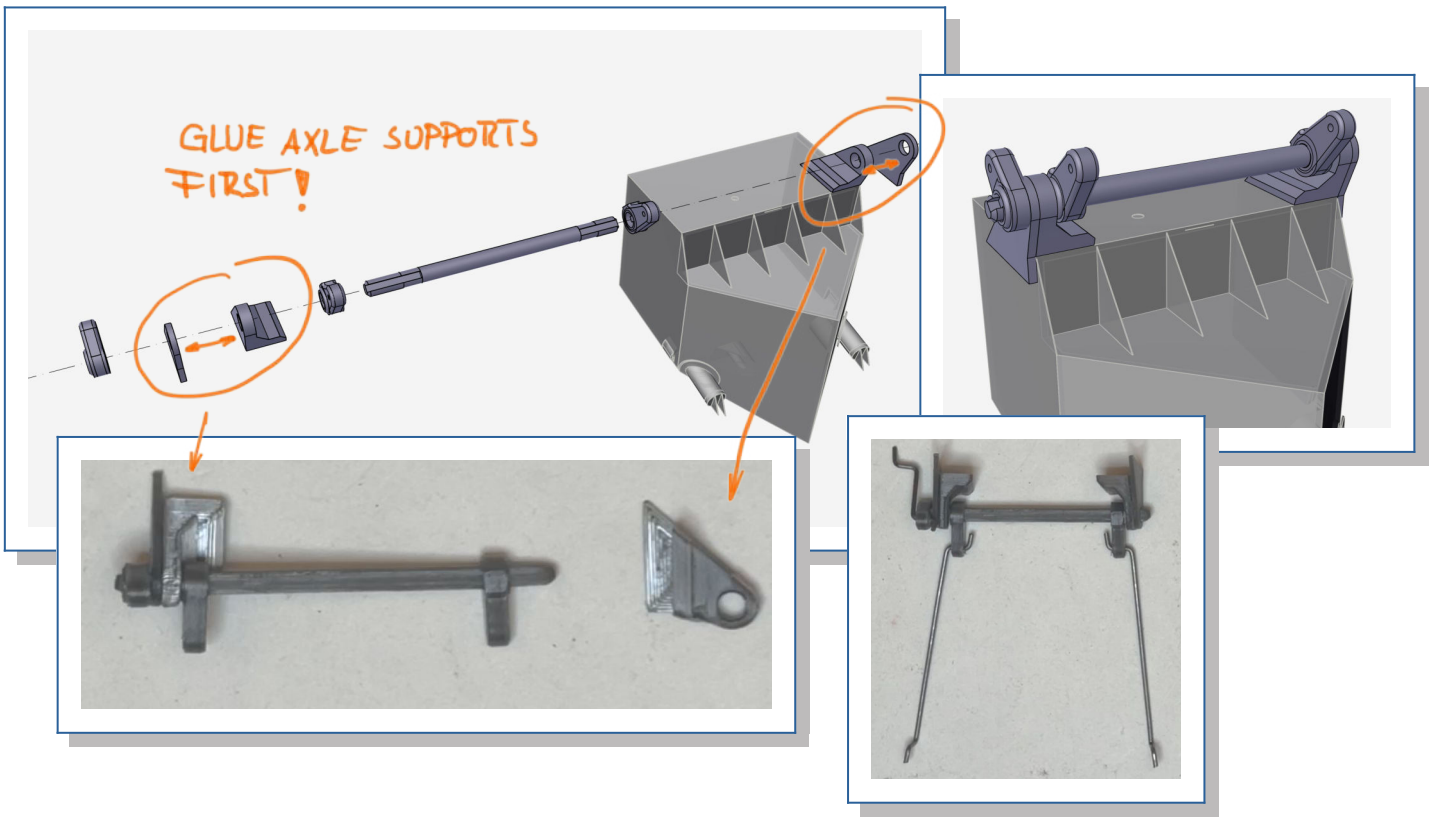
5. Align section #1 and #2, fix with masking tape and glue with CA glue.



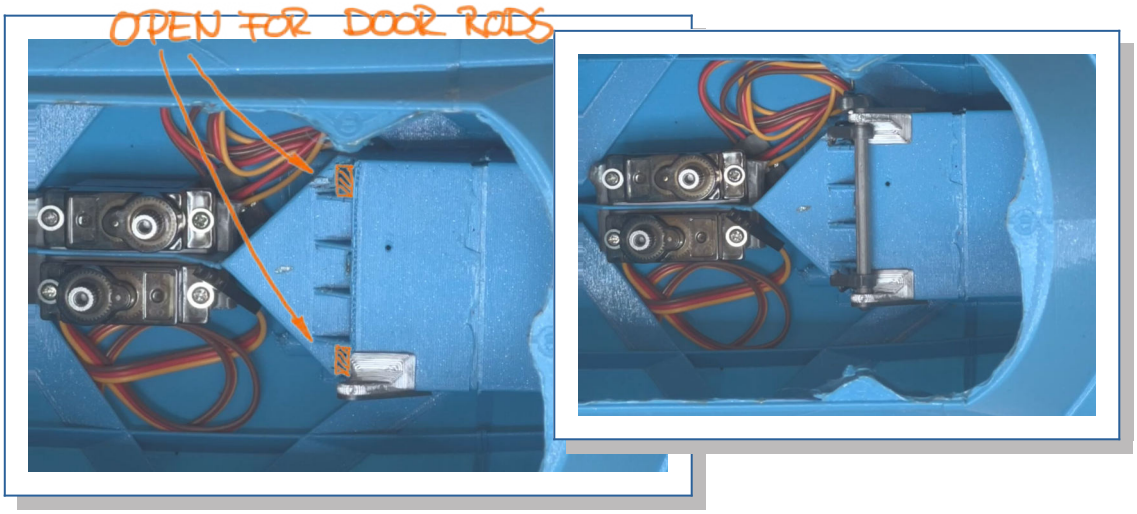
6. Open the cut-out for the canopy with the hot-tool. Since the canopy opening will be heavily stressed during installation and battery change, its a good idea to support the brim with a layer of silicone, or "Fix All" sealant. Use a short brush to apply a layer of sealant from inside the fuselage along the cut-out to the window line and allow to dry. Masking tape on outside will give additional protection during assembly.



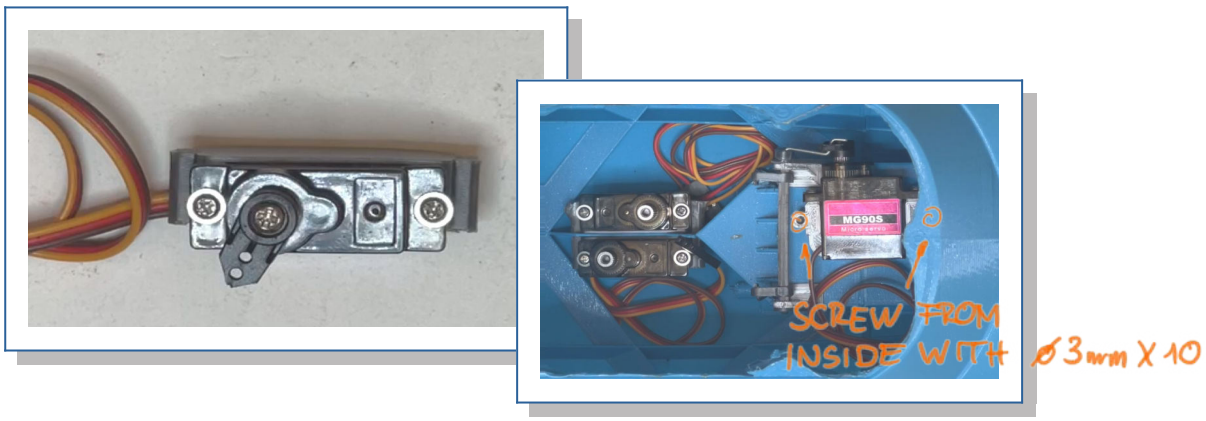
7. Glue together the left and right axle-supports, line up with the other parts according to drawing and hook the door and servo push-rods to the control horns.



8. Cut the openings for the door push-rods, ad a tiny drop of CA to the free axle support and glue it to the right rear corner of the nose-gear bay. Guide in the door push-rods and fit the axle into the support. Check for alignment, and glue in the other support. the unit to position on the nose-gear bay. Check for correct alignment and add a little accelerator to cure.

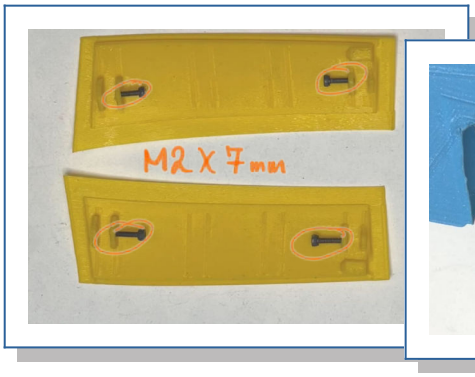


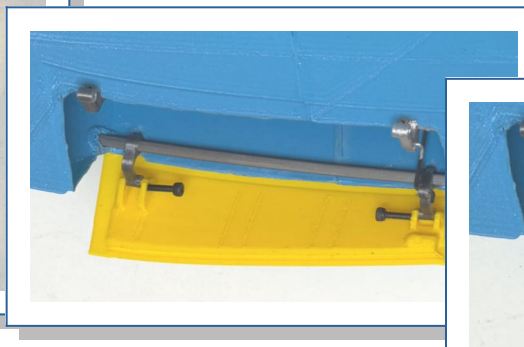
9. Fix another MG90S servo to the last servo-mount, add a short servo horn and hook the unit to the short door pushrod. Fix with two ∅3×10mm self tapping screws from inside the nose-gear bay.

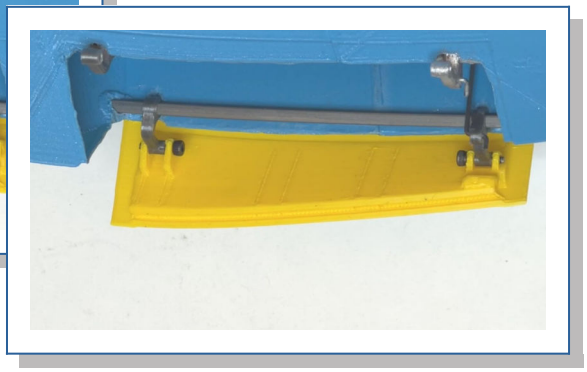


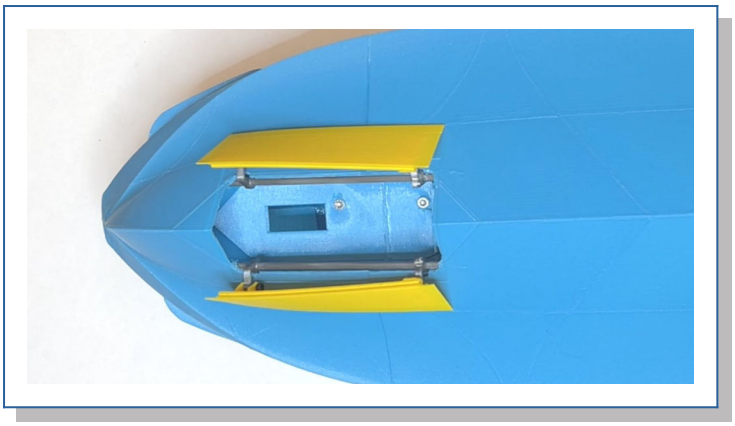
10. Clean the 2mm bore of all hinges with a drill. Connect the two rear hinges to the other side of the door pushrods. Slide the front hinges onto the side of the door axles with the short grooves.
Now take one axle, guide the side with the longer groove trough the rear hinge and into the rear bushing, bend axle a little to snap it into the front bushing. Repeat with the other side. Use servo to check for smooth and simultaneous movement, if necessary remove axles again, clear the paths and check the pushrods for angle, length and clamping

11. Take the gear doors and apply two m2x7 cylinder screws each, but set in only a few turns to keep clear the opening for the hinges. With the hinges in "open" position bring in first door and use a long Allen key to close the screws. Move door and adjust cut-out if necessary, continue with second door.

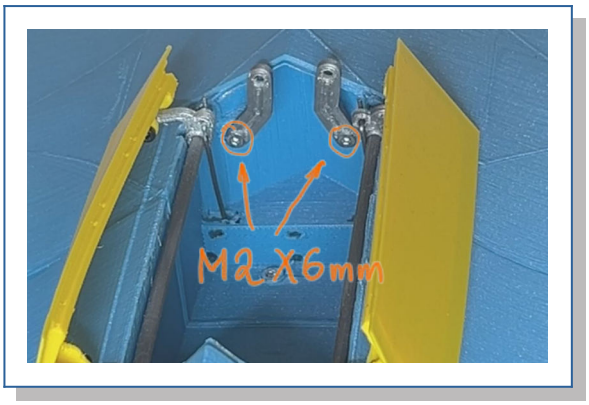


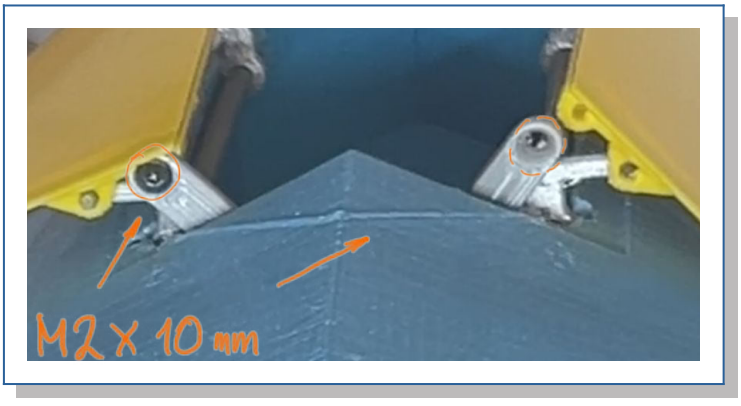




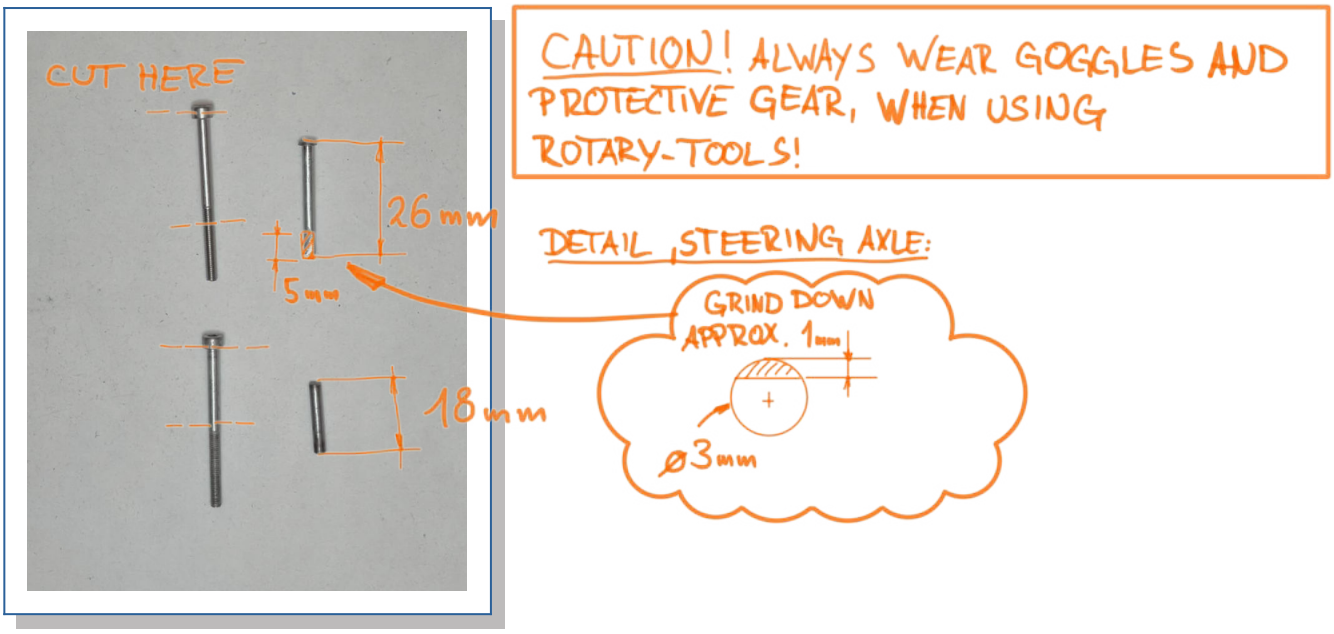


12. Clean the chamfered holes of the two guiding levers and check if screws settle well in, then use long Allen key and m2x6 countersunk screws to connect the levers to the pivot points in the bay. Tighten only lightly! Swing levers to the outside and use m2x10 countersunk screws to connect to the gear door, also close lightly, then check for ease of movement.

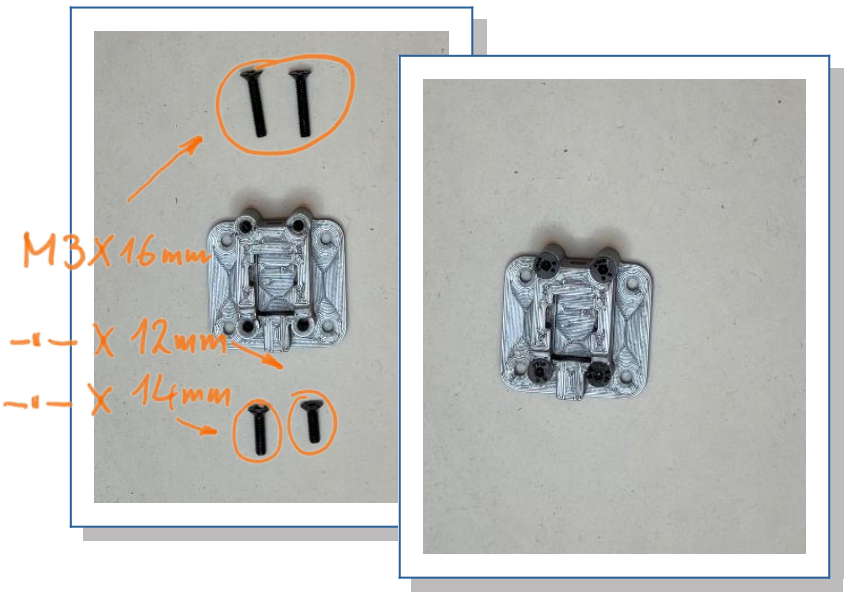




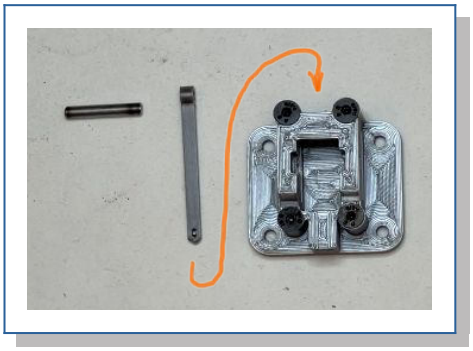
13. We will use a DIN 912 m3x50 screw as steering axle. Since they come only with 18mm thread there is enough smooth steel left for our purpose. Take your rotary-tool or angle-grinder to cut it to 26mm length, then grind down the head, so there is only a platform of about 1mm thickness left and finally add a plane surface of about 5 to 8mm in length and around a third of the screw diameter in depth to the bottom end. Use another screw or a 3mm steel wire and cut out an 18mm unthreaded piece.

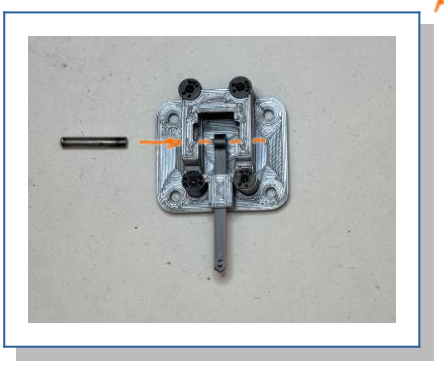


14. Take the nose-gear base and fit with one m3x12, one m3x14 and two m3x16 countersunk screws.

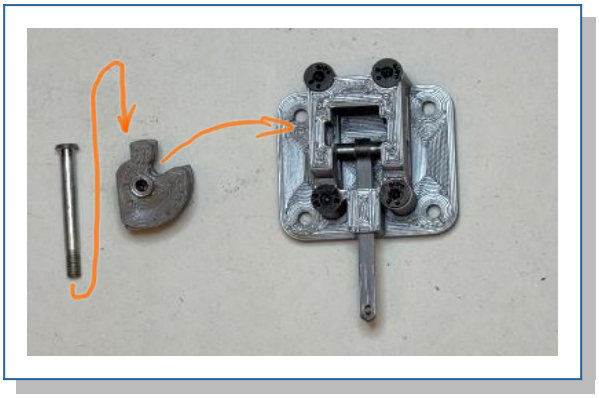


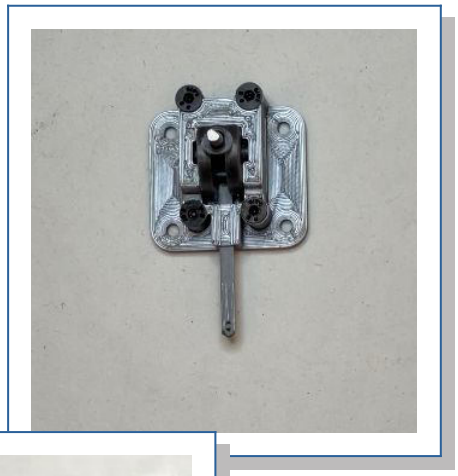
15. Insert the control lever and when in place, add the 18mm steel axle to it. Check for easy travel, centre carefully and glue the axle to the lever. Use a small tip or a needle to apply a very little amount of glue and be careful not spill.

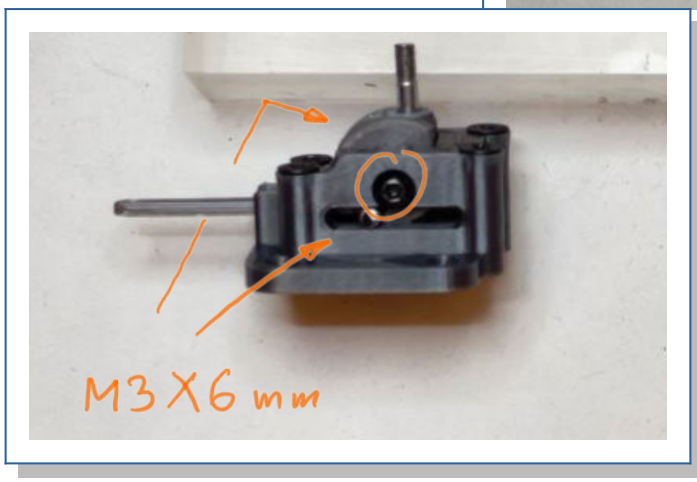




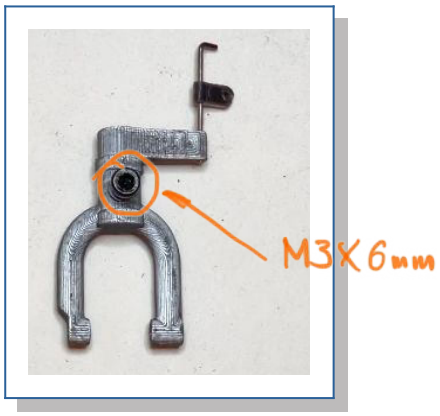
16. Now insert the steer axle into the central piece and both into the base. Use two m3x6 pan head screws to join, tighten carefully and check travel again.



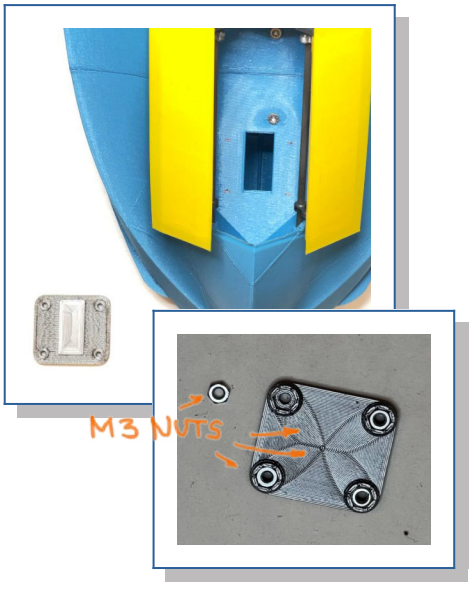




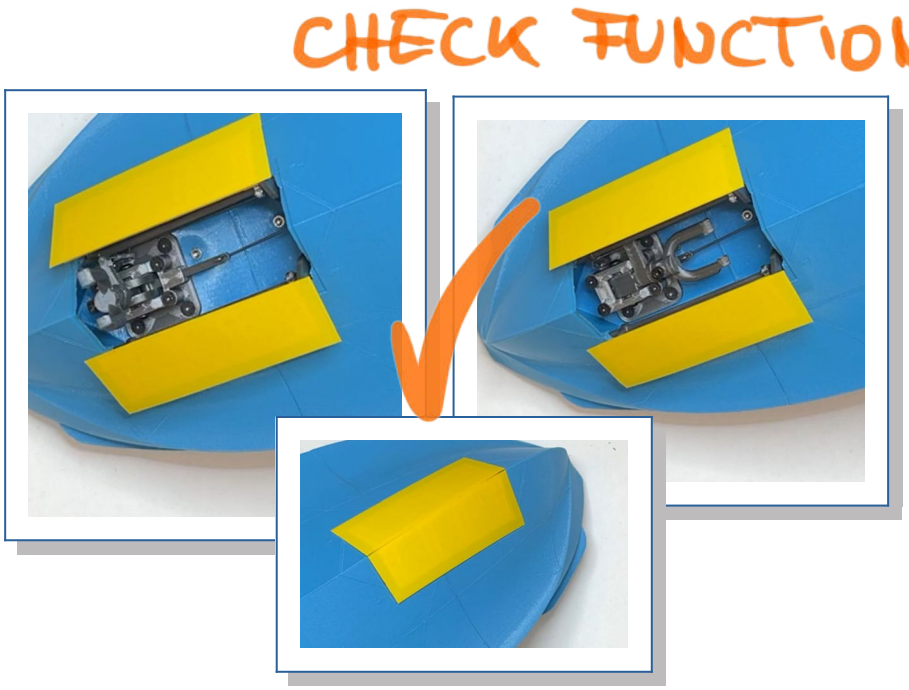
17. Create the nose-gear sliding rod according to wire sheet, pick up the steering lash and insert into the control horn of the front fork from top, secure with CA. Turn in a m3x6 cylinder screw, but don't tighten yet.



18. Now use the counter-plate to mark the holes in the fuselage and open to ∅3mm with hot-wire (Please mind, the plate is not symmetric! Turn it to max forward position before marking.) Glue four m3 nuts into the counter-plate openings and cure.
Then link the articulating rod to gear unit, guide it trough the opening in the bay to the servo, settle unit in bay and fix with four m3x12 countersunk screws to counter-plate. Connect rod to servo and check for function.



19. Attach the steering rod to the lash and guide it through the other opening to the steer servo. Use an Allen key to prevent the steer axle from slipping into the central piece, when setting up on the nose-gear fork. Align the plane of the gear axle to screw and tighten to secure the fork. Connect the servo to pushrod, adjust travel and check complete nose-gear for function.



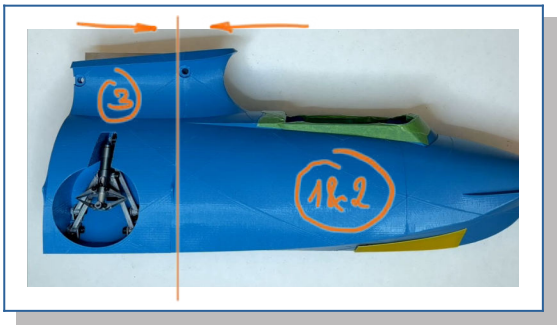
Fuselage – final assembly

The remaining parts of the fuselage assemble basically like the ones of the water-version, so I recommend to have a look at the videos

Please prepare:

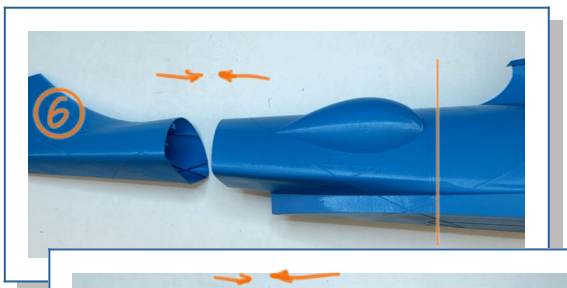
- ✗ fuselage sections #4 to #7
- ✗ control surfaces (elevators, rudder, fin, stabilizers)
- ✗ rims and tires
- ✗ 4x rear servo mount block
- ✗ 2x MG90S servo
- ✗ 2x servo extension cable 30cm
- ✗ elevator-axle with control horn, (see wire-pattern)
- ✗ pushrods for elevator and rudder
- ✗ 2x pushrod connector
- ✗ 2x brass tube ∅4×0.5mm, 23mm long
- ✗ 1x brass tube ∅4×0.5mm, 11mm long
- ✗ Screws:
  - 1x m3×10, cylinder
  - 1x m3×20, pan-head
  - 1x m3×26, cylinder
  - 2x m3×36, cylinder

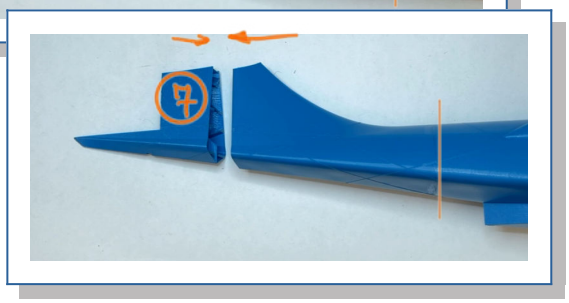
1. Glue part #3 to the front section using CA, accelerator and masking tape.

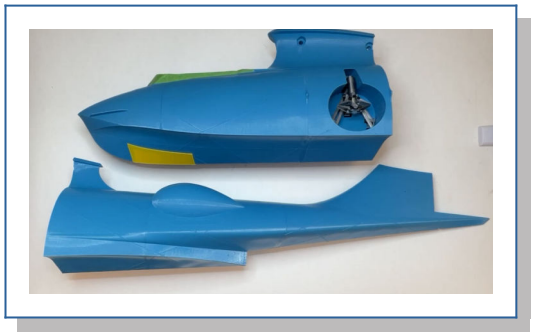


2. Use hot-tool to cut a 10mm x 10mm opening into the bulkhead of #3 for the servo cables.

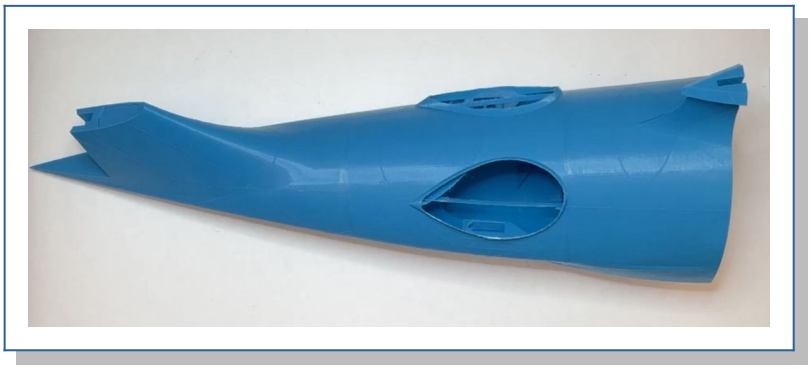
3. Glue together parts #4,#5, #6 and #7, but do not connect them to the front section yet.



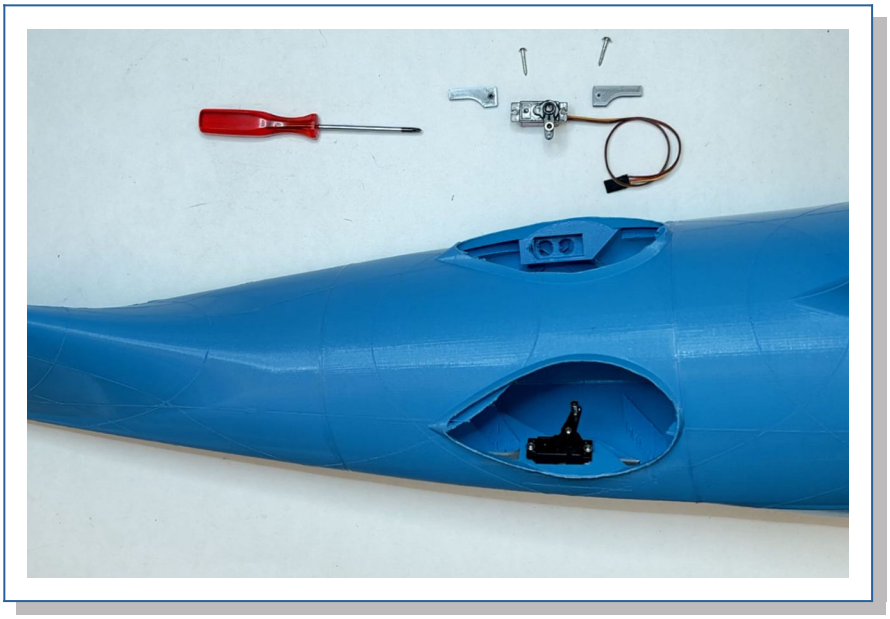




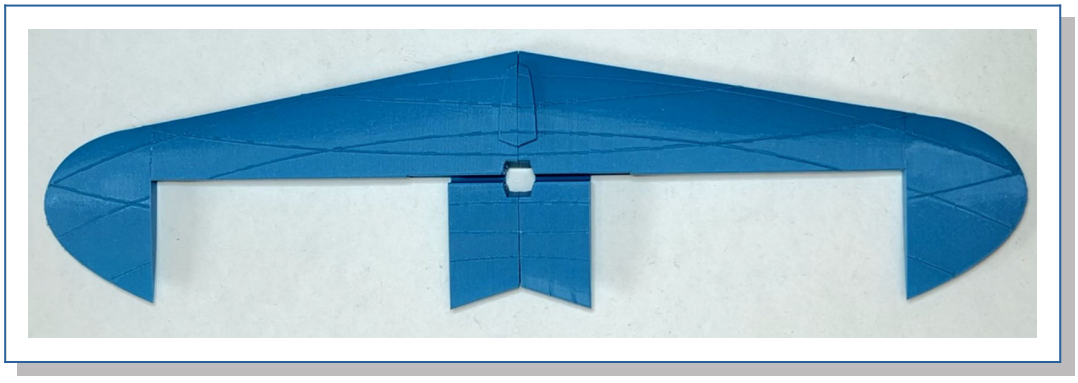
4. Use hot-tool to open the blisters. Leave about 5mm brim on the fuselage.



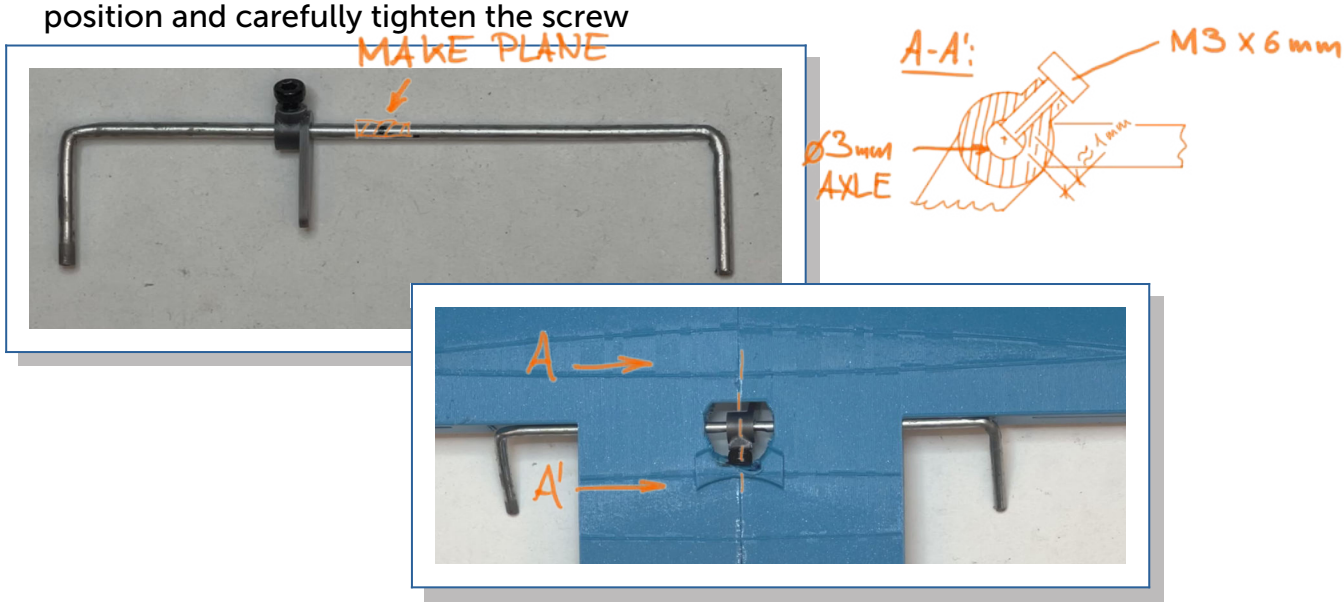
5. Attach pushrod connectors and horns and install the two MG90S servos. Use the mount-blocks and servo screws to clamp into the servo-crates.



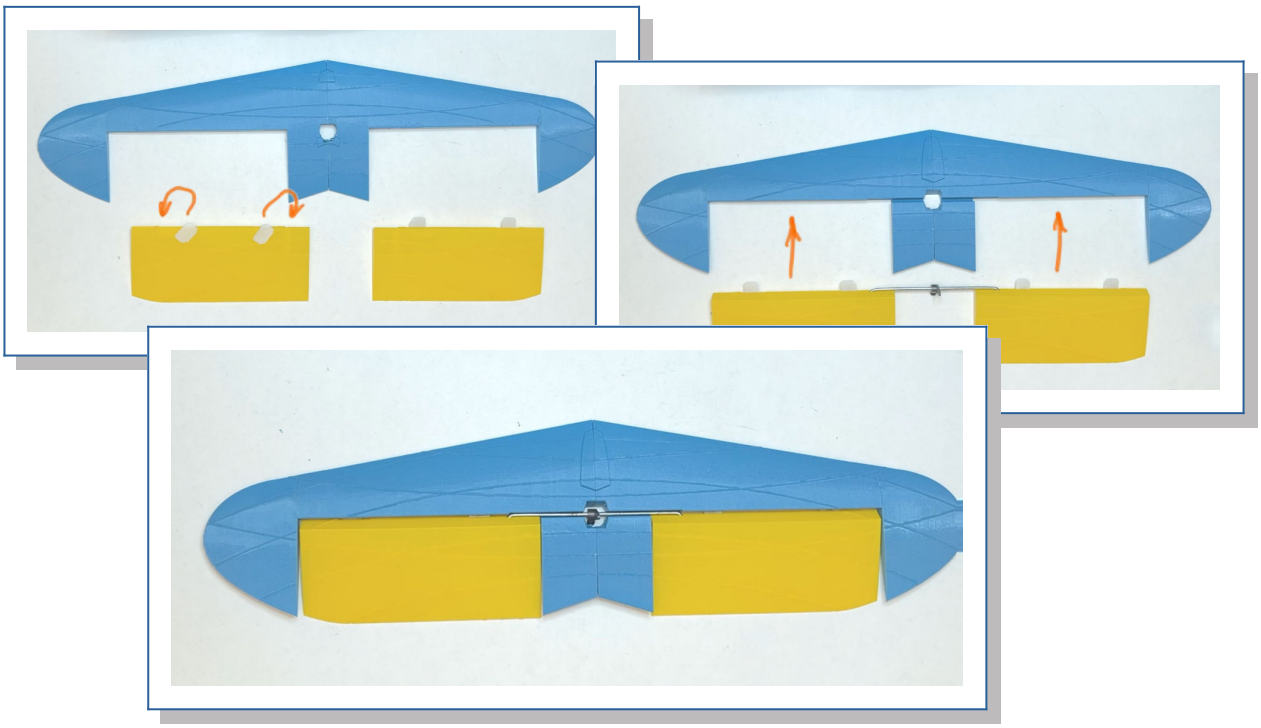
6. Glue together the four horizontal stabilizer parts.



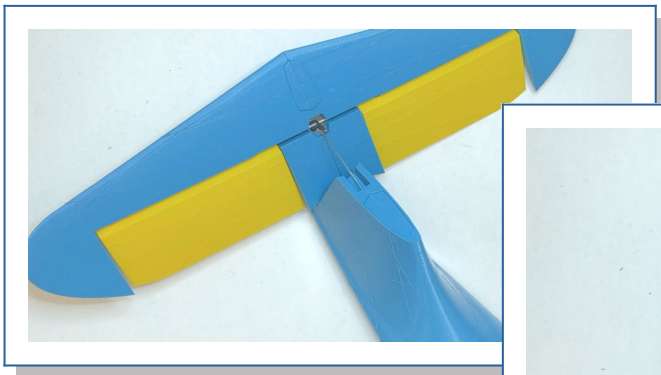
7. Prepare the elevator-axle and keep in mind to add the control lever **before** bending the second side. Use a file or multi-tool to create a plane with about 1mm in depth, located where the screw will clamp the lever. Slide lever to position and carefully tighten the screw

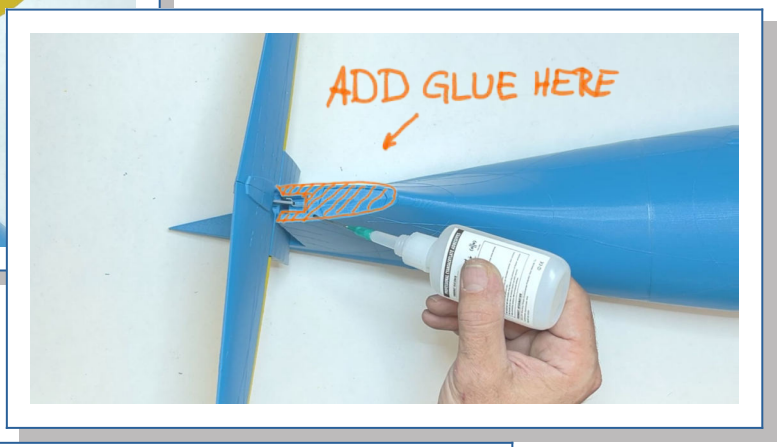


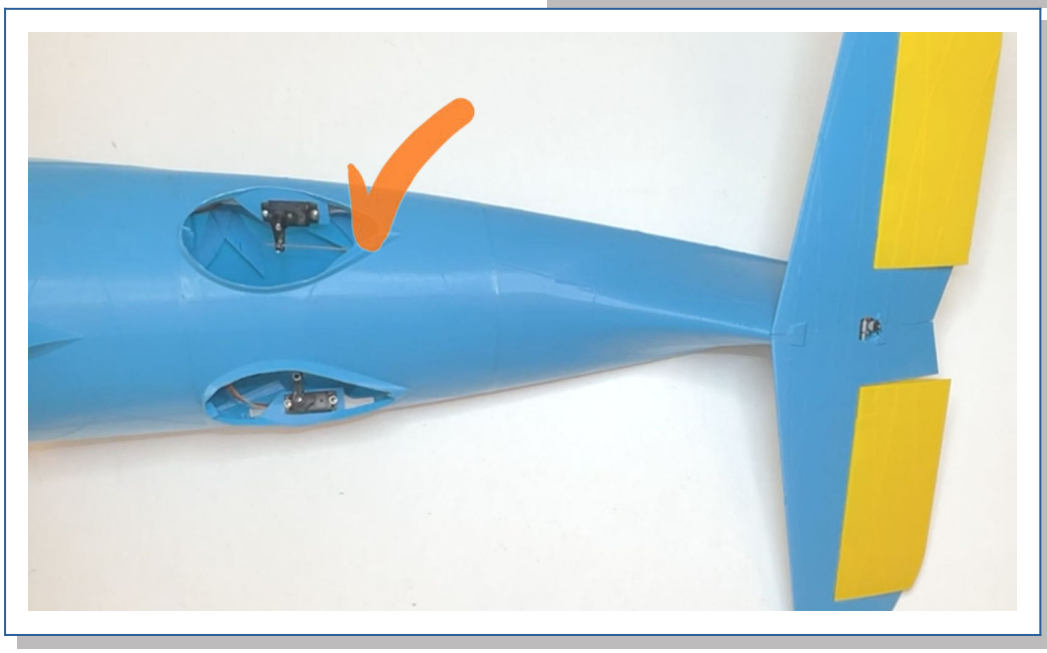
8. Equip the elevators with AC hinges, stick the ends of the axles into the corresponding openings and insert the whole unit into the horizontal stabilizer. Place on an even surface to align and fix the hinges and the rod with a little CA.



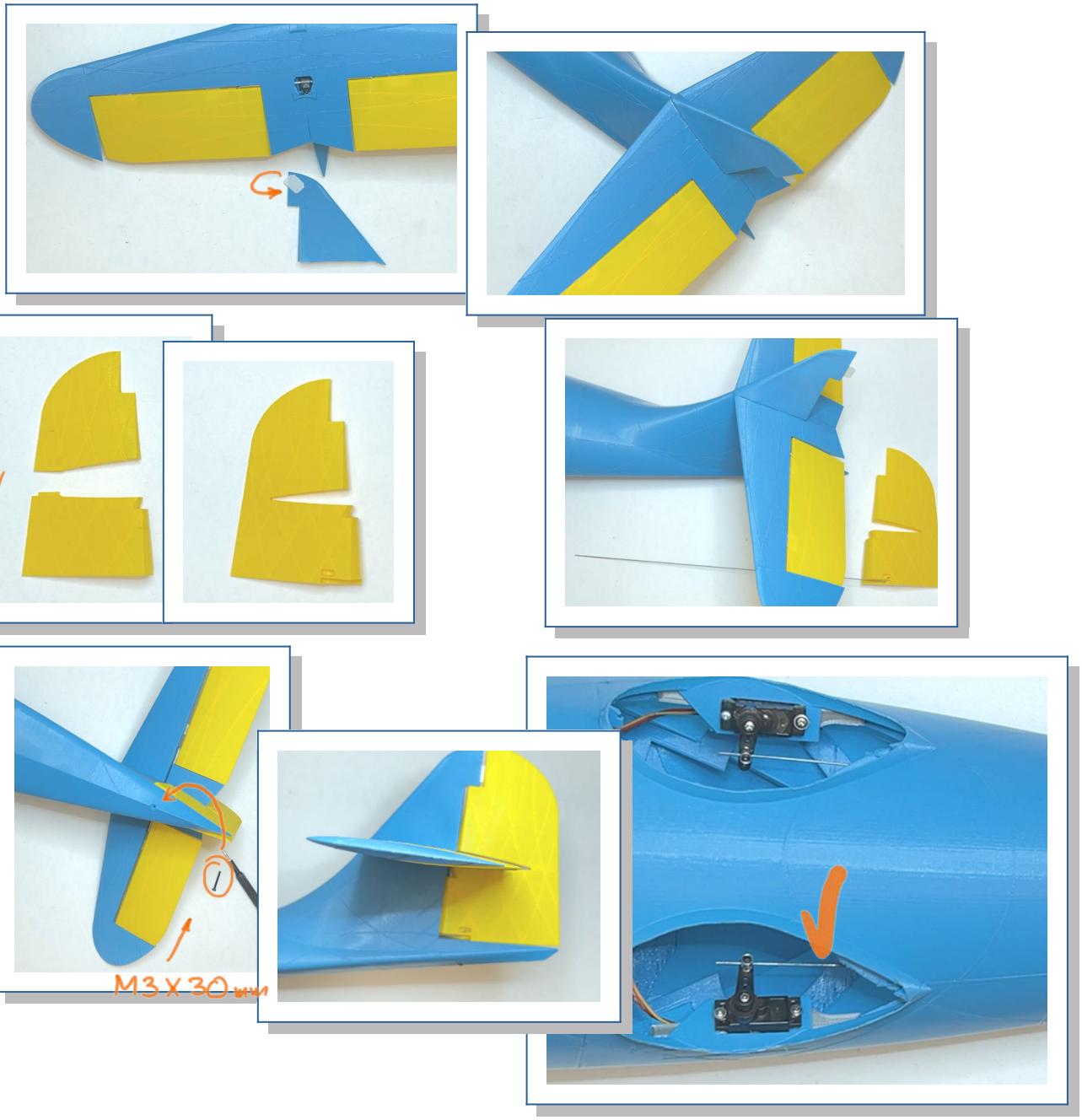
9. Z-bend the elevator push-rod, cut roughly to 380mm, grease it a little and insert it to the Bowden tube. Check for ease of movement.
   Link rod to the elevator lever, then apply some glue to the top of the fin, place horizontal stabilizer on, check for correct alignment and angle and fix with accelerator. Connect rod to the servo and test function.



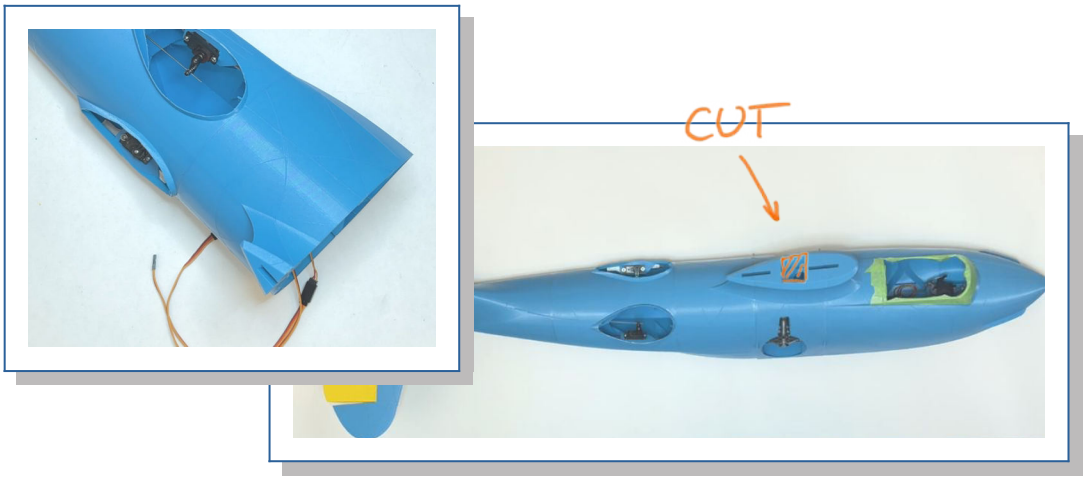




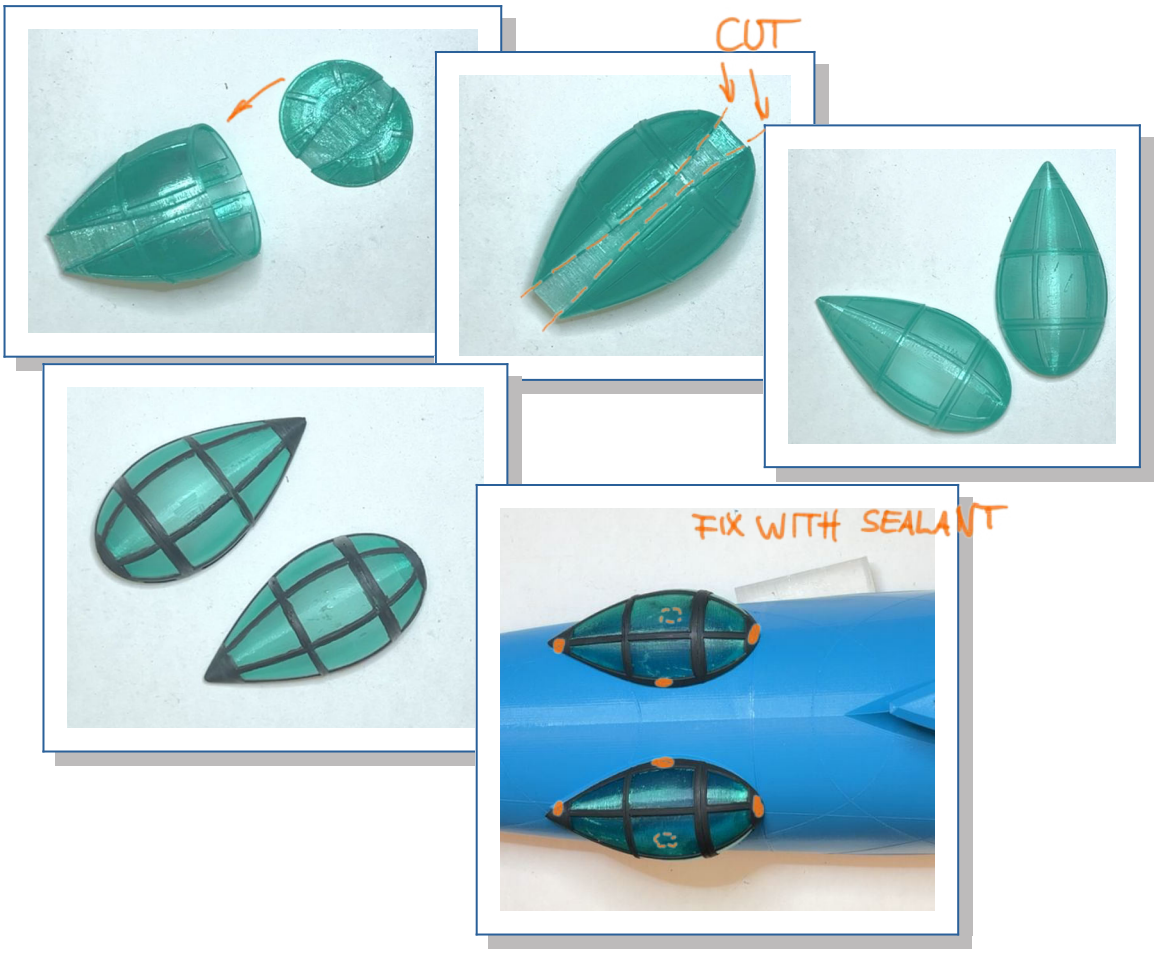
10. Glue the fin onto the elevator, then the two ruder parts together, followed by attaching the hinge into the fin.
    Bend the z-offset into the rudder pushrod, cut to around 375mm, grease, link to the rudder and guide into Bowden-tube until the rudder is in place.
    Use a m3x30 cylinder screw for lower joint of the rudder, then add some CA to the hinge, check alignment of rudder and cure glue. Connect rod to servo and check function and travel as well.



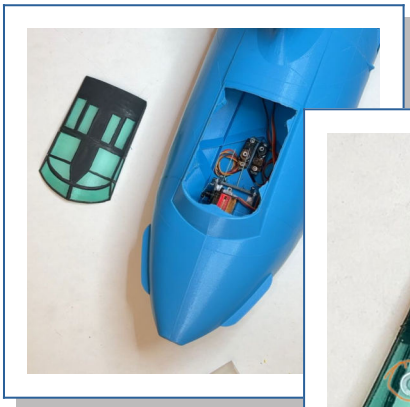
11. Apply extension cables to the servos and guide the plugs through the opening of the bulkhead, then glue together front and rear part and finally cut an opening for the wing-cables into the pylon.

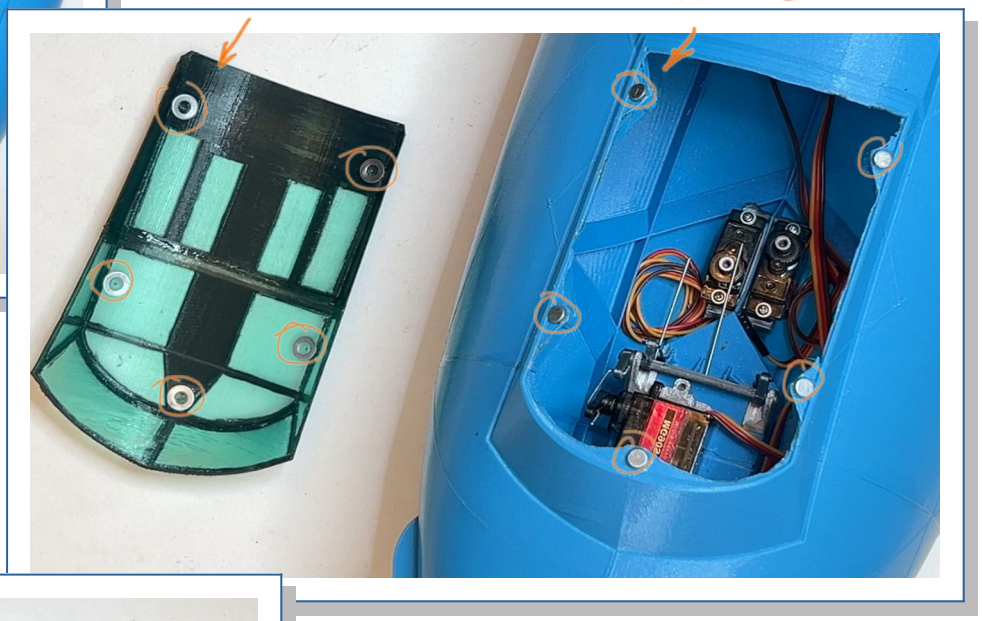


12. Join the rear canopy parts using CA, then divide the "egg" with the hot-tool and clean the edges. Add some colour to the frame, if wanted and use tiny dots of sealant to fix the bulbs to the fuselage.

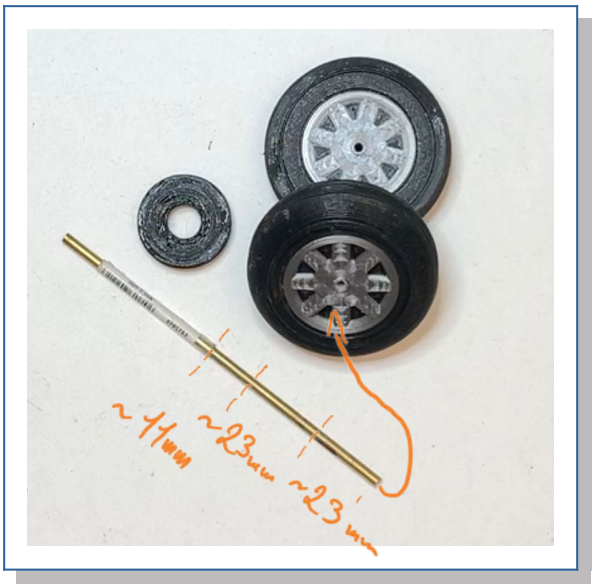


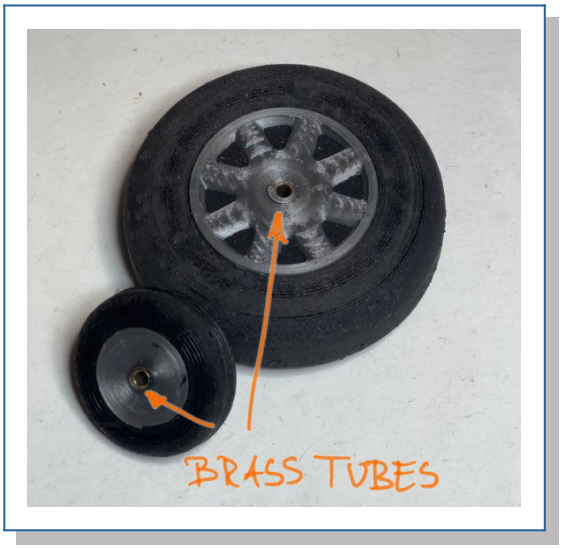
13. Join (and paint) the front canopy, then glue five ∅5x1mm neodymium magnets to the mount points in the fuselage and stick m3 or m4 washers as counter-pole to the front canopy. (If flying in the water I recommend to pierce holes and using servo screws instead of the magnets.)





14. Glue together rims and tires and clamp with bench vice until cured. Insert the brass tube to each wheel, mark length and remove to cut. Use m3x36 cylinder for mains and m3x20 pan-head screws on front to attach the wheels.





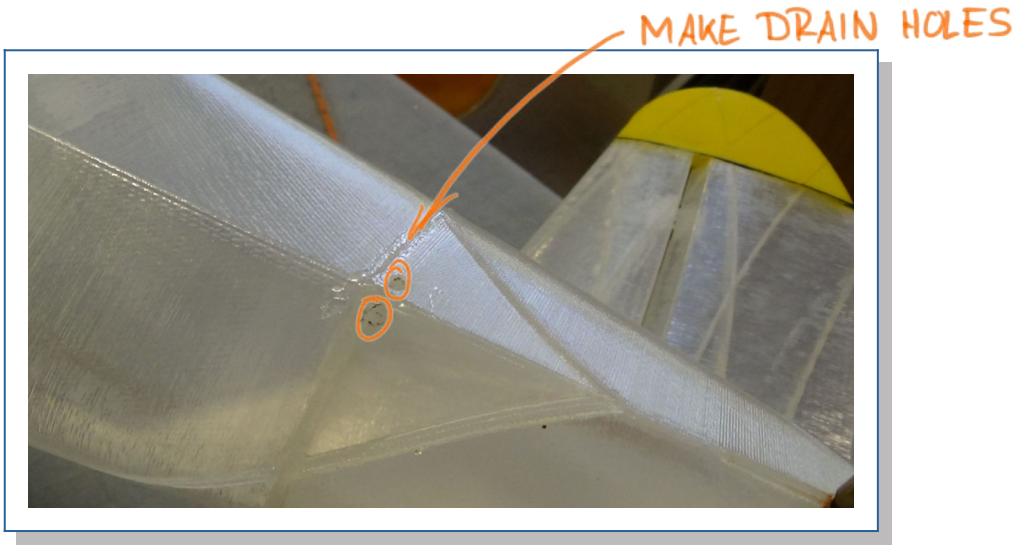
Part 1b: The water fuselage

-Some parts of the water fuselage have bulkheads to prevent water, that might have come in, from running through the fuselage. Be sure to have two complete bottom layers at part #2, #3 and #5 to #7 when printing with your own settings.

-When assembling be sure to produce a good complete sealing between the parts by adding a thin extra layer of glue around the joint. The prints should come out pretty watertight from the printer, and the Prusa slicer helps a lot with this, but check for any gaps and seal with glue or sealant.

-Remember to install the cable guiding tube between parts #2 and #3.

-The very last part (#7) of the fuselage might catch some water during start or landing. Please puncture two drain holes to the bottom, right before the bulkhead of this section.



Use:
-snap knife for cleaning the parts (take good care of the push-rod tubes)
-CA glue and activator
and
-see video guide #1

Part 2: Glueing the Wing and control-surfaces

Please prepare:

- ✗ Wing parts #1 to #5 for left and right side
- ✗ aileron parts
- ✗ AC hinges
- ✗ CA Glue and activator

See video-guide#2 and video-guide#3

Part 3: Wing, equipment installation

Please prepare:

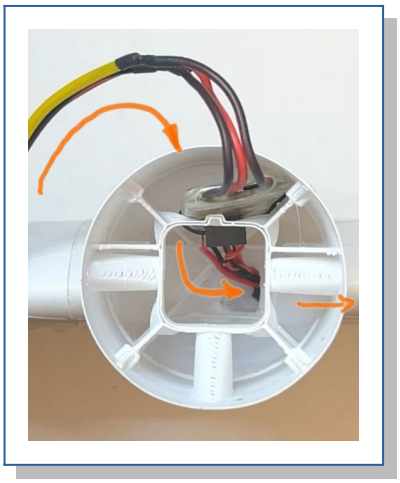
- ✗ 2x ∅3mm spring-steel wire
- ✗ 2x ∅1.7mm or ∅2mm threaded pushrod
- ✗ aileron pushrods, diameter 1.0mm
- ✗ 16AWG cables red and black
- ✗ XT male and female connectors
- ✗ 2x MG90S servos
- ✗ 2x servo-less gear retracts or the mount-blocks for fixed installation
- ✗ 4x (2x) servo extension cable, 100cm
- ✗ 2x servo extension cable, 30cm
- ✗ 2x servo Y-connectors
- ✗ Screws:
  - 14x ∅3x12mm, self tapping, countersunk
  - 8x m3x16mm, cylinder
  - 8x m3 washers
  - 6x (∅1.2mm-∅2.2mm)x9mm, self-tapping

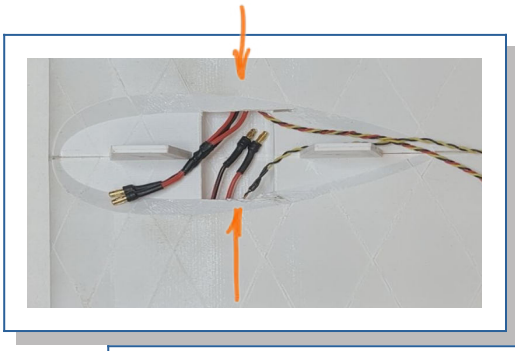
See video-guide #4 and video-guide #5 .

1. Prepare the threaded pushrods and ∅3mm steel wires, according to wire pattern sheet, decide weather to install the retracts or the mount-blocks and attach the 3mm floater-rods to. Pierce holes for the retracts and the servo-covers with a hot wire.
2. Attach servo-horns and apply extension cords to servos and retracts, guide cables into the wing, push servos into pockets and use ∅3x12mm, self-tapping, countersunk screws to fix retracts. Screw on the servo-covers with the small self-tapping screws and mount pushrod-connectors to horns.

3. Install the motor mounts to the motors using m3x16 screws with washers.

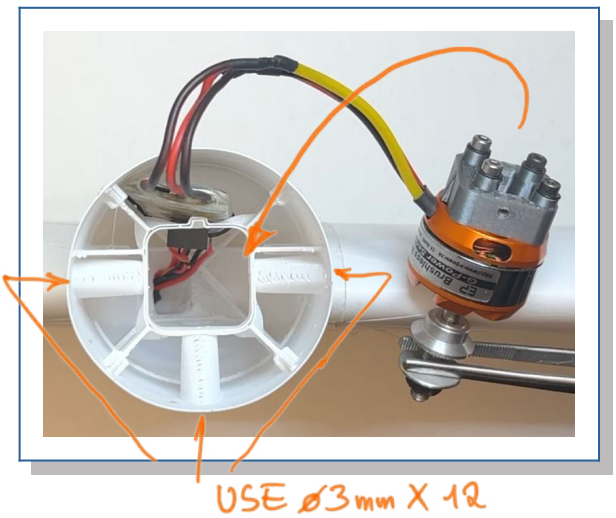
4. Connect the short servo extension cables to the ESCs and use some tape to wrap it up with the power lines, then use pliers to guide each cable-package through the upper spacing of the motor pods into the wing and meet again in the centre. Unwrap cables, connect the power lines solder to XT-plug. Use Y-connector to link ESC control-lines.





Hint: It figured out, that permanently connecting the ESCs isn't very handy. So I recommend creating a Y-connector cable instead. Solder AWG cables to a XT battery-connector, then use the same pins and plugs as from the ESC to motor to create the Y-connection.

5. Connect the motors to the ESCs and make sure they are counter-rotating. (If not, simply switch cables.) Then insert ESCs to the motor-pods, pushing the ESC and power cables further to the centre.
   Now slide the motor into the pod and fix with ∅3x12mm self taping screws.



6. Finally use zip ties to arrange the cables in the wing centre, and create a nice cable loom.

Part 4: Final assembly

Please prepare:

- ✗ Steel- and threaded- pushrods, diameter 1.0mm and 1.7mm (See wire-sheet.)
- ✗ 48/20 insulation-tube, approx. 20cm long (from hardware-store)
- ✗ Velcro tape
- ✗ PU insulating-foam in spray-can, or better with reusable pistol.
- ✗ CA glue and accelerator
- ✗ Screws:
  - 8x (∅1.2mm-∅2.2mm)×9mm, self-tapping
  - 8x m2×7, cylinder
  - 2x m3×20, cylinder

and see video-guide #6 and video-guide #7

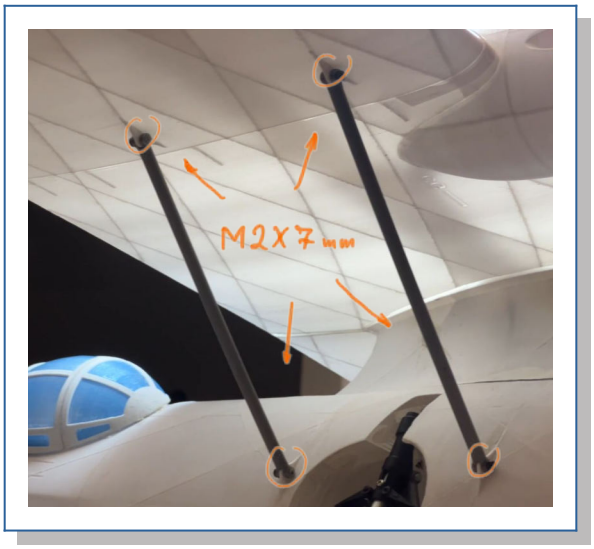
1. Install the joints to the threaded pushrods and insert into pockets in the wing, then use m3×20 cylinder screw to secure. Now slide on the wing covers and bring the mechanics to retracted position, or use the corresponding hole in the mock- up. (Remark: Other than written, the following pictures show the aileron and floater already installed.)

2. Glue together the floater, mind for left and right part and bring some glue into the holes, then slide on the support-rods. Align wing-cover with its cut-out in the wing and use accelerator to fix floater. Repeat with other side.

3. Glue together the ailerons and install CA-hinges to. Then Z-bend and cut the aileron-rods according to wire-pattern, link to aileron-horns. Slide hinges into wing and use CA to fix.
When cured, guide in rod, adjust the ailerons and tighten the set screws.

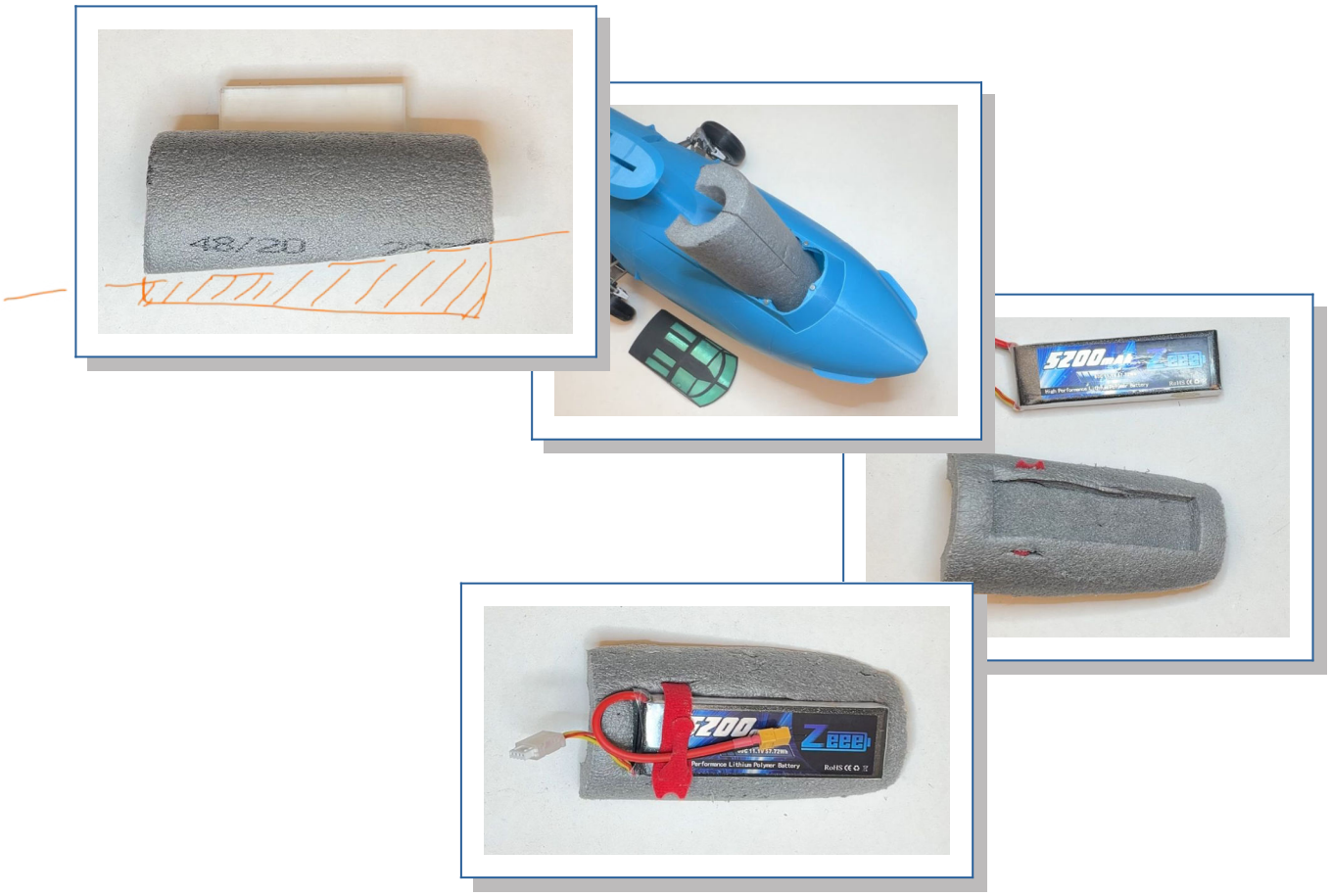
4. Insert the cable-loom into the pylon and place the wing onto the fuselage. Then secure with the m5 nylon screws and nuts and cut the rear screw to length.

5. Now take the m2×7 cylinder screws and install the wing struts. (Install the longer ones to the front.)



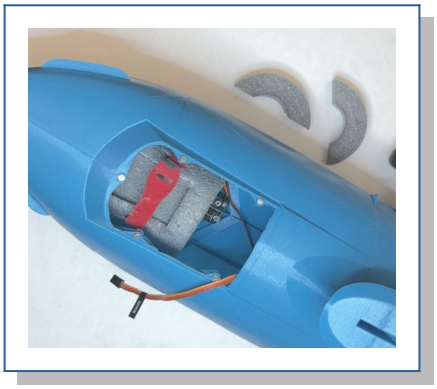
6. Slide on motor-hoods, install propellers and align the hoods to. Puncture screw holes with hot wire and fix the hoods with 2.2×9mm screws. (A pocket lamp will help locating the right position.)

7. Take the 48/20 pipe insulation-tube and cut it diagonally into halves. Fold in the middle, then carefully insert it to the fuselage and slide to the front. Check for fit and clearance to the door servo. Trim or support with remains if needed. Put in the battery and mark position then remove tube again.
   Now use the snap-knife to create a pocket for the battery, add some slots for the Velcro and thread it through.



8. Now its a good idea to take care of the cable-management. We will find a nice spot for the receiver next to the battery, so prepare for this.

9. Set in the foam-tube again (and supports) and bring into position, put the battery in a small plastic bag or wrap with cling film, insert into its place in the carrier and secure with the Velcro.



10. Take the PU- spray gun, maybe do a test shot to the waste-bin to get comfy, then insert nozzle between hull and tube and add a **small!** amount to foam to bound our battery-carrier.
Allow to dry for an hour, then remove the plastic bag and finish connecting your radio system, if not done already.

Attention!!
Be very careful with PU!
Care for good ventilation, wear gloves and safety equipment and don't use too much! The foam expands extremely and will spoil everything in contact with.

Keep in mind:
It's much easier to add some more, than trying to remove. ;)

Setup and first take off:

Drive setup:

While testing different drive settings, it showed, that the Catalina is quite sensitive to the angle of down-thrust in relation to the forward thrust generated by the engine/prop combination.
The rule is: The more forward force, the more thrust angle required. Starting from 0° with the standard 3530 motors and the 10×4 scale 3-blade props and going up to 3° with Volantex 4023 motors and good 9×7 or 8×8 mincers.
Having had this in mind, I added motor-mounts in two different sizes and three different angles to the stl-files to give you more freedom to choose your setup.

Centre of gravity:

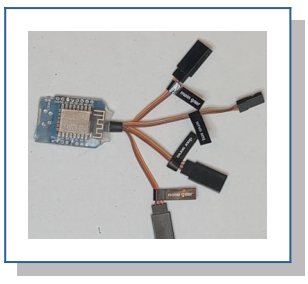
The centre of gravity markers on the wing bottom are chosen with a lot of safety. If you set the CoG exactly to the mark you should be good for the first flights. Later you can carefully go back 5-10 mm.

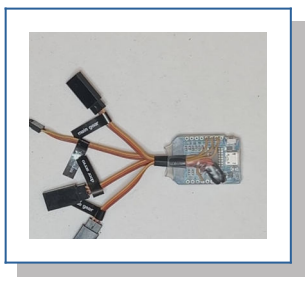
Basic Radio setup:

- Elevator +25mm/-20mm
- Rudder +40mm/-40mm
- Ailerons +20mm/-15mm (35% diff.)

Reducing channels:

Fully equipped the Catalina takes 12 channels for operation. This can be reduced to 9 with the application of Y-cables on ESCs, floater-retracts and rudder/steering-servos. But that's still one above the sacred number of eight and may cause more or less effort to deal with, and lately happened to me as well.
My quick and dirty solution was to engage a ESP8266-mini node mcu with micropython installed. The ESP is cheap, works with 5v, can be administrated by Wi-Fi and last but not least, needs only a few servo cords soldered in.
- If interested, contact me on 3dLabGang channel on discord.





About the gear:

The gear of the Catalina was designed to be engaged on solid ground. Landing on grass will cause heavy sheer loads to the bumper suspensions, usually ripping one or both out. So, if you have to land on lawn, I advise to leave the gear up an and do a belly-landing.
It proofed to put some effort into pre-assembling a few spare parts and take them to the field, to be equipped for harsh landings. Think of: 1-2 complete bumpers, a steering-axle and the central-piece, a front-fork and the nose-gear housing.

The first start:

After a final check of the control-surfaces and the CoG, go for a little taxiing experience and adjust directional trimming of the steer-servo. If you feel confident, turn the nose into the wind and throttle up. Allow to gain speed and focus on keeping track. Be aware of the increasing reactions to rudder input with rising speed!
Then carefully pull the elevator to take off.

How to land:

Reduce throttle to loose height and approach with toe gas. Then flare out, reducing throttle and increasing elevator until mains touch ground. Throttle down completely and focus on keeping track while still on high speed.

Here you can find the maiden fight video of the flying boat.
And here i of the wheeled versions.

Now enjoy flying and many happy landings with your PBY Catalina!