

ENRAGED RABBIT : CARROT FEEDER ASSEMBLY MANUAL

VERSION 2021.09.16

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INTRODUCTION

THE ENRAGED RABBIT PROJECT

This project aims to bring multimaterial capabilities to 3D printers using a single Direct Drive toolhead. While this project is mainly dedicated to be used on VORON printers, it can also be used (or adapted) on any 3D printer that runs Klipper, and potentially RRF.

Find all the project information on the Github page : <https://github.com/EtteGit/EnragedRabbitProject>

The project is composed of 4 different components :

- The Enraged Rabbit Carrot Feeder (ERCF). The Carrot Feeder allows to use a high number of different filaments (tested up to 9 channels so far) and feed them, one at a time, into the printer toolhead. The ERCF gear motion system (i.e. what is used to push and pull the filament) is based on the Voron Design M4 extruder.
- The Enraged Rabbit Carrot Patch (ERCP). It is a light spool-holder and buffer combo to help you deal with the filament management issue associated with multimaterial systems.
- The Enraged Rabbit King's Seat (ERKS). The King's Seat is a pellet-purge system to remove the need for a wipe-tower and make faster filament purges. This system is designed for VORON V2s only so far.
- The filament sensor : a filament sensor system located below the extruder gears to check proper loading and unloading of filament.

The ERCF was inspired by the Prusa MMU2 and the Smuff.

ACKNOWLEDGEMENTS

It is important for me to mention that while I started this project alone, many people have joined along the way and have participated (and still are) in this adventure, whether it is by providing feedback, developing a mod or simply expressing kind words. I would never been able to do all of that without this support, thanks a lot!

I would like to particularly thank Tircown (the master of sensors!), the Voron Dev team (special mention to Dunar), Dustin Speed, Kageurufu and the HonHonHonBaguette people!

Ette // Romain

INTRODUCTION

STL FILE KEY

The STL file naming convention is the same as for VORON designs, namely :

PRIMARY COLOR

Example Filament_Block_xN.stl

These files will have nothing at the start of the filename.

ACCENT COLOR

Example [a]_Blocks_End_Feet.stl

These files will have “[a]” to the front to mention that they are intended to be printed with an accent color.

QUANTITY REQUIRED

Example Filament_Block_xN.stl

If a file ends with “_x#”, that is telling you the quantity of that part required to build this system. For the ERCF, “N” means the number of channels.

PRINT GUIDELINES

The print guidelines are also the same as for VORON designs, namely :

FDM MATERIAL

The ERCF was tested only with ABS, so I recommend to use ABS to build the ERCF.

LAYER HEIGHT

Recommended : 0.2mm

EXTRUSION WIDTH

Recommended : Forced 0.4mm

INFILL PERCENTAGE

Recommended : 40%

INFILL TYPE

Grid, Gyroid, Honeycomb, Triangle or Cubic.

WALL COUNT

Recommended : 4

SOLID TOP/BOTTOM LAYERS

Recommended : 5

SUPPORTS REQUIRED

None at all.

INTRODUCTION

HOW TO GET HELP

If you need assistance with your build you can head over the VORON Discord group and post your questions (typically in the « voronuser_mods » channel). It is the primary medium to help people with their ERCF build and tuning! You can also check the Github page for the latest releases.



<https://discord.gg/xgXWctB>



<https://github.com/EtteGit/EnragedRabbitProject>

FINAL THOUGHTS

Building and using a multi-filament system can be a daunting task. Take your time! Little issues in the assembly phase tend to stack up and cause you trouble later on. If at any point you get stuck or are just not sure about something, please ask on Discord. There are no stupid questions!

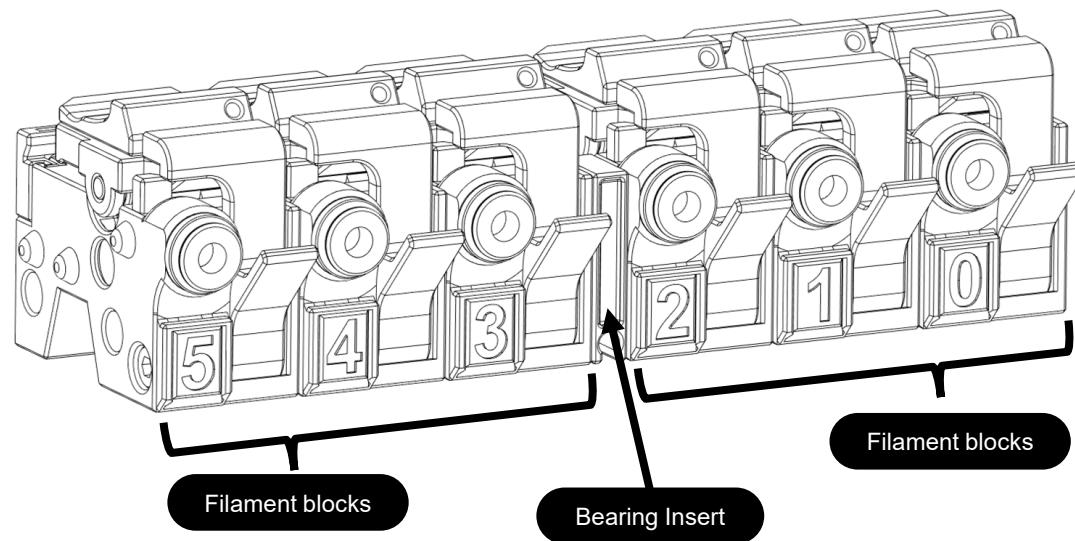
You already probably heard that multi-filament systems are quite often a pain to deal with, and that's quite true. While the goal for the Enraged Rabbit Project is to offer a cool, reliable and easy to use system, you'll probably face issues at one time or another. Check the documentation, the guides and, again, don't hesitate to come on the Discord and ask. There are plenty of possible issues, and there is a very high chance it's been seen and solved already.

Have fun building and using the ERCF!

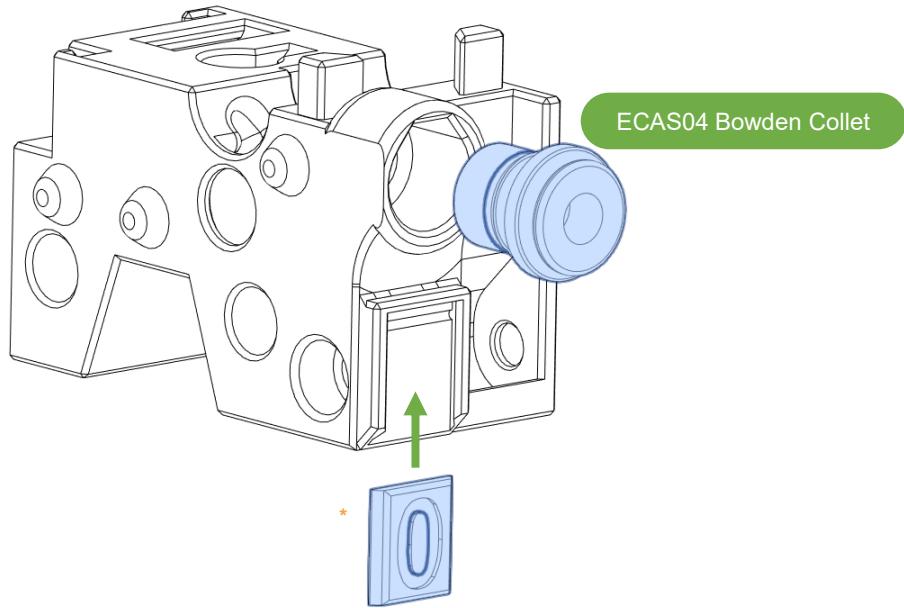
FILAMENT BLOCKS



OVERVIEW

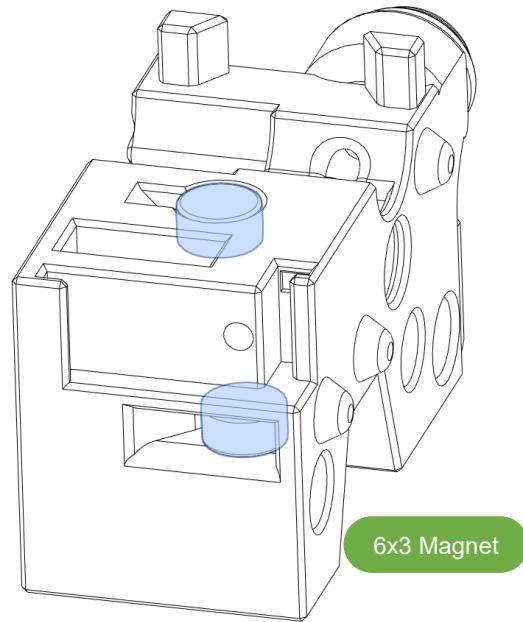


FILAMENT BLOCKS



FILAMENT BLOCK NUMBERING

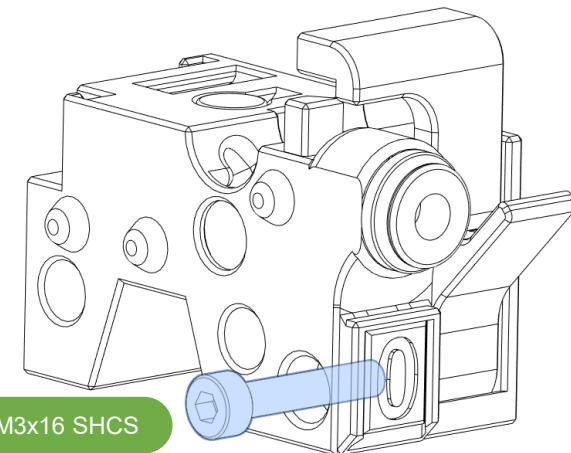
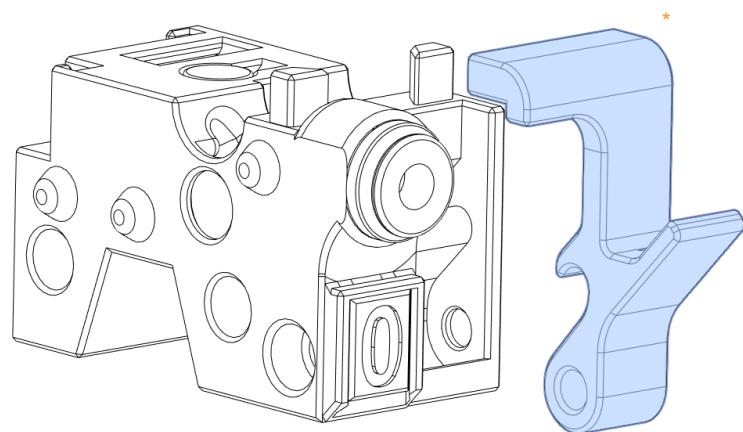
Use the different numbered plates to easily identify each of the ERCF channels.



MAGNET ORIENTATION

Install the top magnets with the same polarity for all filament blocks. Polarity for the front magnets does not matter.

FILAMENT BLOCKS

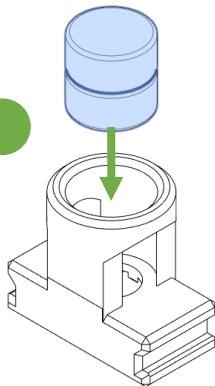


LATCH SCREW

The latch screw is screwed directly into the plastic. Don't over tighten it, it's just the latch rotation axis.

MAGNETIC GATES

6x3 Magnet

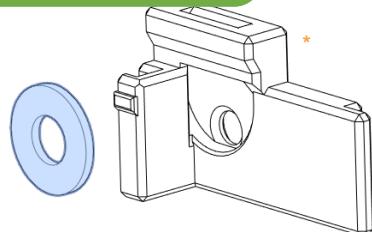


GATE KEY

Insert the two magnets into the Gate Key.

The Gate Key allows you to open Magnetic Gates when the selector is not in front of them, and also to secure the washers in the magnetic gates when you install or remove them.

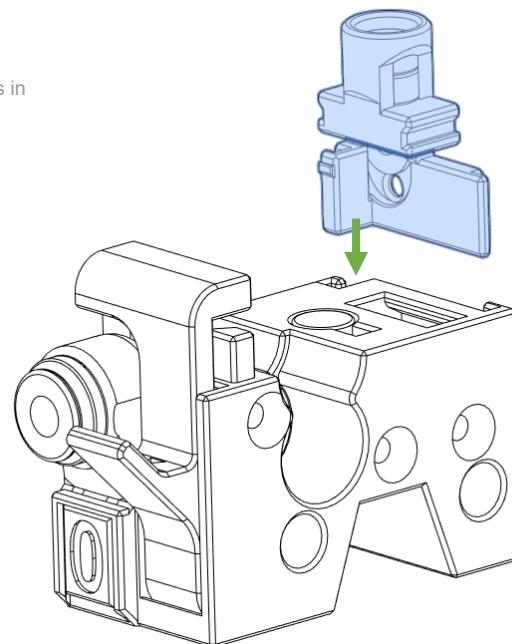
DIN125 M3 Steel Washer



WASHER INSERTION

First check that each washer has a flat surface for both sides (i.e. no residues from the stamping process). If not, use a file to fix that.

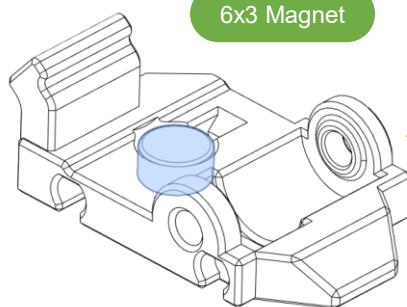
Insert the washer from the bottom right (using picture orientation) and push it into its slot. It should move freely up and down.



INSERTION

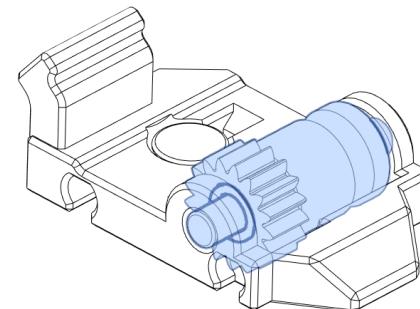
Use the Gate Key to keep the washer in place while you slide down the Magnetic Gate, then remove the Gate Key.

TOP HATS



MAGNET ORIENTATION

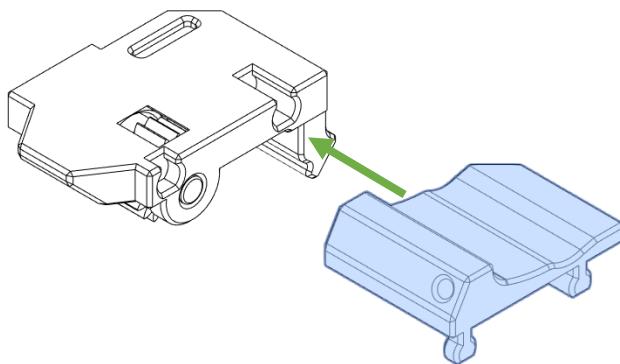
Install the magnets so they will repel from the top magnets on the Filament Blocks.



CHECK GEAR ROTATION

Make sure the BMG idler is spinning freely.

TOP HAT LOCKERS

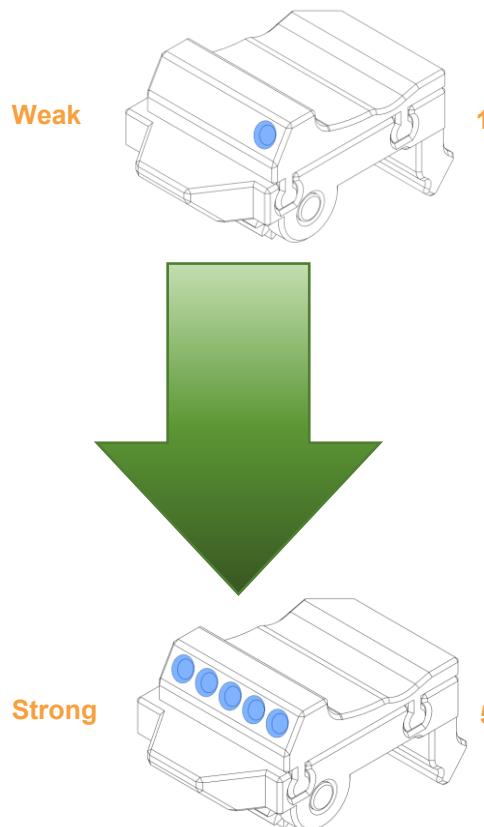


TOP HAT LOCKERS

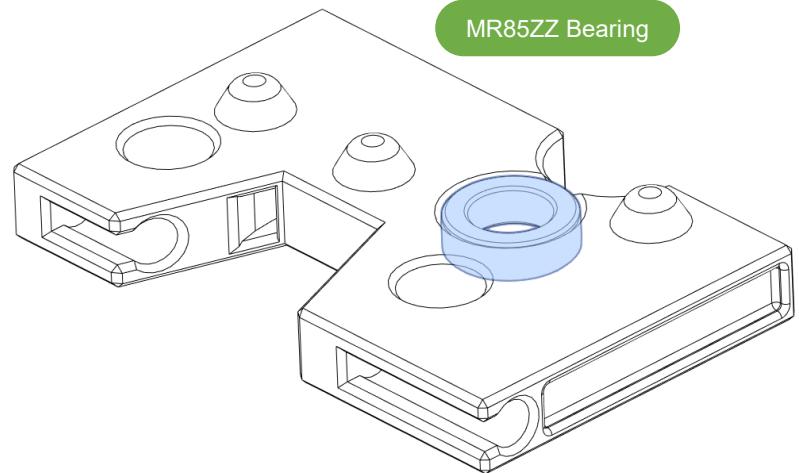
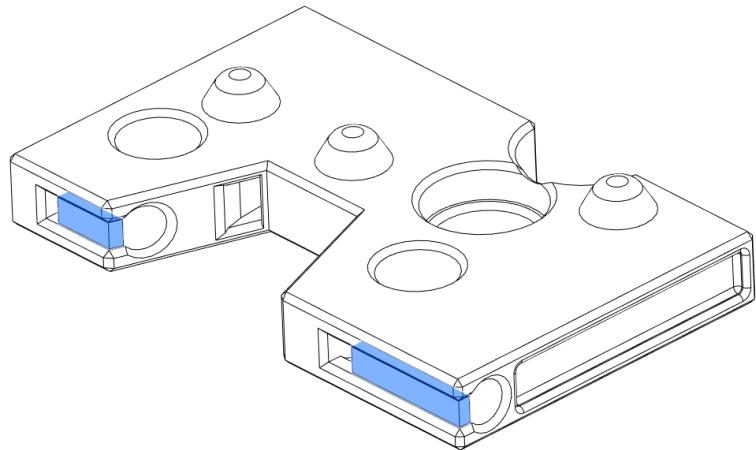
Slide-in the Top Hat Locker for each Top Hat until you hear the « click ». Top Hat Locker values (i.e. the number of dots on the front side) are used to adjust the pressure applied on the filament for each channel. The higher the number, the stronger the pressure on the filament. Start with all channels at « 1 », the values will be adjusted in the setup and tuning section of the ERCF.

Do not install the Top Hats on the Filament Blocks for now.

PRESSURE ON FILAMENT



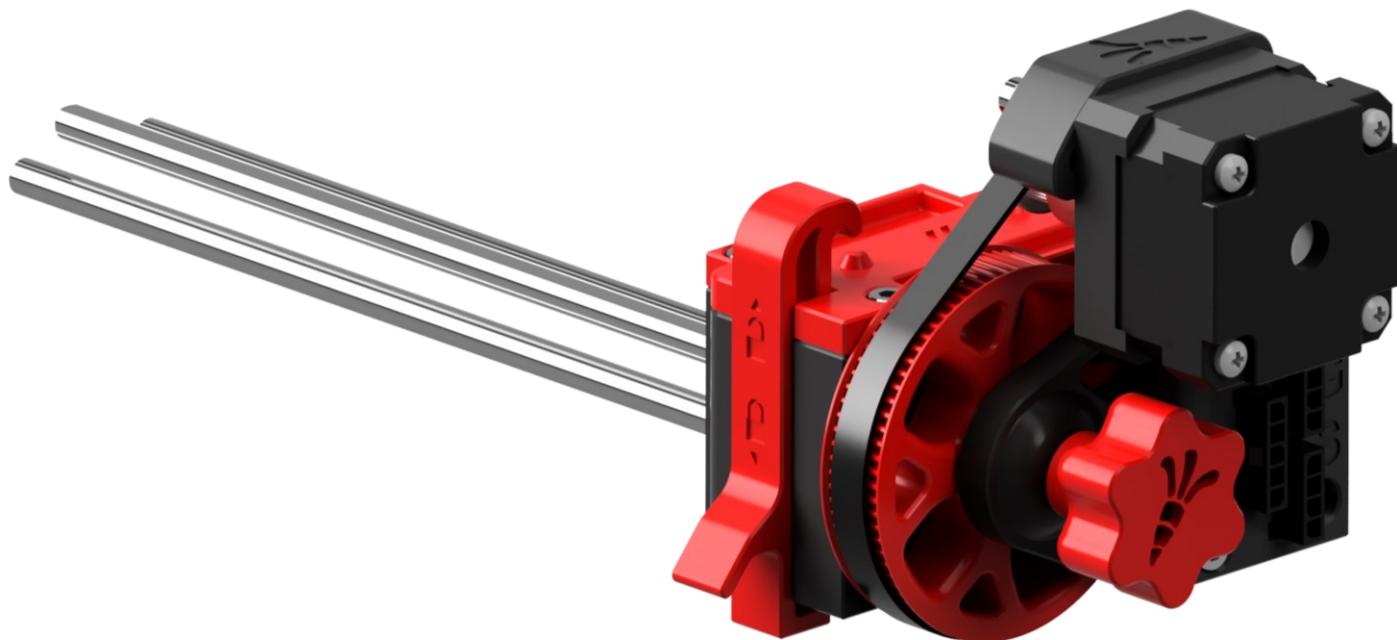
BEARING INSERTS



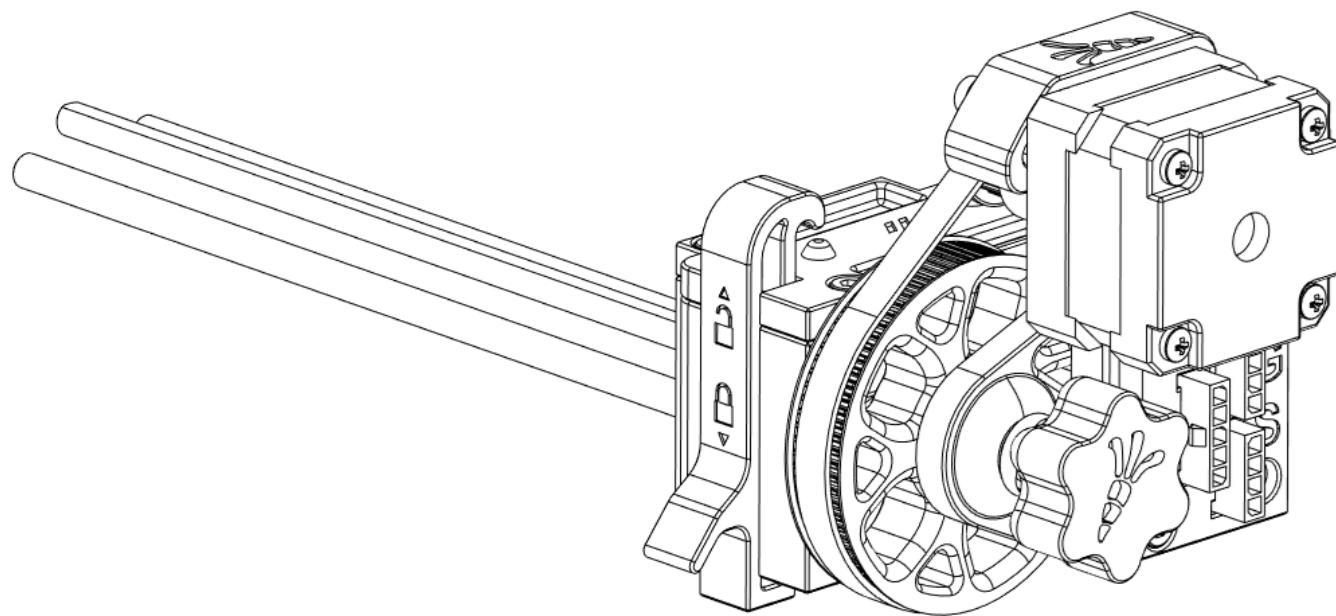
REMOVE BUILT-IN SUPPORTS

Use a small tool, like an allen key, to remove the two built-in supports.

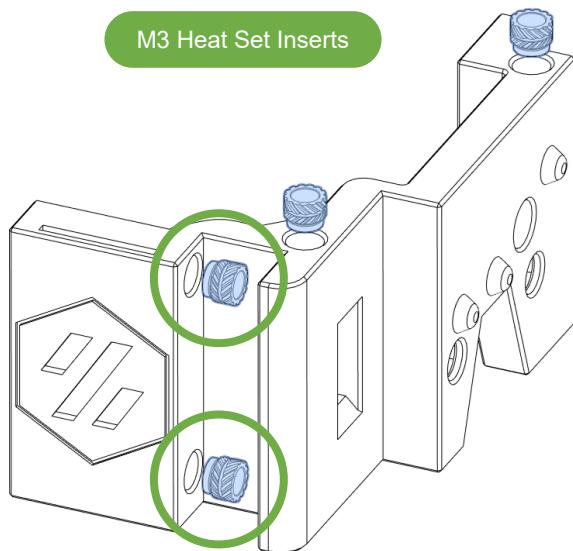
GEAR BOX



OVERVIEW

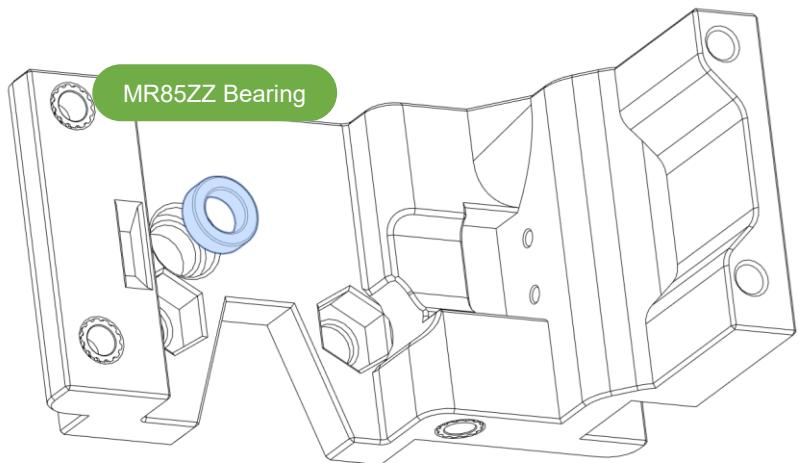
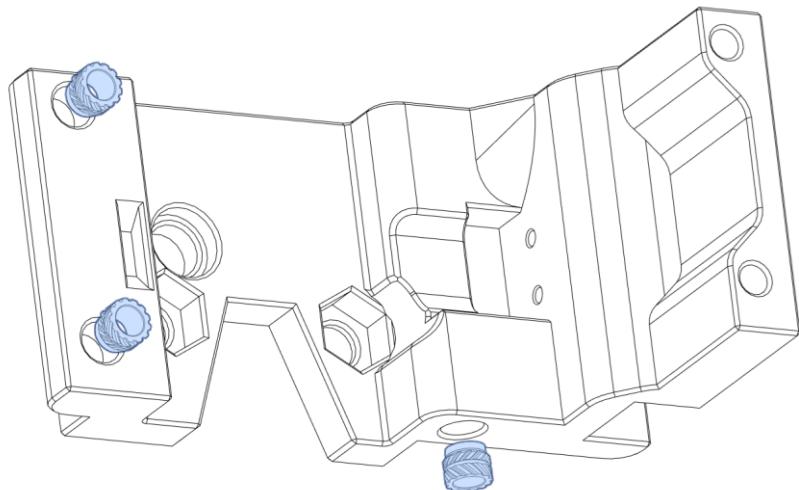


GEAR BOX FRONT

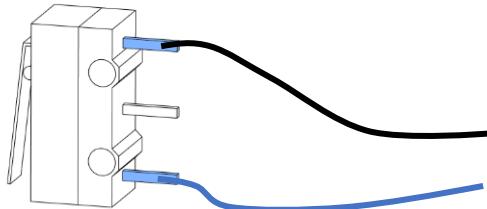


HEAT SET INSERTS TIP

Push those inserts using the soldering iron from the side and take your time to make them well flush with the surface and aligned with the screw path.



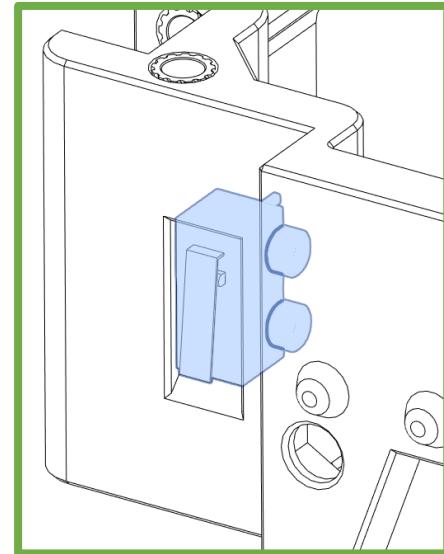
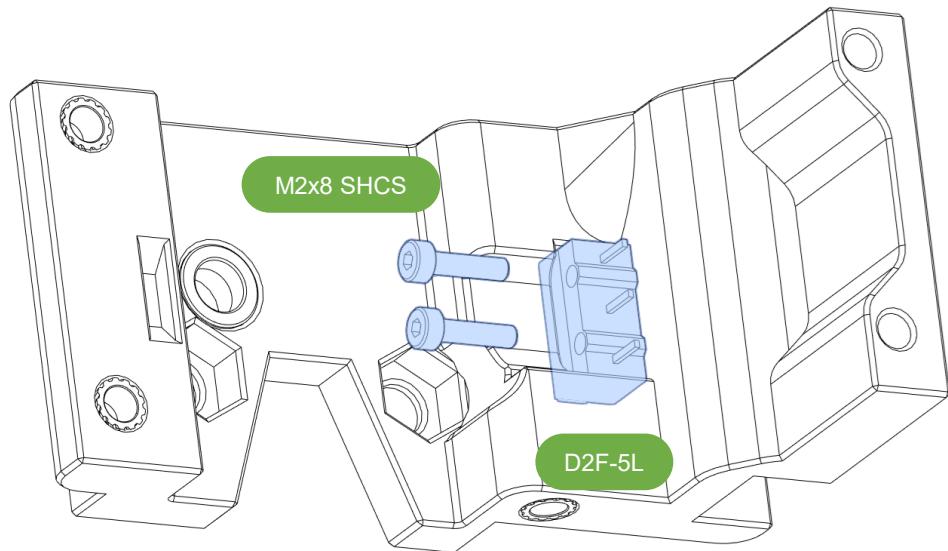
SELECTOR ENDSTOP



MICRO SWITCH WIRING

Pre-wire the endstop. Around 10cm of 24 AWG wire will be more than enough. Don't crimp the wires free ends for now.

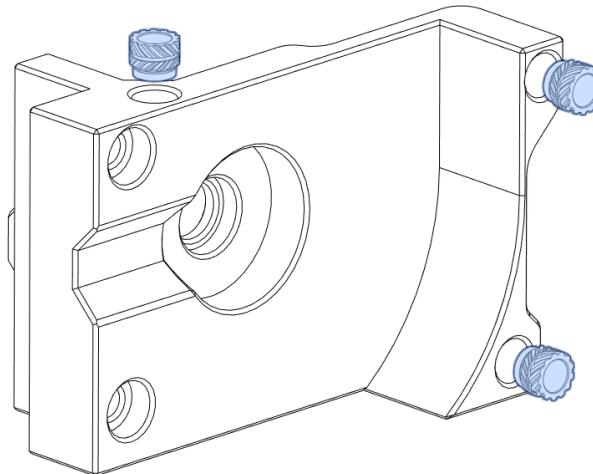
Wires are not shown in the other pictures but are assumed present.



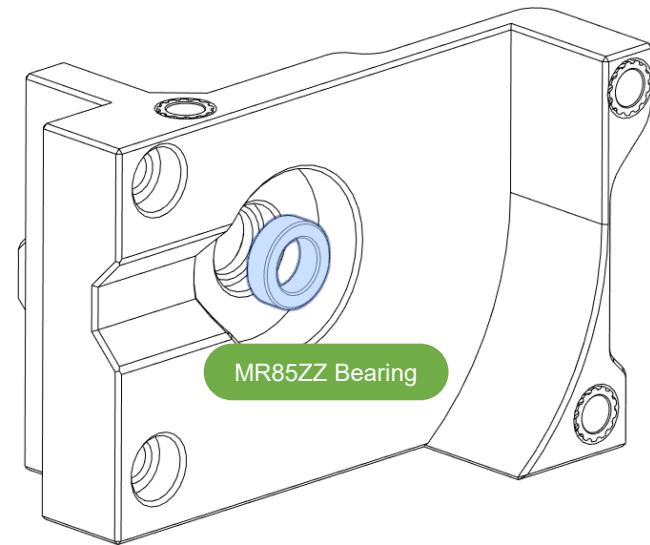
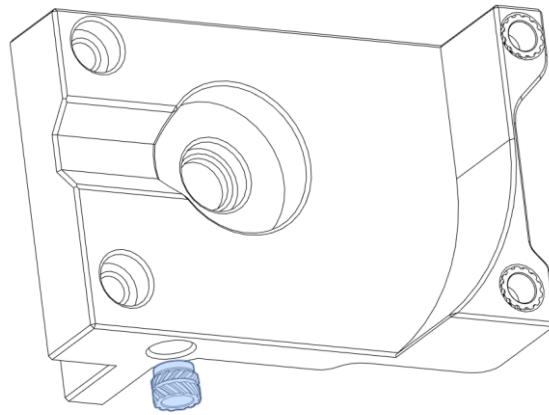
MICRO SWITCH ORIENTATION

If you are using a levered micro switch, install it as shown. In case you are using a micro switch without a lever, install it in the other direction, with the button on the bottom side.

GEAR BOX BACK

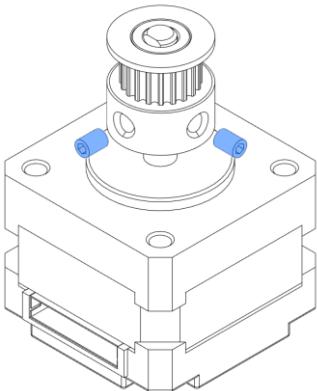


M3 Heat Set Inserts



MR85ZZ Bearing

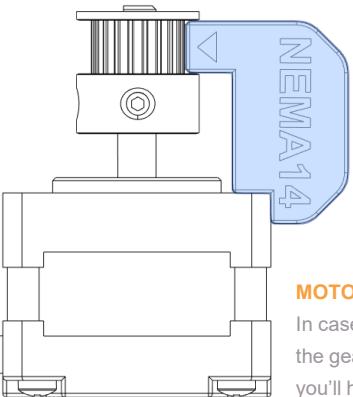
MOTOR ARM



GRUB SCREWS

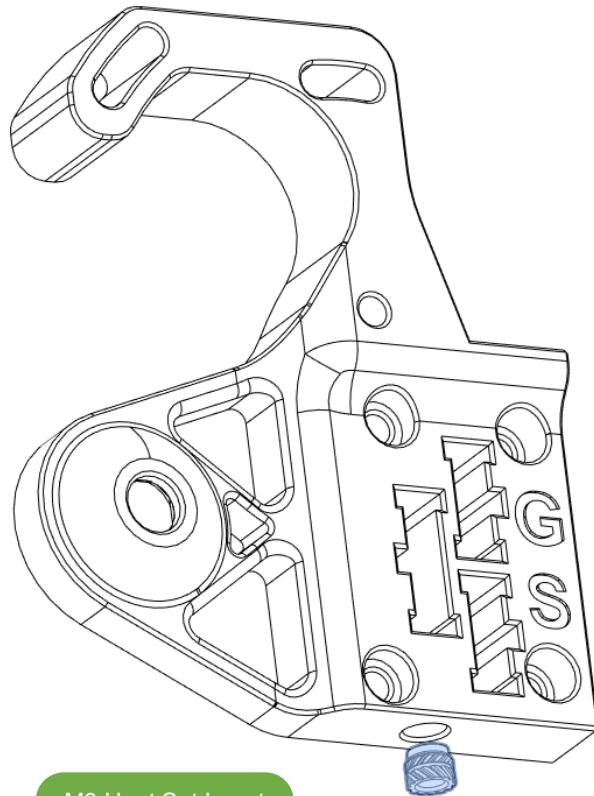
Insert both grub screws and use thread locker on them.

Use the pulley tool to install the pulley at the proper position on the motor shaft.



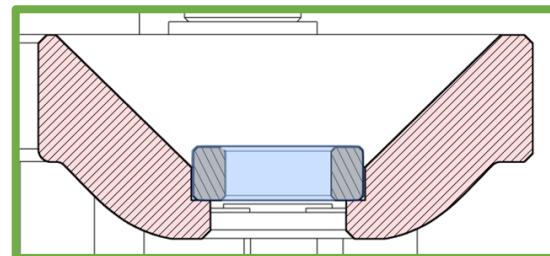
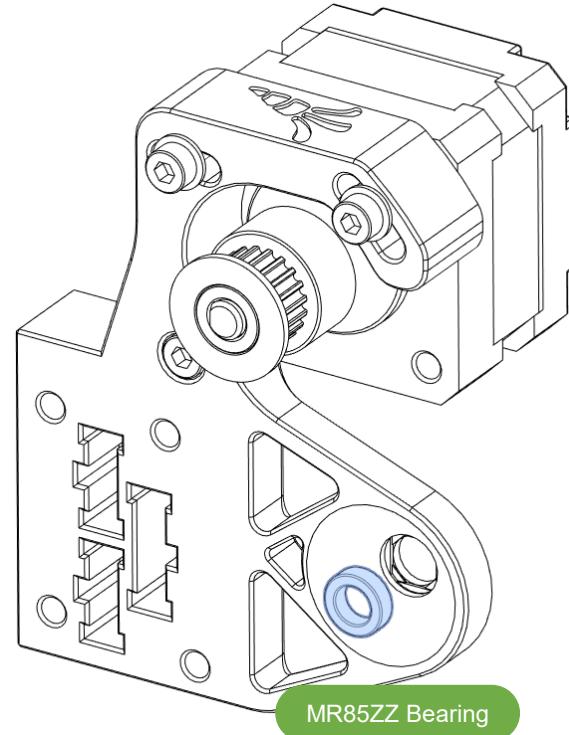
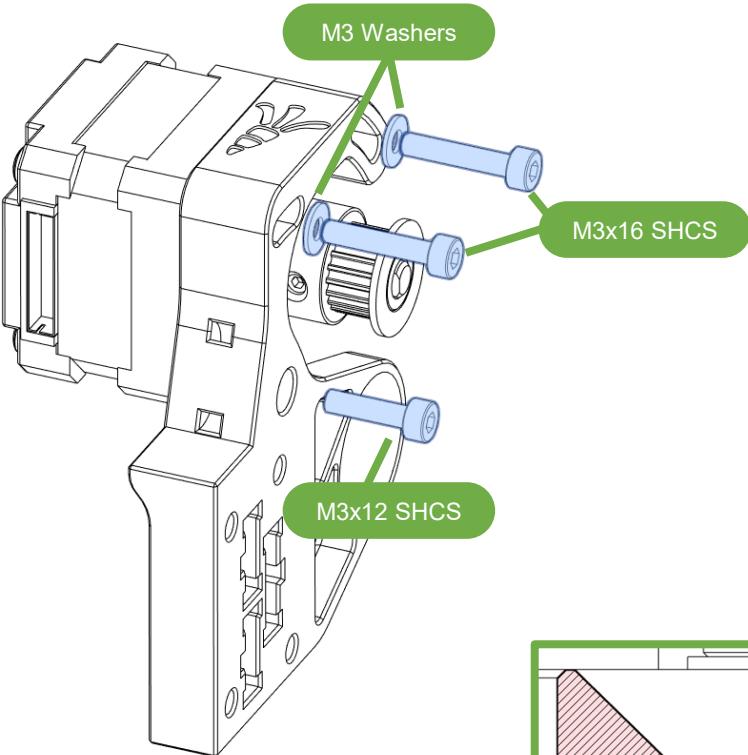
MOTOR SIZE

In case you are using a NEMA17 motor for the gear axis, assembly is the same, but you'll have to use the NEMA 17 pulley tool.



M3 Heat Set Insert

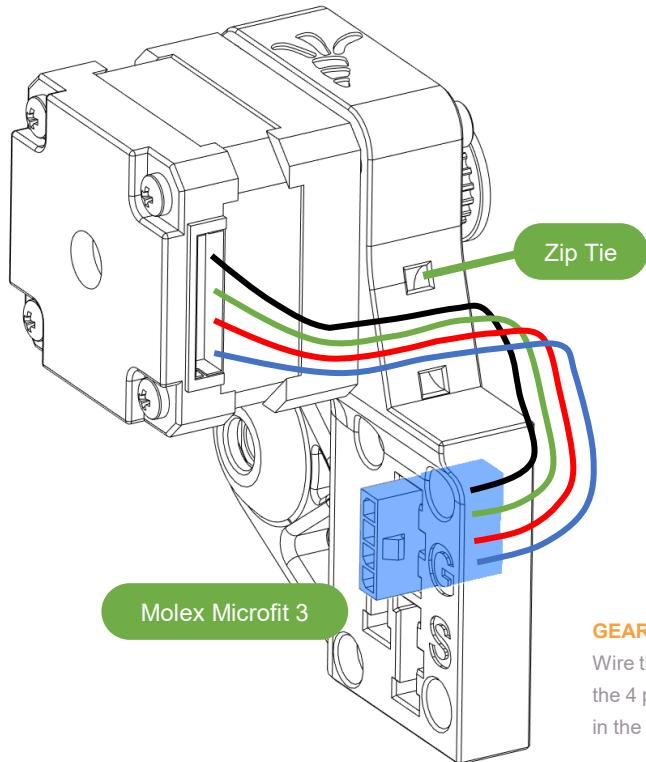
MOTOR ARM



BEARING POSITION

Once installed, the bearing will not be flush and will stick out as shown.

MOTOR WIRING

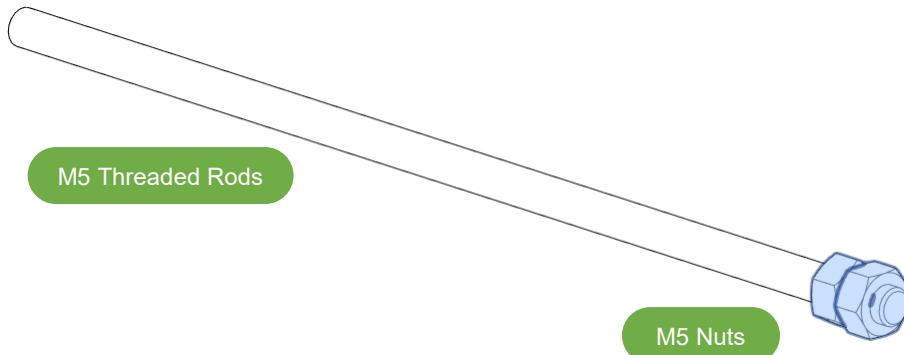


Molex Microfit 3

GEAR MOTOR WIRING

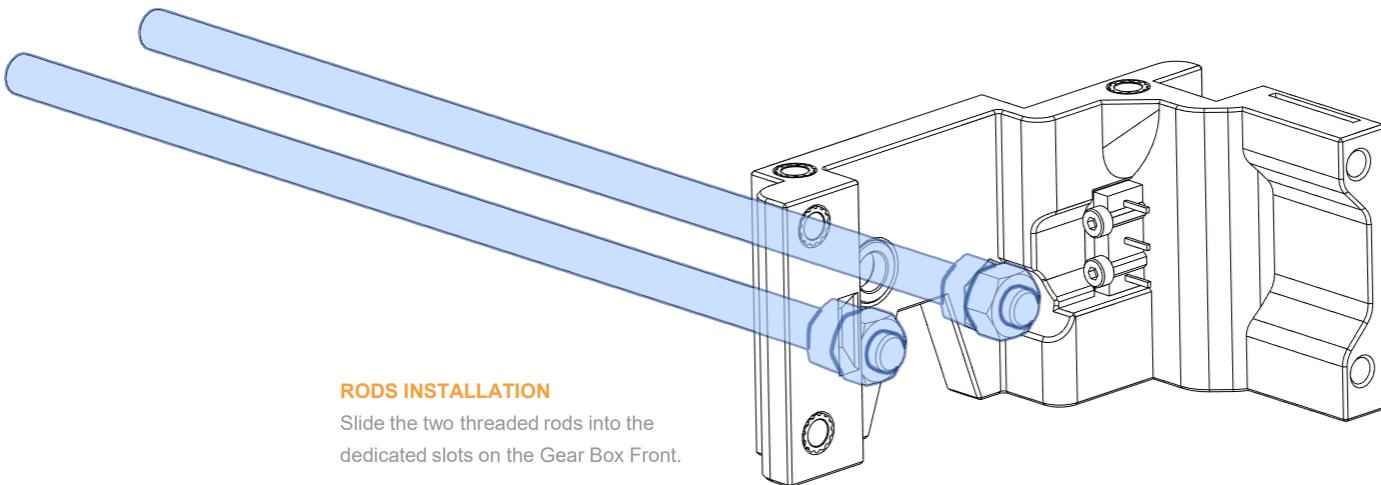
Wire the gear motor as shown. Push the 4 pins MicroFit3 female connector in the top left spot (« G »).

5MM THREADED RODS

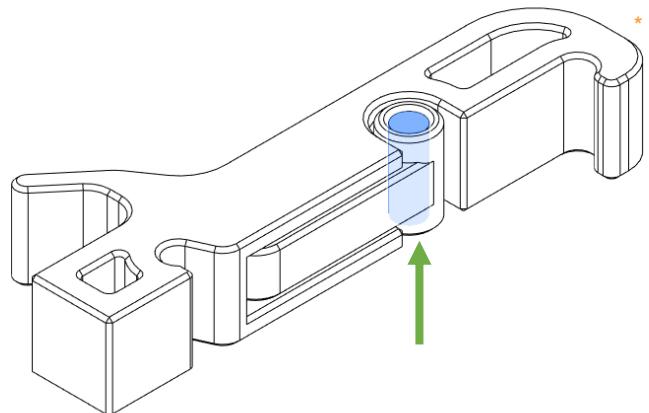


NUTS

Install the two M5 nuts tightened against each other (locking mechanism) at the end of each M5 threaded rod.

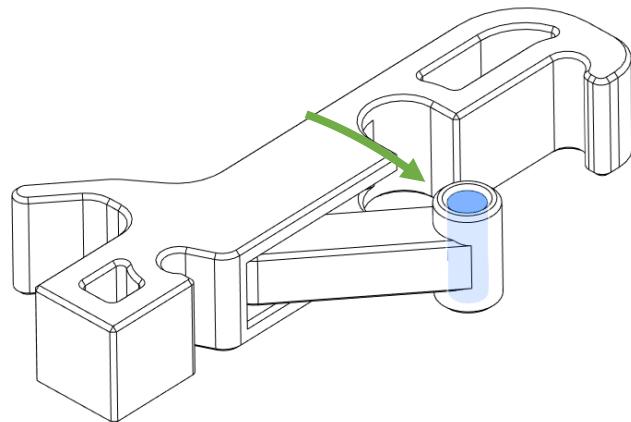


LATCHES PREPARATION

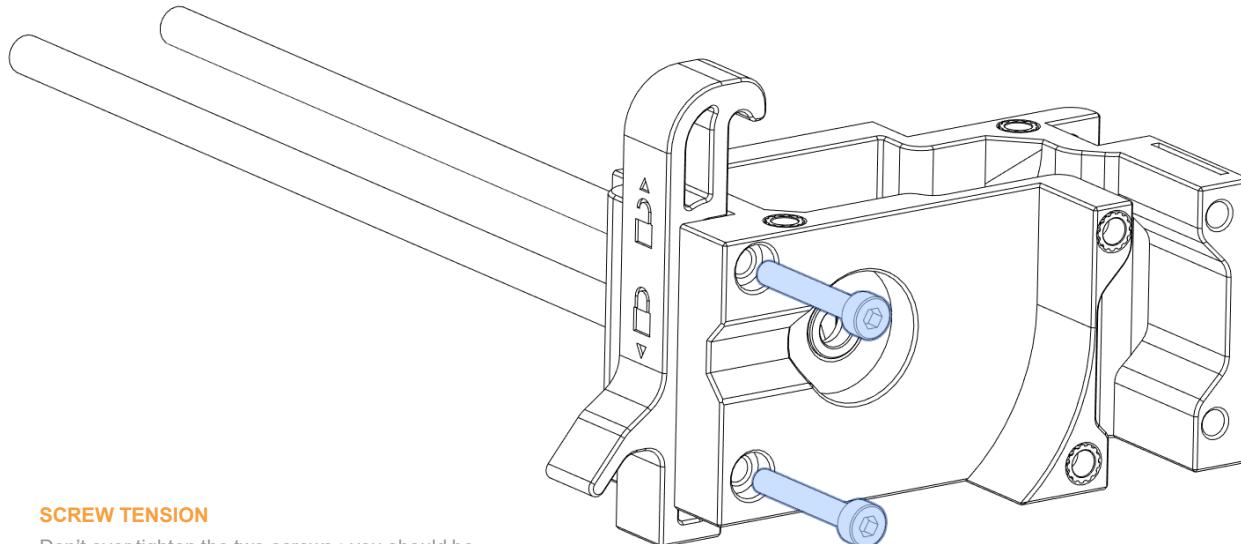


HINGE UNLOCK

Use a small tool (like an allen key) inserted into the hinge hole to free the print-in-place mechanism and ensure it rotates easily. Do that for both latches.



LEFT LATCH



SCREW TENSION

Don't over tighten the two screws : you should be able to lock and unlock the latch without trouble.

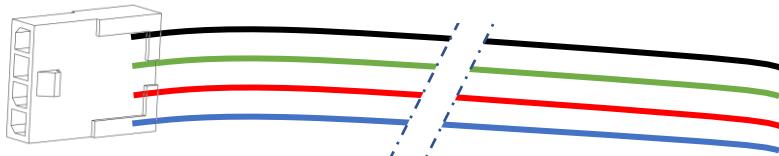
M3x20 SHCS

WIRING

Molex Microfit 3 – 4 pins

SELECTOR MOTOR WIRE

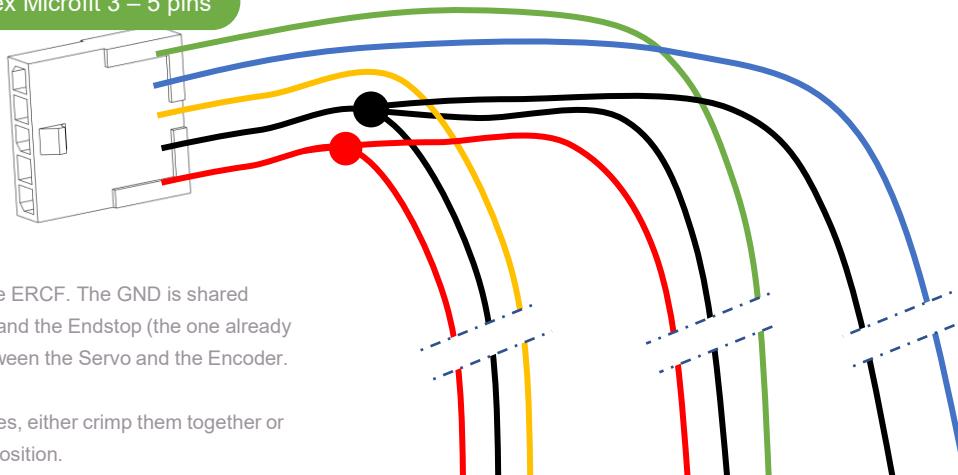
Prepare the 4 wires bundle for the selector motor. Don't crimp the free ends for now.



Typical wire length required for each component (with some room already)

Chans.	Length (cm)		
	Selector motor	Servo	Encoder
3	25	50	60
6	33	65	75
9	40	80	90

Molex Microfit 3 – 5 pins



GENERAL CONNECTOR WIRE

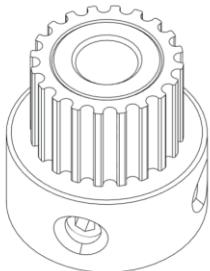
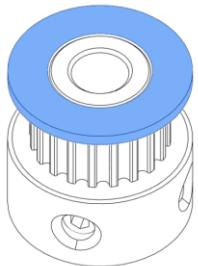
Prepare the 5 wires bundle for the ERCF. The GND is shared between the Servo, the Encoder and the Endstop (the one already installed). The +5V is shared between the Servo and the Encoder.

To join the multiple GND//+5V lines, either crimp them together or make a splice prior to the crimp position.

Also remember that the endstop was already pre-wired (on the endstop side), so it will now be fully wired.

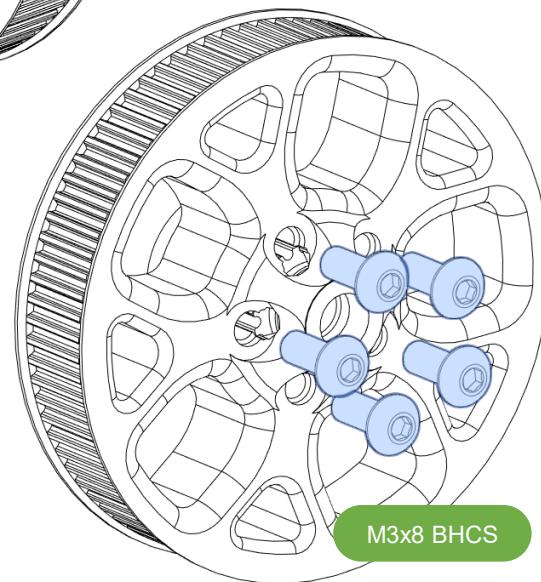
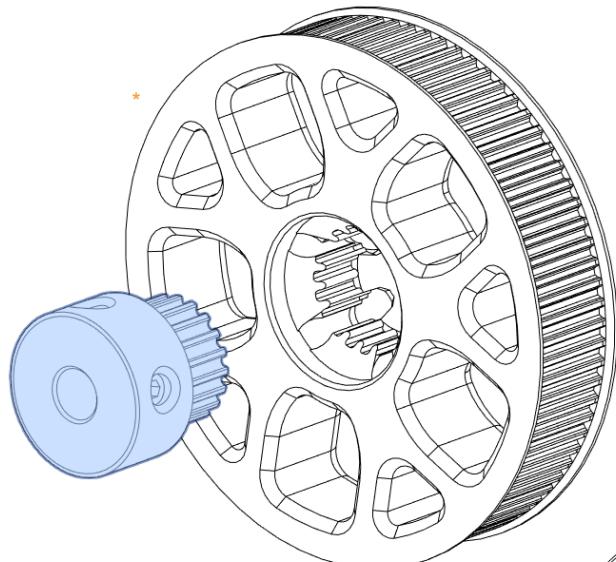
M4 EXTRUDER 80T GEAR

GT2 20T Pulley

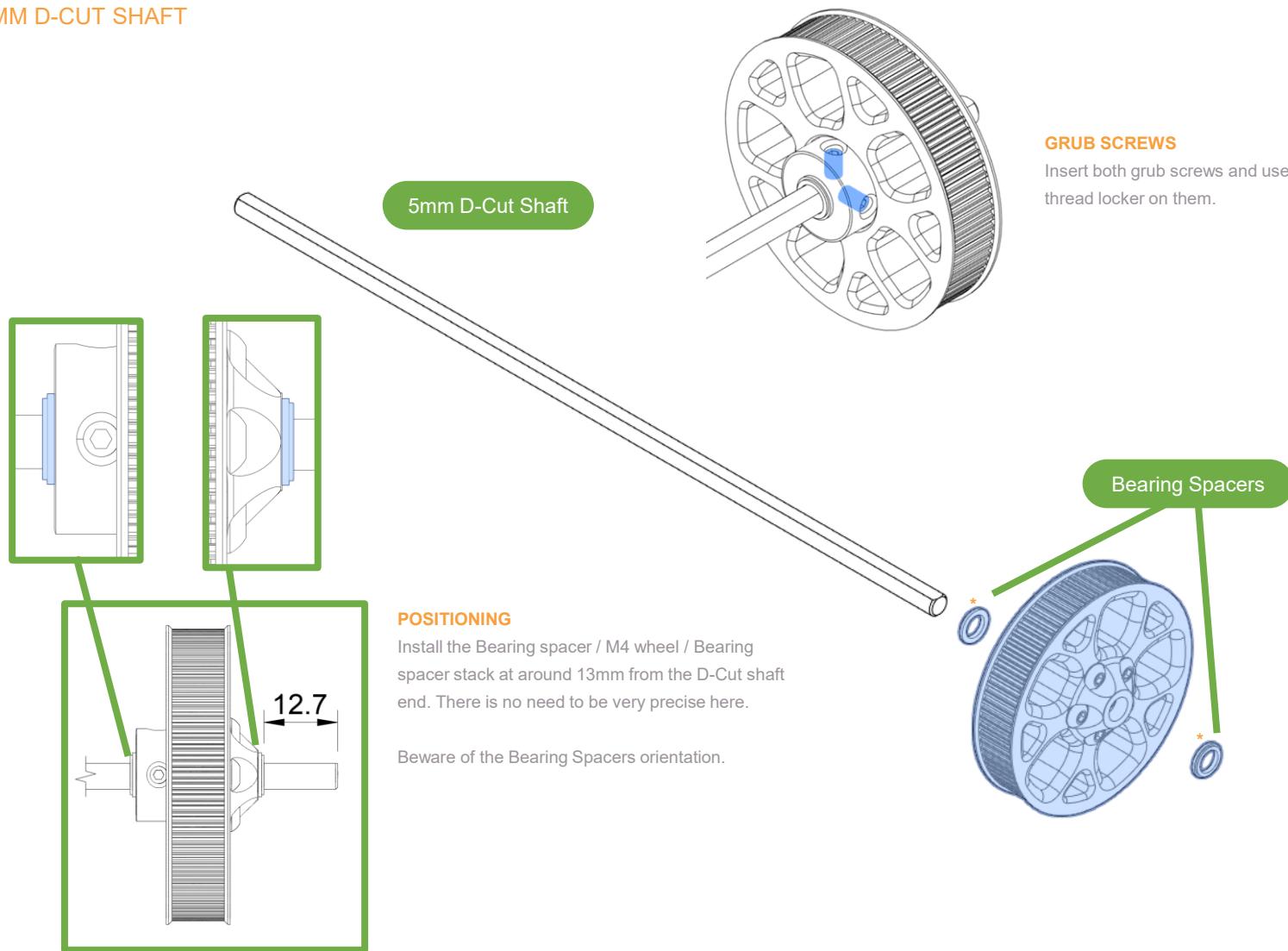


REMOVE FLANGE

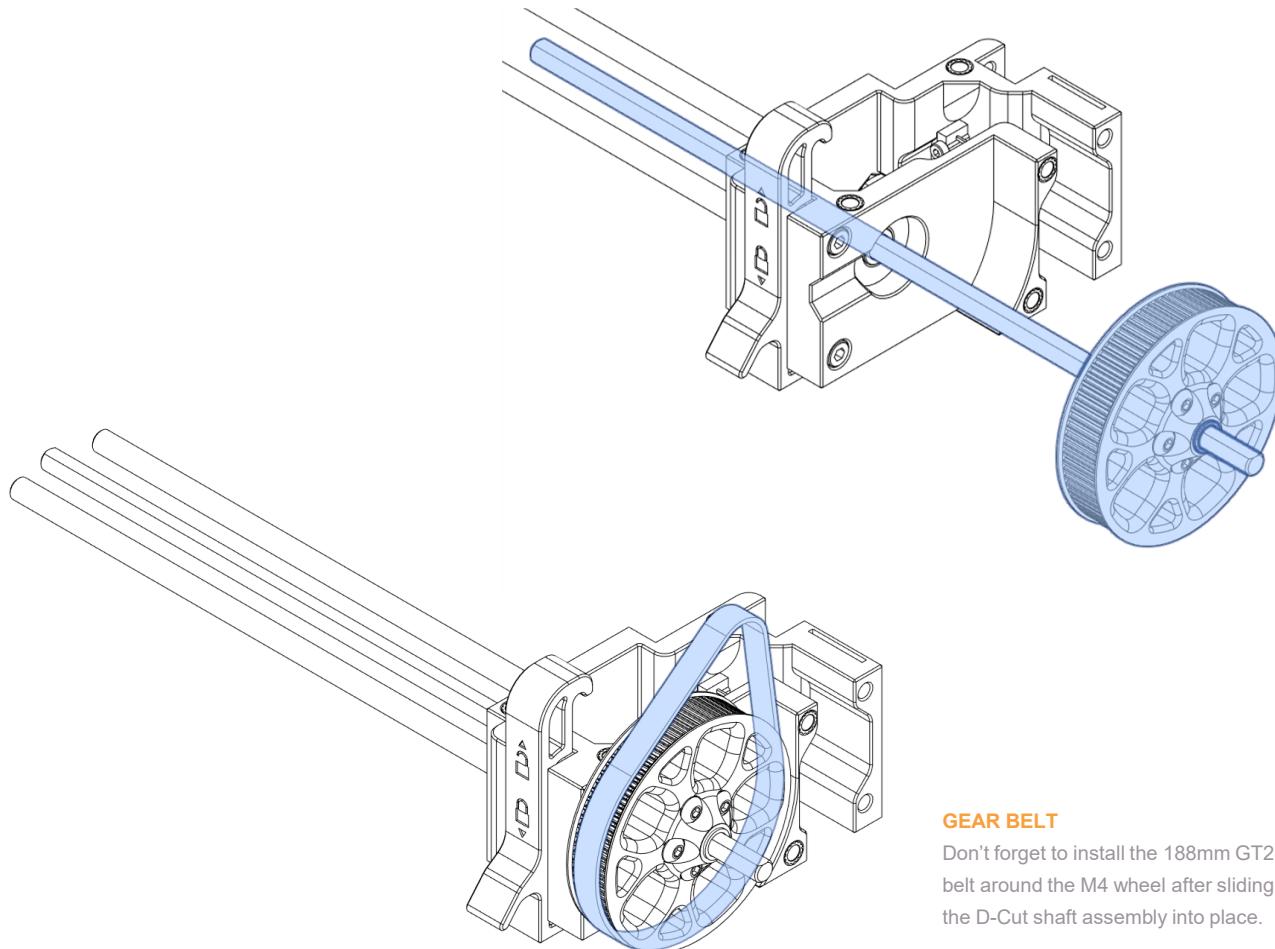
Use some pliers to remove the top flange of the pulley.



5MM D-CUT SHAFT



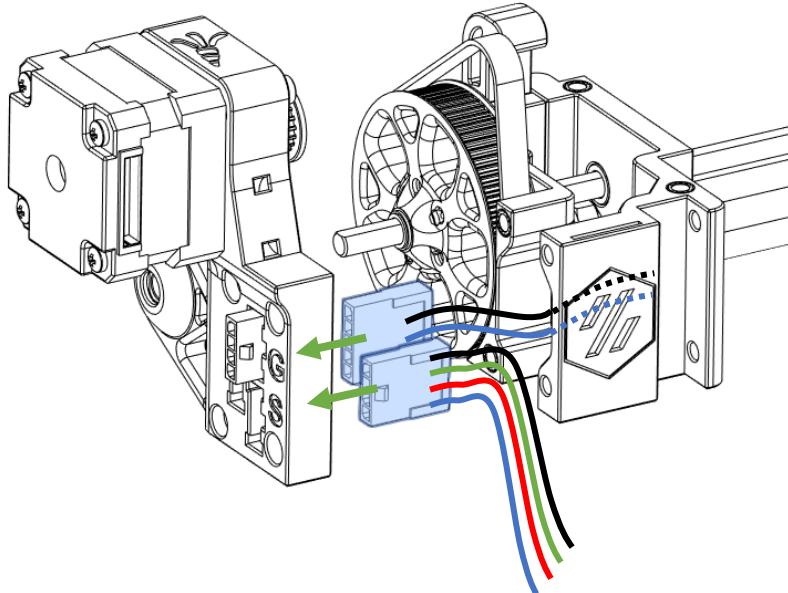
GEAR BOX



GEAR BELT

Don't forget to install the 188mm GT2 belt around the M4 wheel after sliding the D-Cut shaft assembly into place.

GEAR BOX



INSERT THE MICROFIT CONNECTORS

Insert the two microfit connectors from the wire bundles into their dedicated holes in the Motor Arm.

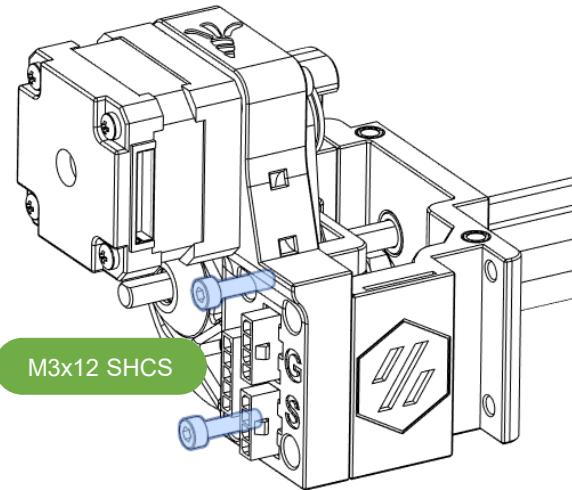
For picture clarity, only the microswitch wires are shown for the 5pins connectors (but the others are assumed present).

Let all the free wires hang to the bottom.

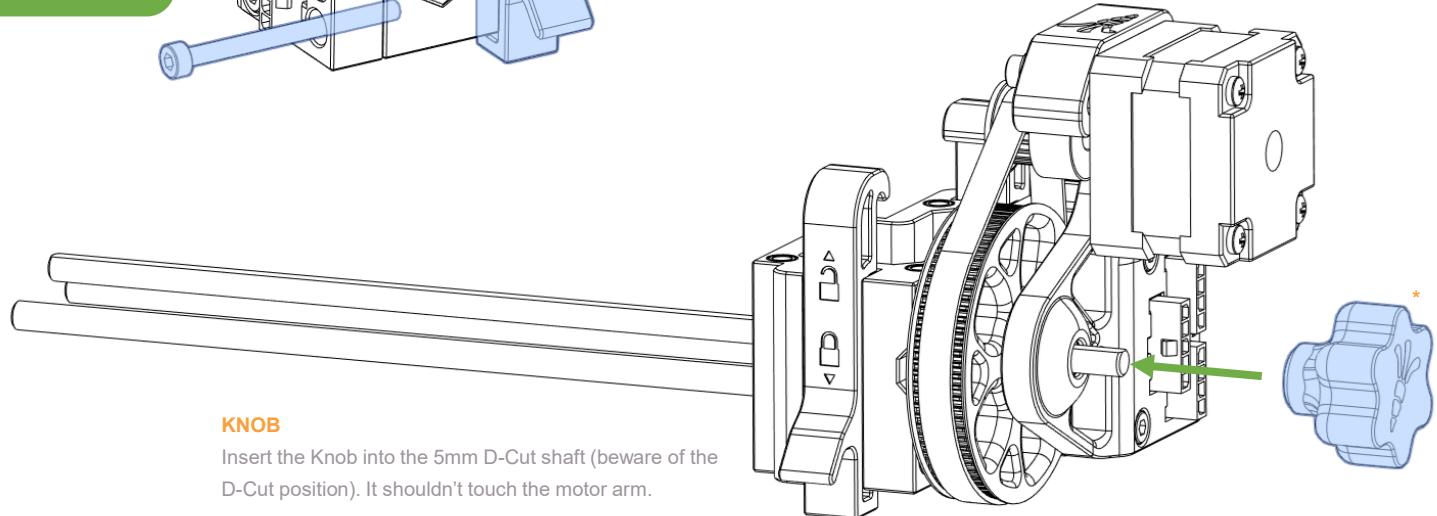
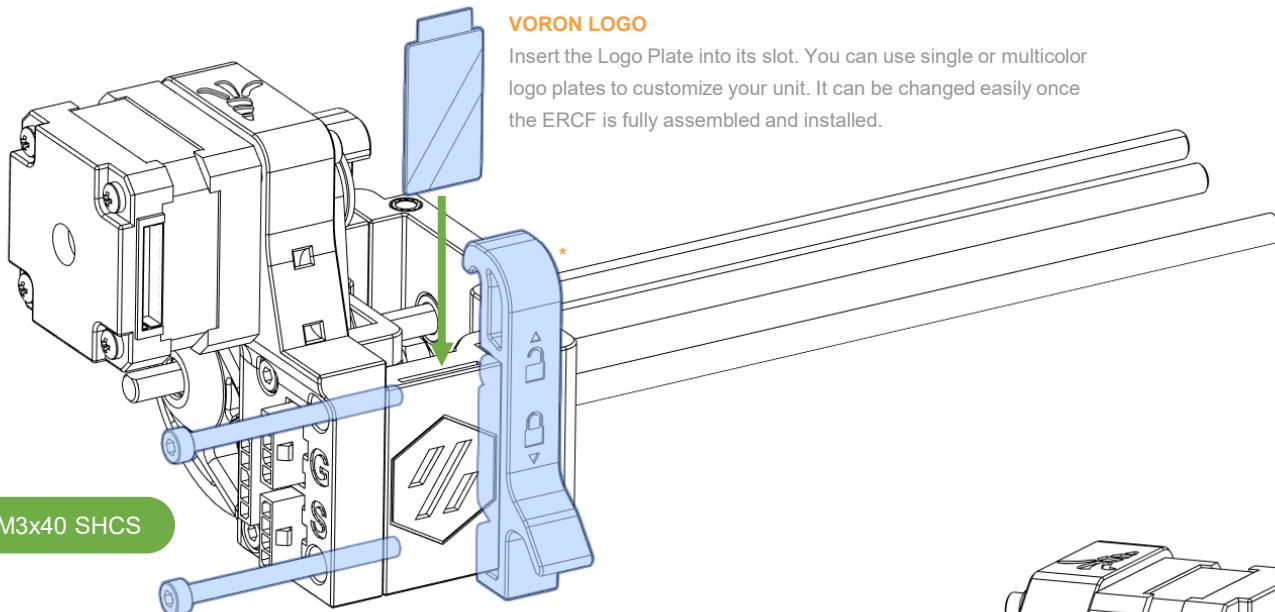
CLOSING THE GEAR BOX

Install the Motor Arm, pass the belt around the GT2 pulley of the Gear Motor, but don't tension it yet.

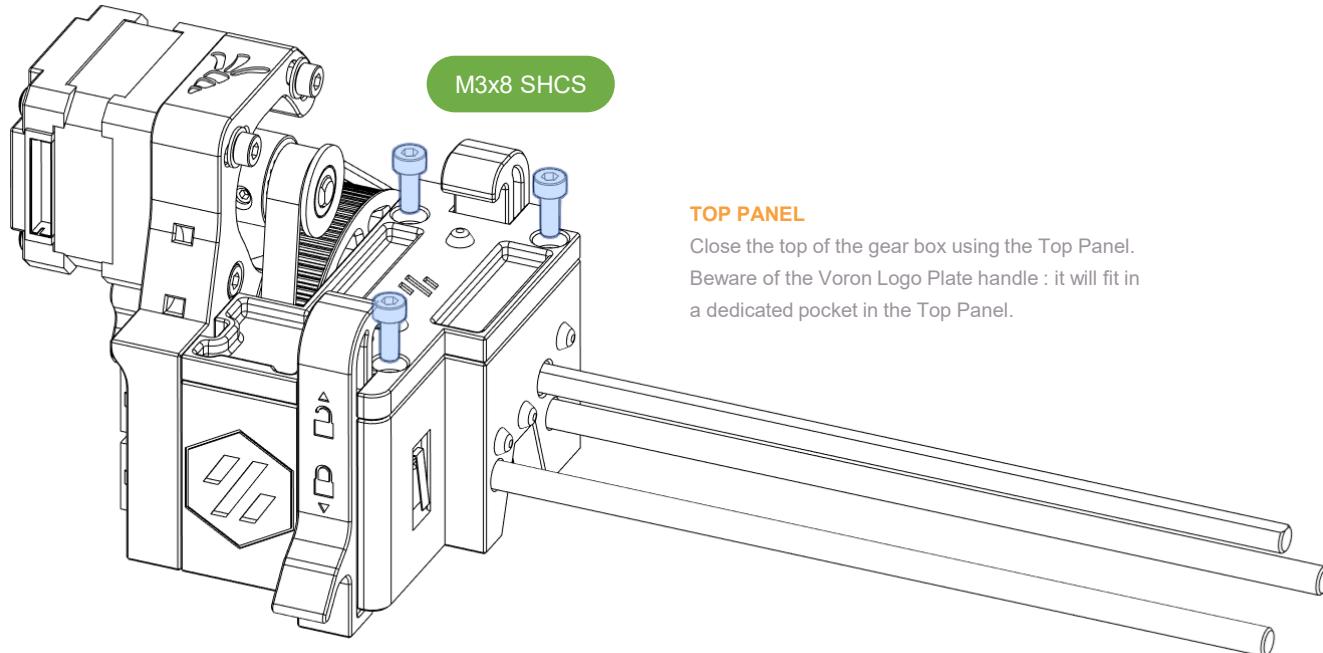
Make sure no wire is pinched between parts. All free wires should hang to the bottom.



GEAR BOX



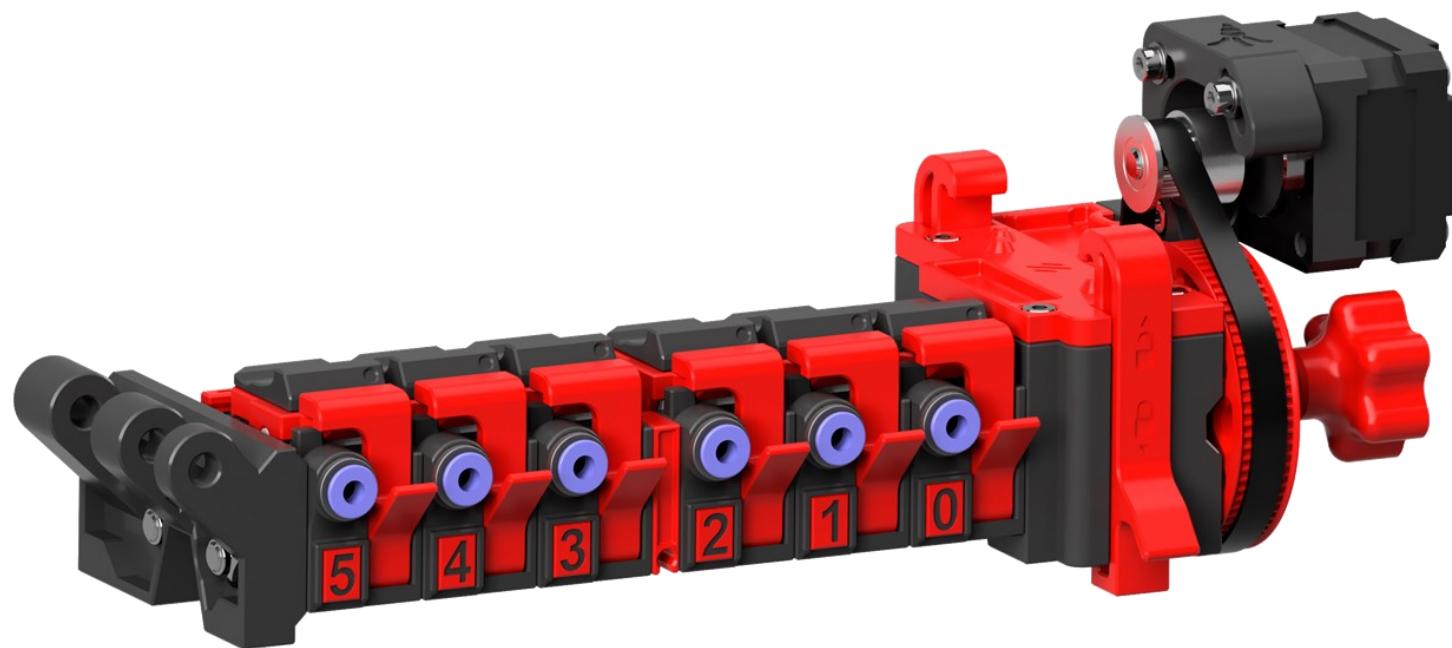
TOP PANEL



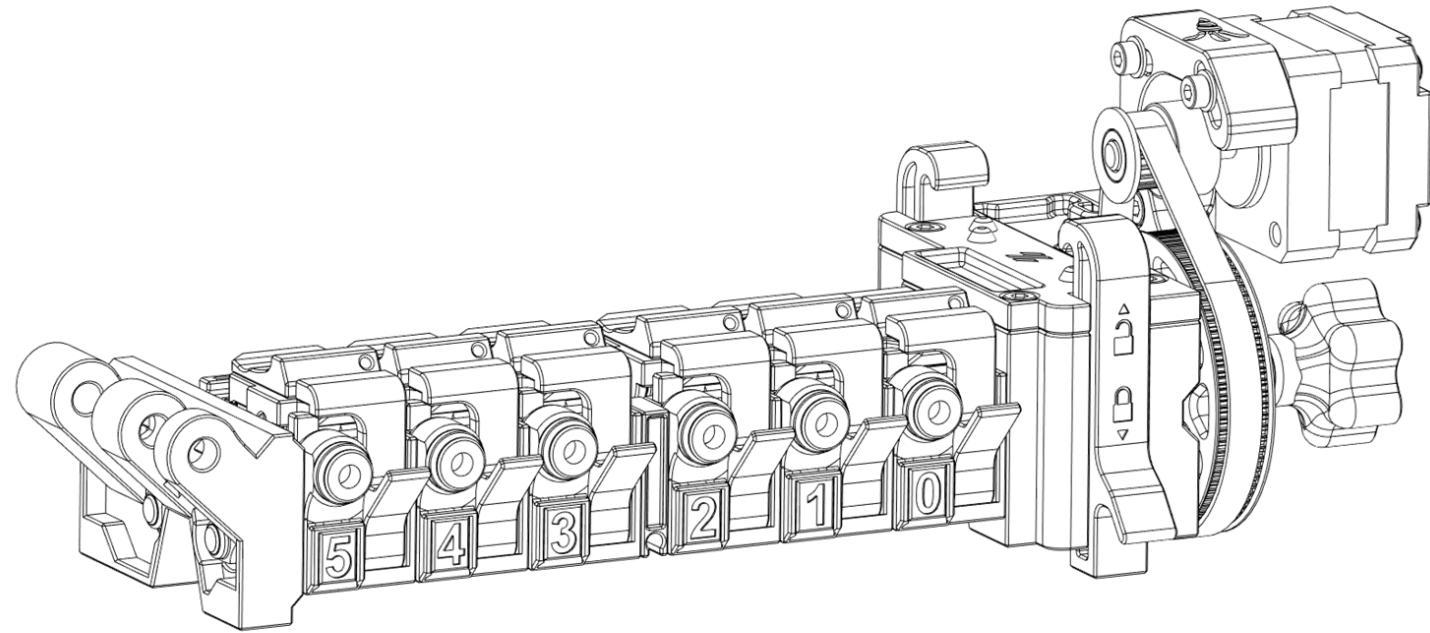
TOP PANEL

Close the top of the gear box using the Top Panel.
Beware of the Voron Logo Plate handle : it will fit in
a dedicated pocket in the Top Panel.

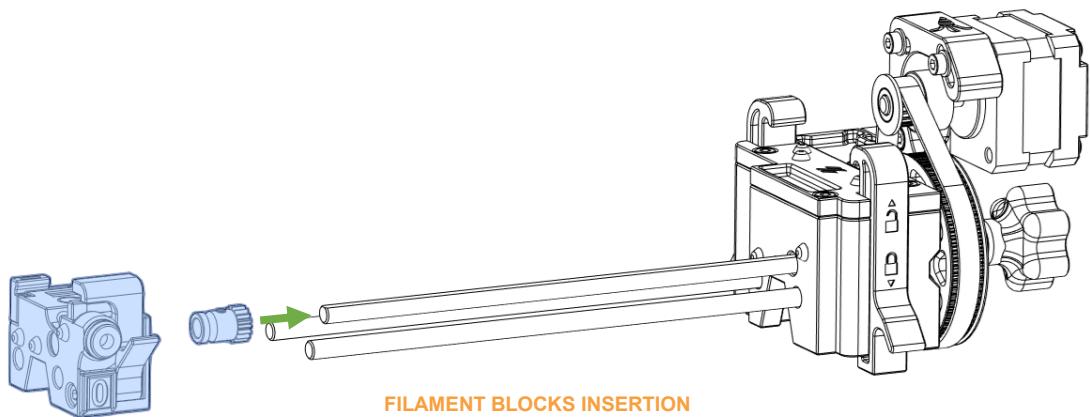
BOTTOM BLOCK



OVERVIEW

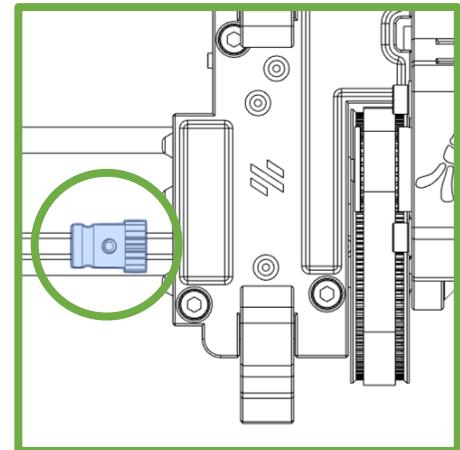


FULL BOTTOM BLOCK



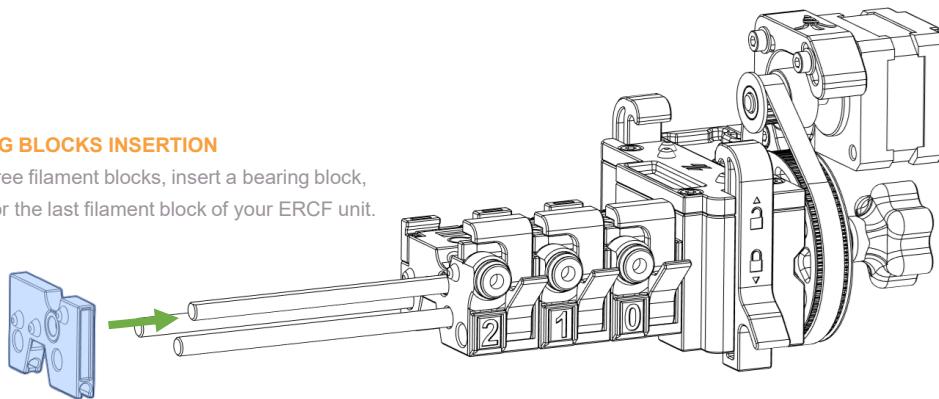
FILAMENT BLOCKS INSERTION

Slide a single Bondtech gear on the D-Cut shaft (beware of its orientation!) and only then slide the first filament block.
Do not tighten the grub screws yet.

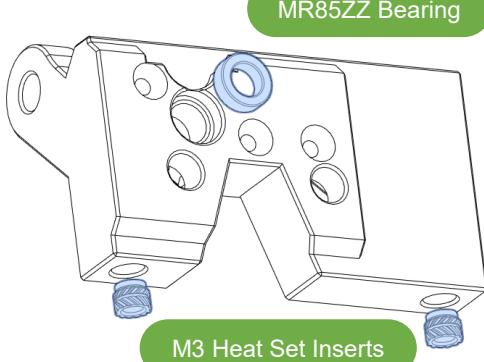


BEARING BLOCKS INSERTION

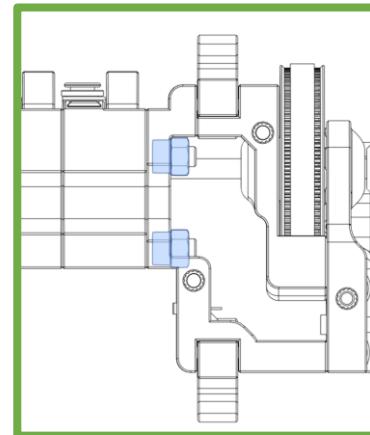
Every three filament blocks, insert a bearing block,
except for the last filament block of your ERCF unit.



FILAMENT BLOCKS END

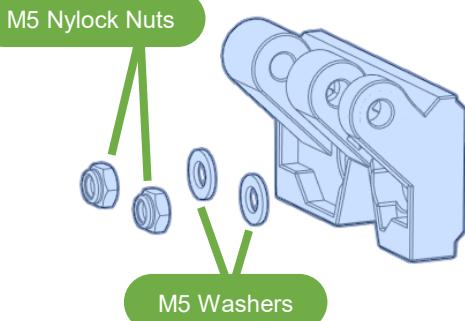


View from the bottom of the ERCF.



FILAMENT BLOCKS END

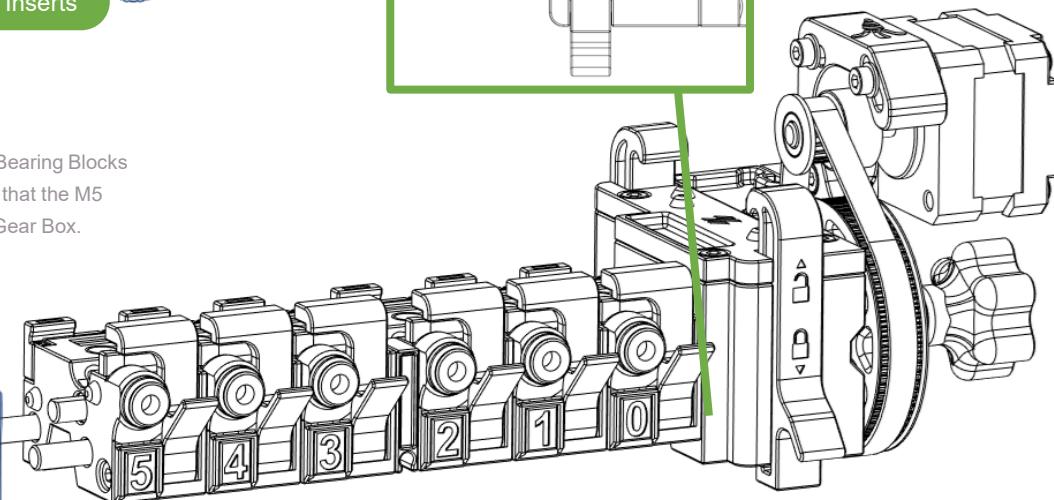
After all your Bondtechs gears, Filament Blocks and Bearing Blocks are slid in, insert the Filament Blocks End. Make sure that the M5 Threaded Rods are fully inserted in their slots in the Gear Box.



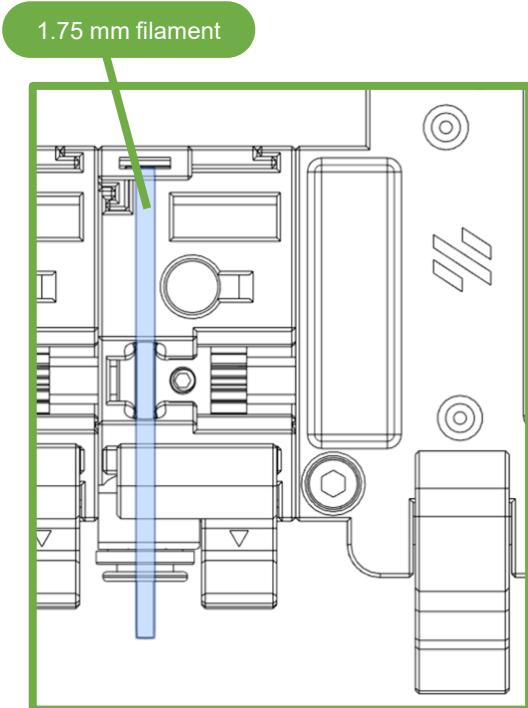
M5 NYLOCK NUTS

Do not over tighten those screws, as this will bend the unit and can cause issues later on. Whole assembly should not wobble but will still flex if you apply pressure on it, this is normal.

Do not turn the 5mm D-Cut shaft yet : no Bondtech gears grub screws are tightened at this stage.



BONDTECH GEARS ALIGNMENT



View from the top of the ERCF.

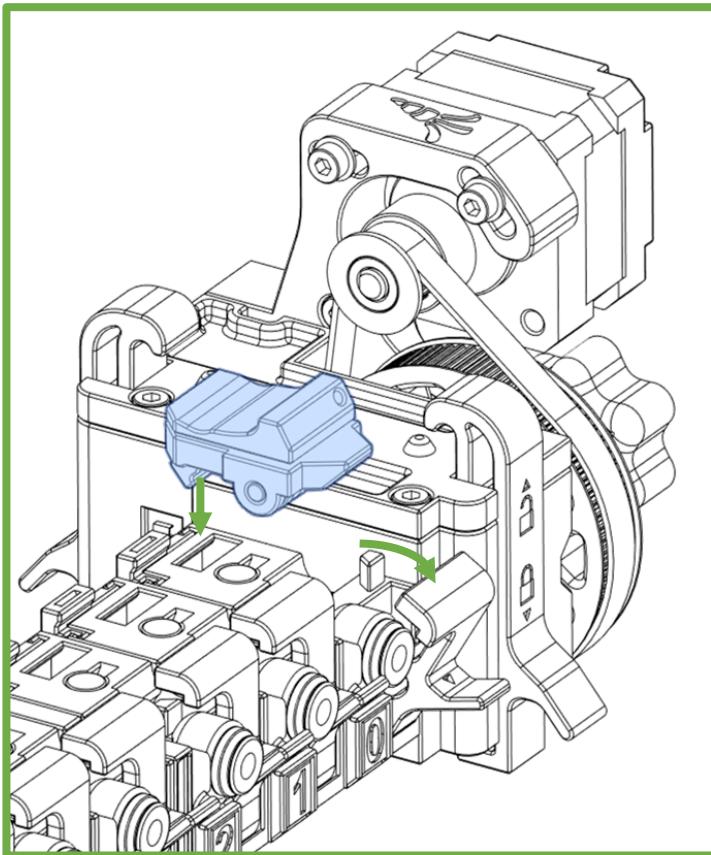
GEAR ALIGNMENT

Insert a small PTFE tube (few cms is enough) into the first channel ECAS and then insert some filament through the channel. Make sure the flat part of the D-Cut shaft is facing the Bondtech gear grub screw and use the filament to properly align the gear, then tighten the grub screw.

Don't forget to use thread locker on the grub screw.

Repeat this process for all channels.

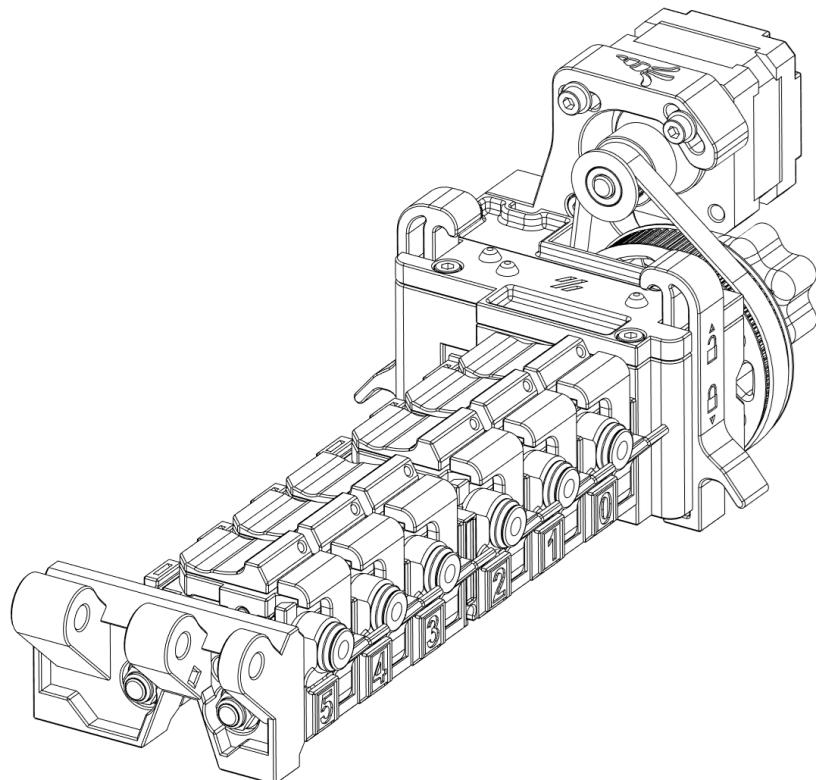
TOP HATS



TOP HATS INSTALLATION

Open the latch of the first channel and slide the Top Hat arm into the Filament Block dedicated hole. You'll need to find the proper orientation to insert it, you should not force too much.

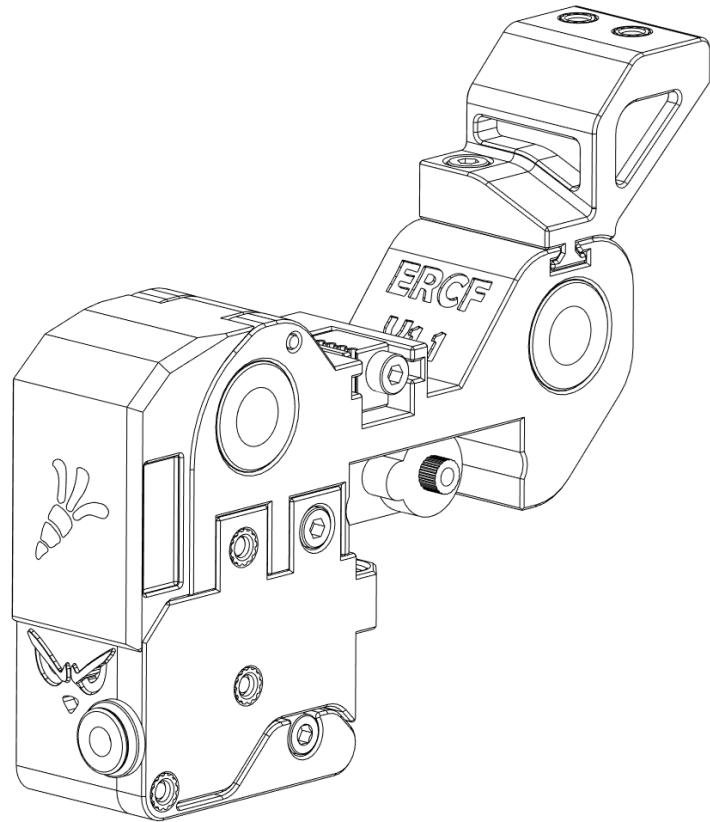
Once installed, close the latch, and repeat this process for all channels.



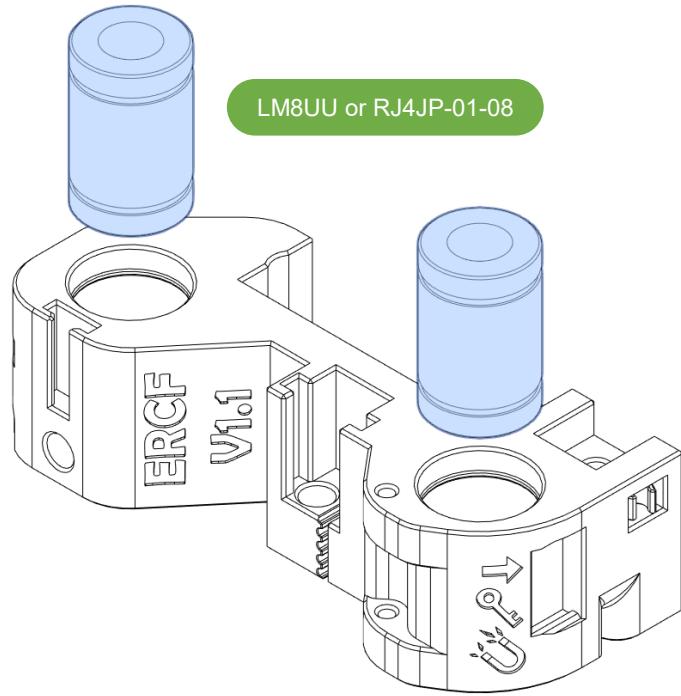
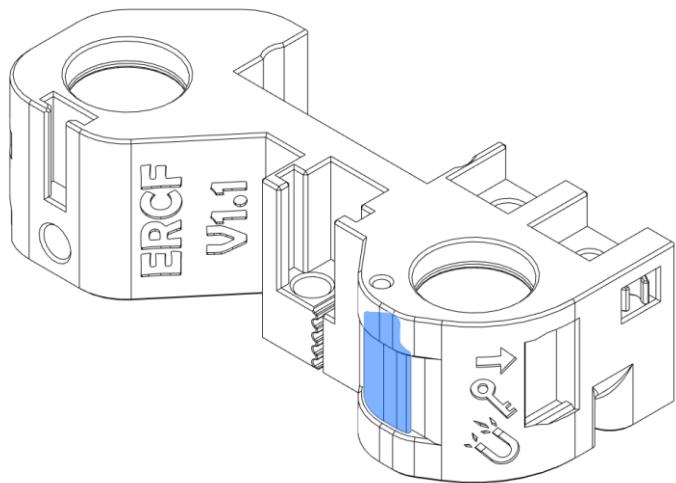
SELECTOR



OVERVIEW



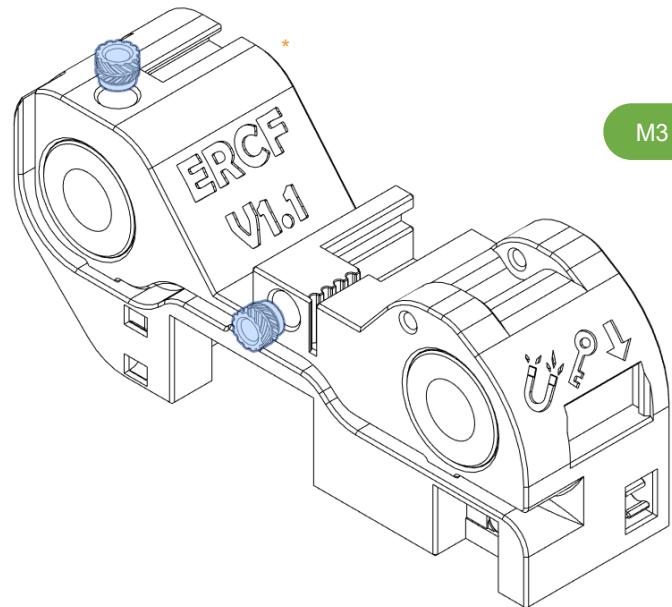
SELECTOR CART



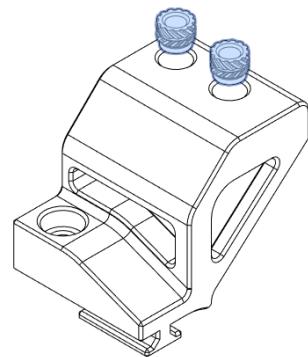
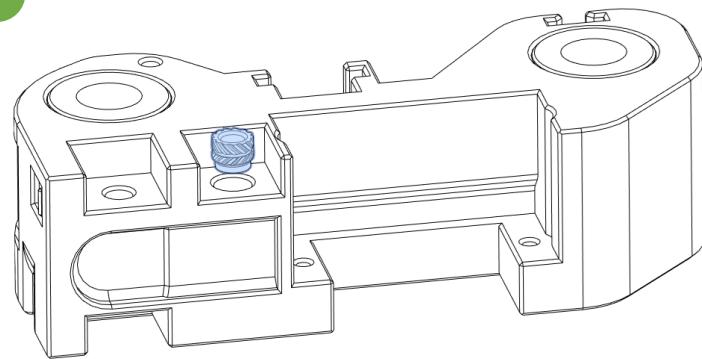
REMOVE BUILT-IN SUPPORT

Use a small tool, like a small flat screwdriver, to remove the built-in support.

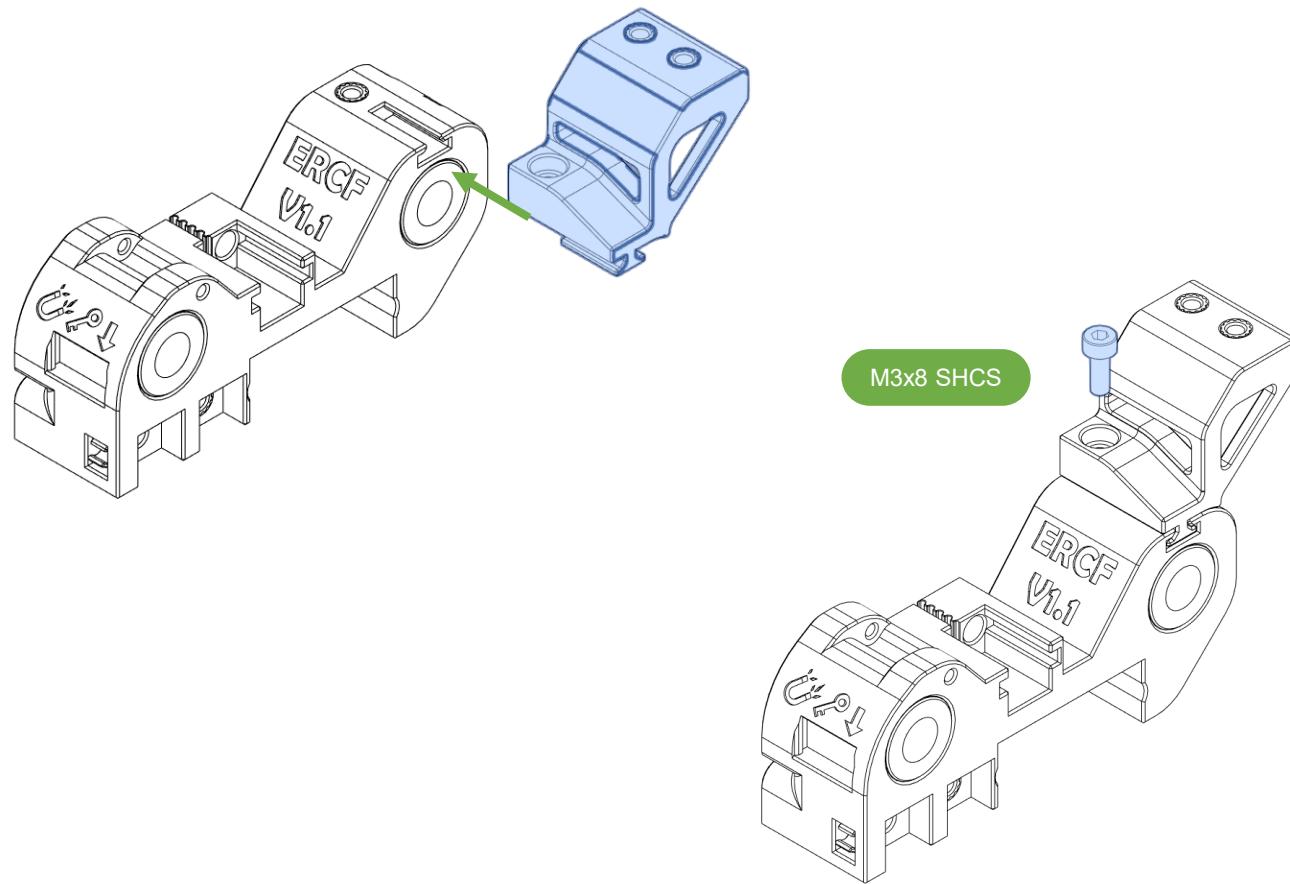
SELECTOR CART



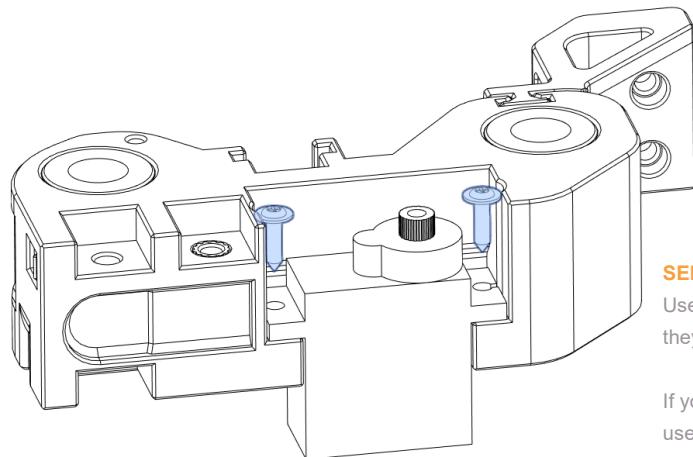
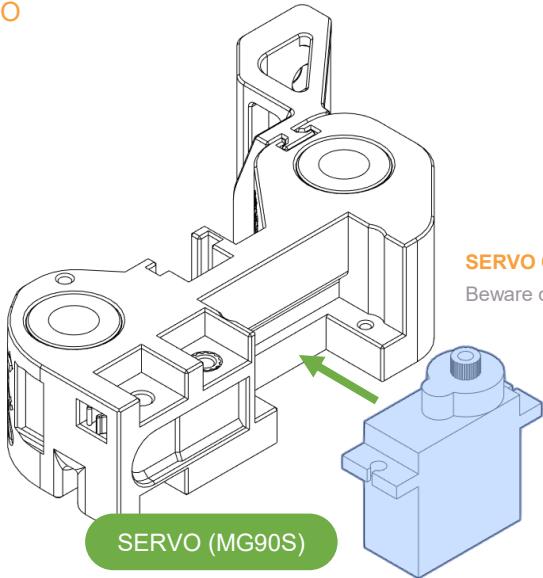
M3 Heat Set Inserts



DRAG CHAIN ANCHOR



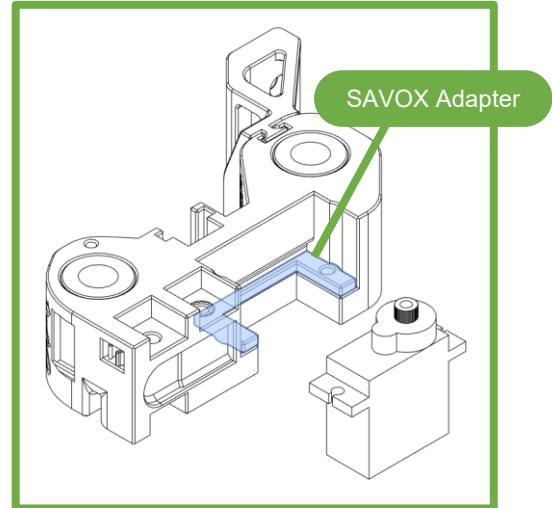
SERVO



SERVO SCREWS

Use the screws from the servo kit you have, they'll tap directly into the selector cart plastic.

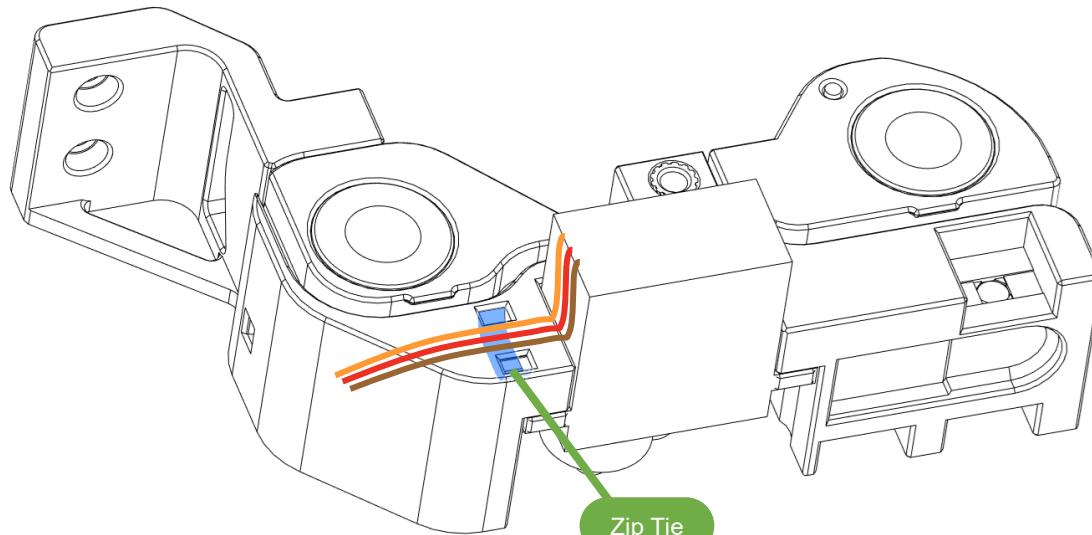
If you're using a SAVOX SH0255-MH servo, use two M2x10 SHCS.



ERCF V1.0 SERVO COMPATIBILITY

In case you're using the SAVOX SH0255-MH servo, please use the Savox Adapter spacer before installing the servo.

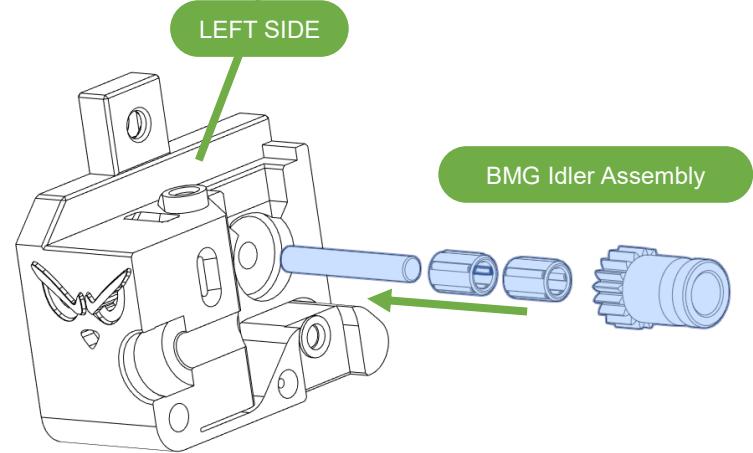
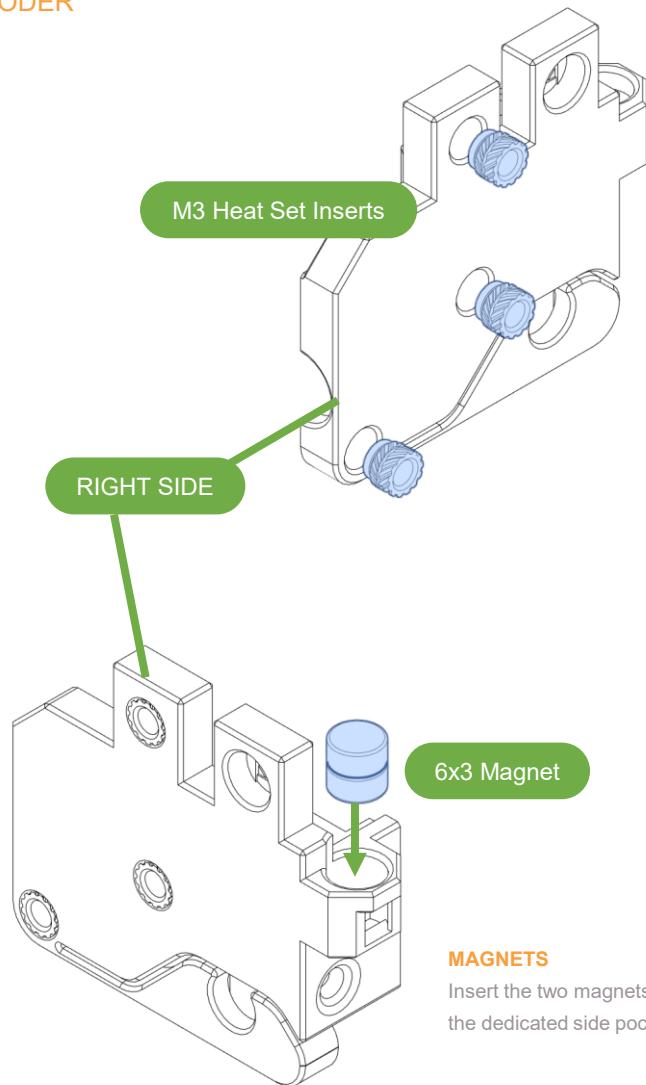
SERVO WIRES



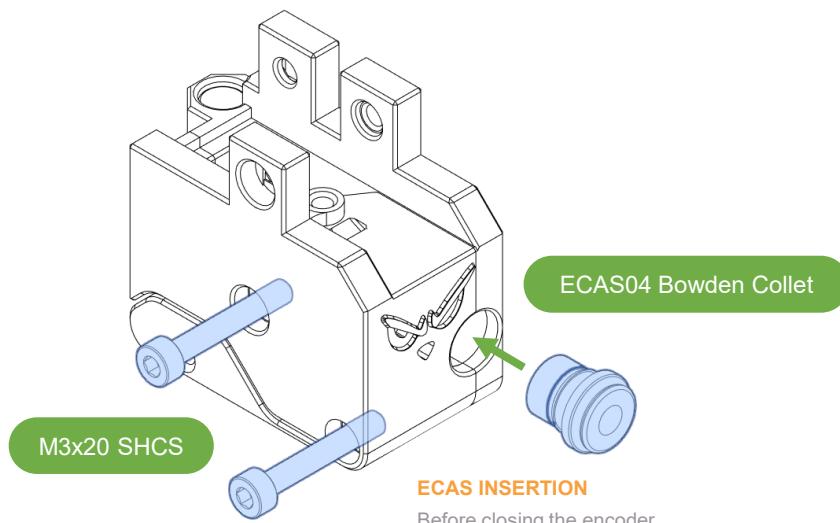
SERVO WIRES

Secure the servo wires using a zip tie. Make sure the wires are flat against the side of the servo, as shown.

ENCODER

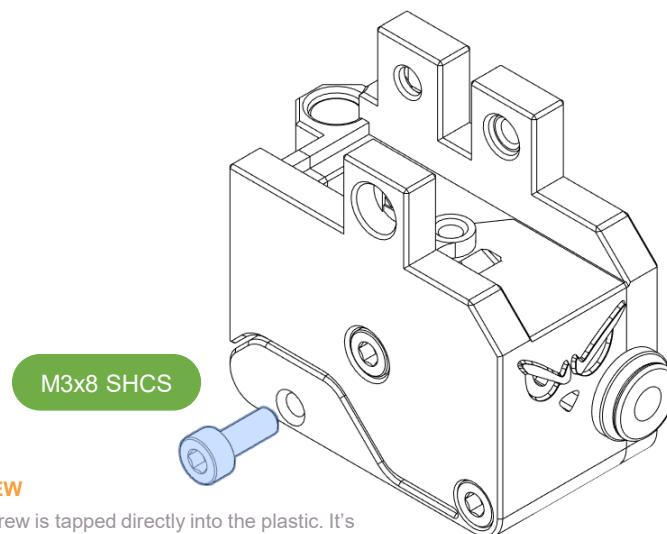


ENCODER



ECAS INSERTION

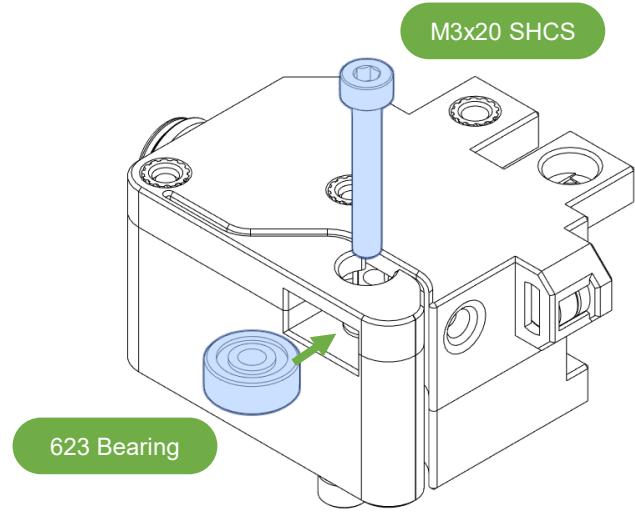
Before closing the encoder cart, insert the ECAS.



SIDE SCREW

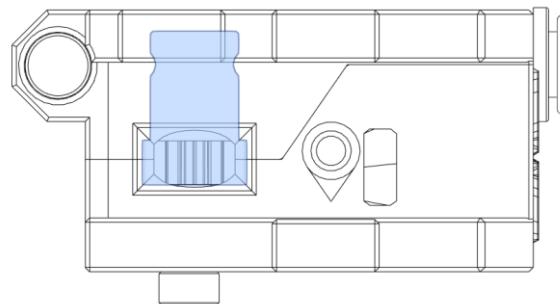
The side screw is tapped directly into the plastic. It's used to make physical contact with the selector endstop.

ENCODER

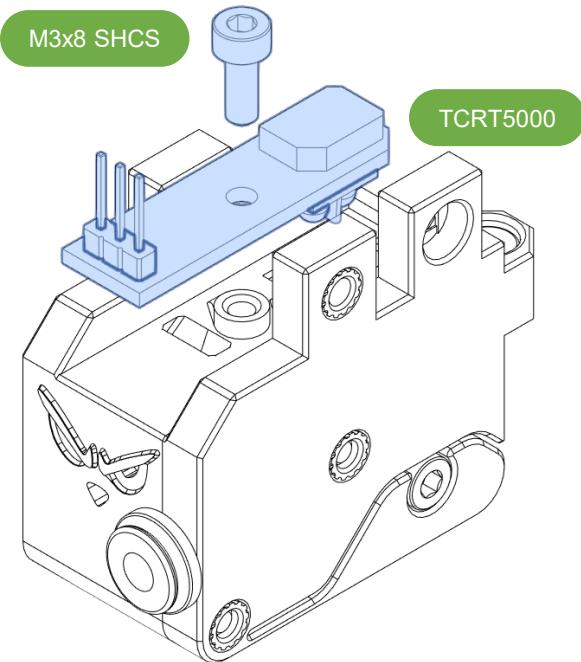


BMG GEAR ROTATION

Using some 1,75mm filament, check that the BMG gear spins well when you slide the filament in the encoder cart.



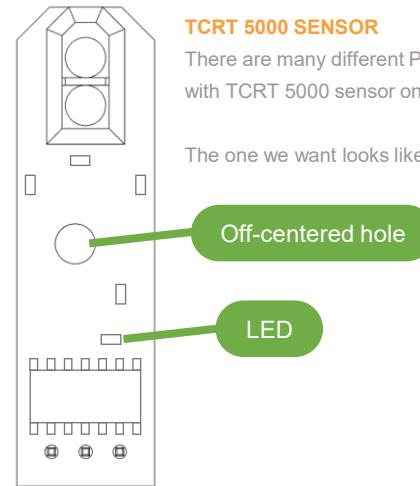
ENCODER SENSOR



TCRT 5000 SENSOR

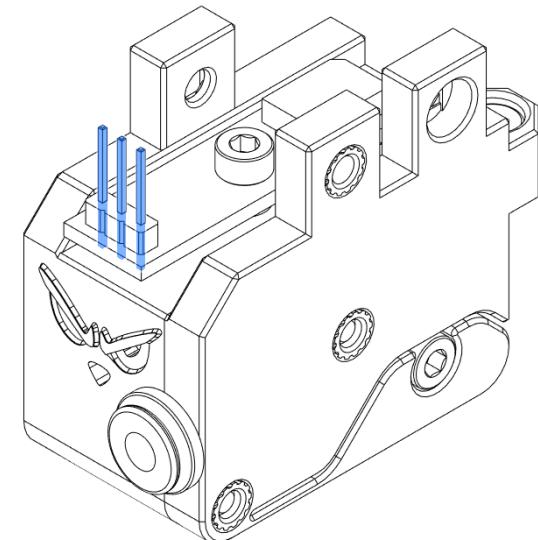
There are many different PCBs with TCRT 5000 sensor on them.

The one we want looks like this.

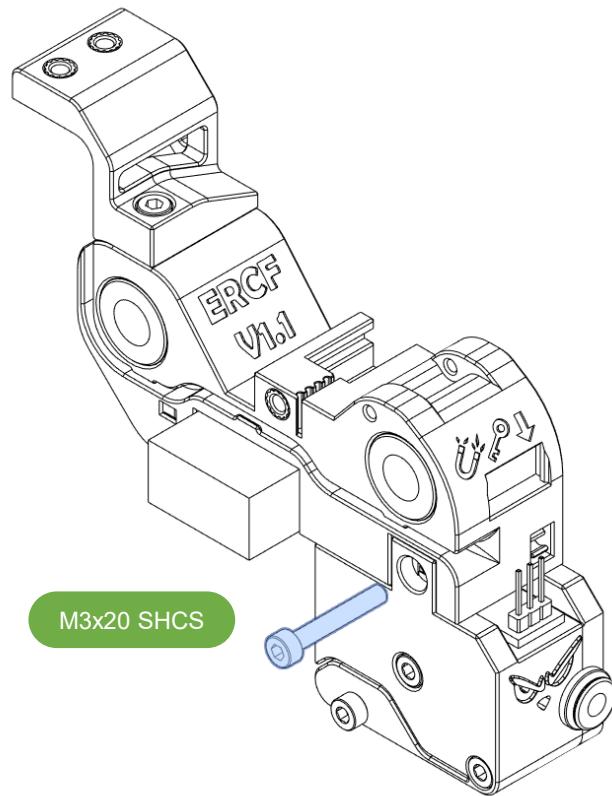
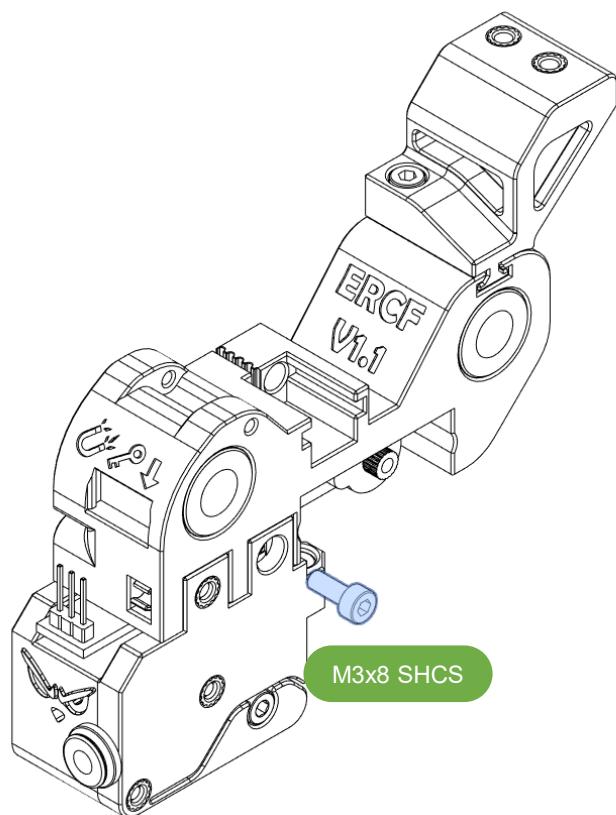


SENSOR PINS

Delicately straighten the sensor pins using pliers.



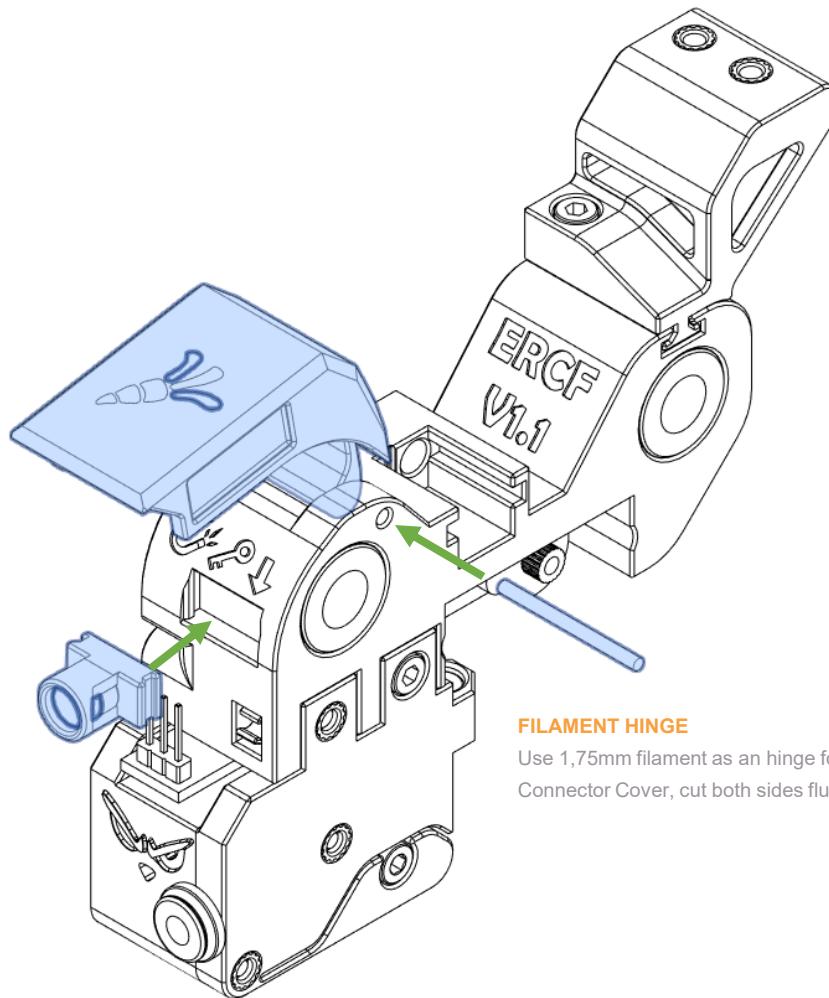
SELECTOR CART



GATE KEY

GATE KEY

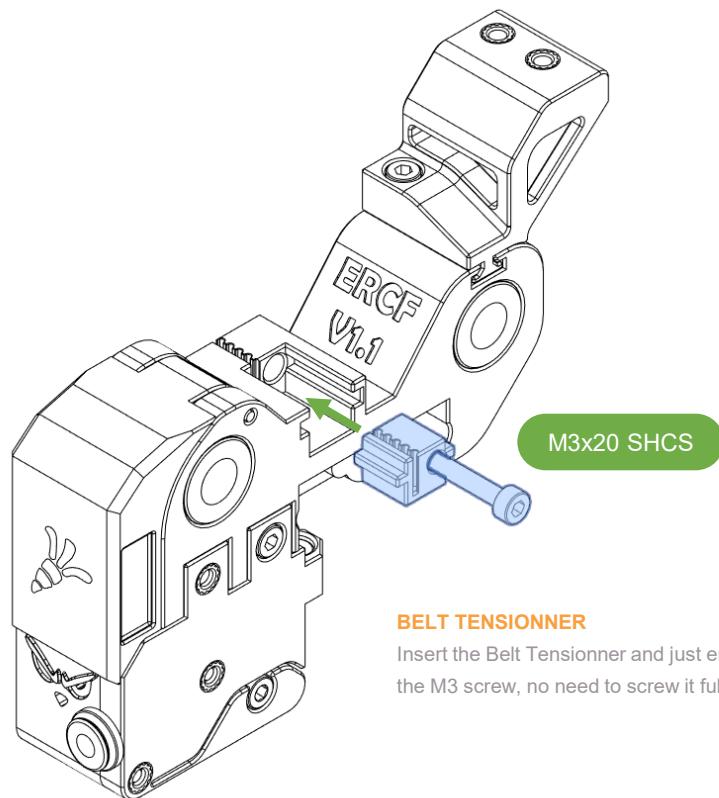
Install the Gate Key we assembled in the beginning in its dock.



FILAMENT HINGE

Use 1,75mm filament as an hinge for the Connector Cover, cut both sides flush.

BELT TENSIONNER



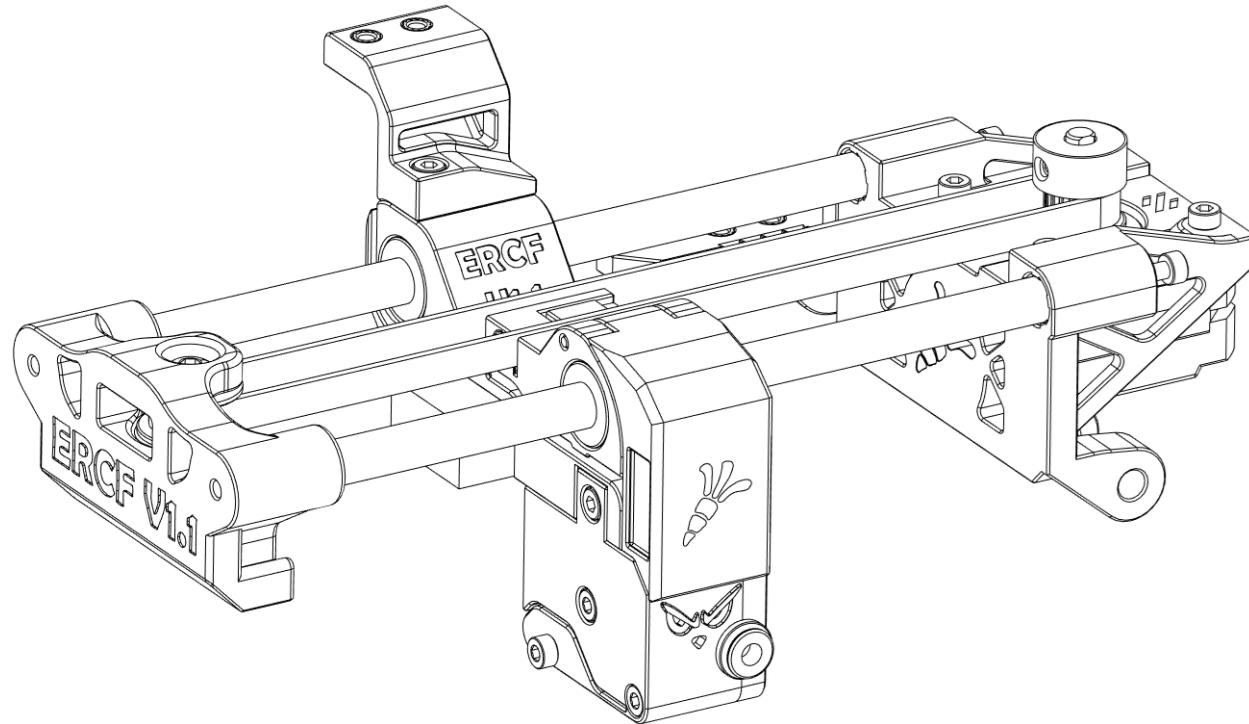
BELT TENSIONNER

Insert the Belt Tensionner and just engage the M3 screw, no need to screw it fully.

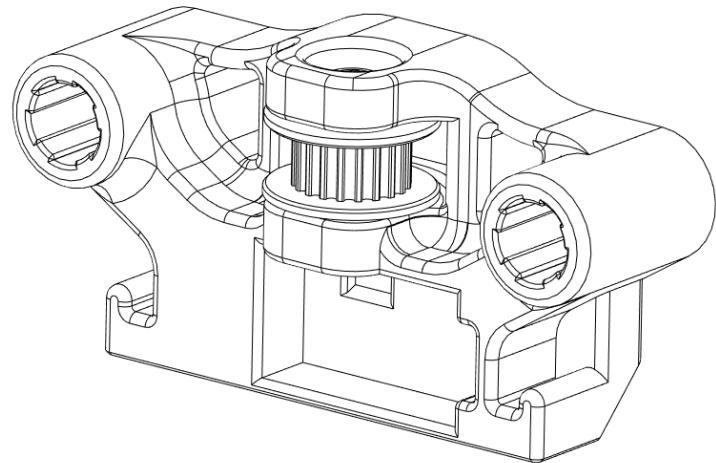
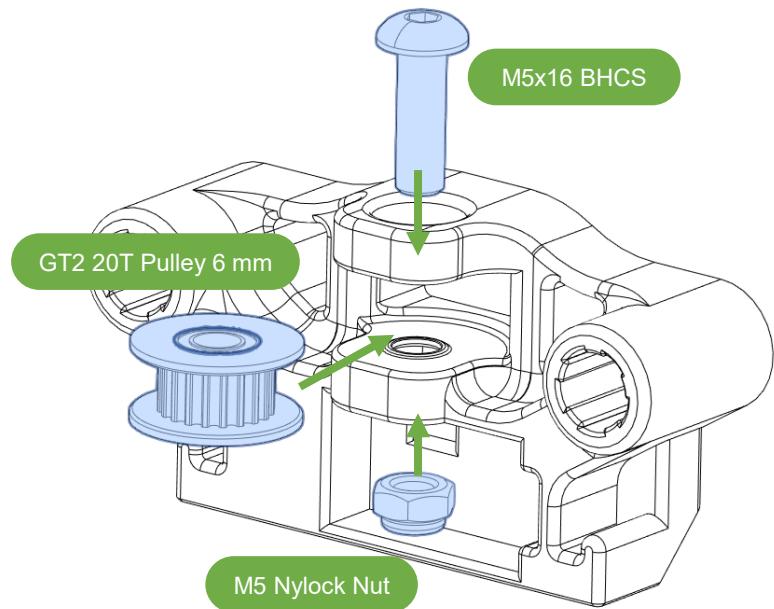
LINEAR AXIS



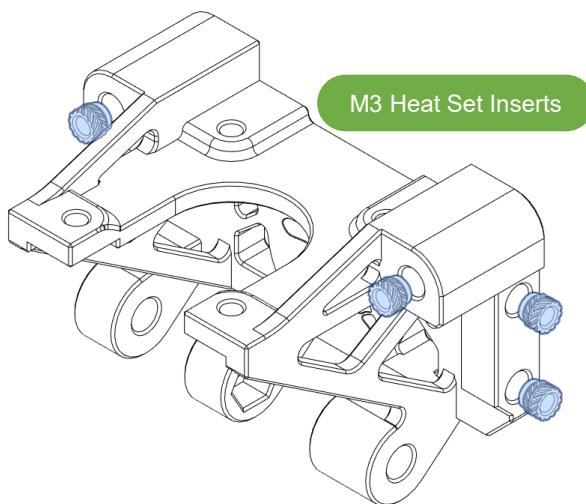
OVERVIEW



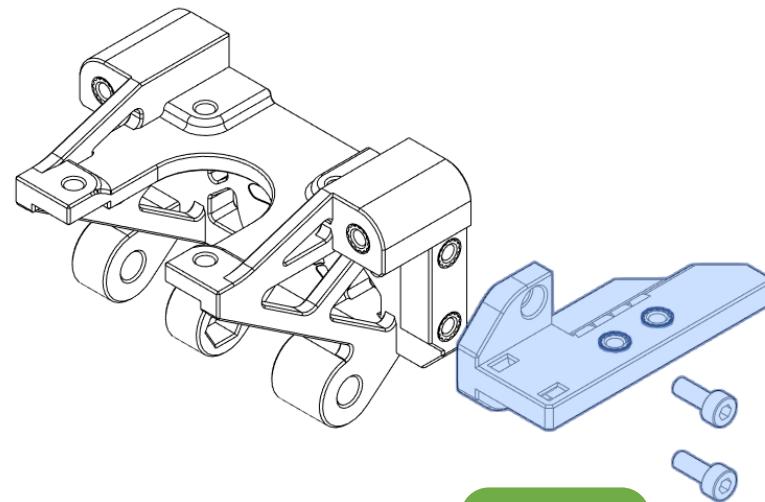
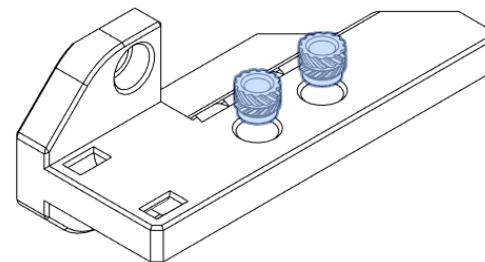
IDLER BLOCK



SELECTOR MOTOR SUPPORT

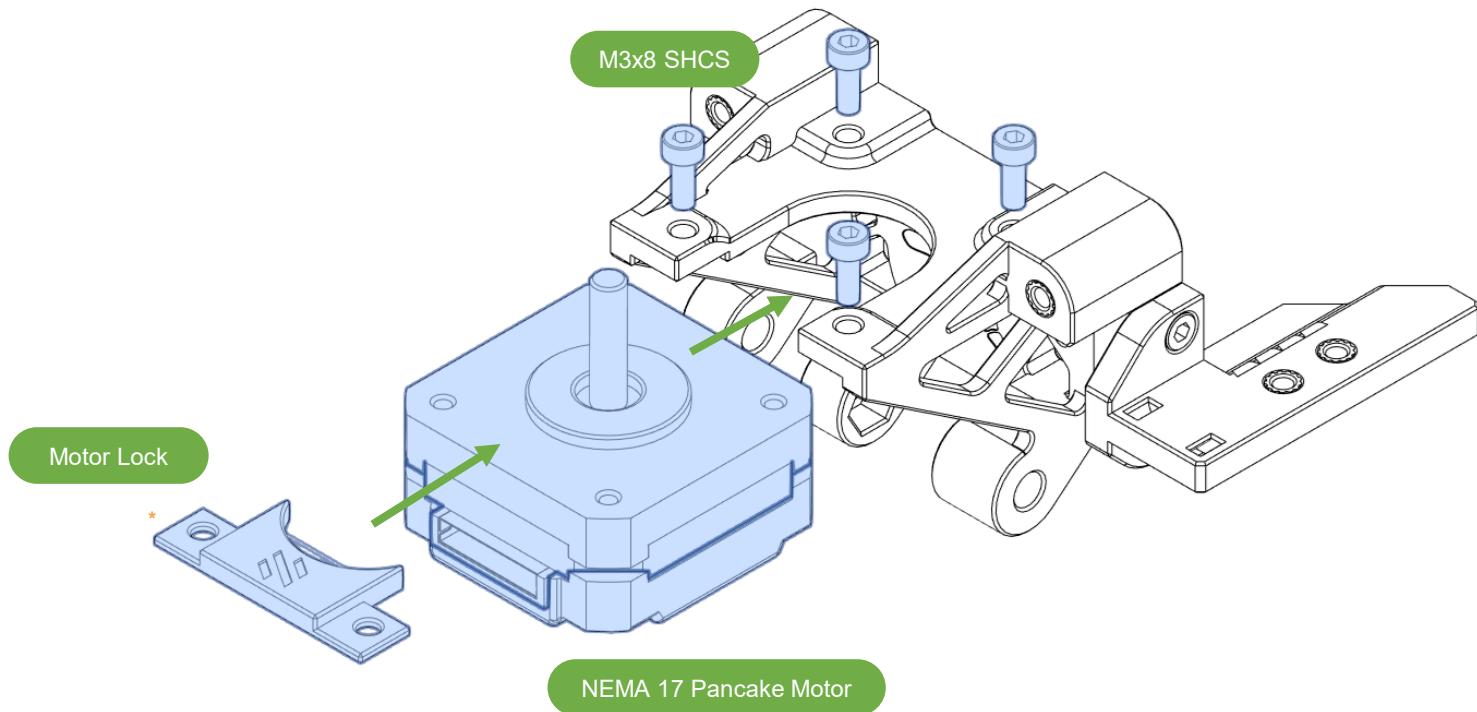


M3 Heat Set Inserts

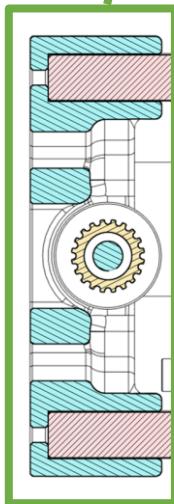
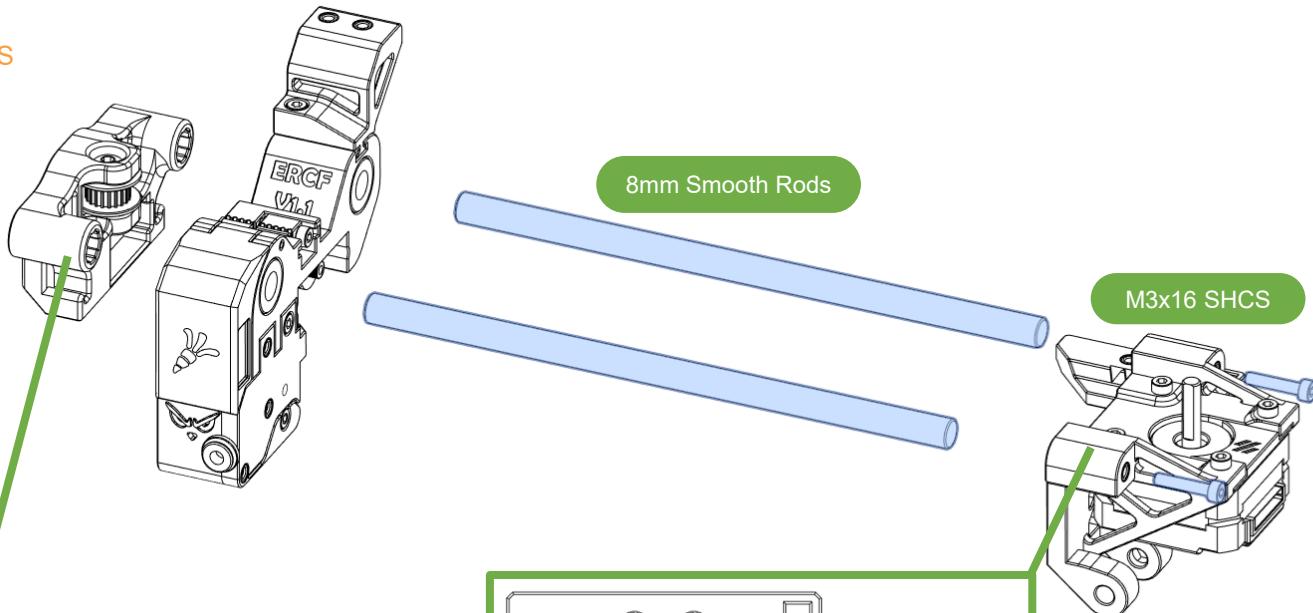


M3x8 SHCS

SELECTOR MOTOR SUPPORT

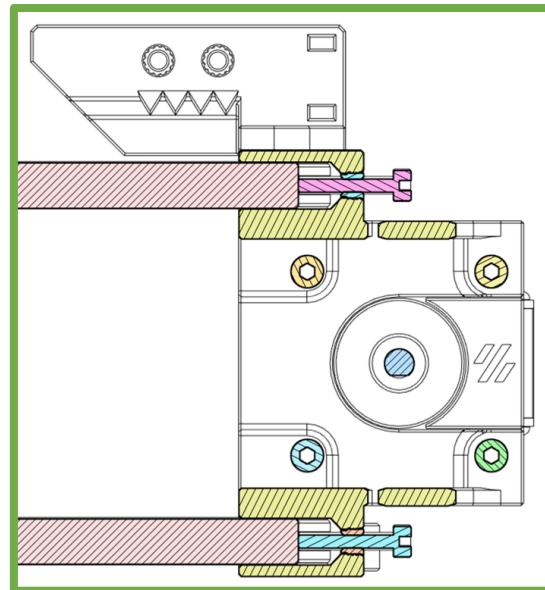


LINEAR AXIS



IDLER SIDE

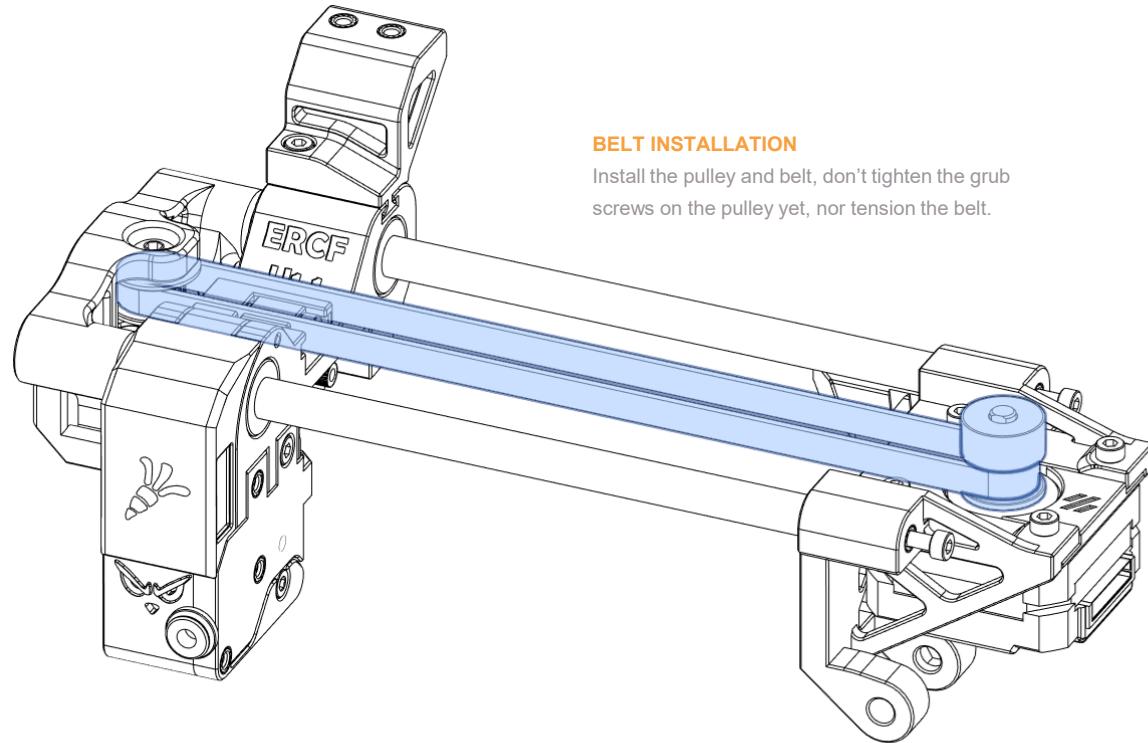
Insert fully the 8mm Smooth Rods on the idler side. There are holes allowing you to check the rods are well in place.



MOTOR SIDE

Don't fully insert the rods on the motor side for now, let them in a central position and just get the M3x16 SHCS screws to contact.

BELT



BELT INSTALLATION

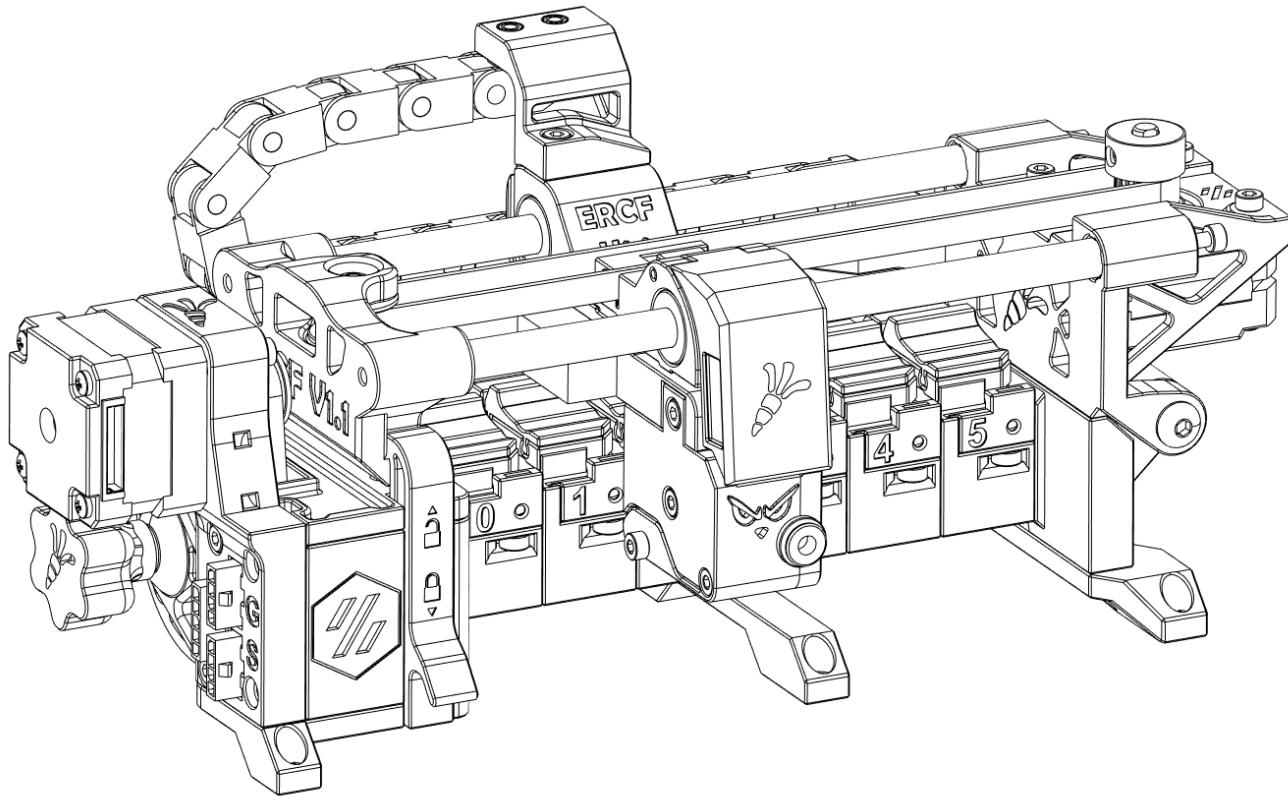
Install the pulley and belt, don't tighten the grub screws on the pulley yet, nor tension the belt.

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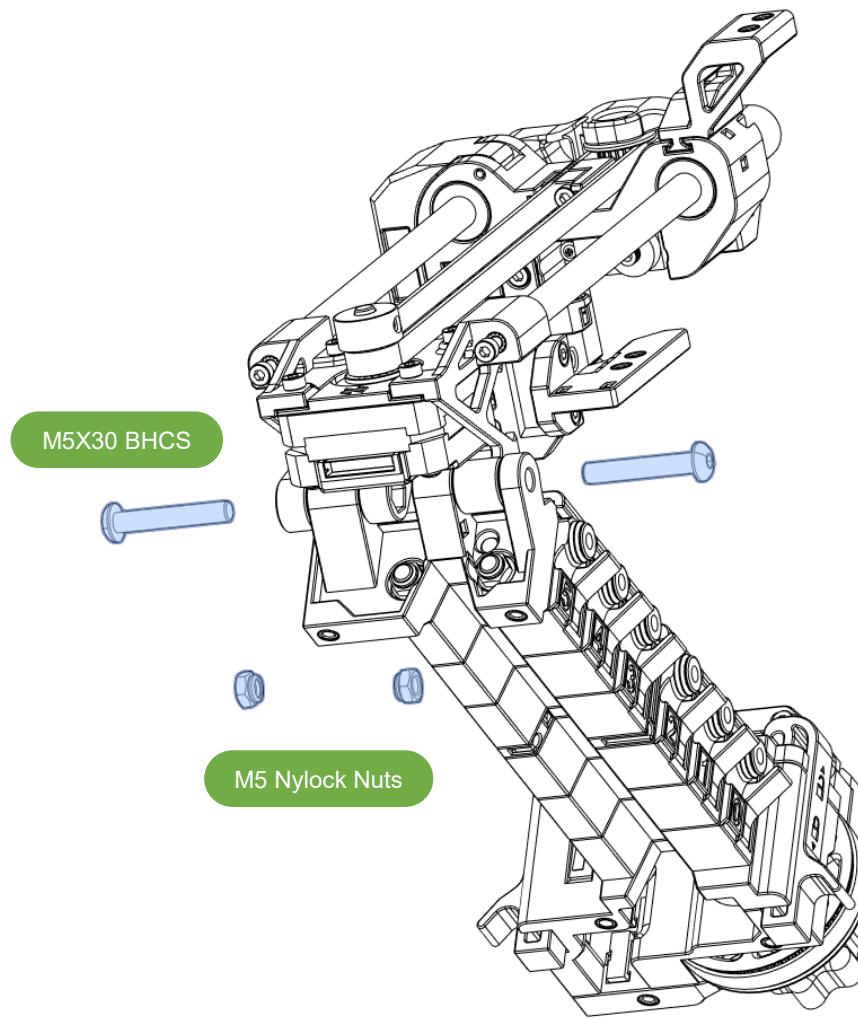
FINAL ASSEMBLY



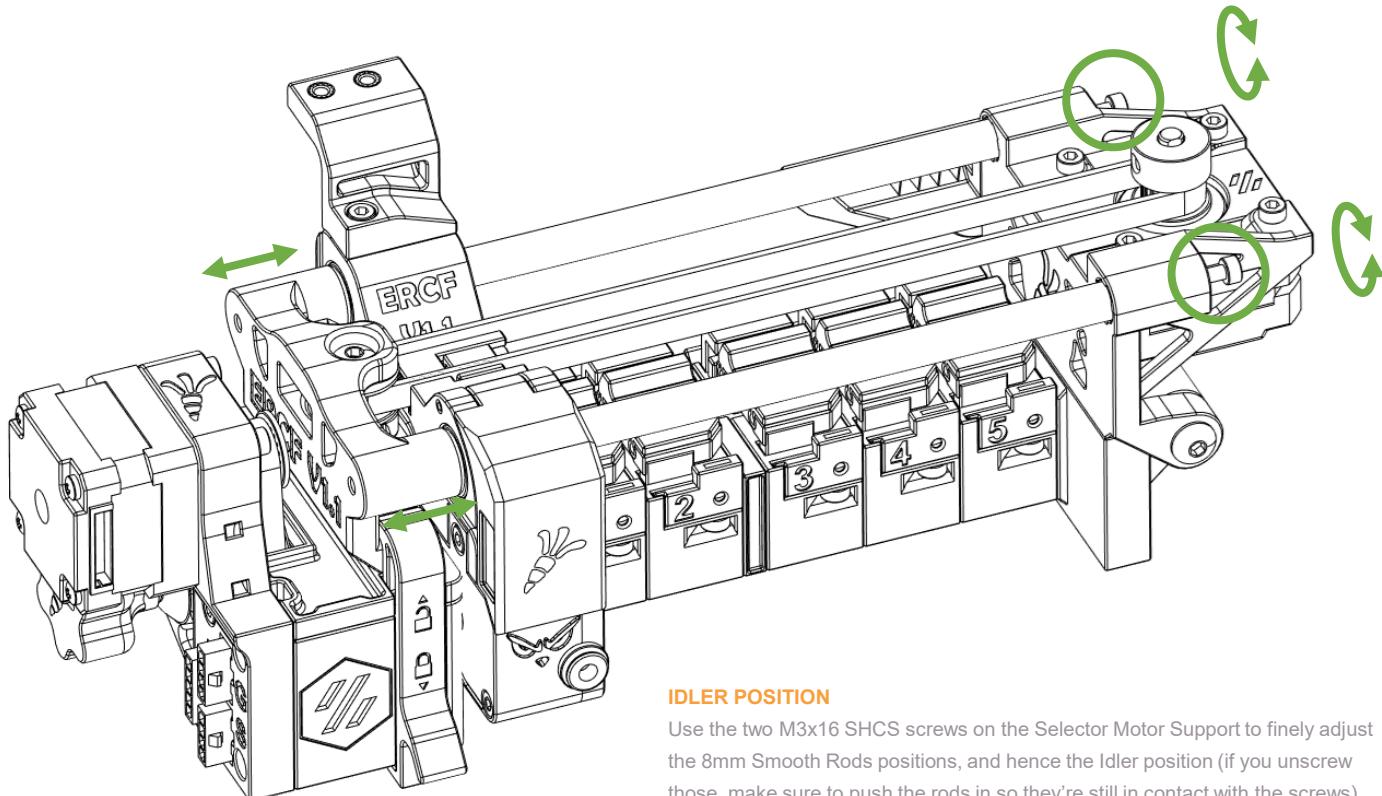
OVERVIEW



JOINING THE TWO BLOCKS



IDLER ADJUSTEMENT



IDLER POSITION

Use the two M3x16 SHCS screws on the Selector Motor Support to finely adjust the 8mm Smooth Rods positions, and hence the Idler position (if you unscrew those, make sure to push the rods in so they're still in contact with the screws).

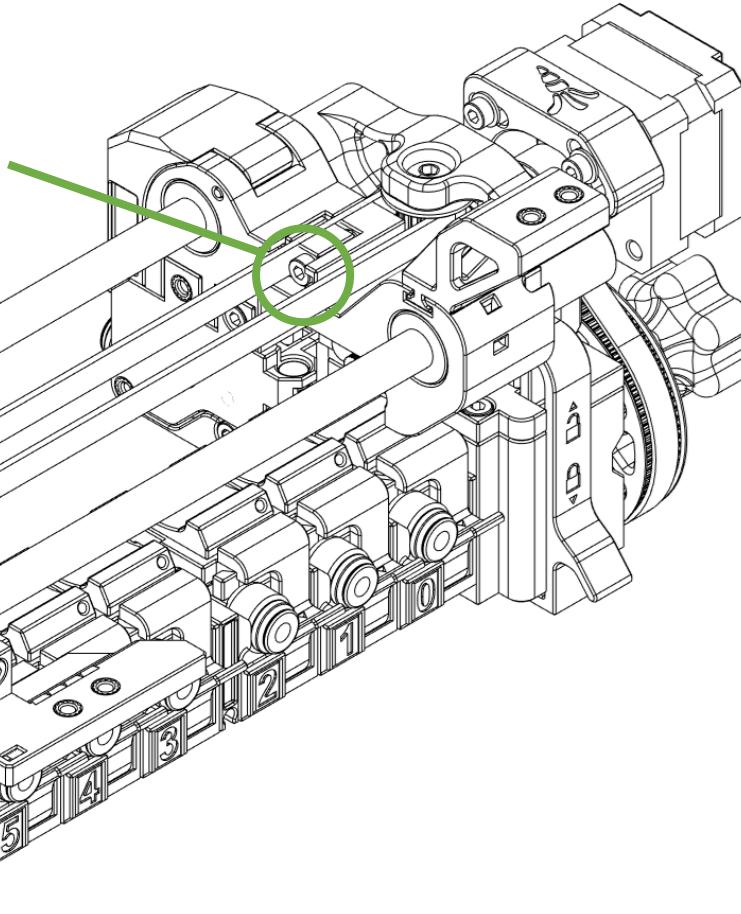
Make sure the 3 small slots on the Idler match the Gear Box Top Panel bumps.

Once the tuning is done, lock the linear axis using the two Gear Box Side Latches.

TENSIONING THE BELT

BELT TENSION

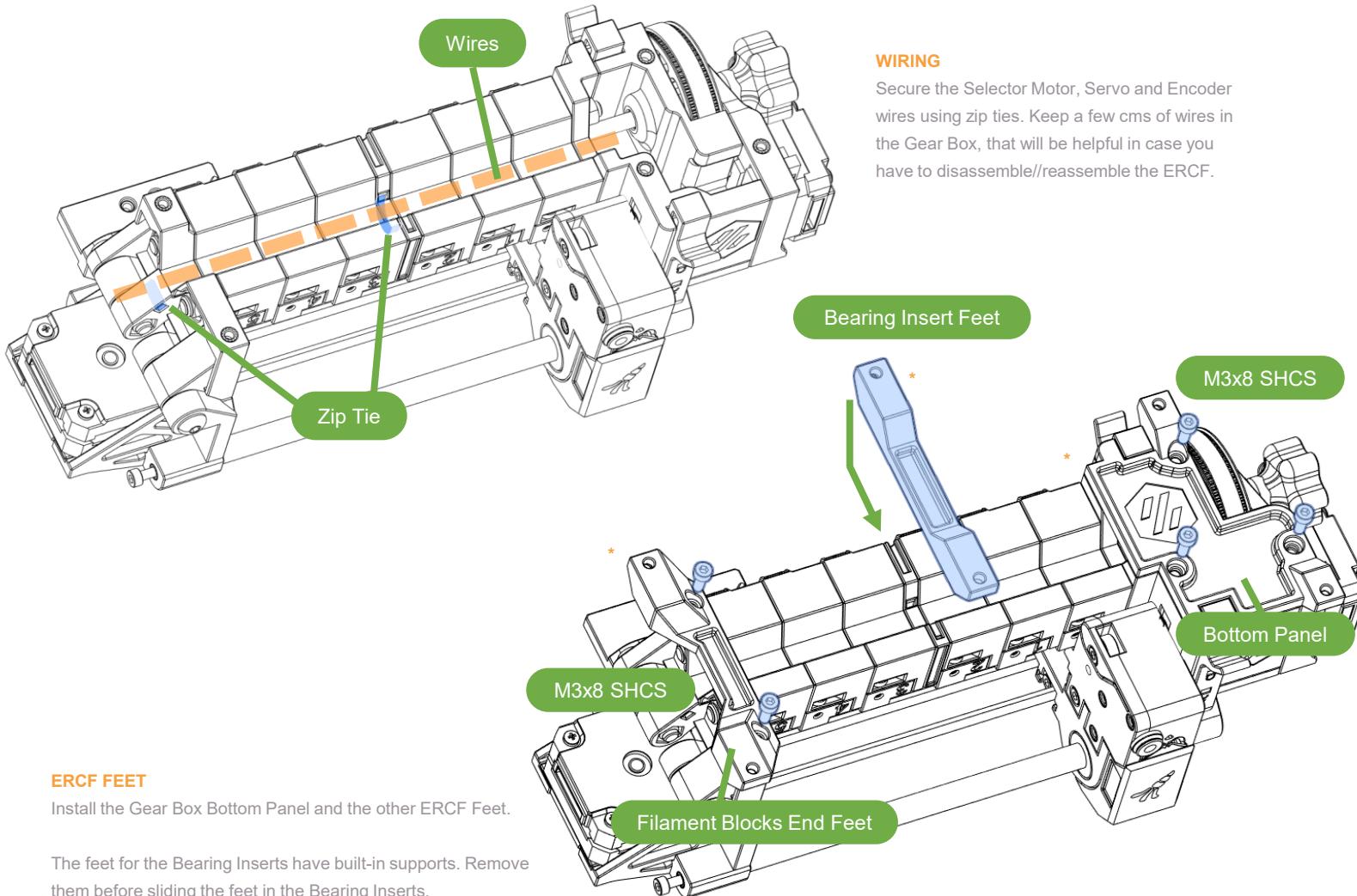
Adjust the belt tension.



GRUB SCREWS

Align the pulley with the belt and then use thread locker on the grub screws.

WIRE MANAGEMENT & FEET



WIRING

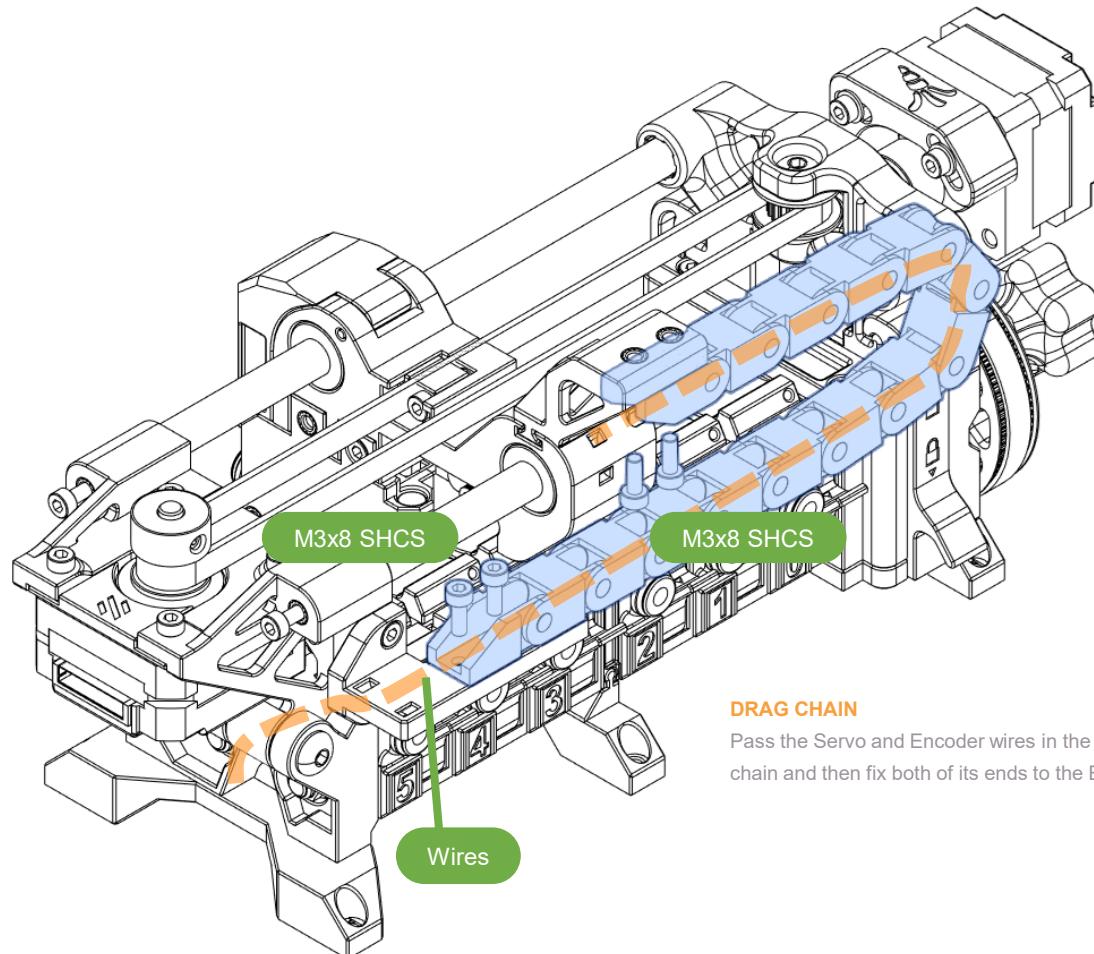
Secure the Selector Motor, Servo and Encoder wires using zip ties. Keep a few cms of wires in the Gear Box, that will be helpful in case you have to disassemble//reassemble the ERCF.

ERCF FEET

Install the Gear Box Bottom Panel and the other ERCF Feet.

The feet for the Bearing Inserts have built-in supports. Remove them before sliding the feet in the Bearing Inserts.

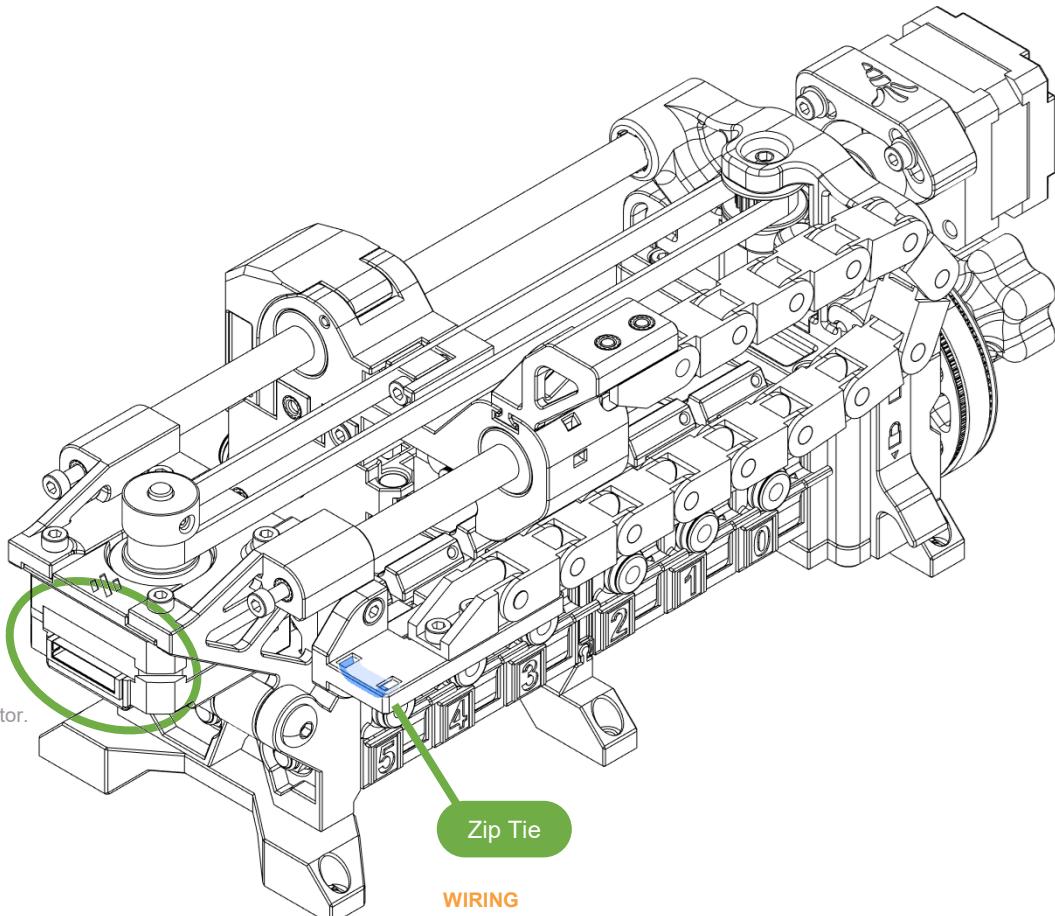
DRAG CHAIN



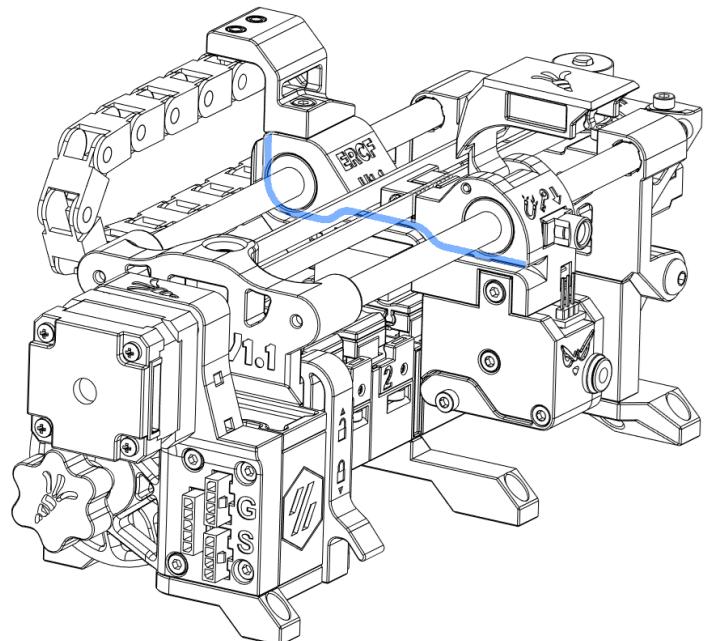
DRAG CHAIN

Pass the Servo and Encoder wires in the drag chain and then fix both of its ends to the ERCF.

ERCF

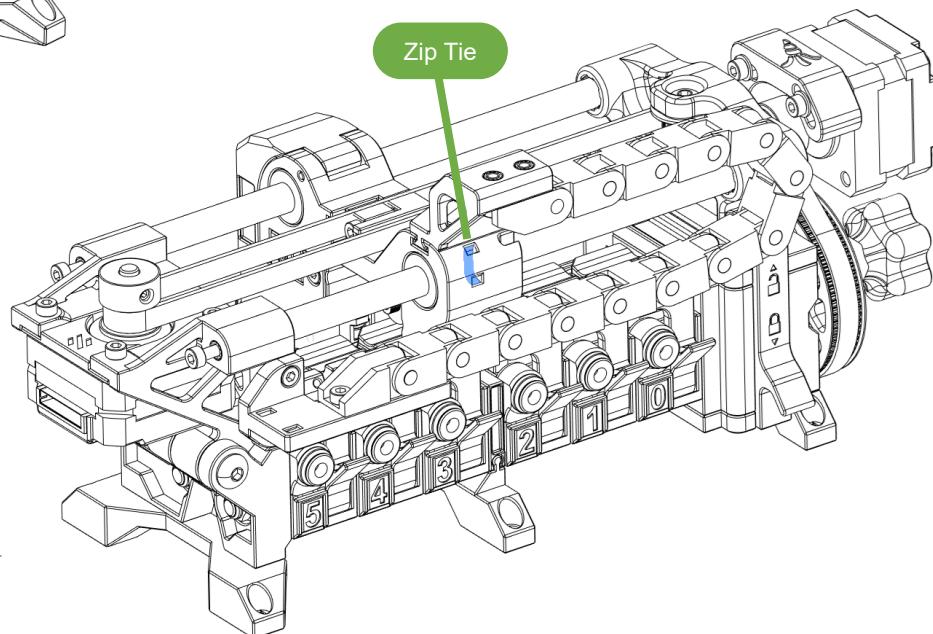


FULL ERCF



ENCODER WIRES

Pass the Encoder wires into the dedicated channel in the Selector Cart. Cut excess wires and install a connector (Dupont or JST XH will work), then connect the Encoder and close the selector door.

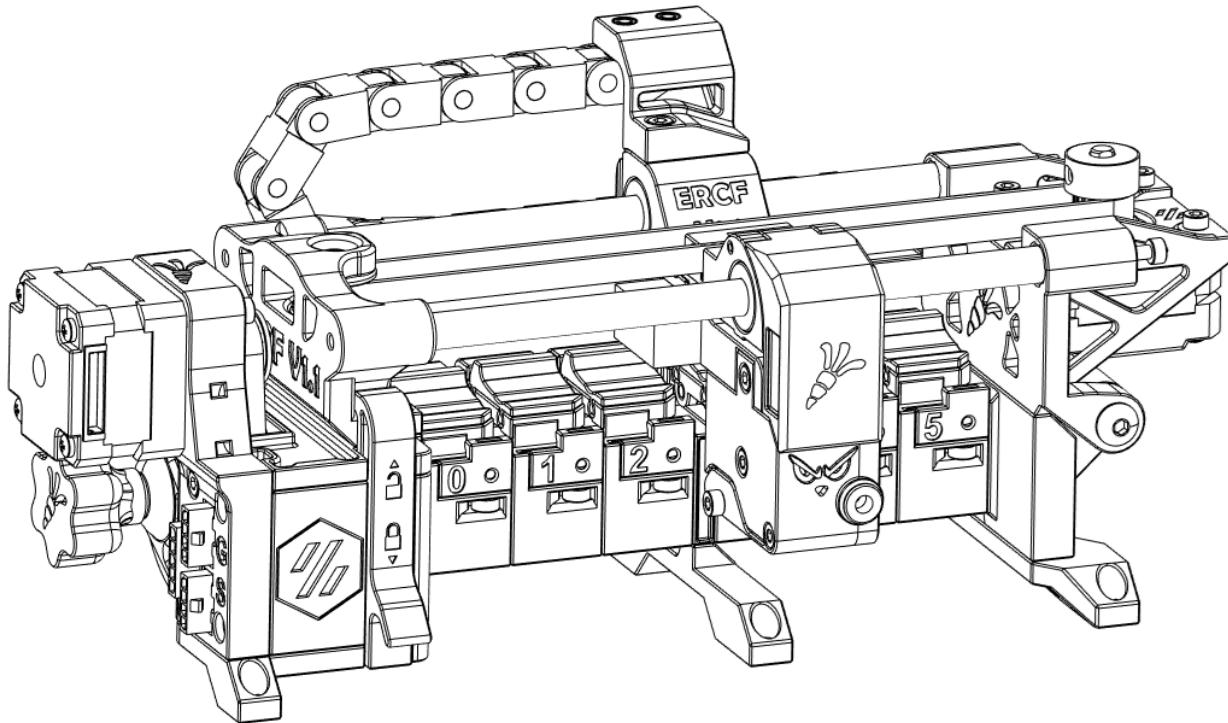


SERVO WIRES

Cut excess wires and connect the Servo (you can use a Dupont connector for example).

Secure both the Servo and Encoder wires using a zip tie.

THE END! ... OR ALMOST :D

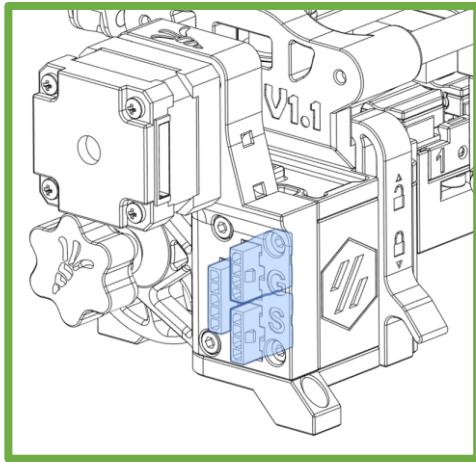


NEXT STEPS

The ERCF is now fully assembled, except, as you probably have noticed, for the Servo Arm!

Its installation on the ERCF will be done in the ERCF Setup section!

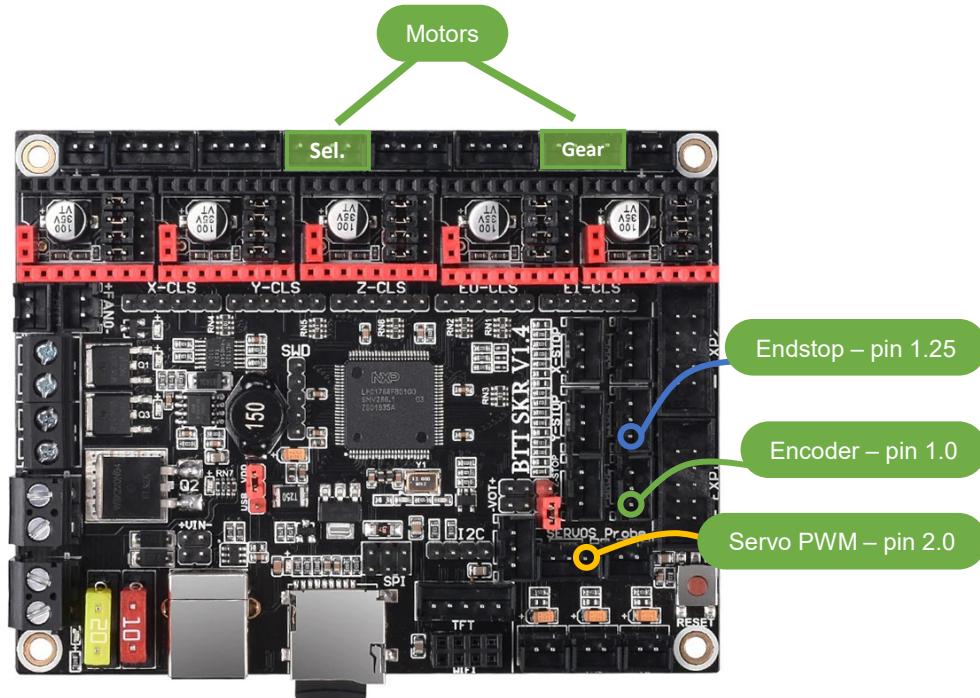
CONNECTING THE ERCF



FIRST CONNECTION

You can keep the ERCF on a table or desk for all the incoming steps, you just need to be able to connect it to your printer.

Plug in the 3 connectors to the ERCF (5 pins general connector and the two 4 pins motors connectors)



Example on a SKR 1.4 board.

RECOMMENDATIONS

It is recommended to use the +5V and GND from a reliable current source, like the one in use for your Raspberry Pi.

The GND of your board, like the SKR1.4 in this example, should be connected to your 5V PSU GND.