Starship 2019

Assembly manual

Designed by Nicolas Schmit for Epic Space Models.

Last update: 15th February 2020

1 Introduction

Thank you for acquiring this 1/100 scale model of Starship. It was a lot of work to make it available as a kit, and I hope you will have a lot a fun assembling the kit and playing around with it.

Don't forget to follow Epic Space Models on Twitter and YouTube!

Nicolas

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3 Warnings

This kit contains strong magnets. Be careful if you are wearing a pacemaker. Also, do not leave your credit card or any device sensitive to magnetic fields near the bag with the magnets.

The windows at the front of Starship are fragile (only 0.8m thick). Never apply pressure on the windows, especially the big widow with the black lattice.

The upper half of the fore segment of the hull has a black shade on the inner side. Do not attempt to disassemble the shade from the hull. You would likely break something.

Do not use a power tool to drill holes in the plastic parts. The rapid rotation of the drill bit heats the plastic up and warps the 3d printed part.

Wear safety glasses when cutting out the plastic parts with a sharp knife.

When connecting Starship to a computer using the USB cable, plug the DC adapter to a wall outlet before plugging the USB cable to the computer. The USB port alone is not capable of providing enough power for Starship.

4 Model specifications

4.1 Dimensions

- Scale: 1/100
- Length: 50cm (20 inches)
- Hull diameter: 9cm (3.5 inches)
- Wingspan: 18cm (7 inches)
-

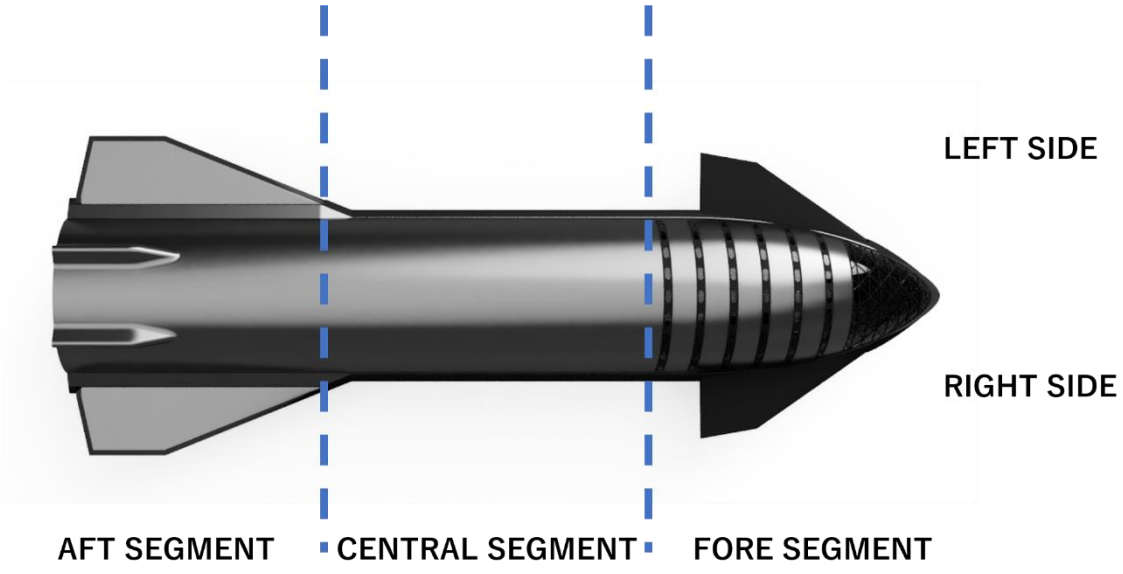
4.2 Functions

- Moving fins
- Engines and windows lighting (RGB LEDs)

4.3 Main structure

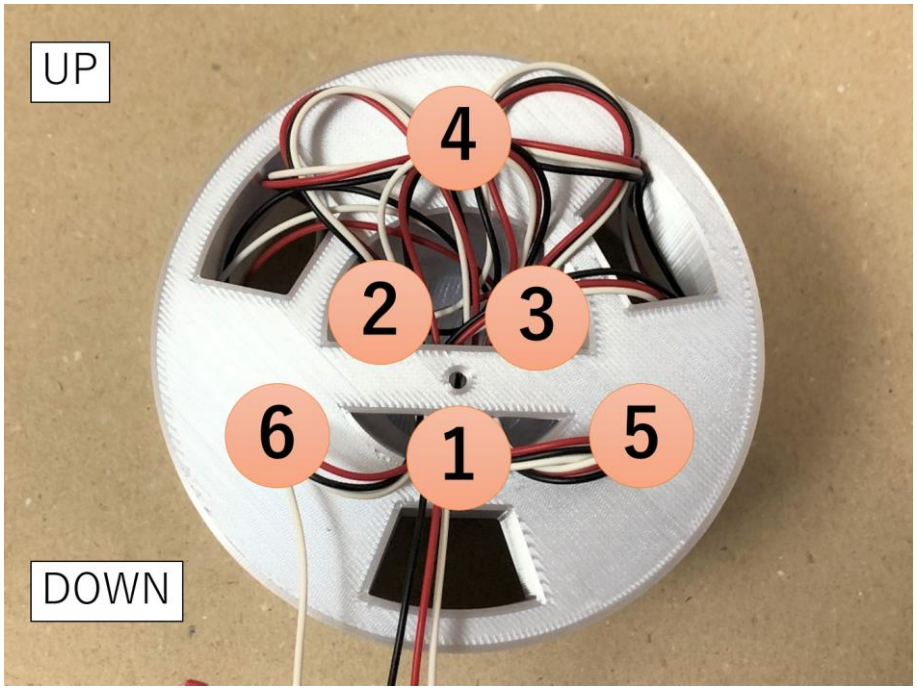
The hull is split into three segments:

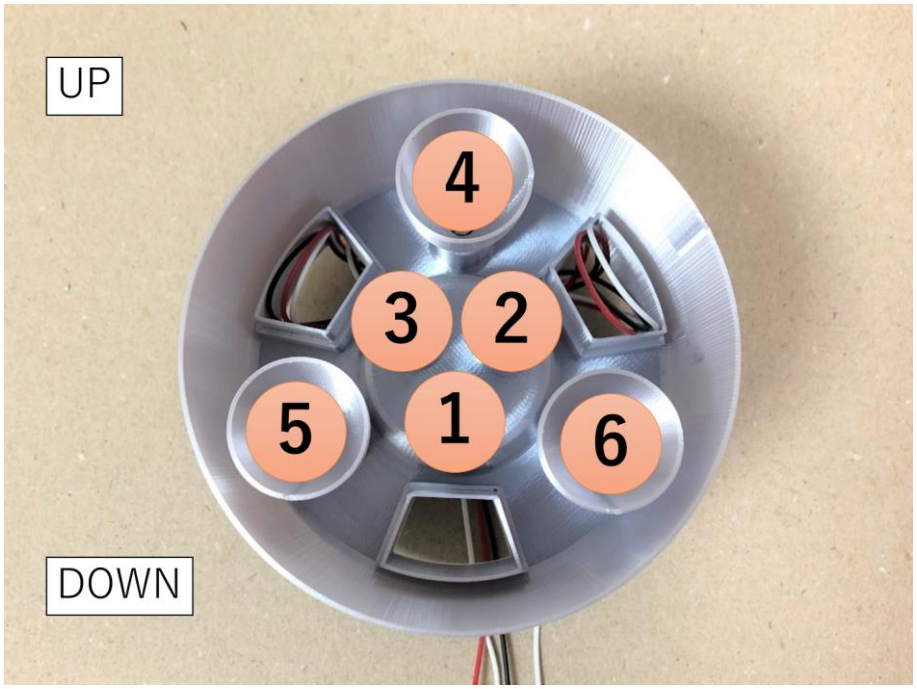
- Fore segment: Contains the servomotors for the small fins and the LED strip to light the windows.
- Central segment: Contains the control board
- Aft segment: Contains the servomotors for the big fins and the engine pod



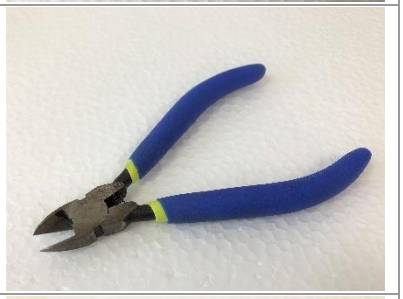
4.4 Engine layout

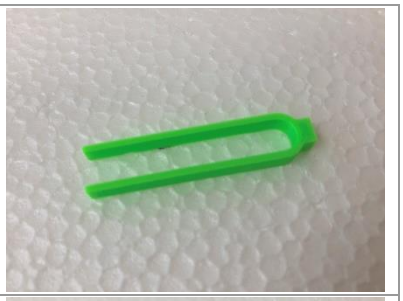
Sea level engines are numbered from 1 to 3. Vacuum engines are numbered from 4 to 6. Refer to this page when troubleshooting the LEDs.





5 List of tools required

Part	Photo
Soldering iron	
Solder	
Flux (optional)	
Wire cutter	
Wire stripper	

Starship tweezers (included in kit)	
2mm drill bit	
Vinyl tape	
Caliper	
Sharp knife	

0.8mm drill bit	
Safety glasses	
Hex key	
Super glue	
Marker	

6 Take your time!

You might manage to assemble Starship in one day if you are an experienced model maker and have enough caffeine to keep you focus all day. But no need to rush. It will probably take you two days, and this is ok.

Take time to read the instructions, especially before soldering or gluing parts together.

7 Assembly

7.1 Hull disassembly

The hull comes as three separate segments: fore/central/aft. Each segment has two halves, black on the bottom and silver on the top. To assemble starship, we first need to disassemble each segment into its two halves. We also need to remove the engine pod from the aft segment.

This section shows the hull segments with the magnets already in place. However, your magnets should still be in the plastic bag with a bunch of other parts. Wait for the specific instructions before inserting the magnets.

The first time it might be a bit difficult to slide the two halves. Do not worry, it gets easier each time. If the parts are really too tight, put them in a cold room for a while. The plastic will contract a little bit, making it easier to slide the parts.

Do not yank on the parts!

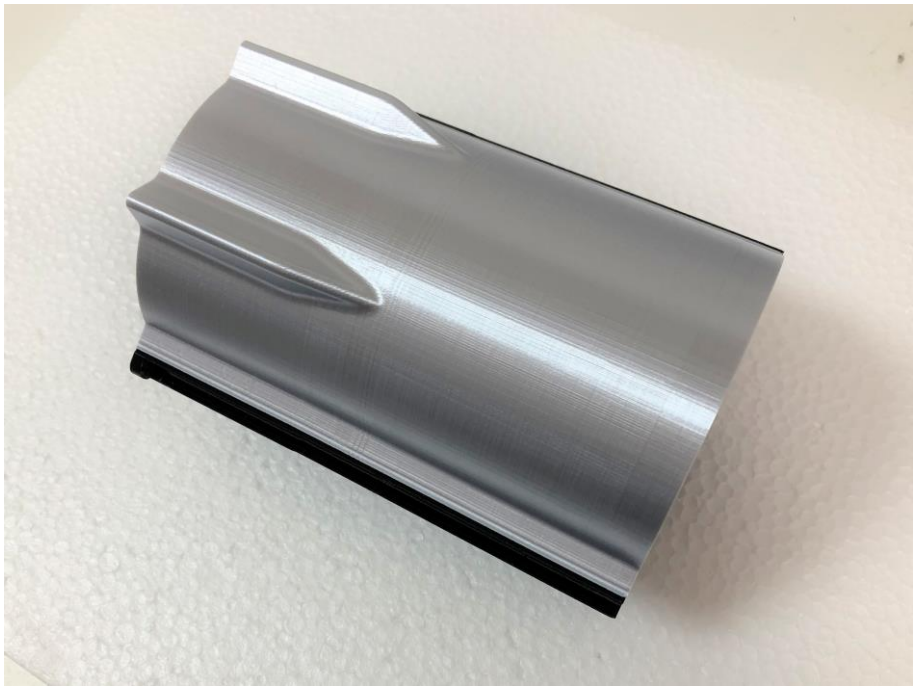
Important!

- When finished, the top and bottom halves are locked using flat keys inserted at the end of each segment. If your kit serial 16 or below, you will have to remove the keys to disassemble the two halves. If your kit serial is 17 or above, the keys are shipped in the transparent plastic bag with the other black parts, so you do not need to remove them at this step.
- The kit is shipped with bags of parts inside the hull segments. Be careful when sliding the two halves.

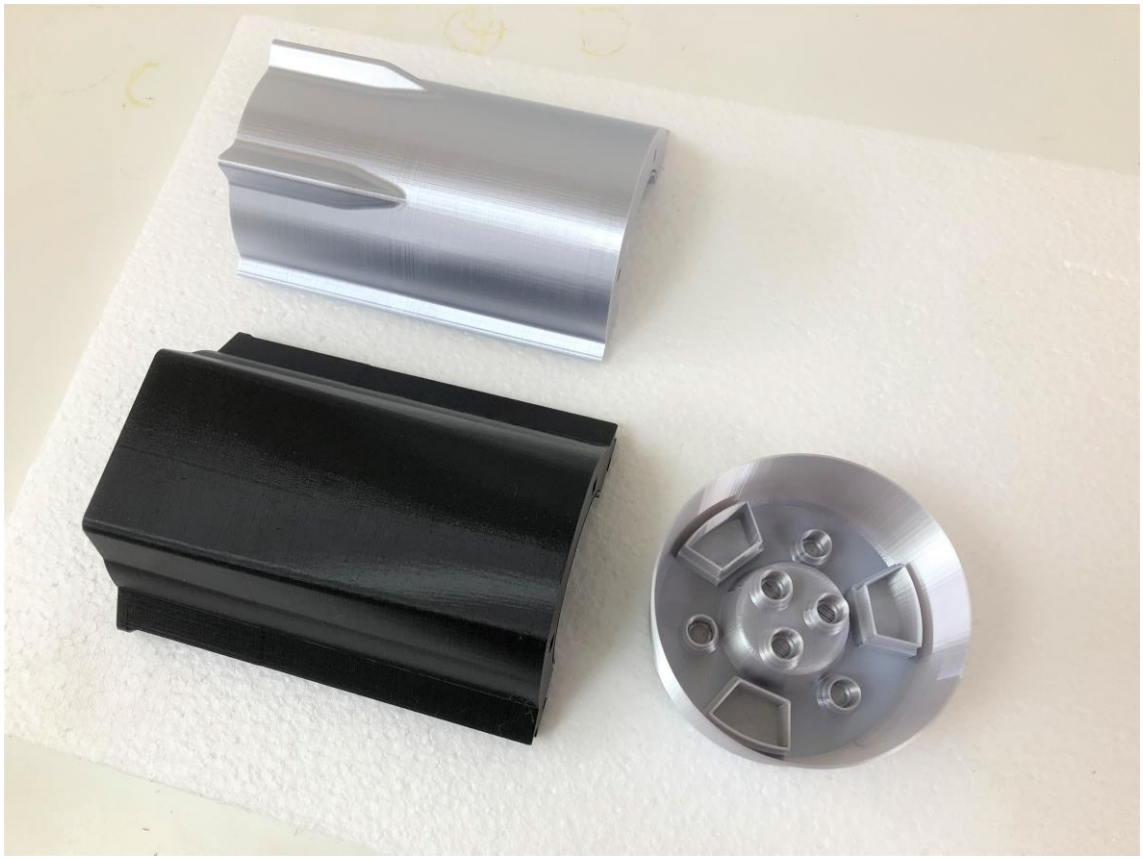
7.1.1 Aft segment

Take the aft segment of the hull (the one with the small fins on the top). At the front side of the segment locate two keys (flat parts) that stick out from the hull. Carefully pull these parts towards the center of the hull to remove them. DO NOT TROW THEM AWAY. We will need these parts later.

If your kit serial is 17 or above, the keys are in the plastic bag with the other black parts, so you do not need to remove them yourself.



Disassemble the two halves by carefully sliding the top half towards the front of the segment, then remove the engine pod.

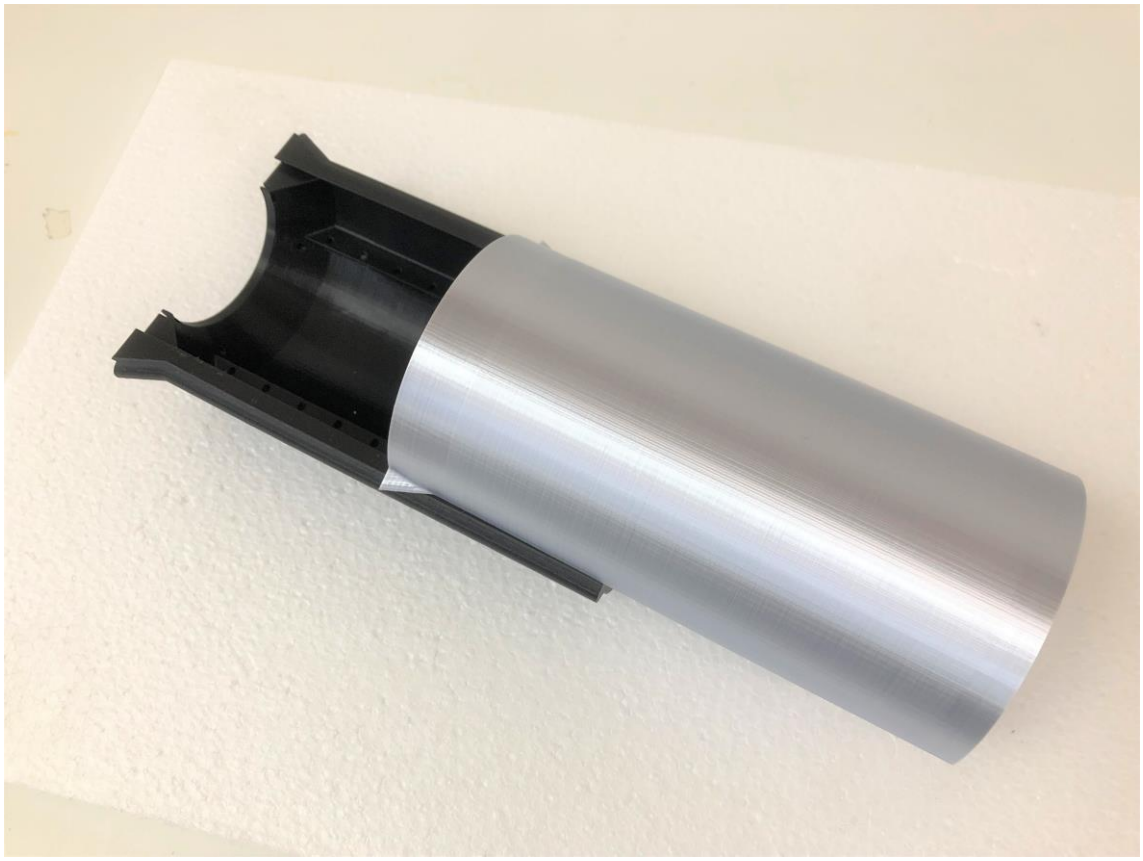


7.1.2 Central segment

Take the central segment of the hull (the longest one). On one side you will find two keys locking the two halves, similarly as for the aft segment. Remove the keys.

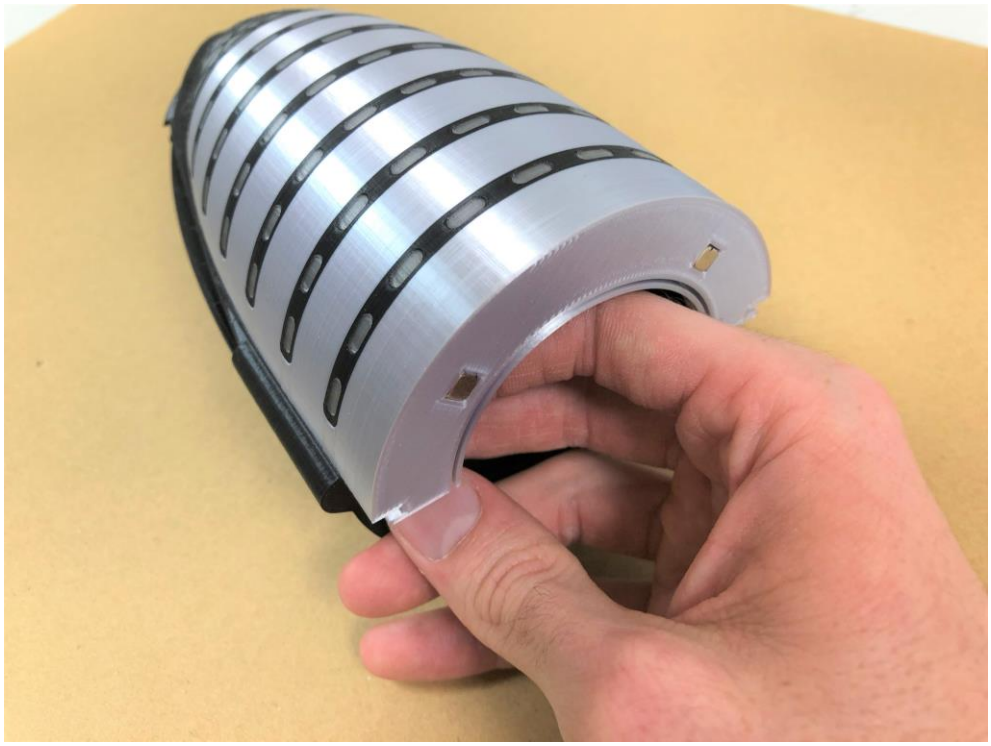
If your kit serial is 17 or above, the keys are in the plastic bag with the other black parts, so you do not need to remove them yourself.

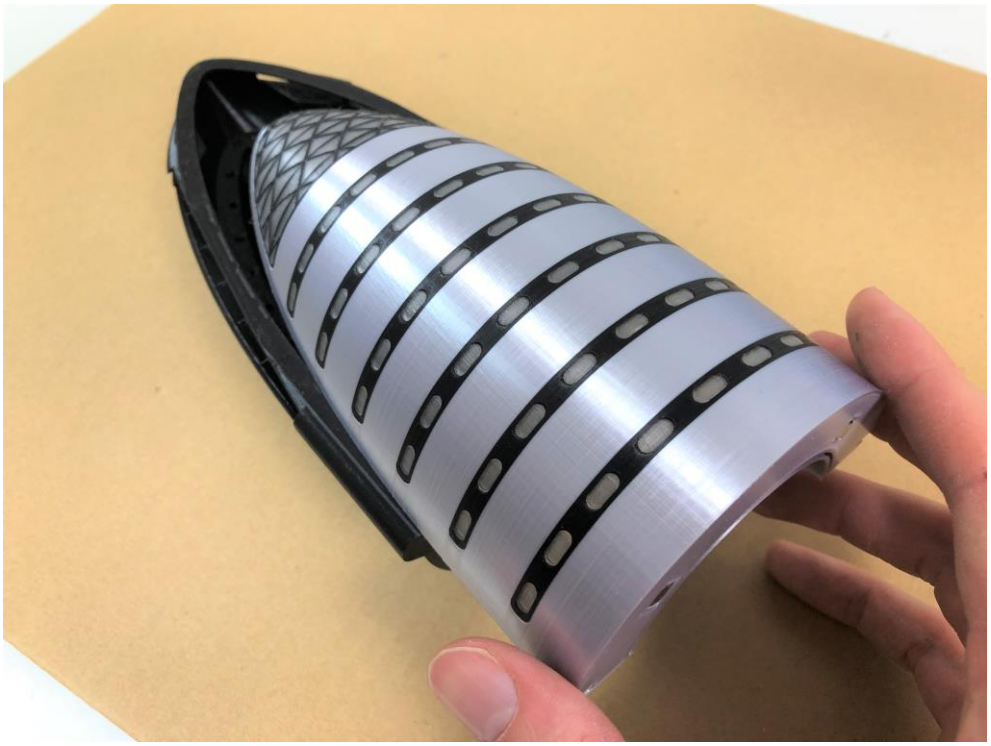
Disassemble the segments by sliding the top half towards the front.



7.1.3 Fore segment

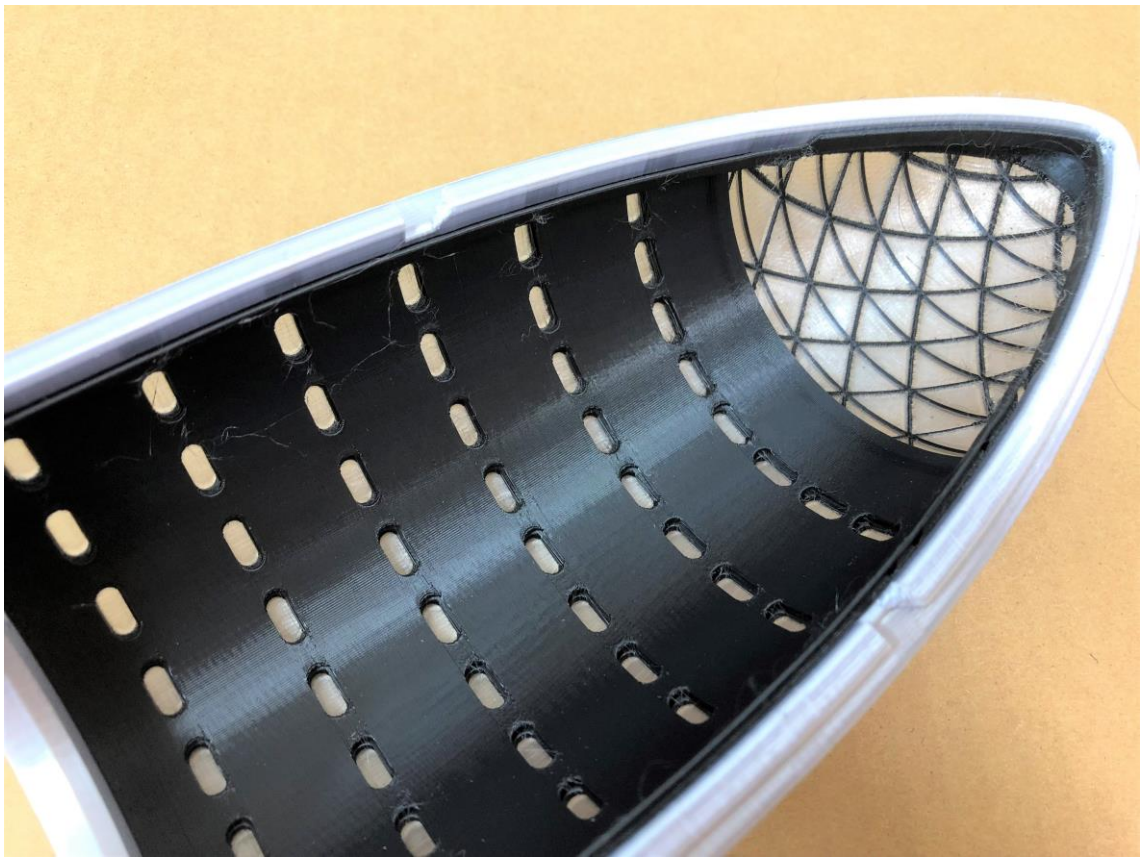
Take the fore segment of the hull (the one with the windows). Remove the two keys at the back of the segment. If your kit serial is 17 or above, the keys are in the plastic bag with the other black parts, so you do not need to remove them yourself. Slide the top half to the back by pulling the part from the half ring at the back. DO NOT PUSH ON THE WINDOWS!





The upper half of the fore segment has a black shade on the inner side. Its purpose is to make the hull opaquer and ensure that the light from the LEDs goes only through the windows, without having the entire hull glowing.

DO NOT ATTEMPT TO DISASSEMBLE THE SHADE FROM THE HULL. You would likely break something…

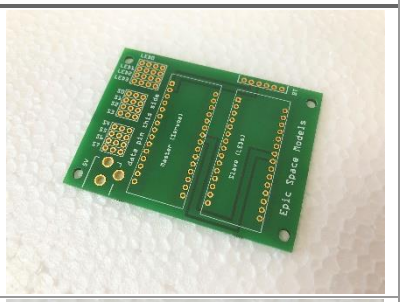
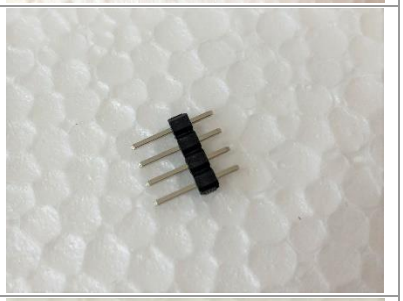
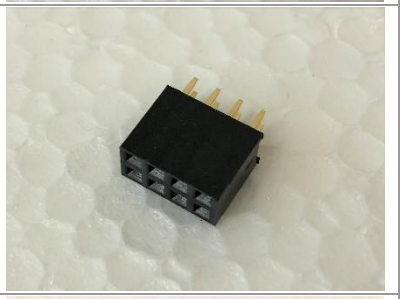
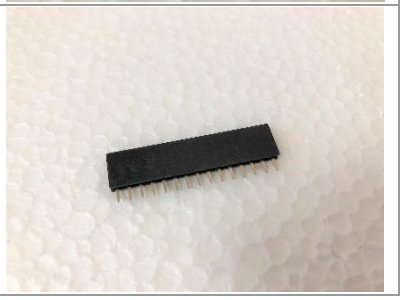


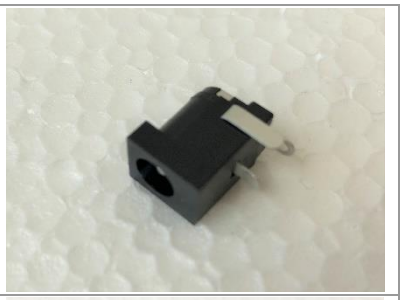
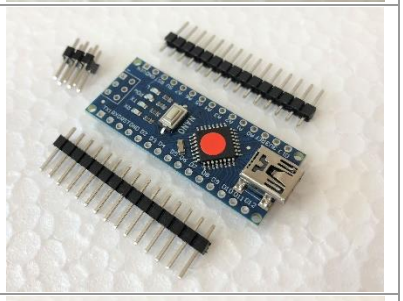
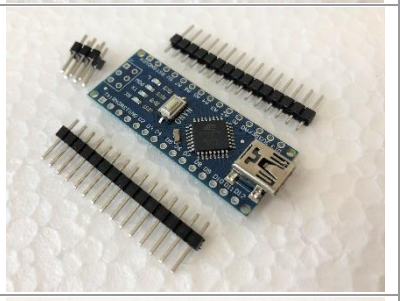
7.2 Control board soldering

7.2.1 Parts & tools preparation

The design of the control board might vary slightly, but the functionality remains the same. The male pin headers come as a single 1x40 part. Break this part to make pin headers with the required number of pins.

Prepare the following parts.

Part	Number of parts	Photo
Control board	1	
Male pin header 1x4	3	
Female pin header 2x4	1	
Female pin header 1x15	4	

Power plug	1	
Arduino (master)	1	
Arduino (slave)	1	
5V power adapter	1	

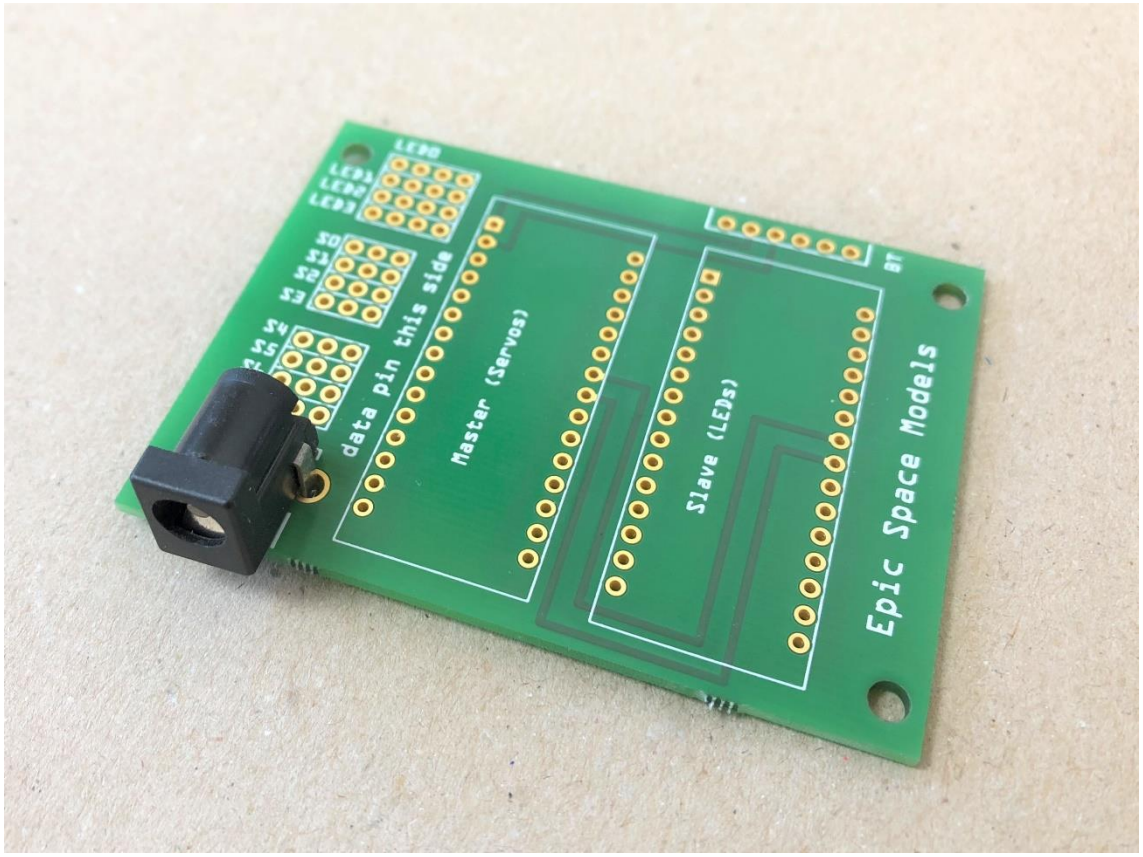
Prepare the following tools

Part	Photo
Soldering iron	

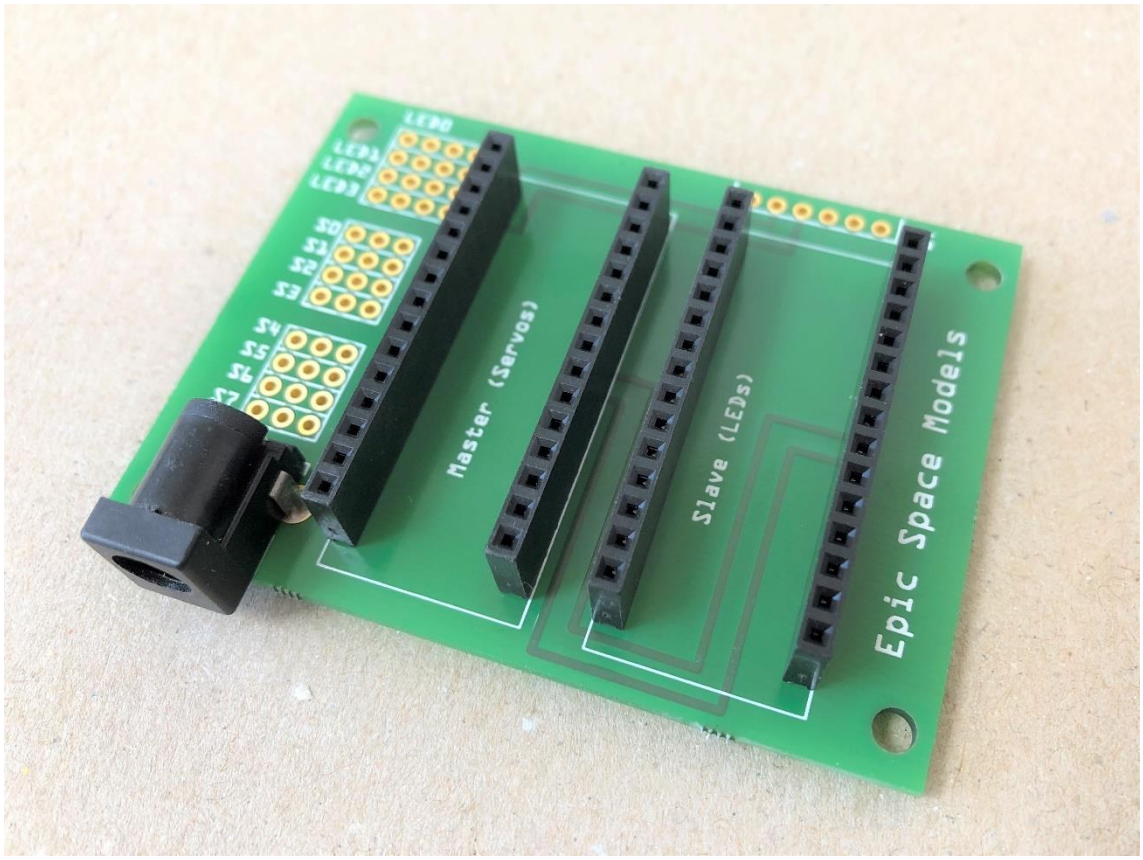
Solder	
Flux (optional)	

1.1.1 Soldering

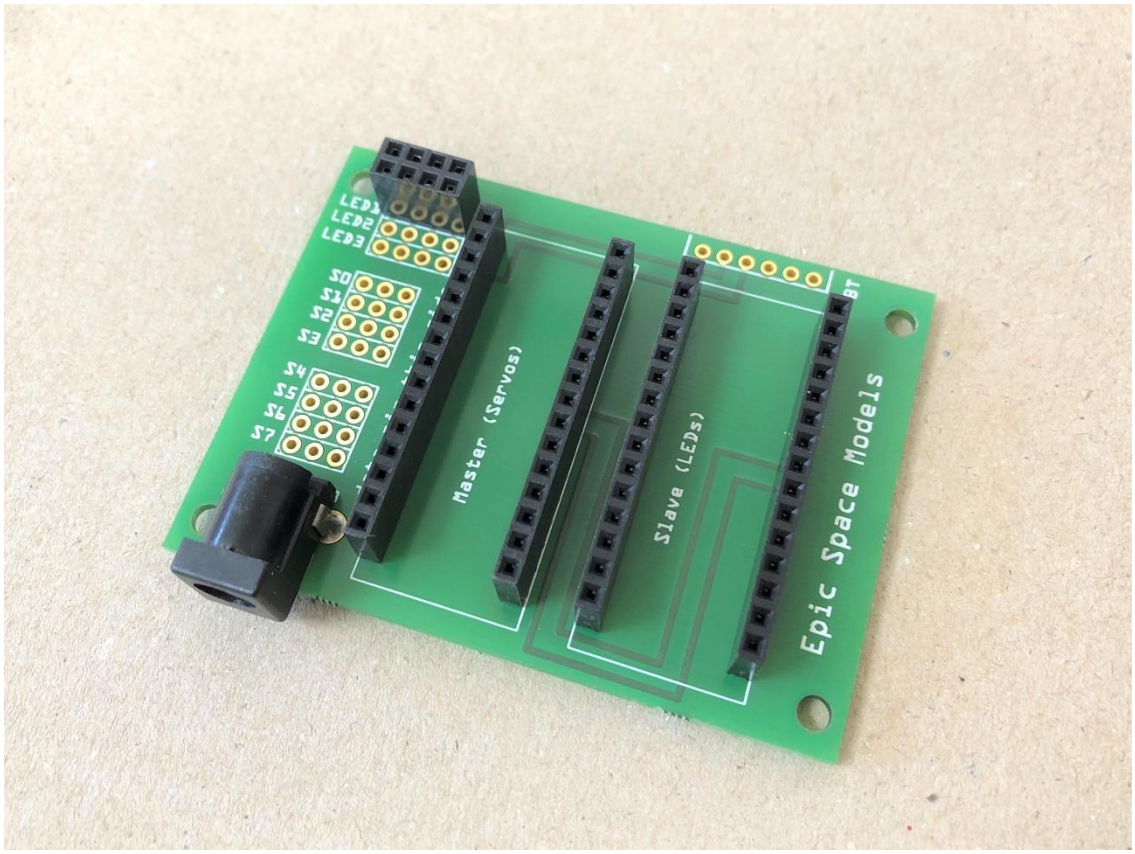
Solder the power plug next to the “5V” label. The plug might already be soldered. In this case, proceed directly to the next step.



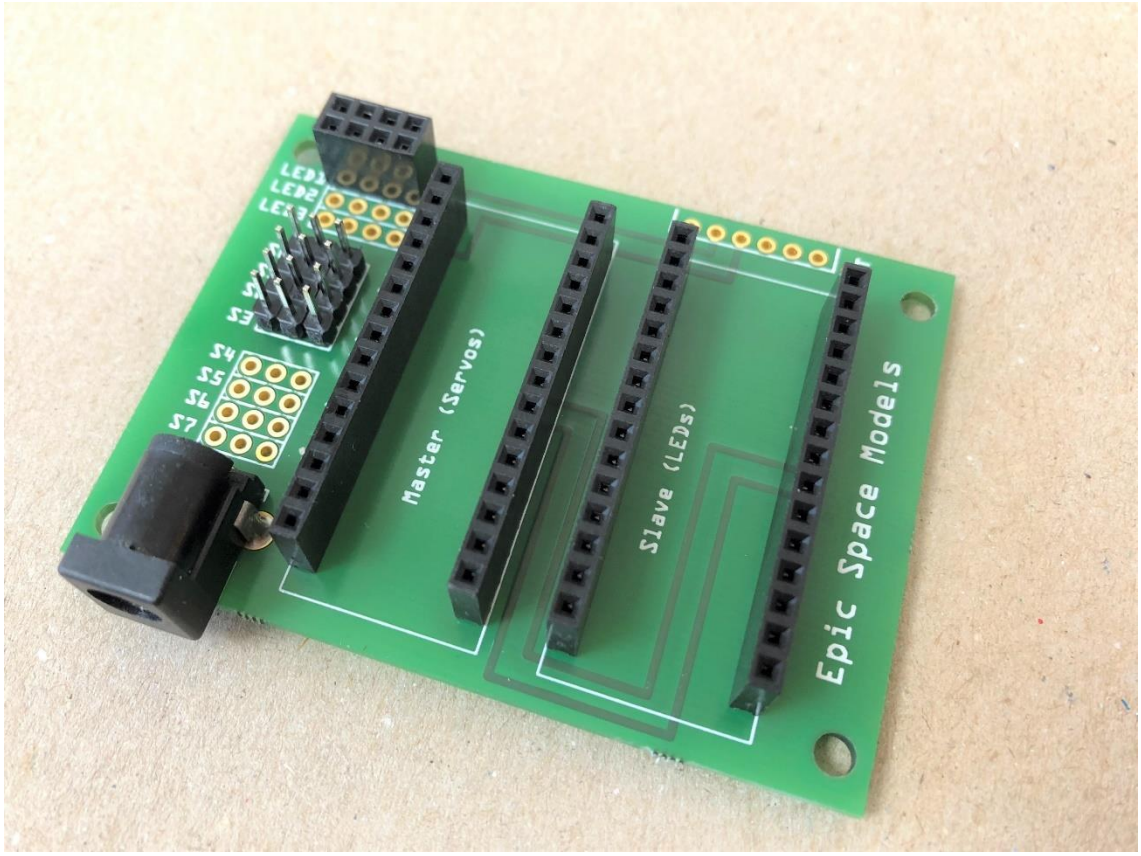
Solder the 1x15 female pin headers as shown on the photo.



Solder the 2x4 female pin headers as shown on the photo. Use the slots LED0 and LED1. Leave the other slots LED2 and LED3 free, they are not used by Starship.

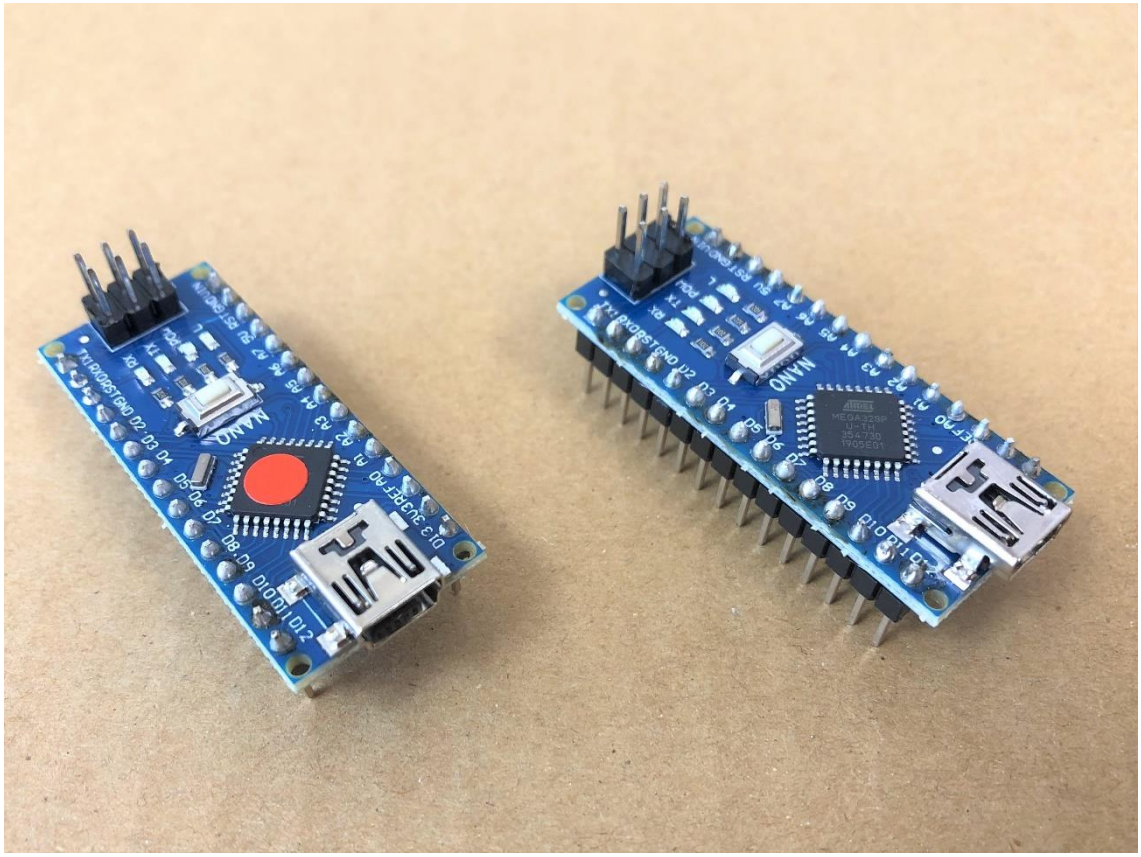


Take the male pin headers. Solder them across the slots S0 to S3. Leave the other slots S4 to S7 free, they are not used by Starship.



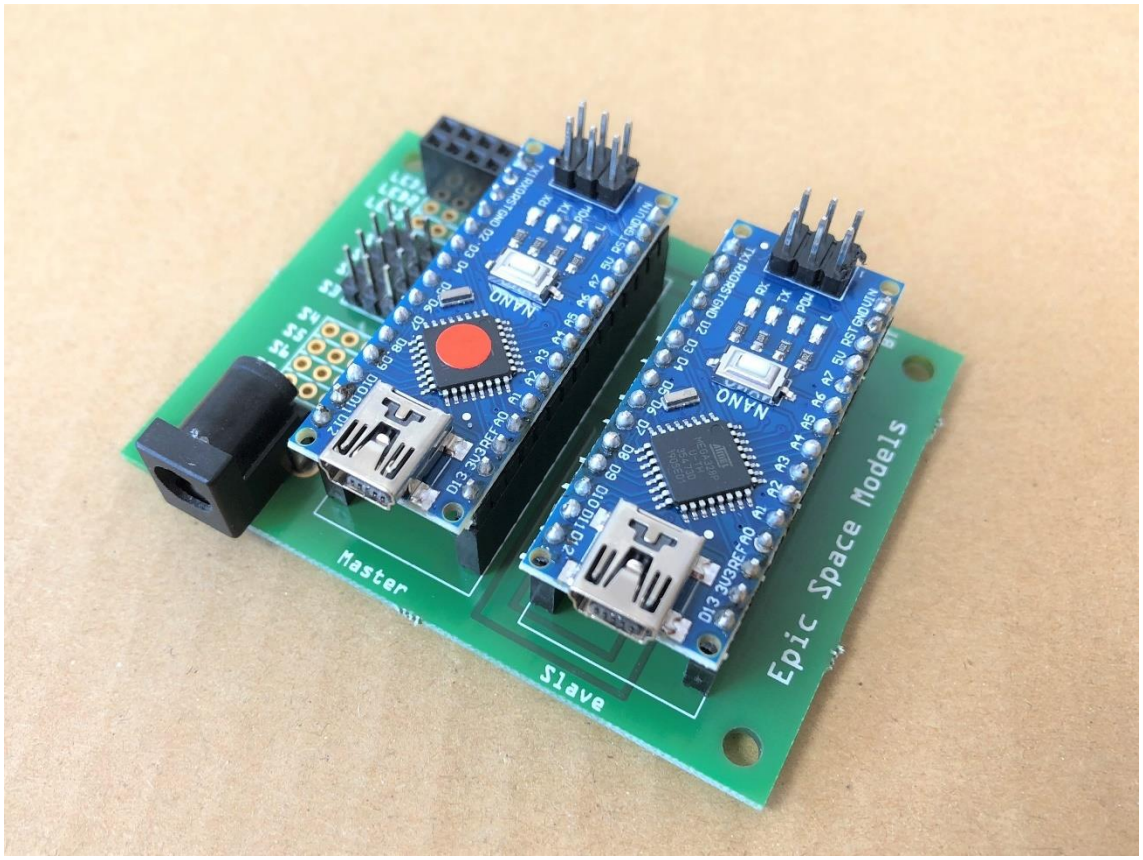
Take the 2 Arduinos out of their bag. One has a colored dot on it. Do not remove the dot! The 2 Arduinos run different programs, and Starship will not work if you swap them. Apart from the Arduino boards there are also pin headers in the bag. Solder the 1x15 pin headers below the boards, and the 2x3 pin headers above the board.

The pin headers might already be soldered. If this is the case, go directly to the next step.



7.2.2 Arduinos installation

Insert the Arduinos into the pin headers as shown on the picture below. The Arduino with the dot must be on the side of the board with the servo and led connectors. The USB connector of the Arduino must be on the same side as the power plug. Make sure you insert each Arduino at the correct location.



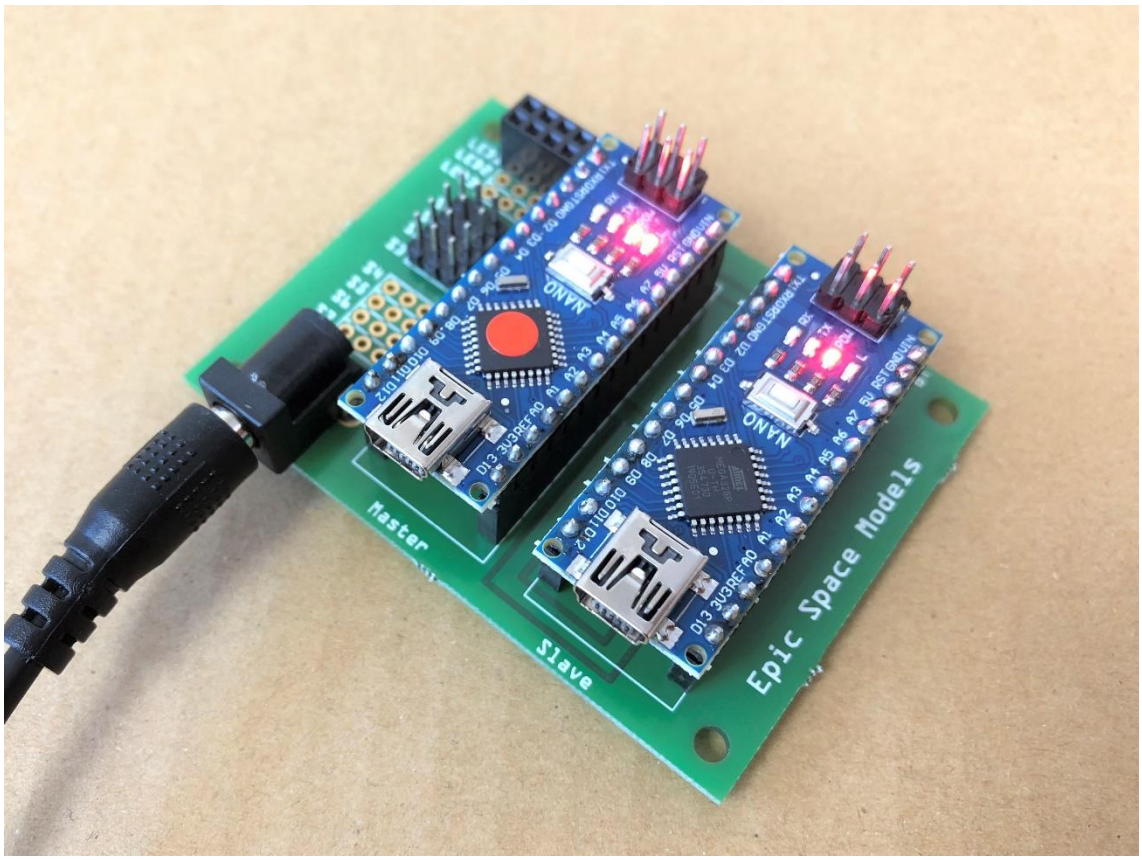
7.2.3 Testing

Take the power adapter out of its box. Connect the 5V plug (round plug) to the control board. Connect the power adapter to a wall outlet. Depending on your country, you might need to insert a plug adapter.

After plugging the power adapter, wait a few seconds. The red LED on the Arduino on the servo/led connector side (the one with the dot) should blink about 1 time per second. The other Arduino LED should blink 1 time every 2 seconds (two times slower). Once you checked that the LEDs blink as expected, unplug the control board.

There is a USB cable included in the kit, but do not connect it for the moment.

Put the control board in a safe place out of reach of your cat.



7.3 Engine pod assembly

7.3.1 Parts & tools preparation

The wires can come as 3 single wires or as a 3 conductors tape wire. In this case, you do not need to separate the tape into 3 wires.

The kit comes with spare nozzles in case you break one during the assembly.

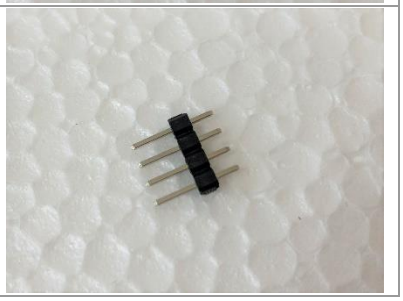
The kit comes with spare LEDs in case one burns out.

Tip

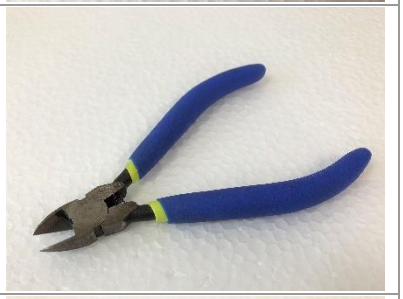
Before soldering a LED, pre-tin the pads on the LED and the stripped part of the wires. This will make it easier to solder.

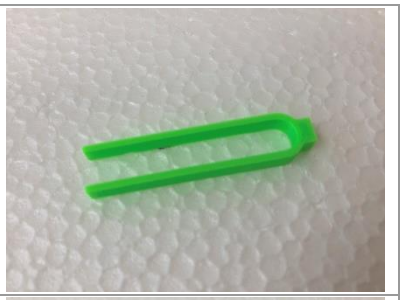
Prepare the following parts

Part	Number of parts	Photo
Engine pod	1	
Sea level engine (small ones)	3	
Vacuum engine (big ones)	3	

Red wire	1	
Black wire	1	
White wire	1	
LEDs	6	
Male pin header 1x4	1	

Prepare the following tools

Part	Photo
Soldering iron	
Solder	
Flux (optional)	
Wire cutter	
Wire stripper	

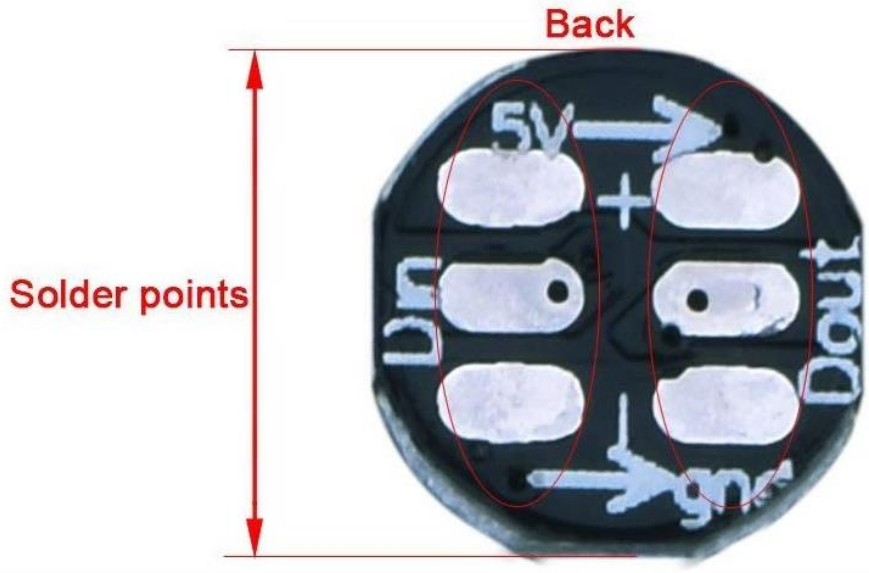
Starship tweezers (included in kit)	
2mm drill bit	
Marker	

7.3.2 Poking the engine holes

Using the 2mm drill bit, poke the three holes at the center of the engine pod. The result should look like the second photo.

7.3.3 Wiring engine 1

Take one LED and flip it to have the soldering pads upwards. Look carefully at the markings on the LED. Red wire goes on the “5V” side, black wire goes on the “gnd” side, and white wire goes in between. Notice the labels “Din” and “Dout”. They indicate the data input and data output pad respectively.



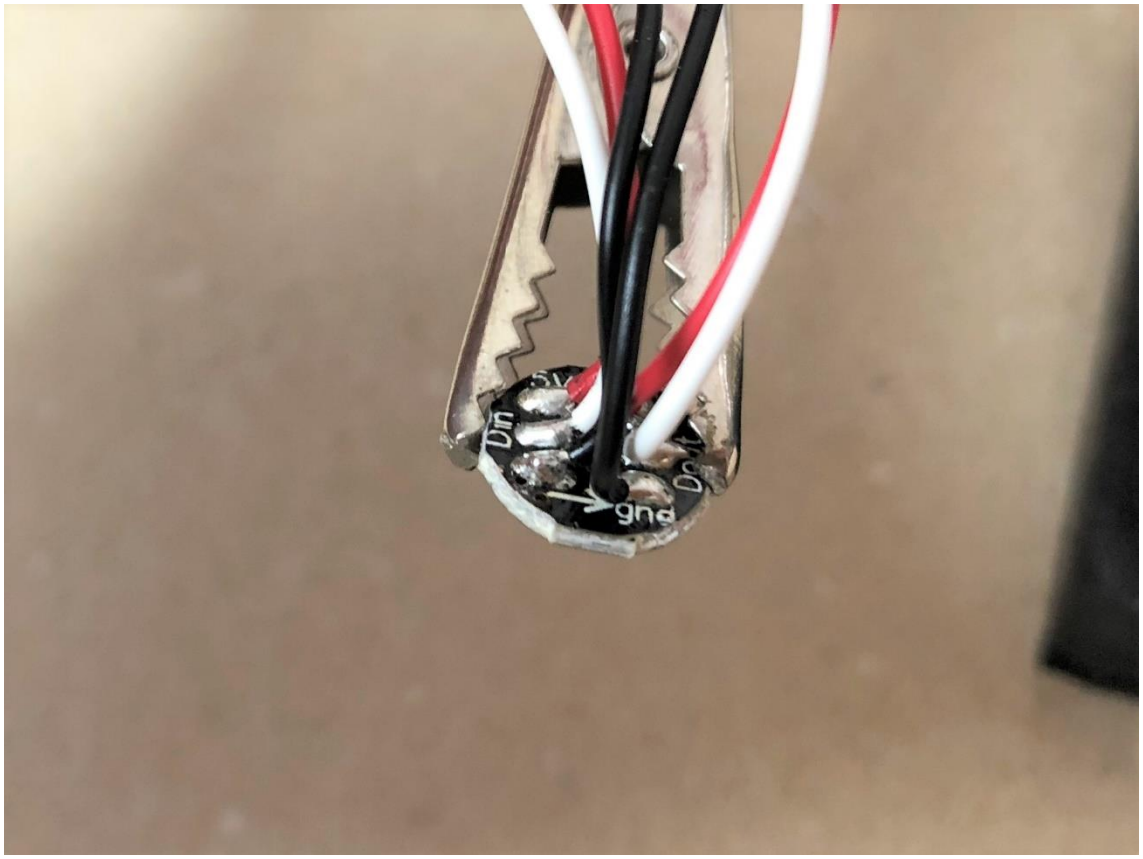
Optional: apply flux to the pads of the LED to facilitate the soldering.

Cut 40 cm of each wire: red, black, white. Strip 2 mm at one end of each wire. Bend the stripped part of the wires 90 degree. Solder the wires on the LED as follows:

- White: Din pad
- Red: 5V pad on the Din side
- Black: gnd pad on the Din side

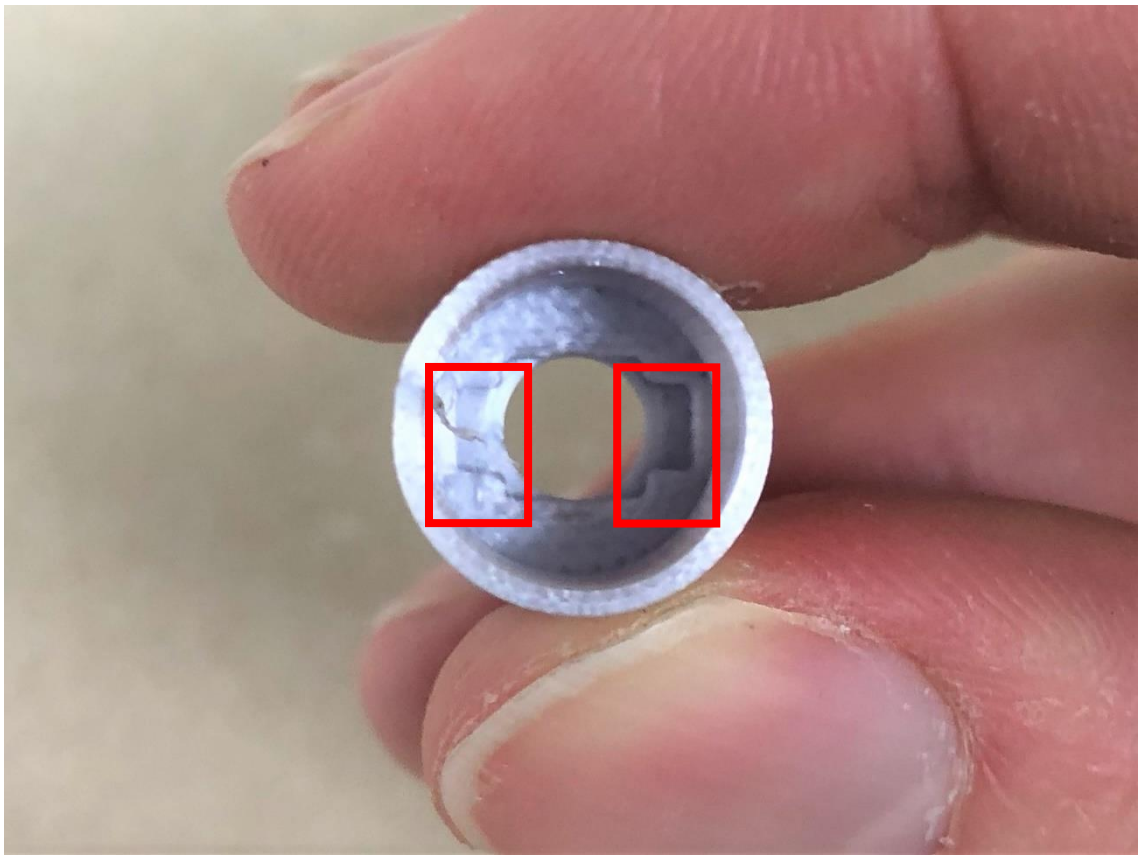
Pay attention to the orientation of the wire. It must leave the pad in direction of the center of the LED, then bend 90 degrees away from the LED. The wires should stand vertical at the center of the LED. The result should look like the photo below.

Cut 15cm of each wire, and strip 2mm at one end of each wire. Bend the stripped end 90degrees. Solder to the LED on the Dout side as show on the photo.



Look at the top of the LED board. On both sides of the LED, you can see two small resistors (the rectangles).

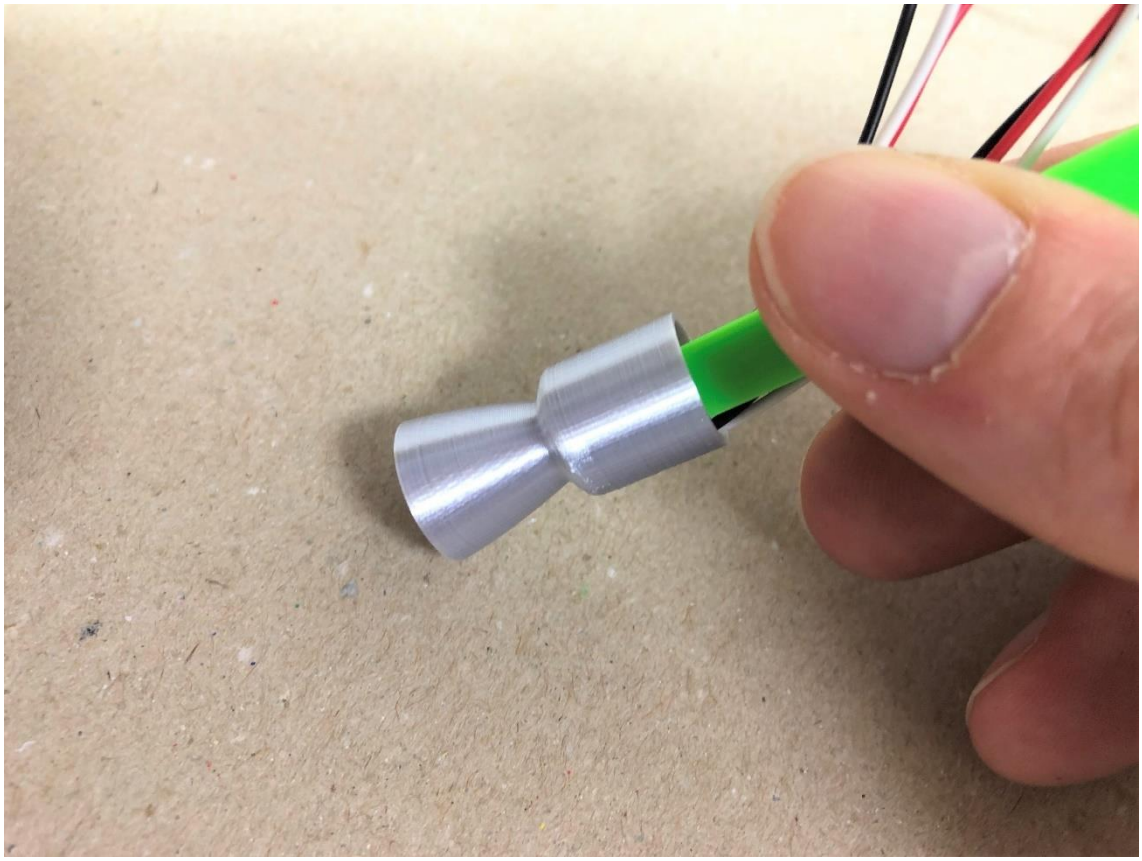
Now, take one of the see level engines (the small ones), and look inside from the top. There is a square hole near the engine throat, and two notches on the sides of the hole. When inserting the LED inside the engine, the orientation of these notches must match with the resistors on the LED.



Grab the LED using the Starship tweezers as shown on the photo.

Holding the LED with the tweezers, carefully insert the LED inside the engine. Adjust the orientation of the LED until it snaps inside the engine.

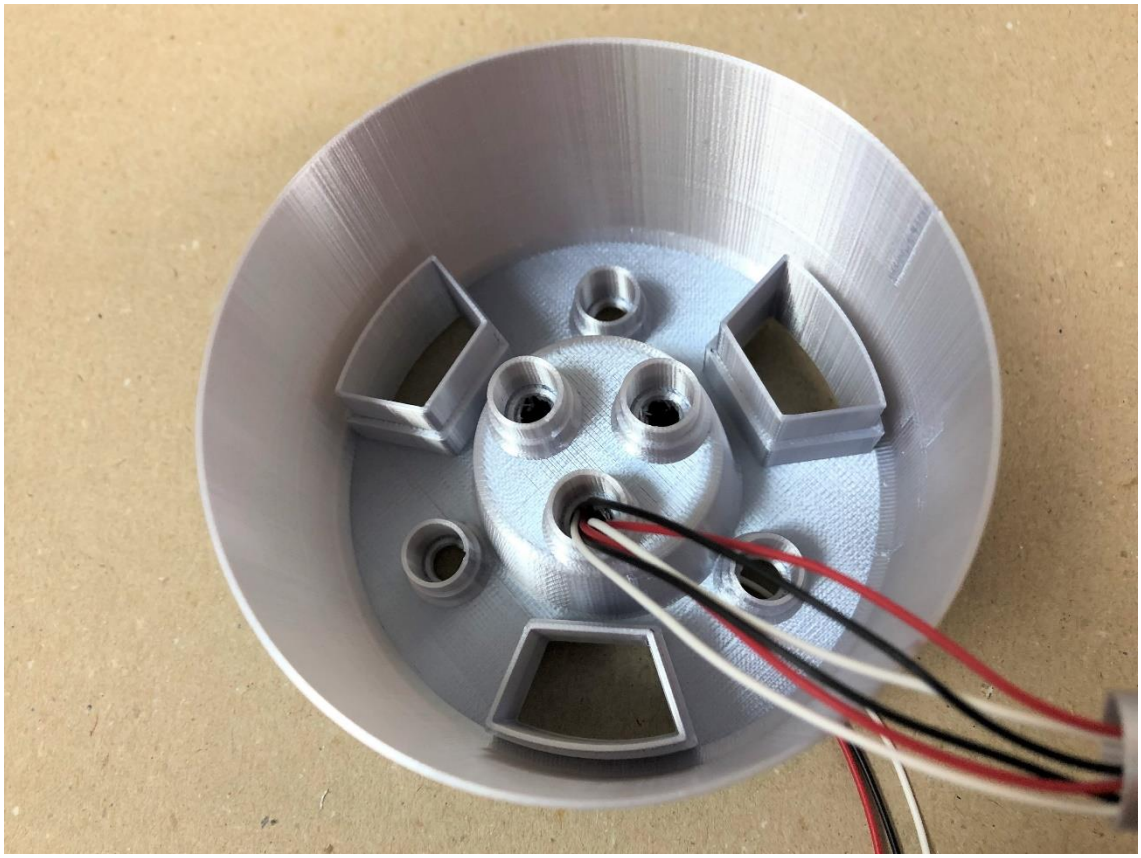
DO NOT GLUE THE LED.

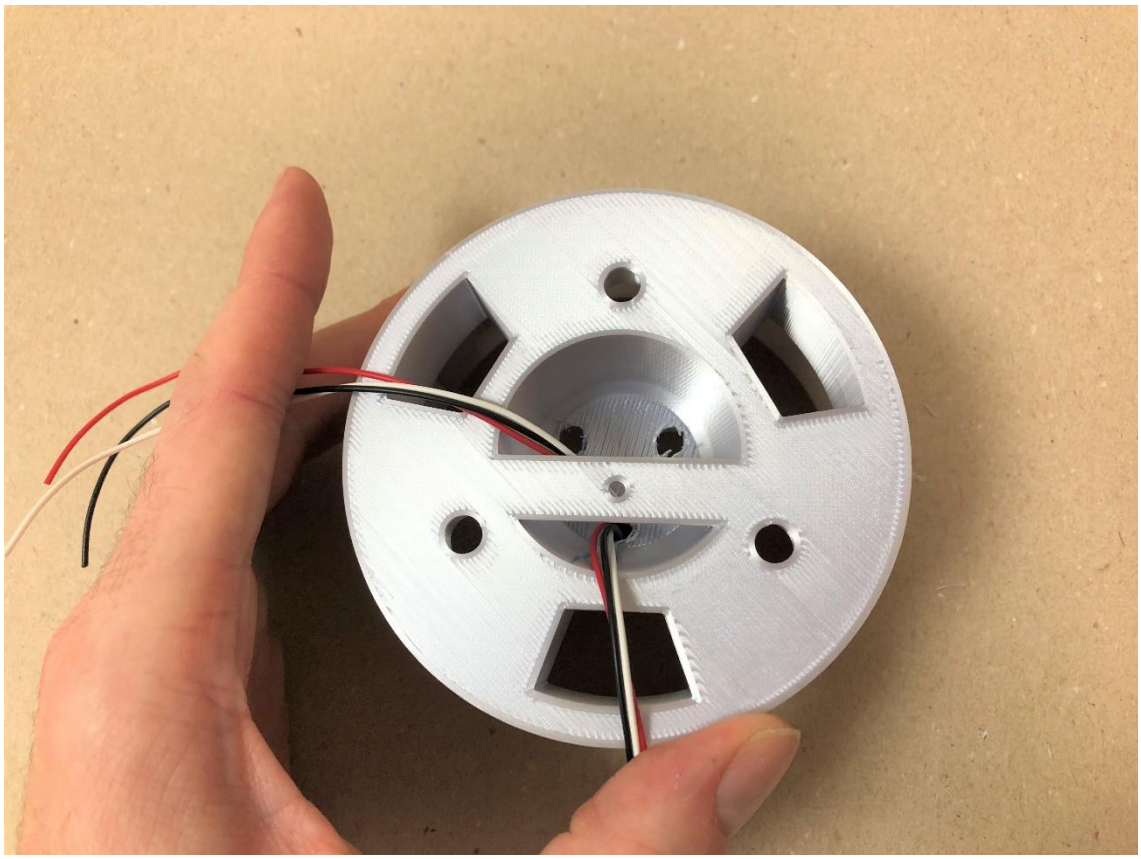


Insert all the wires into the hole as shown on the photos below. Make sure that you are using the correct hole. The long wire bundle must leave the engine pod below the “beam”, while the short wire bundle must leave the engine pod above the beam.

Snap the engine onto the engine pod. Do not worry if the engine is a bit loose, we can fix it later.

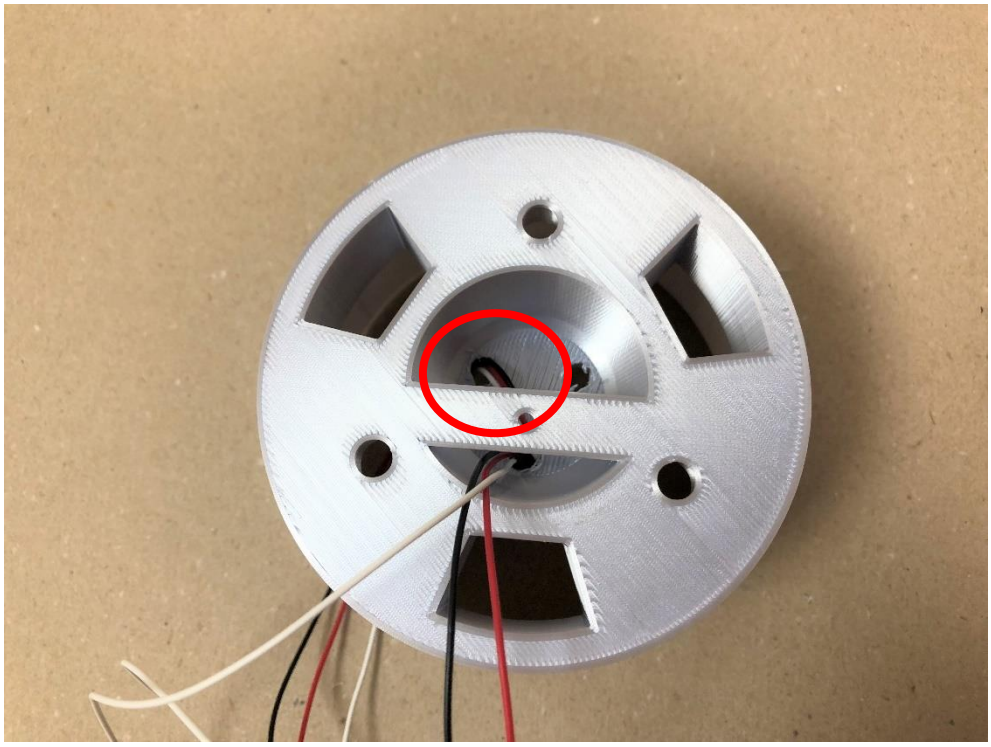
Congratulations! You have soldered the 1st engine! 5 more to go.

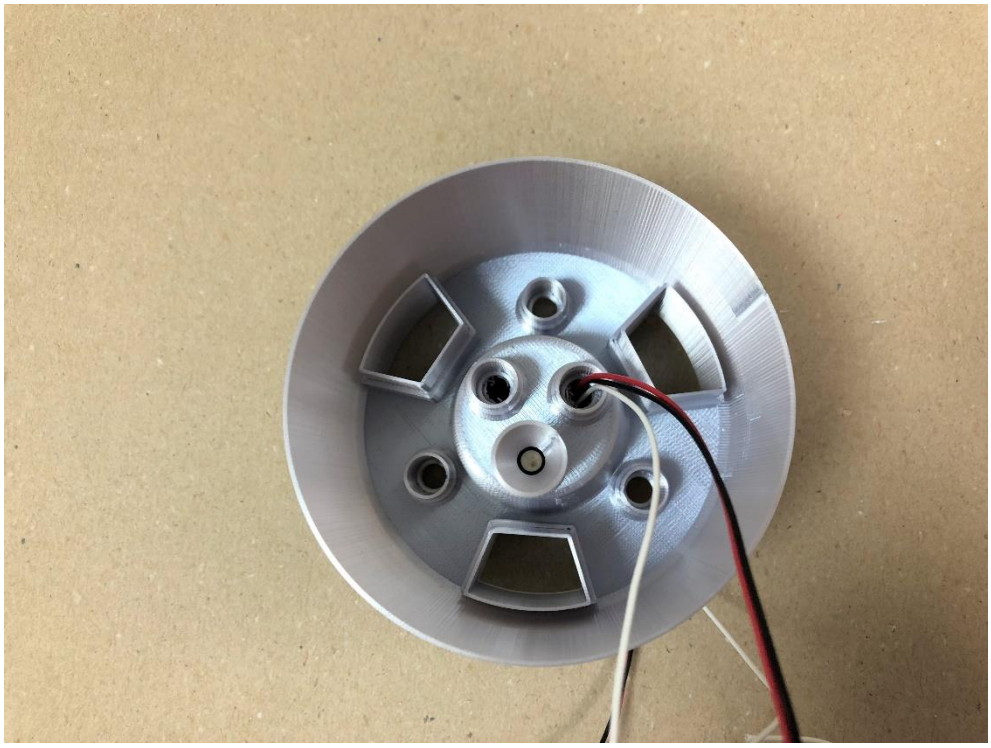




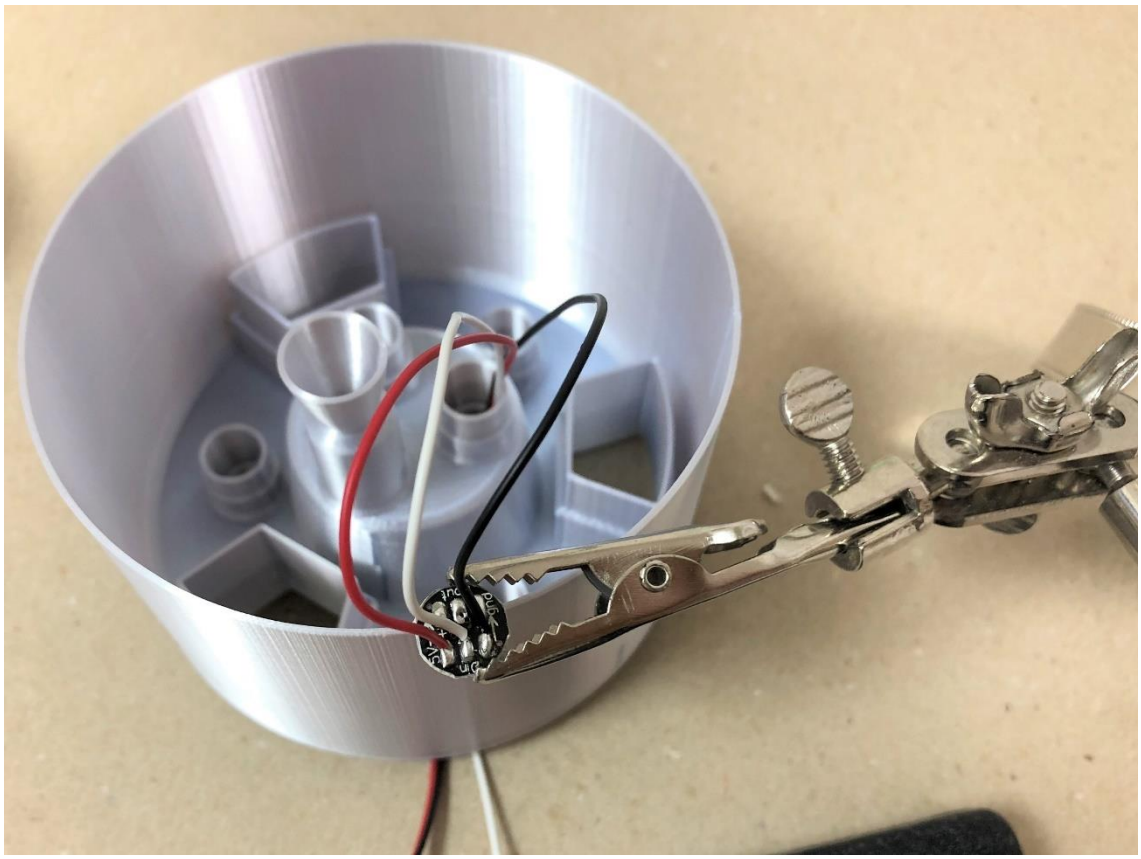
7.3.4 Wiring engine 2

Take the short wire bundle and insert it into the hole as shown on the photos below.

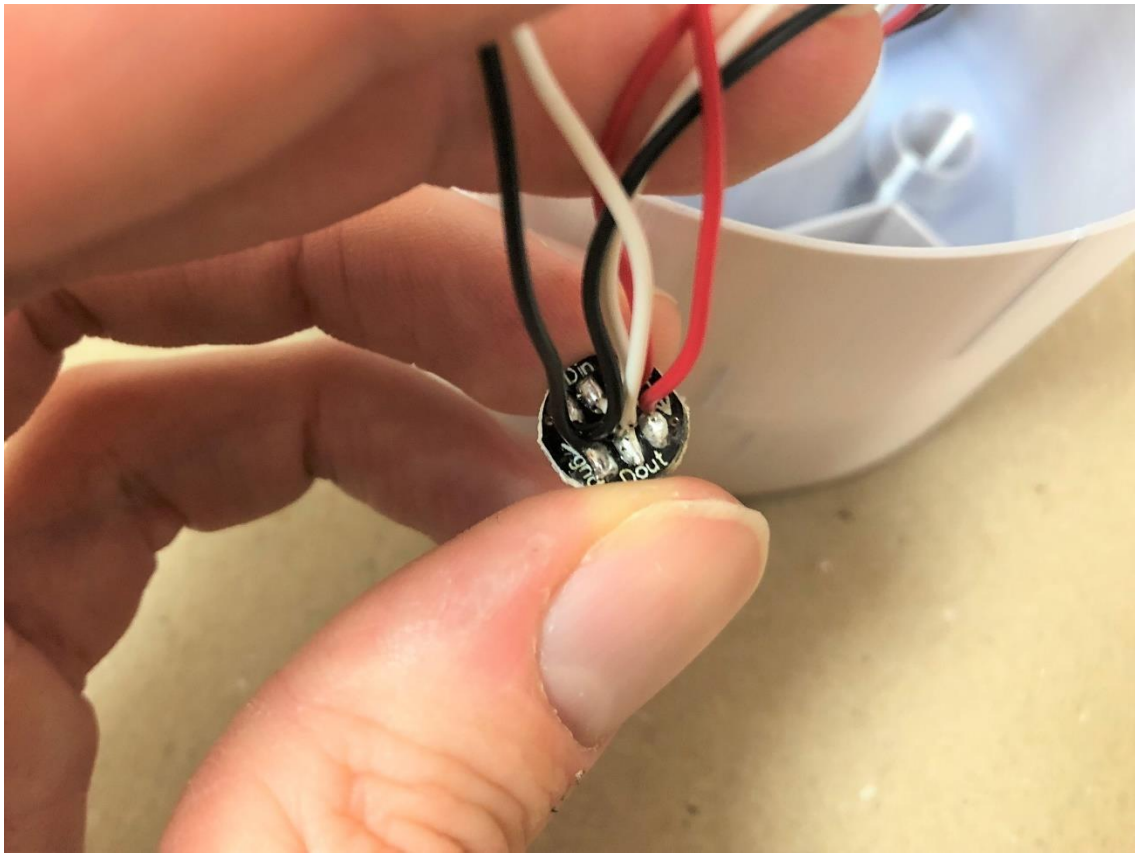




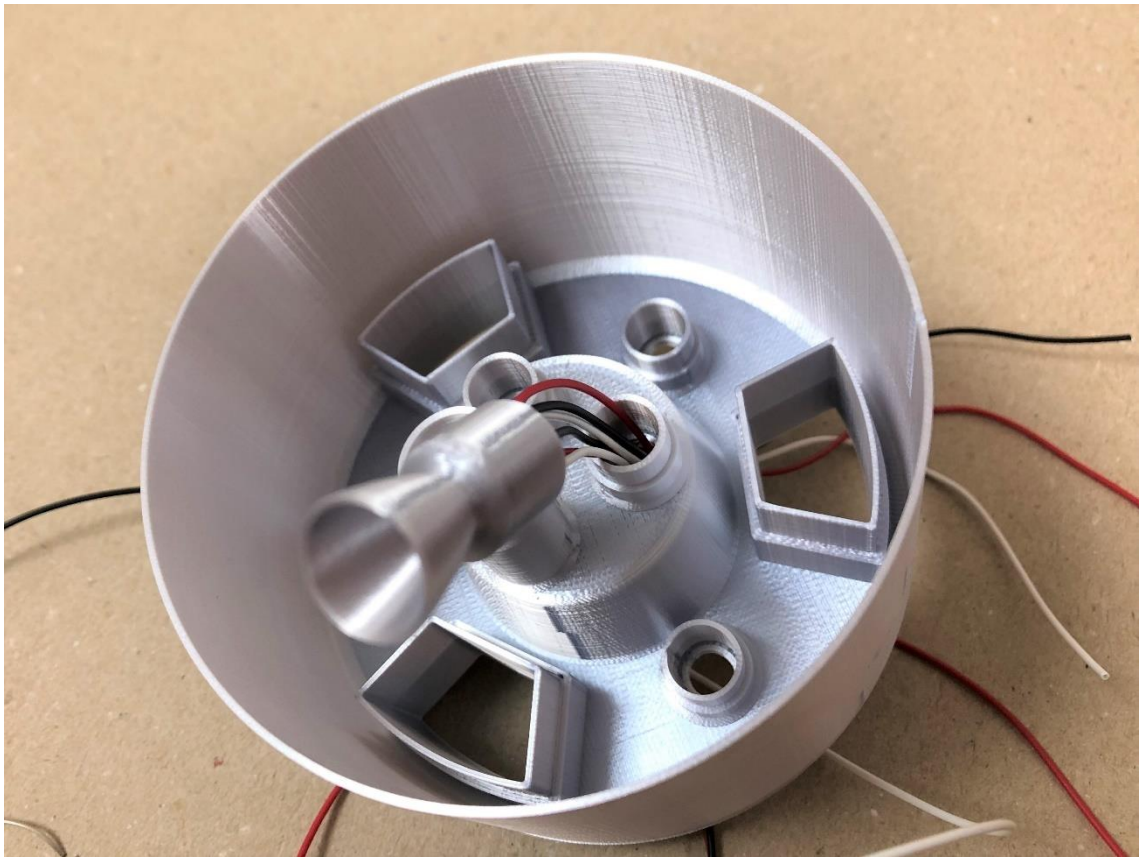
Strip the end of each wire (of the short bundle) and bend the stripped part 90 degrees. Take another LED and solder the wires on the Din side.



Cut 15cm of red/black/wire cable and solder them on the Dout side like for the first LED.



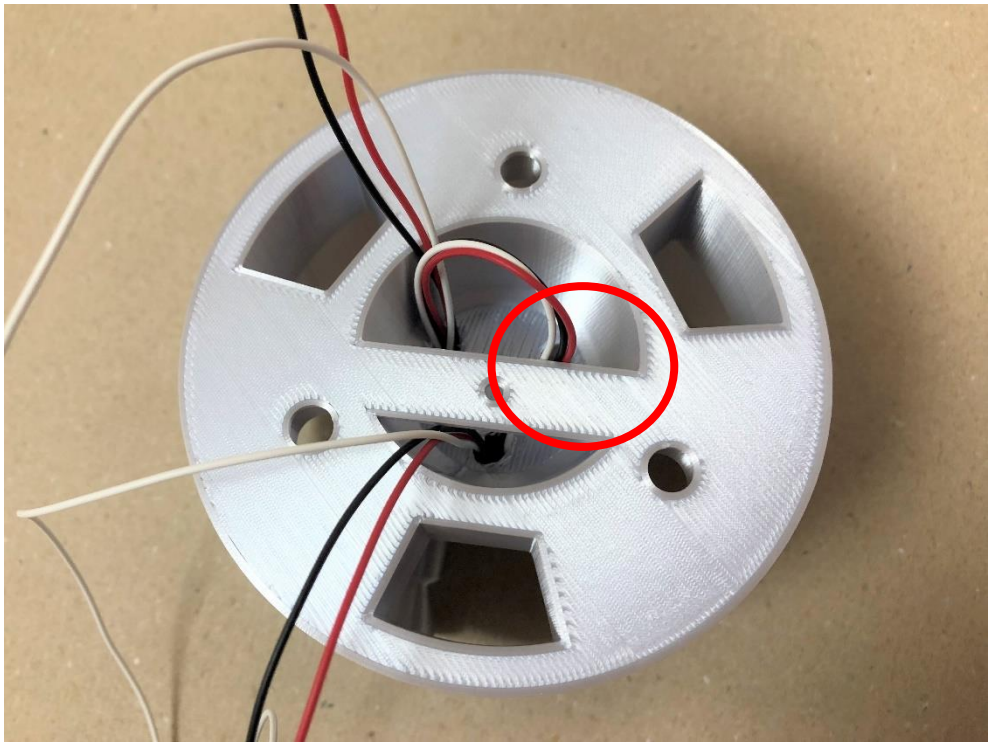
Insert the LED in a sea level engine using the same technique as for the first LED. Draw the cables from the Dout side through the hole in the engine pod (the hole from which the cables of the Din side are coming out).

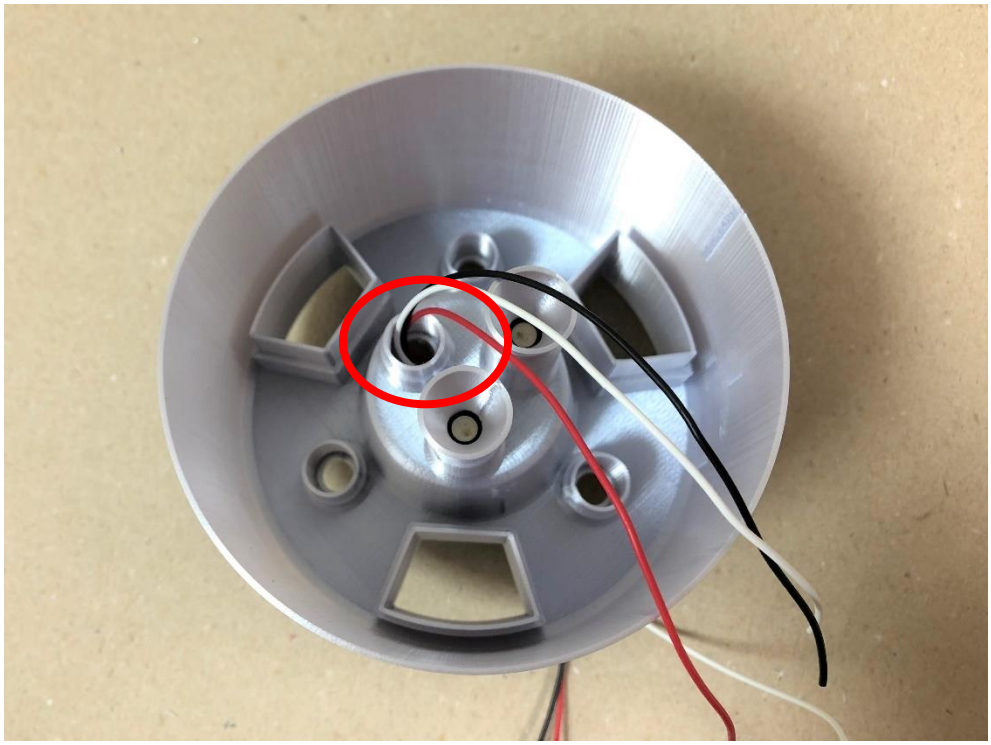


Gently pull the cables inside the engine pod and snap the second engine on the engine pod.

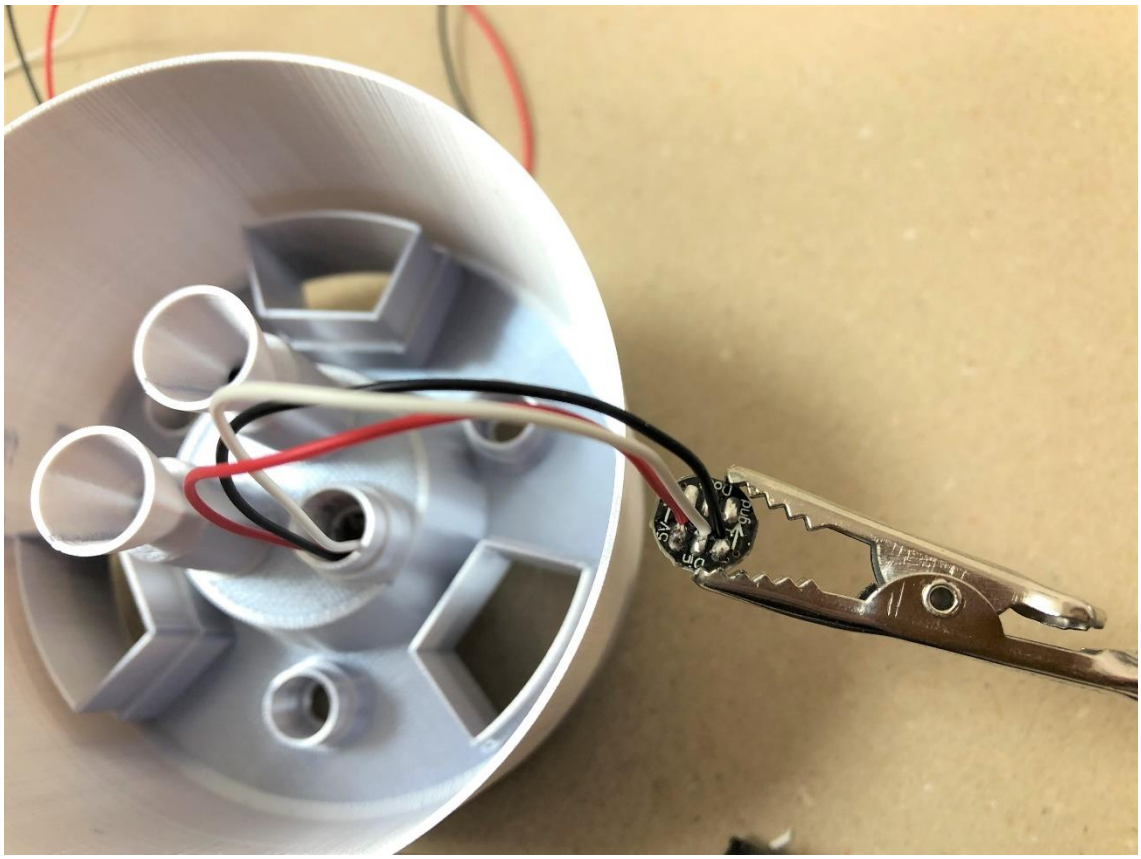
7.3.5 Wiring engine 3

Take the cable from the Dout side and draw them through the third inner hole of the engine pod.

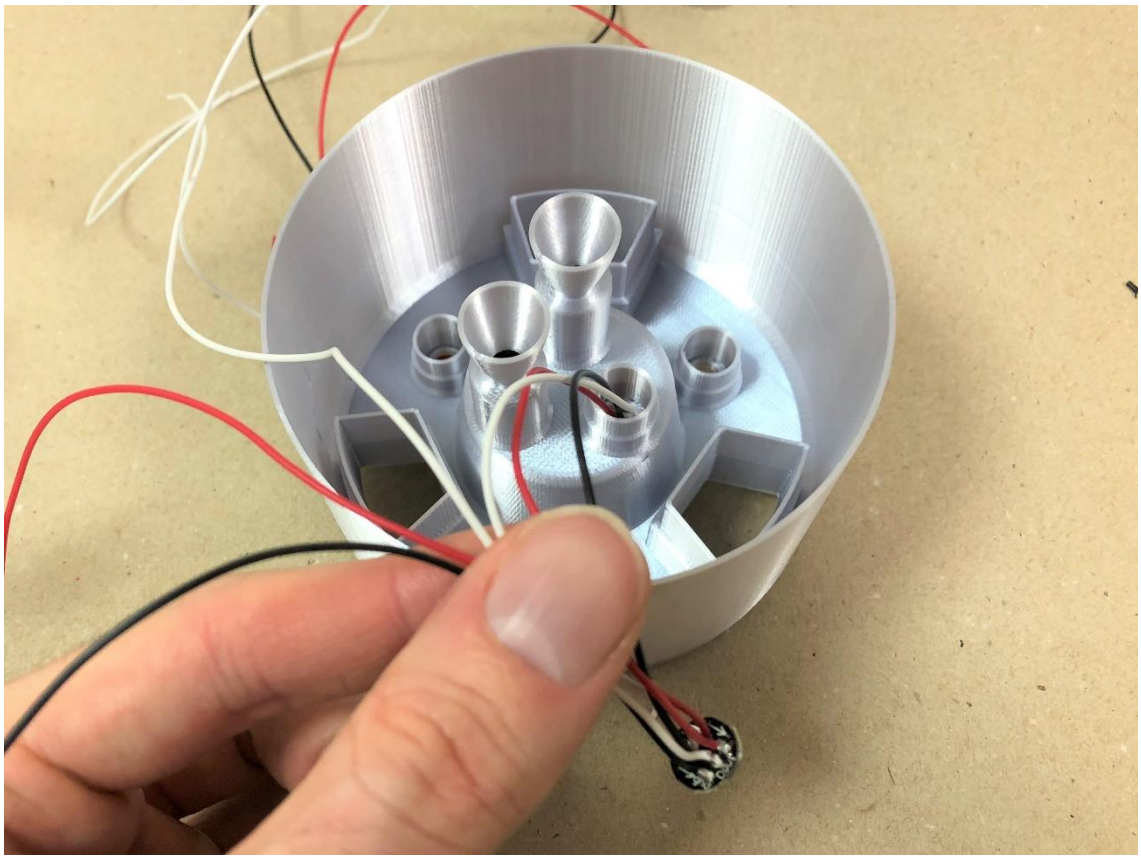




Strip the end of each wire (of the short bundle) and bend the stripped part 90 degrees. Take another LED and solder the wires on the Din side.



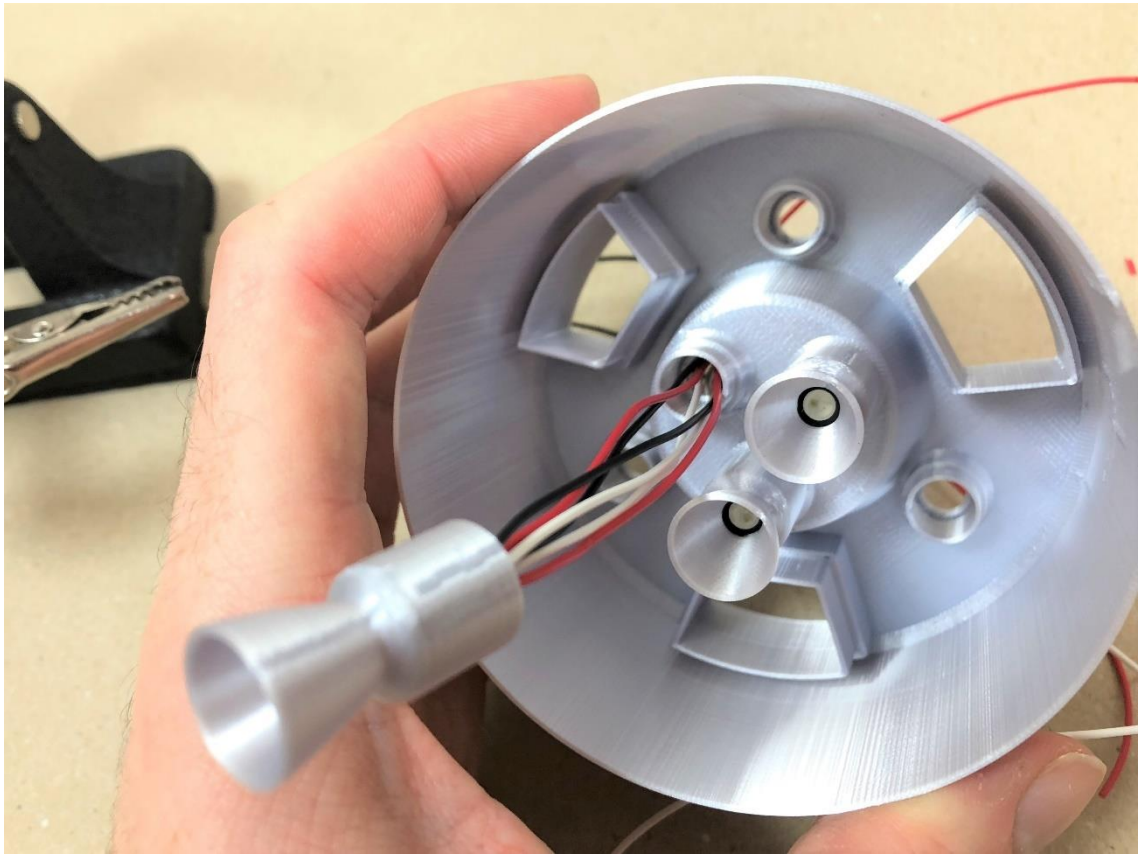
Cut 20cm of red/black/wire cable and solder them on the Dout side like for the first LED.



Insert the LED in a sea level engine using the same technique as for the first LED. Draw the cables from the Dout side through the hole in the engine pod (the hole from which the cables of the Din side are coming out).

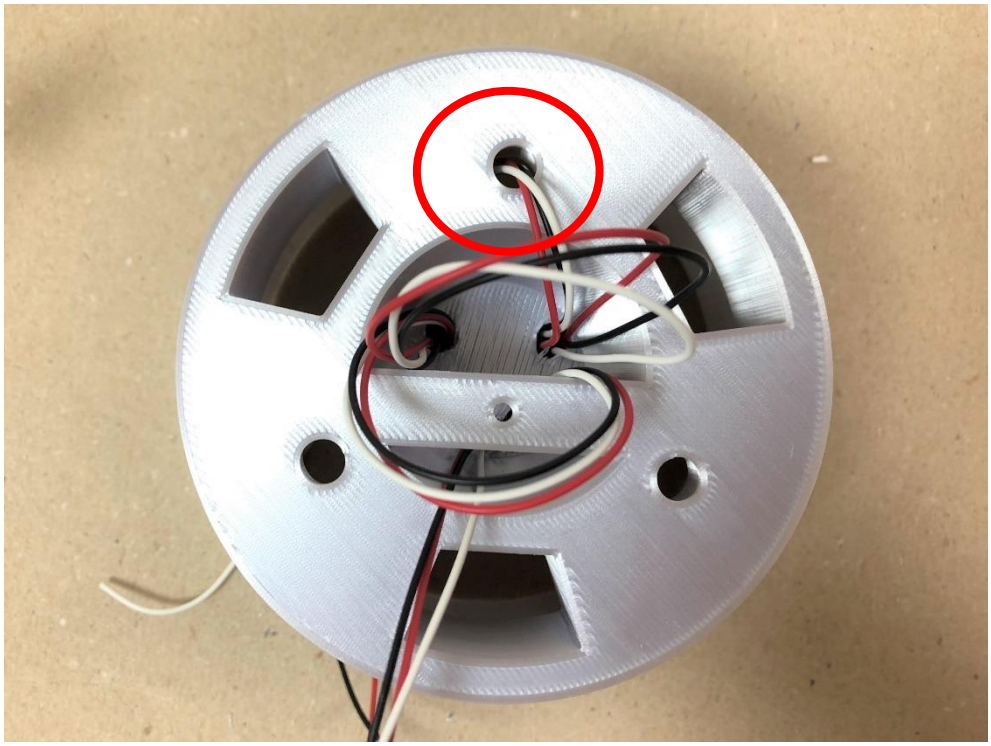
Gently pull the cables inside the engine pod and snap the third engine on the engine pod.

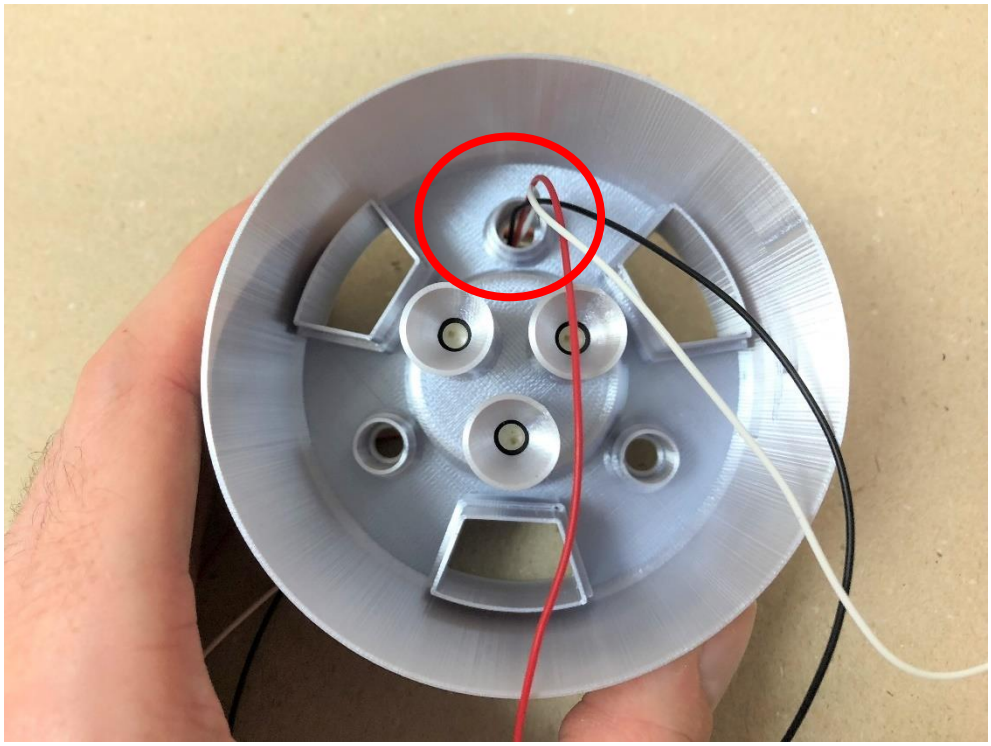
We are done with the sea-level engines. Now, let's wire the vacuum engines.



7.3.6 Wiring engine 4

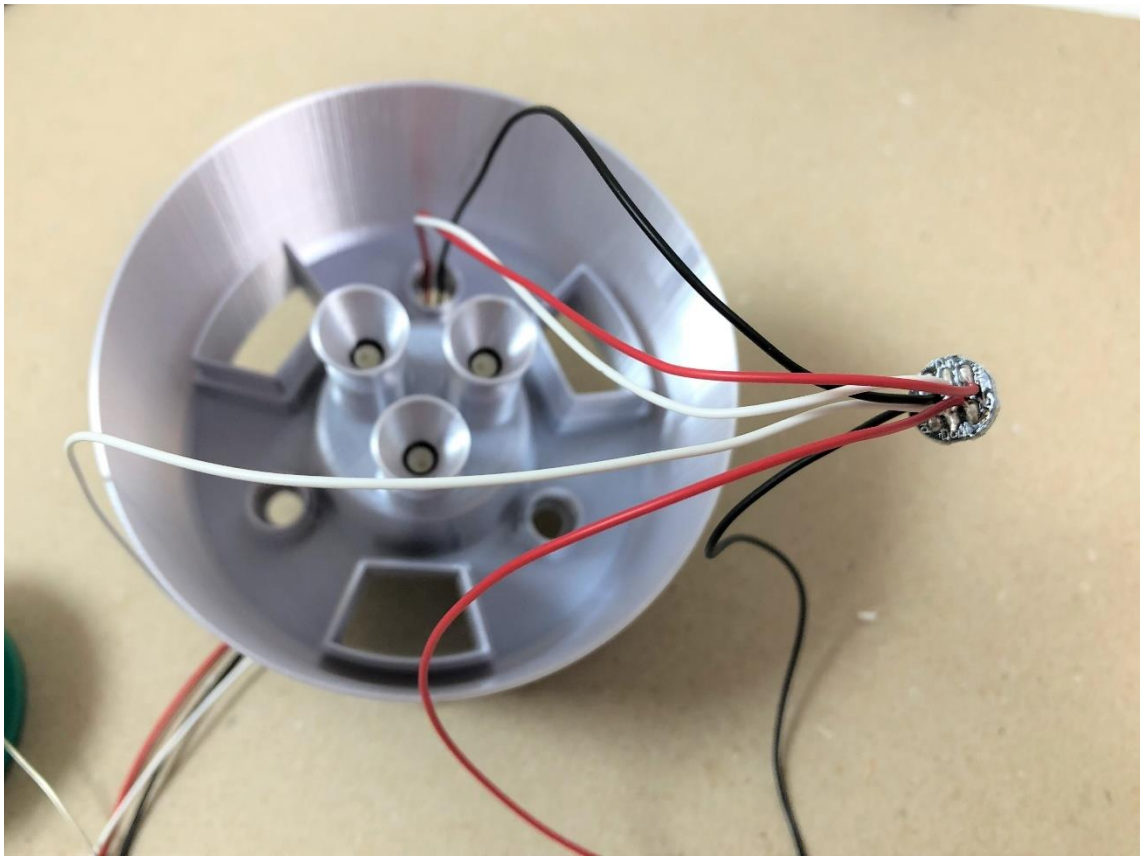
Take the cables from the Dout side and draw them through the upper hole of the engine pod.



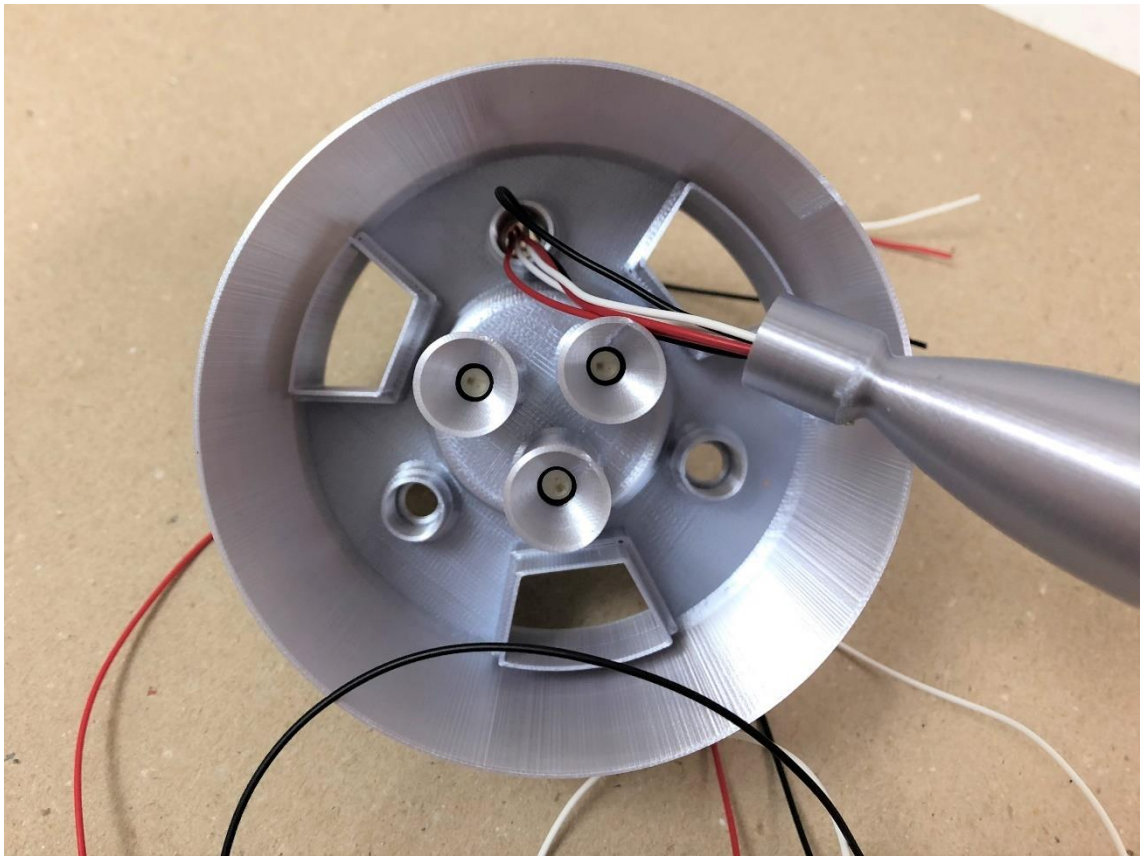


Strip the end of each wire and bend the stripped part 90 degrees. Take another LED and solder the wires on the Din side.

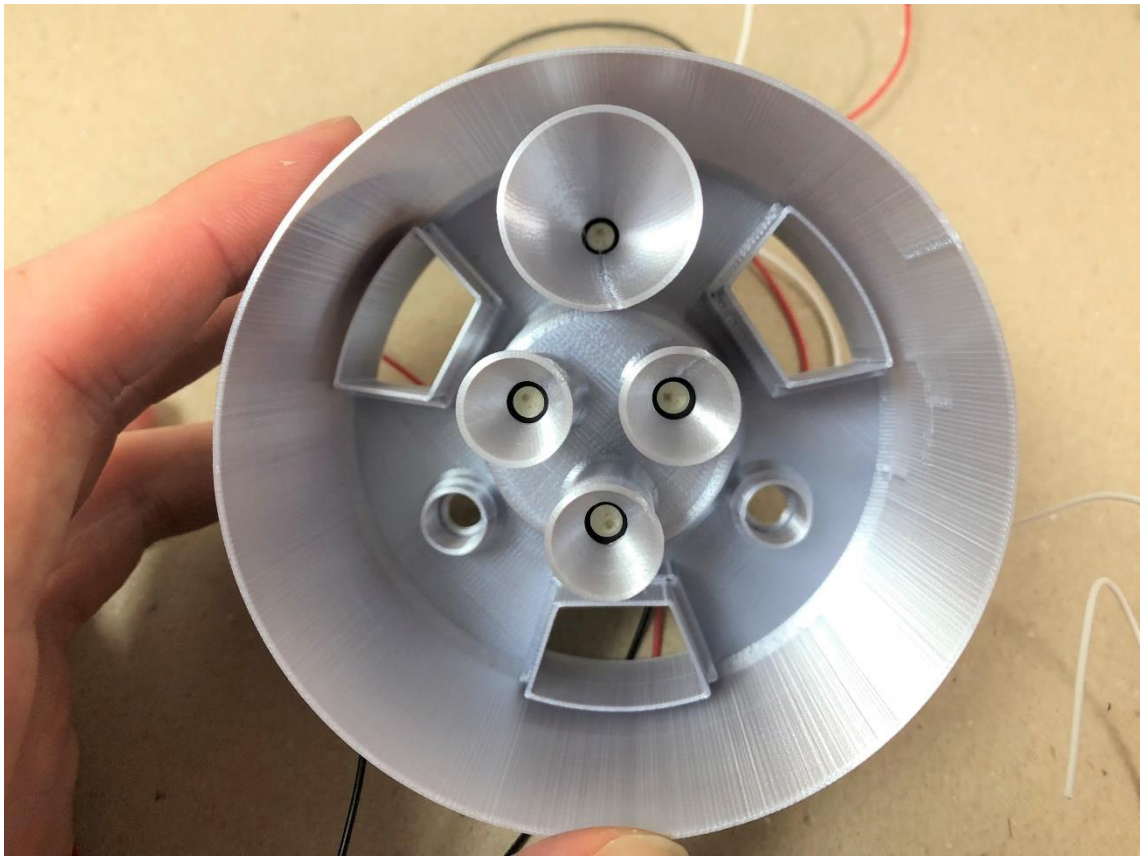
Cut 20cm of red/black/wire cable and solder them on the Dout side like for the first LED.



Insert the LED in a vacuum engine using the same technique as for the first LED.

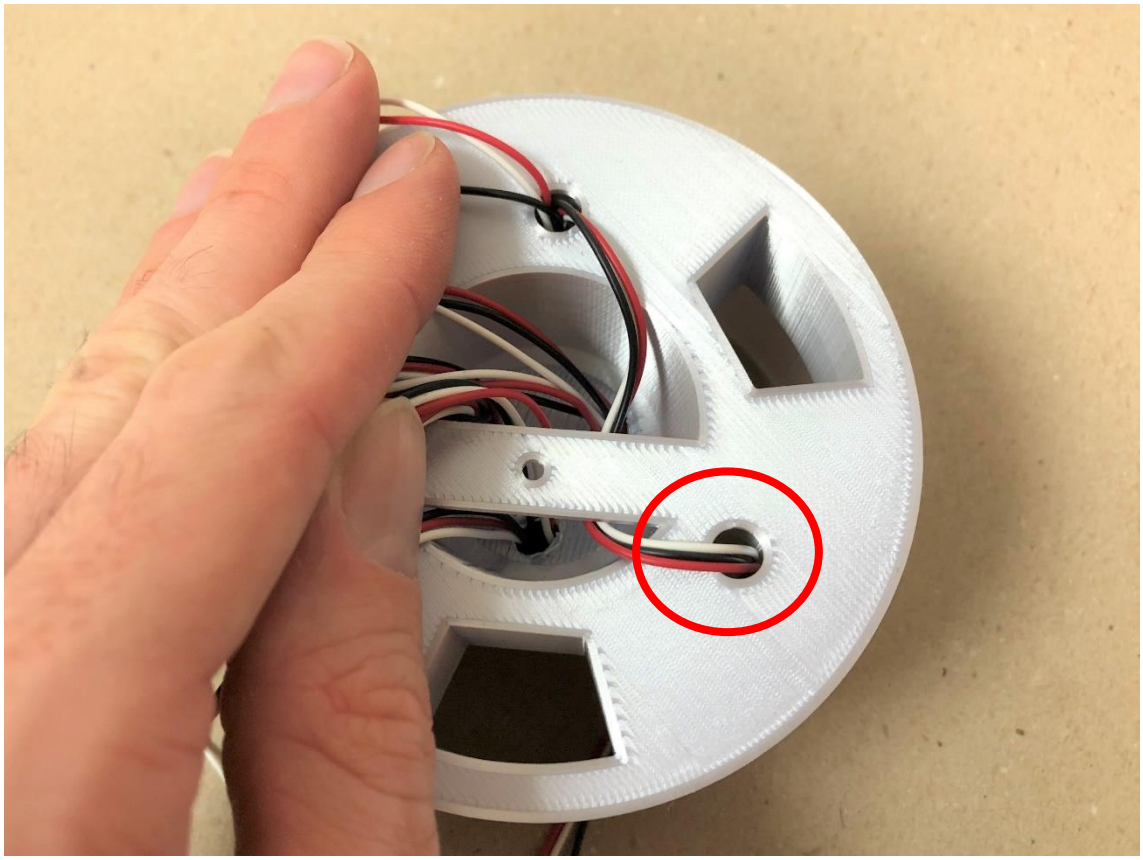


Draw the cables from the Dout side through the hole in the engine pod (the hole from which the cables of the Din side are coming out). Gently pull the cables inside the engine pod and snap the engine on the engine pod.



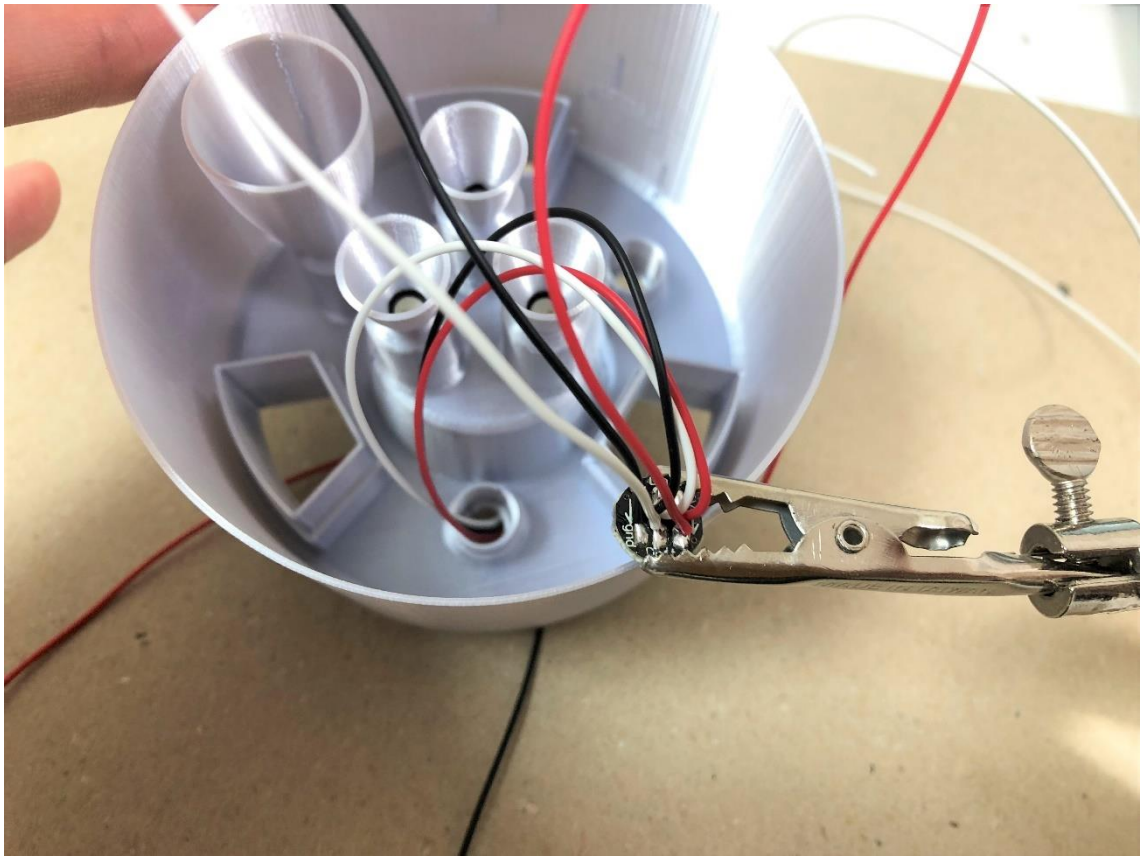
7.3.7 Wiring engine 5

Take the cables from the Dout side. Draw them under the beam then through the right outer hole the engine pod.

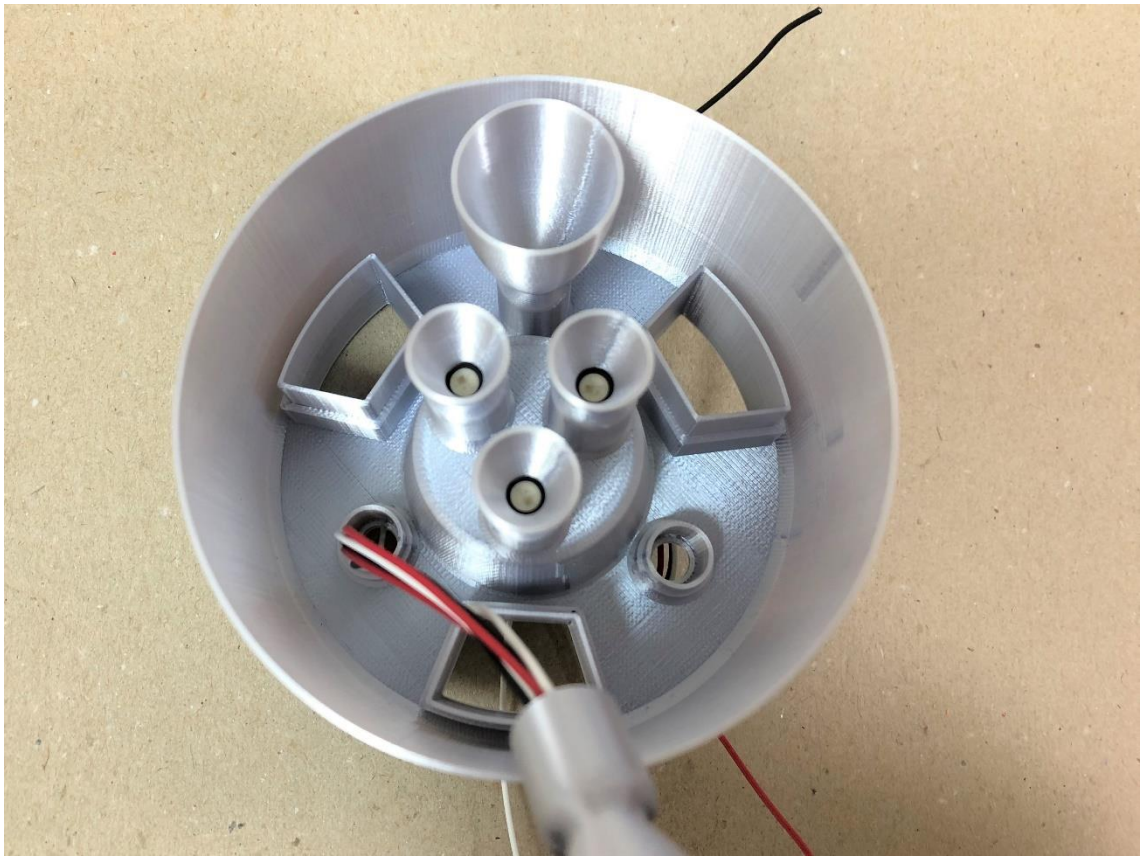


Strip the end of each wire (of the short bundle) and bend the stripped part 90 degrees. Take another LED and solder the wires on the Din side.

Cut 20cm of red/black/wire cable and solder them on the Dout side like for the first LED.

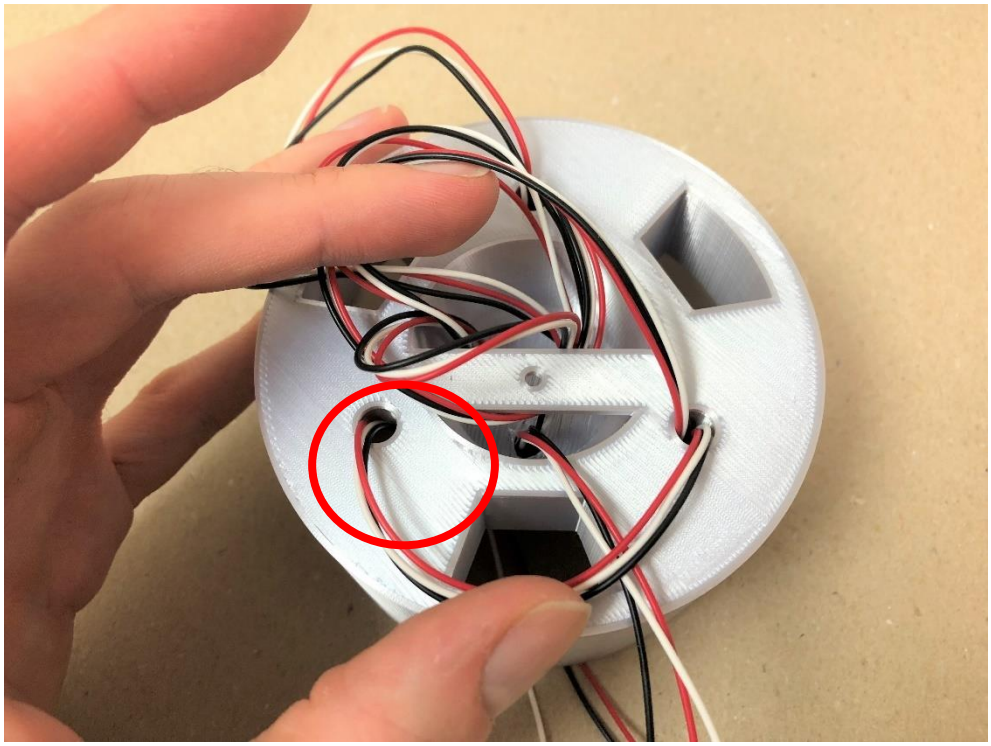


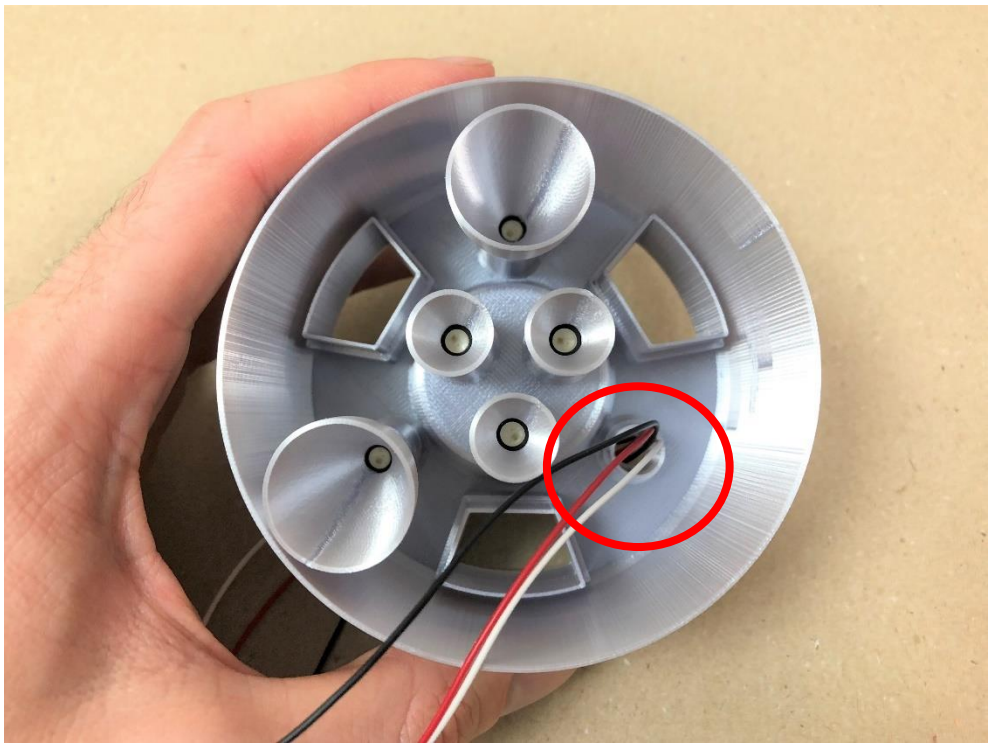
Insert the LED in a vacuum engine using the same technique as for the first LED. Draw the cables from the Dout side through the hole in the engine pod (the hole from which the cables of the Din side are coming out). Gently pull the cables inside the engine pod and snap the engine on the engine pod.



7.3.8 Wiring engine 6

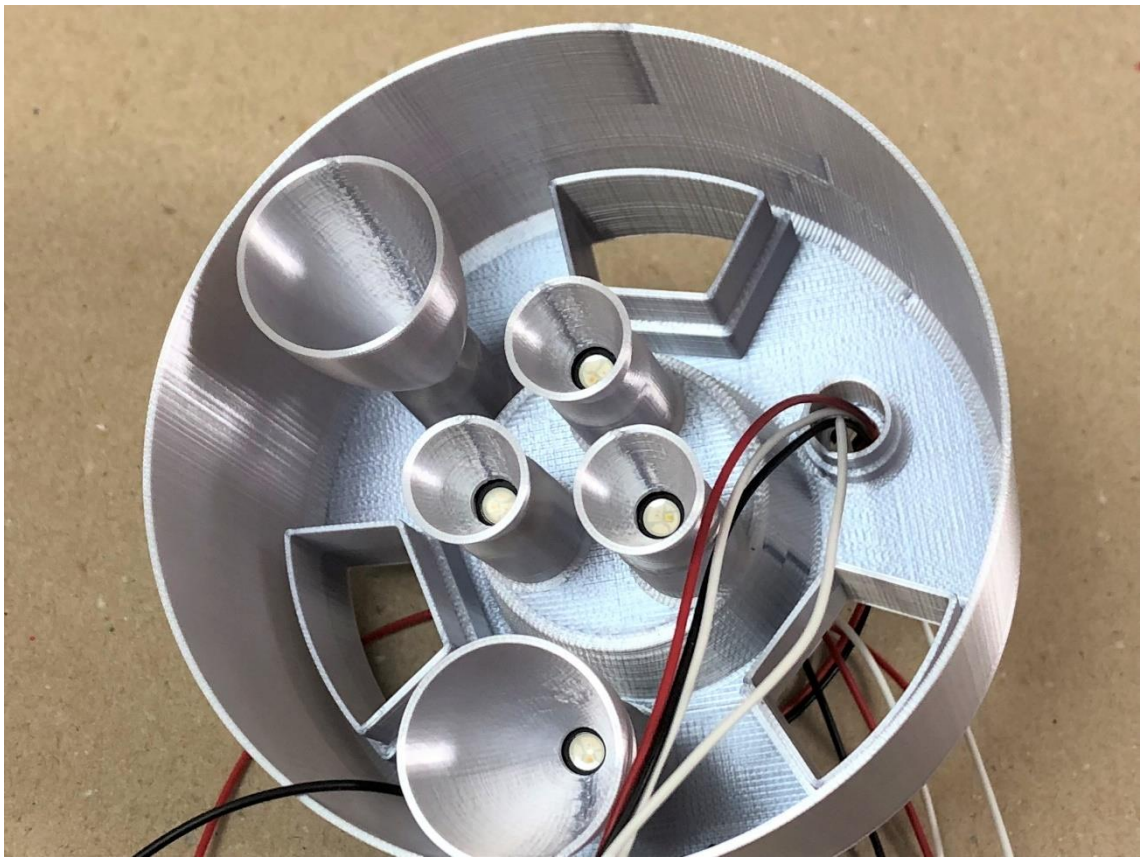
Take the cable from the Dout side. Draw the cables through the last hole in the engine pod.





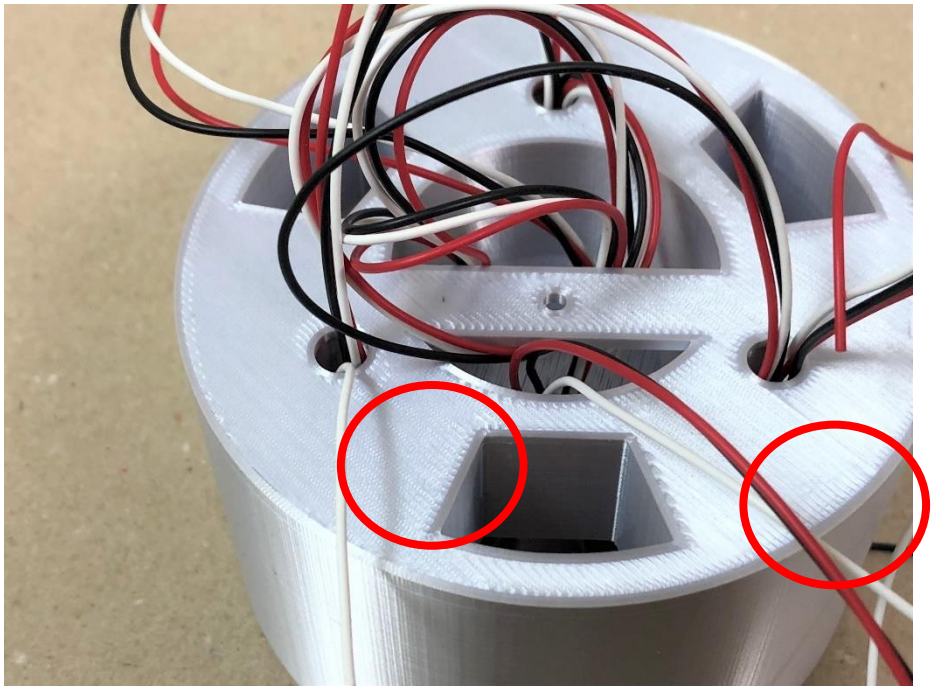
Strip the end of each wire (of the short bundle) and bend the stripped part 90 degrees. Take another LED and solder the wires on the Din side. Take the remaining of the white cable. Strip one end and solder it on the Dout center pad. Leave the 5V and gnd pads on the Dout side free.

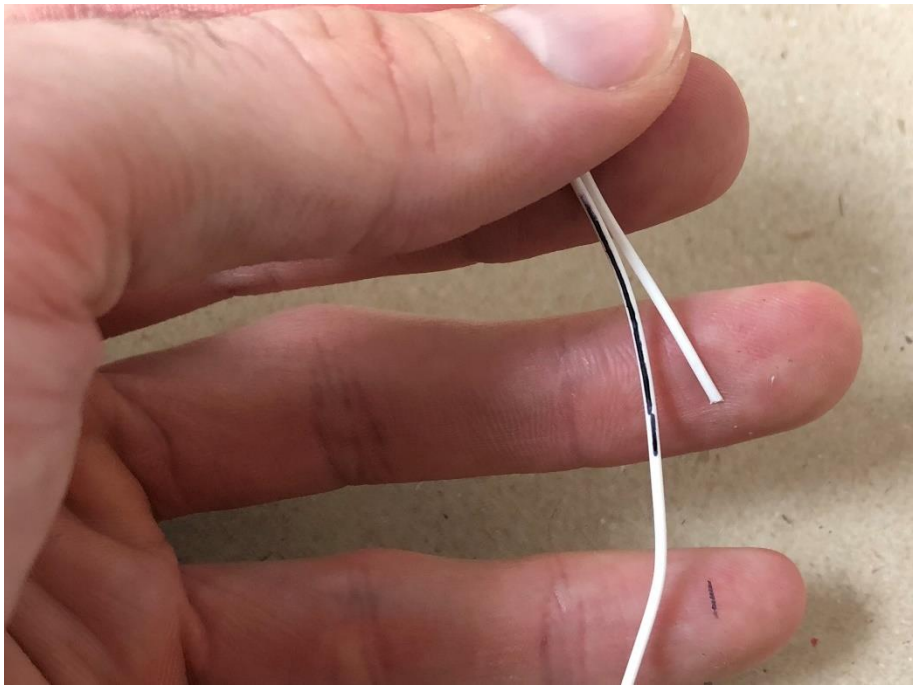
Insert the LED in a vacuum engine using the same technique as for the first LED. Draw the white cable from the Dout side through the hole in the engine pod (the hole from which the cables of the Din side are coming out). Snap the engine on the engine pod.



7.3.9 Wiring the connector

Take the two white cables coming out from the engine pod. The last one that you soldered should be longer. Place the cables side by side. At the location where the first white cable ends, make a mark using a marker on the other white wire (the longest one), then cut the wire so that they have the same length. The mark will help you identify the outbound data wire.

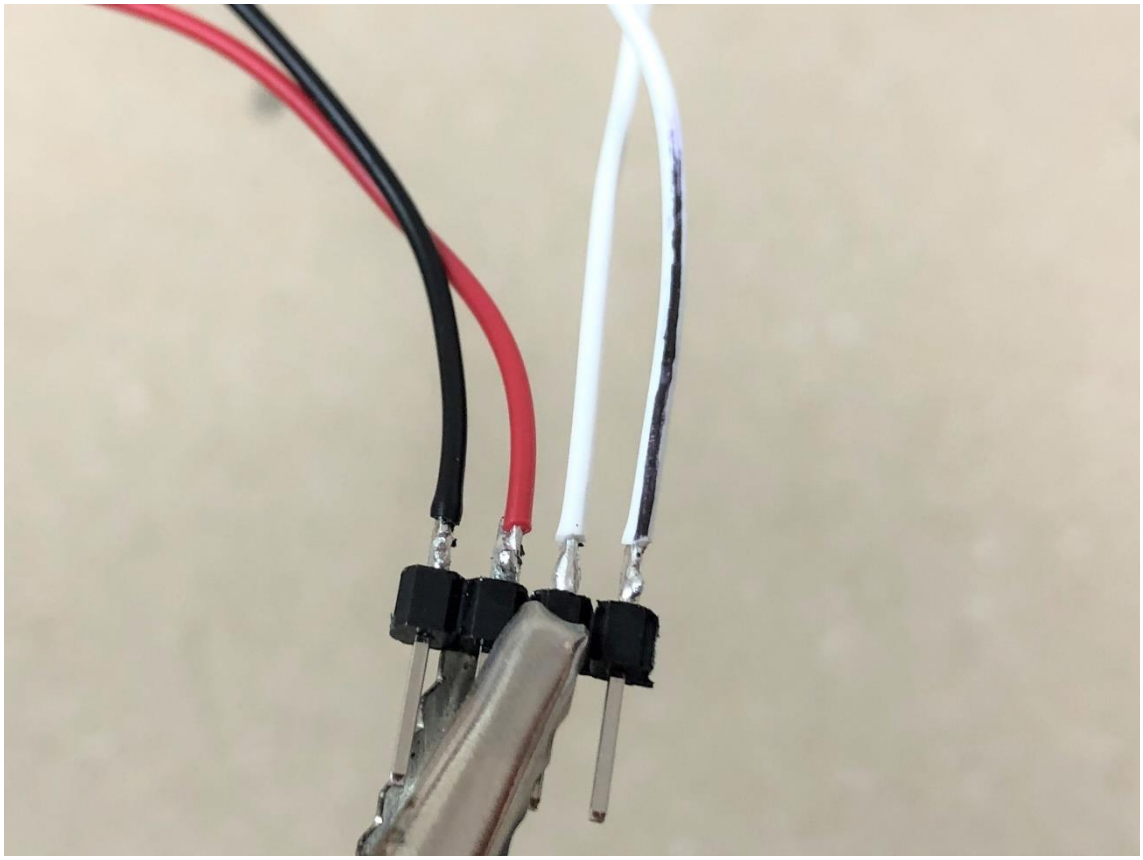




Strip the end of all 4 wires. Take a 1x4 male pin header and solder the cables in the following order.

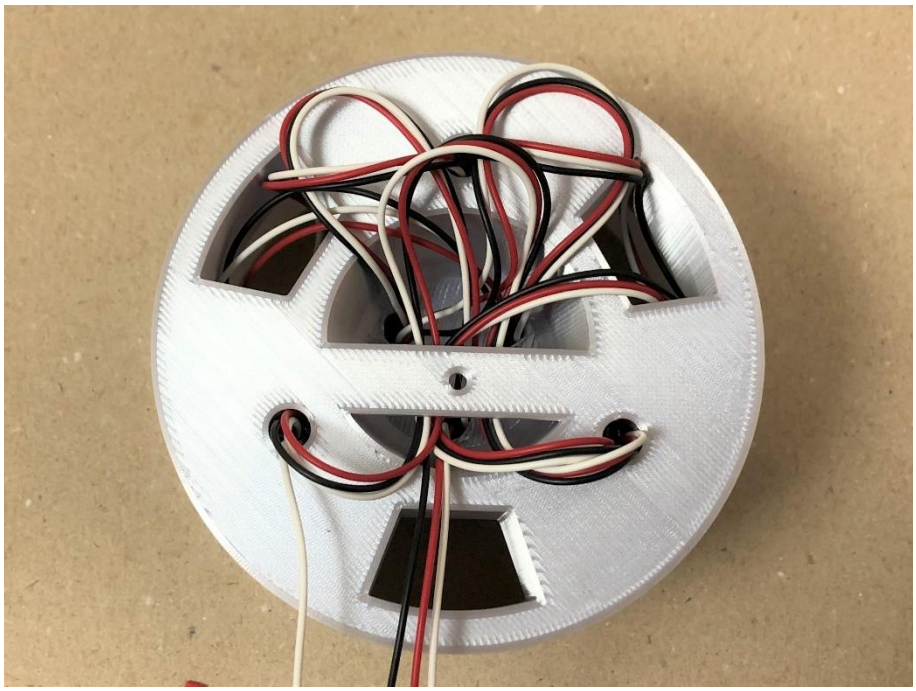
- Black (GND)
- Red (5V)
- White, without mark (DATA IN)
- White, with mark (DATA OUT)

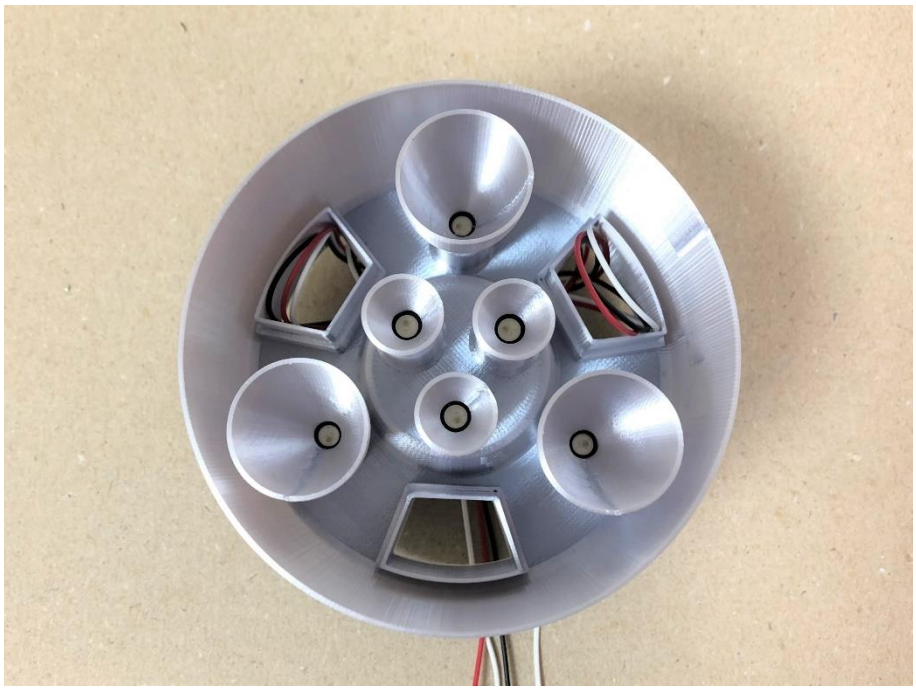
The result should look like the photo below.



7.3.10 Cable management

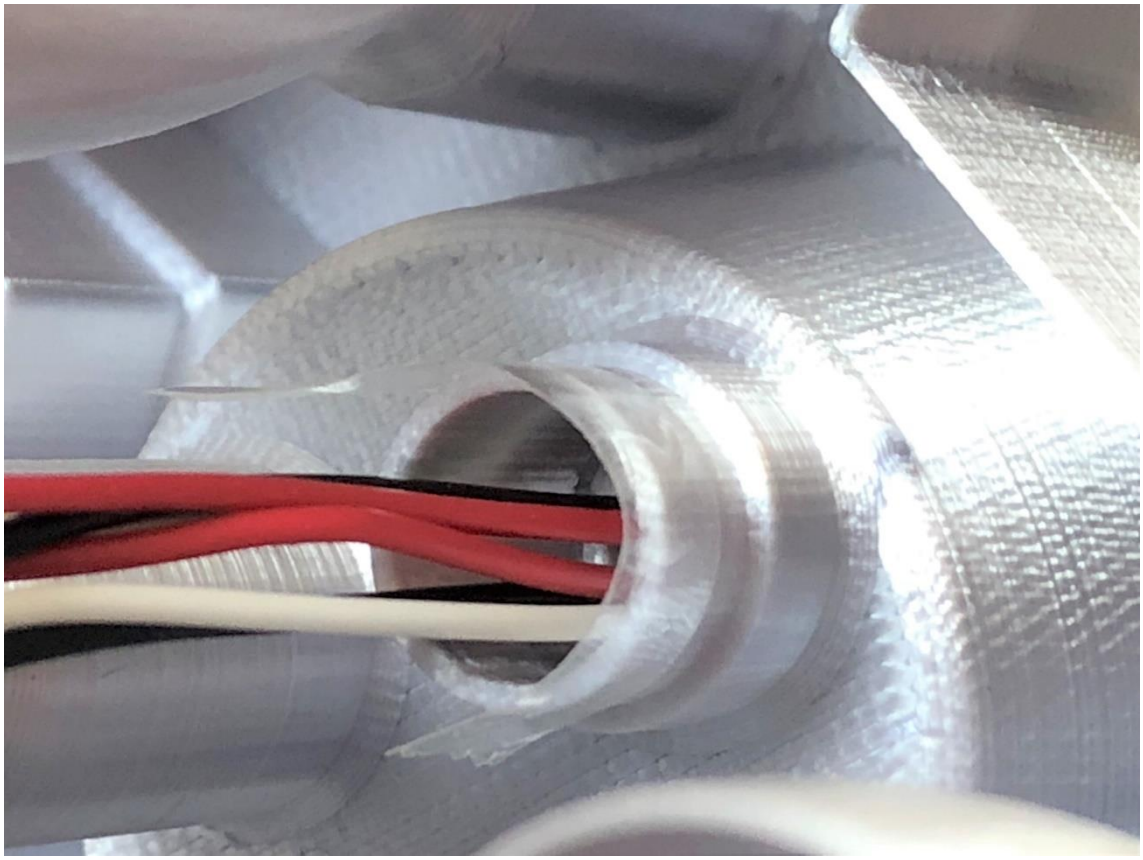
Arrange the bulk of the wires like in the photos. You can use the holes of the left and right cargo containers to store the bulk of the wires but leave the lower hole free. We will need it later to draw the power and USB cables.





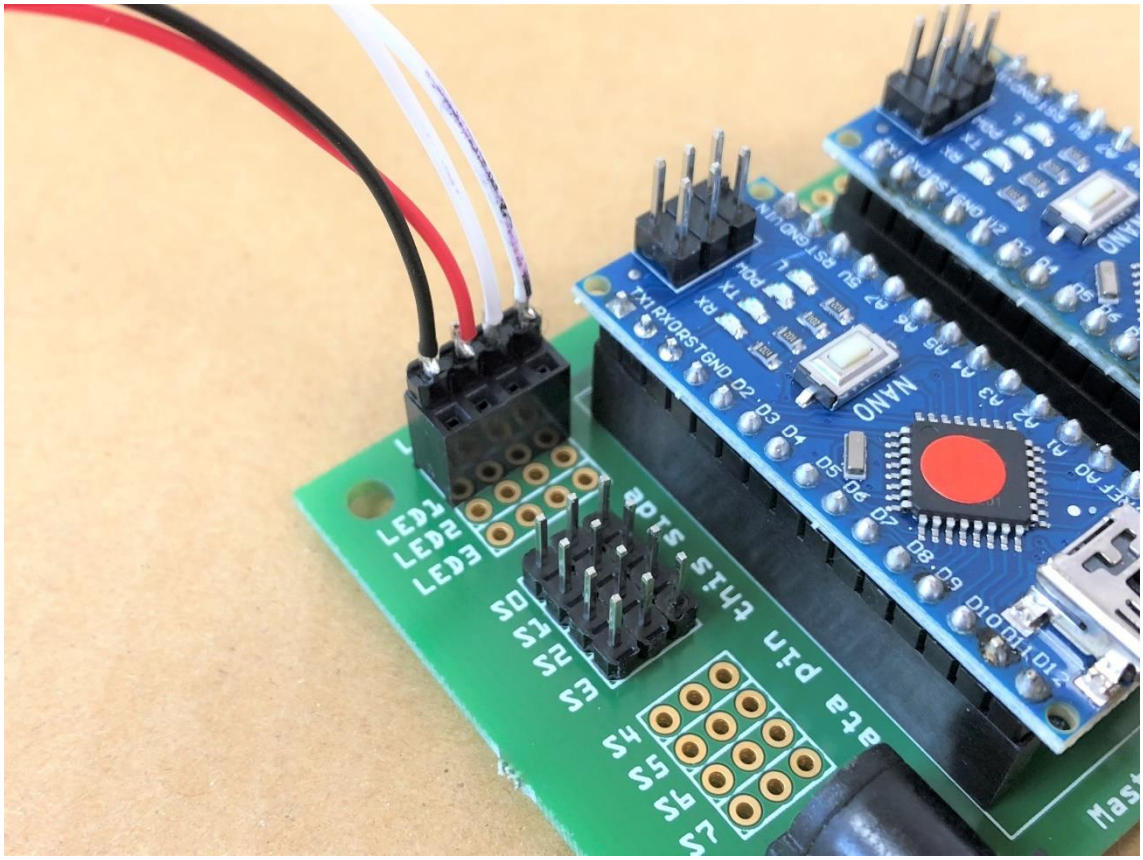
7.3.11 Adjustment

If the nozzles are too loose, wrap tape around the part of the engine pod where the nozzle attaches. This will remove the clearance between the parts.



7.3.12 Testing

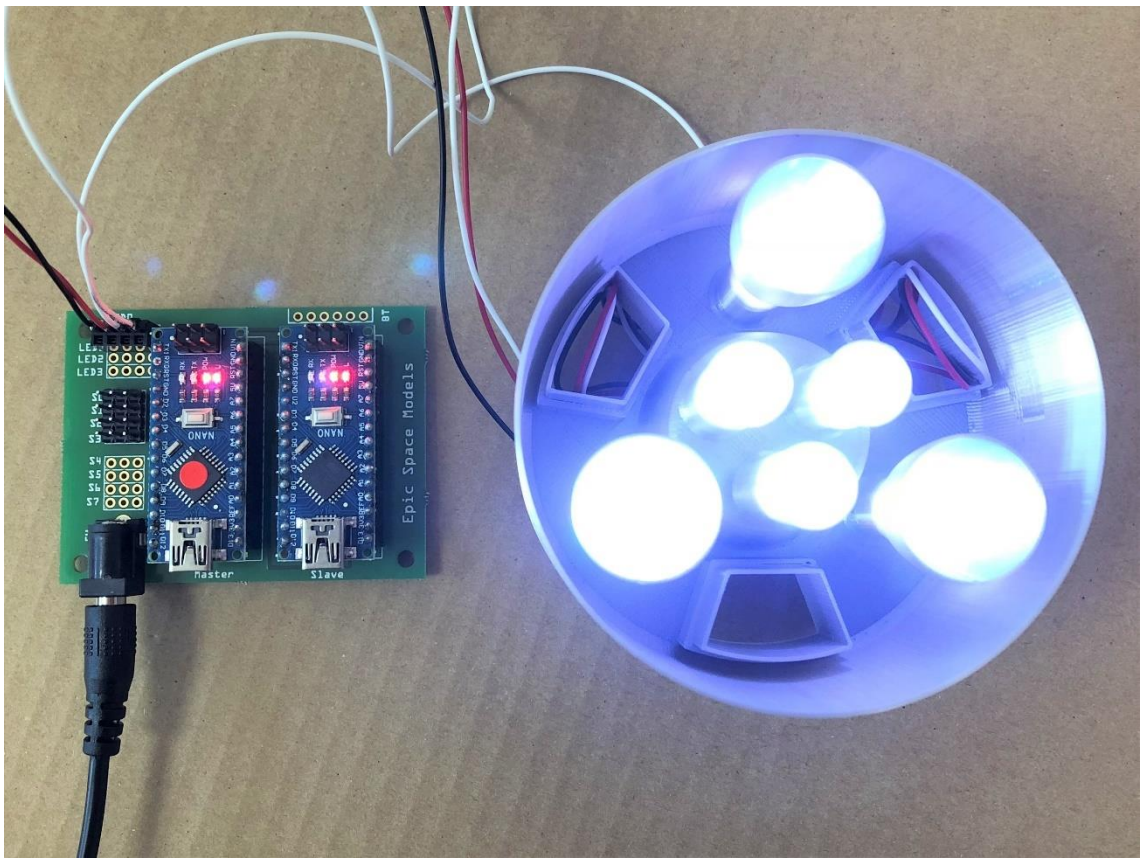
Plug the connector to the LED0 slot of the control board. The black wire must be closest to the board edge, while the white wires must be closest to the Arduino.



Power on the control board. After a few seconds, all the engines should light up. If one or several engines do not light up, power off the control board, and check the soldering of the LEDs. All the LEDs will flicker. This is normal! The control board constantly changes the brightness of the LEDs to make the engines flicker as if the light was coming from a combustion reaction. If you do not like this effect, you can deactivate it later.

If one of several engines do not work, follow the procedure in section 10.1.

Power off the control board but leave the engine pod connected to it.

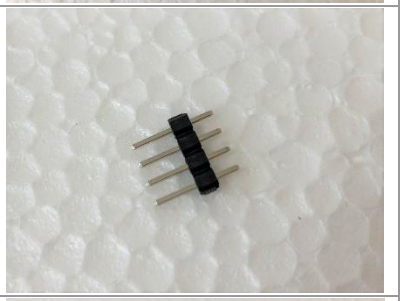
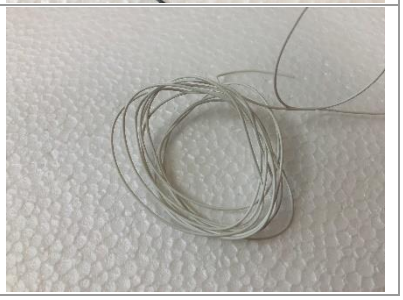


7.4 Windows LED soldering

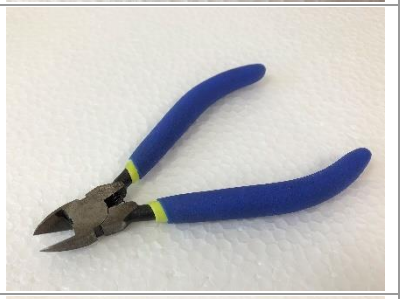
7.4.1 Parts & tool preparation

This time the LEDs come as a strip, so no need to solder them one by one!

Prepare the following parts

Part	Number of parts	Photo
LED strip	1	
Male pin header 1x4	1	
Red wire	1	
Black wire	1	
White wire	1	

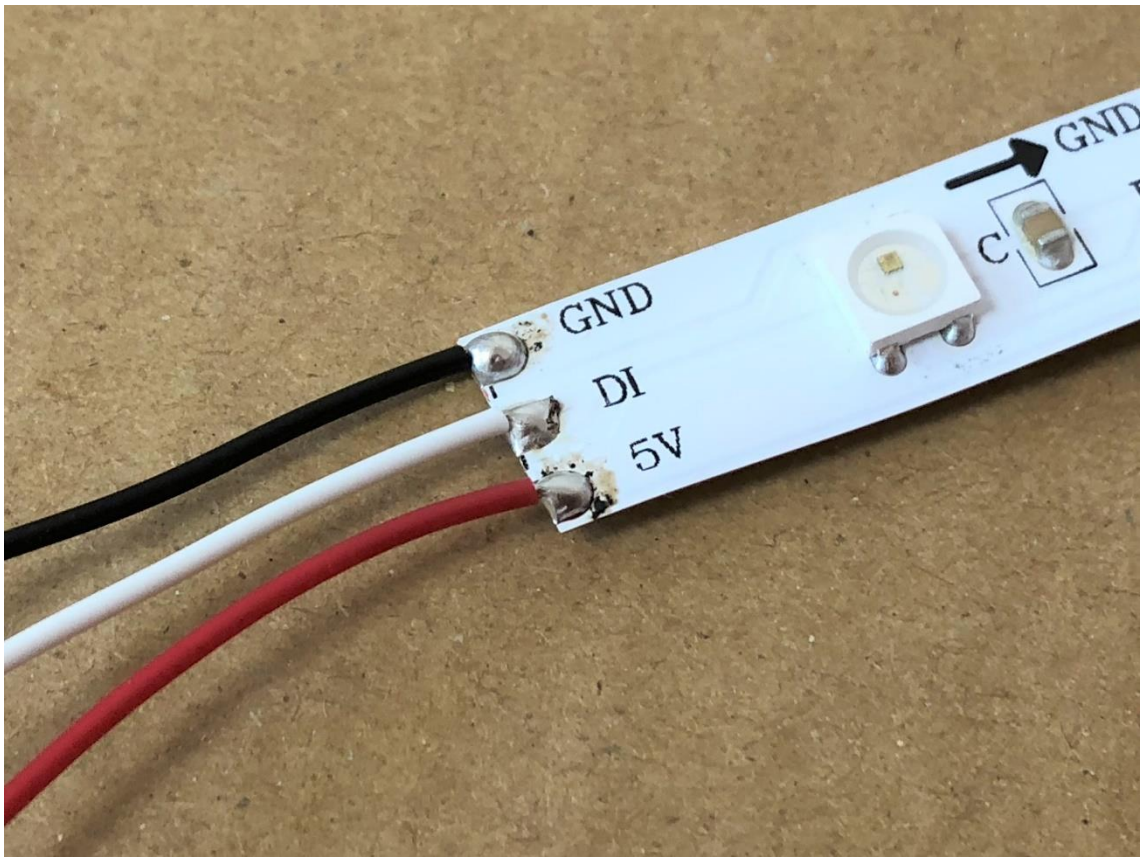
Prepare the following tools

Part	Photo
Soldering iron	
Solder	
Flux (optional)	
Wire cutter	
Wire stripper	

Vinyl tape	

7.4.2 Wiring the LED strip

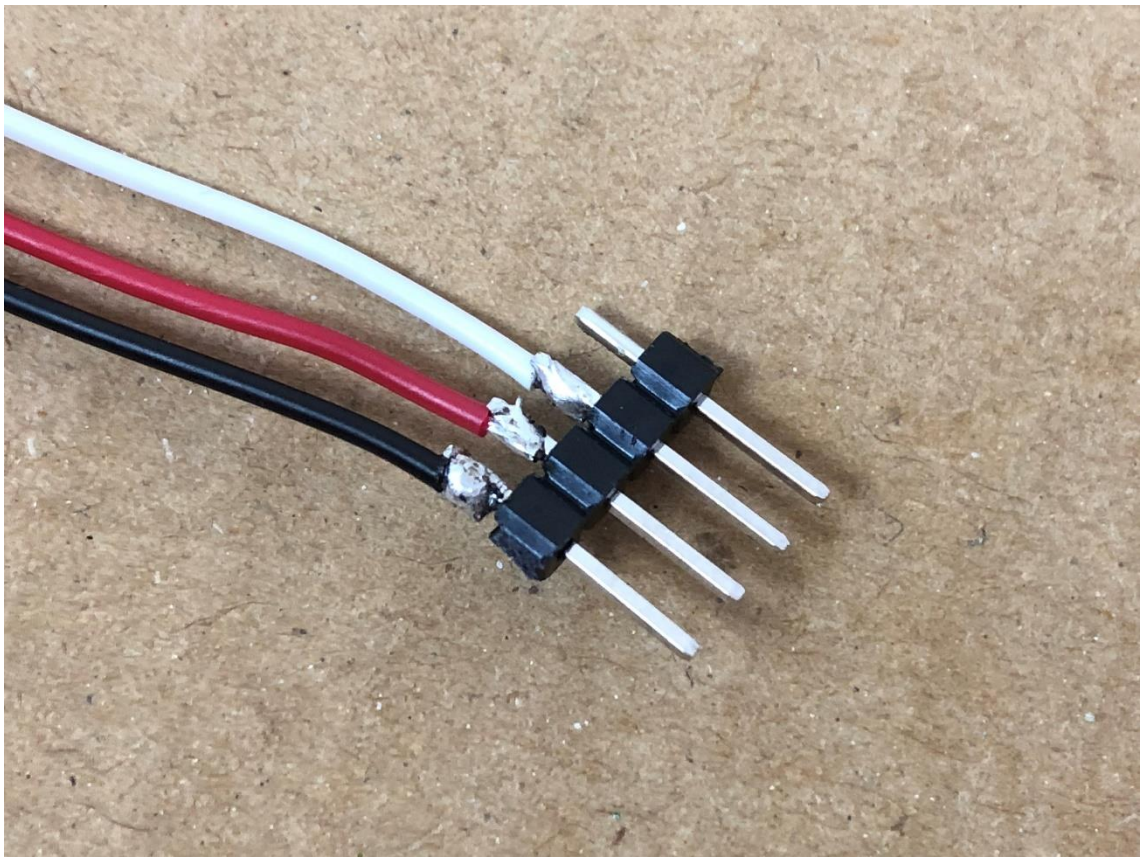
Cut 30cm of black, red and white wire. Strip 3mm on both ends. Take the LED strip. Locate the end with the label “DI” or “in” or “data in”. This is the side where you have to solder. Solder the red wire on the 5V pad, the black wire on the gnd pad, and the white wire on the data in (central) pad.



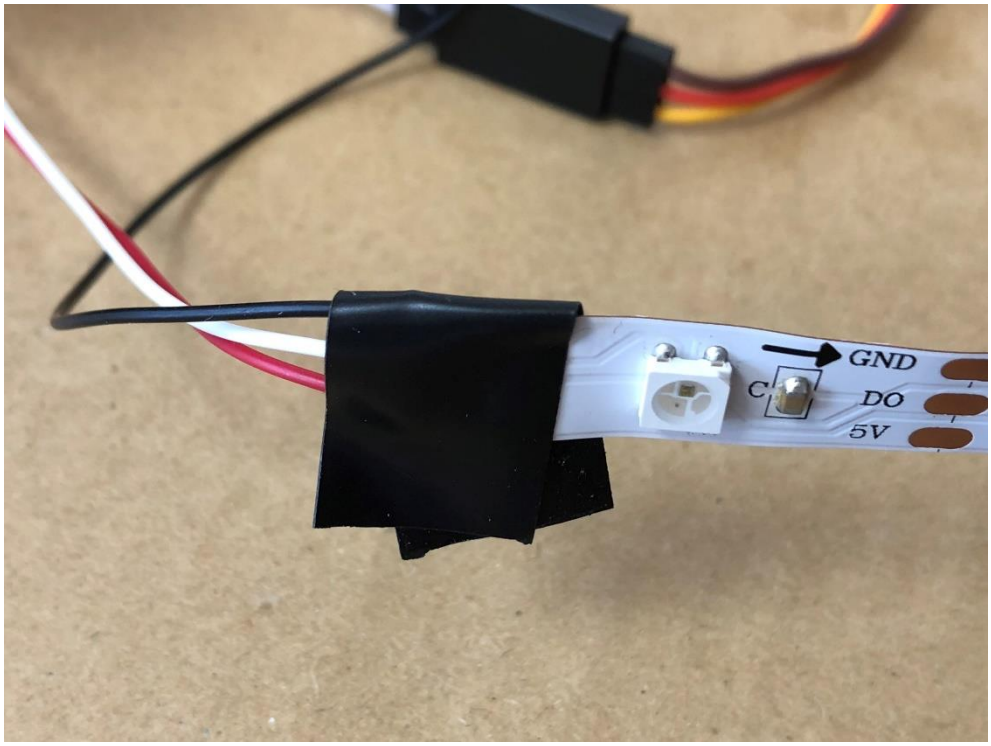
Take the 1x4 pin header. Solder the wires in the following order

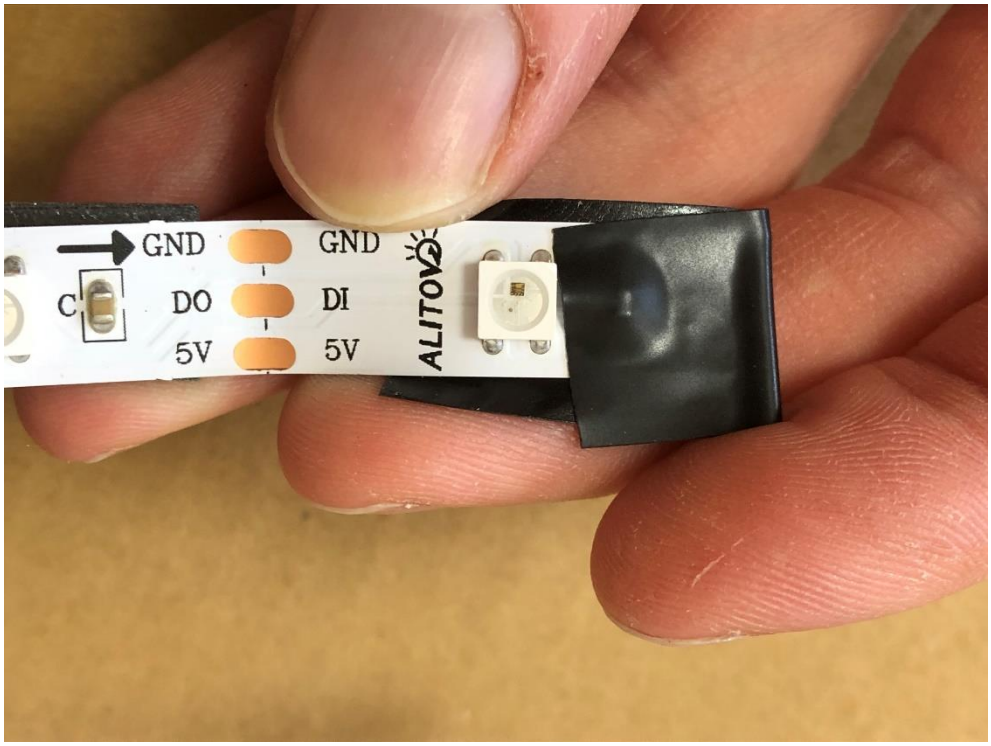
1. Black (gnd)
2. Red (5V)
3. White (data in)

Leave the last terminal free.



Wrap vinyl tape on both ends of the strip to cover the exposed terminals. In the following instructions, the LED strip might sometimes appear without vinyl tape at the ends. Do not pay attention to this detail, and make sure that both ends are fully covered with tape.

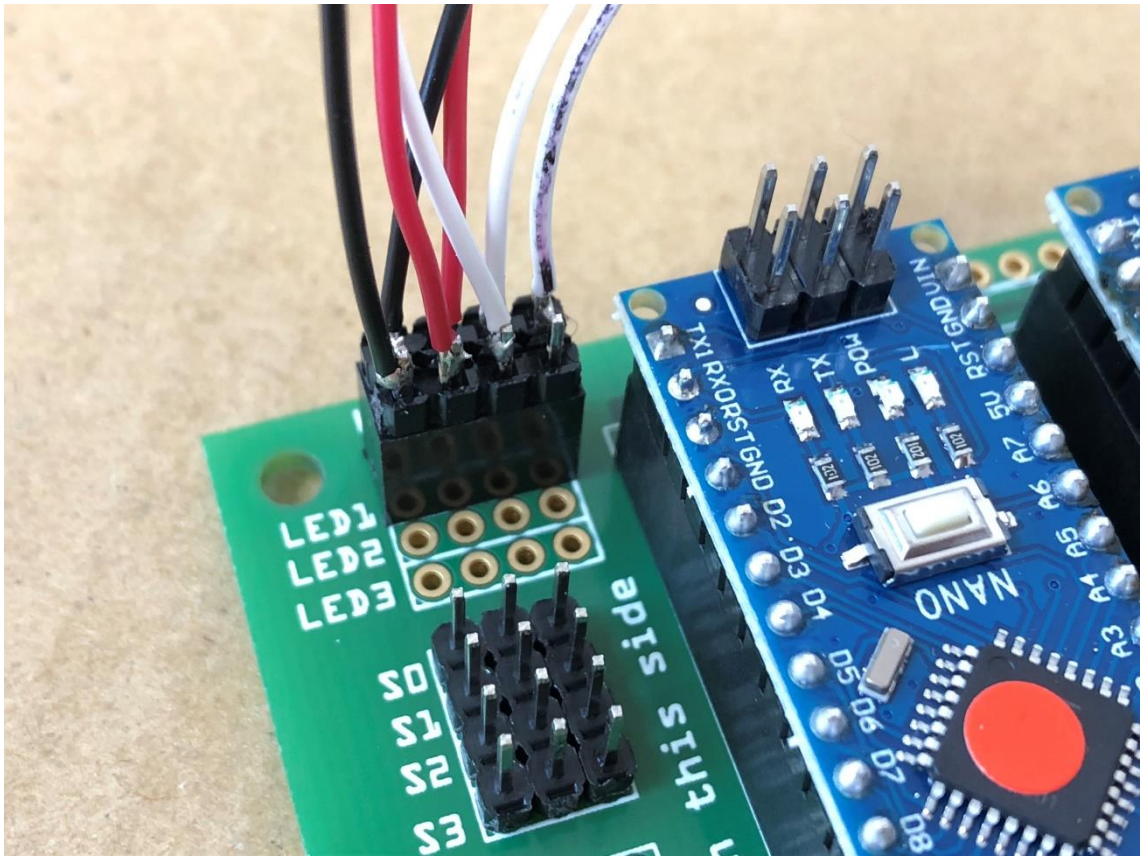




7.4.3 Testing

Insert the connector in the LED1 slot of the control board. The black wire must be closest to the board edge, while the white wire must be closest to the Arduino. Make sure that the engine pod is still connected to the LED0 slot!

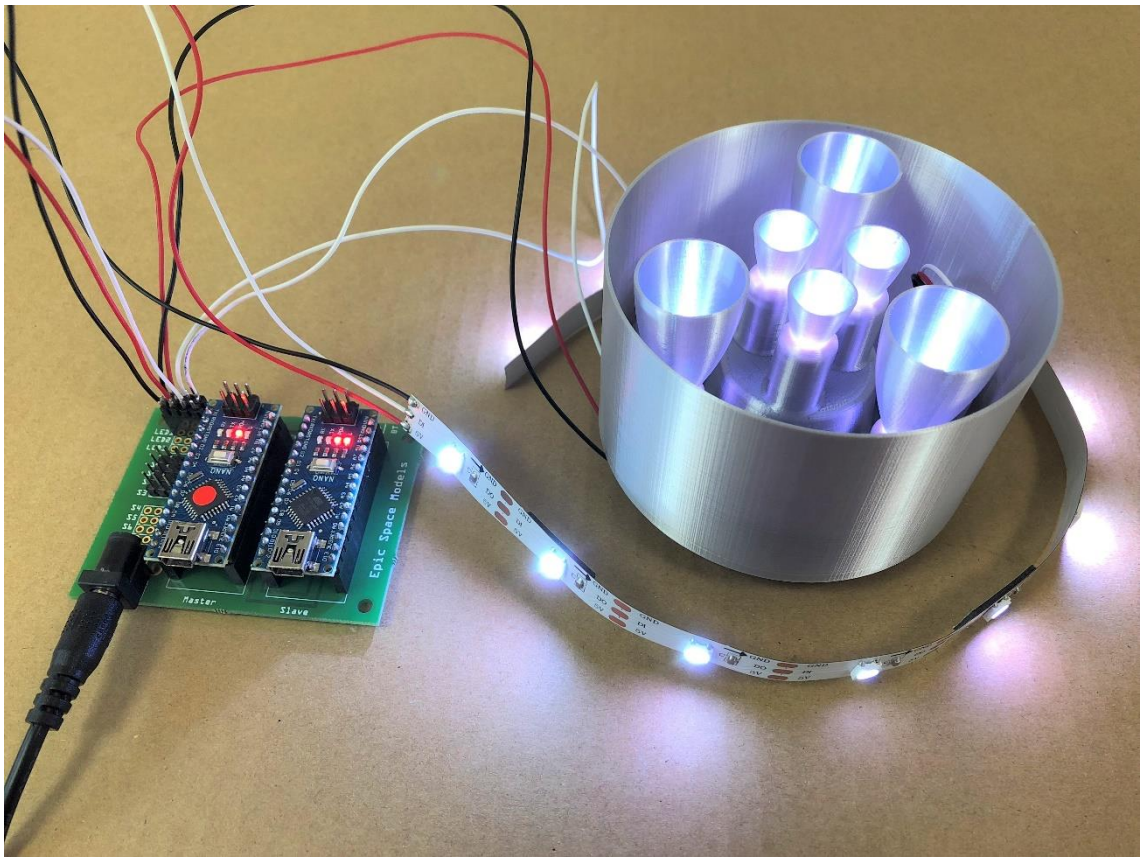
The LED strip will not work if the engine pod is not connected too.



Power on the board. After a few seconds, all the engines and the LED strip should light up. The LED strip should brighten from the center, then the brightest spot should move towards both extremities. The cycle then repeats.

Power off the control board. Unplug the LED strip and the engine pod.

Put the control board, the engine pod and the LED strip in a safe place.



7.5 Hull preparation

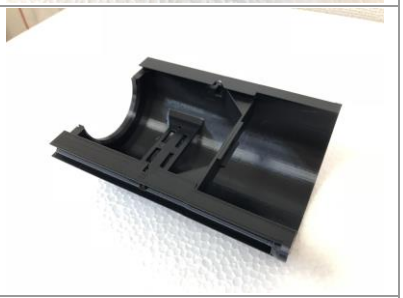
7.5.1 Parts & tools preparation

Starship's parts are designed to require as little post processing as possible. However, because of the complex geometry, some parts include support structures that help prevent the print from collapsing. These structures must be removed to assemble Starship.

IMPORTANT: WEAR SAFETY GLASSES WHEN CUTTING OUT THE PLASTIC PARTS.

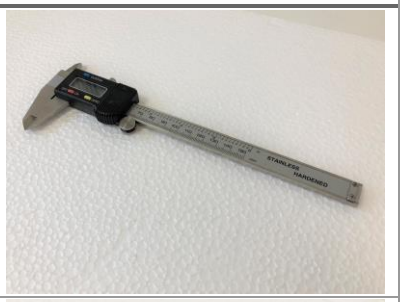
Small sharp plastic bits can sometimes jump right into your face, so make sure to protect your eyes.

Prepare the following parts

Part	Number of parts	Photo
Hull bottom half, fore segment	1	
Hull bottom half, aft segment	1	
2x25mm pin x1	1	

M3 screw x1	1	

Prepare the following tools

Part	Photo
Caliper	
Sharp knife	
2mm drill bit	
Safety glasses	
Hex key	

7.5.2 Fore segment: removing the braces

Take the fore segment of the hull and locate the openings for the fins on the side. You will see thin braces obstructing the openings (5 on each side). These braces must be removed.

Using a sharp knife, carefully cut the 5 braces on each side. Make sure that the braces are completely gone. The result should look like the second photo.

Put the hull segment aside, we will not need it for a while.

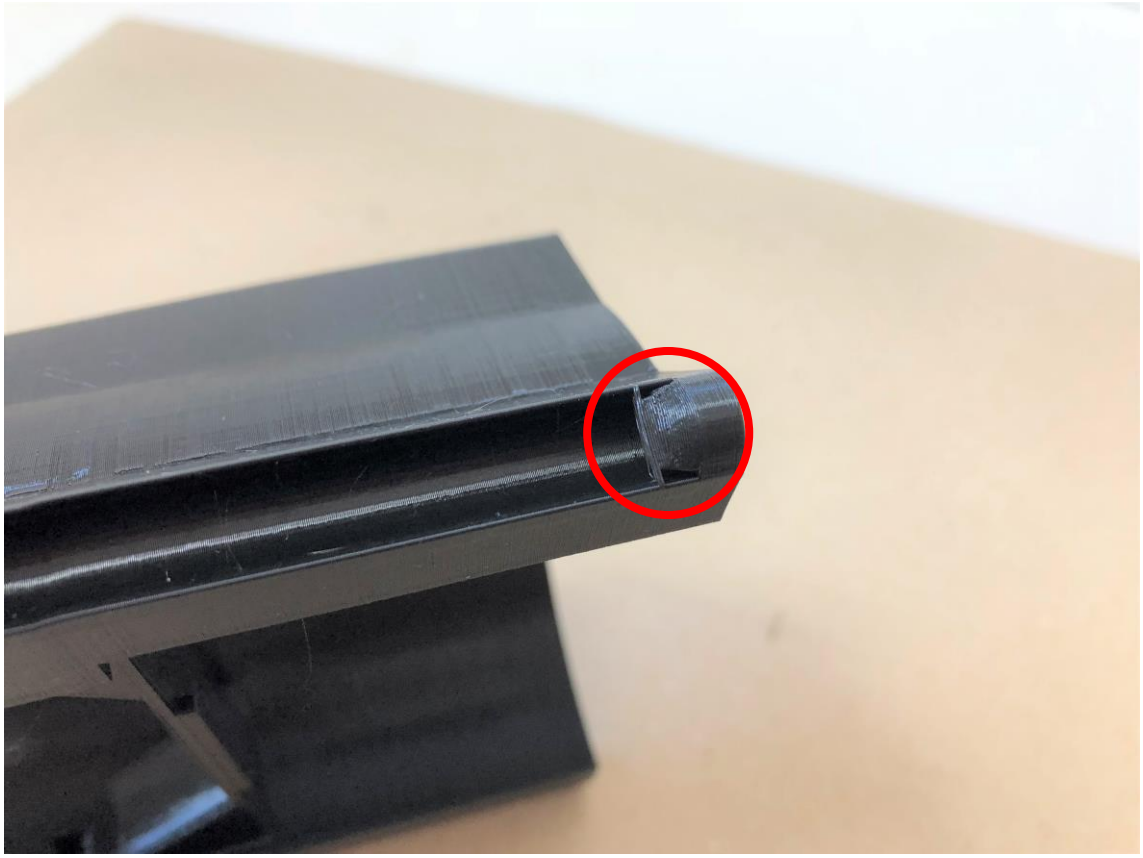
7.5.3 Aft segment: removing the lever hole support

Take the aft segment of the hull and locate the slot for the fins on the side. About midway of the part, locate the hole for the fin lever. Next to the hole, you will see a thin structure across the slot. This structure must be removed.

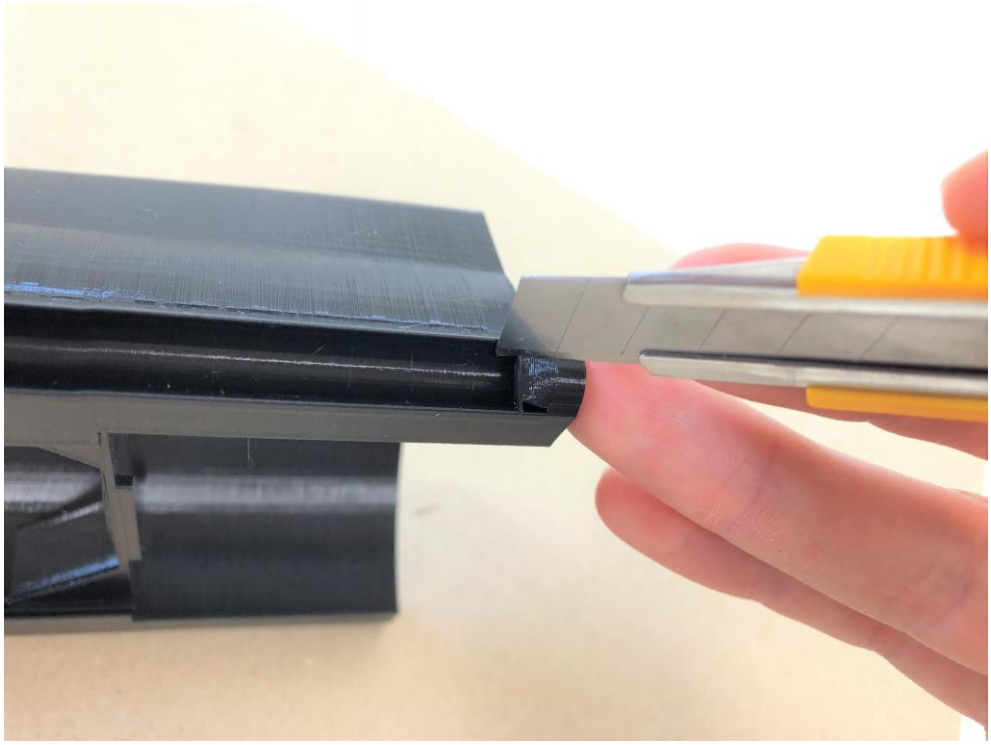
Using a sharp knife, carefully remove the support structure. The support structure must be completely gone.

7.5.4 Aft segment: removing the hinge support

Locate the fin hinge at the rear end of the part. You will see a conical structure ahead of the fin that is attached inside the slot. This structure must be removed.

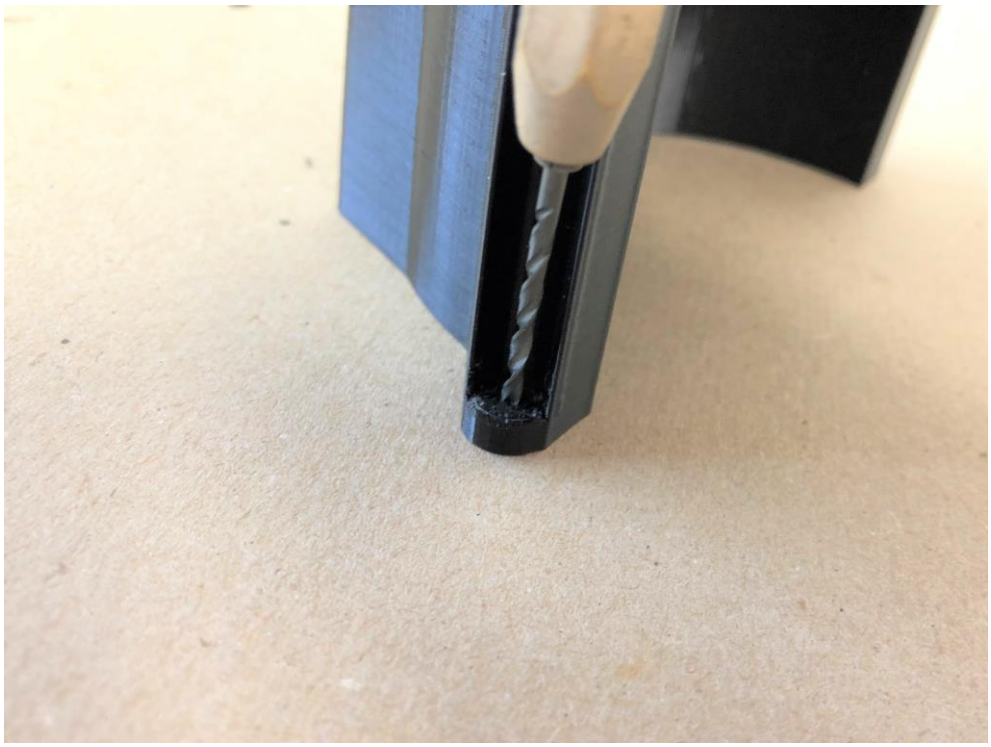


Using the sharp knife, carefully cut the conical part to leave only the flat part of the hinge. Using the caliper, check the thickness of the hinge. The hinge thickness should be close to 4.0 m. If it is thicker than 4.1mm, trim it using the sharp knife. Make sure that all the support structure is gone. The result should look like the third photo.



7.5.5 Aft segment: poking the fin hinge hole

The fin hinge has a hole inside, but is it is covered by a thin layer. Using the 2mm drill bit, carefully poke the hole in the middle of the hinge. DO NOT DRILL ALL THE WAY THROUGH THE HINGE. You just need to poke the hole, not drill deep. Insert the 2x25mm pin in the hole, and check that it can rotate freely. Once you are done, remove the 2x25mm pin and put it back it the bag. We will not need it for a while. Be careful not to lose it.

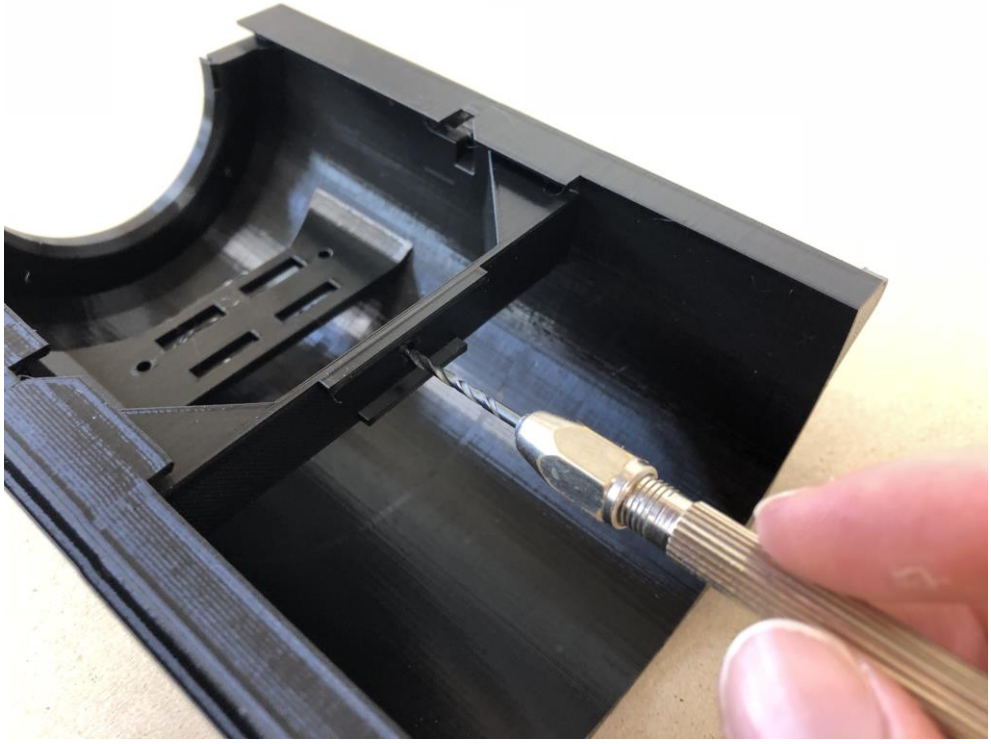


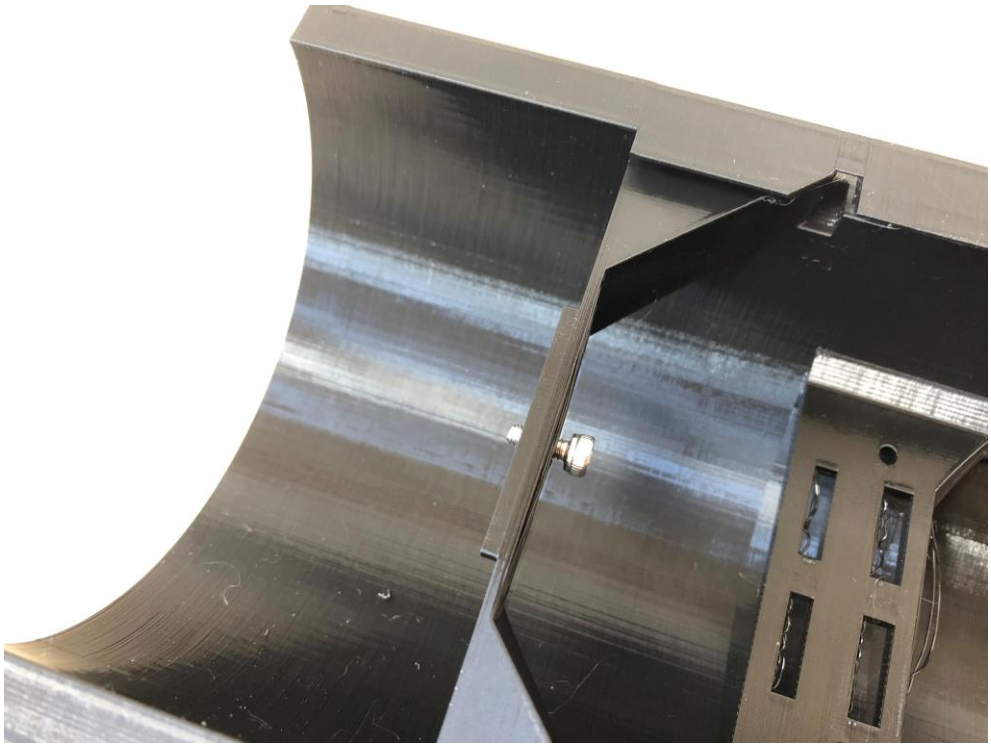
7.5.6 Aft segment: poking the engine pod mount hole

Locate the engine pod mount. This is the structure across the hull about halfway of the part. At the center of the part is a mount hole, but this hole is covered by a thin layer.

Using the 2mm drill bit, carefully poke the hole. Using the hex key, screw the M3 screw from the front. Screw about two third of the length of the screw. This is just to make sure that the hole has been widened enough.

Remove the M3 screw and put it back in the bag. We will not need it for a while.



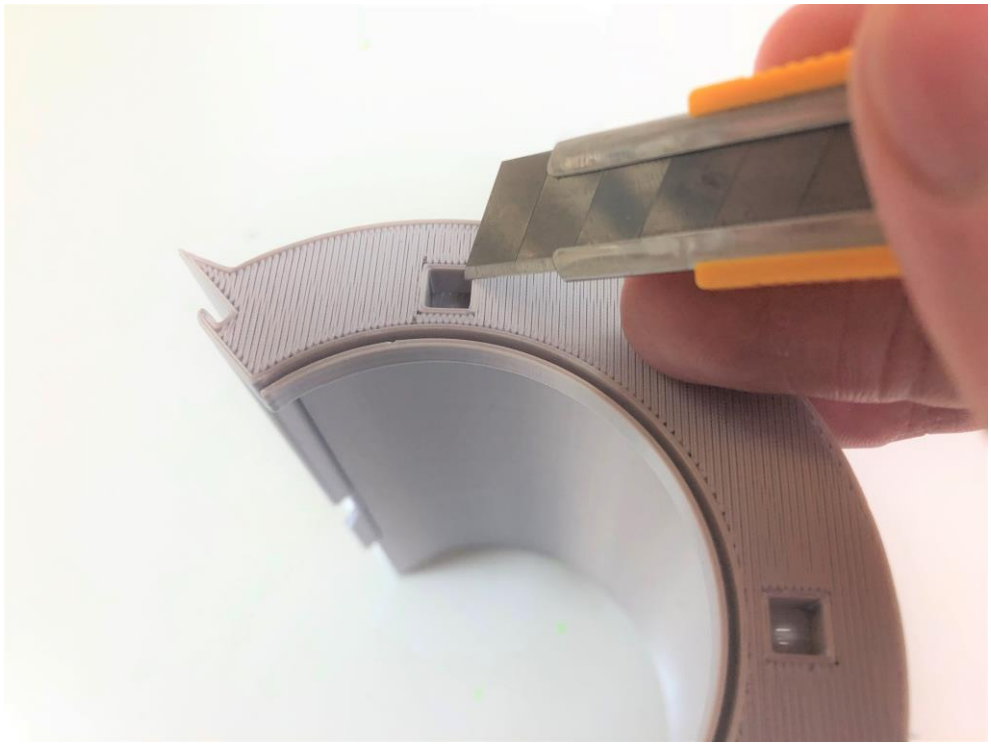


7.6 Magnets assembly

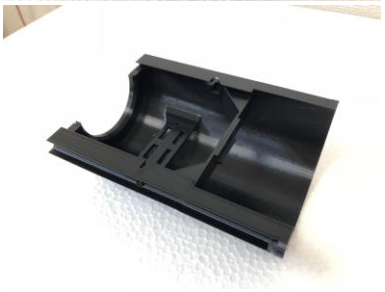
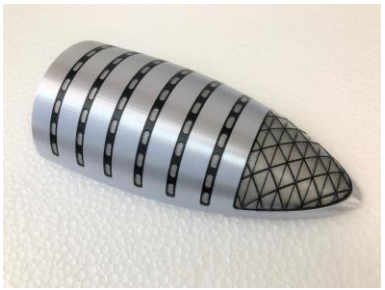
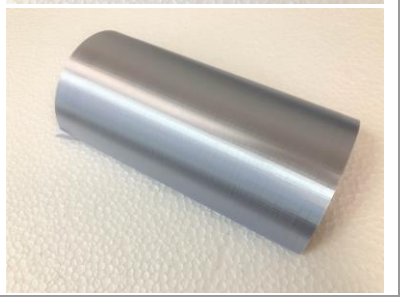
7.6.1 Parts & tools preparation

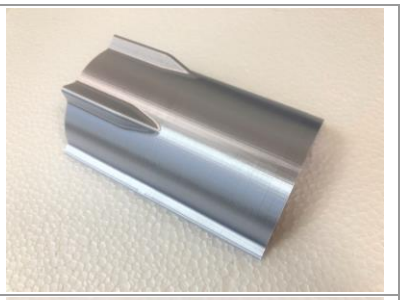
Starship uses magnets to hold the hull segments together. Be very careful to the orientation of each magnet!

If you have difficulties inserting the magnets inside the holes, use a sharp knife to chamfer the entrance of the holes.



Prepare the following parts

Part	Number of parts	Photo
All 6 hull segments	1+1+1+1+1+1	  

		
Magnets	16	

Prepare the following tools

Part	Photo
Super glue	
Marker	

7.6.2 Magnets preparation

Take the magnets and arrange them in a row。Using a marker, draw a black line near one edge of each magnet like in the photo below. This line will help you identify the orientation of the magnets. For the following steps, before gluing each magnet check that the magnet hole is not obstructed, and check that you are orienting the magnet correctly.

You can also use a compass to check the orientation of the magnets.

Wait for the glue to dry completely before mating the segments! Otherwise they will break loose.

7.6.3 Aft segment

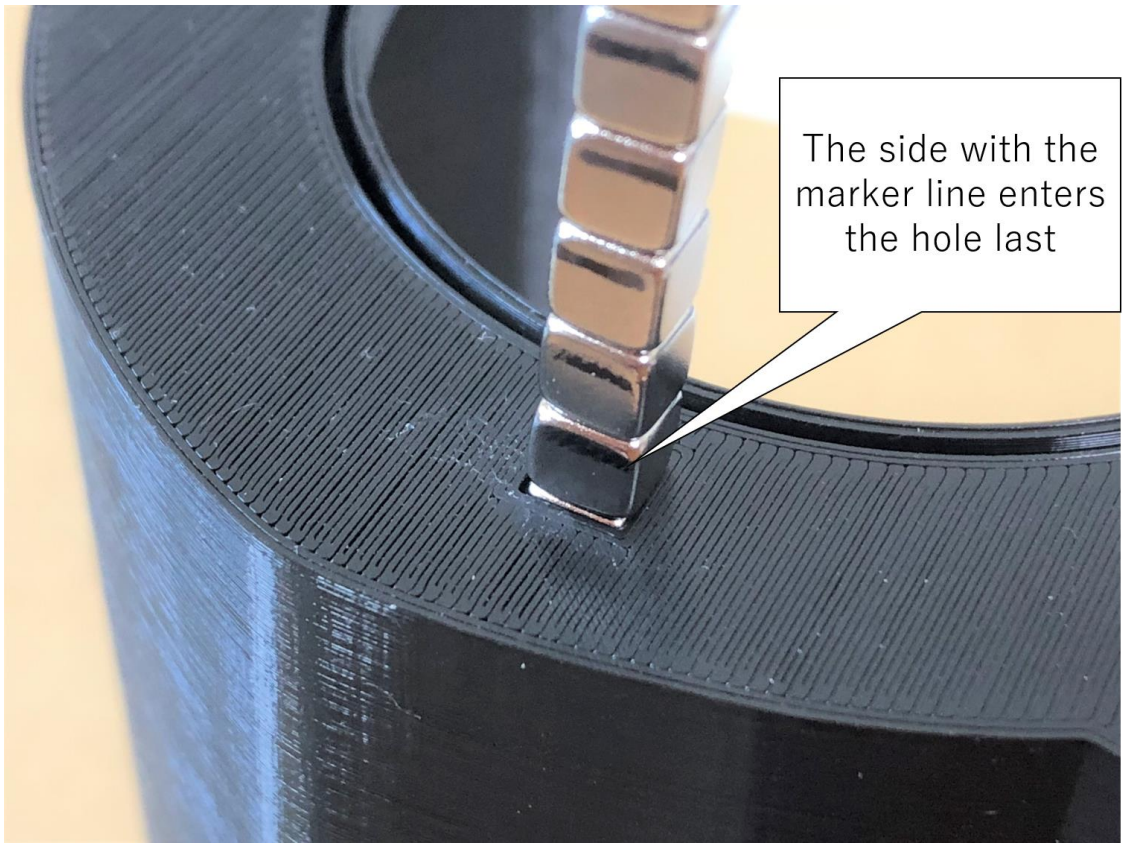
Take both halves of the aft segment. Orient the parts such that the magnet holes are facing up.

Important: check that there is no debris in the holes before inserting the magnets.

Take 4 magnets. On the side where the marker line is farther from the magnet edge, put glue on the tip of the magnet. Insert one magnet in the hole. Pay very attention to the orientation of the magnet. The side with the maker line must enter the hole last! Once the magnet is in the hole, use the back of the marker to push the magnet to the bottom of the hole. Do this quickly before the glue dries, or you will not be able to mate the hull segments correctly. Look at the hull segment from the side. The magnet must be flush (not sticking out).

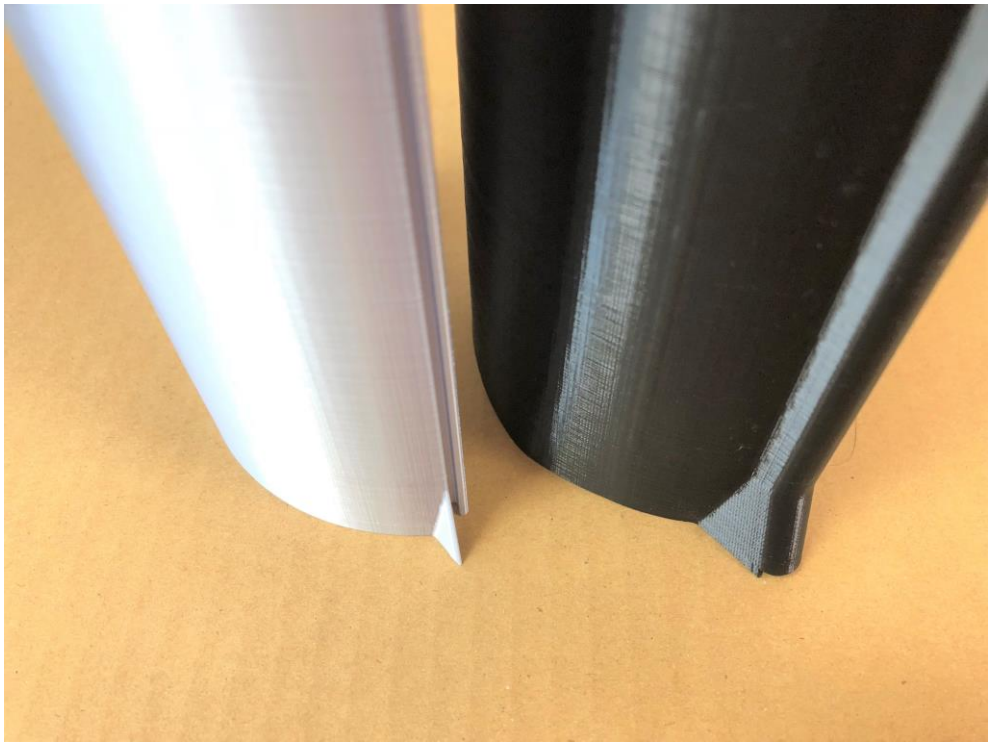
Repeat the steps for the 3 other magnets. Insert the magnets with the same orientation.

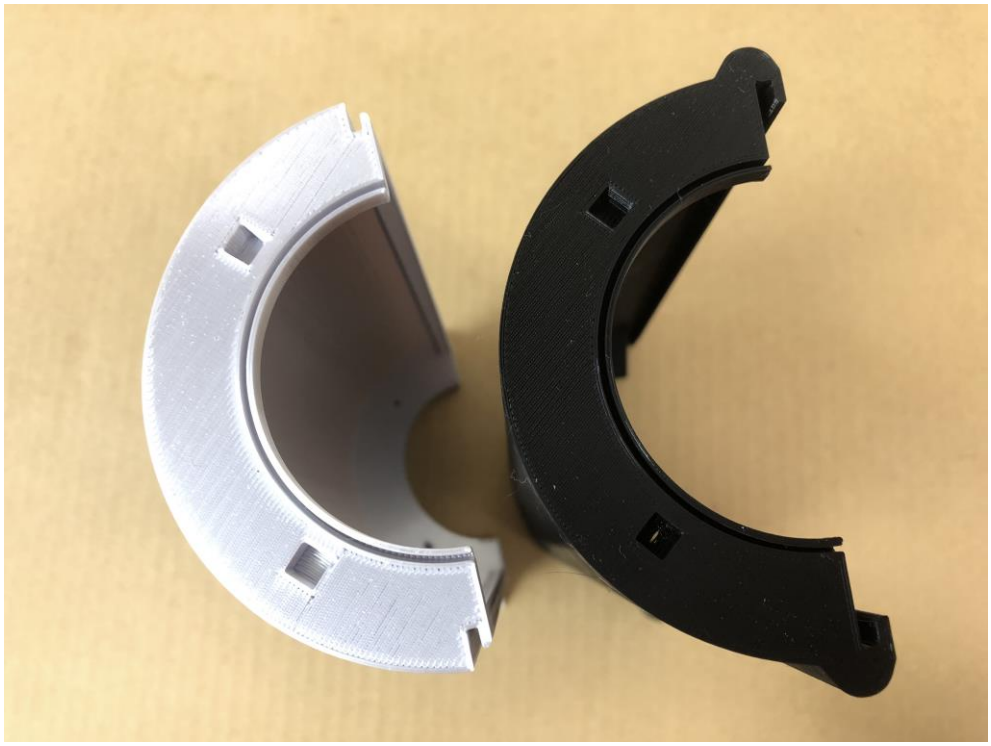
Let the glue dry.



7.6.4 Central segment (front)

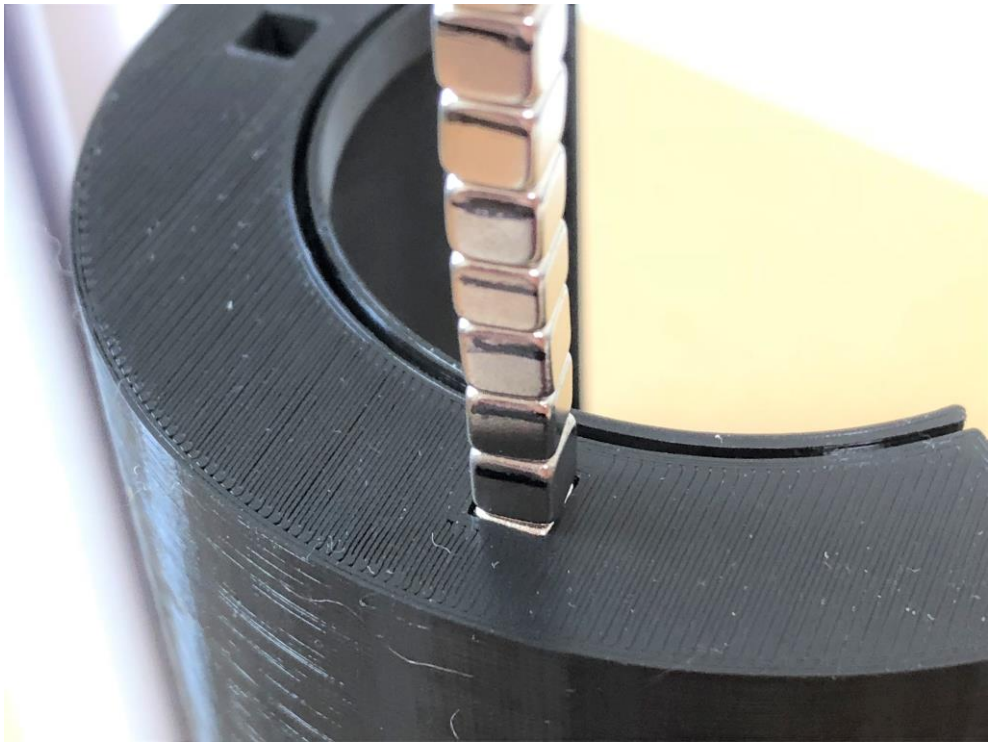
Take both halves of the central hull segment. Place the parts vertically so that the triangular structure on the sides of the hull are facing down.





Take 4 magnets. Insert the magnets in the top holes. The orientation is the same as for the aft hull segment (the edge of the magnet with the marker line must enter the hole last).

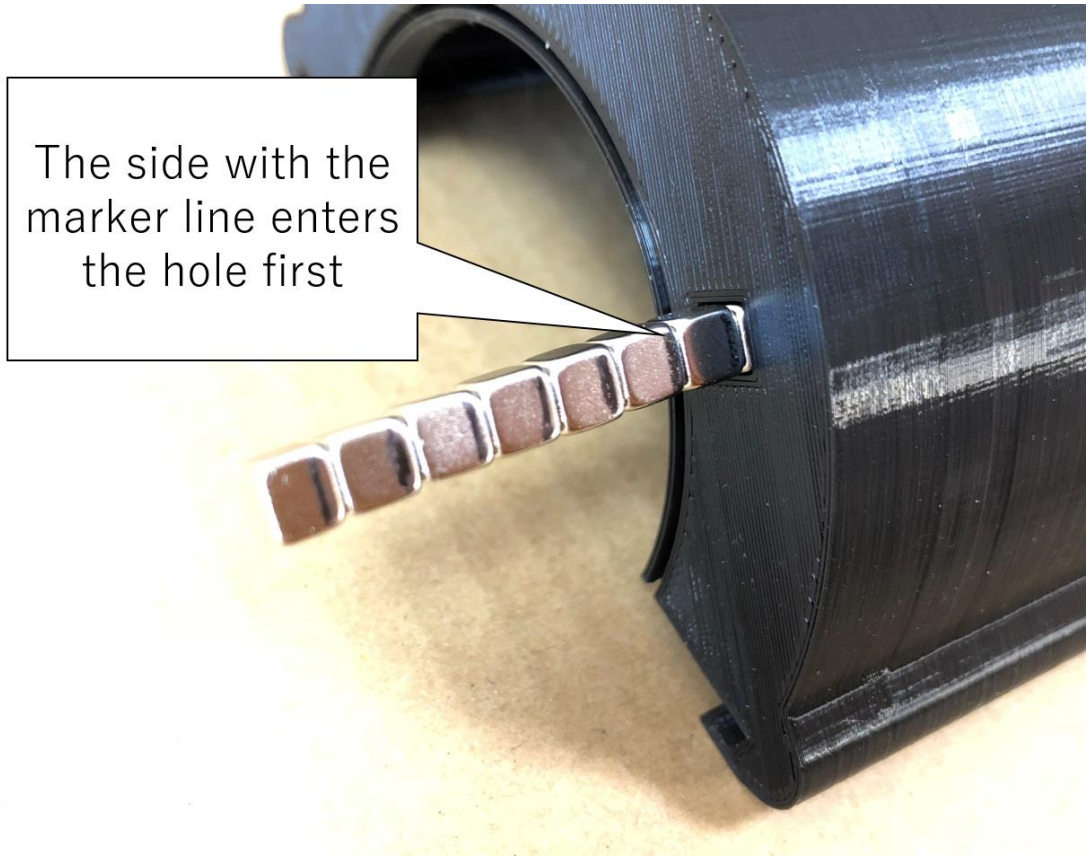
Let the glue dry.



7.6.5 Fore segment

Take both halves of the fore hull segment. Take 4 magnets. For this part, the orientation of the magnets is reversed compared to what you did before. The edge of magnet with the marker line must enter the hole FIRST.

Let the glue dry.

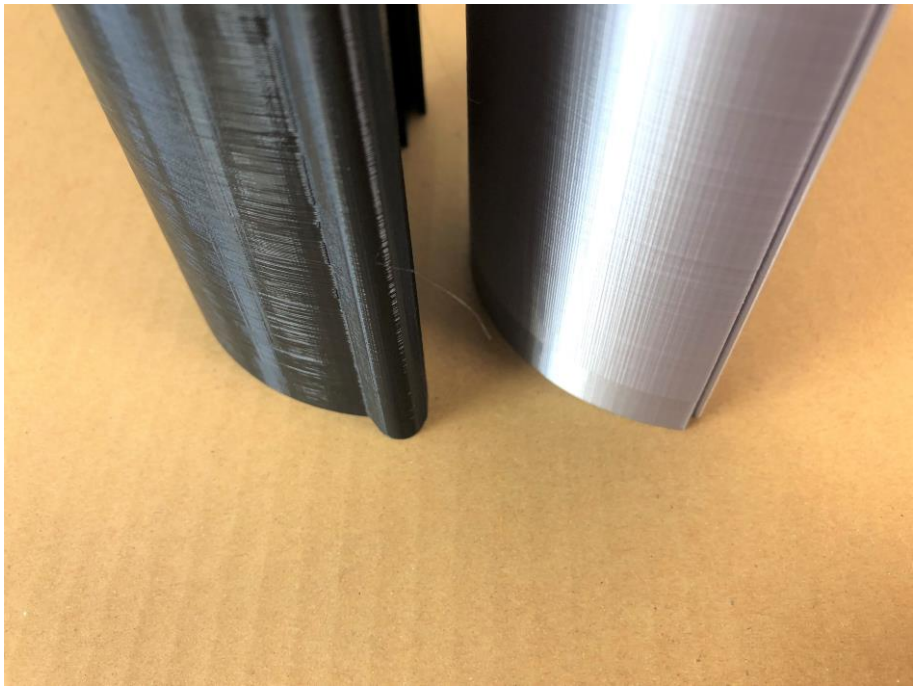


7.6.6 Central segment (rear)

Take both halves of the central hull segment. Take 4 magnets. Flip the parts so that the triangular structures on the sides of the hull are facing up.

Insert 4 magnets in the holes. The orientation is the same as for the fore hull segment (side of magnet with the marker line must enter the hole first).

Let the glue dry.



7.7 Fins preparation

7.7.1 Parts & tools preparation

Each fin has a label engraved on the flat side. The number indicates the location of the fin:

1: fore left

2: fore right

3: aft left

4: aft right

The letter indicates the side

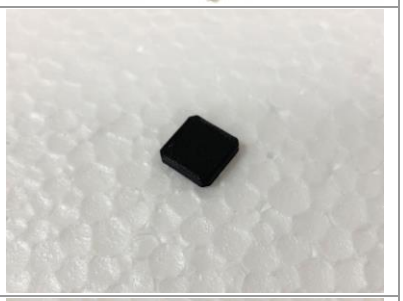
A: bottom half

B: top half

When gluing two parts together, you want to match the numbers, not the letters. 1A goes with 1B, 2A goes with 2B, etc.

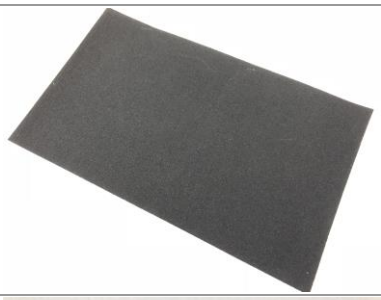
Prepare the following parts

Part	Number of parts	Photo
Half fins (each part is different)	8	

Fin peg	8	
2x25mm rod (short ones)	8	
2x40mm rod (long ones)	4	

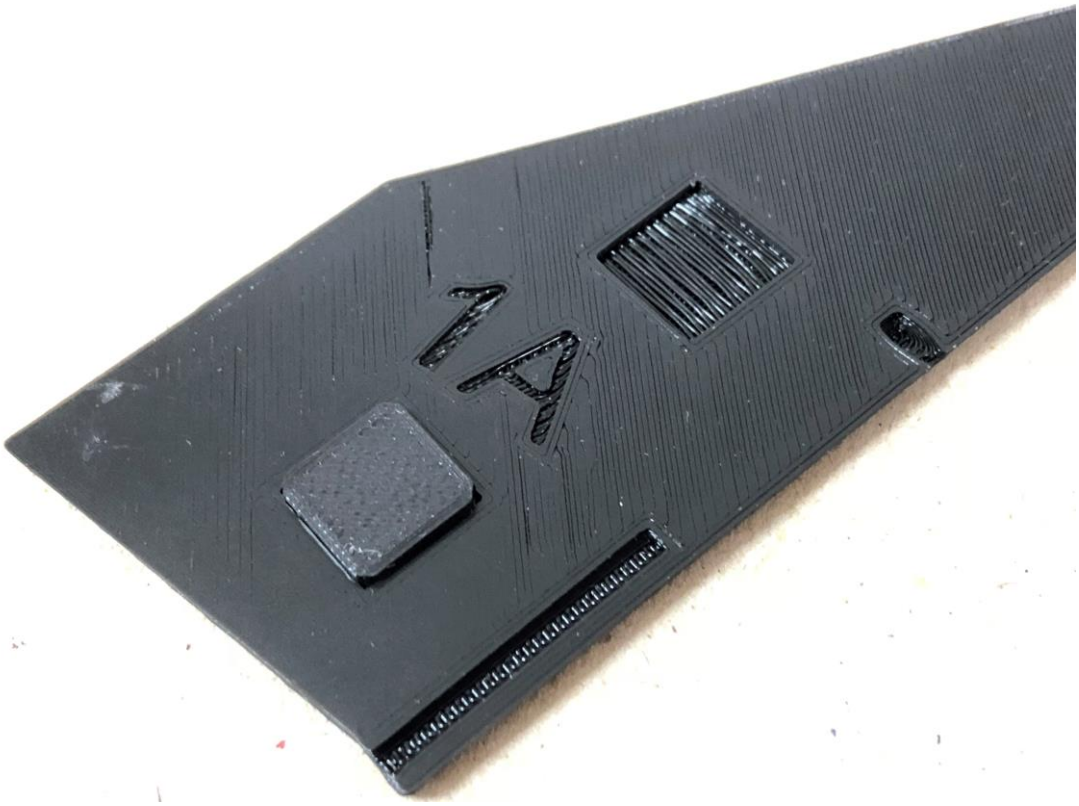
Prepare the following tools

Part	Photo
Super glue	

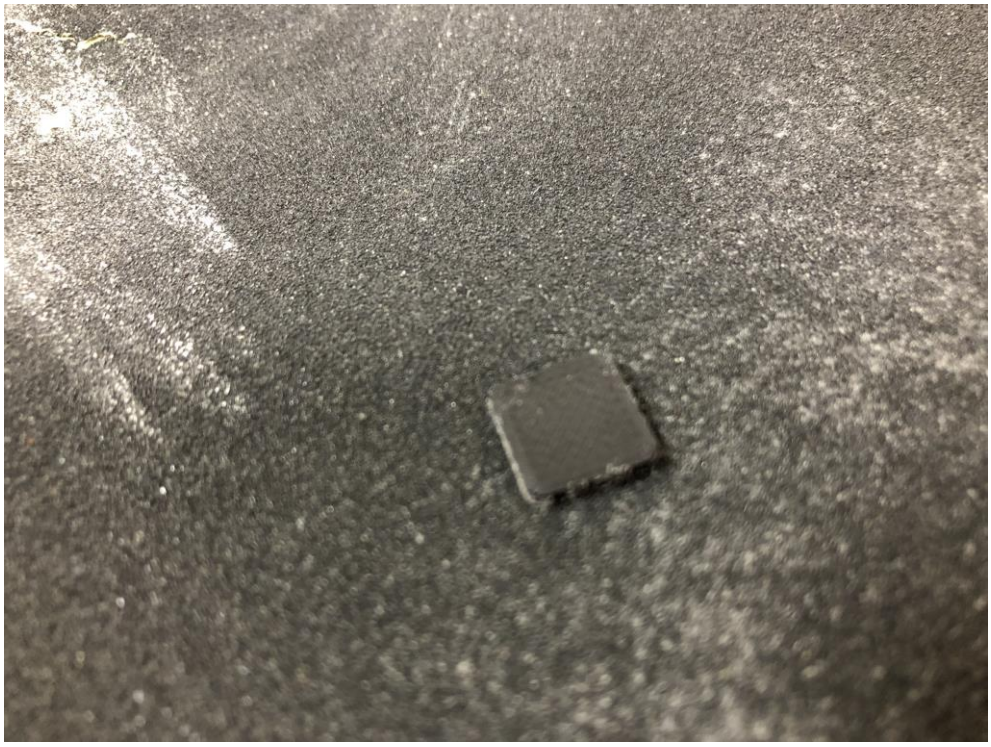
Sandpaper	
Clothespins	
2mm drill bit	

7.7.2 Fins assembly

Take the part with the label 1A. Take one peg and place it in one of the square openings on the flat side. Do not glue it yet!



Take the part with the label 1B and place it on top of 1A. Close the two halves. If you cannot fully close the two halves, remove the peg from the fin, and trim it using sandpaper.

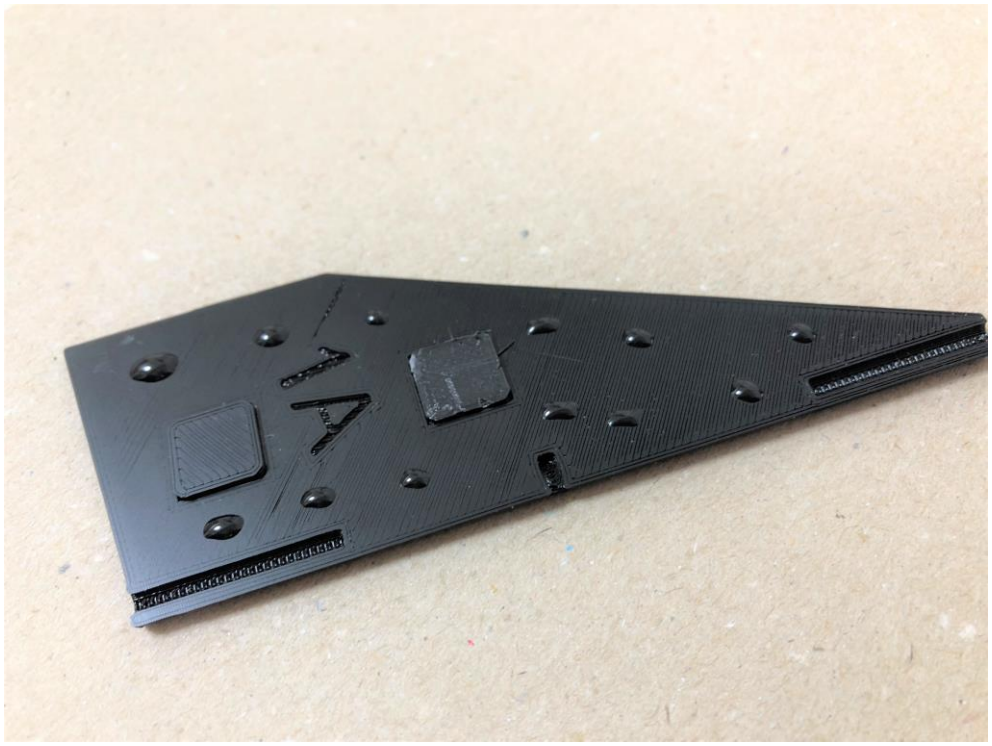


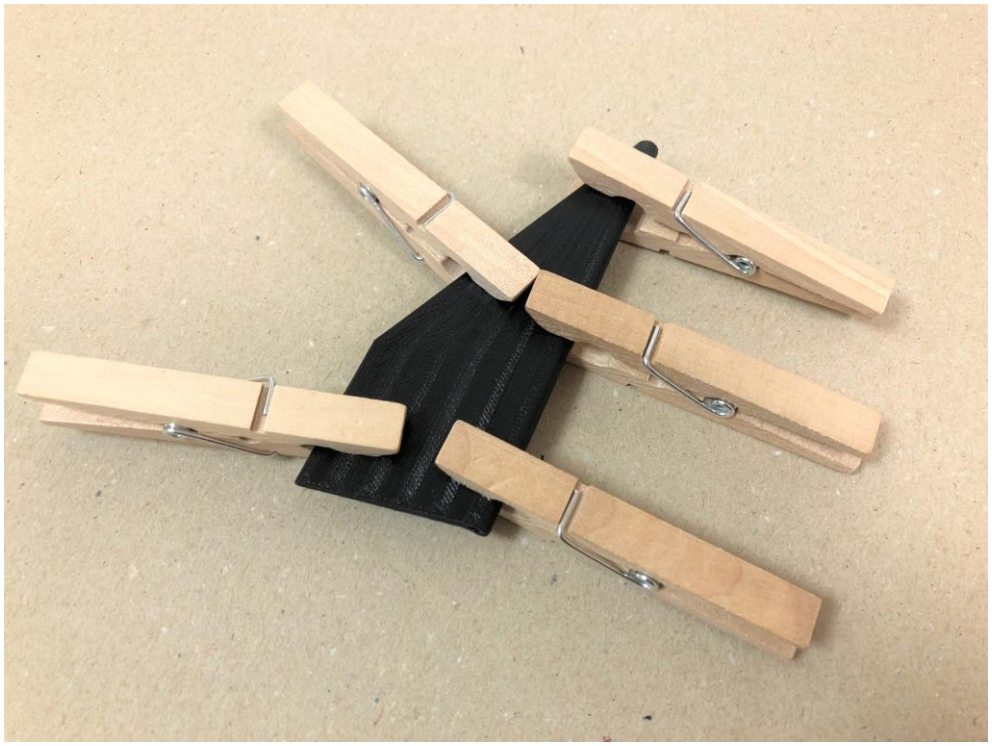
Remove the part 1B. Take another peg and place it in the other opening. Again, close the two halves 1A and 1B, and check if there is no gap in between.

Take 5 clothespins and put them at your hand reach. Read the following instruction carefully before starting.

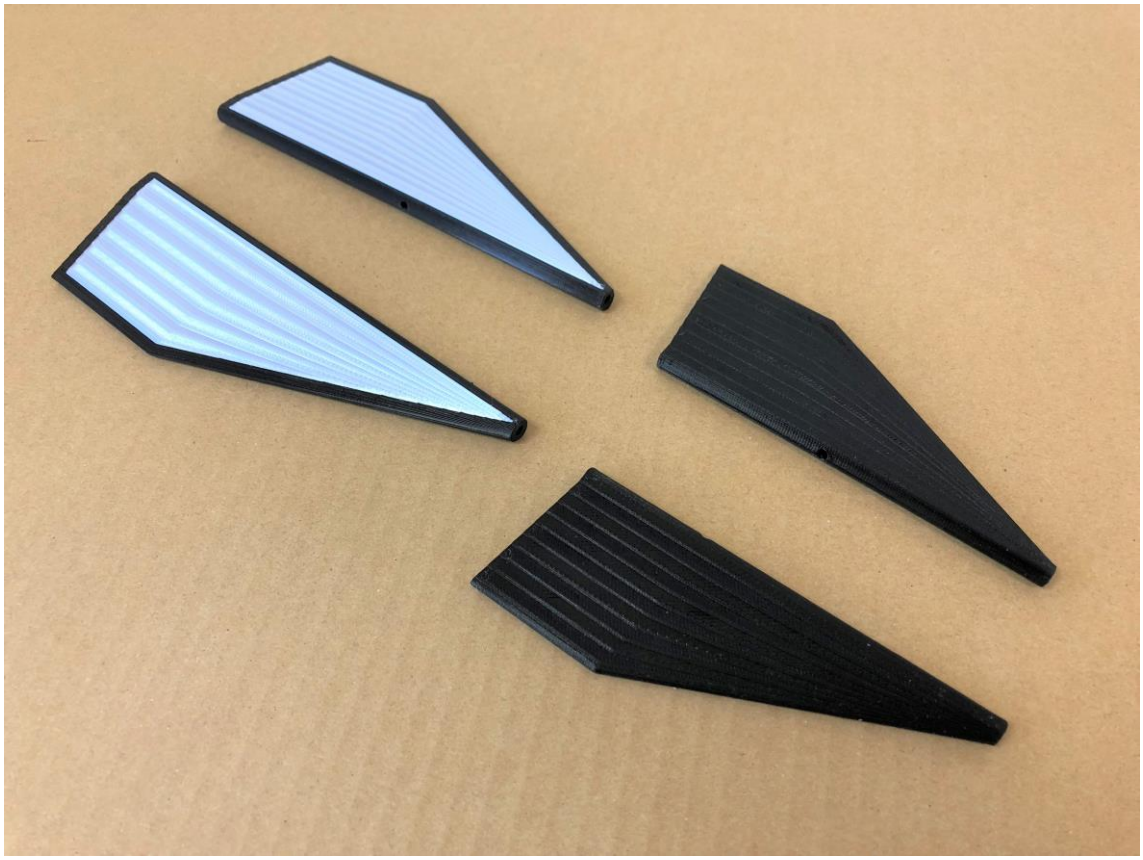
Make sure that the two pegs are fully inserted into the part 1A. Put some superglue on the flat face of 1A. Close the two halves, make sure that there is no gap left, and place clothespins all around the fin like in the picture below. Be careful not to have glue leaking and reaching the visible side of the parts! It would leave an ugly white mark.

Put the fin aside for a while until the glue dries.





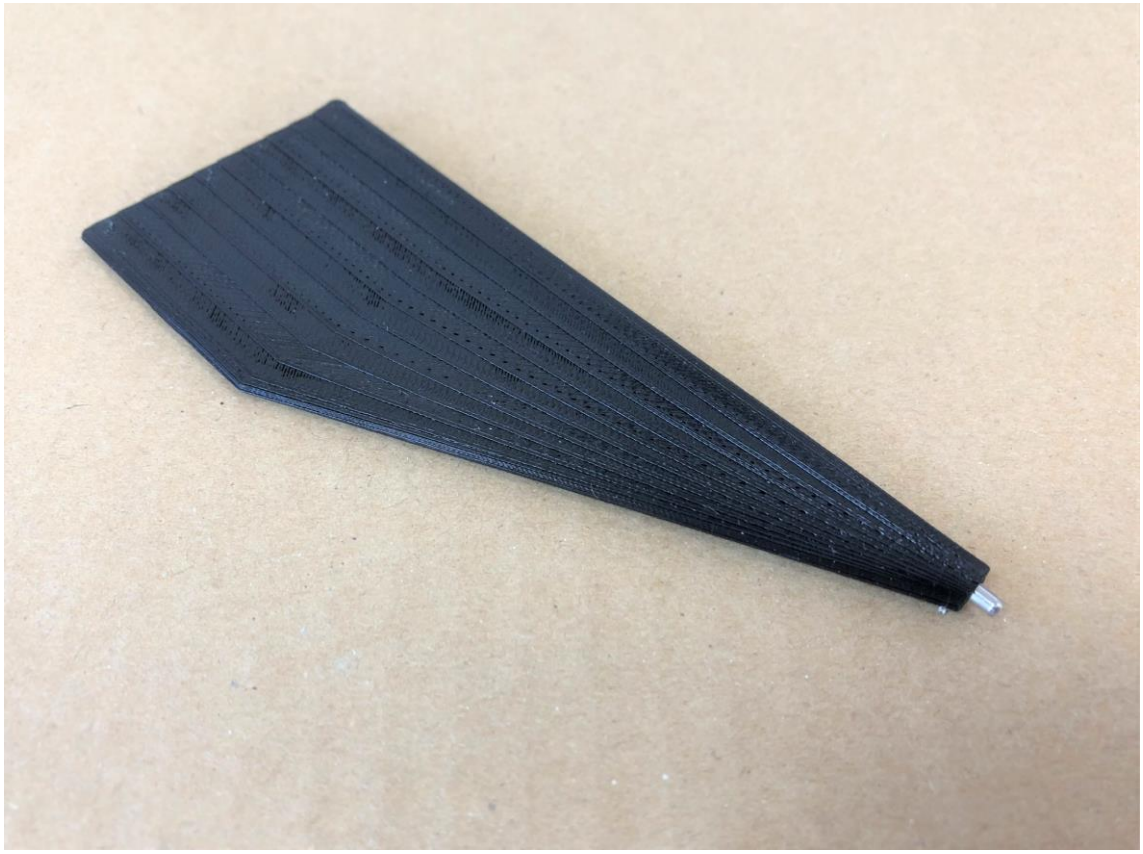
Repeat the above instructions for the 3 other fins. Match 2A with 2B, 3A with 3B and 4A with 4B.



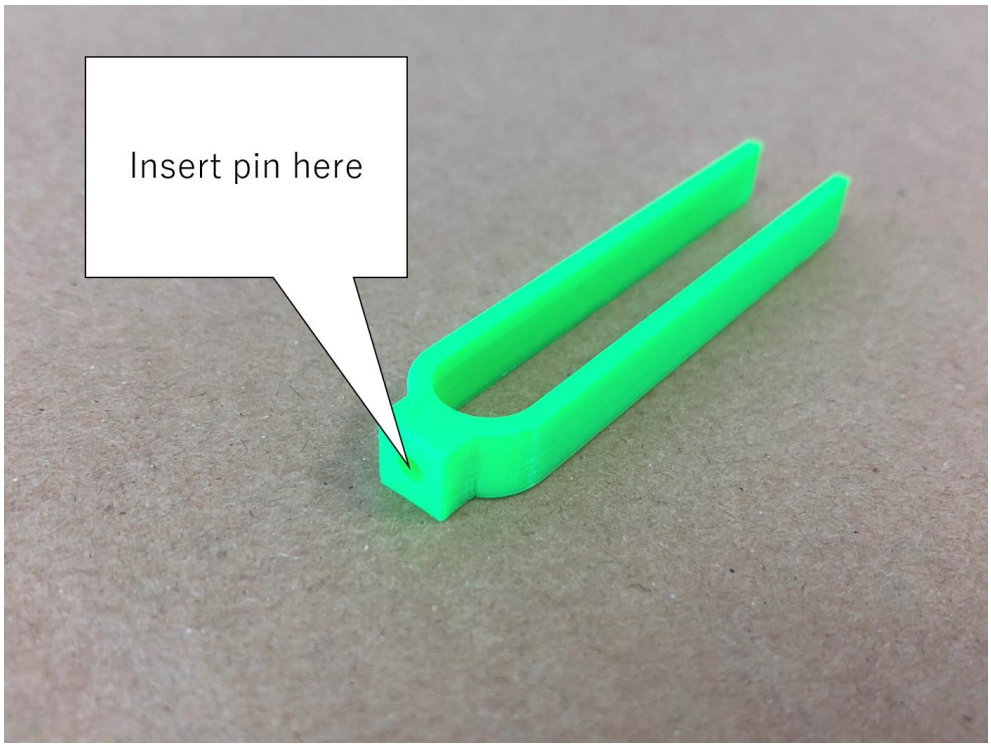
7.7.3 Hinges assembly

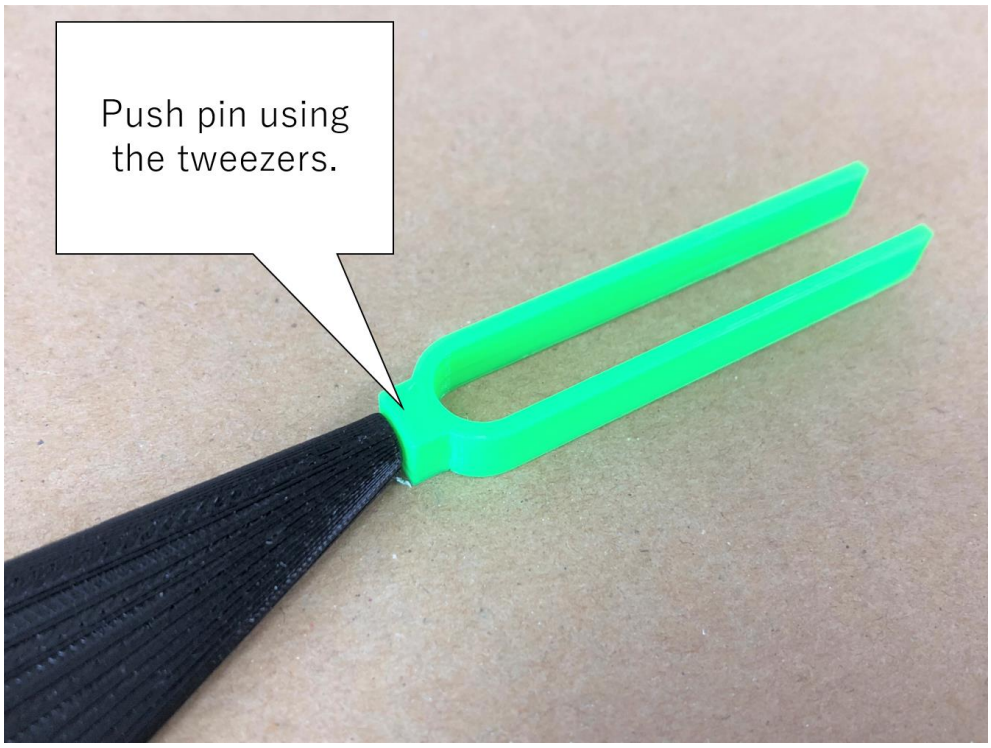
Take the fin 1 that you assembled before, two 2x25mm pins, and the Starship tweezers. Read the following steps to the end before executing the instructions.

Insert a pin at one end of the fin. You should be able to insert almost the totality of the pin into the fin, letting only about 2mm sticking out. If the hole is too tight, take the 2mm drill bit and carefully drill trough the pin hole. The hole is a little deeper than the optimal depth. This is to allow for slight variation in the length of the pin itself.



Take the Starship tweezers. At the place where the two fingers are joined, you will see a small hole. Insert the tip of the pin in this hole, then use the tweezers to push the pin inside the fin. Remove the tweezers. Remove the pin from the hole, and practice pushing the pin in the hole using the tweezers a few more times.



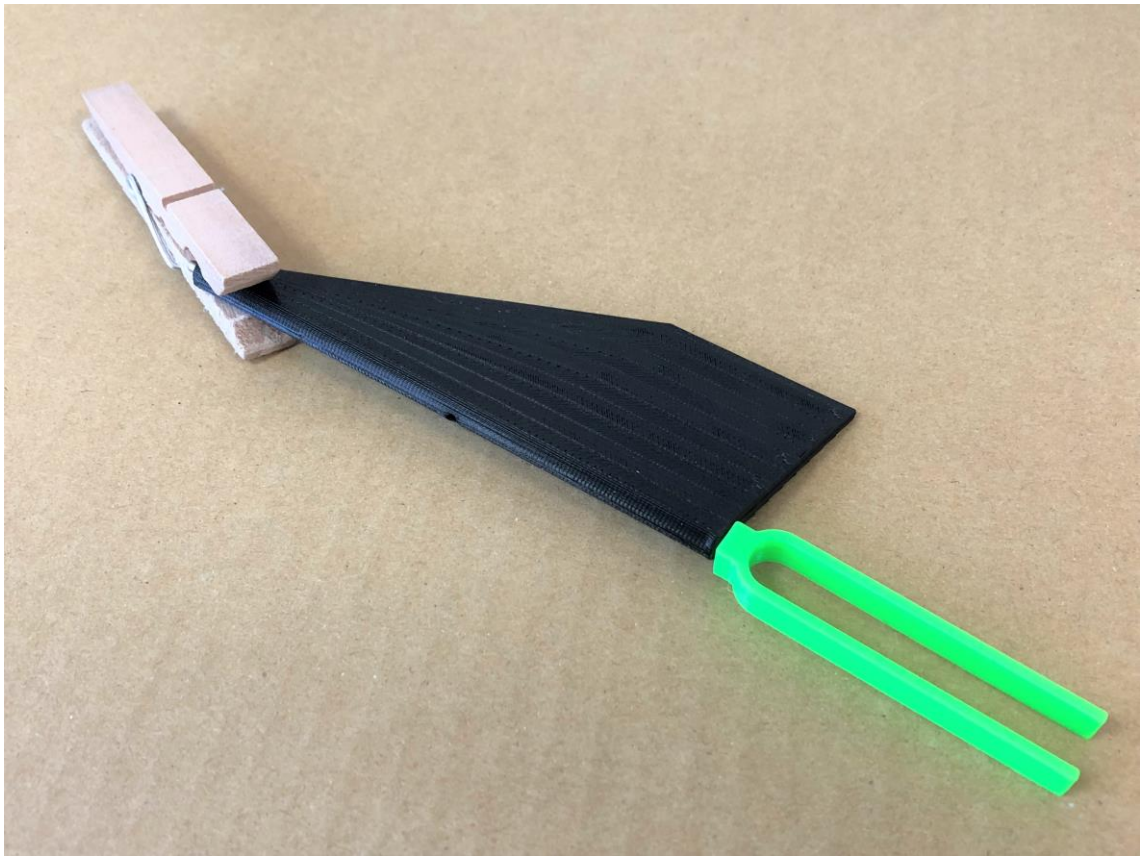


Once you feel confident, remove the pin from the hole. Apply super glue on half of the length of the pin (the side that goes into the hole), then push the pin inside the hole using the tweezers as you practiced before. Once you have pushed the pin in, remove the tweezers and put a clothespin on the tip of the fin. Do not touch the pin until the glue completely dries.

This method allows to have a consistent length of pin sticking out of the fin, even if the length of the pin and depth of the hole vary slightly.

Using the same method, insert the second 2x25mm pin at the other end of the fin.

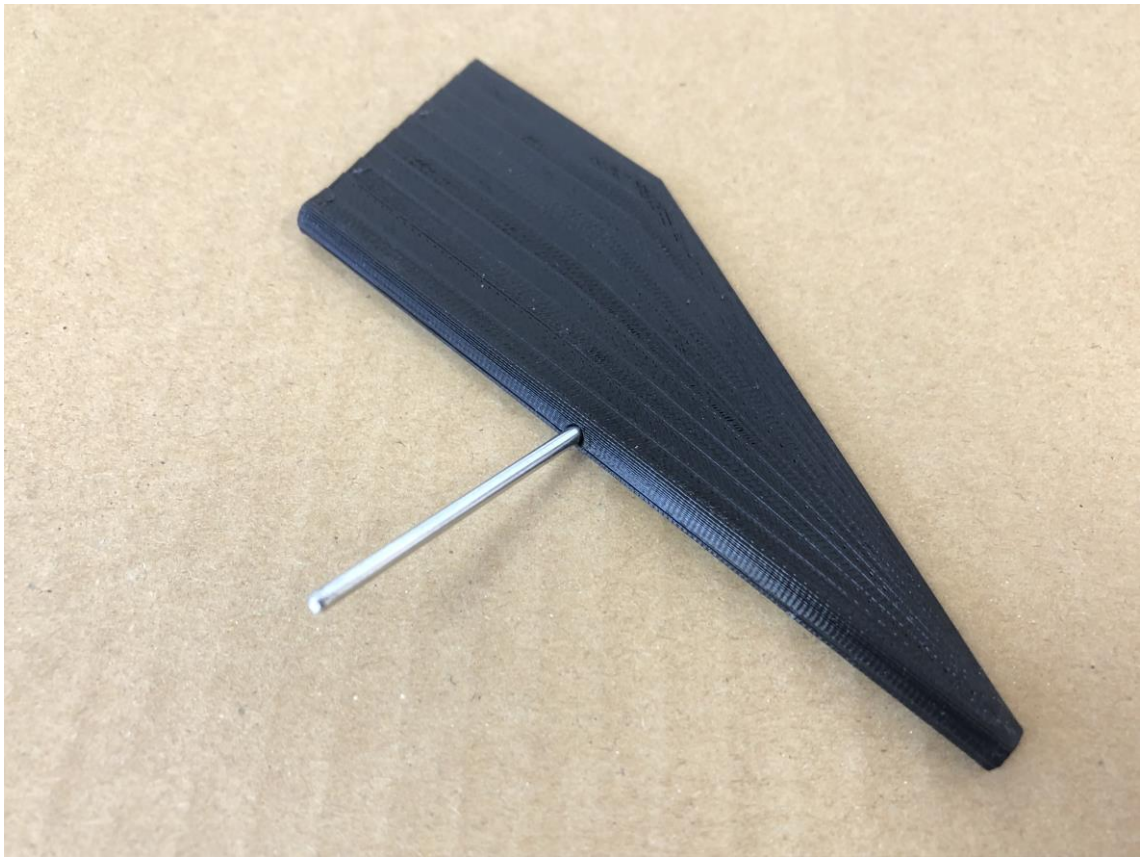
Repeat this step with the tree other fins.



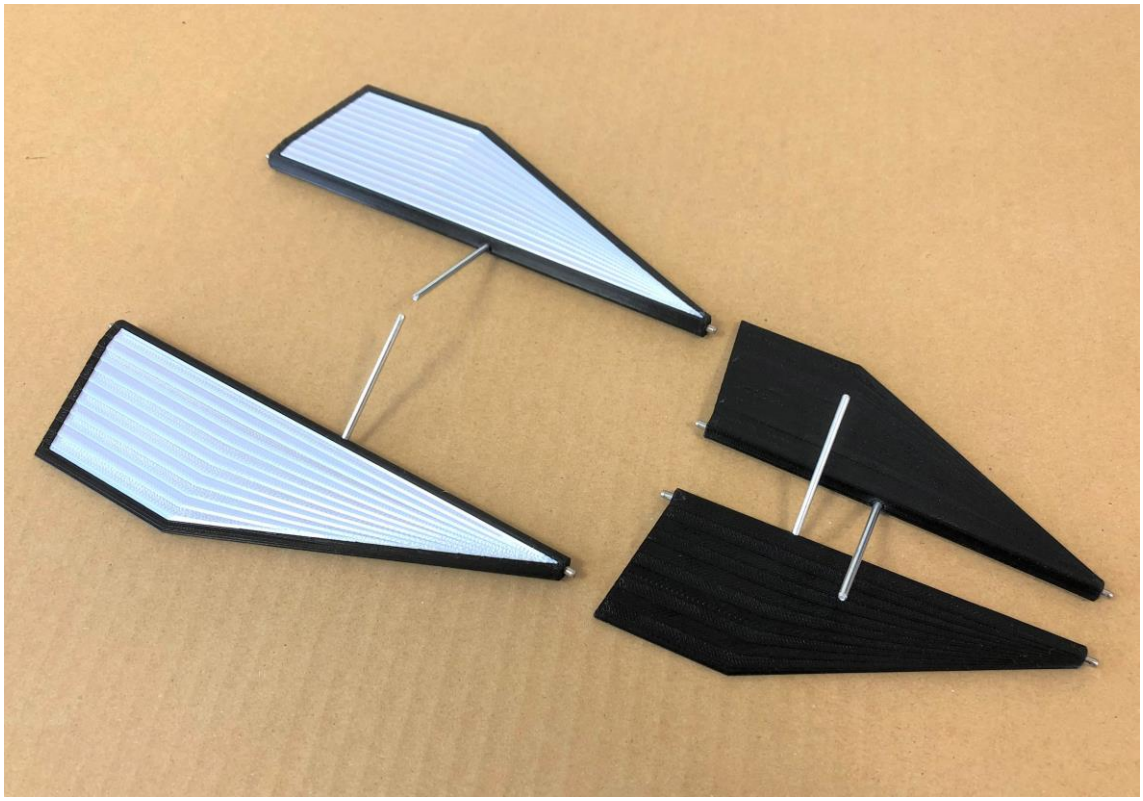
7.7.4 Levers assembly

Take fin 1 and one 2x40mm pin. Locate the hole on the side of the pin, about midway of the length. Carefully insert the pin and check that the pin fits inside. Take the pin out of the hole. Put super glue on the last 2mm of the pin, then insert it into the hole. Insert the pin until it reaches the bottom of the hole. You do not need the Starship tweezers this time. Let the glue dry.

When the fin lays flat on a table, the pin should stick at an angle of about 45 degrees.



Repeat this step with the three other fins. Note that the fore fins are not symmetrical.

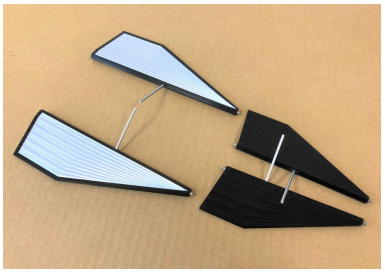


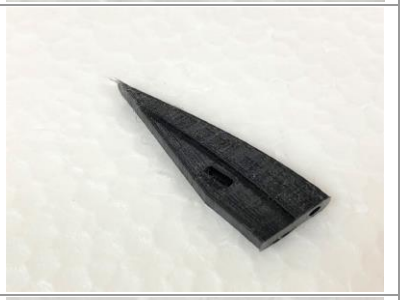
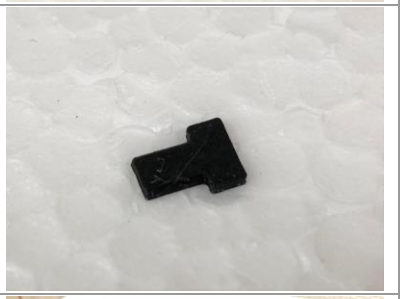
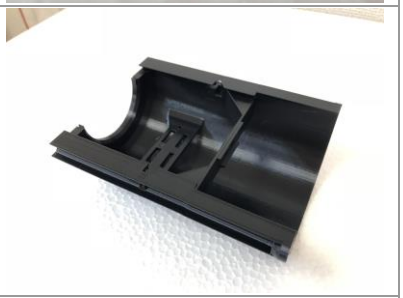
7.8 Fins installation

7.8.1 Parts & tools preparation

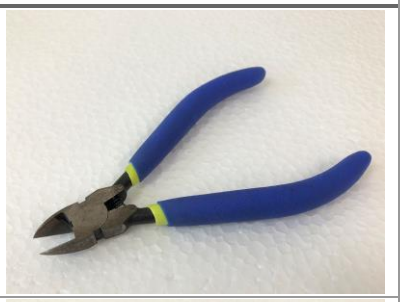
There are spare linkages included in the kit in case you break one during the assembly.

Prepare the following parts

Part	Number of parts	Photo
Fin (prepared in the previous section)	4	
Linkage	4	
Cam	4	
Servo horn set	4	

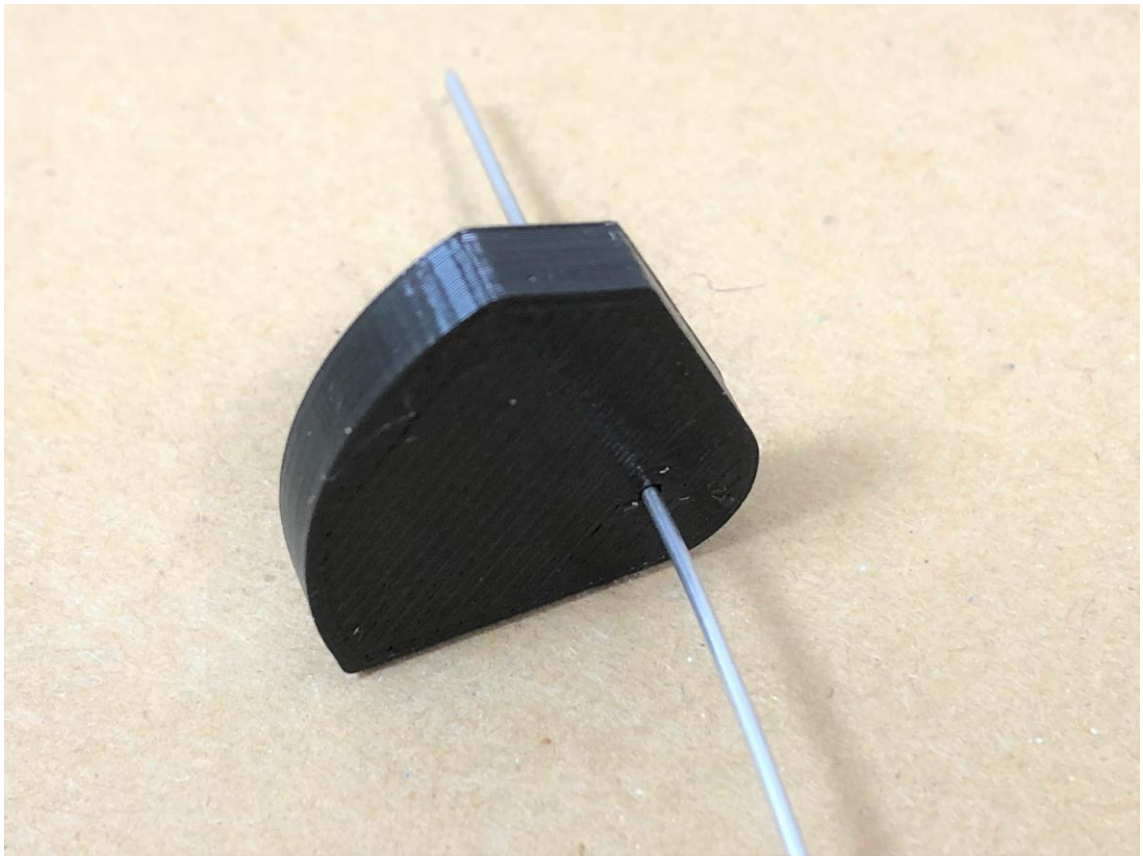
Servo pin wire	1	
Fin axis holder left	1	
Fin axis holder right	1	
Fin lock	2	
Hull bottom half aft segment	1	
Hull bottom half fore segment	1	

Prepare the following tools

Part	Photo
Wire cutter	
Pliers	
0.8mm drill bit	

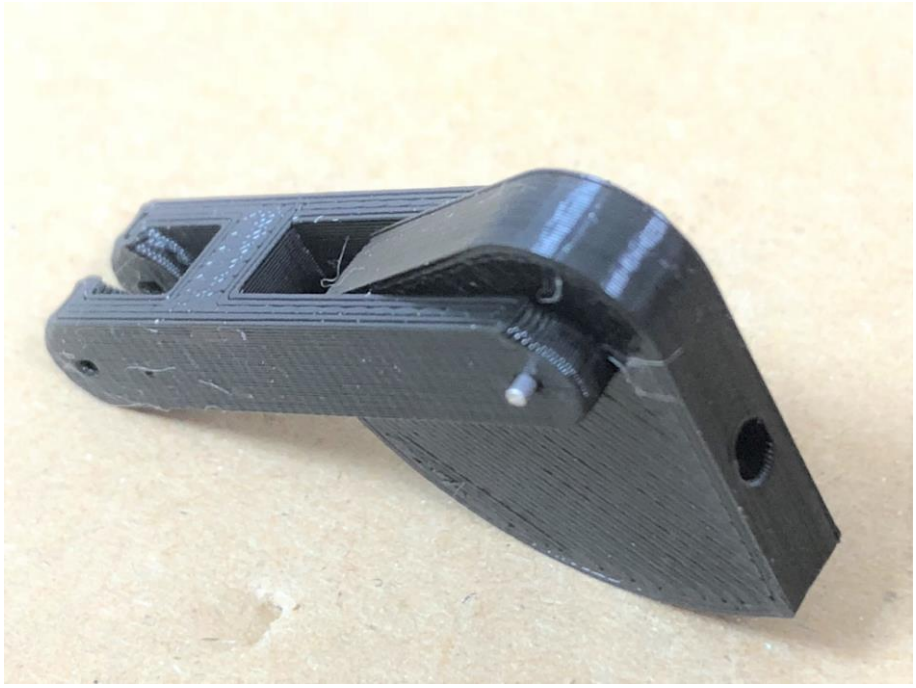
7.8.2 Linkages preparation (cam assembly)

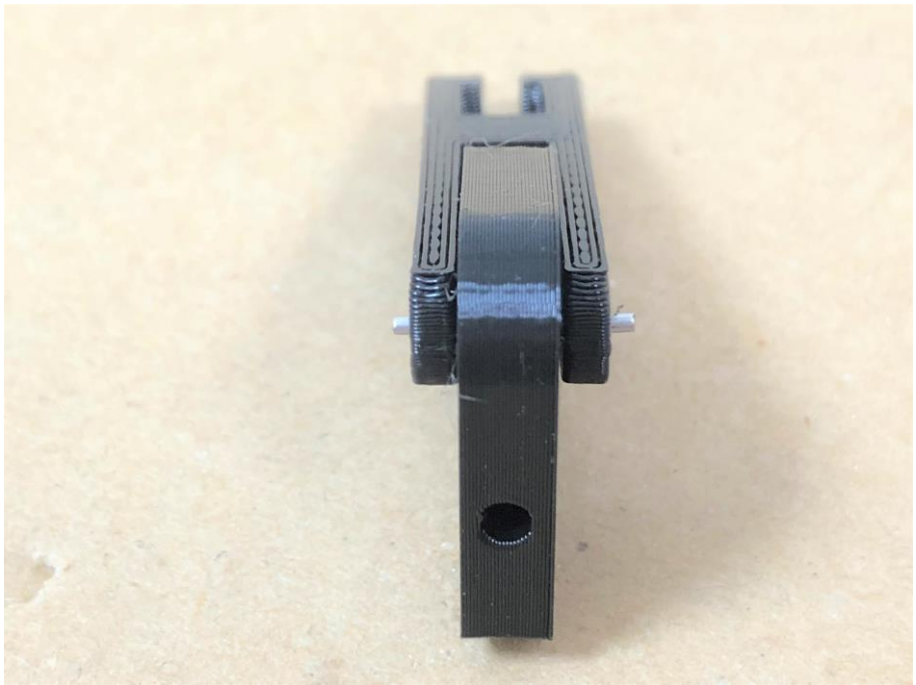
Take a cam and locate the hole on its side. Take the pin wire, and make sure it can go through the hole smoothly. If the hole is too tight, widen it using the 0.8mm drill bit.



Take a linkage and insert the cam into the linkage, on the side where the linkage is the widest. Insert the wire so that it goes through both the linkage and the cam. Leave about 1mm of wire sticking out of the linkage. Cut the remaining wire using the wire cutter. Leave about 1mm of wire sticking out on both sides of the linkage. Check that the cam can rotate freely around the pin.

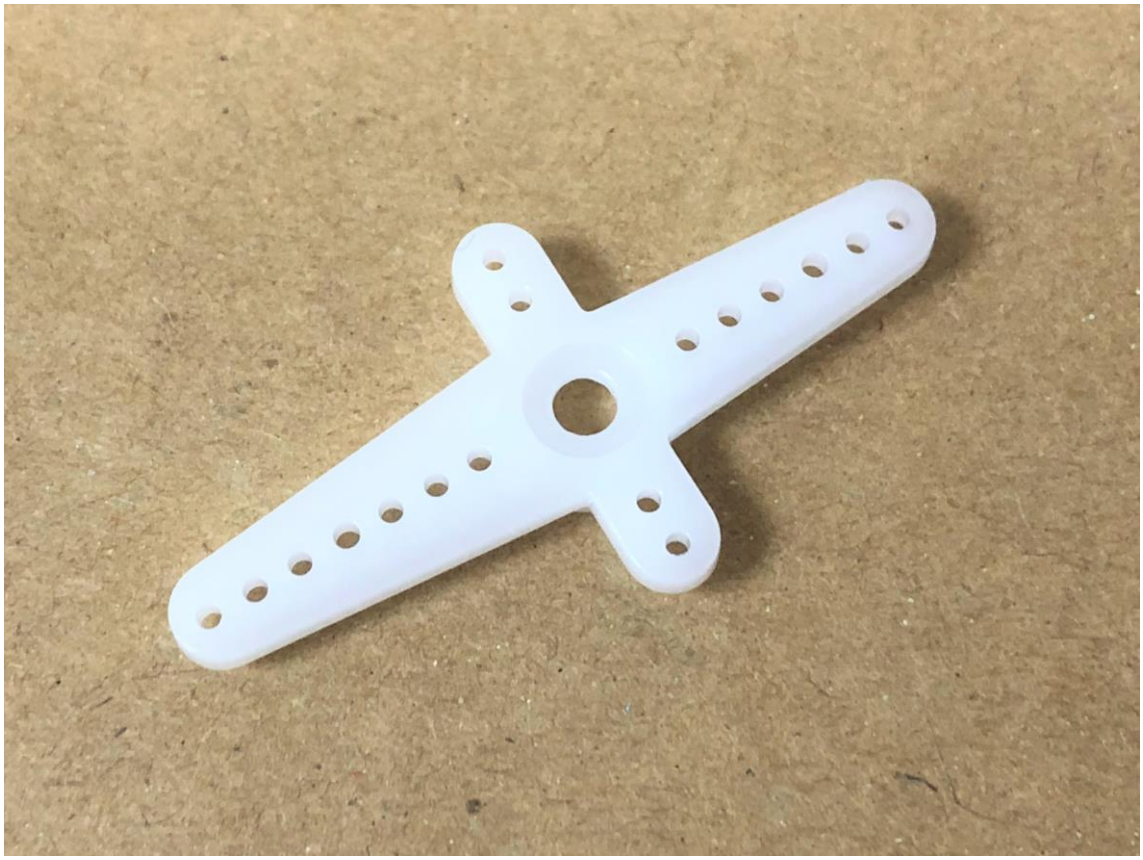
Repeat this step for the three other cams and linkages.





7.8.3 Linkages preparation (servo horn assembly)

Take one servo horn set bag. Take the crossed shaped horn from the bag.

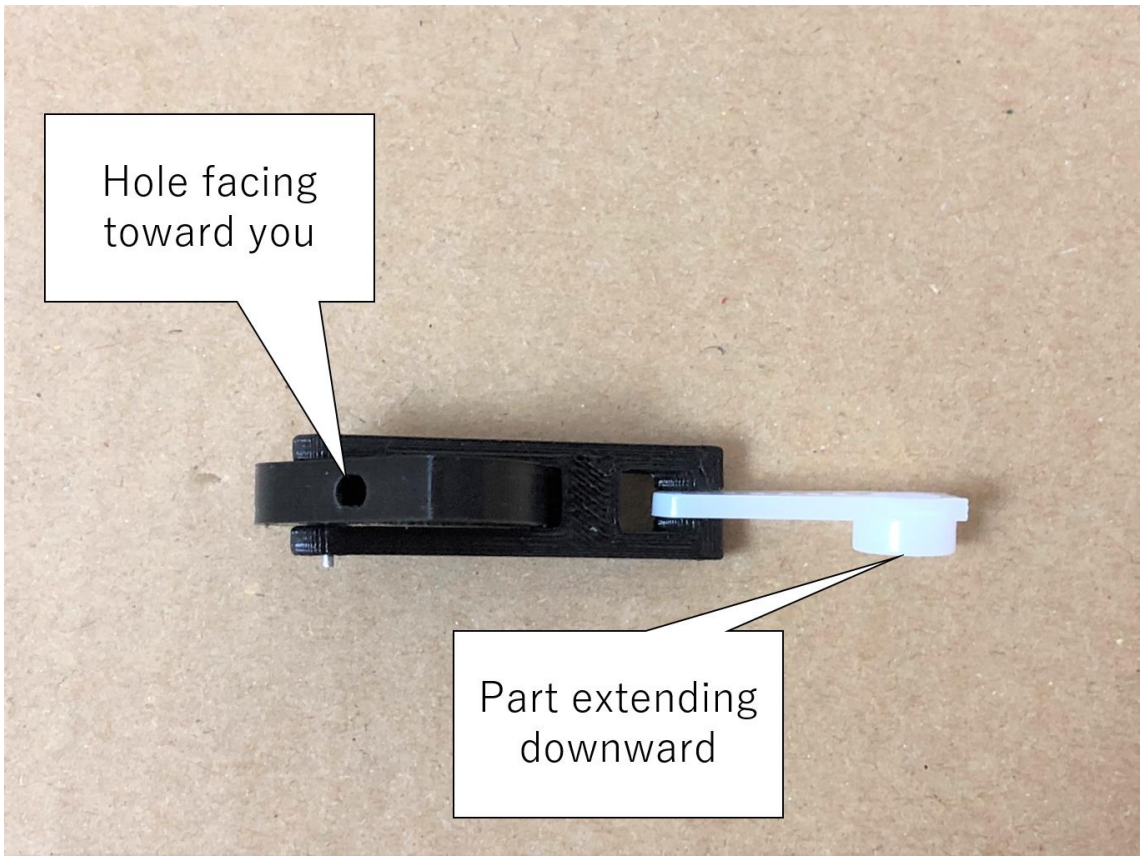


From this part, we want to keep only the longest of the 4 arms. Using the wire cutter, cut out the three arms marked in black in the first photo. The result should look like the second photo.

Repeat this step for the 3 other servo horn set bags.

Take one linkage/cam assembly and one servo arm. Insert the tip of the servo arm inside the free end of the linkage. Pay very attention the orientation of the parts. The hole in the side of the cam must be facing towards you, and the base of the servo arm must be extending downward.

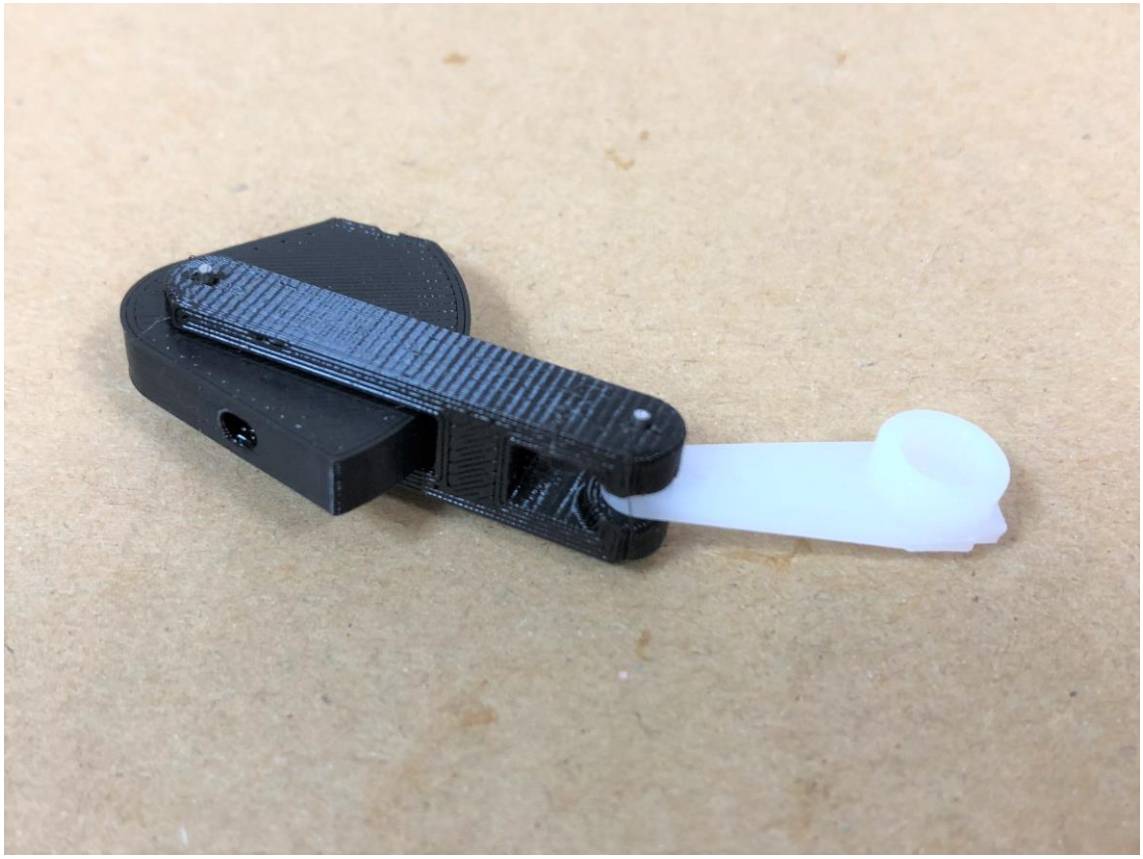
PHOTO



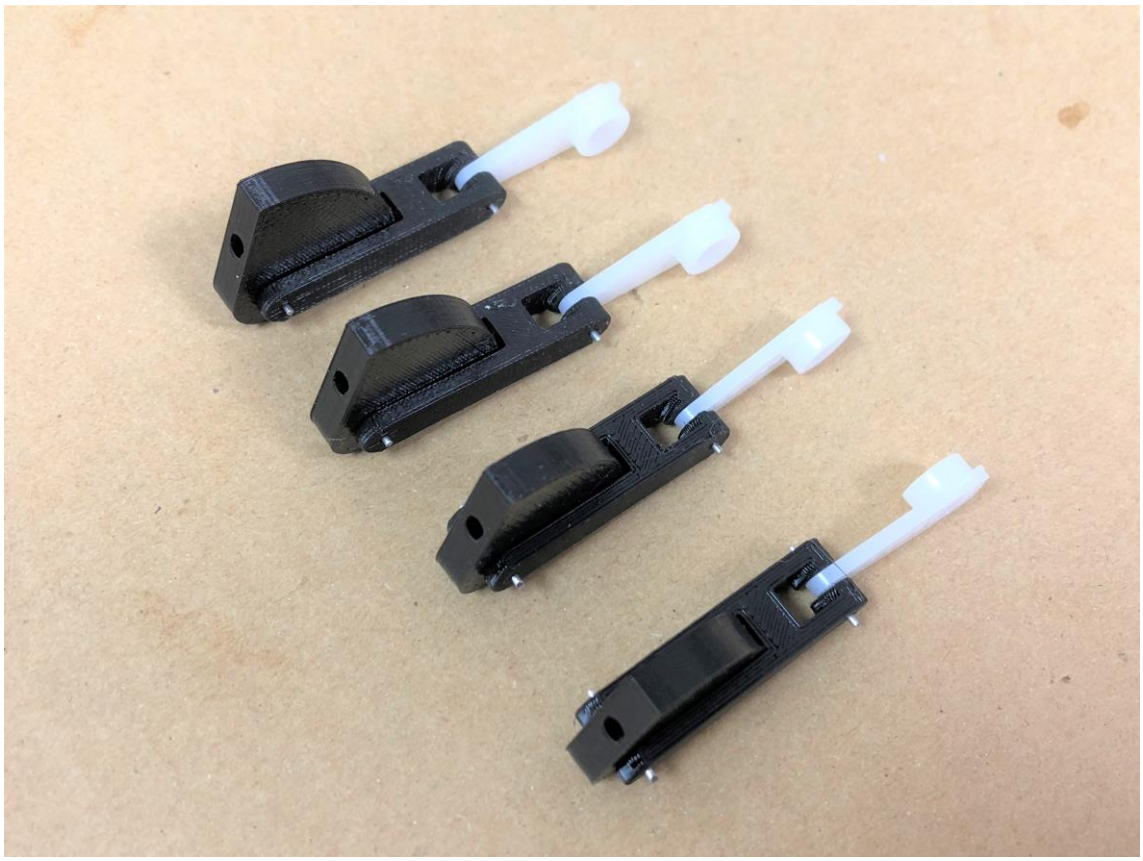
Insert the pin wire through the linkage and the servo arm. You want to use the hole in the servo horn that is the furthest from the base of the horn. Cut the wire to leave about 1mm sticking out on both sides of the linkage.

Make 3 (not 4) assemblies like this one.

For the last assembly, orient the servo horn so that the base of the arm is extending UPWARD. We will call this assembly the “mirrored assembly”.

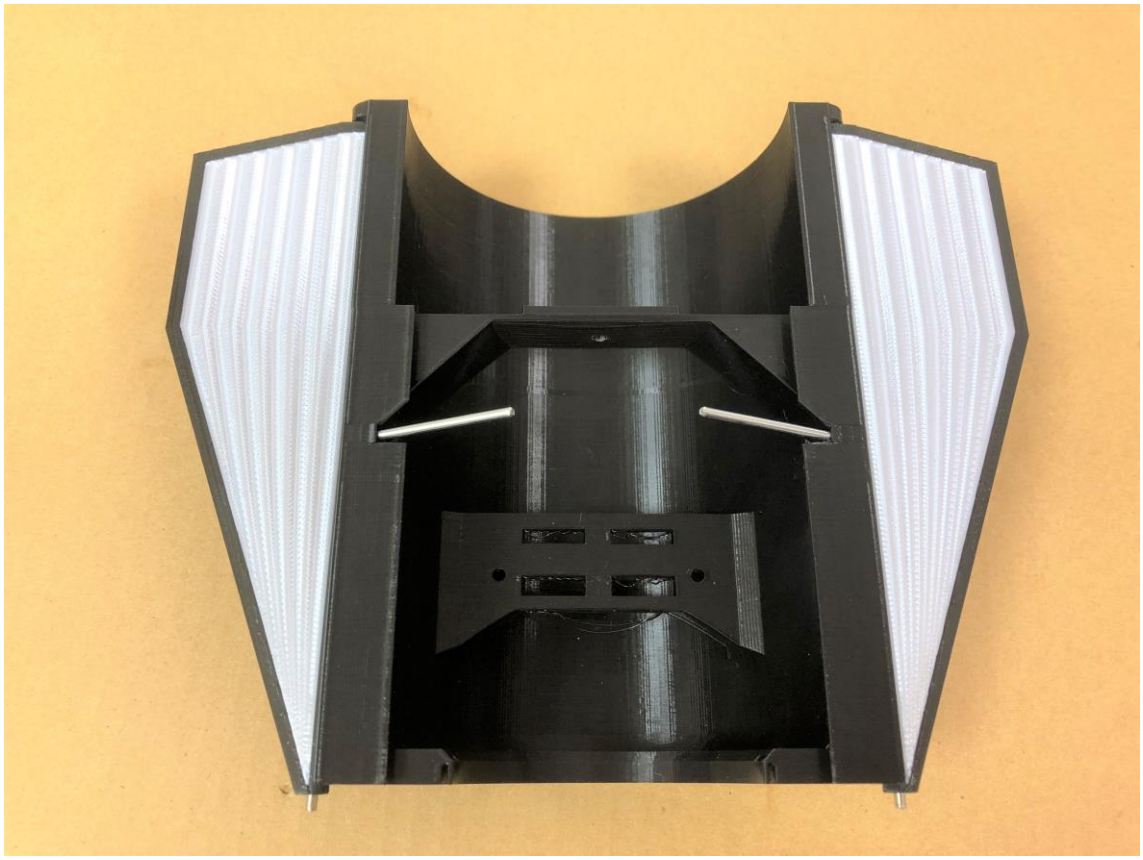


This is what you should obtain. The orientation of the servo horn on the last assembly is reversed.

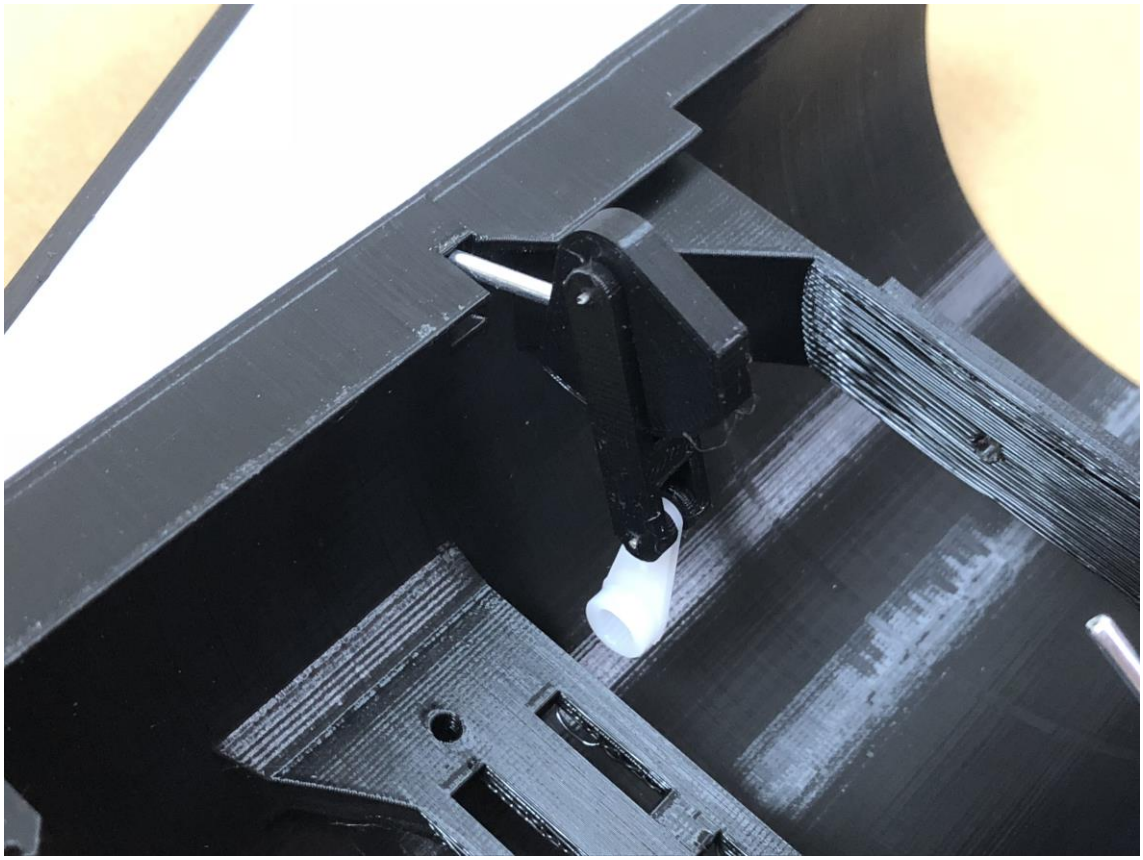


7.8.4 Aft fins installation

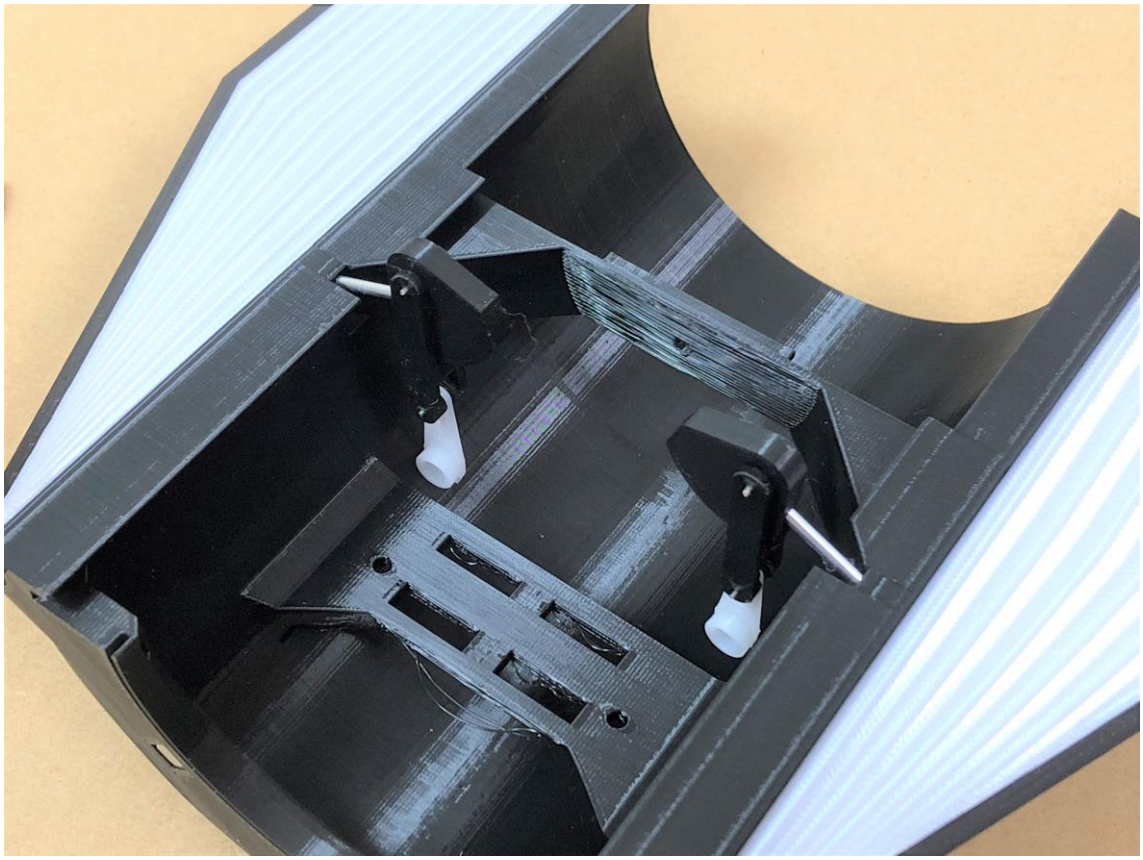
Take the aft fins and the aft hull segment. Insert each fin lever in the hole on the side of the hull, then slide the fins to the rear until the hinge pin is inserted into the hole at the rear end of the hull. The silver side of the fins must be facing up.



Take the MIRRORED assembled linkage, and CAREFULLY insert the fin lever of the RIGHT fin into the hole of the cam. Be careful not to yank on the lever, as it might break away from the fin. Pay closely attention to the orientation of the cam and linkage.



Take one of the non-mirrored assembled linkages and attach it to the fin lever of the LEFT fin. The mechanism should look like in the photo below.

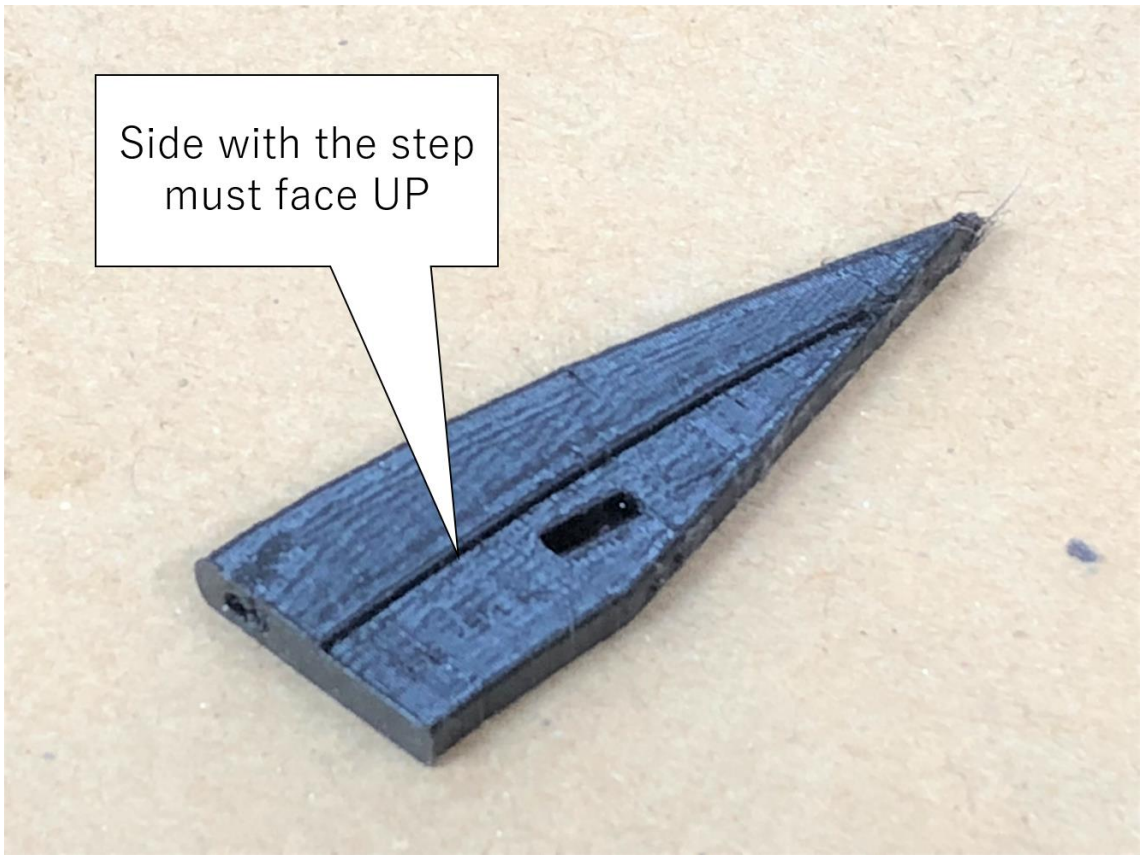


7.8.5 Fore fins installation

Take the fore fins and the hull fore segment. Insert each fin into the notch on the side of the hull then slide the fins to the rear until the rear hinge pin is inserted into the hole in the hull. When the fins are horizontal, the lever must be going up!

Make sure that the fin can rotate freely. If not, use the 2mm drill bit to clean the hole in the hull.

Take the two fin axis holders. Each part has a step on one of its side. This side must be facing up! The two pars are different, so do not swap them.



Locate the hole at the back of the parts. Use the 2mm drill bit to clean the holes. Do not drill further the holes.

Locate a rectangular hole in a flat structure at the front of the hull.

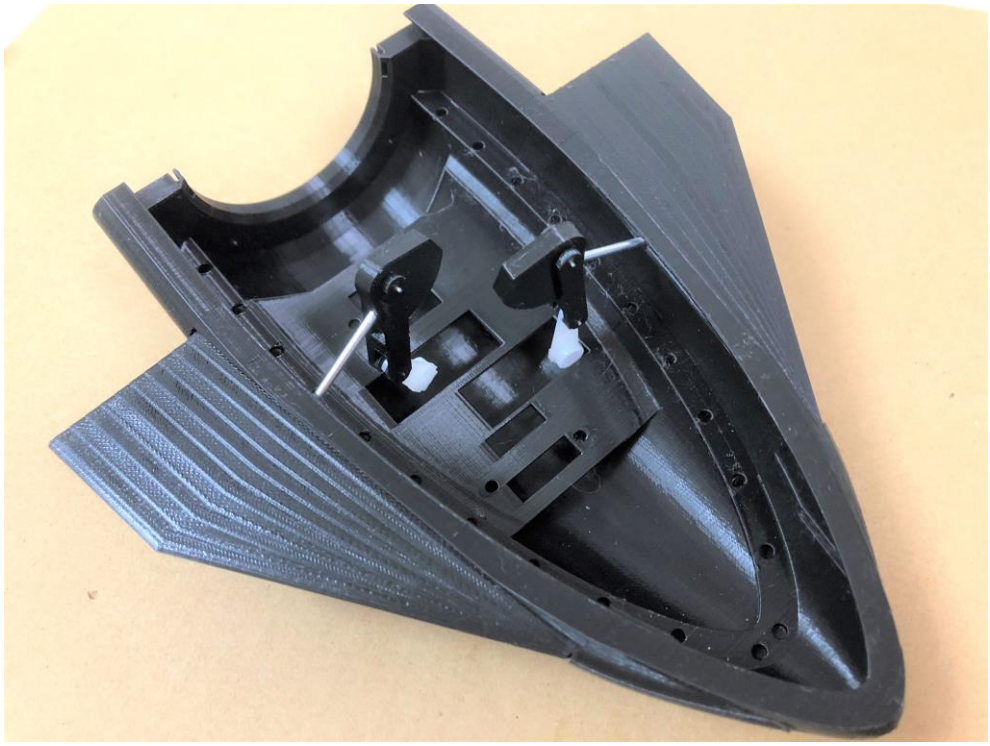
Take one of the fin locks. Hold it with the pliers like in the photo below. Insert the tip of the fin lock into the hole from below. Insert only the tip of the part. It should not stick out of the upper side of the flat part of the hull.

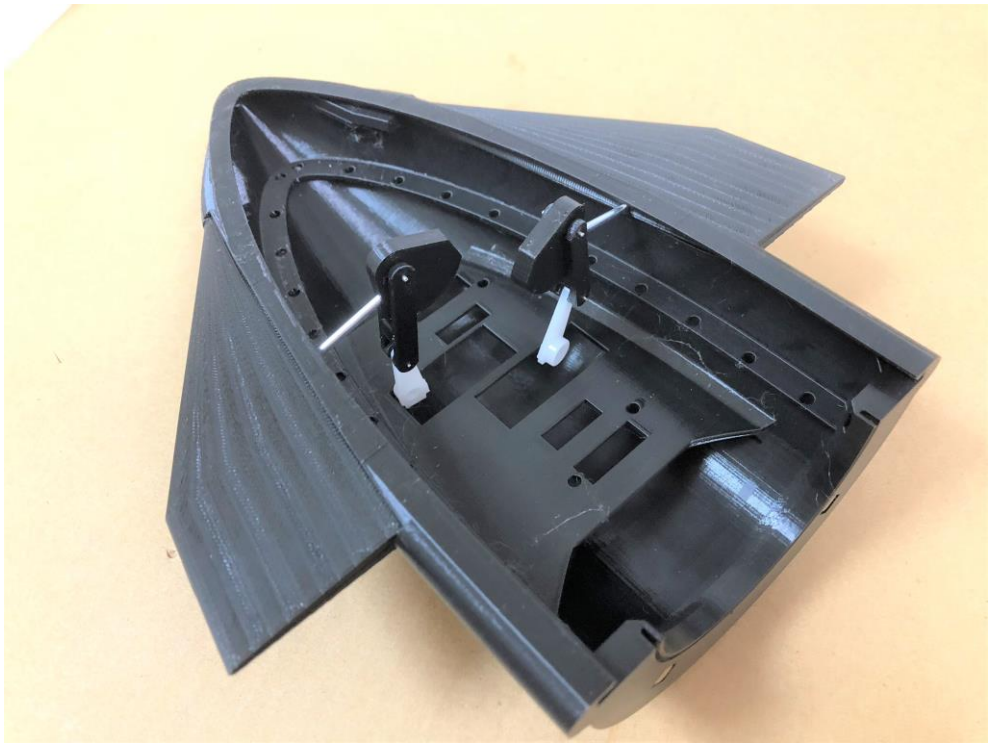
This is a bit tricky… take your time!

Take the corresponding axis holder and insert it into the notch in front of the fin. Slide the holder until the fin hinge pin is full inserted into the holder. Make sure that the holder is fully inserted into the hull. Gently push the fin lock so that it goes through the holder. If the lock does not go through, make sure that the axis holder is fully inserted and try again.

Repeat these steps with the other fin.

Take the two assembled linkages and attached them to the fins like in the picture below. Be careful not to yank on the levers.

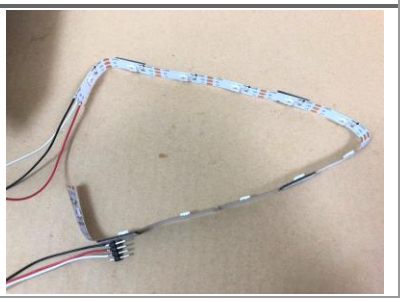




7.9 LED strip installation

7.9.1 Parts & tools preparation

Prepare the following parts

Part	Number of parts	Photo
LED strip with connector	1	

Prepare the following tools

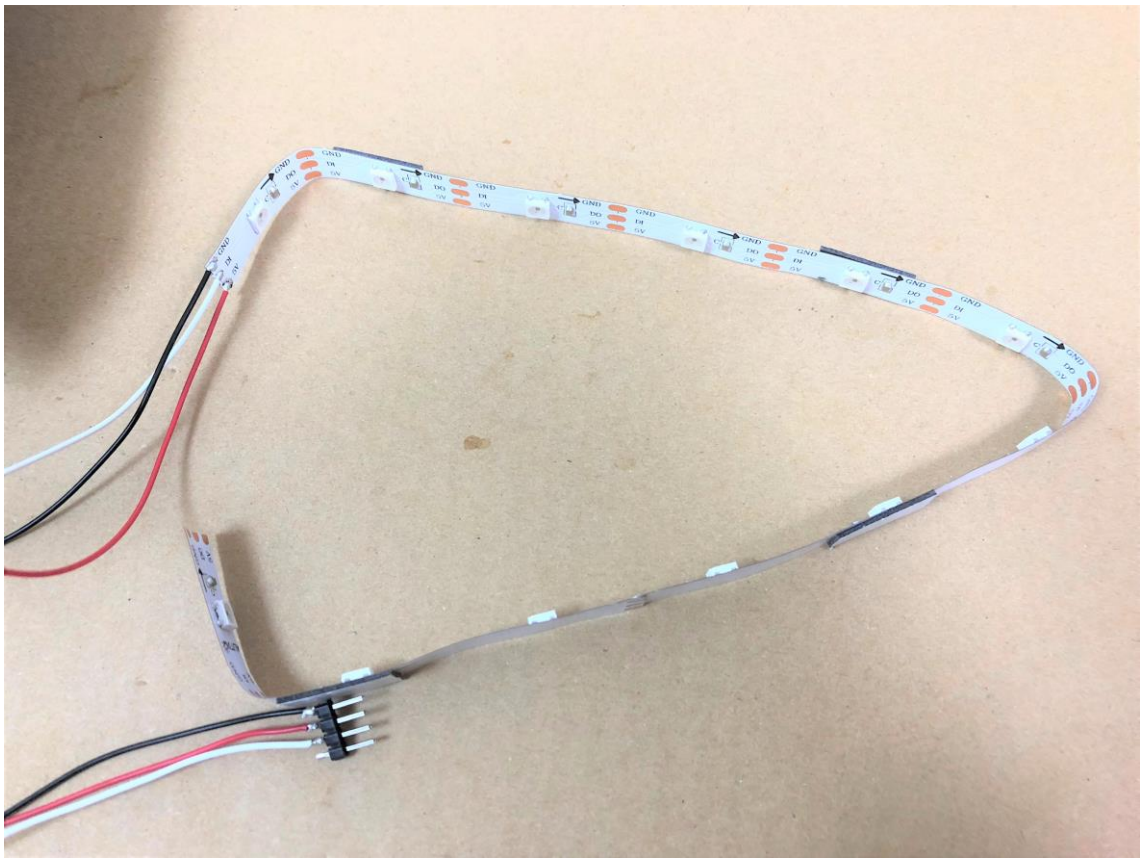
Part	Photo
Thick double side tape	
Scissor	

7.9.2 Assembly

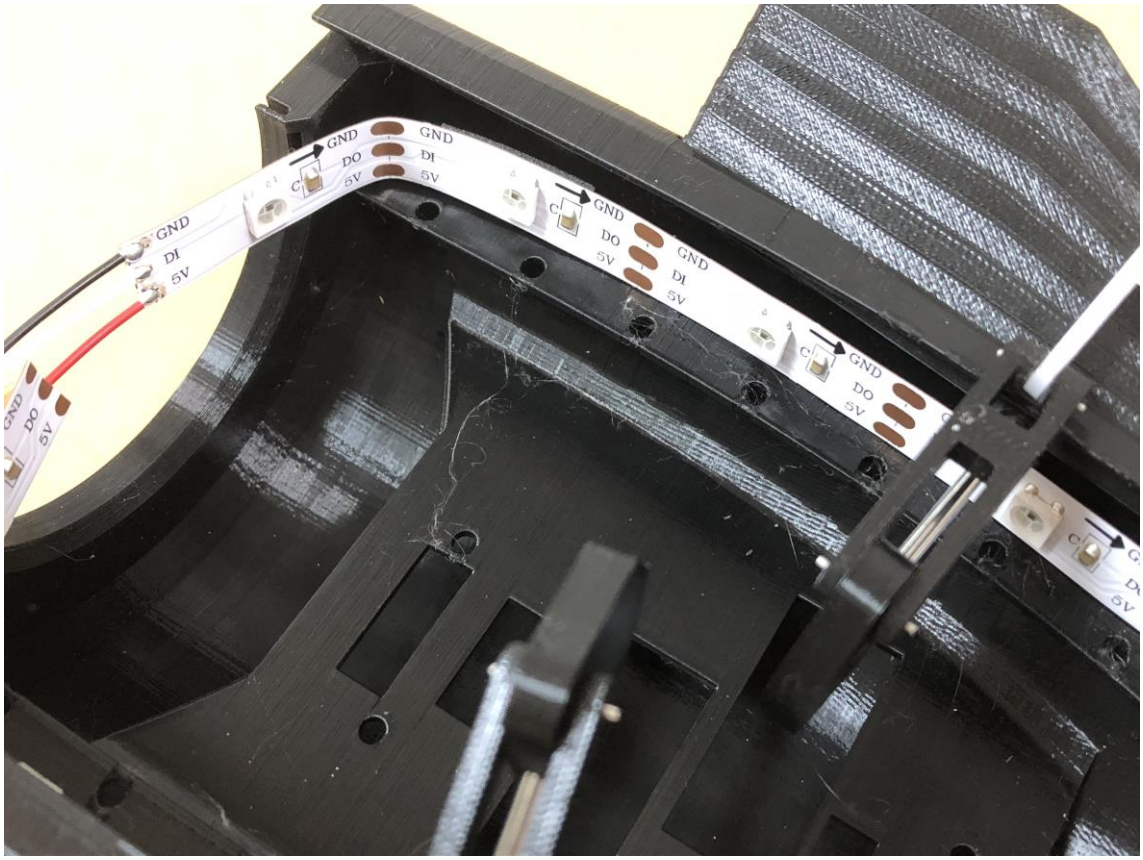
Unplug the LED strip from the control board. Bend the strip so that the LEDs are facing inward.

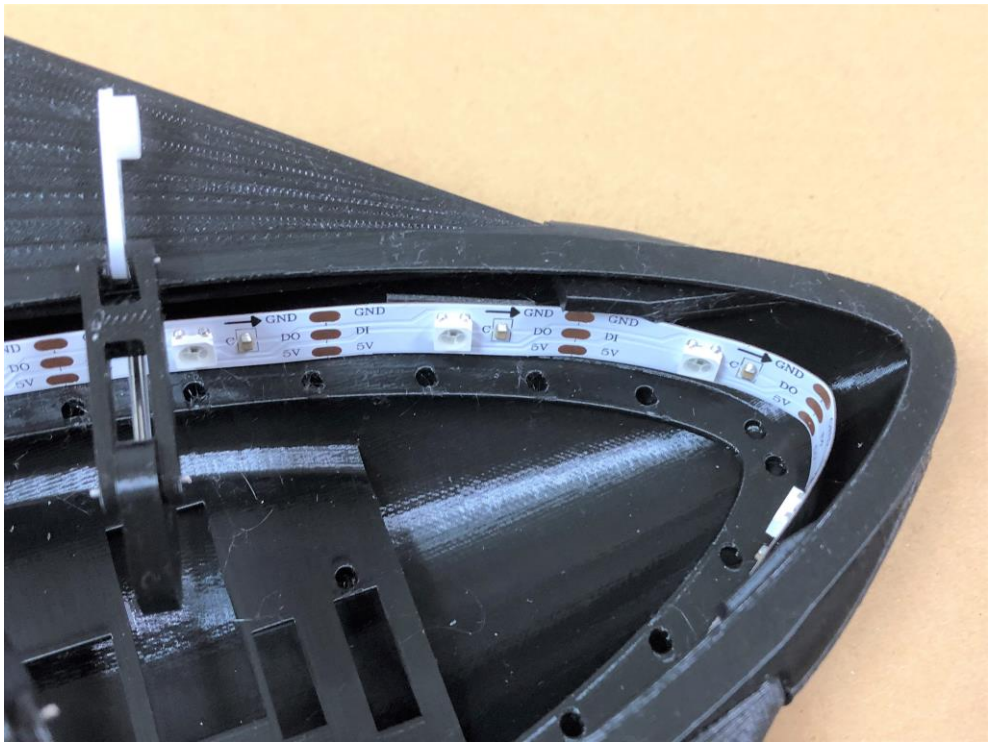
- Bend 90 between LEDs 1 and 2
- Bend 45 degrees between LEDs 6 ad 7
- Bend 90 degrees between LEDs 11 and 12

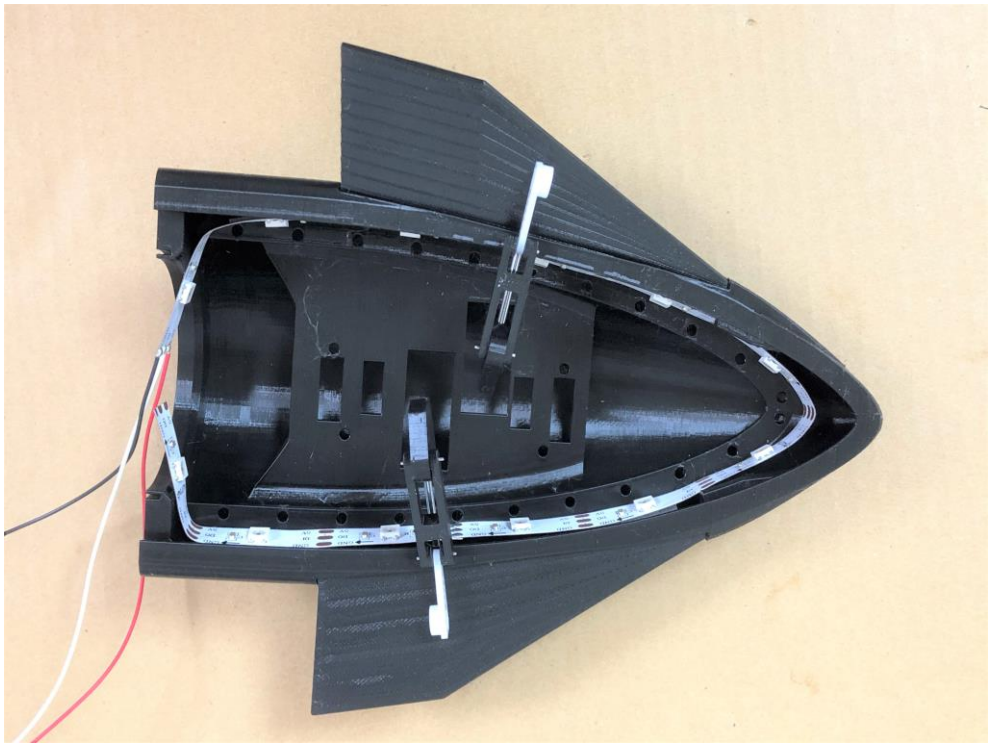
Bend the strip with “round” angles, not sharp angles. Sharp angles could damage the electrical connections.



Apply double side tape on the outer surface of the strip. Remove the cover from the tape. Take the bottom half of the fore hull segment (it should have the fins attached by now). Inside, you fill find a rail with holes. Place the LED strip on top of the rail like in the photos below. The holes themselves will not be used.



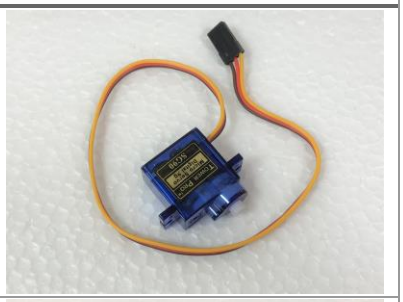
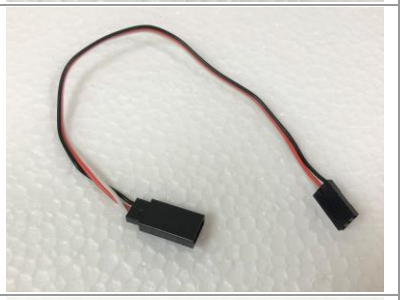
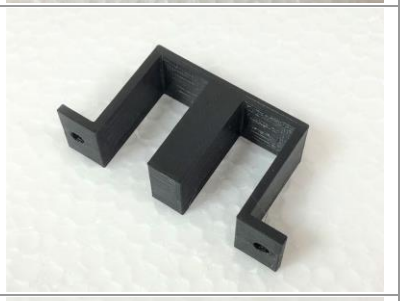
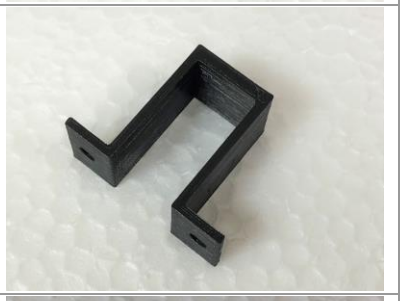

GND
DO
5V
GND
DI
5V
GND
DO
5V
GND
DI
5V
GND
DO
5V

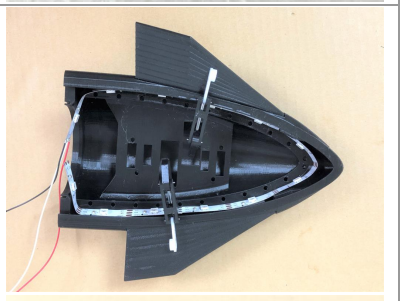
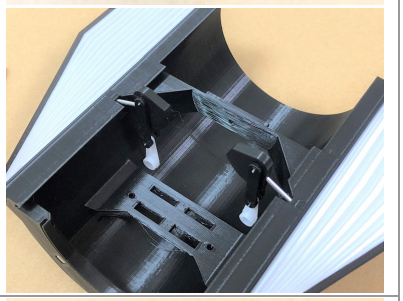
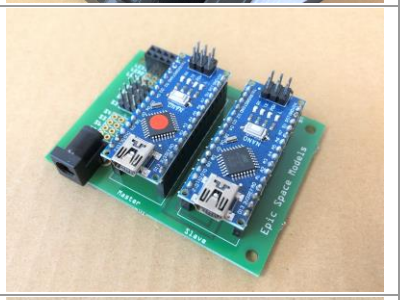


7.10 Control board and servomotors installation

7.10.1 Parts & tools preparation

Prepare the following parts

Part	Number of parts	Photo
Servomotor	4	
Servo extension cable	2	
Aft servo bracket	1	
Fore servo bracket	2	
M3 screws	10	

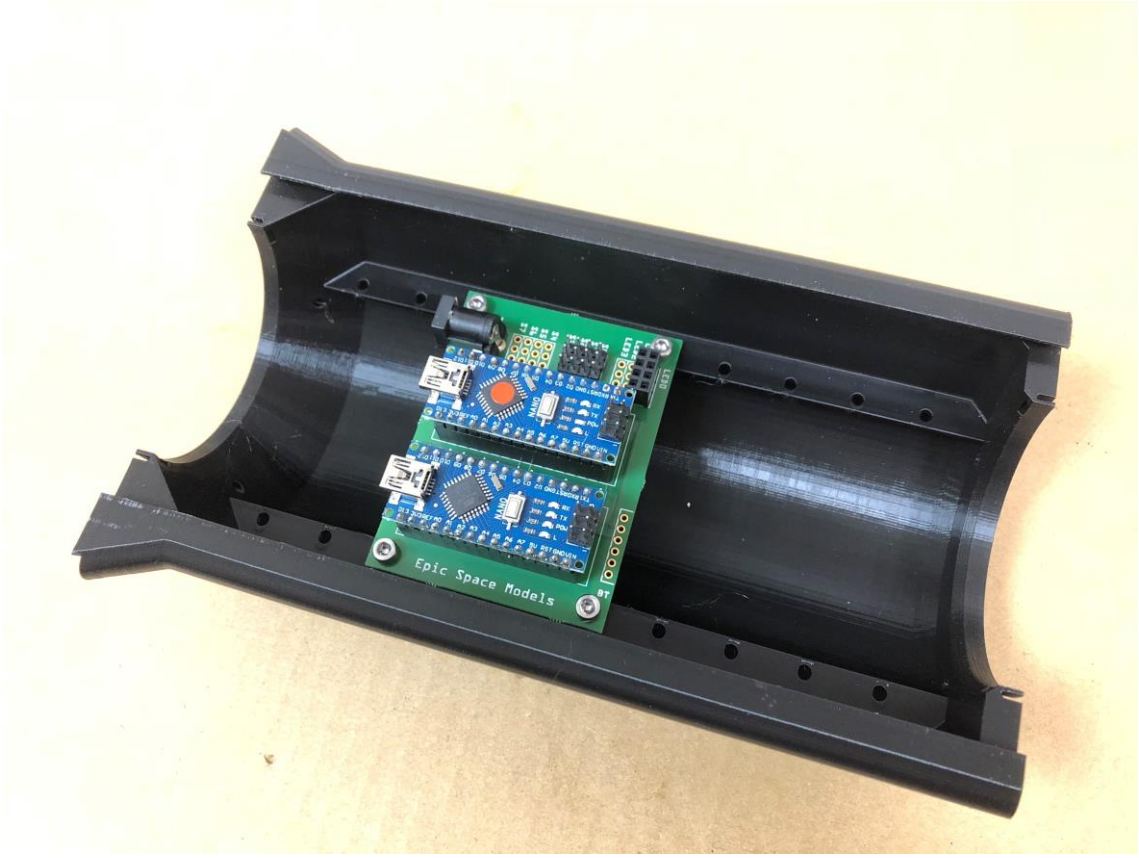
Seal	2	
The three bottom halves of the hull.	1+1+1	 
Control board	1	
Servo horn set bag	4	

Prepare the following tools

Part	Photo
Hex key	

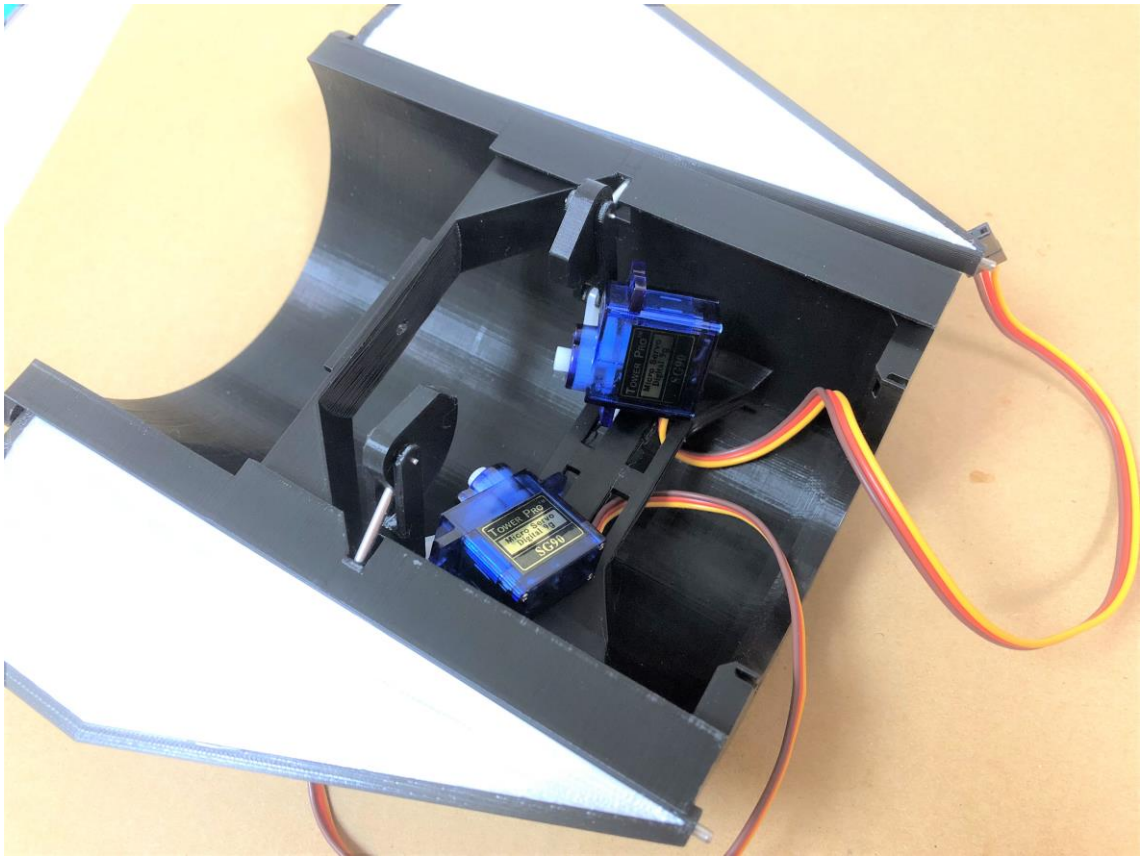
7.10.2 Control board installation

Bolt the control board to the central segment using 4 M3 screws. Pay attention to the orientation of the board. The power and USB connectors but be facing towards the back of the ship.



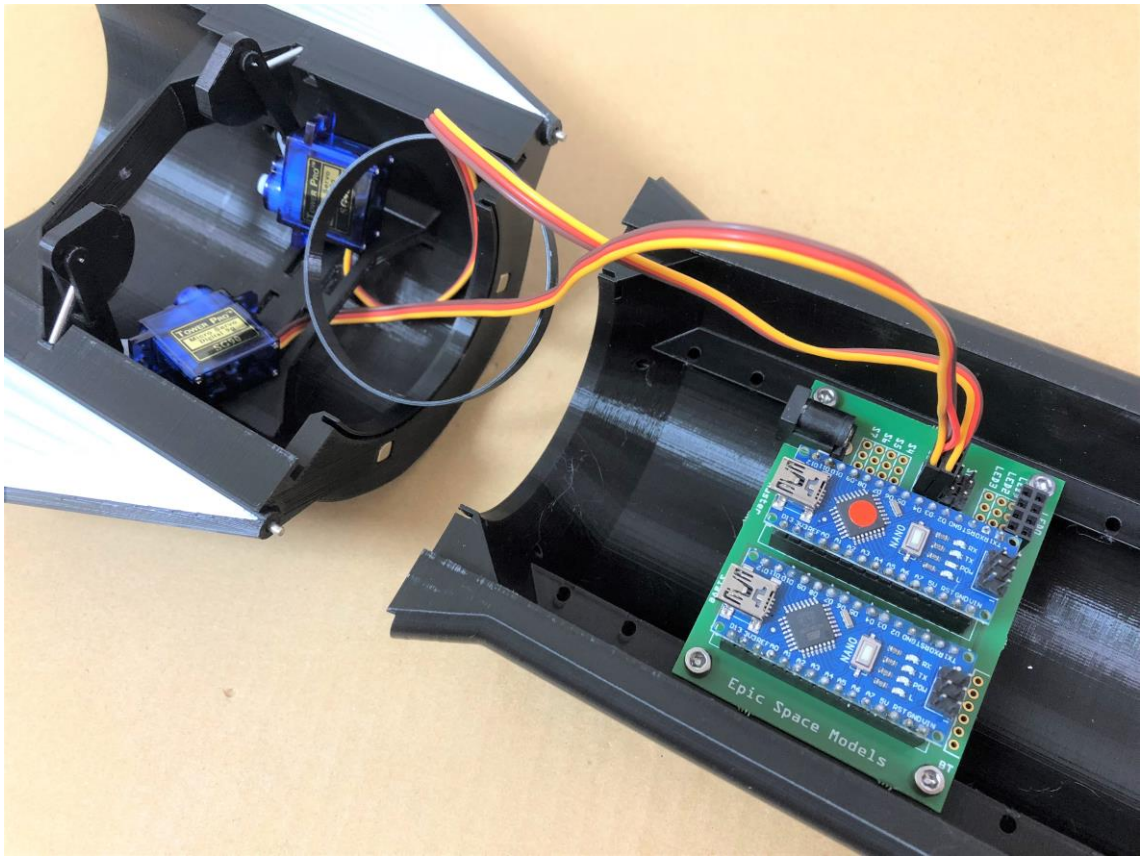
7.10.3 Servomotor connection

Take two servomotors. Place them inside the aft hull segment as shown in the photo below. Draw the servo cables through the rectangular openings in the servo mount plate. Make sure to use the correct holes!

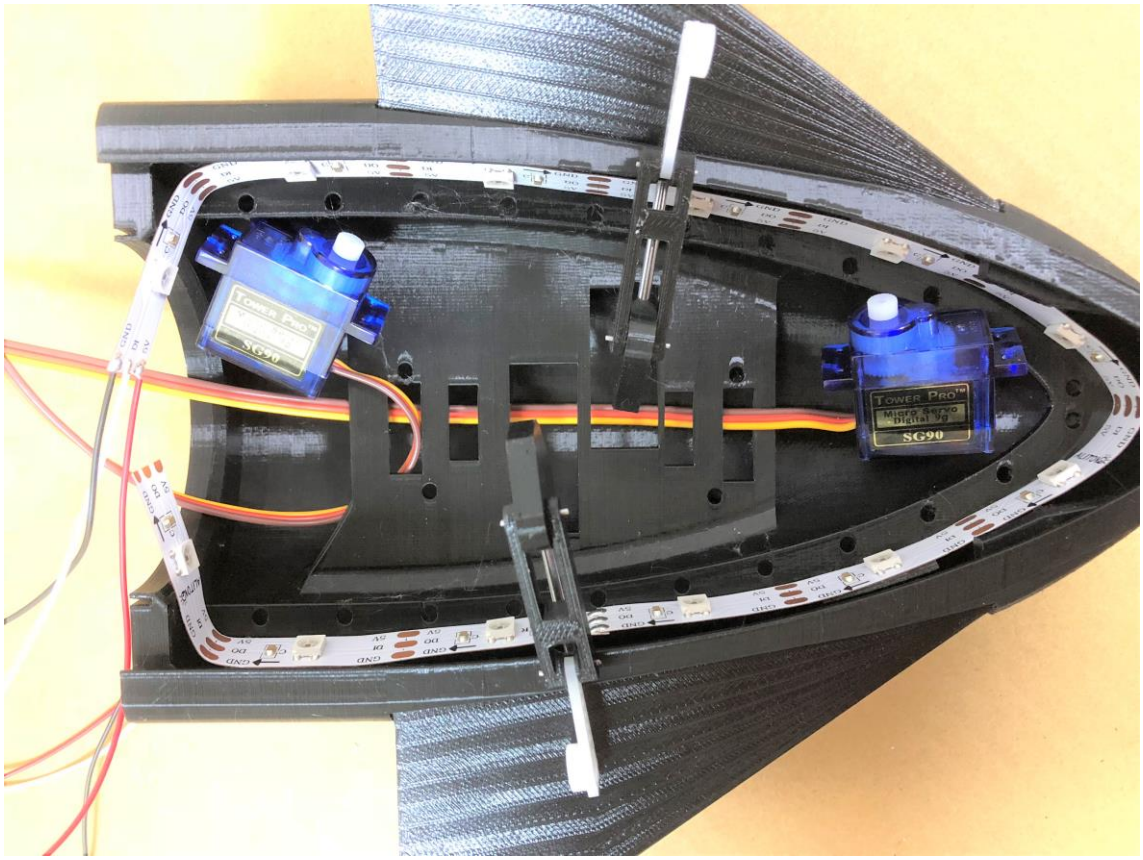


Take a seal. Draw the servo wires through the seal, then connect the servomotors to the control board. The black wire must be closest to the edge of the board.

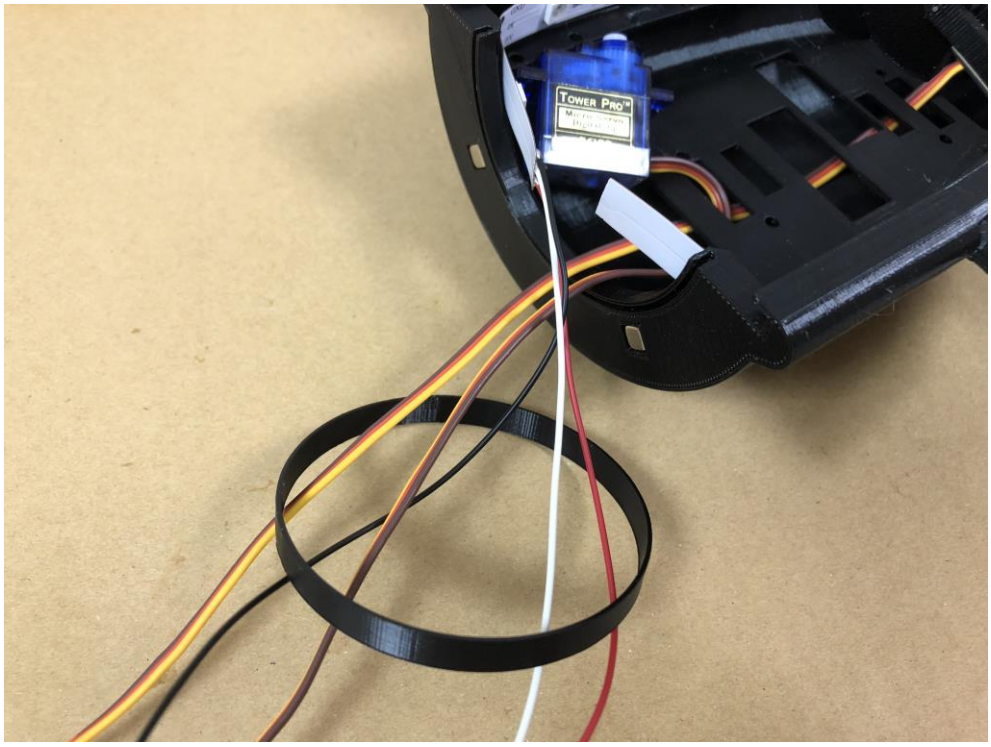
- Connect the left fin servomotor to the slot S2.
- Connect the right fin servomotor to the slot S3.

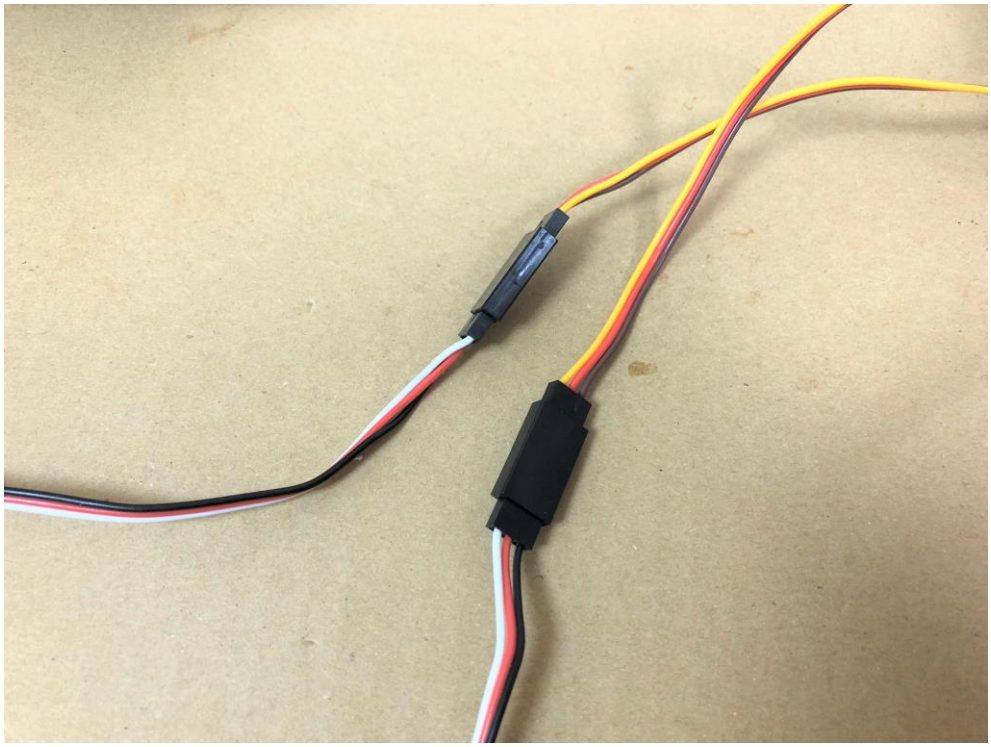


Take the two other servomotors. Place them in the fore hull segment like in the picture below. Draw the servo cables through the rectangular openings in the servo mount plate. Make sure to use the correct holes!



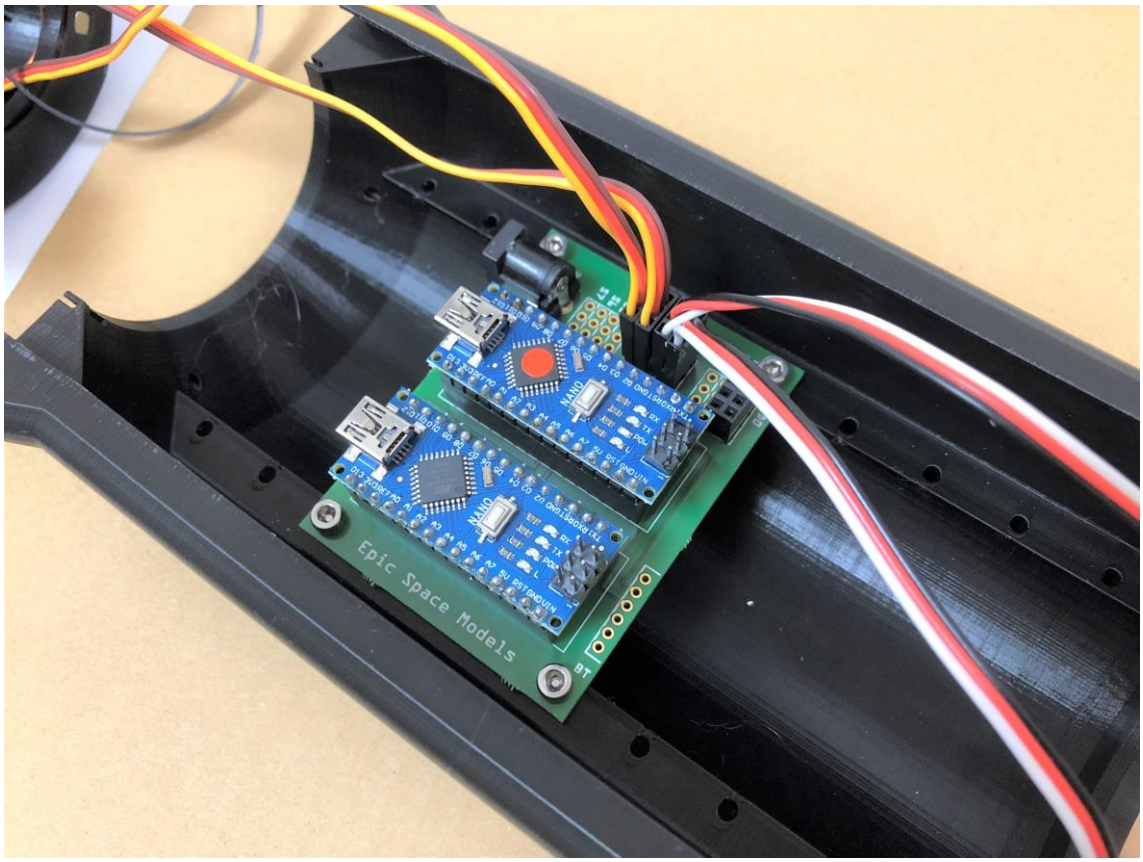
Connect one servo extension to each servomotor cable. Take the second seal. Draw the servo wires and the LED strip wires through the seal.





Connect the servomotors to the control board. The black wire must be closest to the edge of the board.

- Connect the left fin servomotor to the slot S0.
- Connect the right fin servomotor to the slot S1.



7.10.4 Servomotor initialization

Power up the control board. The servomotors will move for a fraction of a second then stop at their default position. Once the servomotors stop moving, wait 4 seconds then power down the control board (disconnect the DC adapter). If you wait more than 10 seconds the servomotors will start moving continuously. In this case, power down the board and start again.

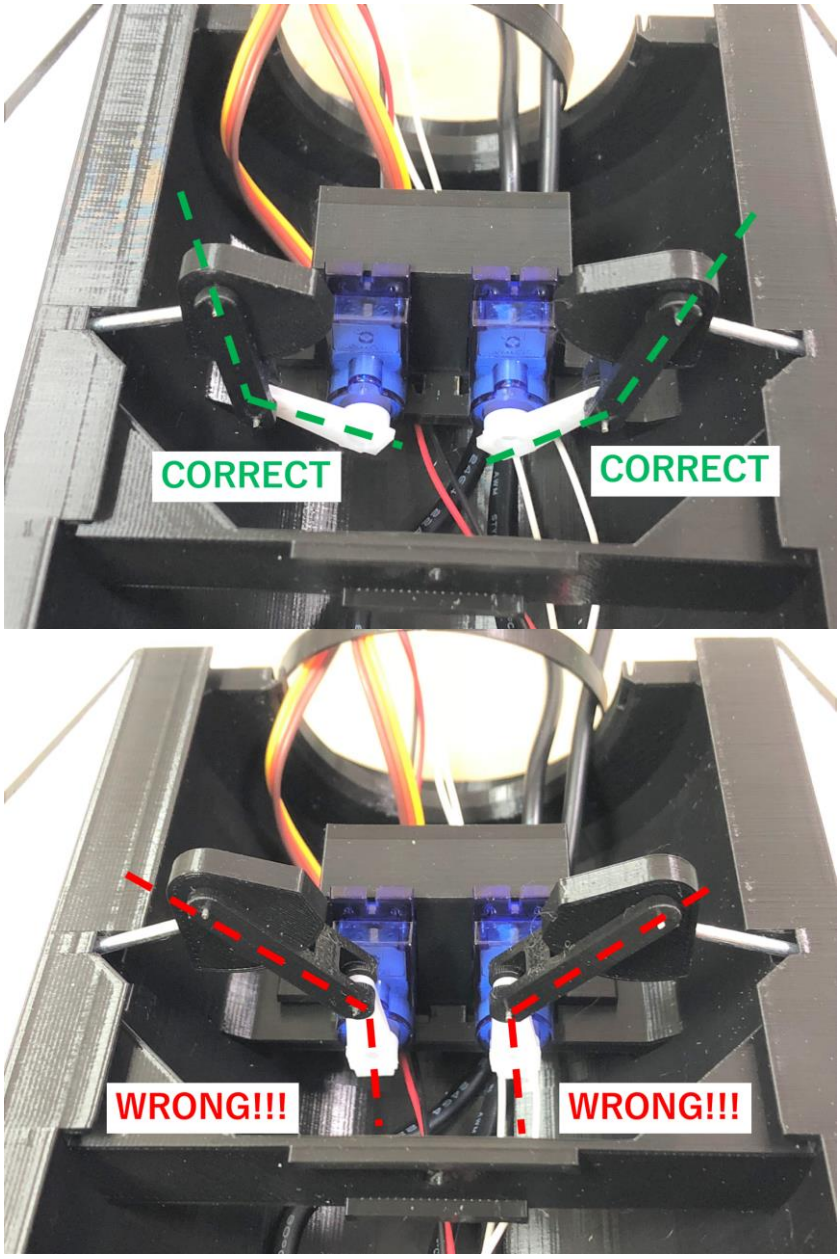
The purpose of this step is to place all servomotors at their default position before connecting the fin linkages. This is very important for the fins to move correctly.

7.10.5 Aft servos installation

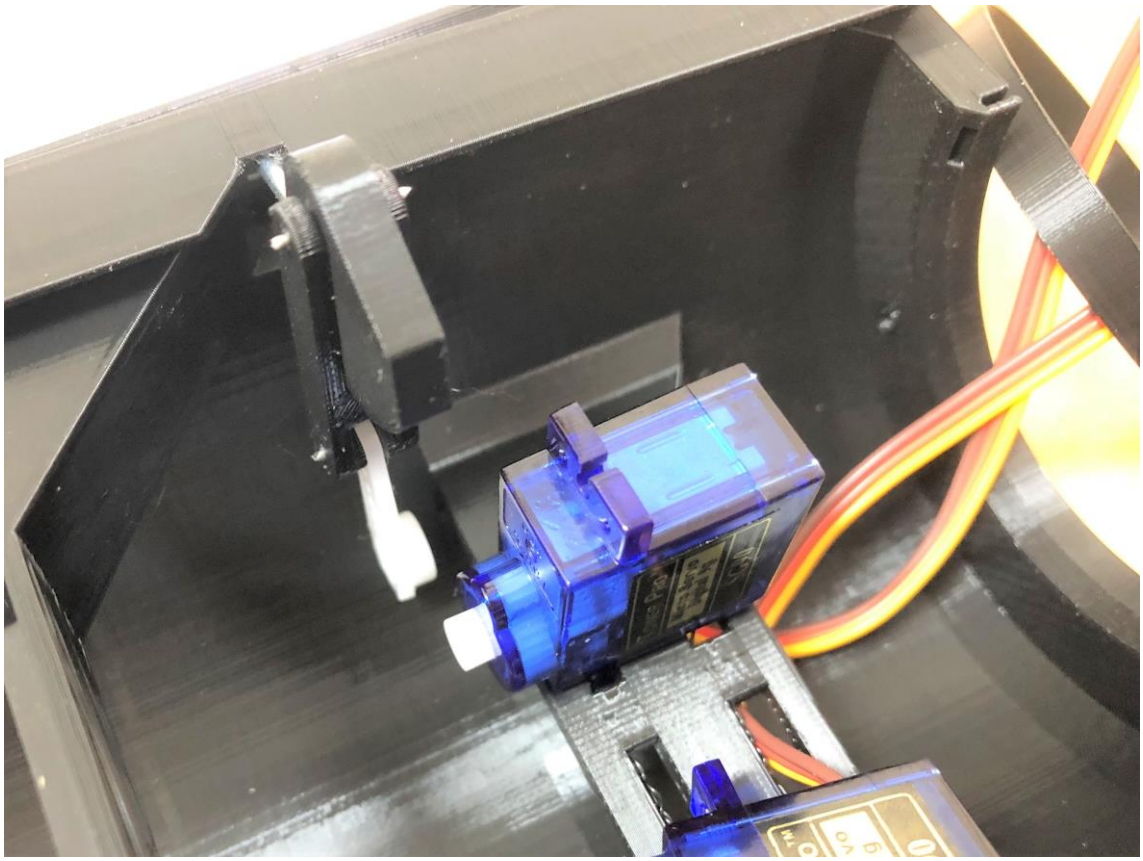
Before attaching the servomotors, read carefully the instructions below. This is critical for the fins to work properly.

On the first photo the servo horns are pointing towards the hull. **This is the correct way to assemble the mechanism.** On the second photo, the servo horns are pointing up, and the angle between the servo horn and the linkage (dashed line) does now follow the curvature of the hull. This assembly is wrong! If you setup the servomotors like this the fins will not move correctly.

Be sure to assemble the mechanism like in the first photo.

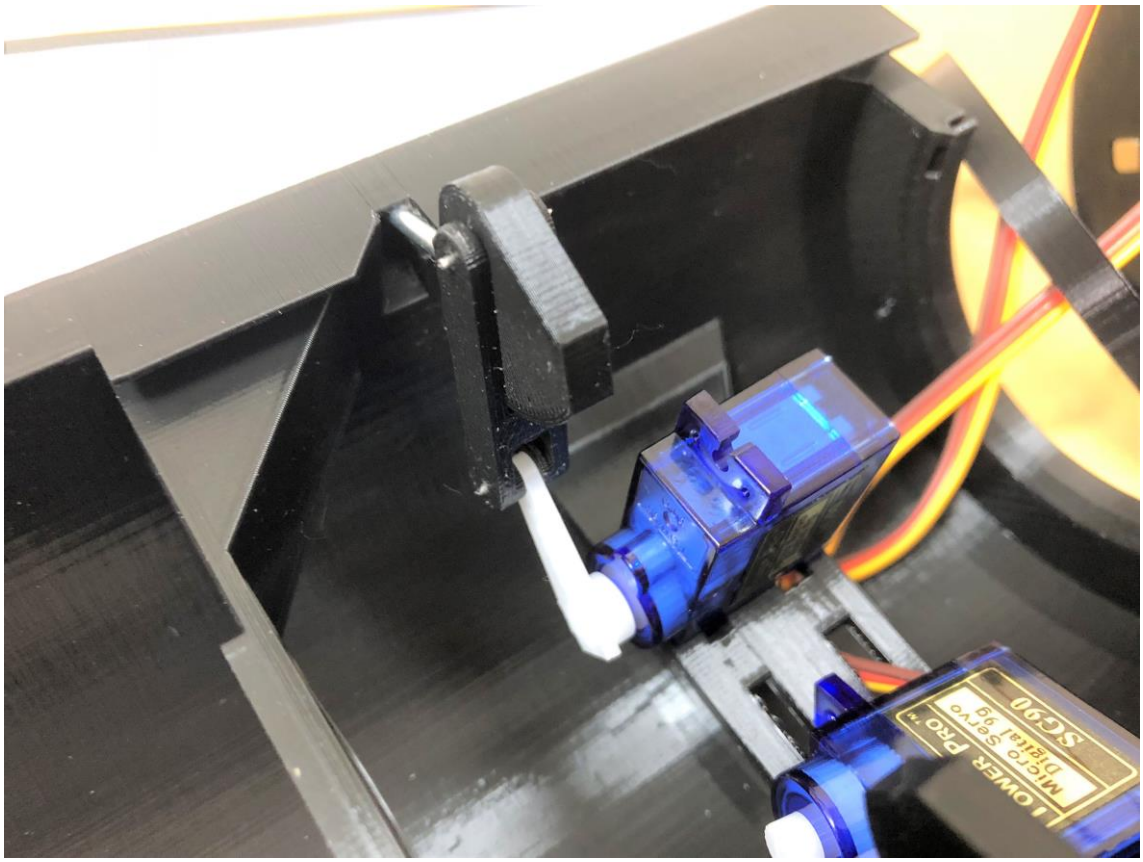


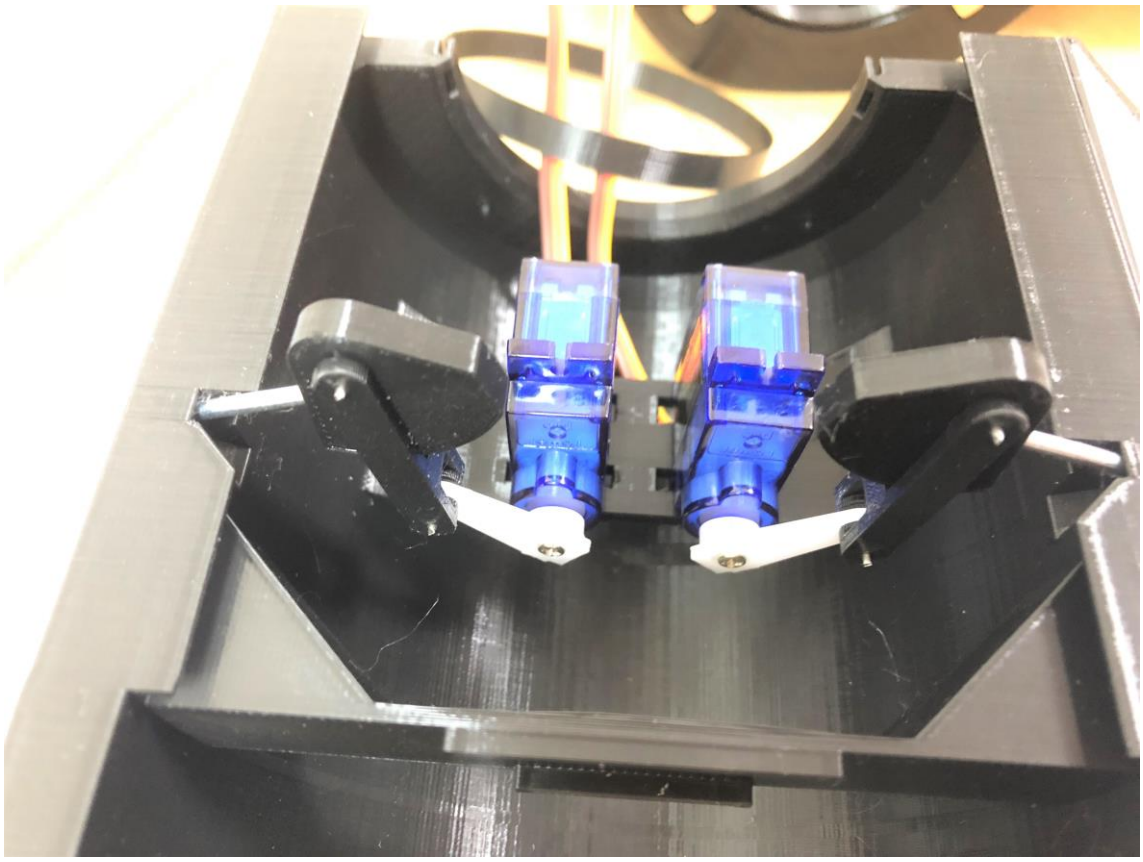
Take the aft hull segment. Push the left servomotor against the mount plate like in the photo below.



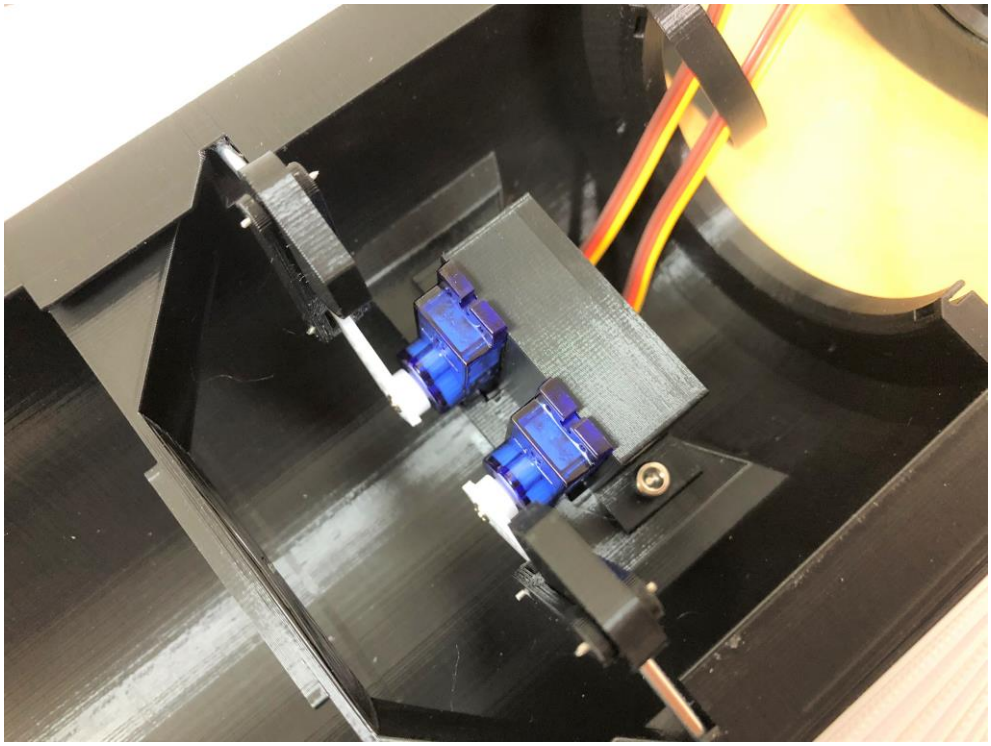
Place the left fin as horizontal as possible. While pushing the servomotor against the mount plate, connect the servo horn to the servomotor shaft WITHOUT ROTATING THE SERVO SHAFT. The servo horns and servo shafts are toothed, so you will probably not be able to have the fin perfectly horizontal. Do not worry, this can be adjusted later using Starship Control. Once you have pushed the servo horn onto the servo shaft, take one servo horn set bag. Take the smallest screw form the bag and screw it on top of the servomotor shaft. It is Ok if the servo shaft moves a little bit when you tighten the screw, as long as the servo horn stays toothed with the servo shaft during the process.

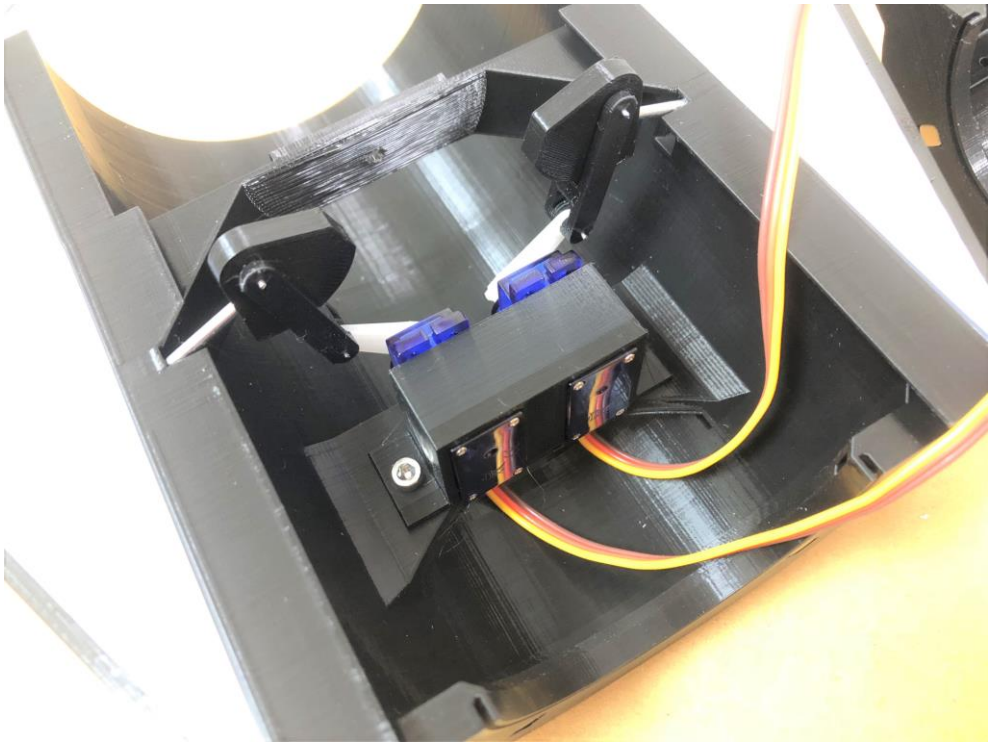
Do the same for the right fin.





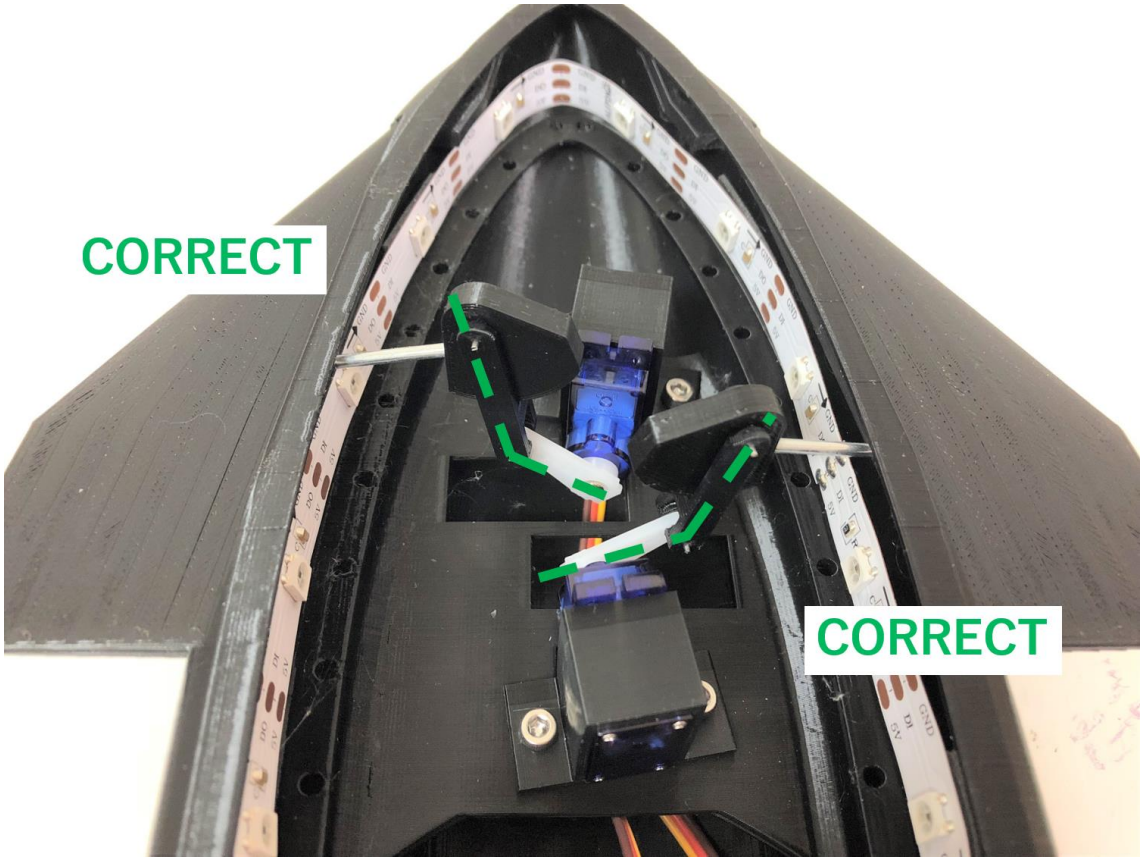
Take the aft servo bracket and place it above the two servos. Use two M3 screws to attach the servo bracket to the hull. Tighten the screws enough so that the servomotors cannot move, but do not overtighten them either.



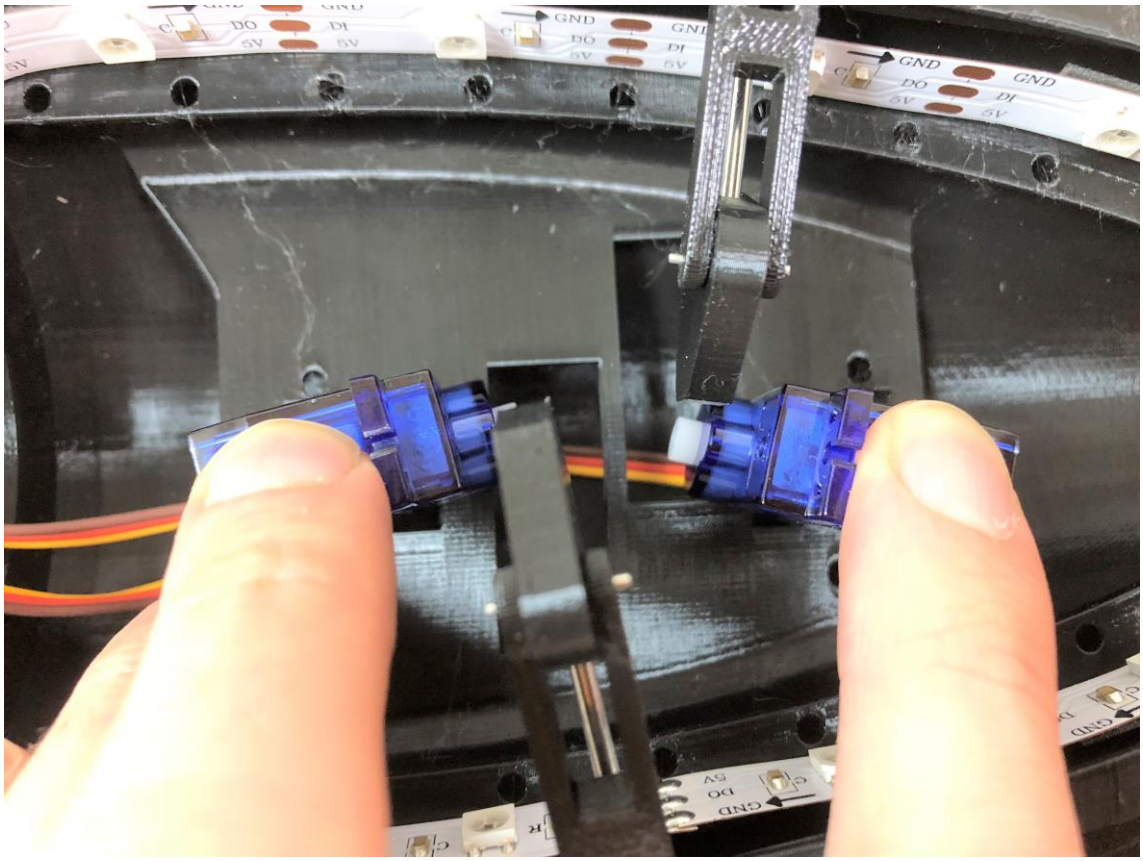


7.10.6 Fore servos installation

Like for the aft servos, watch carefully the photo below showing the correct way to setup the servomotors and linkages. The servo horns must be pointing towards the hull, not up.

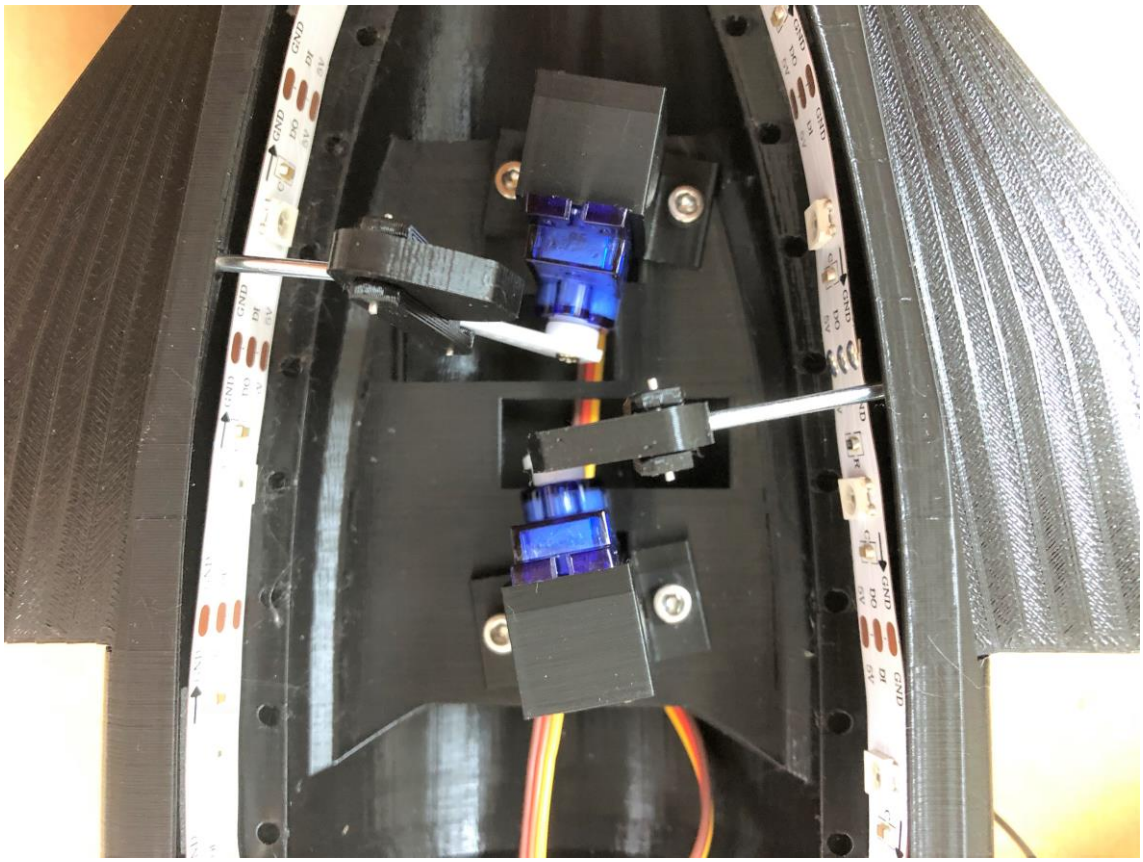


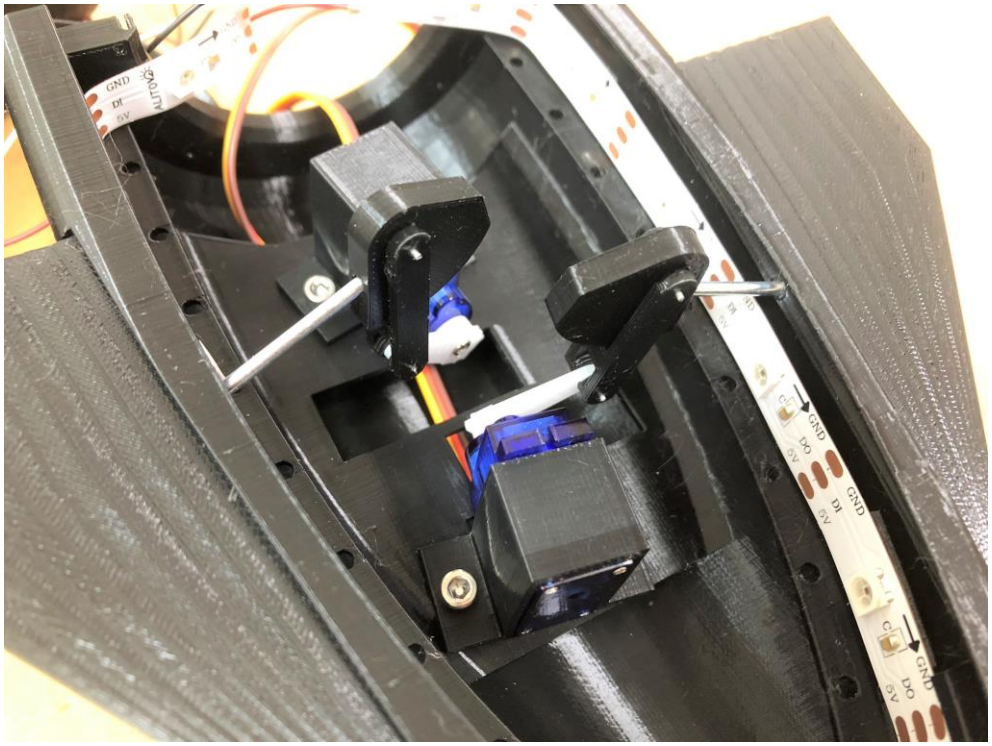
Take the fore hull segment. Push the left servomotor against the mount plate as in the photo below.

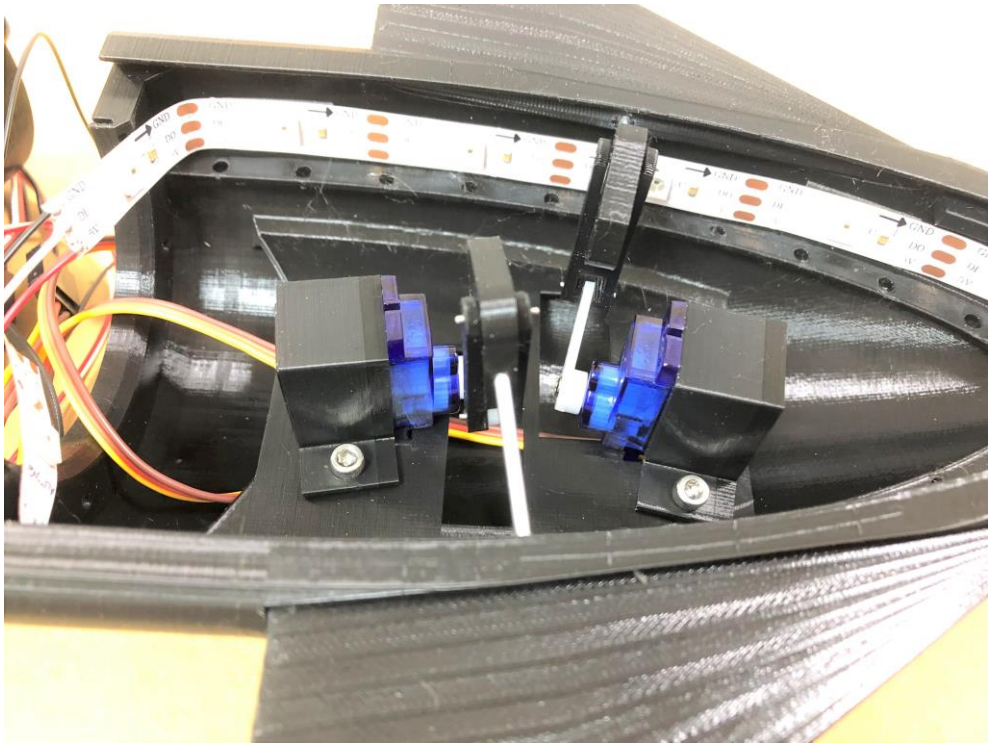


Place the left fin has horizontal as possible. While maintaining the servomotor against the mount plate, connect the servo horn to the servomotor shaft, WITHOUT ROTATING THE SERVO SHAFT. Once you have pushed the servo horn onto the servo shaft, take one servo horn set bag. Take the smallest screw form the bag and screw it on top of the servomotor shaft. It is Ok if the shaft rotates when tightening the screw if the servo horn stays firmly attached to the shaft during the process.

Take the fore servo brackets and place them above the servos. Use four M3 screws to attach the servo brackets to the hull. Tighten the screws enough so that the servomotors cannot move, but do not overtighten them either.




GND
DI
5V
GND
DO
5V
GND
DI
5V
GND
DO
5V

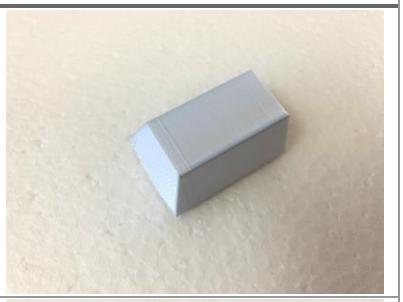
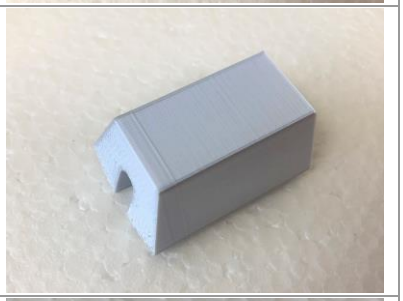


7.11 Lights connection and check

7.11.1 Parts & tools preparation

In the future, a wireless upgrade might be available for Starship. For this reason, the kit includes a third cargo container with no cable notch. For the moment, keep the extra cargo container in a safe place.

Prepare the following parts

Part	Number of parts	Photo
Cargo container	2	
Cargo container with cable notch	1	
M3 screw	1	
Arduino LED cover	2	

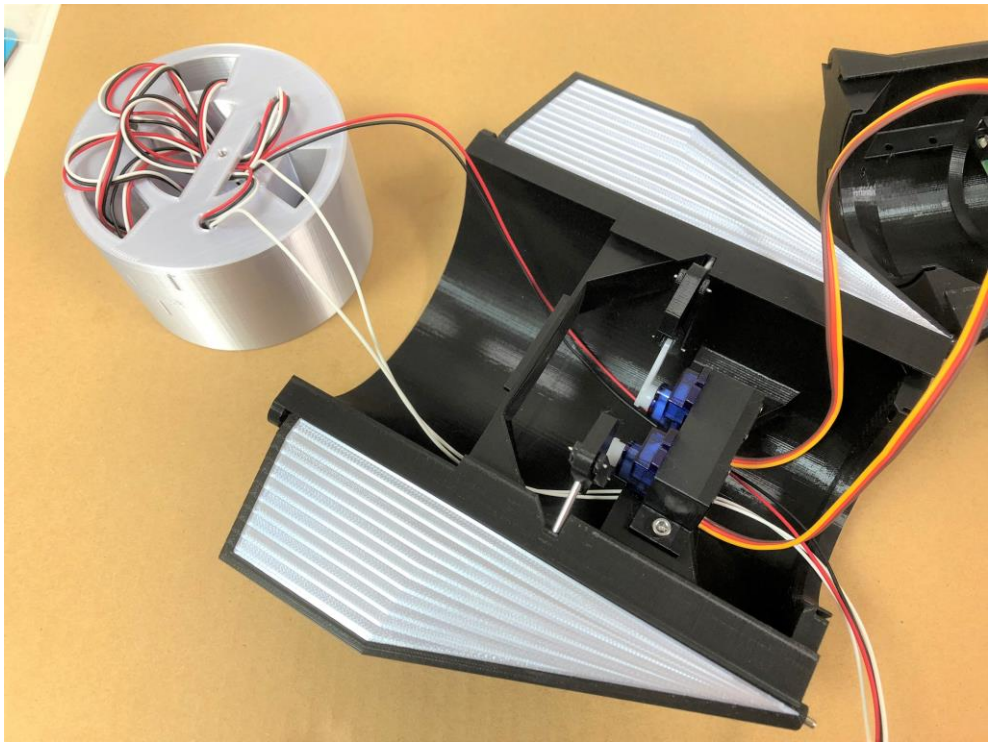
5V power adapter	1	
USB cable	1	

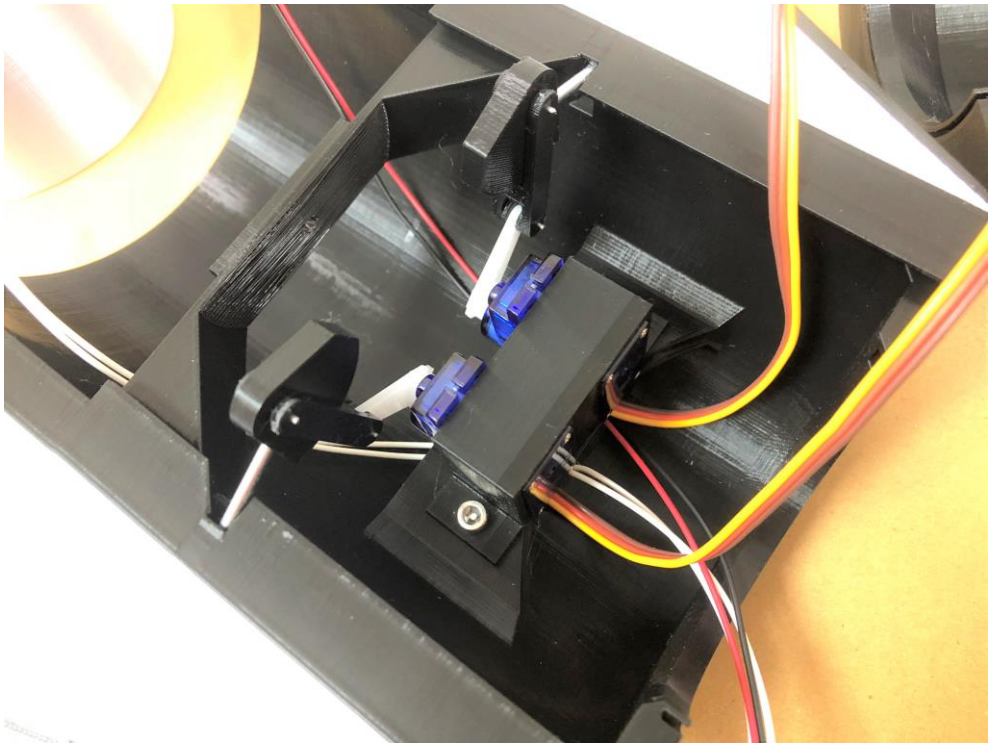
Prepare the following tools

Part	Photo
Hex key	

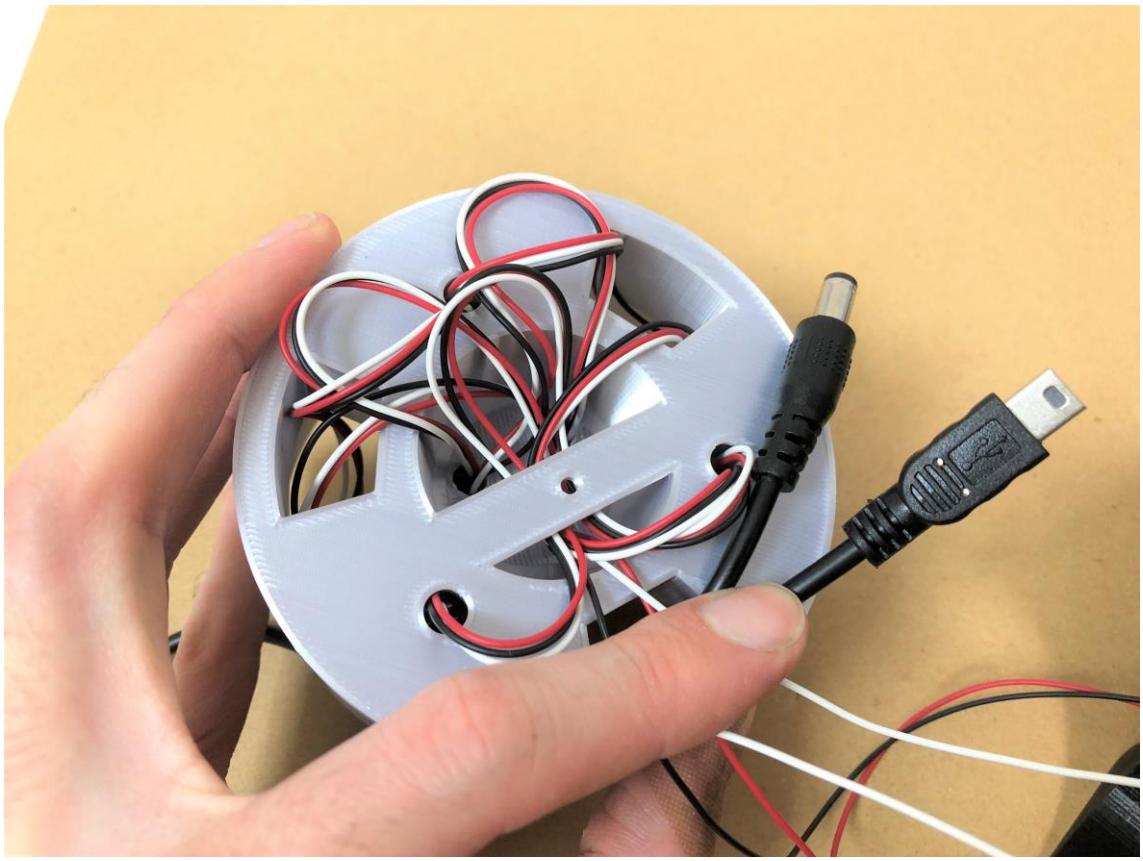
7.11.2 Engine pod installation

Take the engine pod. Place it close to the fore hull segment, then draw the cable from the engine pod close to the hull underneath the servomotor like in the photo below.

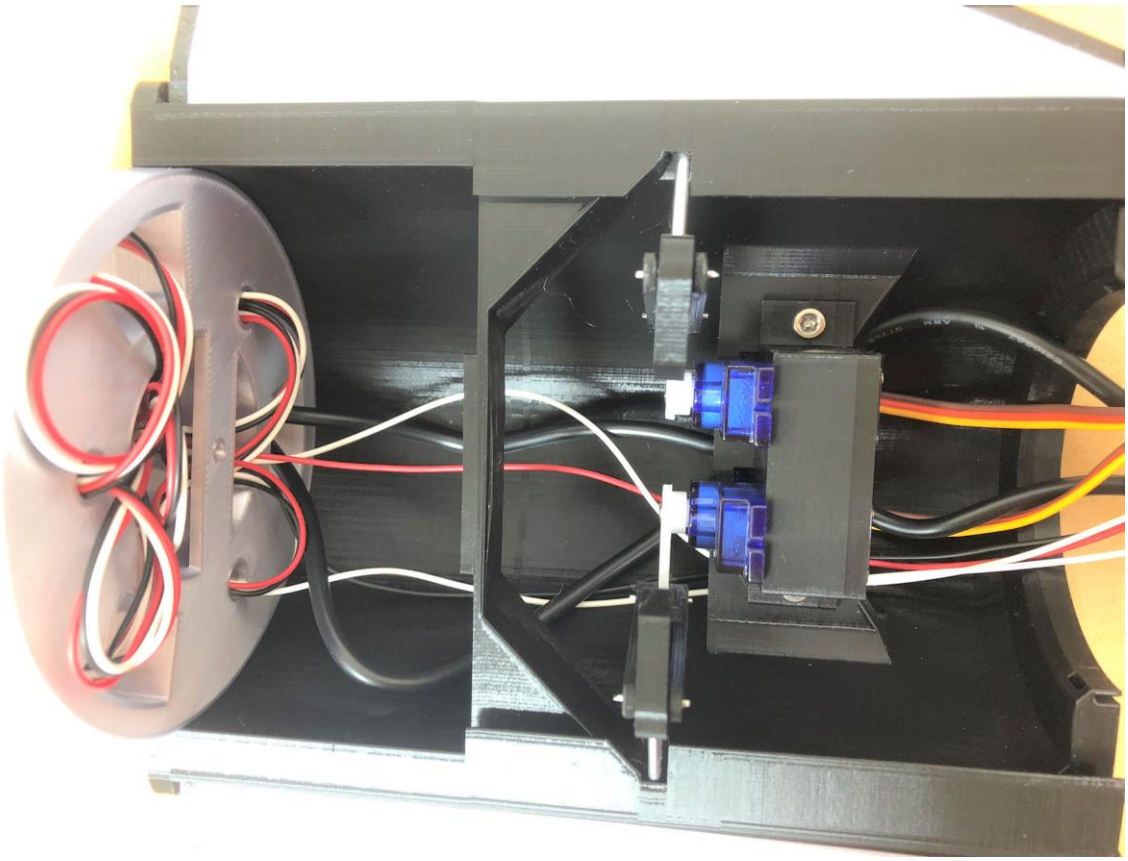




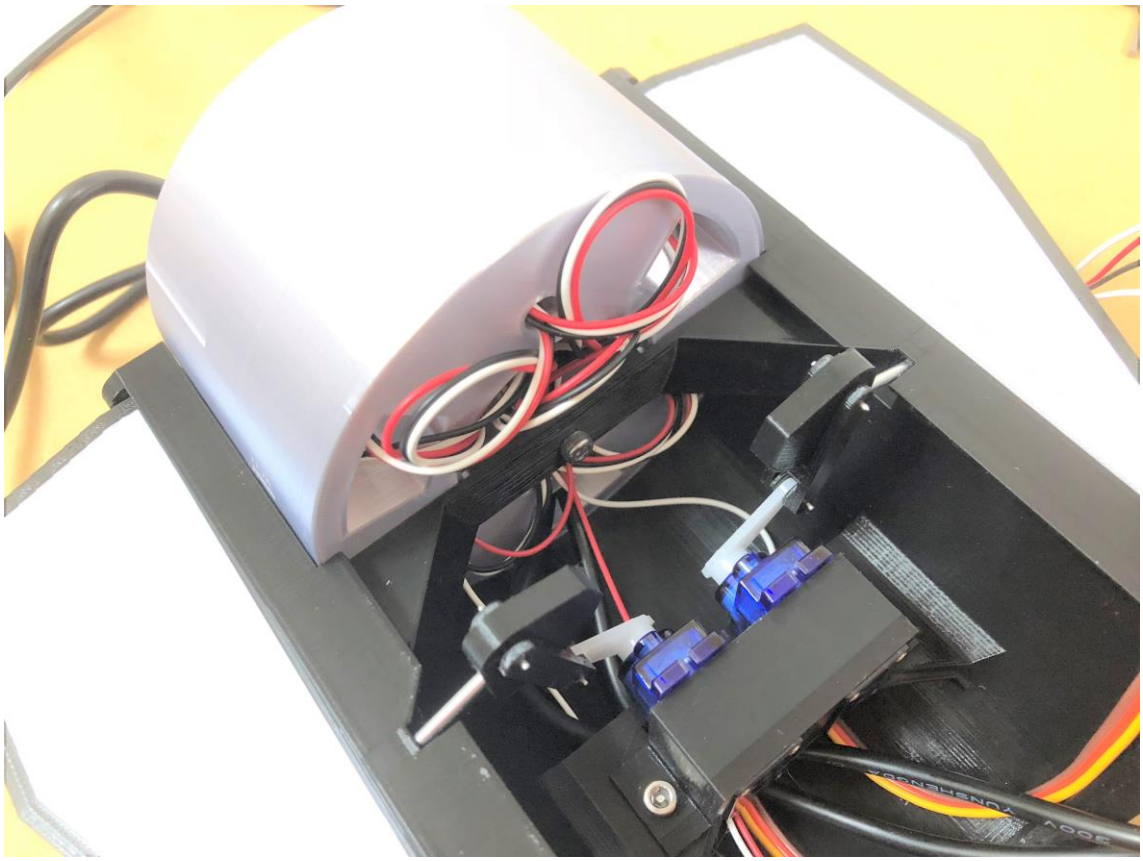
Take the cable from the DC adapter and the USB cable. Draw both cables through the bottom cargo container hole of the engine pod. Make sure to use the correct hole.



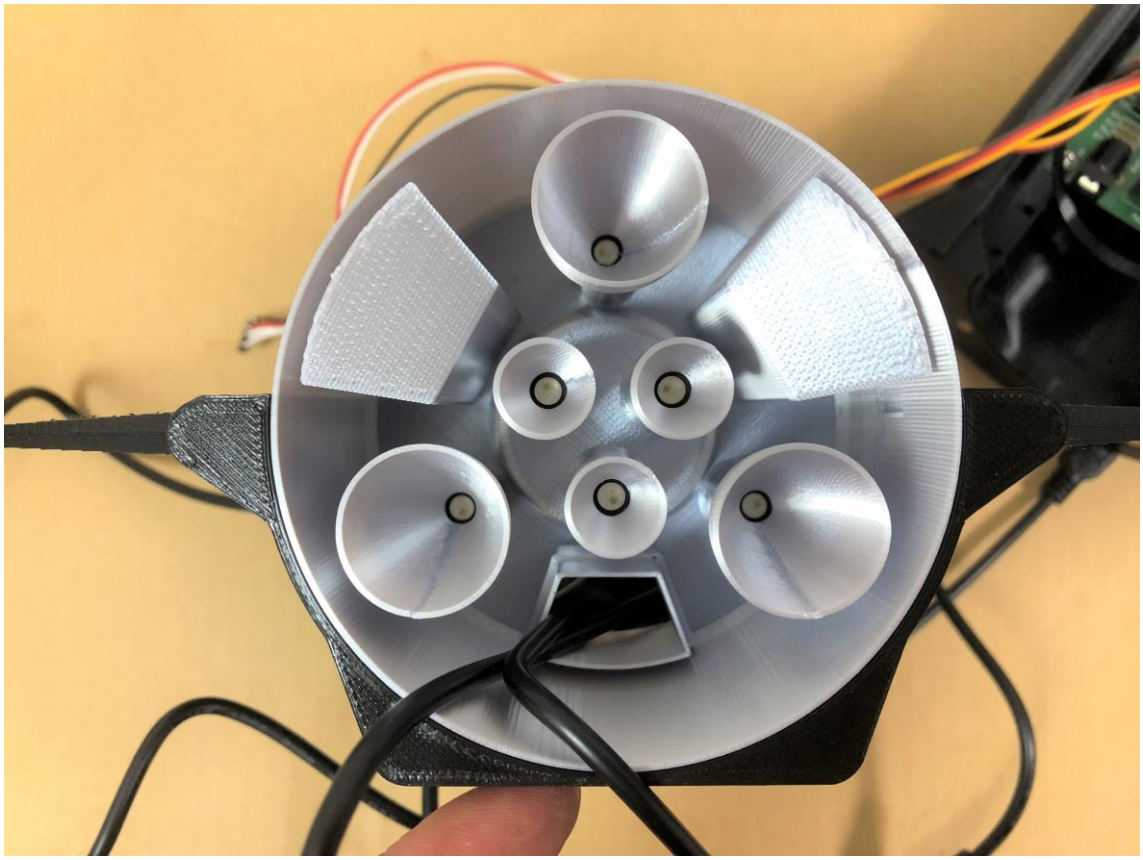
Draw the two cables next to the other cables underneath the servomotors. Make sure that the cables do not interfere with the fin mechanisms.



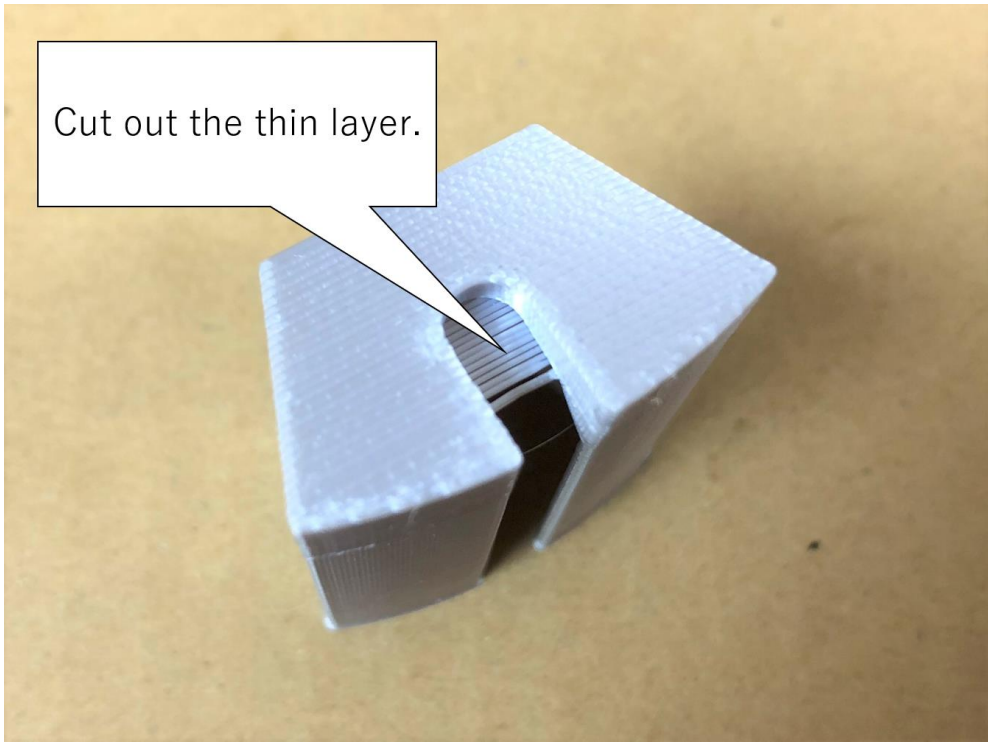
Secure the engine pod to the hull using an M3 screw. Be careful not to have any wire pinched between the plastic parts!

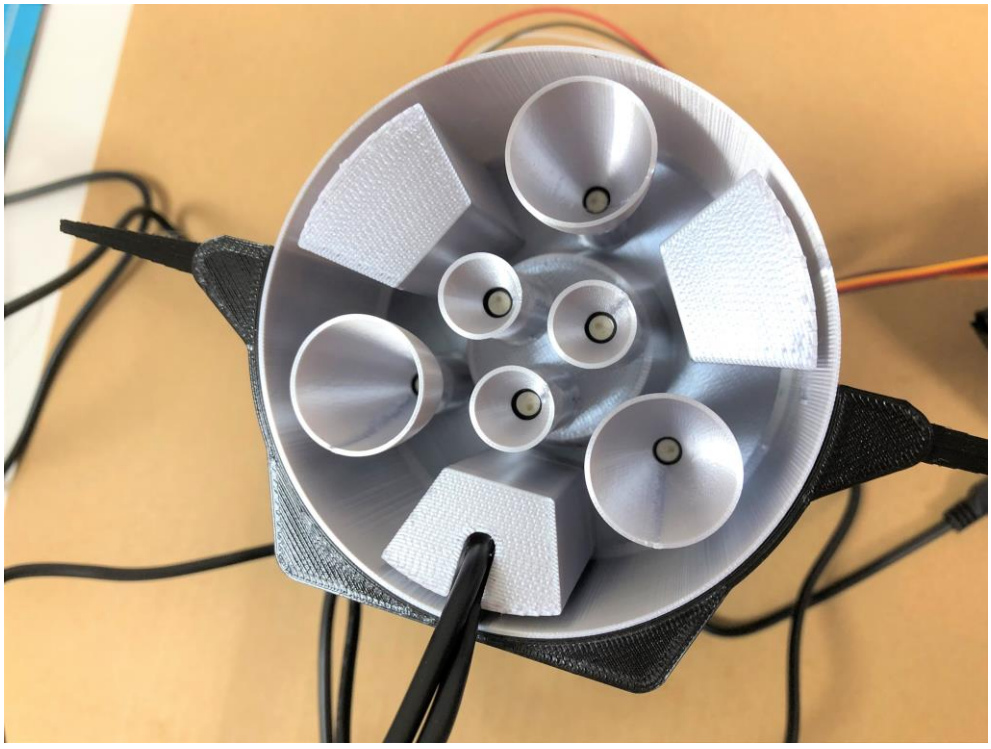


Take the two cargo containers (without notch) and attach them to the engine pod.



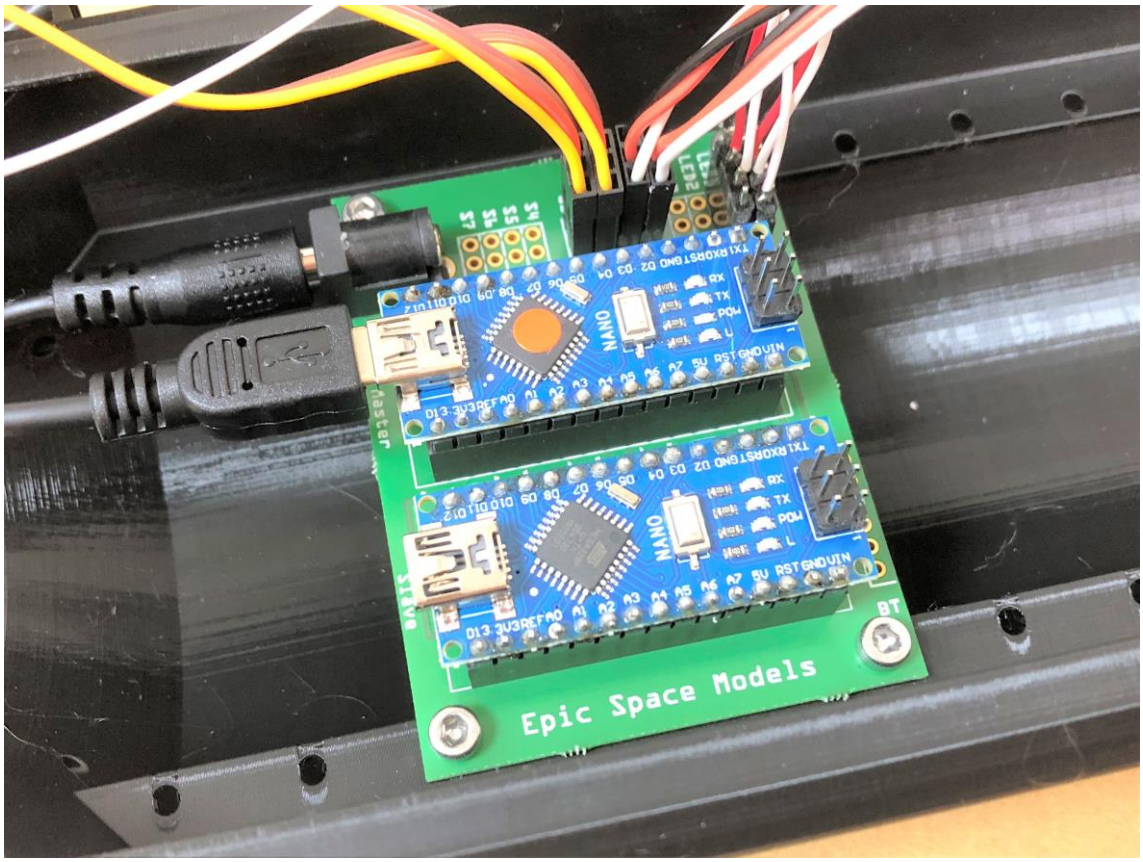
Take the cargo container with the notch. Using a sharp knife, cut the thin layer that blocks the notch. Insert the part at the back of the engine pod.





Draw all the wires form the aft segment trough the seal (the servo cables should already be going through). Connect the cable from the engine pod (4 wires) to the LED0 slot. The black wire must be closest to the board edge. Connect the cable from the DC adapter to the power plug. Connect the USB cable to the master Arduino (the one with the dot).

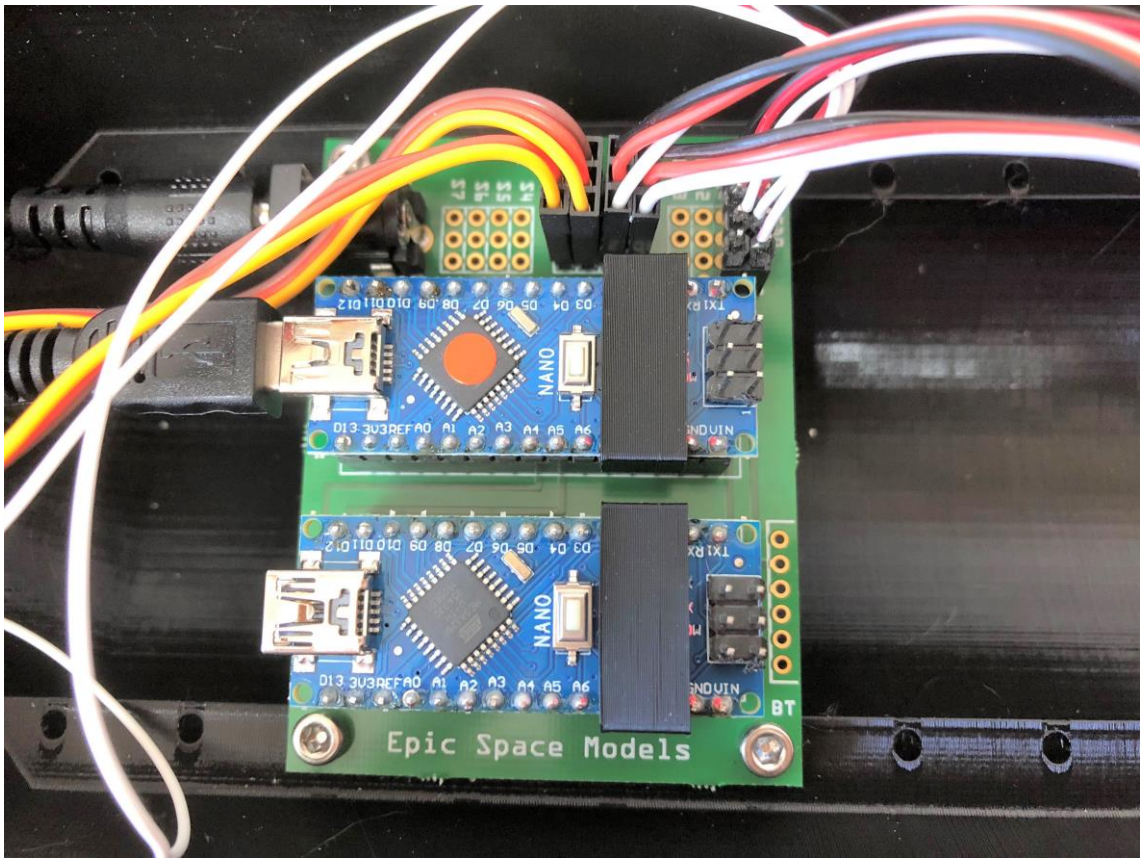
Take the cable from the LED strip. Make sure that it goes through the seal along with the cables from the two fore servos. Connect the cable to the LED1 slot. The black wire must be closest to the board edge.



7.11.3 Arduino covers

Place the led covers on top of the Arduinos like in the photo below. They role is to prevent the lights of the red LEDs from leaking trough the hull (the silver plastic is not opaque enough to block the light).

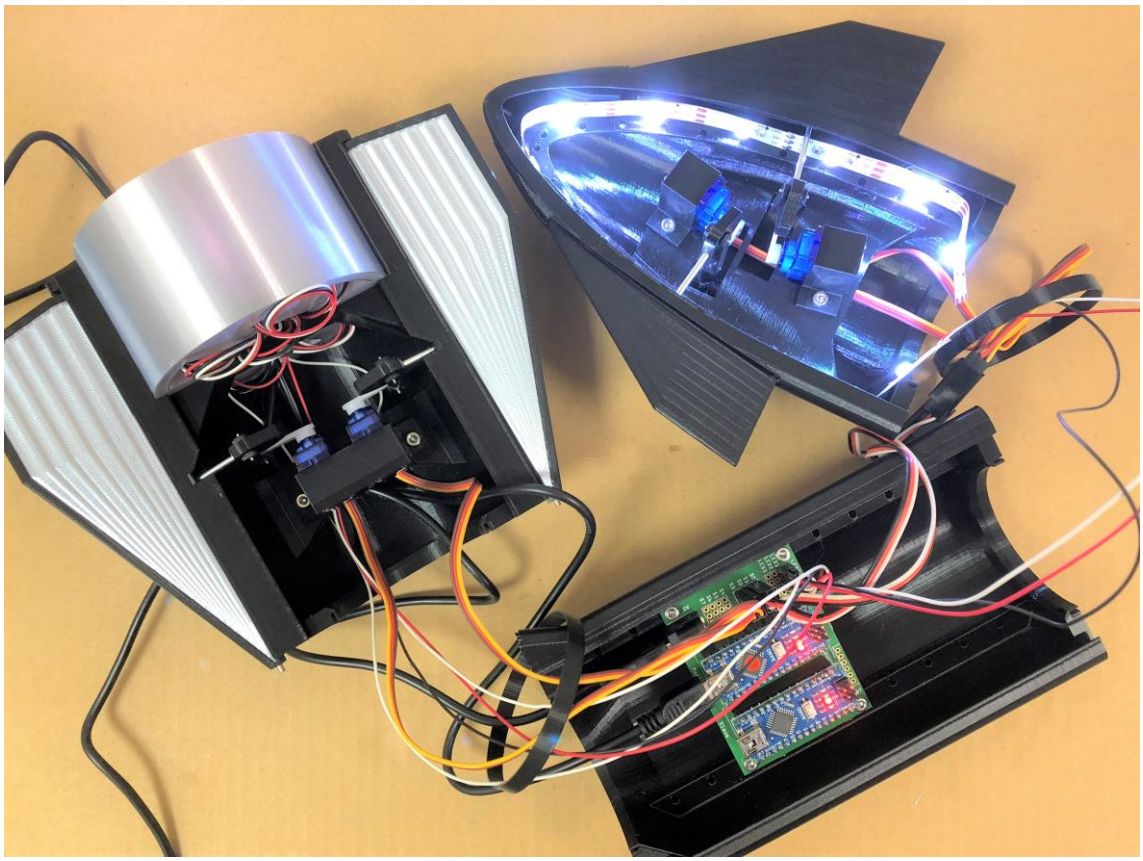
In the following steps the photos might show the control board without the LED covers, but should leave the covers in place from now.



7.11.4 Check

Connect the DC adapter. Check that all the lights (engines and LED strip) light up. After 10 seconds the servomotors should start moving. They will move continuously for 2 min, then stop. Once they stop, unplug the DC adapter.

Almost there!

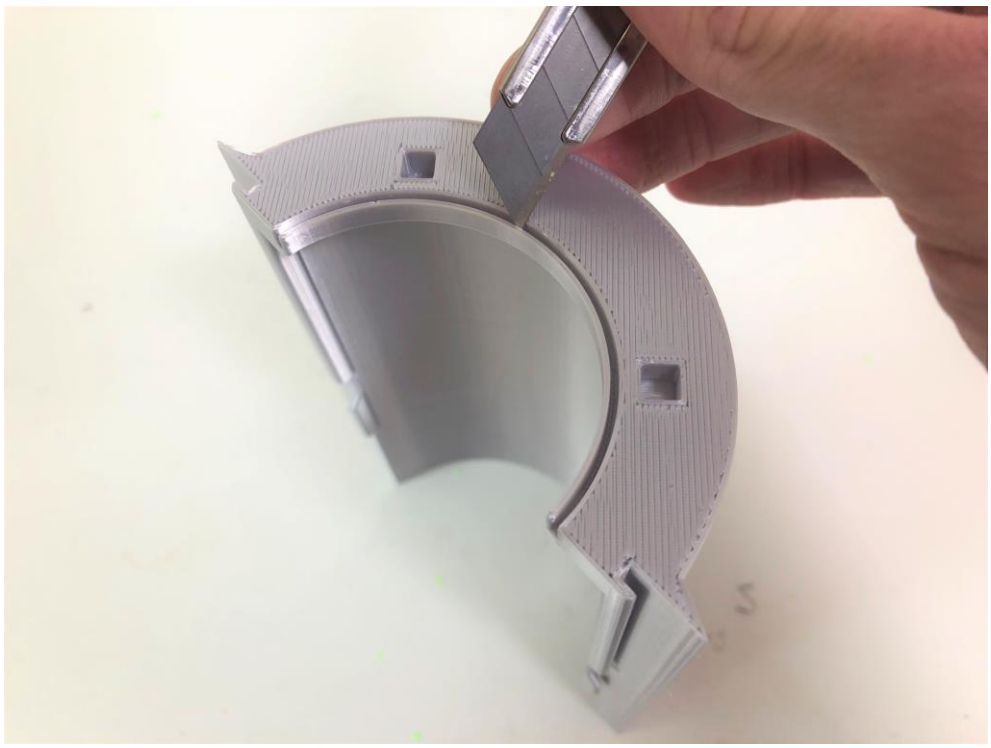


7.12 Hull closing

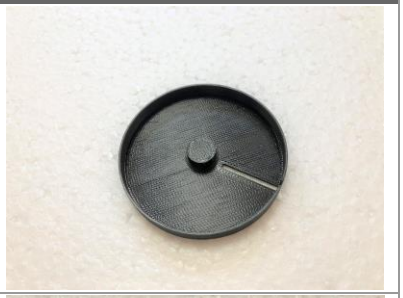
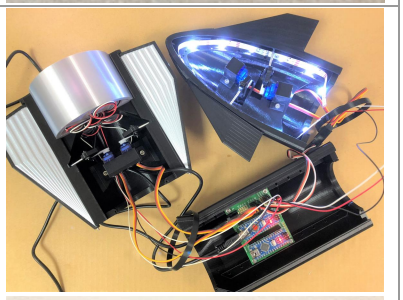
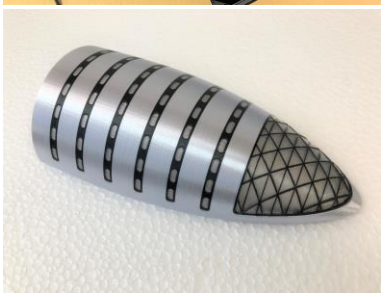
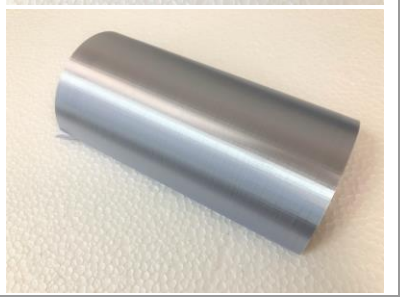
7.12.1 Parts & tool preparation

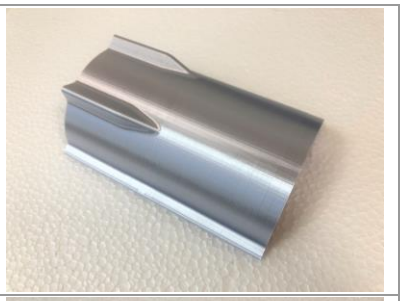
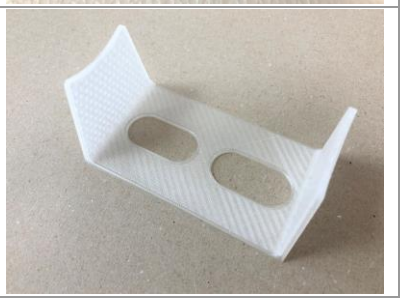
If the segment keys are too thick and do not fit in the segment slots, use sandpaper to make them a little thinner.

If you have difficulties inserting the seals into the slots, use a sharp knife to chamfer the entrance of the slots. A 0.5mm chamfer on the outer perimeter of the slot is enough.



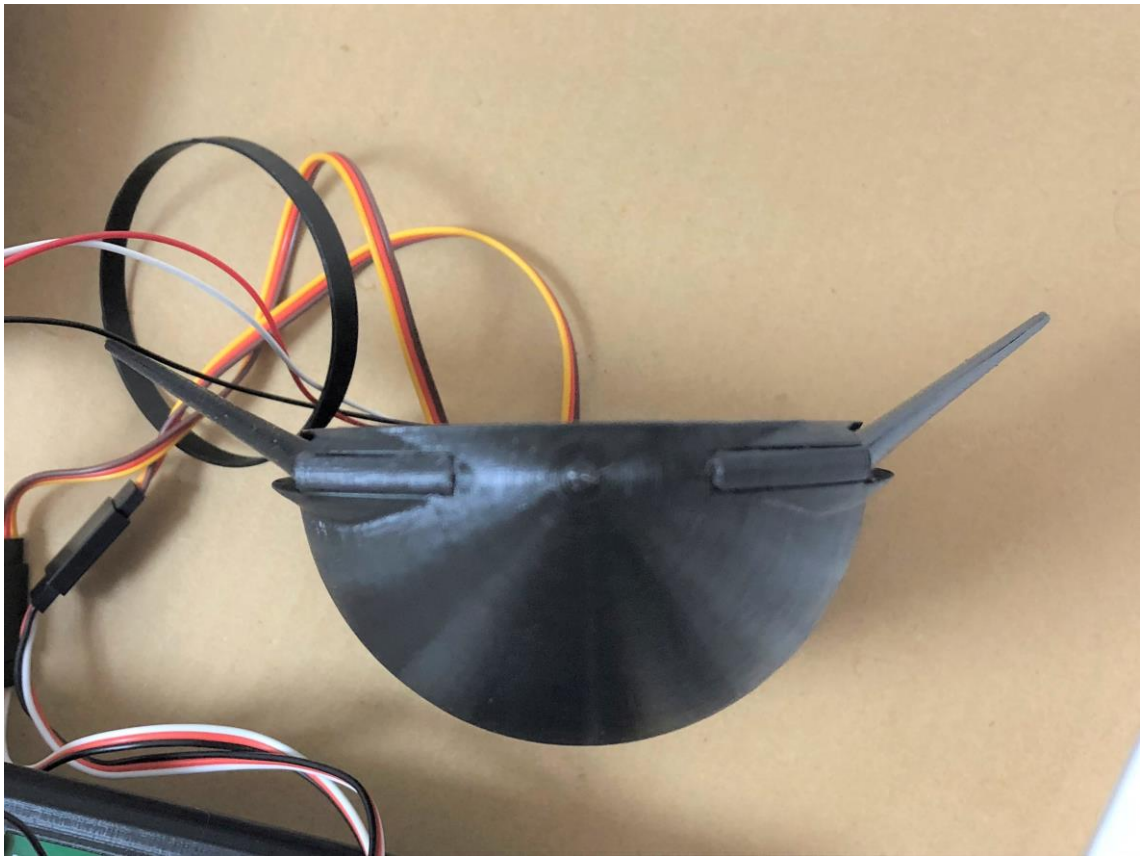
Prepare the following parts

Part	Number of parts	Photo
Circular shade	1	
Segment key	6	
All hull segments	6	  

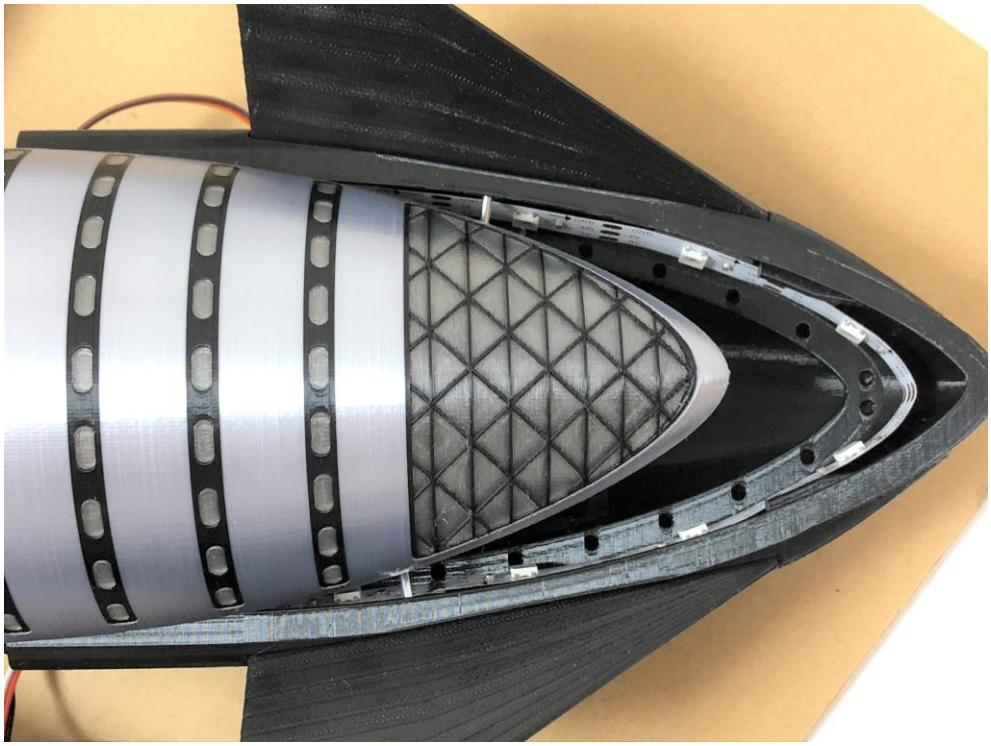
		
Horizontal stand	1	

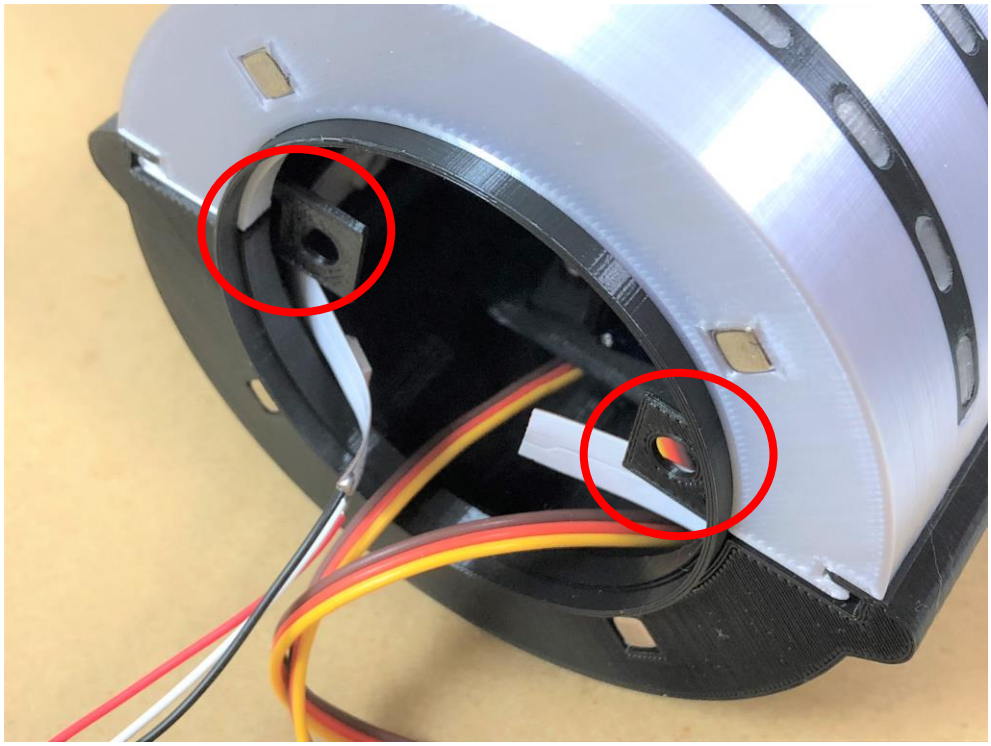
7.12.2 Fore segment closing

Take the bottom half of the fore hull segment. Gently rotate the servo horns so that the fins are bent upward.



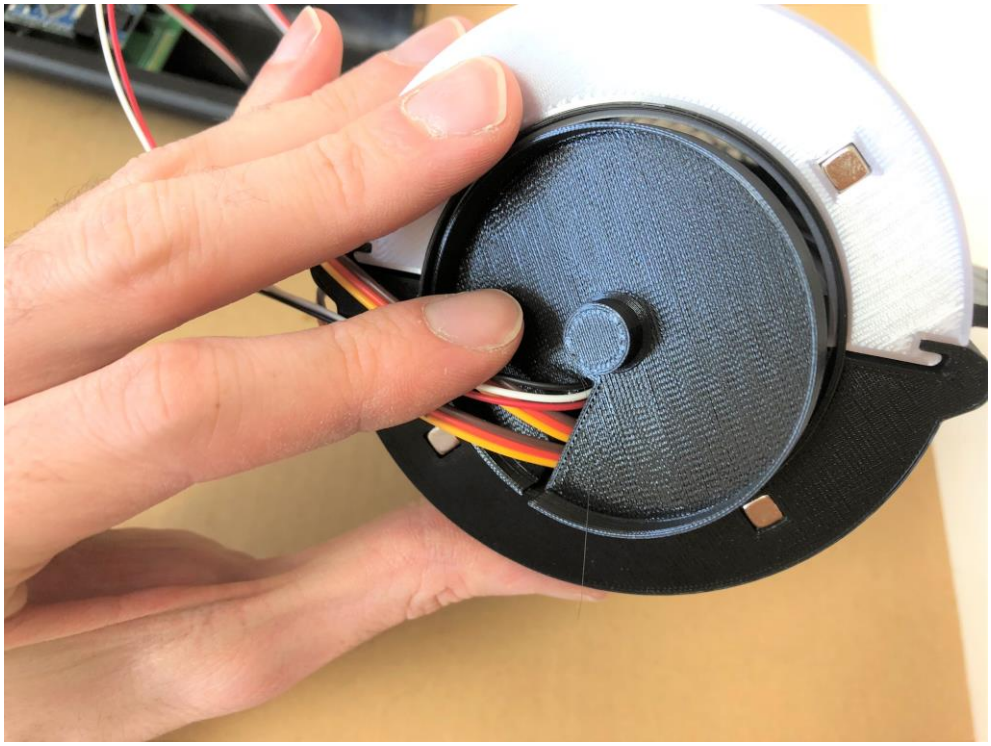
Take the upper half of the hull, and carefully slide it from the back. Once it is in place, make sure that the two halves are aligned, then insert two segment keys at the base of the segment. Insert the seal at the back of the segment.

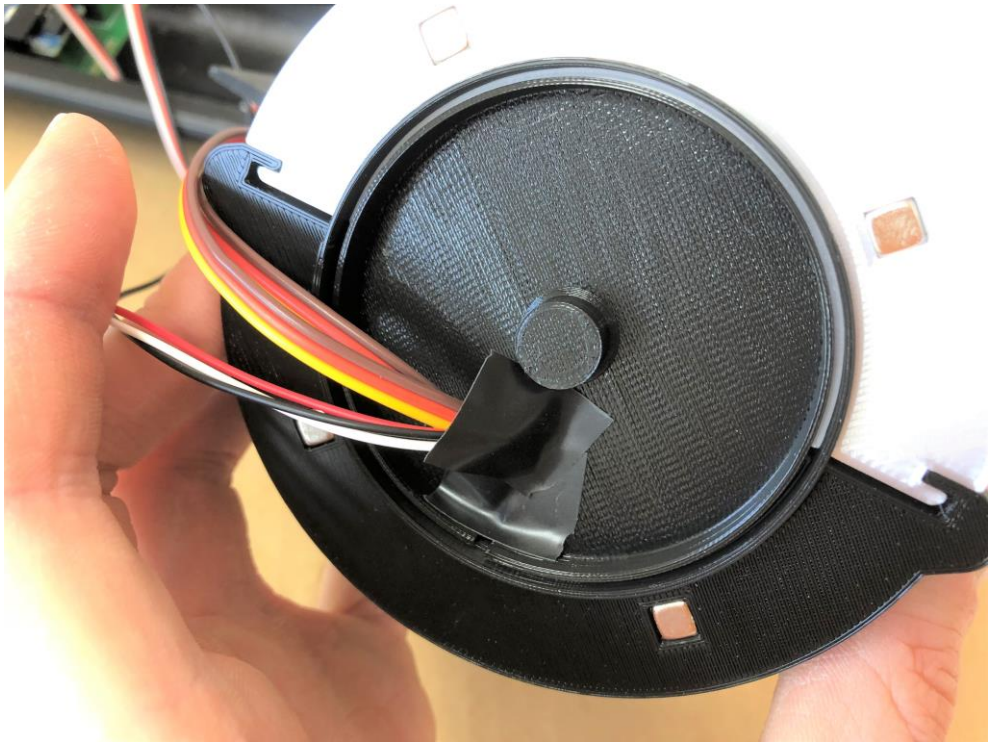




Take the circular shade. Insert the cables in the slit like in the photo below. Insert the shade into the fore segment. Use vinyl tape to close any remaining opening in the shade.

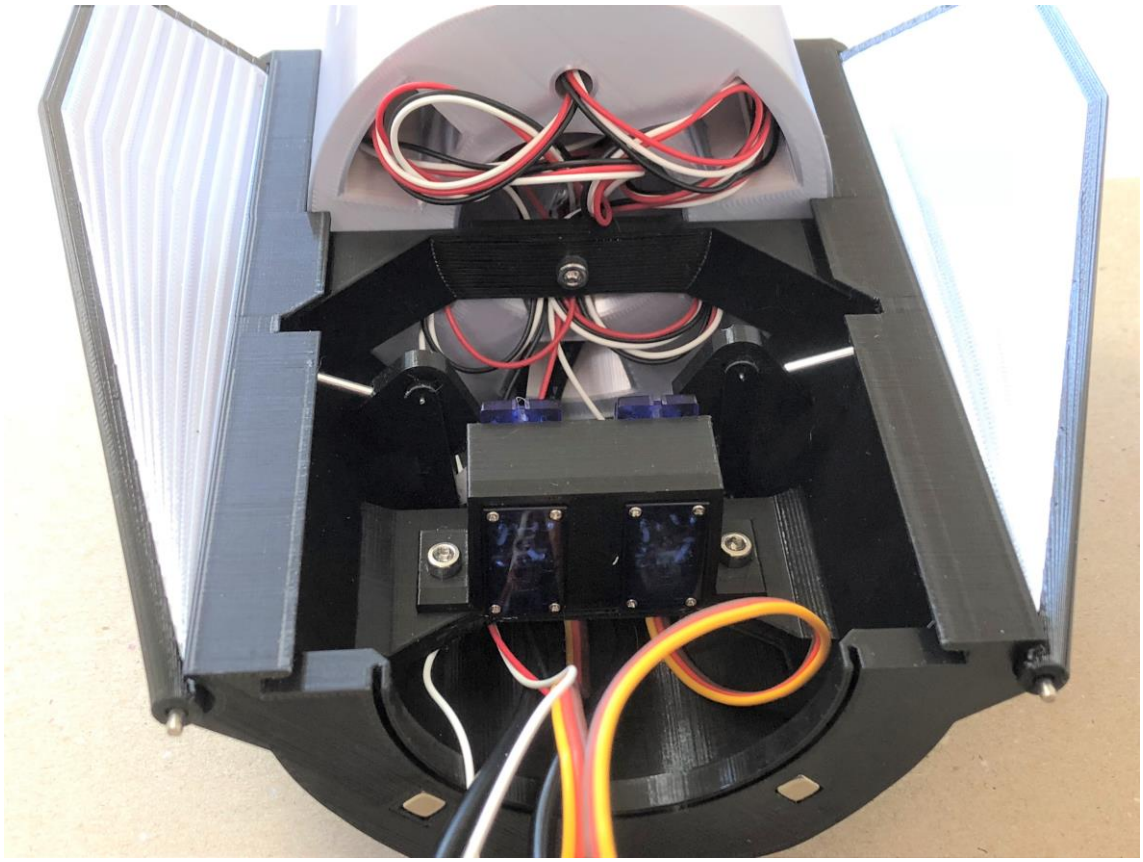
The shade might be loose, be once the segments are mated it will stay in place.

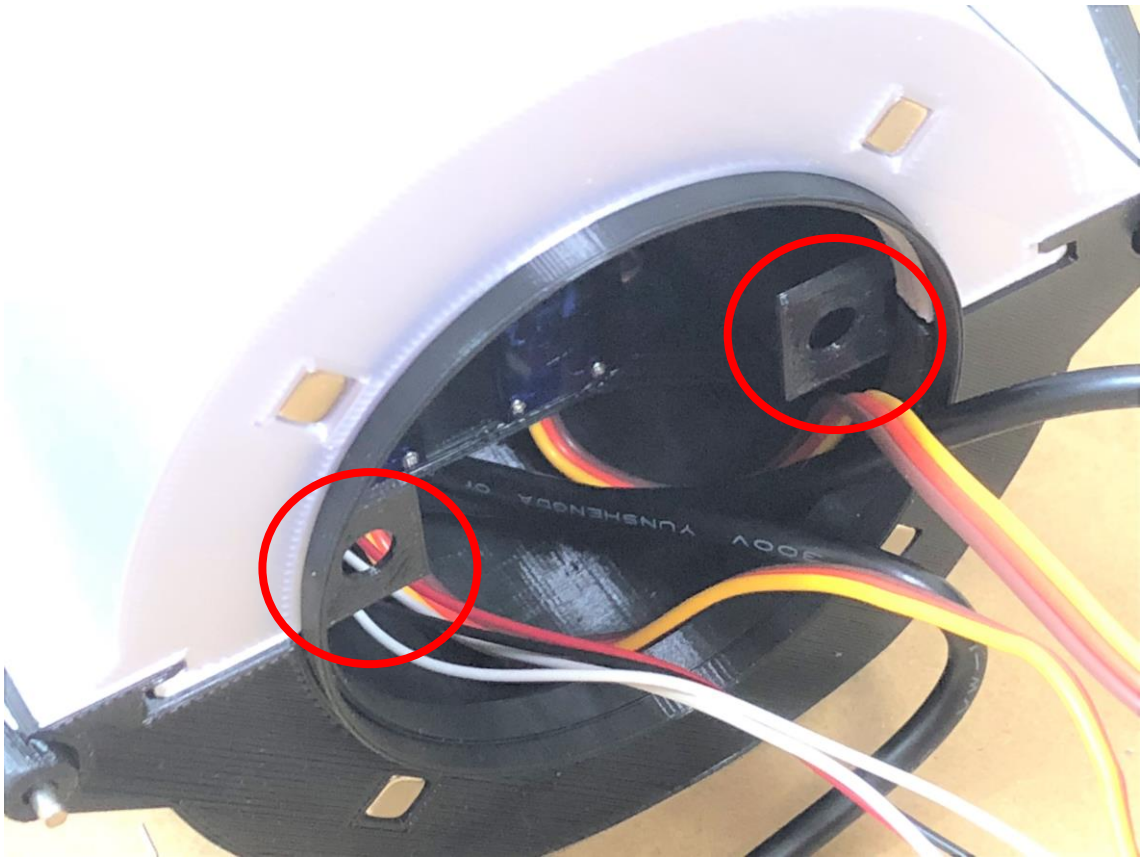




7.12.3 Aft segment closing

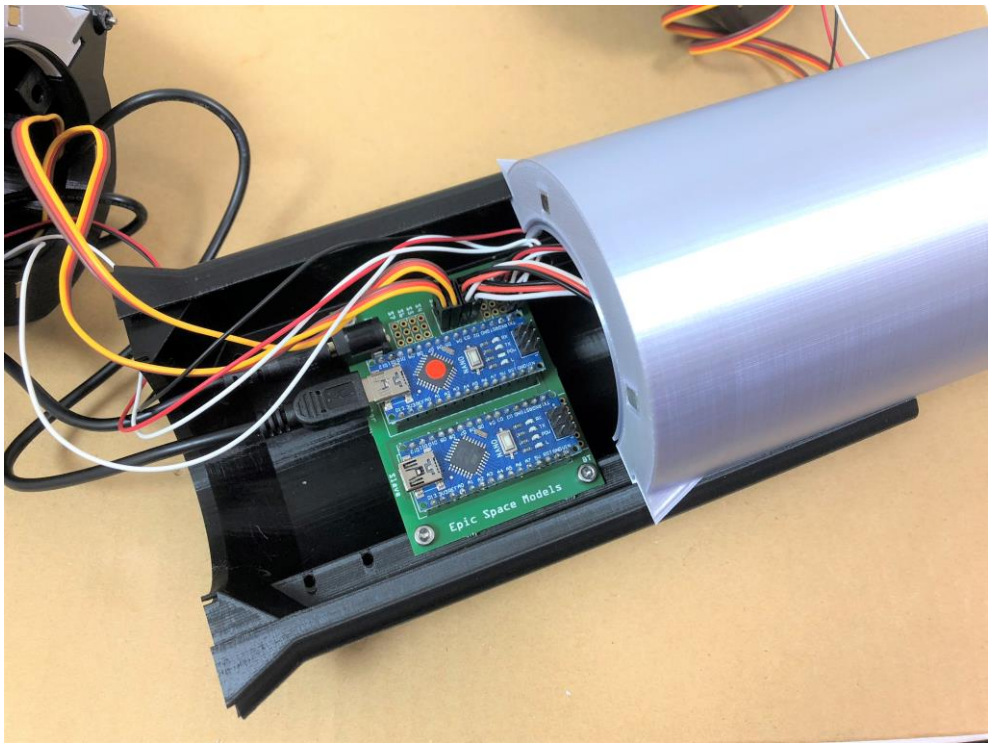
Take the bottom half of the aft hull segment. Gently rotate the servo horns so that the fins are bent upward. Take the upper half of the hull, and carefully slide it from the front. Once it is in place, make sure that the two halves are aligned, then insert two segment keys at the front end of the segment. Insert the seal at the front of the segment.

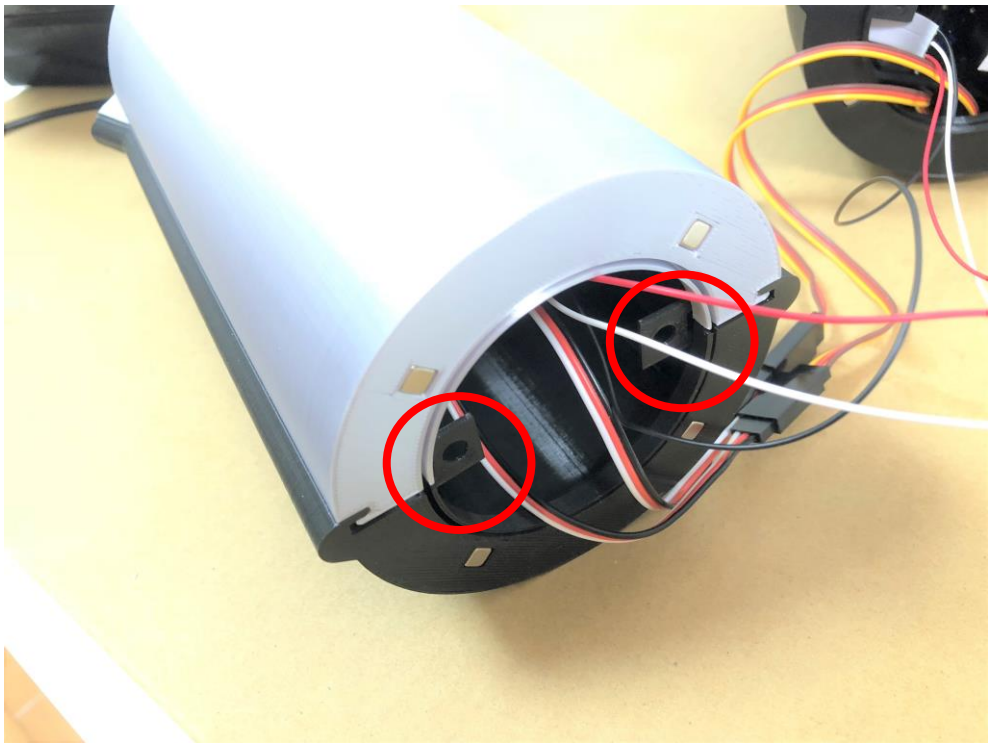




7.12.4 Central segment closing

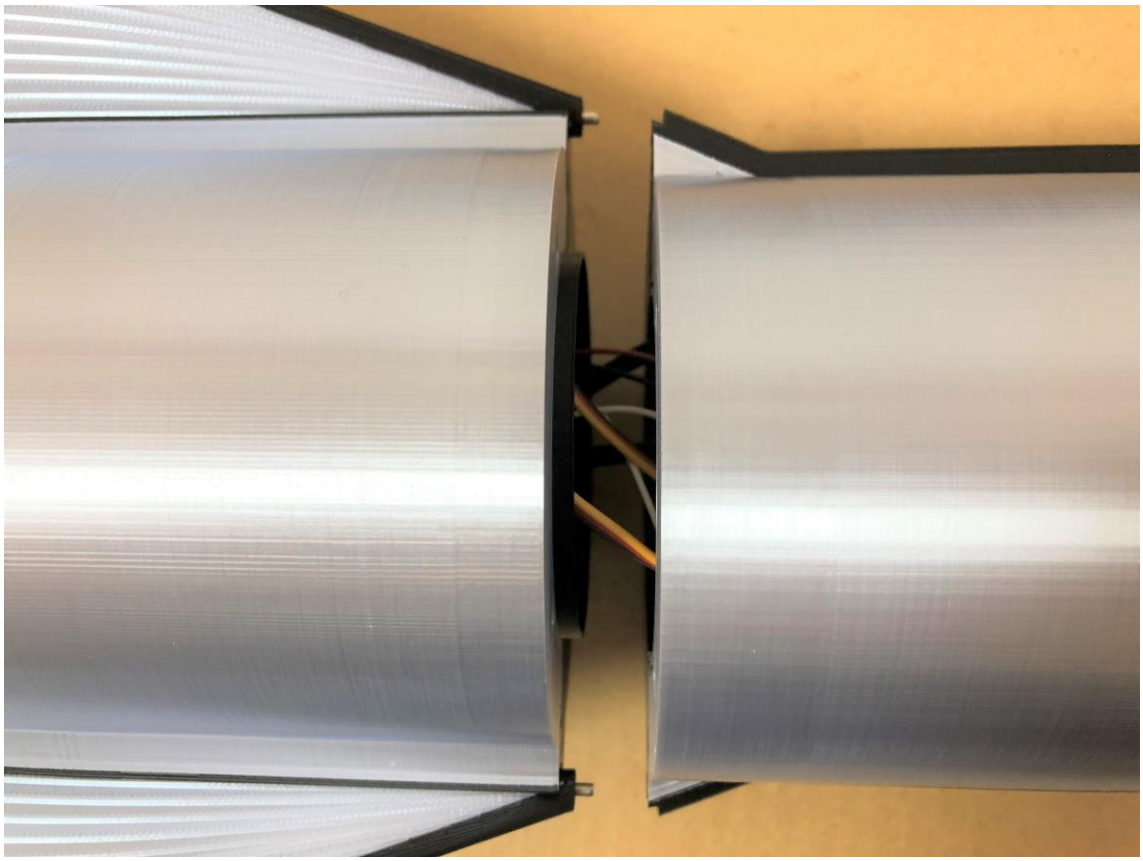
Take the bottom half of the central hull segment. Slide the top half on top of the bottom half, then secure it by inserting two keys at the front. Be careful not to have wires pinched between the two halves!



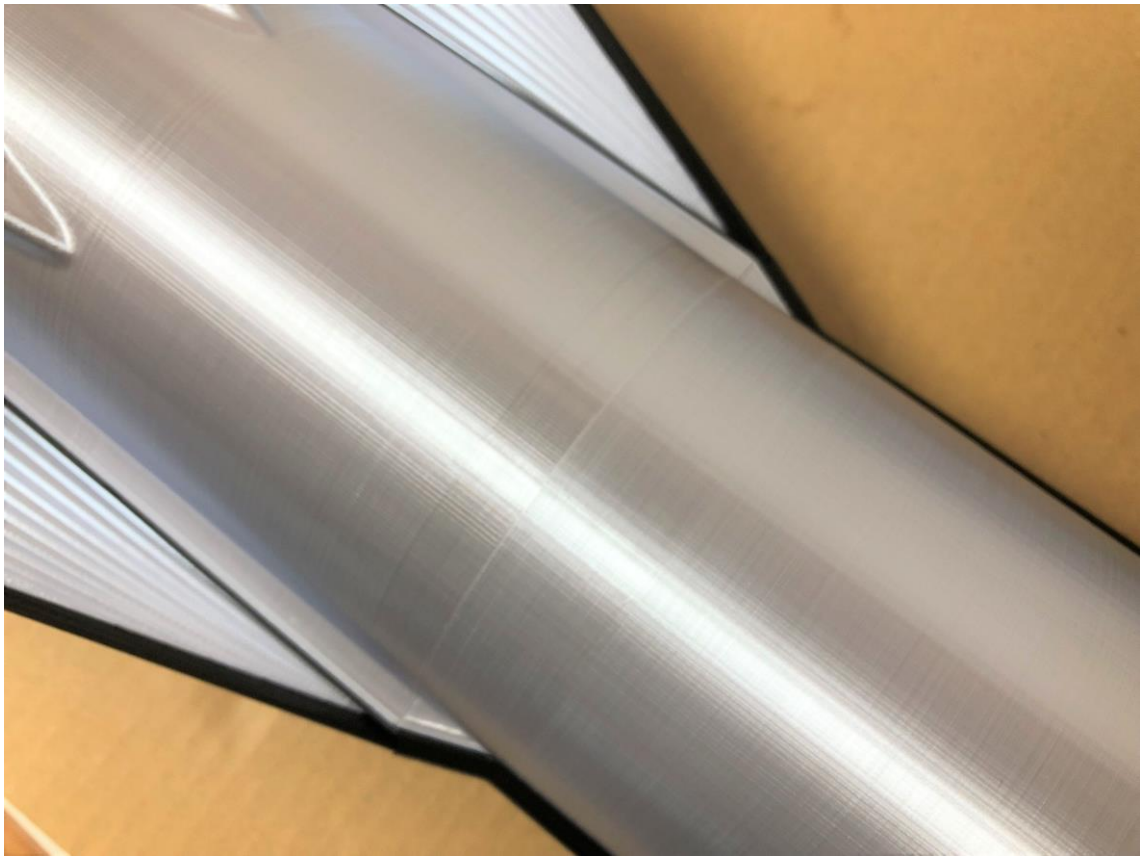


7.12.5 Segments coupling

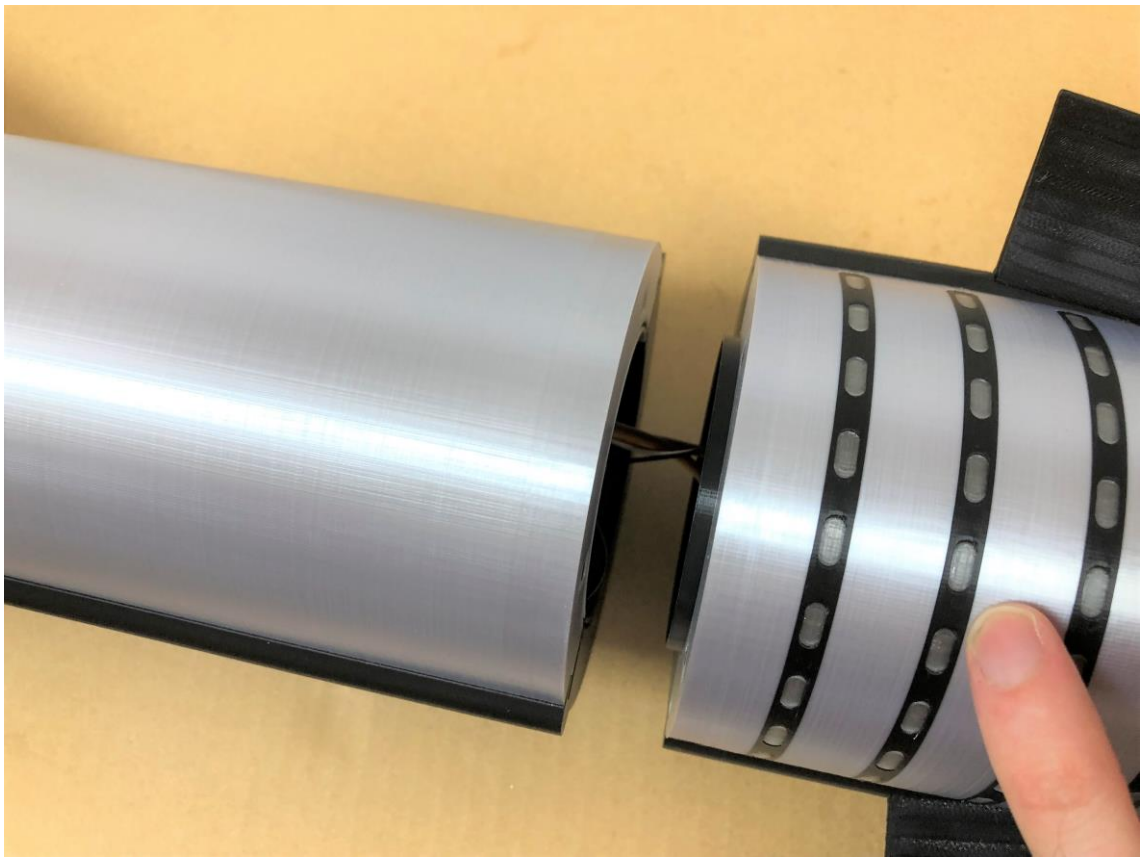
Clean the flat surfaces where the aft and central segments will connect. Gently pull on the power and USB cables coming out from the engine pod and reduce the cable slack between the aft and central segments. Do this until the two segments are about 1cm apart.



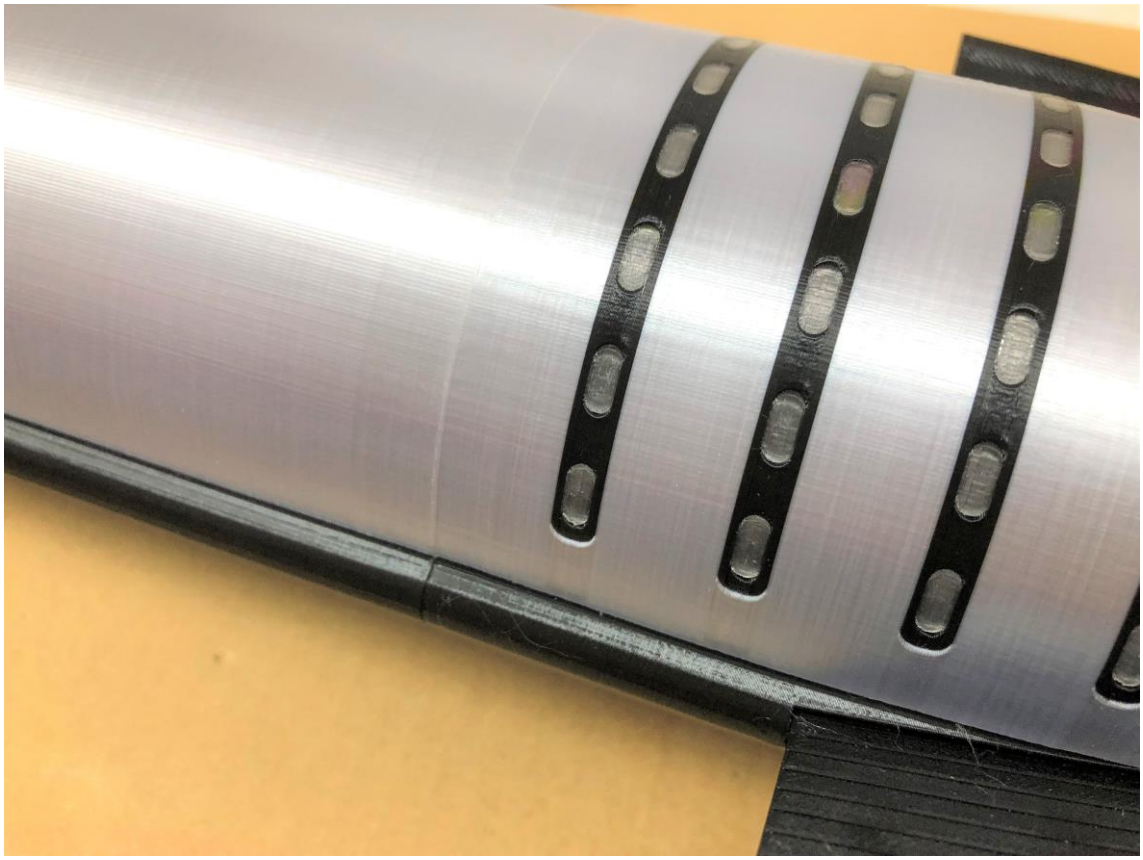
Connect the two segments. Once the segments are correctly aligned with the seal inserted in its slot the segments should snap together automatically. Check that they are no gaps left between the segments.



Clean the flat surfaces where the fore and central segments will connect. Take the bulk of cable from the fore segment and put it into the central segment.



Connect the two segments. Make sure that there are no gaps left.



7.12.6 Check

Place Starship on the stand and plug the DC adapter into a wall outlet. Verify that the engines and windows light up. The fins should start moving after 10s.

7.12.7 Fins calibration

When at rest the fins might not be perfectly horizontal. This can be adjusted using Starship Control. See the Starship Control manual for the calibration procedure.

8 Congratulations!

Congratulations for putting together Starship!
Reward yourself appropriately.

Don' forget to download Starship Control to play with Starship from your computer.
http://www.epicspacemodels.com/starship2019/

9 What's next?

Although I did my best to provide you with the best experience, there is probably still room for improvement.

And I am always open to feedback.

Other Epic Models will follow…

10 Troubleshooting

10.1 One or more engines do not work

10.1.1 Symptoms

After connecting the engine pod to the control board and powering on the board, one or several engines do not work.

10.1.2 Possible causes

One LED is dead or not properly soldered.

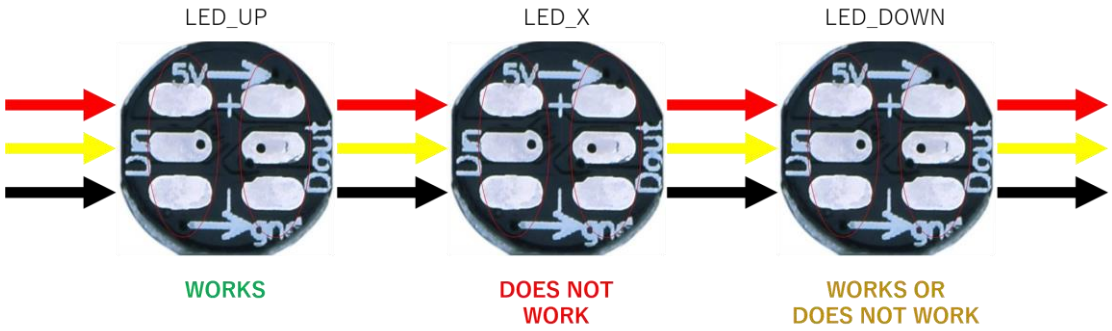
Because all LEDs are connected in series along a common data line, if one of the LEDs stops working all the LEDs downstream also stop working. They are not damaged; they are just not getting the required signal to operate.

10.1.3 Solution

10.1.3.1 Identify the first LED not working

Identify which LED is not working. In case several LEDs are not working, identify the most upstream LED not working (the one that was soldered first). From now, we will refer to this LED as LED_X. The LED connected upstream (on its Din side) will be referred as LED_UP, while the LED connected downstream (on its Dout side) will be referred as LED_DOWN.

For example, in the above photo the engines 5 and 6 are not working. Therefore
LED_UP = 4
LED_X = 5
LED_DOWN = 6



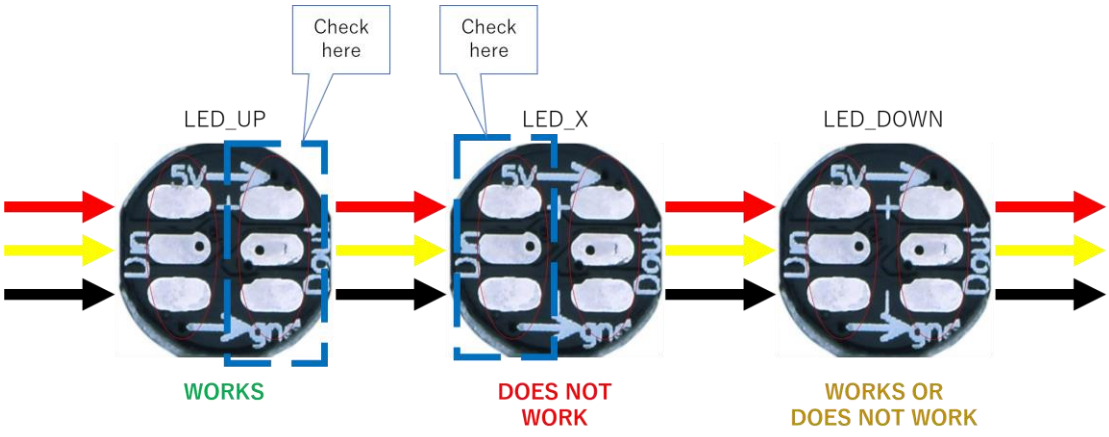
For the following step, leave the engine pod connected to the control board, but power up the control board only when instructed to do so.

10.1.3.2 Check inbound connections

Check the following connections

- The 3 pads on the Din side of LED_X.
- The 3 pads on the Dout side of LED_UP. If LED_X = 1, check the solders on the connector instead.

Especially, check that the central pad is not shorted with one of the other pads (red / black). Most problems with the LEDs come from one bad solder.



If you see a suspicious solder, desolder the wire then solder it again. Power up the control board.

Dis this solve the problem?

Yes

End of troubleshooting.

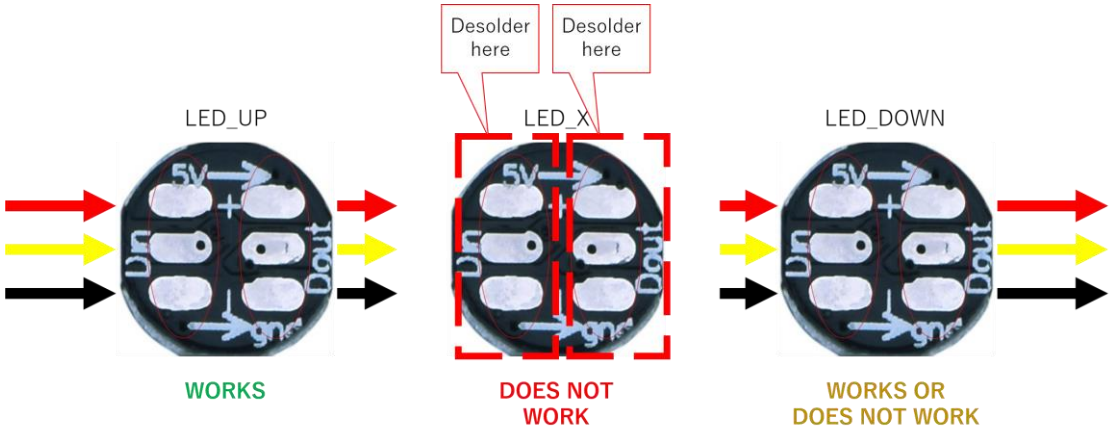
No

If this did not solve the problem, or if you are not sure what a suspicious solder looks like, proceed to the next step.

10.1.3.3 Disconnect LED_X

Desolder all the pads of LED_X and put it aside. Do not throw it away! It might still be good.

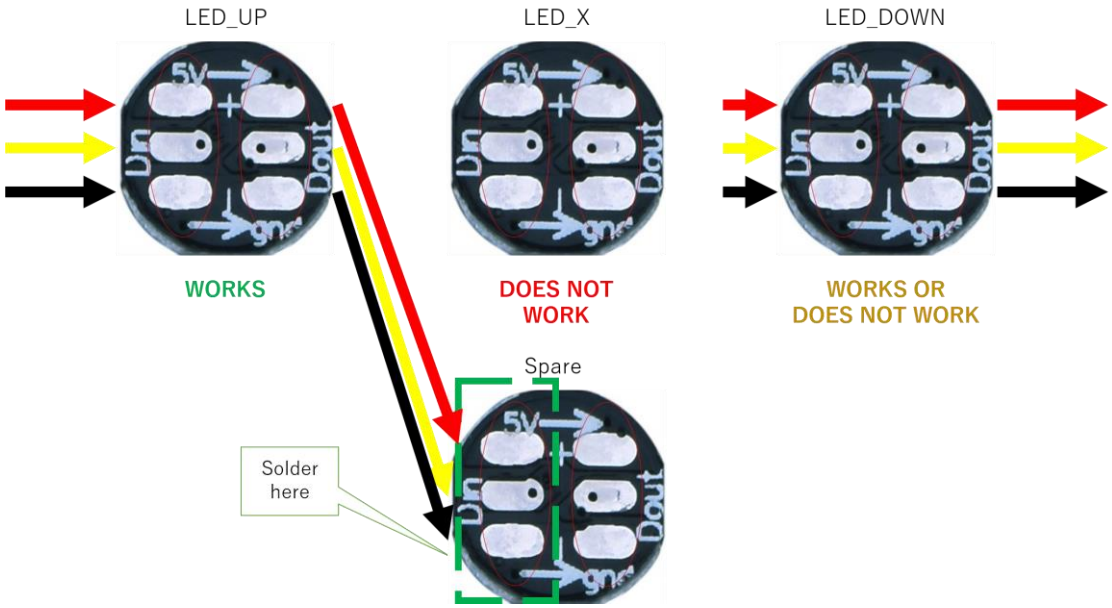
If LED_X = 1 (no upstream LED) proceed to step 10.1.3.5. Otherwise, proceed to step 10.1.3.4.



10.1.3.4 Check the inbound data stream

In this step, we check that the upstream LED is correctly transmitting data through its Dout port.

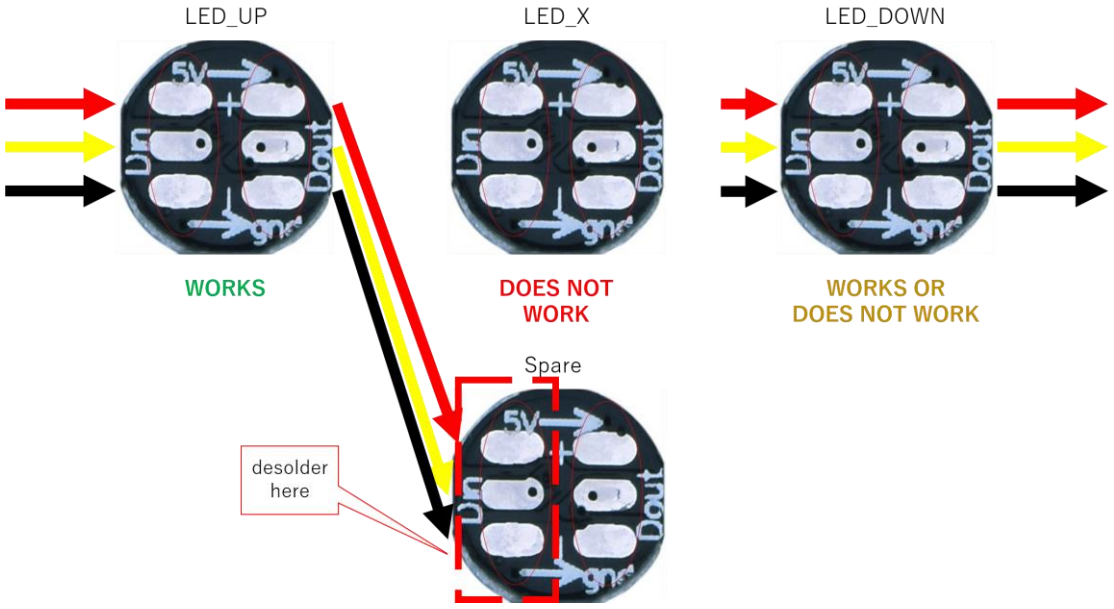
Take a spare LED from the bag. Connect its 3 pads on the Din side to the 3 pads on the Dout side of LED_UP. Power up the control board.



Does the spare LED light up?

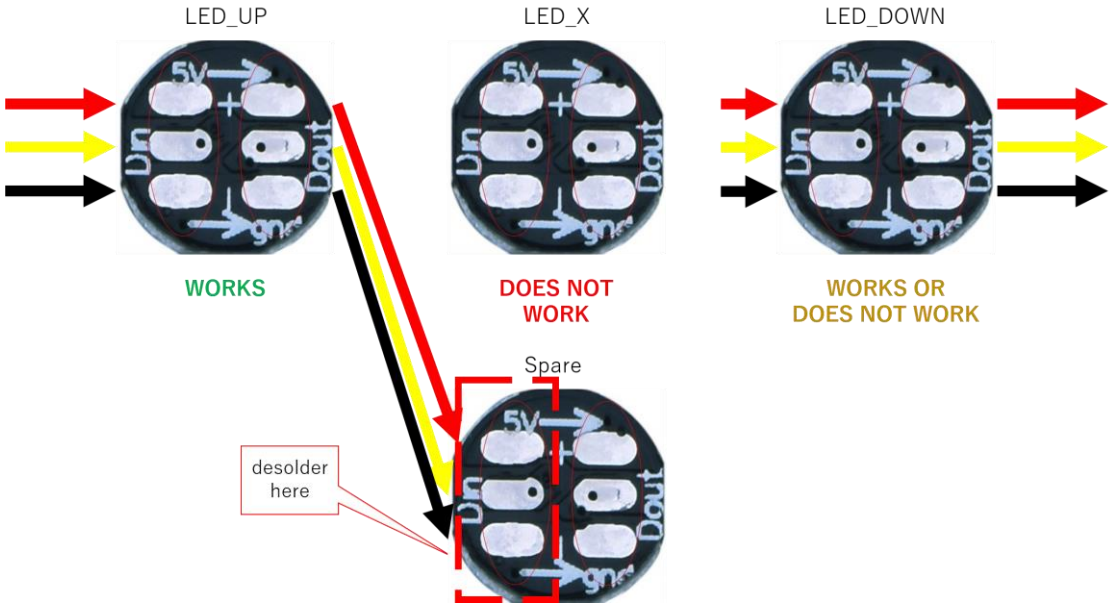
Yes

We can rule out a problem with LED_UP. Desolder the spare LED and keep it in a safe place. Proceed to step 10.1.3.5.



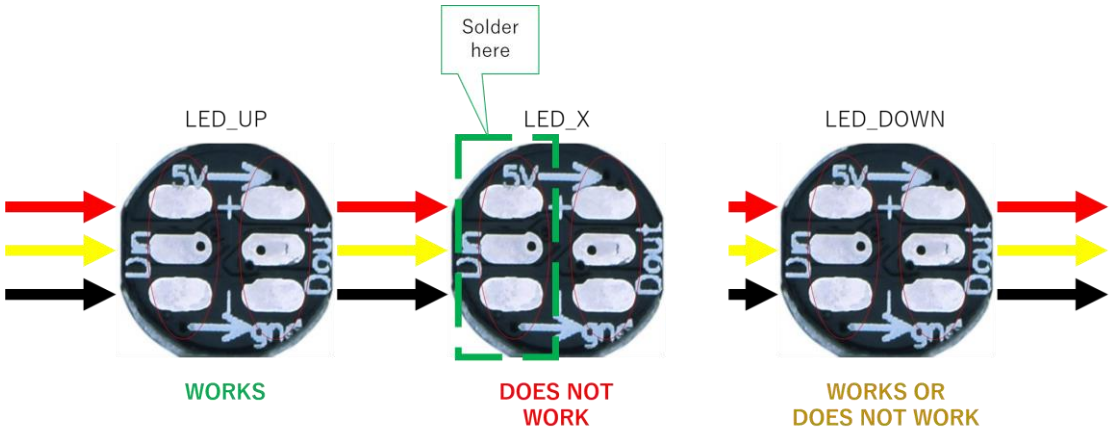
No.

There is a problem with LED_UP. The LED lights up but it is not correctly forwarding data downstream. Desolder the spare LED and keep it in a safe place. Proceed to step 10.1.3.6.



10.1.3.5 Check LED_X

Solder the 3 pads on the Din side of LED_X to the 3 pads on the Dout side of LED_UP. Power up the control board



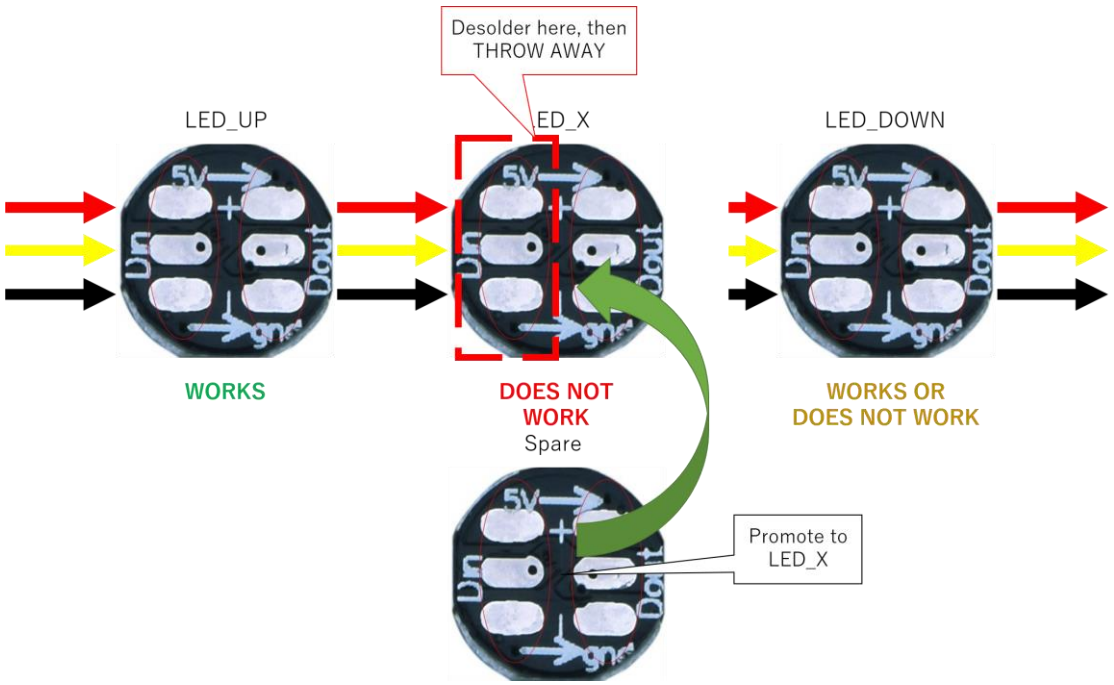
Does LED_X light up?

Yes

Problem with LED_X is fixed. Proceed to step 10.1.3.7.

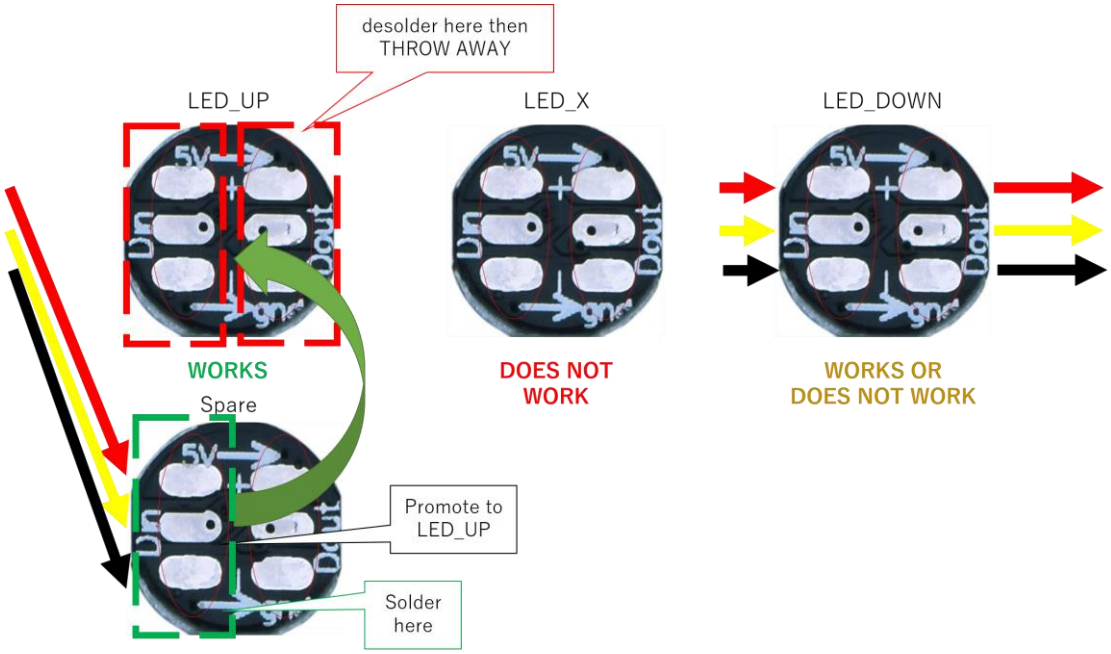
No

LED_X is dead. Desolder the 3 pads on the Din side and THROW AWAY this LED. Take a spare LED. This new LED will now officially become LED_X. Repeat step 10.1.3.5



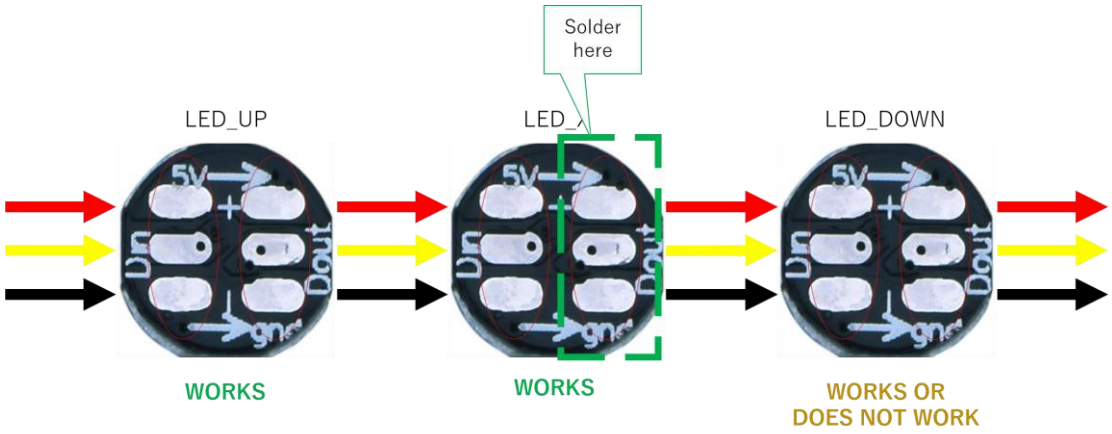
10.1.3.6 Problem with upstream LED

Desolder LED_UP and THROW IT AWAY. Take a spare LED and solder it in place of LED_UP. This LED now officially becomes LED_UP. Go back to step 10.1.3.4.



10.1.3.7 Reconnect downstream of LED_X

Solder the 3 pads on the Dout side of LED_X to the 3 pads on the Din side of LED_DOWN. Power up the control board.



Do the all the engines light up?

Yes

Troubleshooting is finished!

No

There are problems with other LEDs. Go back to step 10.1.3.1.

11 Change log

11.1 2019/12/07

11.1.1 Corrected typo in 7.1.3.

The instruction was saying “DO PUSH ON THE WINDOWS”. This has been corrected to “DO NOT PUSH ON THE WINDOWS.”

11.1.2 Engine layout

Added engine layout map in section 4.4.

11.1.3 Engine troubleshooting

Added engine troubleshooting section 10.1.

11.2 2020/02/15

11.2.1 Aft servos installation

Added instructions in 7.10.5 to avoid incorrect installation of the servomotors.

11.2.2 Fore servos installation

Added instructions in 7.10.6 to avoid incorrect installation of the servomotors.

11.2.3 LED wiring

Added pre-tinning tip in 7.3.1.

11.2.4 Hull disassembly

Updated instructions in 7.1. Kits with serial number 17 or above are shipped with bags of parts in the segments, and the segment keys are in the bag with the other black parts (no need to remove them from the segments).

11.2.5 Magnets assembly

Added tip (chamfering) in 7.6.1.

11.2.6 Hull closing

Added tip (chamfering) in 7.12.1