

ERCF v2 BUILD GUIDE

RC2 EDITION

Even the smallest one can change the world.
—Peter Rabbit

VERSION 2024-09-26



Before you begin on your journey, a word of caution.

This machine can maim, burn, and electrocute you if you are not careful.

Please do not become the first ERCF fatality.

There is no special Discord flair for that.

Please, read the entire manual before you start assembly.

As you begin wrenching, please check our Discord channels for any tips and questions that may halt your progress.

Most of all, good luck!

The ERCF Team

THANKS!

Thanks are in order to several groups of people:

Dr. Lorincz Robert for his work on stepper motors and his help understanding the physics of stepper motors. His help was integral to the design of the Direct Drive system.

Blamm! for the inspiration of the Disco Stick, **Shammy** for his work adapting it to an ERCF-friendly format, and **Fabreeko** for their work with **XR Bunker** co-producing the Carrot on a Stick and Carrot on a Twig boards.

LDO, SIBOOR, and BTT for working with us to prototype kits and bespoke kit solutions.

FizzyTech for giving us a dedicated online space to congregate and discuss ERCF while developing RC1.

The ERCF Team

TABLE OF CONTENTS

| | |
|-----------------|------------|
| Introduction | <u>12</u> |
| Wiring | <u>20</u> |
| Gearbox Part 1 | <u>28</u> |
| Filament Blocks | <u>76</u> |
| Gearbox Part 2 | <u>93</u> |
| End Block | <u>101</u> |
| Selector | <u>108</u> |
| Encoder | <u>125</u> |
| Linear Axis | <u>134</u> |
| Final Assembly | <u>144</u> |

INTRODUCTION

WARNING



BEWARE

This project requires a well-tuned printer and slicing profile, as there are many press fits and plastic on plastic mechanisms. Before you print all of the parts, you should first print the [ERCF_Calibration_Tool.stl](#) along with a [Tophat_xN.stl](#), and test fit the parts as shown on [page 18](#). You may need to tune your printer and profile before you print the rest of the parts!

Easily half of problems with this build we see on Discord can be avoided by making sure that your printer is up to the task first.

If you haven't tuned your printer yet, please start by tuning:

- Your [Extruder](#)
- Your [Pressure Advance](#)
- Your [Extrusion Multiplier](#), and
- Your [Cooling and Layer Times](#)

We can't speak highly enough of the [Tuning Guide](#) that Andrew Ellis has put together. The other steps are optional / for if you encounter problems. Try his [Troubleshooting Guide](#)!

INTRODUCTION

PRINT GUIDELINES

PART PRINTING GUIDELINES

The Voron Team has provided the following print guidelines. We recommend you to follow them in order to have the best chance at success with your parts. There are often questions about substituting materials or changing printing standards, but we recommend you follow these.

FDM MATERIAL

The ERCF was developed for use only with ABS, so we strongly recommend you use ABS to build the ERCF. All reported community efforts to use different materials (PLA, PETG, resin) have failed for a variety of reasons.

Use only ABS.

LAYER HEIGHT

Recommended : 0.2mm
First Layer: 0.25mm

LAYER HEIGHT EXCEPTIONS

(The [o]_Encoder_Wheel and Servo_Arms)
Recommended : 0.1mm or less if capable
First Layer: 0.2mm or less if capable

EXTRUSION WIDTH

Recommended: Default Width of 0.4mm

INFILL TYPE

Grid, Gyroid, Honeycomb, Triangle or Cubic.

INFILL PERCENTAGE

Recommended: 40%

WALL COUNT

Recommended : 4

SOLID TOP/BOTTOM LAYERS

Recommended : 5 or more

INTRODUCTION

STL FILE KEY

FILE NAMING

By this time you should have already downloaded our STL files from the ERCF GitHub. You might have noticed that we have used the Voron naming convention for the files. This is how to use them.

PRIMARY COLOR

Example `End_Block.stl`

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

ACCENT COLOR

Example `[a]_End_Bypass.stl`

These files have an “[**a**]” prefix to denote that they should be printed with an **accent** color.

QUANTITY REQUIRED

Example `Filament_Path_xN.stl`

Files ending with “_x#” are telling you the **quantity** of that part required to build this system. For the ERCF, “N” means the number of channels.

COLOR REQUIRED

Example
`[c]_Cover_Lens_xN.stl`

These files have a “[**c**]”prefix to denote that they need to be printed in a **clear/transparent** material.

COLOR REQUIRED

Example
`[o]_Encoder_Slotted_Wheel.stl`

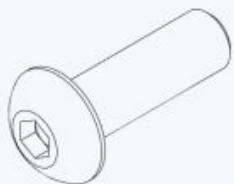
These files have an “[**o**]”prefix to denote that they need to be printed in an **opaque** material light can’t penetrate, preferably black.

OPTIONAL MULTIMATERIAL

Example
`[mm]_Voron_Logo_Plate.stl` †

These files have a “[**mm**]”prefix to denote that they should be printed in **multiple** colors. We always include single-color versions of these files too, for your first build.

INTRODUCTION



BUTTON HEAD CAP SCREW (BHCS)

Metric fastener with a domed shape head and hex drive. Most commonly found in locations where M5 fasteners are used.

ISO 7380-1



FLAT HEAD COUNTERSUNK SCREW (FHCS)

Metric fastener with a cone shaped head and a flat top.

ISO 10642



HEX NUT

Hex nuts couple with bolts to create a tight, secure joint. You'll see these used in both M3 and M5 variants throughout this guide.

ISO 4032



POST INSTALL T-SLOT NUT (T-NUT)

Nut that can be inserted into the slot of an aluminium 2020 profile.

Often also called "roll-in t-nut."

HARDWARE REFERENCE



SOCKET HEAD CAP SCREW (SHCS)

Metric fastener with a cylindrical head and hex drive. The most common fastener used on the ERCF.

ISO 4762



SELF TAPPING SCREW

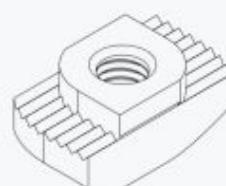
Fastener with a pronounced thread profile that is screwed directly into plastic.



MAGNETS

How do they work?

These are cylinders 6mm in diameter and 3 mm tall. Shorter ones are OK, down to 2.7 mm. N52 are preferred, but N35 can work.



HAMMERHEAD NUT

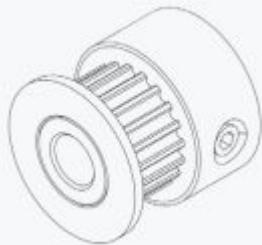
Nut that can be inserted into the slot of an aluminium profile. Used exclusively for panel mounting, all other components use T-Slot nuts.

INTRODUCTION



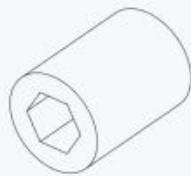
625 BEARING

A ball bearing used on the Encoder.



PULLEY

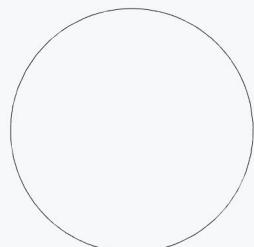
GT2 pulley used on the linear motion system of the ERCF.



SET SCREW

Small headless screw with an internal drive. Used in pulleys and other gears. Also called a grub screw.

ISO 4026



5.5MM BALL BEARING

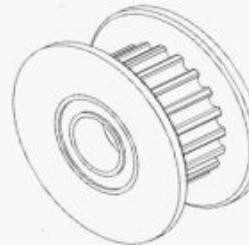
A ball bearing used in the CottonTail Buffer (optional).



WASHER

Plain metal stamped washer.

DIN 125



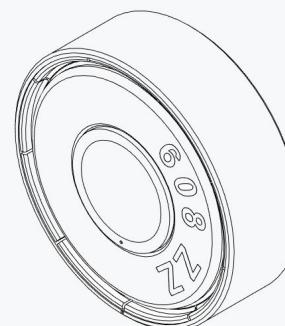
IDLER

GT2 idler used in the linear motion system of the ERCF.



HEATSET INSERT

These are made of brass , threaded on the inside and has ridges on the outside. Heat them up to approx 250C with a soldering iron and push them into the plastic. As the plastic cools, it solidifies around the knurls and ridges on the insert for excellent resistance to both torque and pull-out.



608 BEARING

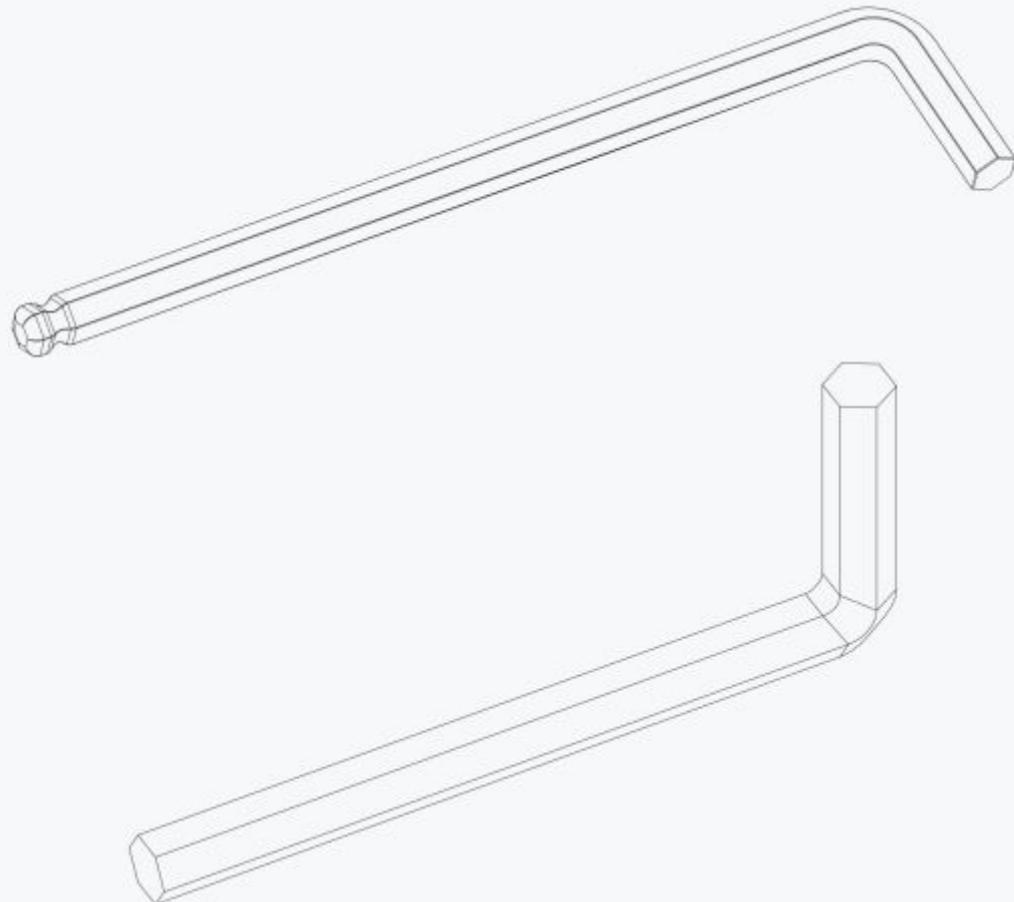
A ball bearing used on the ERCT Buffer (optional),

INTRODUCTION

TOOLS

BALL-END DRIVER

Some parts of this design require the use of a ball-end hex driver for assembly. We use in this manual 1.5mm, 2.0mm, 2.5mm and 3mm.



2.5MM HEX DRIVER

The 2.5mm hex driver will see a lot of use in this build. A quality driver is strongly recommended. Refer to the sourcing guide for suggestions.

ADDITIONAL TOOLS

The tools needed are similar to those used building a Voron. For recommendations, visit https://vorondesign.com/sourcing_guide and switch to the “Voron Tools” tab at the bottom of the page.

INTRODUCTION

SOLDERING IRON

We use this for setting heat-set inserts into parts. Depending on your sensor choice, you might be soldering some wires together.

ANGLE GRINDER/DREMEL

If you need to cut your 8mm smooth rods, nothing less than an angle grinder is going to cut it, literally. Leave your grandfather's trusty hacksaw in the toolbox: rods are usually hardened steel.

VISE

A vise is handy if you have to cut your 8mm rods. A vise may also be helpful when press-fitting bearings into the Selector.

WIRING CRIMPER

You'll need this to wire up the sensor. Or maybe there's a turnkey solution out there you can buy, check Discord. If you got this far without learning how to crimp, we don't judge.

CAD SOFTWARE

ERCF_v2/CAD/ERCF_V2.0.step

Software is a tool too! The CAD file for the ERCFv2 was designed to be used along with this manual as a supplement or reference, even if you aren't a CAD Pro. You can use the free edition of Fusion360, or your choice of CAD program such as TinkerCAD or FreeCAD.

TOOLS

SUPERGLUE

Yes, we consider this a tool. Superglue is useful as a plastic safe threadlock, and magnet glue. Cheap, single-use gel tubes are fine.

PULLEY TOOLS

ERCF_v2\Stls\Tools\Pulley_Tool_NEMA14.stl

ERCF_v2\Stls\Tools\Pulley_Tool_NEMA17.stl

These take the guesswork out of setting your pulley heights. You will always need the NEMA17 version, but you only need the NEMA14 version if you're using the NEMA14 drive motor.

80T GEAR WHEEL GUIDE

ERCF_v2\Stls\Tools\80T_Cog_Guide.stl

This tool helps you align your printed 80T gear when you are assembling it.

SLOTTED WHEEL PUSH TOOL

ERCF_v2\Stls\Tools\Slotted_Wheel_Push_Tool.stl

Helps you set the depth and align the Encoder slotted wheel without damaging it.

FILAMENT BLOCK BEARING INSTALL TOOL

ERCF_v2\Stls\Tools\Bearing_Install_Tool.stl

This optional tool helps you install MR85ZZ bearings into the Filament Blocks without damaging the bearings.

PRINTED PART TRACKER SPREADSHEET

There is a helpful interactive Printed Part Tracker for ERCFv2 here:

[Printed Parts Tracker Google Sheet](#)

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

Find all the project information on the Github page : https://github.com/Enraged-Rabbit-Community/ERCF_v2

The project is composed of 6 different components, some of which are optional:

- **Enraged Rabbit Carrot Feeder (ERCF).** The Carrot Feeder is the main unit and allows use of a high number of different filaments (up to 15 channels reported in the community) and feed them, one at a time, into the printer toolhead on an as-needed basis.
- **Enraged Rabbit Cottontail (ERCT)** is an integrated (but optional) filament buffer system to handle the filament when it is ejected from ERCF on a tool change. It can handle up to 1.5m bowden tube lengths. This has been specifically designed to minimize friction when setup, taking into account the natural filament memory. It has options for LED gate indicators and entry sensors.
- **Enraged Rabbit Filametrix (ERF):** This filament cutter is an optional toolhead modification to cleanly cut the tip of the ejected filament, so it can be loaded easily on next use. This option alleviates the frustrating job of tuning tip formation through movement of the filament within the extruder, which often still results in strings of filament causing clogs.
- **Toolhead Sensor:** This is a set of modifications for popular extruders that provides filament detection capability within the toolhead. Although optional, it is highly recommended, and makes filament change far more reliable and smooth.
- **Happy Hare Firmware:** This has become the go-to extension to Klipper for controlling various types of MMU. It is optimized to support ERCF.
- **Enraged Rabbit Filamentalist (ERFM):** The Filamentalist is a bufferless solution for managing filament unloads. The design ingeniously uses the stiffness of the filament to drive the spool, making it rewind as the filament unloads. The choice between Filamentalist and ERCT is up to you; Filamentalist only works with stiff filaments, so no flexibles.

INTRODUCTION

ACKNOWLEDGEMENTS

This is the place to recognize the origins and evolution of this project. ERCF was originally envisioned and created by Ette and the v1.1 release credits Tircown, the Voron Dev team (special mention to Dunar), Benoit, Dustin Speed, Kageurufu and the HonHonHonBaguette people!

Over time and significant adoption the shortcomings of ERCF v1.1 design came to light, and that inspired a set of modifications to address them: SturdyBunny, TripleDecky, Springy, Binky and other strange names appeared. It was then that Moggieuk, the author of Happy Hare, rounded up these project authors and created the beginnings of the ERCF v2 community release. As the project developed, Kinematicdigit developed and contributed CottonTail, Sorted developed and contributed Filametrix and we were joined by some awesome talent that polished, tested and documented to complete the project.

With the release of ERCFv2 RC1, it quickly became apparent that the Gearbox, among other components, needed to be redesigned to be serviceable without total disassembly. Miriax and Silverback_Attack took up this task, and here we are.

Many hundreds of hours of volunteer effort have gone into this project and we hope it pays tribute to Ette's wonderful original design. **The BMW of MMU's!**

- @moggieuk V0.1503 | V2.4088 (Happy Hare Developer & Chief whip)
- @gneu V2.5345 (Filament Block Designer and Bling Innovator)
- @sneakytreesnake V2.3804 (Sturdy Bunny Designer)
- @mneuhau5 VT.483 (Binky and Encoder Designer)
- @Miriax (Gearbox Redesigner, Printability Expert, Manual Monster)
- @kinematicdigit (Cottontail Designer & Doc Illustrator)
- @ningpj (Tester, Breaker & Doc's)
- @fizzy (King of CAD)
- @gsx8299 (Test Builder Extraordinaire)
- @sorted (Filametrix "don't get enraged" filament cutting system Designer)
- @kieranthe man (Thumper Designer)
- @silverback_attack (Gearbox Feet Redesigner)
- @skibikemake (Filametrix Designer)



INTRODUCTION

HOW TO GET HELP

If you need assistance with your build you can head over the new ERCF Discord group. 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.

If you need help making ERCF work with your VORON printer, head to the VORON Discord group and post your questions in the ercf_questions channel.

ERCF



<https://discord.com/channels/1267663557999329371/>

GitHub

https://github.com/Enraged-Rabbit-Community/ERCF_v2

VORON



<https://discord.com/channels/460117602945990666/909743915475816458>

INTRODUCTION

INTRODUCTION

Constructing and operating a multi-filament system can be a challenging endeavor, often more intricate than assembling the 3D printer itself. Approach this task patiently, addressing each issue methodically. Be aware that minor complications during assembly can accumulate, potentially leading to greater challenges later. If you encounter any uncertainties or roadblocks, feel free to seek guidance on Discord - remember, there are no foolish questions!

You might have heard about the frequent challenges associated with multi-filament systems. Indeed, they can be demanding. However, the Enraged Rabbit Project aims to provide a system that is not only innovative and reliable but also user-friendly. Despite these efforts, encountering some difficulties is not uncommon. In such instances, consult the available documentation and guides, and don't hesitate to ask for help on Discord. Many common issues have likely been encountered and resolved before, so assistance is readily available.

Enjoy the process of building as much as utilizing your Enraged Rabbit Carrot Feeder (ERCF)!

This design relies heavily on heatset inserts. If you've never worked with heatset inserts before, watch this guide:

<https://www.youtube.com/watch?v=cyof7fYFcwQ>

Here is a list of all the pages of this manual where you need to add the heatset inserts into the 3D printed parts, so you can add the headset inserts all at once if desired:

- [Page 32 and 33](#) ([Gearbox](#), 10 heatset inserts)
- [Page 34](#) ([\[a\]_Hatch](#), 2 heatset inserts)
- [Page 111](#) ([\[a\]_Selector_Cart](#), 3 heatset inserts)
- [Page 114](#) ([Drag_Chain_Anchor †](#), 2 heatset inserts)
- [Page 125](#) ([Encoder_Right](#), 3 heatset inserts)
- [Page 136](#) ([Linear_Axis_Selector_Motor_Support](#) and [\[a\]_Drag_Chain_Anchor_Bottom †](#), 4 and 2 heatset inserts)

We have provided the ERCFv2 CAD files ([ERCFv2/CAD/ERCFv2.STEP](#) and [ERCFv2.F3D](#)), so that you can follow along with the instructions in a 3D view, if you like.

The CAD file is organized into folders / units based on the instructions in this manual. If you hide all of the units after the step you are on in this manual, the CAD should closely track what you are building. That's why you'll see titles like [3.1 INSTALL BONDTECH IDLER GEAR](#) - the [3.1](#) denotes the folder / unit in the CAD.

We did our best to keep the CAD units and the manual steps in sync, but even so, sometimes we'll be doing units slightly out of numerical order, or repeating units (eg. [1.2](#), [1.3](#), [1.2](#), [1.3](#), [1.4](#), [1.3](#), [1.4](#)...). *Don't worry about the unit order, just follow along with the manual.*

In summary, The unit numbers are just our way to link together the CAD and the manual. You can ignore them if you aren't looking at the CAD, and still successfully build the base ERCF with just this manual.

INTRODUCTION

If you are upgrading from ERCFv1 or v1.1, you can re-use some of the printed parts. These parts will have a dagger † every time we mention the file name, in case you want to re-use those parts. Here is a list:

ERCF_v2 / STLs / Gear_Box

[a]_Bearing_Spacer_x2.stl †
[a]_Knob.stl †
[a]_Logo_Plate.stl †
[a]_M4_80T_Wheel.stl †
[a]_Side_Latch_x2.stl †
[mm]_Voron_Logo_Plate.stl †
Motor_Arm_NEMA14.stl †
Motor_Arm_NEMA14_EASYBRD.stl †
Motor_Arm_NEMA17.stl †
Motor_Arm_NEMA17_EASYBRD.stl †

ERCF_v2 / STLs / Linear_Axis

[a]_Drag_Chain_Anchor_Bottom.stl †
[a]_Motor_Lock.stl †

ERCF_v2 / STLs / Selector

Belt_Tensioner.stl †
Drag_Chain_Anchor.stl †

ERCF_v2 / STLs / Supports / Adjustable_Mount

[a]_Screw_x3.stl †
Junction_Plate_Flat_x2.stl †
Junction_Plate_Gear_Box.stl †

UPGRADING FROM ERCFv1

ERCF_v2 / STLs / Supports / Adjustable_Mount / 2020

2020_Mount.stl †
2020_Mount_Mirrored.stl †

ERCF_v2 / STLs / Supports / Adjustable_Mount / 3030_(SW_with_panels)

3030_Flat_Mount.stl †
3030_Flat_Mount_Mirrored.stl †

ERCF_v2 / STLs / Supports / Adjustable_Mount / 3030_(SW_without_panels)

3030_Mount.stl †
3030_Mount_Mirrored.stl †

ERCF_v2 / STLs / Supports / Adjustable_Mount / Option

ERCF_Easy_Brd_Bracket_Mount.stl †

ERCF_v2 / STLs / Supports / V1_V2

[a]_Support_Feet_4mm_x4.stl †
[a]_Support_Feet_5mm_x4.stl †

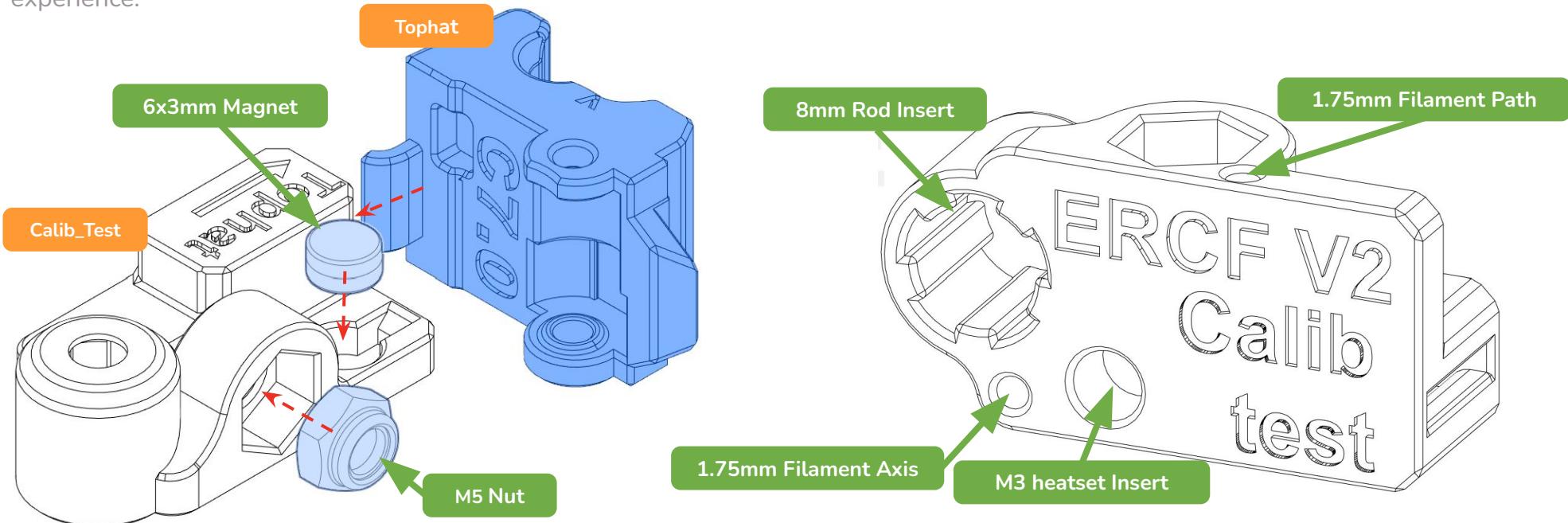
ERCF_v2 / STLs / Tools

Pulley_Tool_NEMA14.stl †
Pulley_Tool_NEMA17.stl †

INTRODUCTION

CALIBRATION TOOL

Print this test piece and a **Tophat** to ensure your printer and slicing profile are tuned, in order to have a pleasant ERCF assembly experience.



TESTS

Insert the different pieces of hardware in their dedicated slots: 6x3mm magnet, M5 nut, and 8mm rod. They should grip the hardware so that they don't fall out easily, but they should not be very difficult to insert or remove. Test the heatset insert hole using a soldering iron and insert.

Use the Filament Path to check that 1.75mm filament slides through without friction. The Filament Axis should have some light friction.

To check the **Tophat**, insert the arm of a **Tophat** into the slot. It should insert without much force. Once inserted, the **Tophat** should be able to move up and down easily. To remove the **Tophat**, pull it up while rotating it.

WIRING (REMOTE MCU)

SELECTOR MOTOR WIRE

LOCAL MCU VS REMOTE MCU

When we say “local MCU” we mean a “buddy board” or other dedicated MCU that will be mounted near the ERCF. Examples include the BTT MMB (preferred and shown in this manual) and the EASY BRD. Skip to [page 22](#) if you’re using a local MCU.

When we say “remote MCU” we mean the dedicated MCU(s) for your printer. It is unusual to have enough spare motor, servo, and endstop ports to run an ERCF unless you’re using a dual SKR board setup, but if that’s you, then you can save some money on the buddy board by using this option.

PREPARING THE WIRES FOR REMOTE MCU

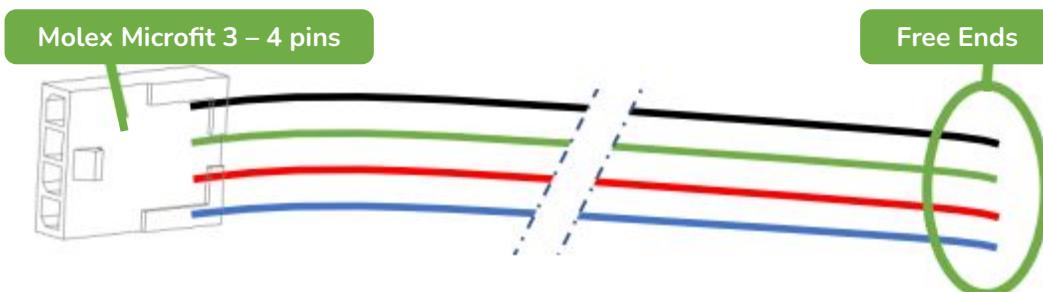
For an ease of installation, it is recommended to prepare the wiring before assembly.

There are two wire looms to do:

- One that goes from the connector plate to the selector motor
- One that goes from the connector plate to all the other components, namely the endstop, the servo and the encoder

SELECTOR MOTOR WIRE FOR REMOTE MCU

Prepare the 4 wire selector motor cable as shown. Don’t crimp the free ends for now.



CONNECTION TO THE SELECTOR MOTOR

When using a remote MCU, it is recommended to finish the selector motor connection later in the assembly, for ease of assembly and to ensure the crimps are done with the proper wire length.

Wire Length Chart for remote MCU

| Channels | Selector Motor Wire Length (mm) |
|----------|---------------------------------|
| N | 175 + 25N |
| 4 | 275 |
| 5 | 300 |
| 6 | 325 |
| 7 | 350 |
| 8 | 375 |
| 9 | 400 |
| 10 | 425 |
| 11 | 450 |
| 12 | 475 |
| 13 | 500 |
| 14 | 525 |
| 15 | 550 |

All wire lengths include approximately 25-50mm of spare length for maintenance.

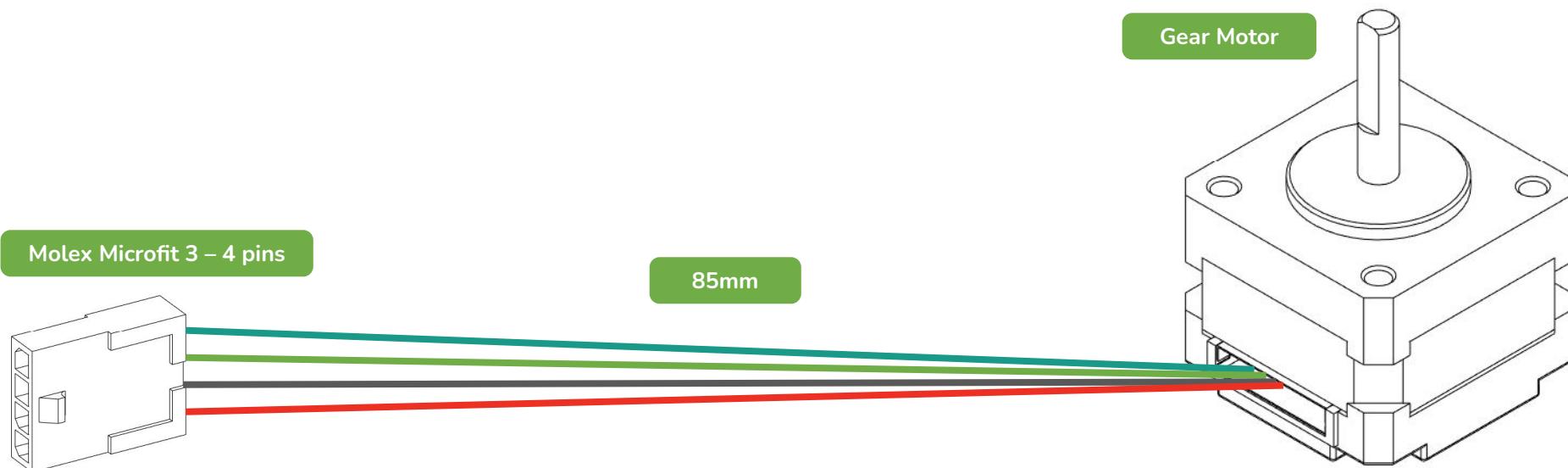
WIRING (REMOTE MCU)

GEAR MOTOR WIRE

GEAR MOTOR WIRE

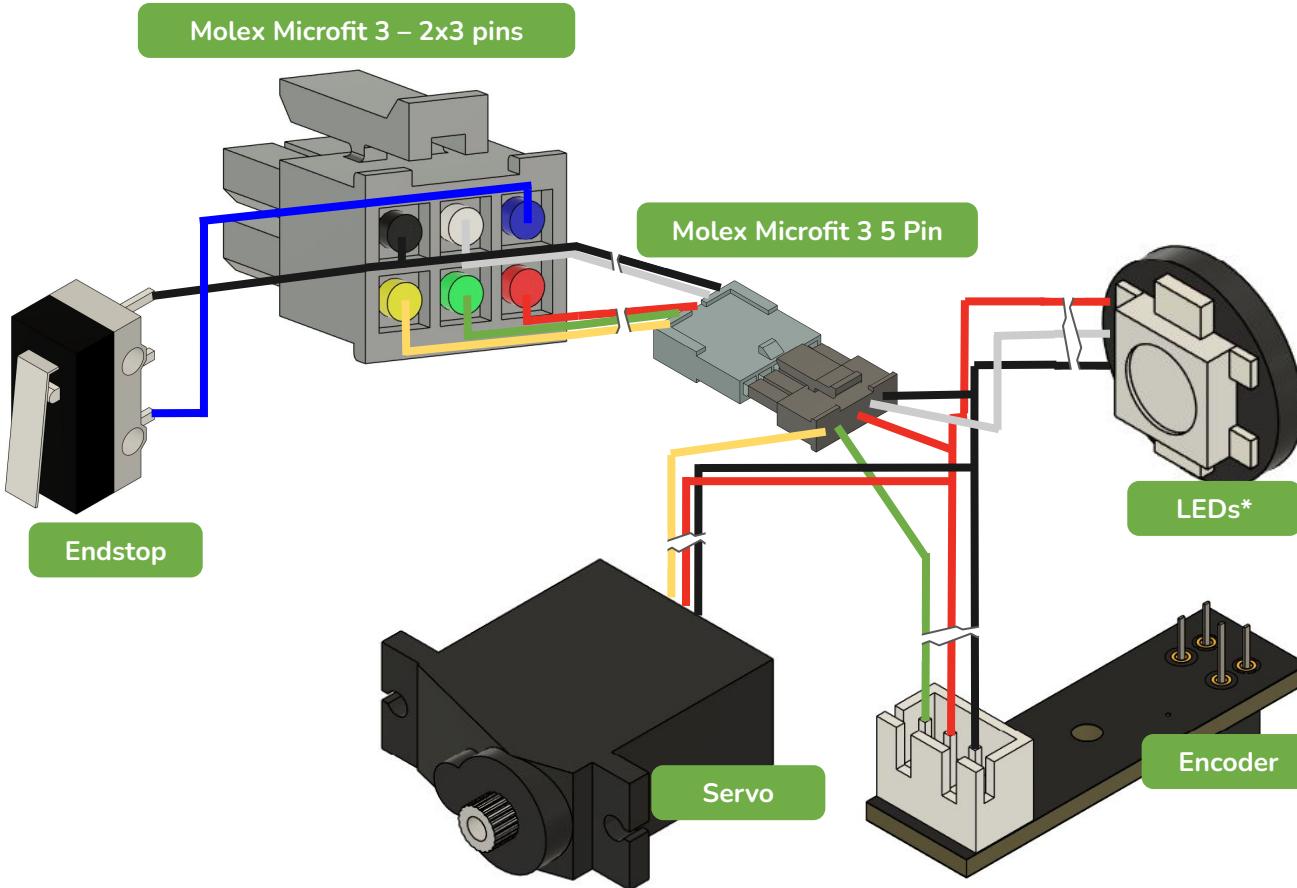
Double-check. You're supposed to skip this page if you're using a local MCU ("buddy board" like EASY BRD or BTT MMB). You wouldn't want to cut your wires too short!

Trim your Gear Motor wires to 85mm, then crimp and add the 4-pin Molex Microfit connector. That's it!



WIRING (REMOTE MCU)

SENSOR AND ENCODER WIRE BUS



| Channels | Wire Length (mm) | | |
|----------|------------------|-----------|-------------|
| | Endstop | Servo | Encoder/LED |
| N | 60 | 350 + 50N | 450 + 50N |
| 4 | 60 | 550 | 650 |
| 5 | 60 | 600 | 700 |
| 6 | 60 | 650 | 750 |
| 7 | 60 | 700 | 800 |
| 8 | 60 | 750 | 850 |
| 9 | 60 | 800 | 900 |
| 10 | 60 | 850 | 950 |
| 11 | 60 | 900 | 1000 |
| 12 | 60 | 950 | 1050 |
| 13 | 60 | 1000 | 1100 |
| 14 | 60 | 1050 | 1150 |
| 15 | 60 | 1100 | 1200 |

*Optional. Other LEDs not pictured.

6 WIRE BUS

Prepare the 6 wire bus for the ERCF. The GND is shared between the Servo, the Encoder, the LEDs, and the Endstop. The +5V is shared between the Servo, the Encoder, and the LEDs. We will try to keep to this color convention: Red for +5V, Black for ground, Yellow for the Servo wire, Green for the Encoder wire, Light Gray for the LEDs, and Blue for the Endstop.

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

Only the Endstop is directly connected to this wire bundle, typically by soldering the wires directly on the microswitch pins. It is recommended to finish the Servo and Encoder connections later in the assembly, for ease of assembly and to ensure the crimps are done with the proper wire length to reach the end of the cable chain, where we typically put Molex connectors.

WIRING (LOCAL MCU)

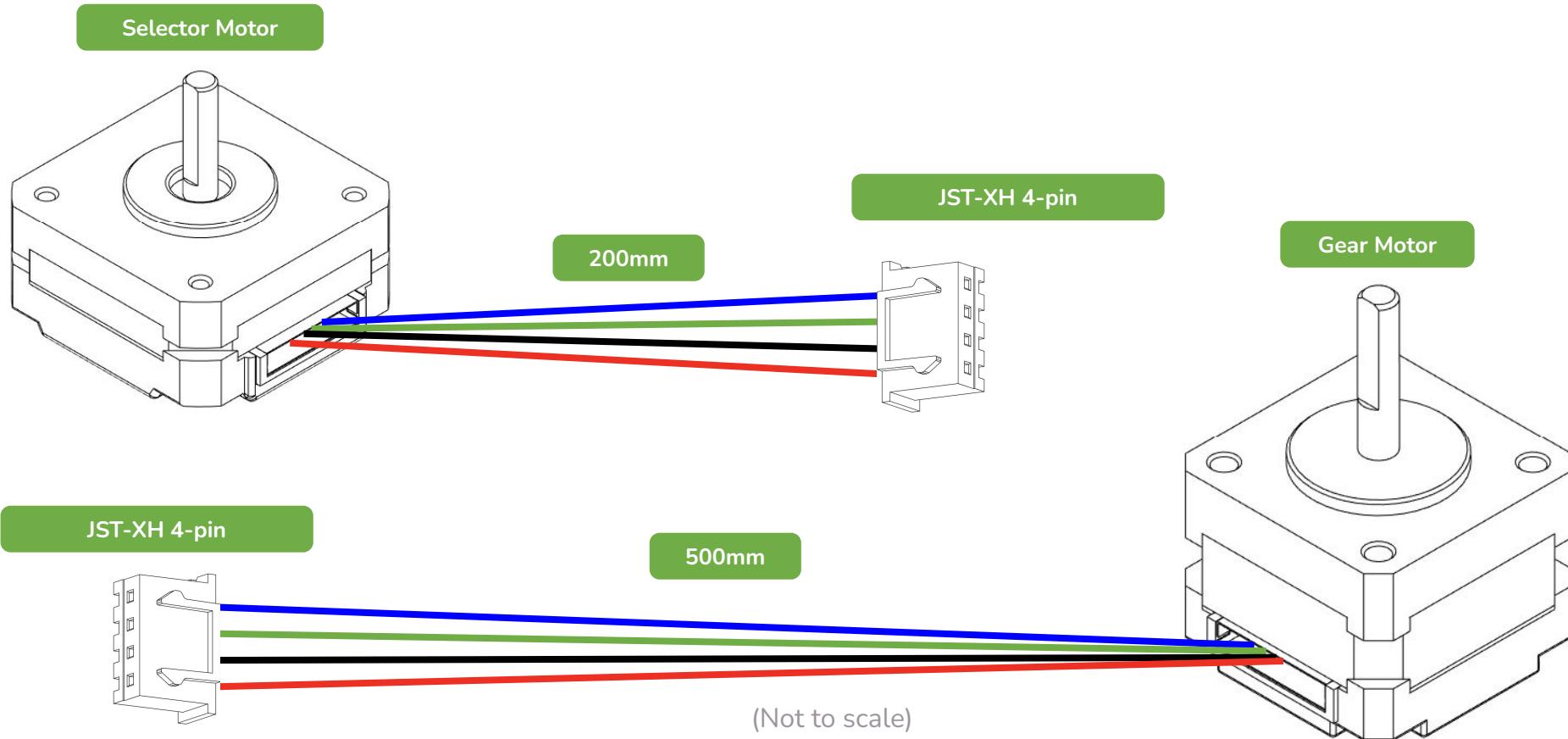
GEAR MOTOR WIRE

WIRING THE MOTORS

Now it's time for the local MCU wiring section! You can skip to the [next page](#) if you're not using a local MCU (like BTT MMB).

Trim Selector Motor wires to 200mm, then crimp and add a 4-pin JST-XH connector.

Trim Gear Motor wires to 500mm, then crimp and add a 4-pin JST-XH connector (NEMA14 shown, you may also use NEMA17).



WIRING (LEDS)

WIRING THE LEDS

WIRING THE LEDS

The new default option is the Carrot on a Stick LED PCB, which has perfect LED spacing with no soldering involved! Thanks to Blamm for letting us use his Disco on a Stick design, Shammy for doing the modifications, and XR Bunker and Fabreeko for manufacturing the Carrot on a Twig and Stick!

If you are using NeoPixels or individual LED PCBs, we provide a wiring jig. See the next page.

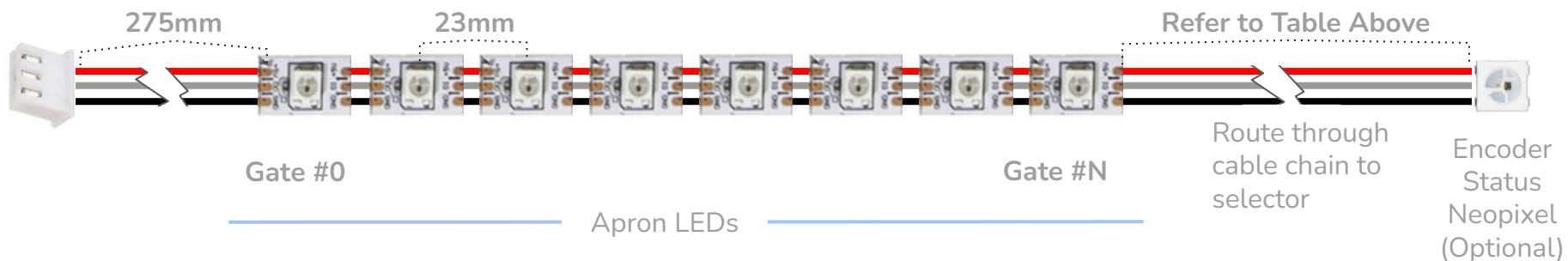
The worst. But still functional, option is to us a premade flexible LED strip. Unfortunately, you will need to cut up the strip and re-solder it in order to get to the necessary 23mm spacing. The suggested method is to stick the segments of LED strip to the inside of each of the [Cover_Body_xN](#), attach all of the [Cover_Body_xN](#) to the 2020 extrusion, and solder short pieces of wire between the strips.

For the wires between each LED, cut 20mm sections of wire and strip them back about 1.5mm on each end. Then carefully use the [Cover_Body_xN](#) as a jig to solder the LEDs in place.

If using a local MCU, the connection between the first LED and the MCU should be about 250mm.

If using a remote MCU, the connection between the first LED and Molex plug is 175mm.

| Channels | Encoder LED Wire Length (mm) |
|----------|------------------------------------|
| N | 450 + 50N |
| 4 | 650 |
| 5 | 700 |
| 6 | 750 |
| 7 | 800 |
| 8 | 850 |
| 9 | 900 |
| 10 | 950 |
| 11 | 1000 |
| 12 | 1050 |
| 13 | 1100 |
| 14 | 1150 |
| 15 | 1200 |



WIRING (EXIT LEDS)

WIRING THE EXIT LEDs

There is a jig for wiring the LED PCBs together in the Tools folder: [/STLs/Tools/Soldering_Tool_24mm.stl](#)

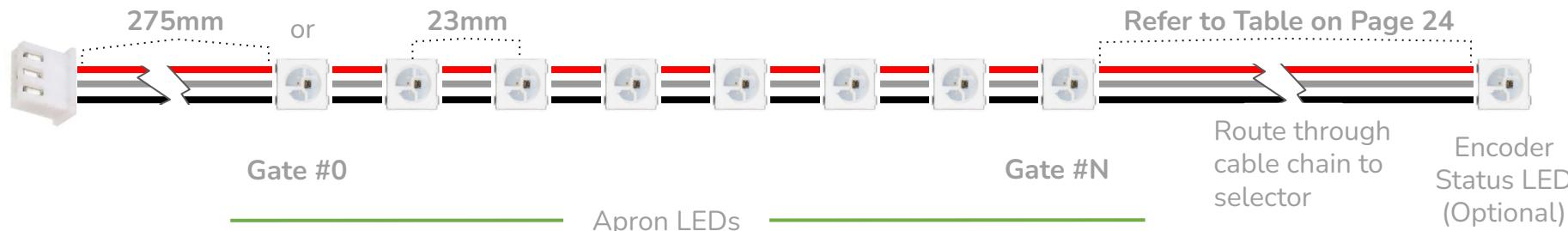
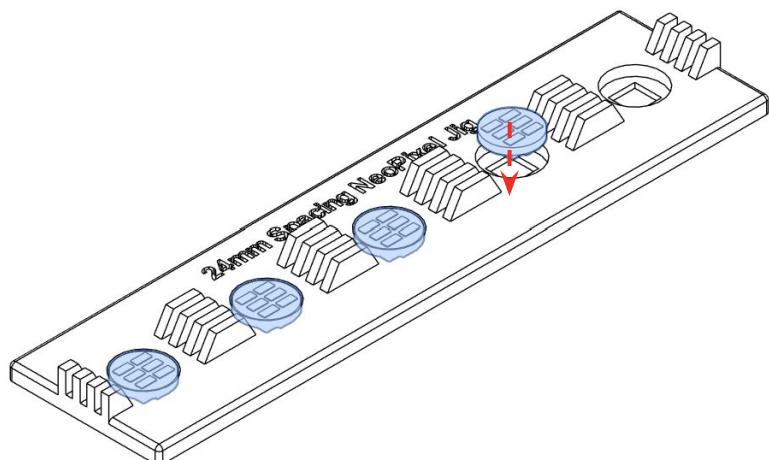
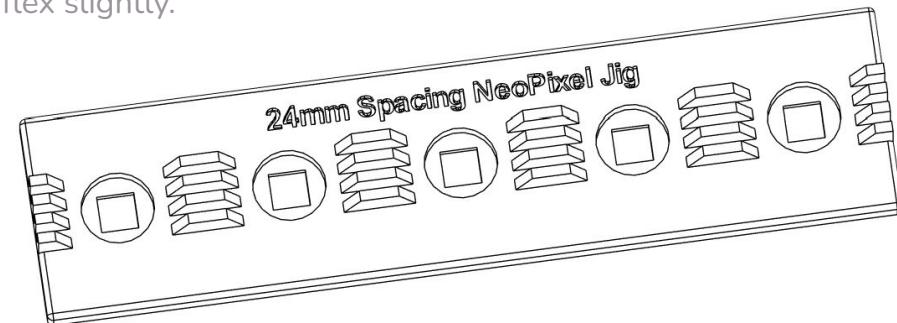
It is spaced to 24mm instead of 23mm to allow for the wires to flex slightly.

22ga Silicone wire is the best wire for this use case.

Cut the inter-LED wires to between 22mm plus or minus 1.5mm, and strip back the ends of the wires between 1.5 and 3mm. Do this once in each color for the number of channels you have, minus one.

Place four or five LED PCBs into the holder. You want the input on the left side.

WIRING THE EXIT LEDs



WIRING (ENTRY LEDS)

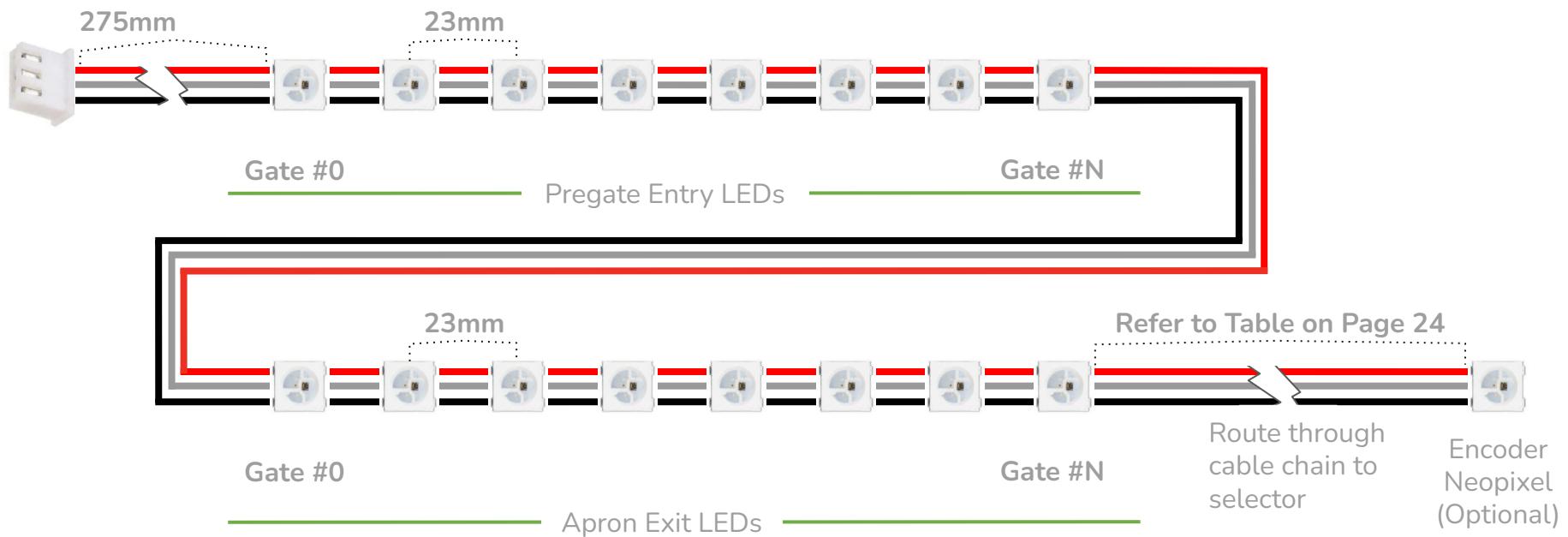
WIRING THE ENTRY LEDs

(OPTIONAL) WIRING THE ENTRY LEDs

The Entry LEDs are optional.

Repeat whichever process you have just used to create a second chain of LEDs.

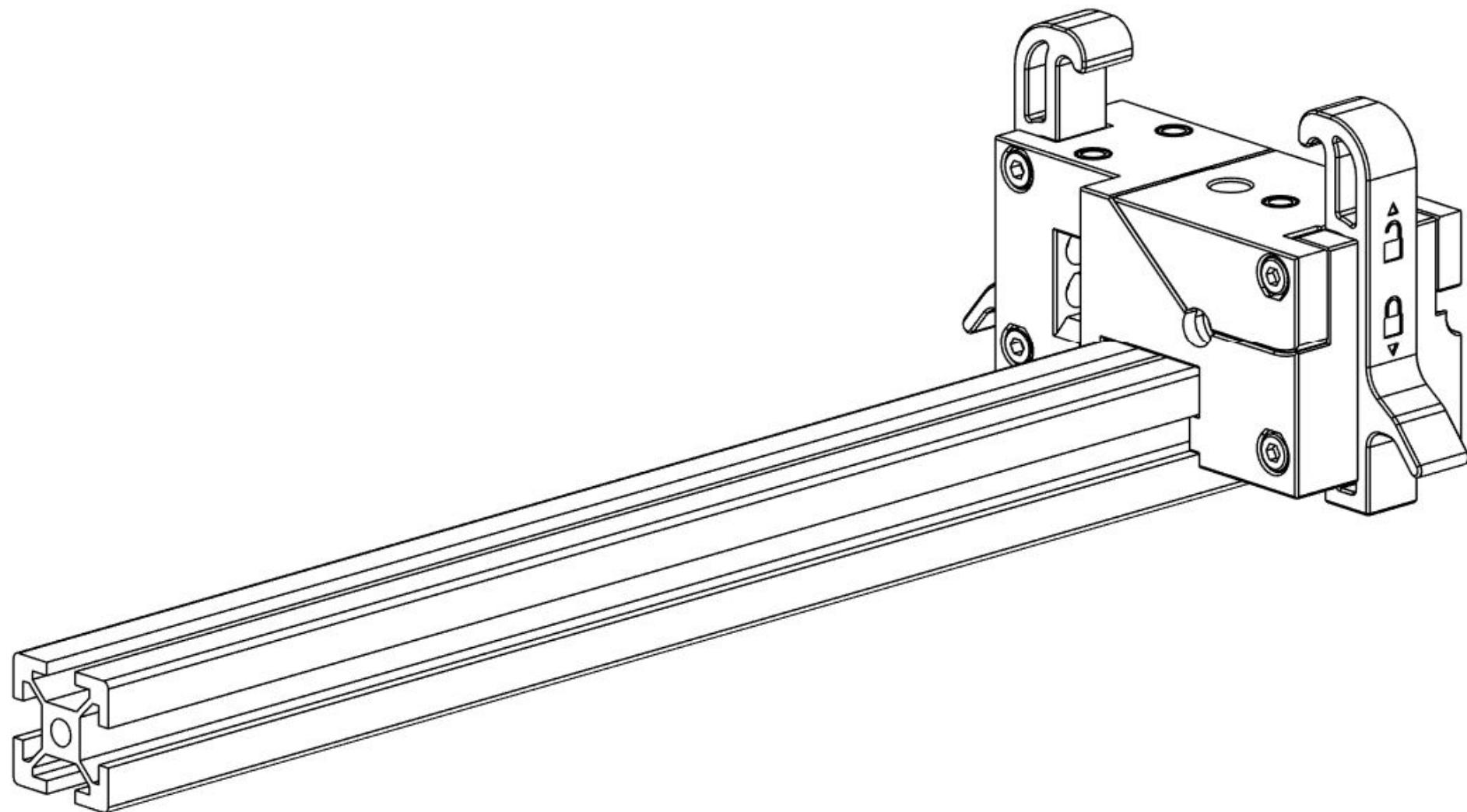
Splice them to the other LED chain, before the Exit LEDs. [length of this wire TBD]



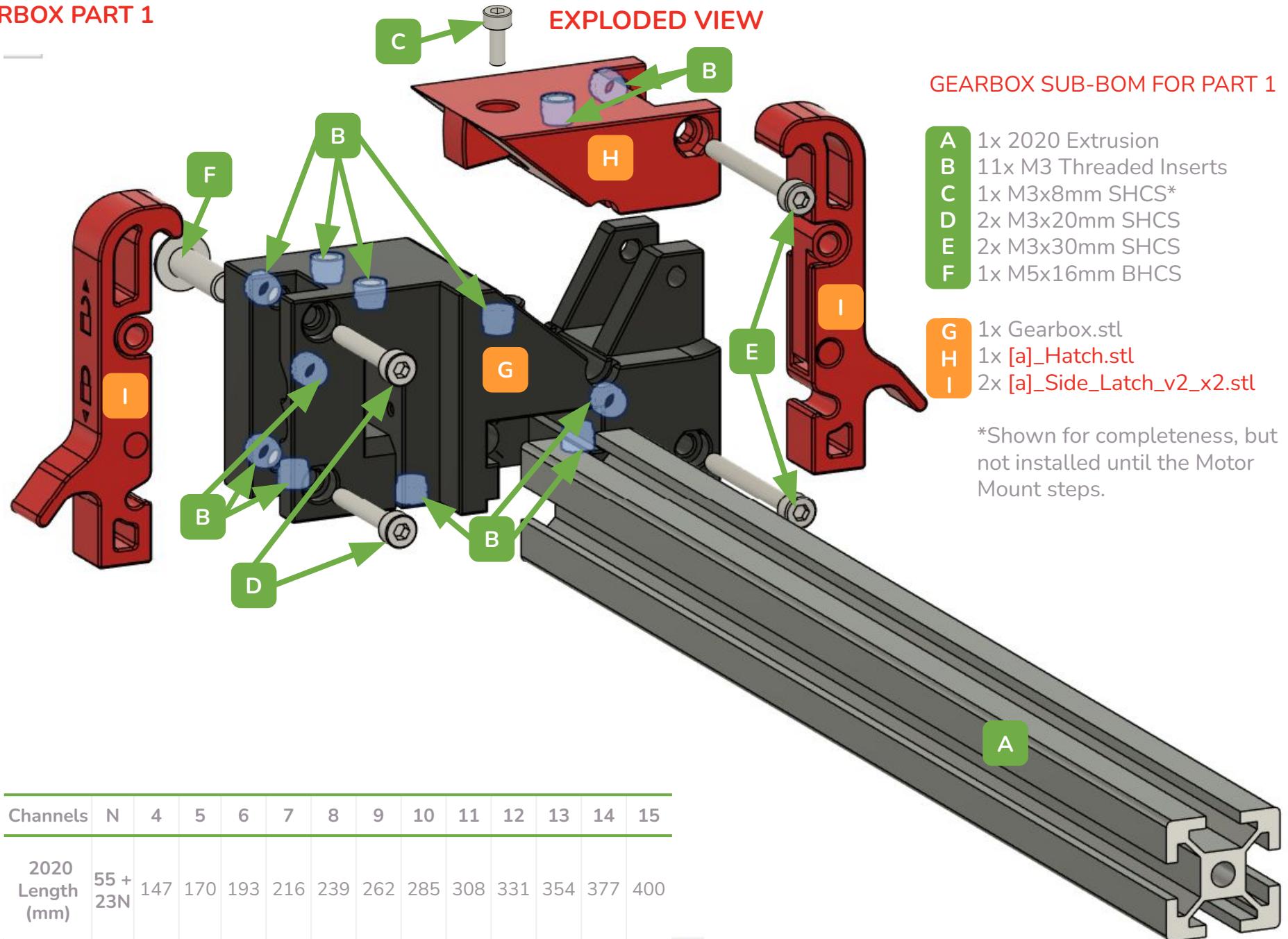
Consistent with the ethos of the Voron community, the ERCF is open-source.

This means its designs and software are freely available for anyone to use, modify, and improve, fostering a collaborative and innovative environment.





GEARBOX PART 1



| Channels | N | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|------------------|----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 2020 Length (mm) | 55 + 23N | 147 | 170 | 193 | 216 | 239 | 262 | 285 | 308 | 331 | 354 | 377 | 400 |

1.1 2020 EXTRUSION PREPARATION

If you bought an RC2 kit, the 2020 should be pre-tapped.

If you are upgrading or self-sourcing, you will need to tap one end of your 2020 extrusion for M5x0.8mm threads to a depth of at least 10mm. Please be careful, use appropriate PPE such as gloves and safety glasses, use oil and take care to tap the threads straight. The first 5 minutes of this video is a good reference:

<https://www.youtube.com/watch?v=2dvbn0rWA60>

Here is a jig to help keep your tap straight against the 2020, with thanks to 2nd Layer Printing Designs:

<https://www.printables.com/model/1008892>

Remember, if you mess up the first time, you can usually flip the 2020 and try the other side.

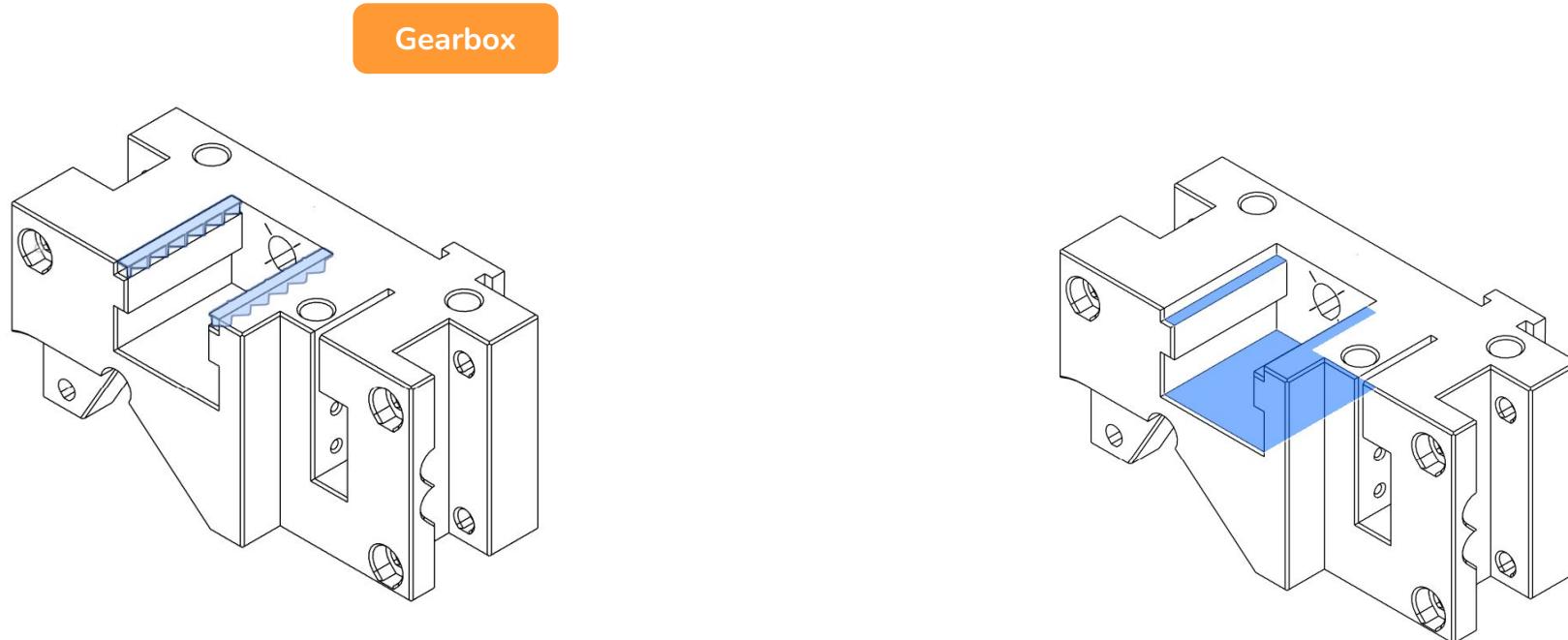
If your 2020 extrusion already has a hole that is 5mm, you can buy a threaded insert kit (the most popular brand is Heli-Coil) which will enable you to add a steel threaded coil that will fit an M5 bolt.

Here is a video on Heli-Coil: <https://youtu.be/sQHRB2ElZJ0>

This is a good option for parts of the world where it is expensive to source 2020 extrusion - if 2020 extrusion is cheap where you live, it may make more sense to just buy new pre-tapped 2020!

GEARBOX PART 1

GEARBOX PREPARATION

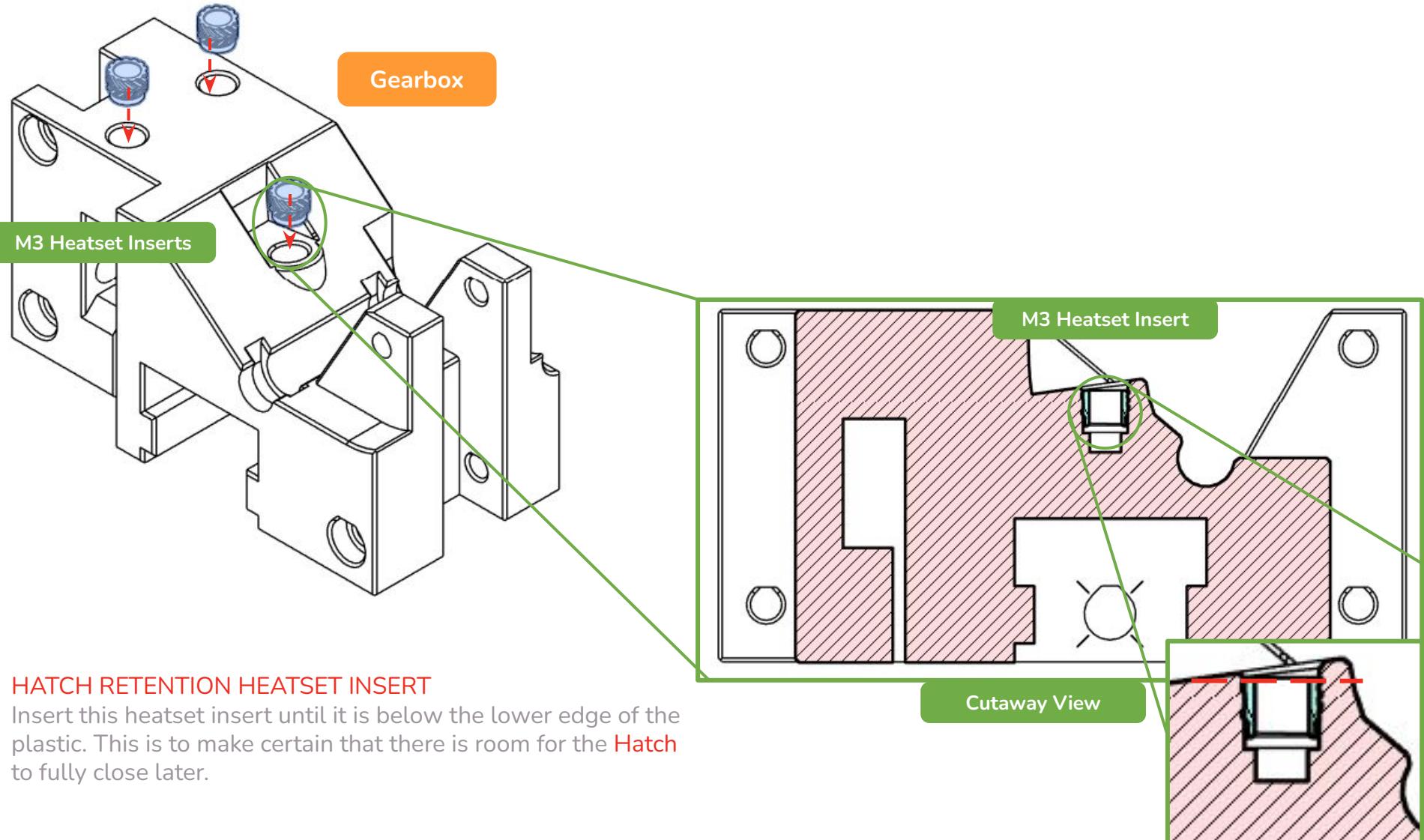


1.2 PRINT-IN-PLACE SUPPORTS

Remove the Print-In-Place supports from the Gearbox as shown. Use a hobby knife, file, or a small flat-bladed screwdriver to remove any stuck pieces of support or loose bridges so that the Gearbox is ready to receive the 2020 extrusion.

1.2 HEATSET INSERTS

The list of pages with heatset inserts is on [Page 15](#).



HATCH RETENTION HEATSET INSERT

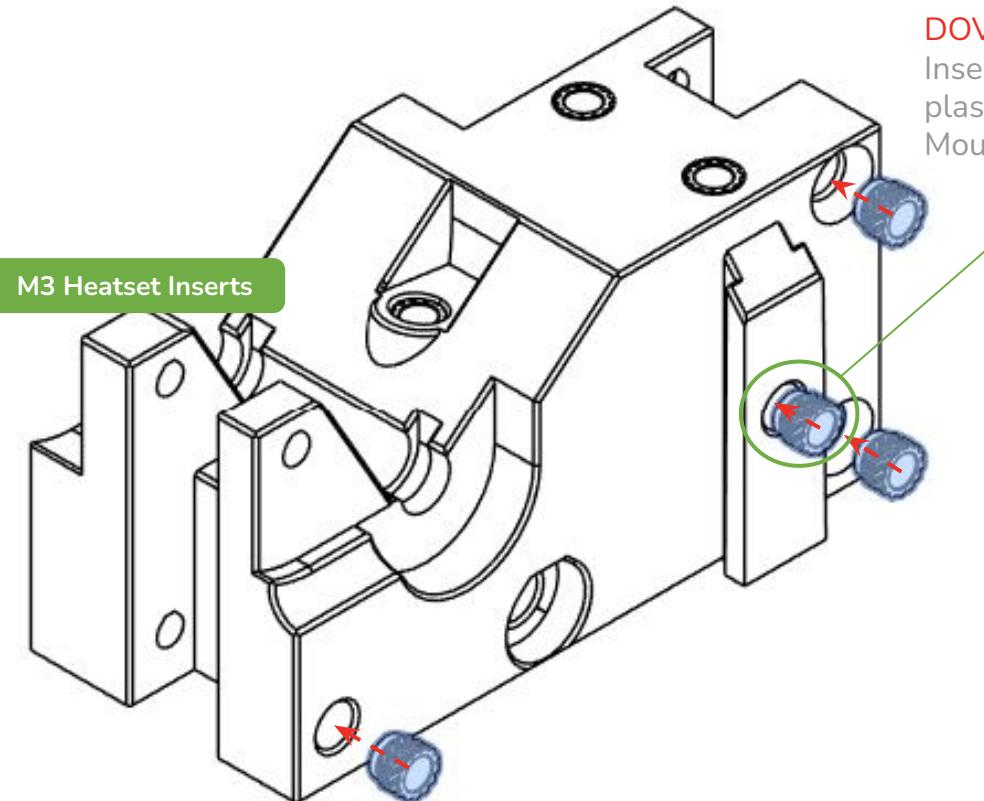
Insert this heatset insert until it is below the lower edge of the plastic. This is to make certain that there is room for the **Hatch** to fully close later.

GEARBOX PART 1

GEARBOX PREPARATION

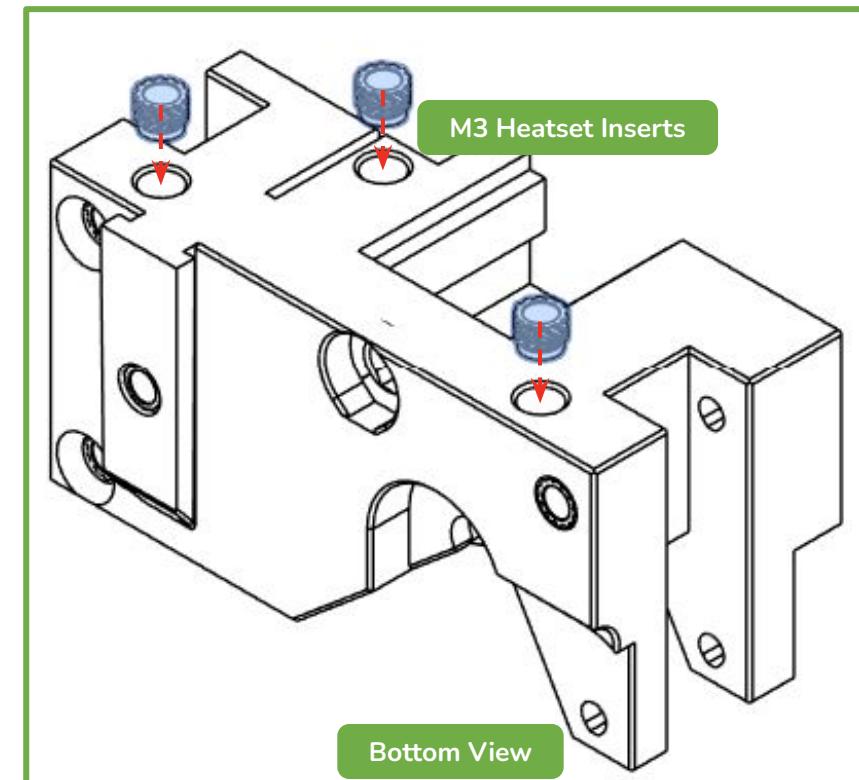
1.2 HEATSET INSERTS

The list of pages with heatset inserts is on [Page 15](#).



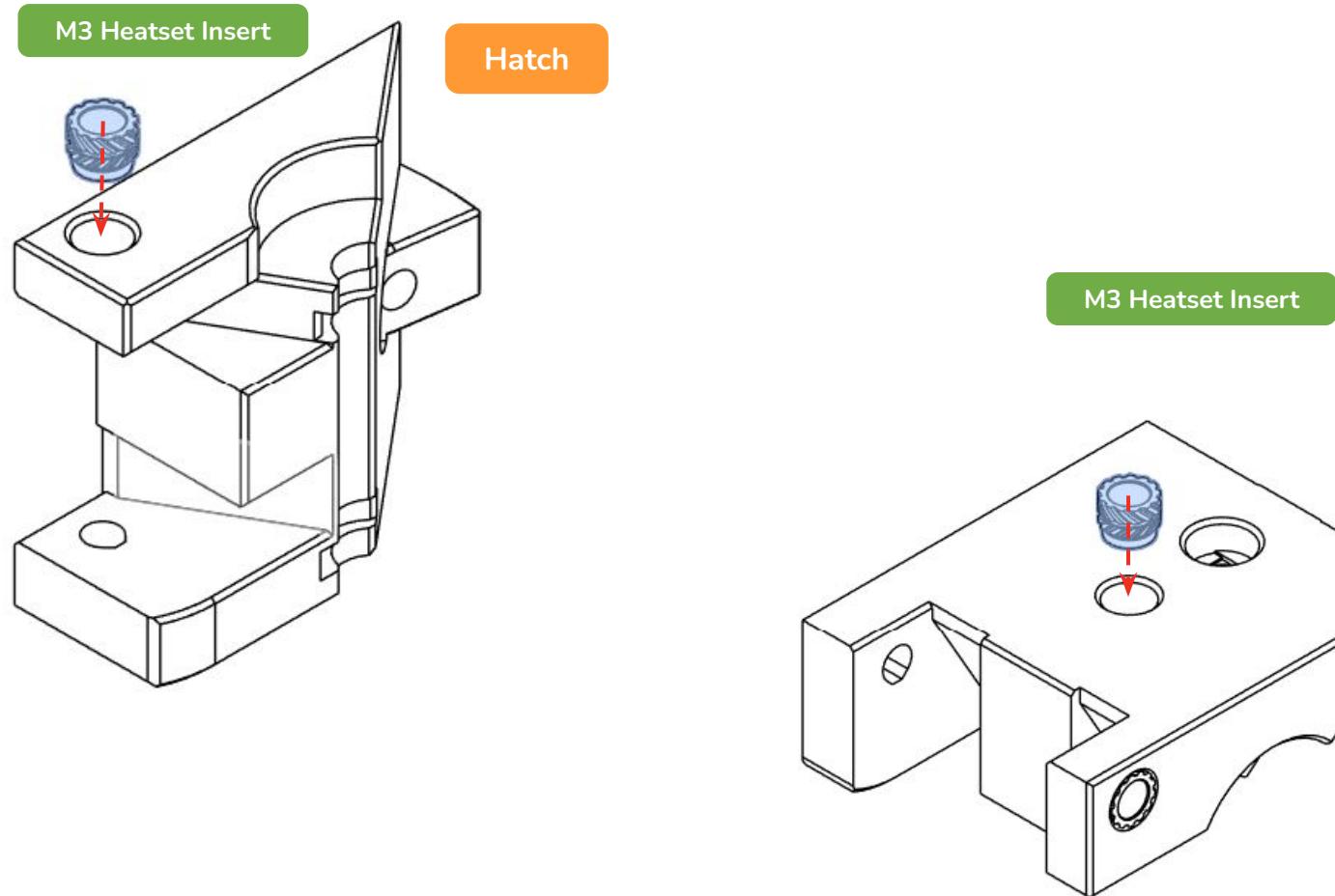
DOVETAIL HEATSET INSERT

Insert this heatset insert until it is just below the edge of the plastic. This is to make certain that the dovetail for the Motor Mount works smoothly and doesn't catch on the heatset insert.



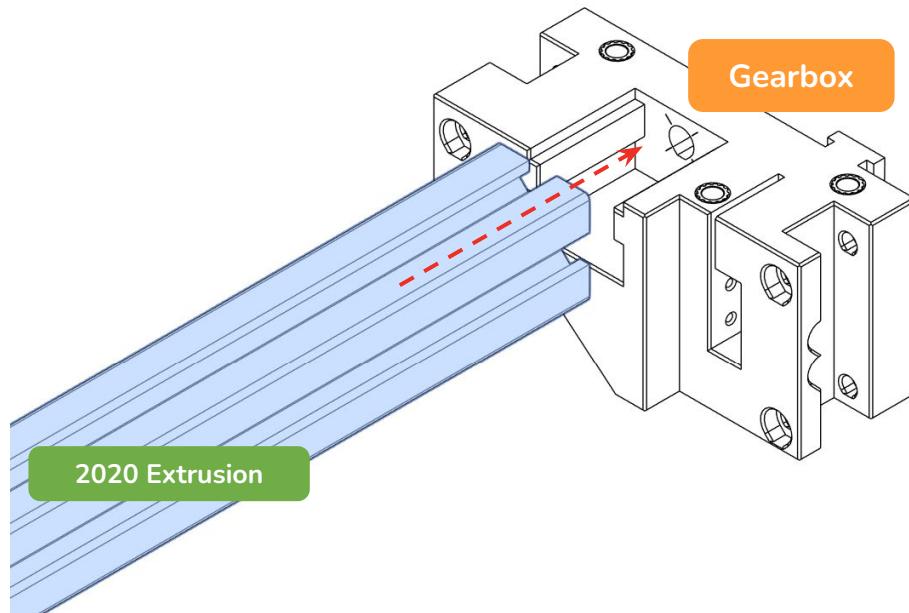
1.3 HEATSET INSERTS

The list of pages with heatset inserts is on [Page 15](#).



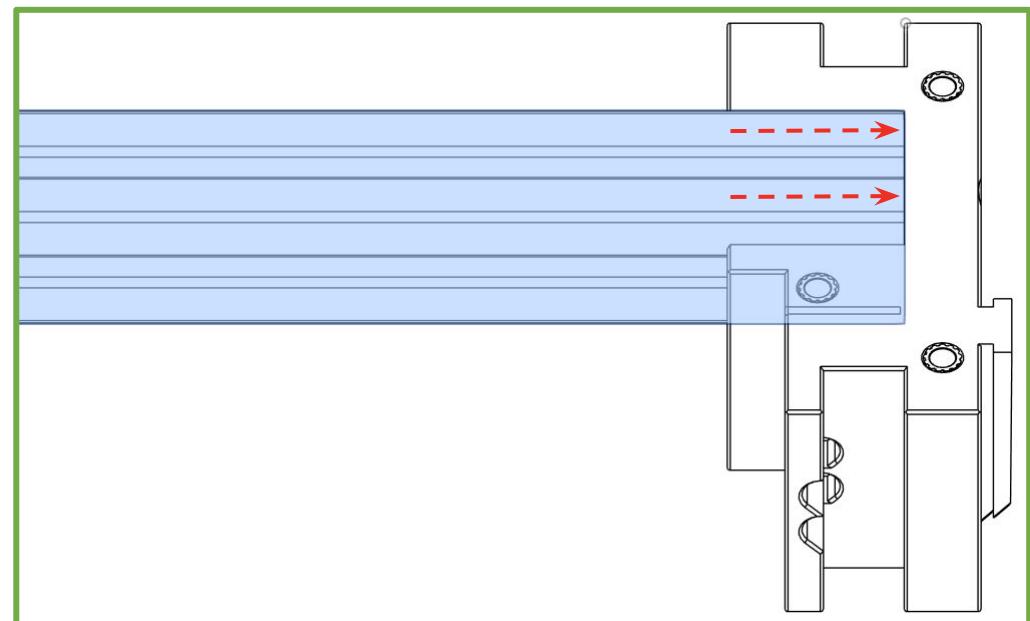
GEARBOX PART 1

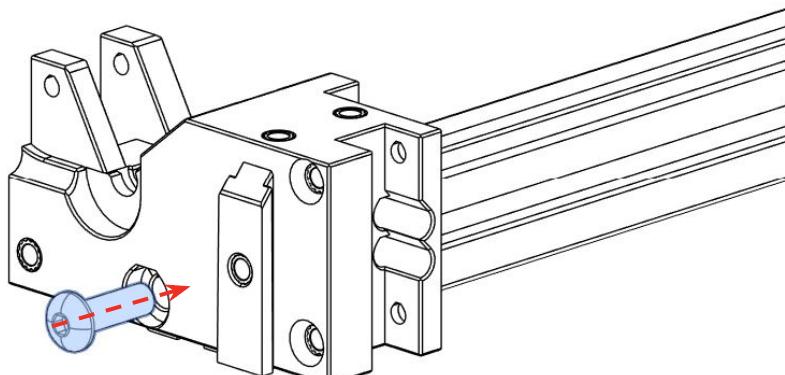
2020 INSTALLATION



1.2 SEAT THE 2020

Align and fully seat the tapped side of the 2020 into the Gearbox. If it doesn't sit flush, remove the 2020 and check the Gearbox for loose plastic from failed bridging. You may need to remove the 2020 and clean up any plastic that the 2020 has shaved off during installation. It's a tight fit, and 2020 may have sharp cut edges, so be careful not to cut yourself on them.

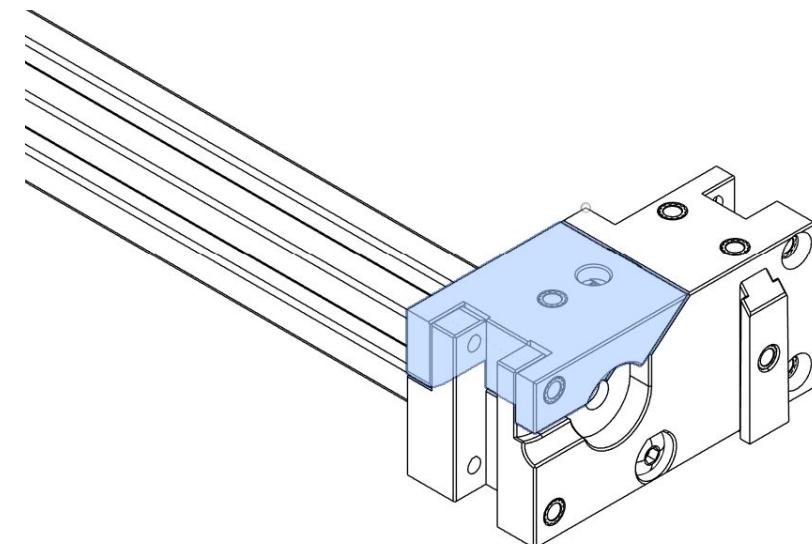
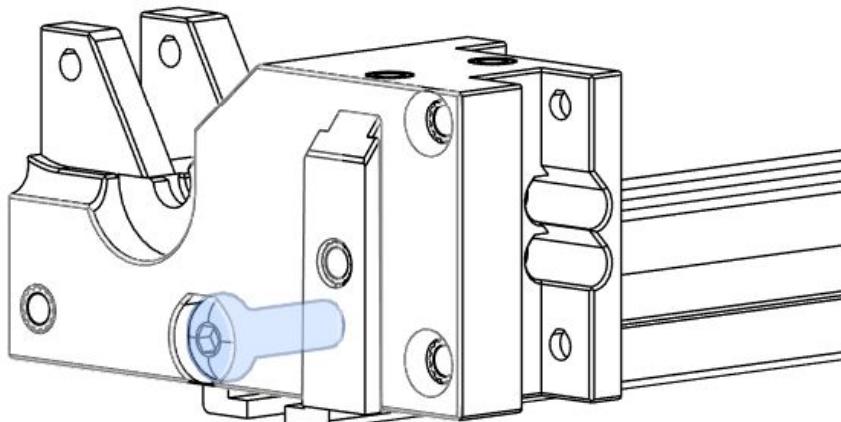




M5x16mm BHCS

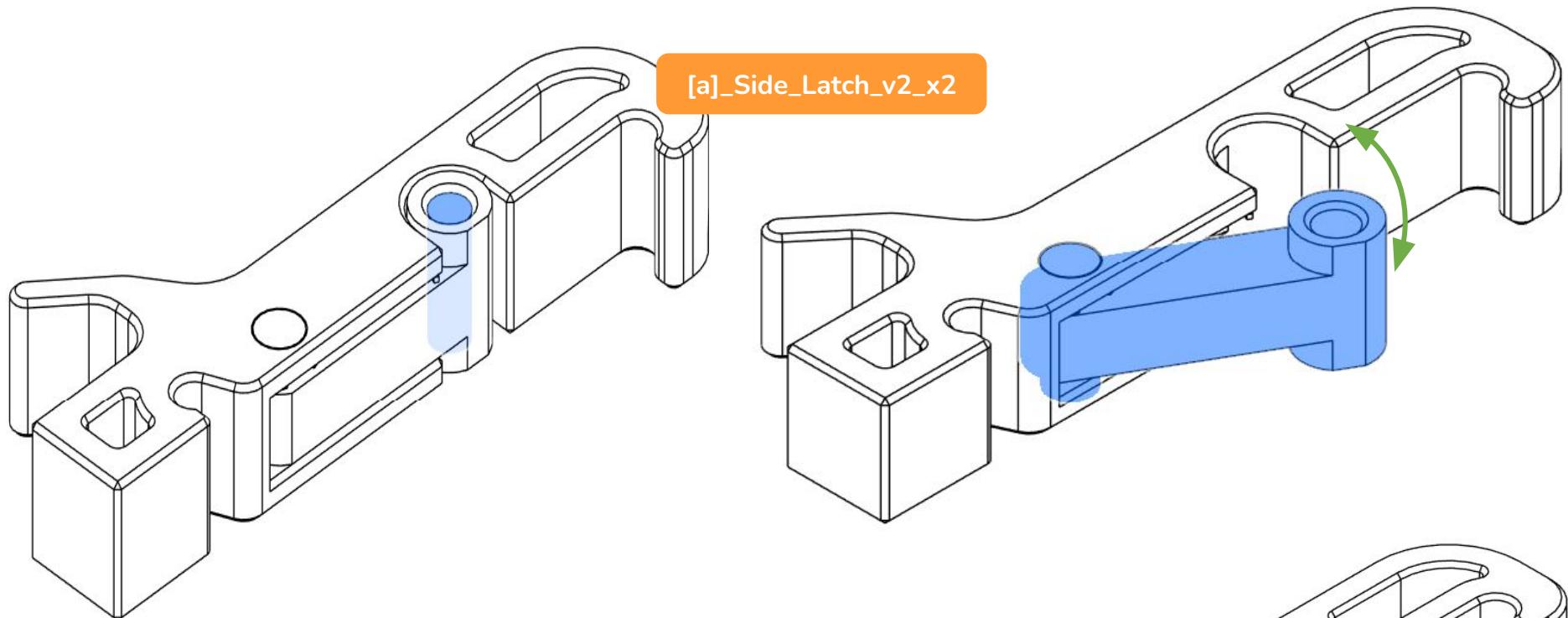
1.2 ADD M5x16mm BHSC

Add the M5x16mm BHCS. Tighten the 2020 to the Gearbox. Go ahead, hulk it down if you like, it's designed to take it! It only needs to be snug enough to pull the gearbox squarely into alignment.



1.3 ADD THE HATCH

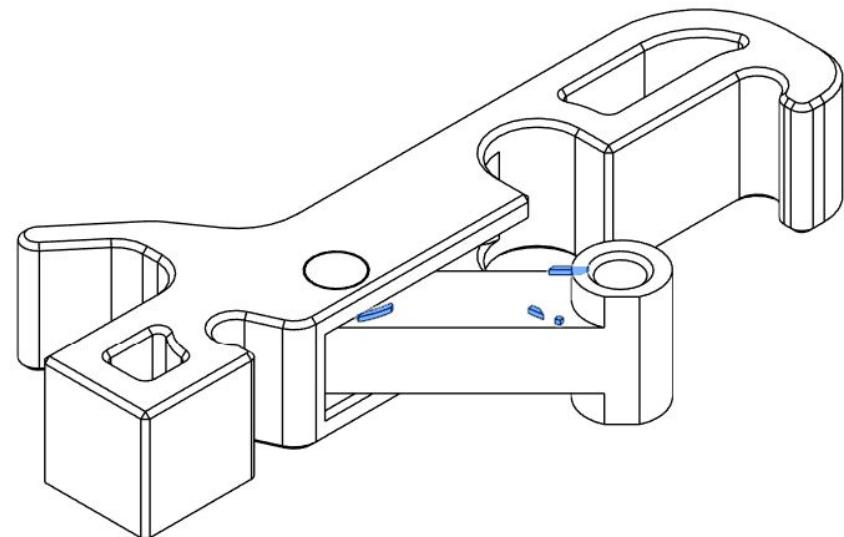
Dry fit the Hatch. We will attach it in the next steps.



1.4 HINGE UNLOCK

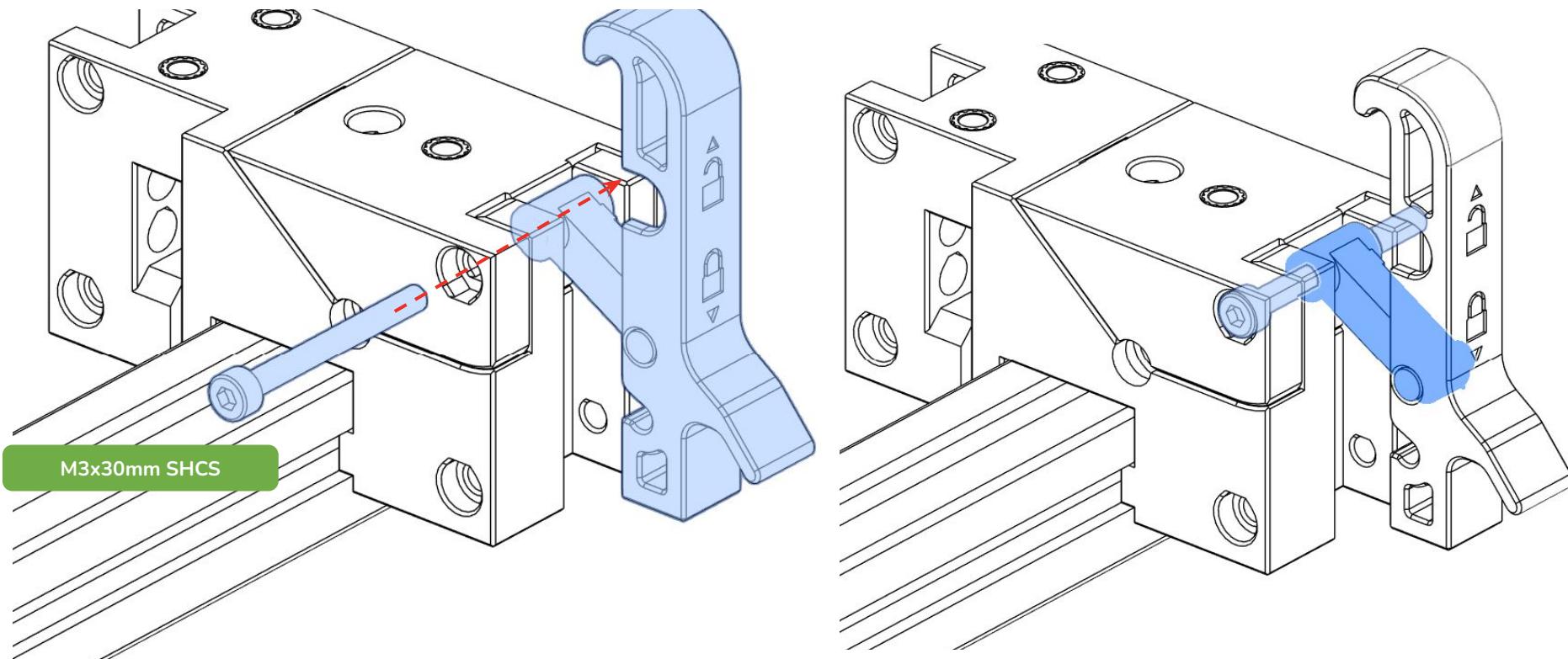
Use a small tool like an allen key or an M3x30mm SHCS inserted into the hinge hole to free the print-in-place mechanism and ensure it rotates freely. You may need to scrape the micro-supports off of the arm if the fit is too tight, but they are designed to either break off or be unobtrusive.

Do this for both of the [Side_Latch_v2](#).



1.3 INSTALL M3x30mm SHCS

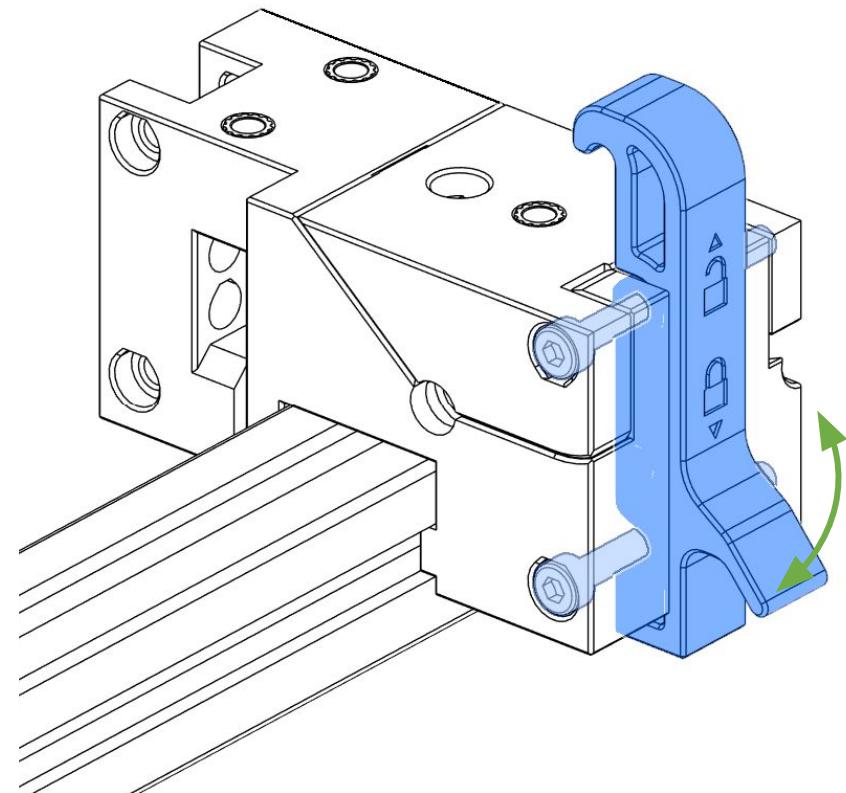
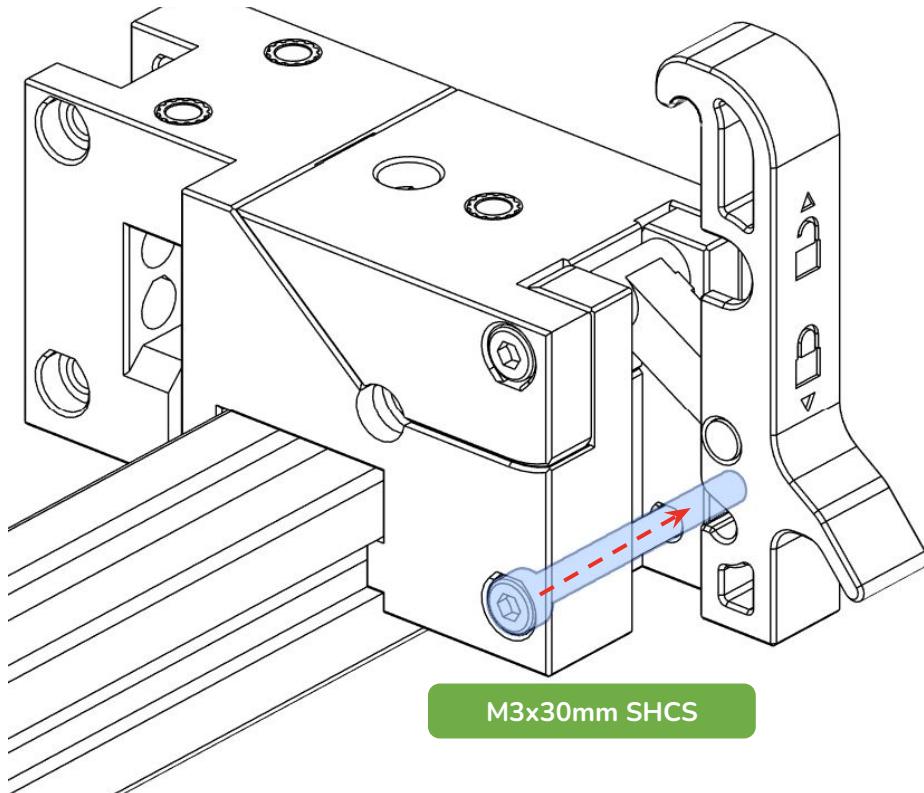
Slide the M3x30mm SHCS bolt through the hole in the arm of the **Side_Latch_v2**. Then snug the bolt. It doesn't need to be very tight - this bolt functions as a hinge for both the **Hatch** and the **Side_Latch_v2**.



1.4 FINISH MOUNTING SIDE_LATCH_v2

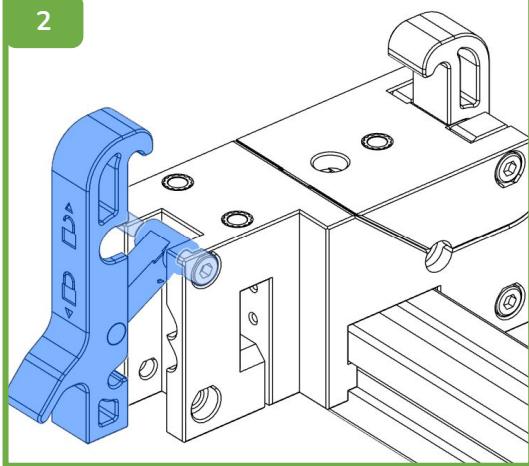
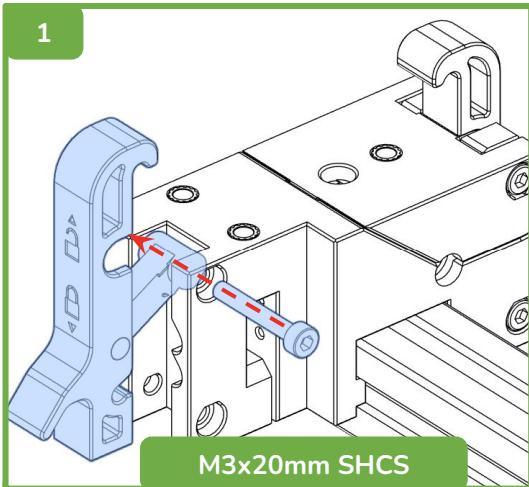
Line up another M3x30mm SHCS on the bottom hole and snug it into place.

You should be able to swing the **Side_Latch_v2** down and snap it into place. Practice opening it with the lever arm - If your bolts are too tight, or it's going to break, you want to know now!

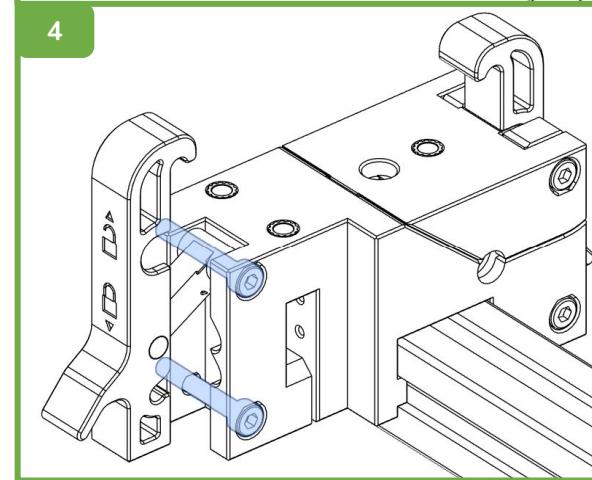
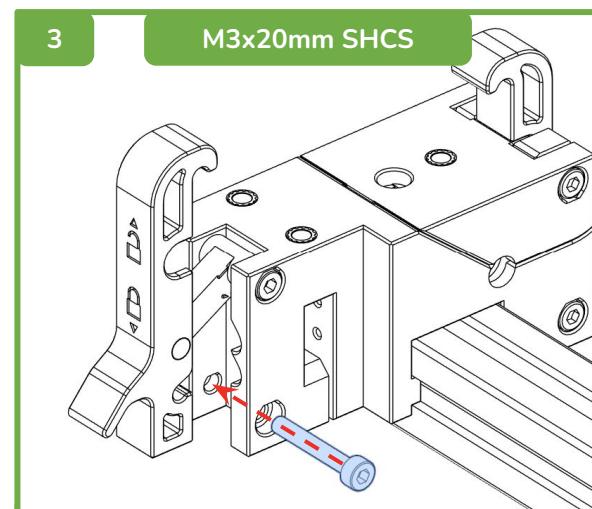
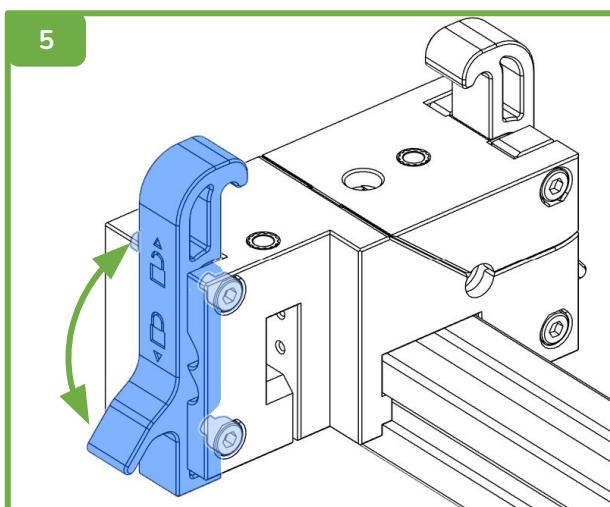


GEARBOX PART 1

SECOND LATCH INSTALLATION



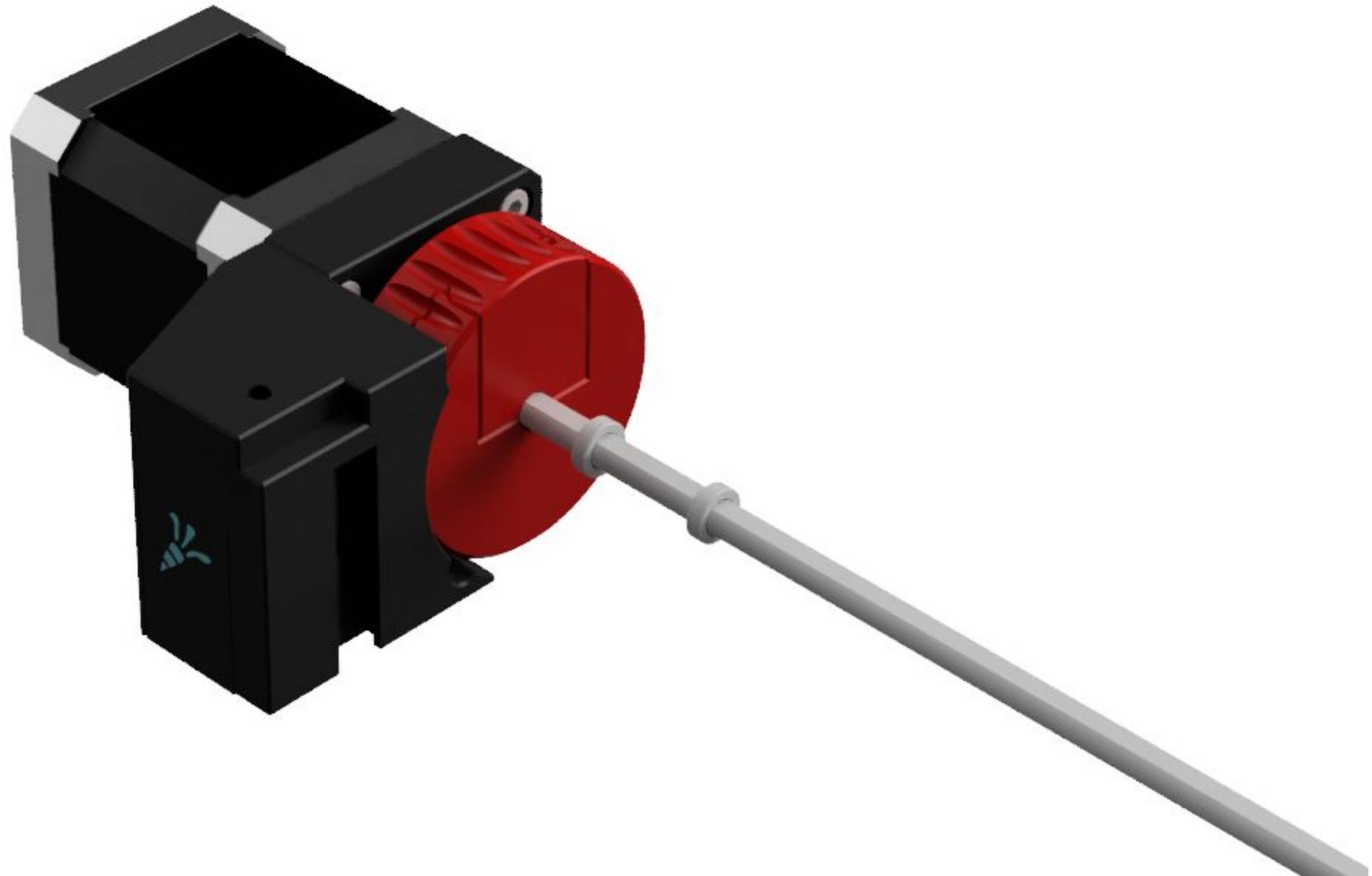
- 1.4 MOUNT THE SECOND SIDE_LATCH_v2
 1. Line up an M3x20mm SHCS with the hole in the *Side_Latch_v2* arm.
 2. Snug the bolt into place. It doesn't need to be very tight - this bolt functions as a hinge for the *Side_Latch_v2*.
 3. Line up another M3x20mm SHCS on the bottom hole.
 4. Snug it into place, the same as the first bolt.
 5. You should be able to swing the *Side_Latch_v2* down and snap it into place. Practice opening it with the lever arm - If your bolts are too tight, or it's going to break, you want to know now!



The first 3D printer was invented in 1986 by Chuck Hull, who called the process "stereolithography".

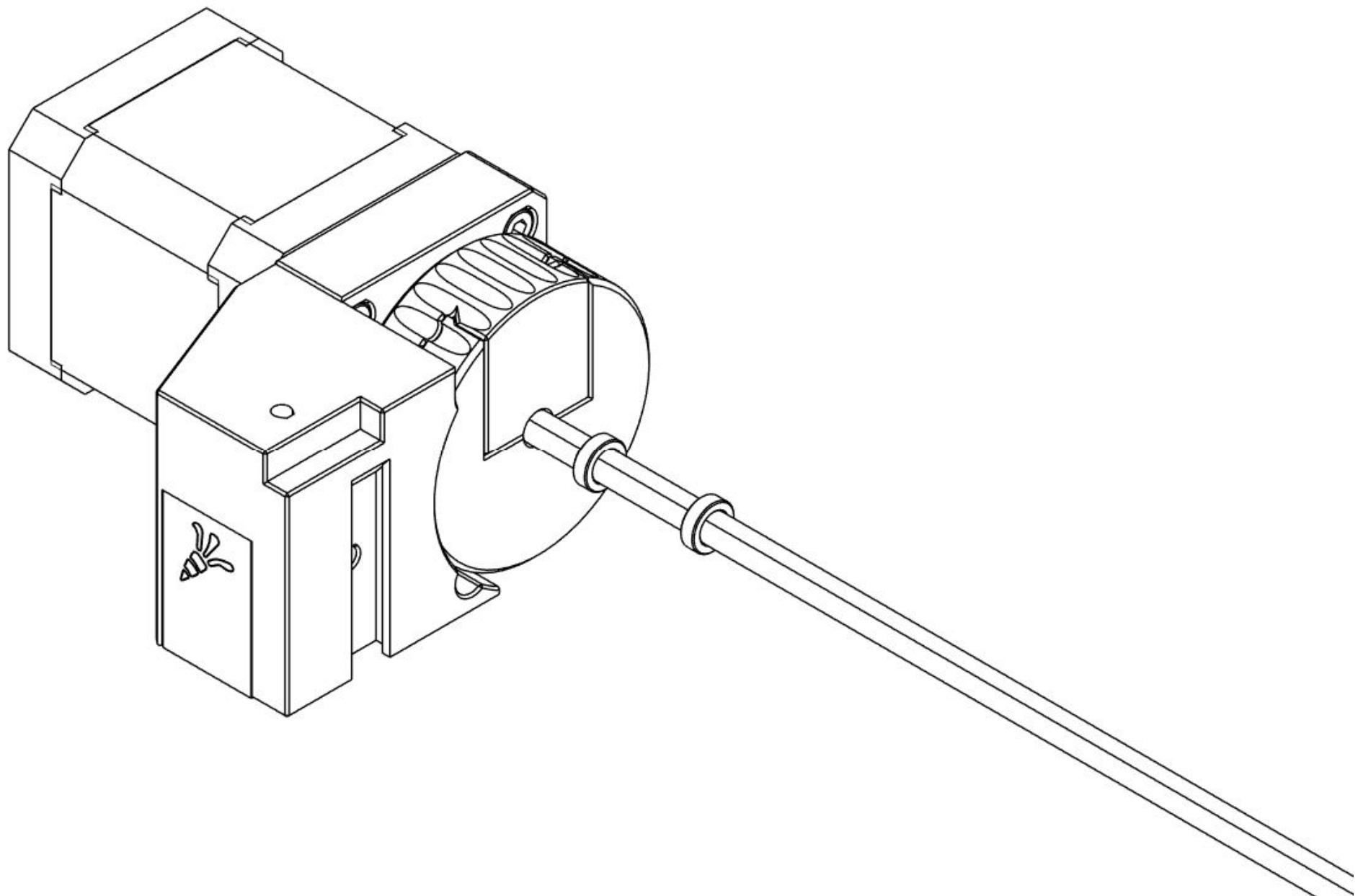
MOTOR MOUNT (DIRECT)

OVERVIEW

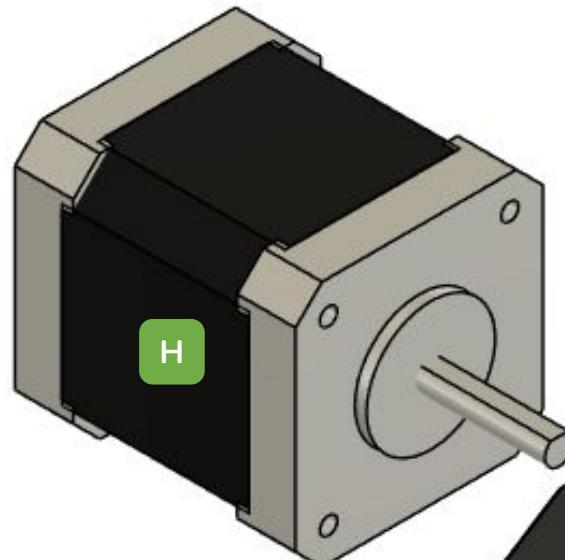


MOTOR MOUNT (DIRECT)

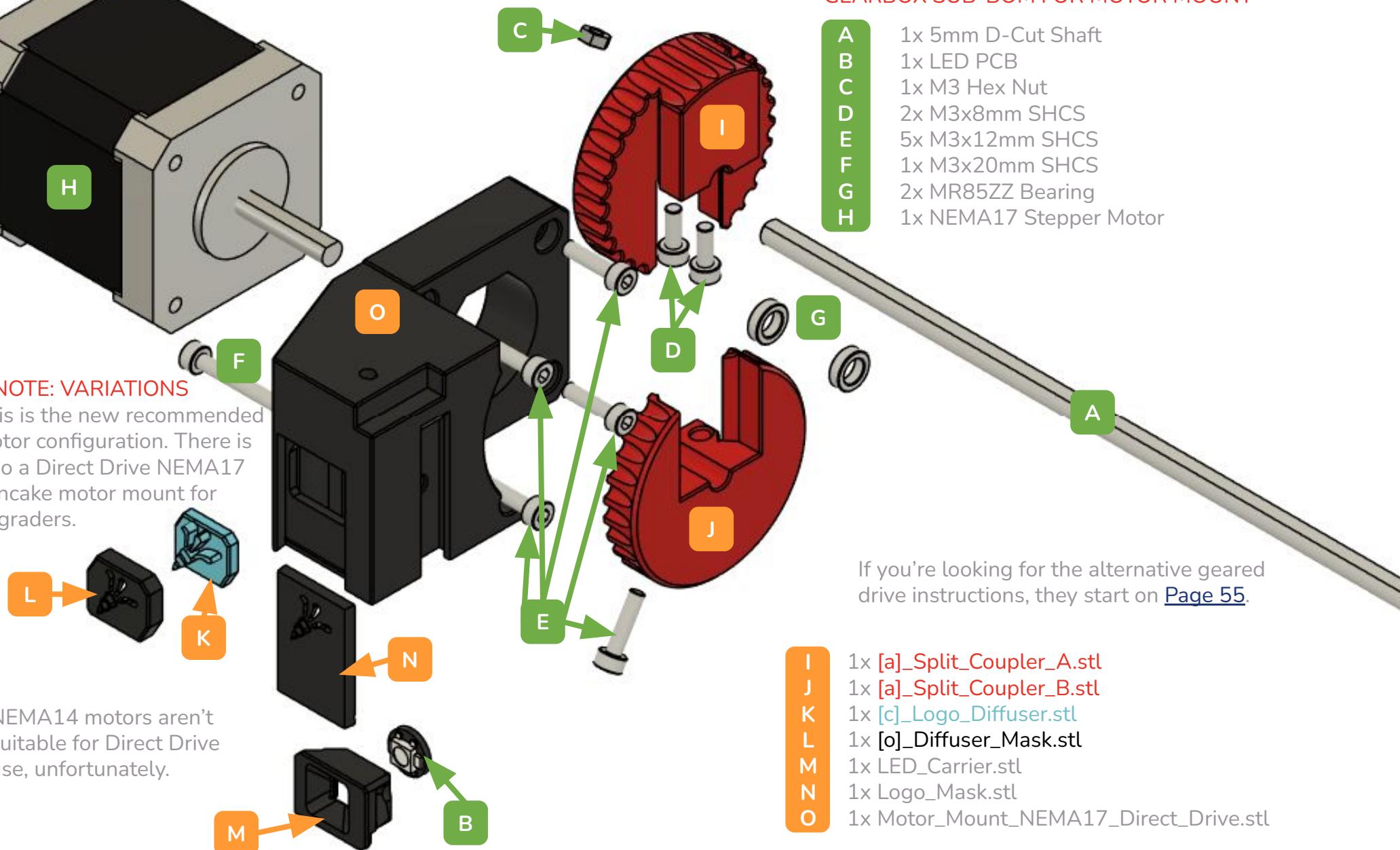
OVERVIEW



MOTOR MOUNT (DIRECT)



EXPLODED VIEW

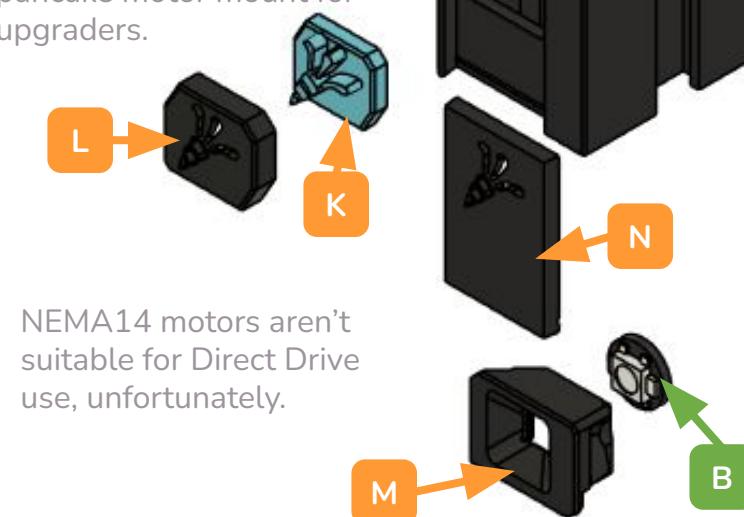


GEARBOX SUB-BOM FOR MOTOR MOUNT

- 1x 5mm D-Cut Shaft
- 1x LED PCB
- 1x M3 Hex Nut
- 2x M3x8mm SHCS
- 5x M3x12mm SHCS
- 1x M3x20mm SHCS
- 2x MR85ZZ Bearing
- 1x NEMA17 Stepper Motor

**NOTE: VARIATIONS

This is the new recommended motor configuration. There is also a Direct Drive NEMA17 pancake motor mount for upgraders.

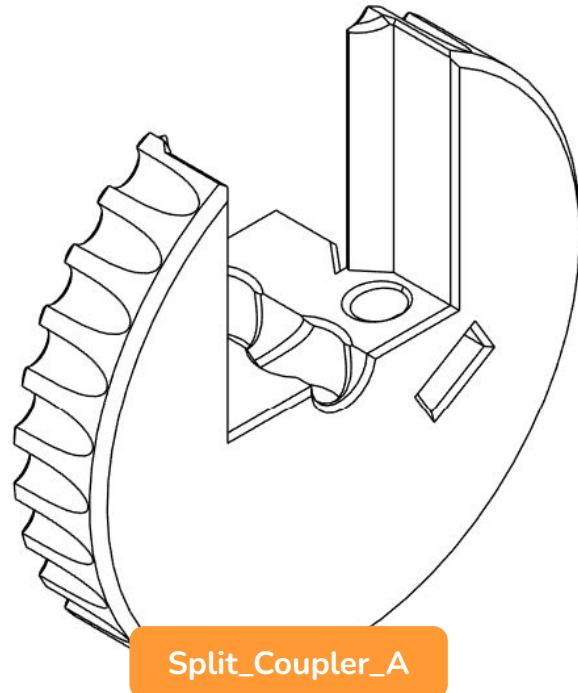


NEMA14 motors aren't suitable for Direct Drive use, unfortunately.

If you're looking for the alternative geared drive instructions, they start on [Page 55](#).

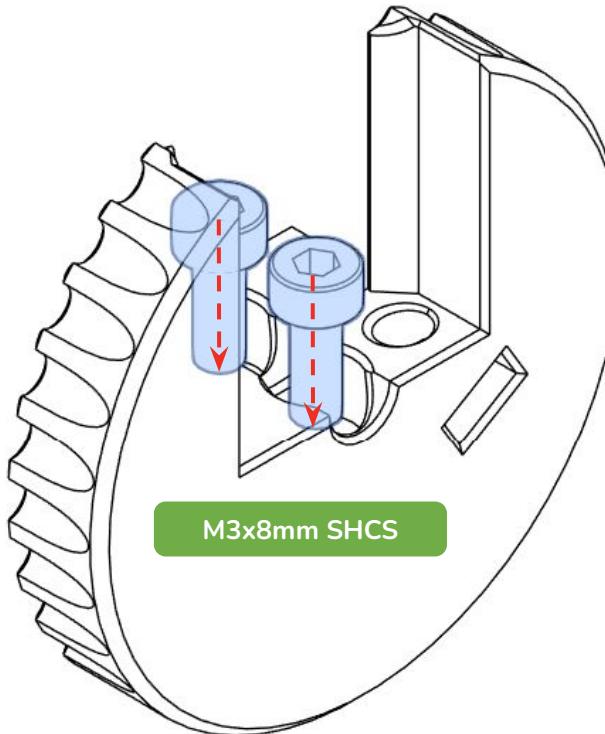
- I
- J
- K
- L
- M
- N
- O
- 1x [a]_Split_Coupler_A.stl
- 1x [a]_Split_Coupler_B.stl
- 1x [c]_Logo_Diffuser.stl
- 1x [o]_Diffuser_Mask.stl
- 1x LED_Carrier.stl
- 1x Logo_Mask.stl
- 1x Motor_Mount_NEMA17_Direct_Drive.stl

MOTOR MOUNT (DIRECT)

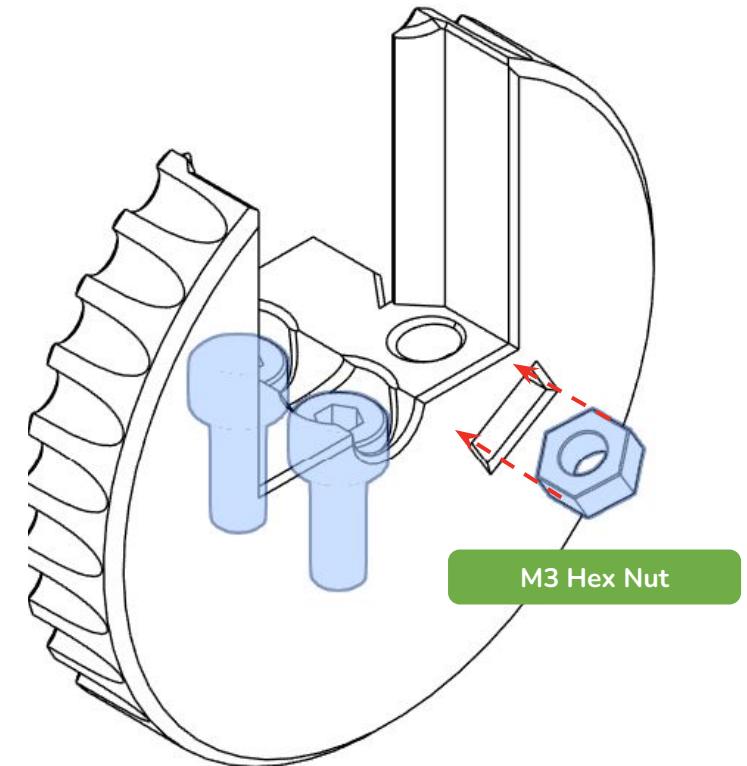


Split_Coupler_A

PREP COUPLER



M3x8mm SHCS



M3 Hex Nut

PREPARING THE COUPLER

Take two M3x8mm bolts and place them into the [Split_Coupler_A](#). It should just barely grip the bolts with no threading necessary,

Using pliers, align an M3 hex nut point-first to the slot in the [Split_Coupler_A](#). Carefully slide it into the slot. Next, switch to a small flathead screwdriver to push the nut all the way into the slot.

Set aside the [Split_Coupler_A](#) for now.

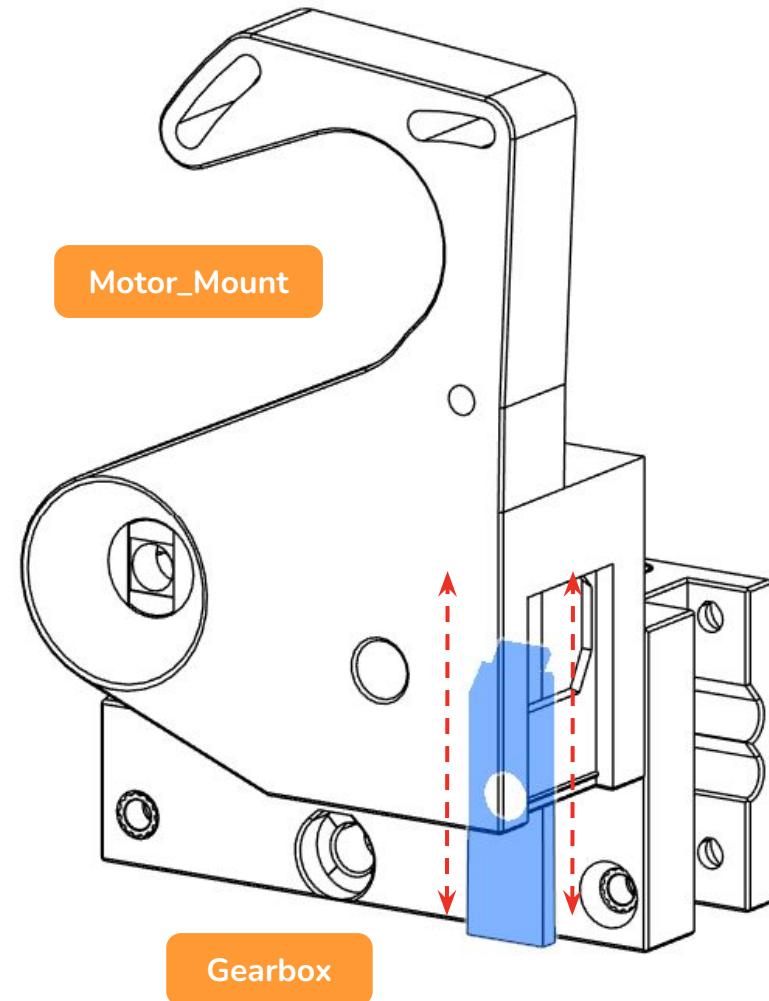
2.1 MOTOR MOUNT MESHING

Take your choice of **Motor_Mount** and carefully mate the dovetail on the **Gearbox** to the slot in the **Motor_Mount**. If it is a tight fit, take sandpaper, a file, or a hobby knife to the parts that are rubbing so that it meshes and unmaches without too much force. We want this dovetail to mesh with little effort so that later assembly steps are easy.

If the fit between these parts is too tight to put together or pull apart, it's a good sign that you either need to reprint the parts, or possibly tune your printer more, especially the Extrusion Multiplier. The parts are designed to fit together and come apart with your hands alone, and without straining. It is normal for the first 3-4 times fitting together to be "sticky," but simply meshing and remeshing the dovetail several times should smooth things out. It is also normal for the area around the dovetail to wear!

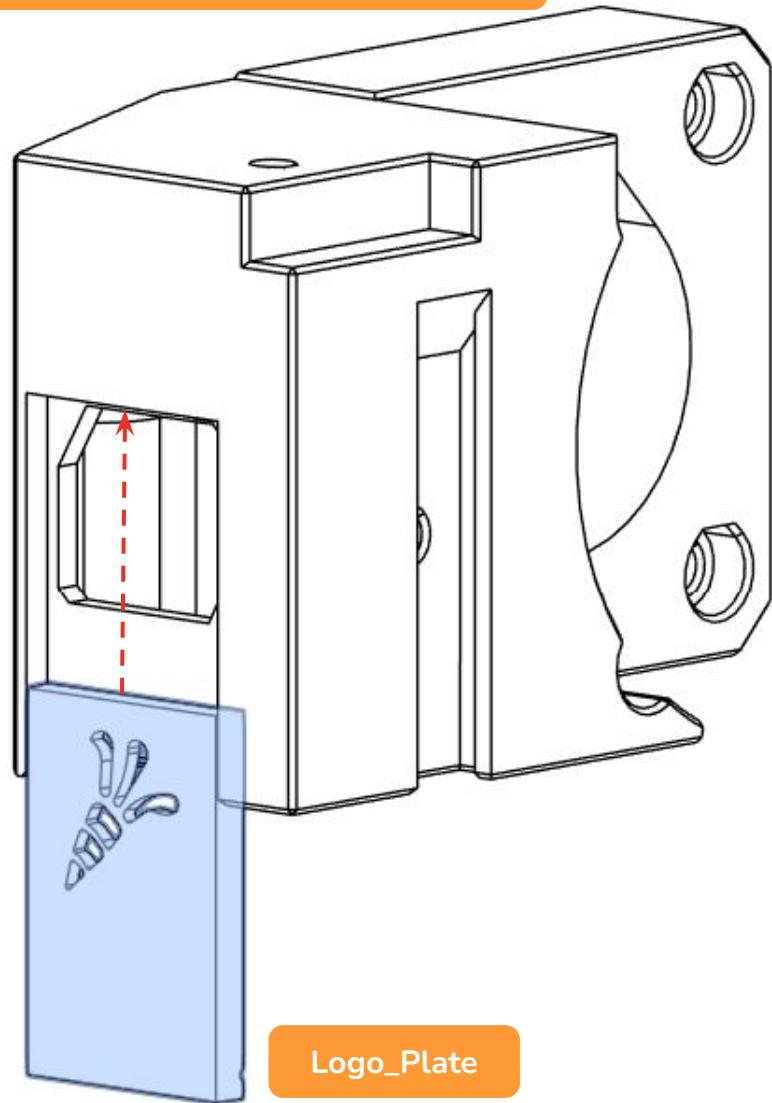
Unmesh and set aside the **Motor_Mount** for now.

Shown: an alternative NEMA17 Motor Mount for a Metal 60T gear.



MOTOR MOUNT (DIRECT)

Motor_Mount_NEMA17_Direct_Drive

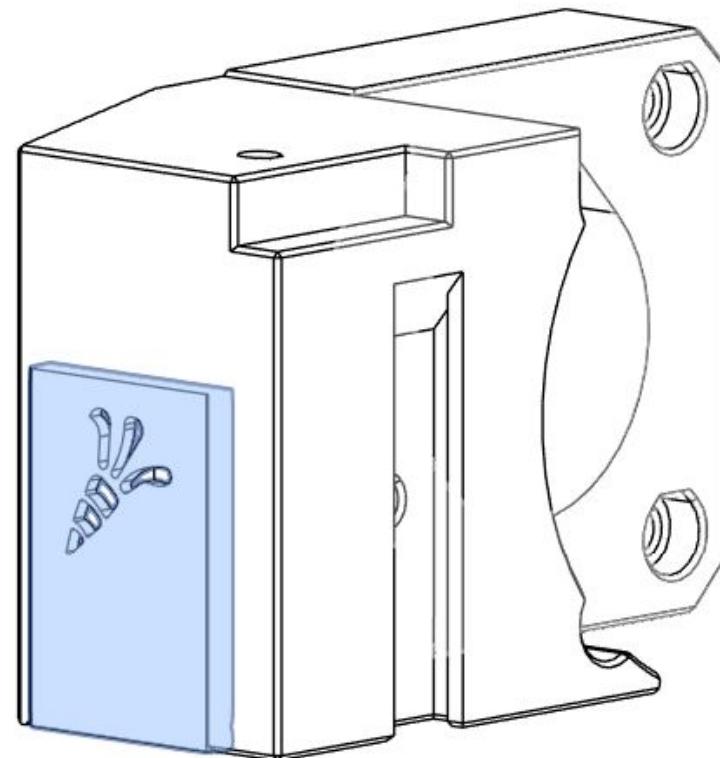


LOGO PLATE

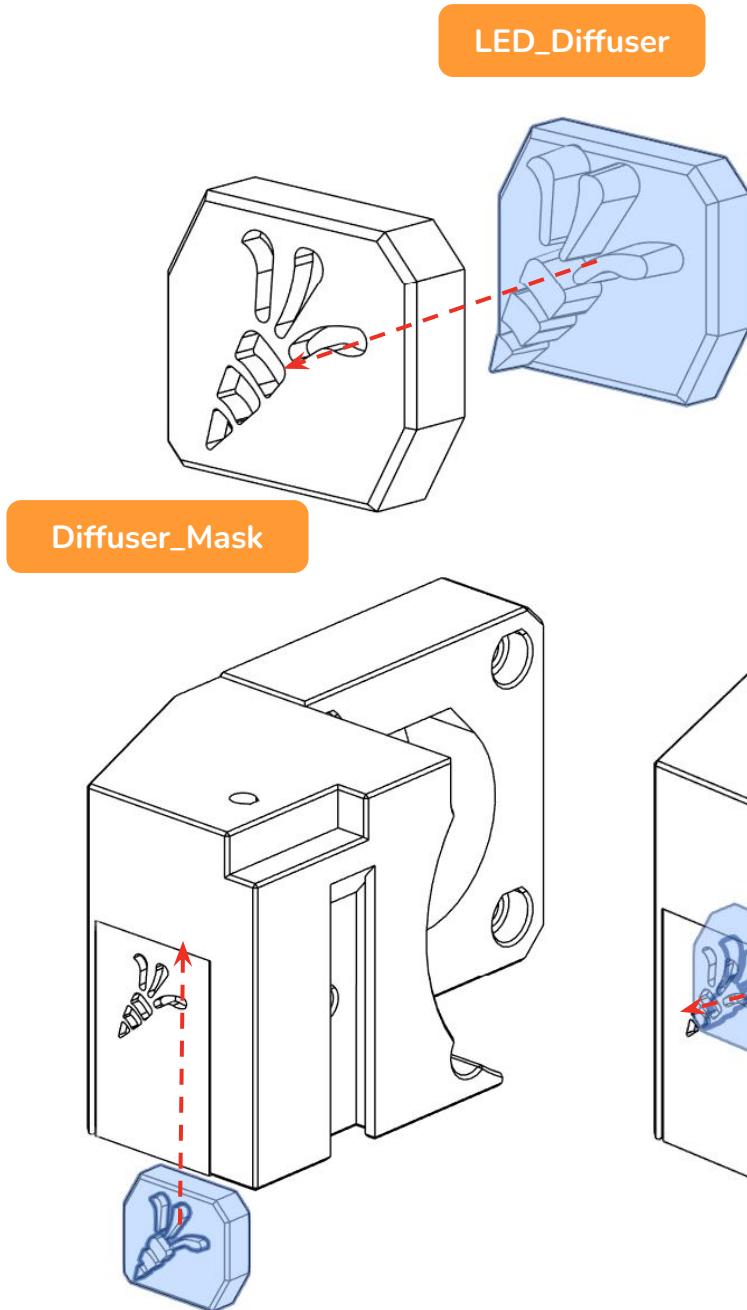
2.2 INSTALLING THE LOGO PLATE

The **Logo_Plate** interlocks with the **LED_Diffuser** and **Diffuser_Mask**, so it must be installed first and uninstalled last.

Align the **Logo_Plate** with the slot in the bottom of the **Motor_Mount**, and slide it upwards until it clips into place.



MOTOR MOUNT (DIRECT)

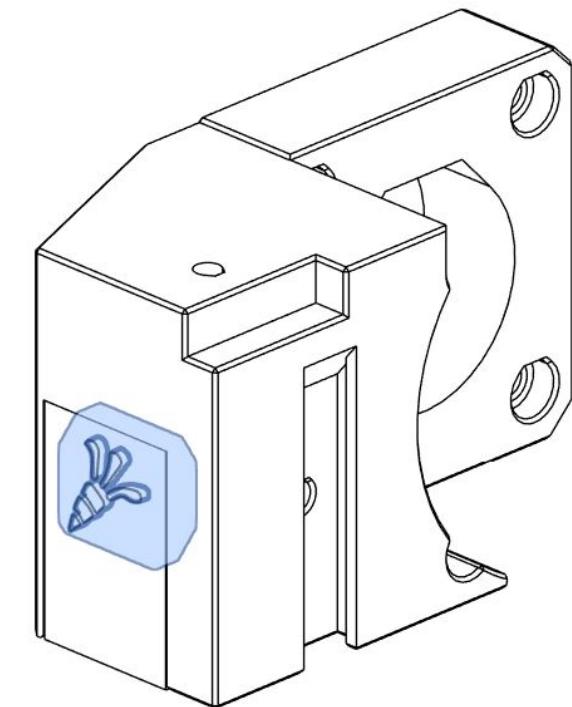


LED DIFFUSER

2.2 INSTALLING THE LED DIFFUSER

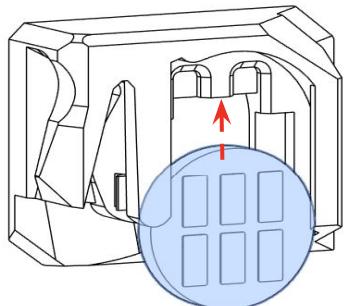
Insert the **LED_Diffuser** into the **Diffuser_Mask**, so that the carrot logo pokes through the **Diffuser_Mask**.

Insert the combined part into the **Motor_Mount** from the bottom. Once the combined part is as far up as it can go, use an Allen key or screwdriver to push it into the **Logo_Plate**.



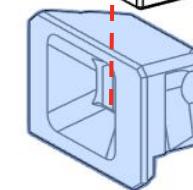
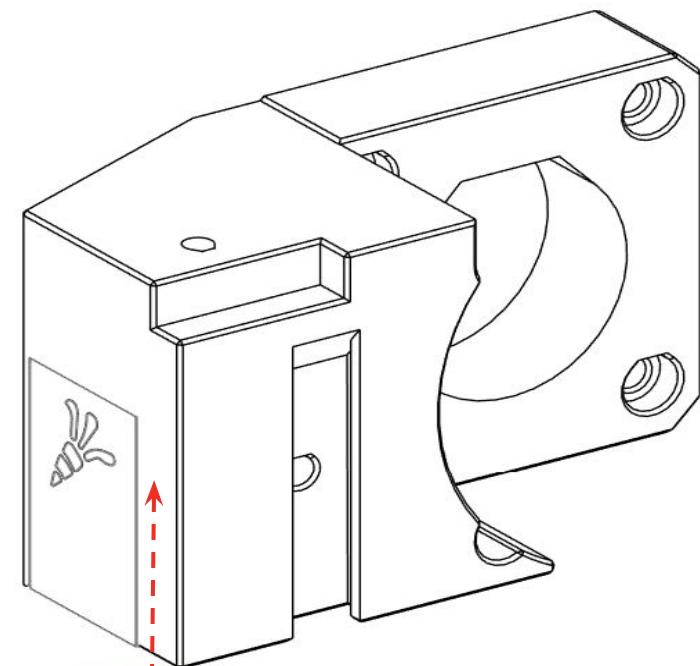
MOTOR MOUNT (DIRECT)

LED_Carrier



LED PCB

LED CARRIER

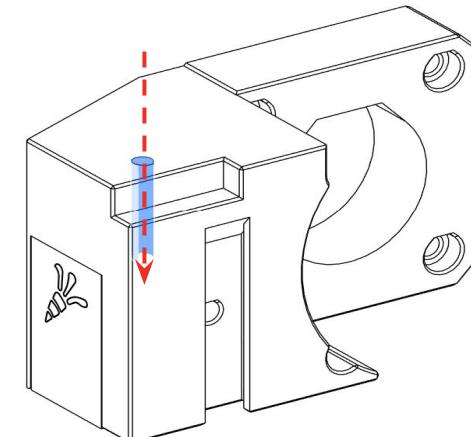


2.2 INSTALLING THE LED CARRIER

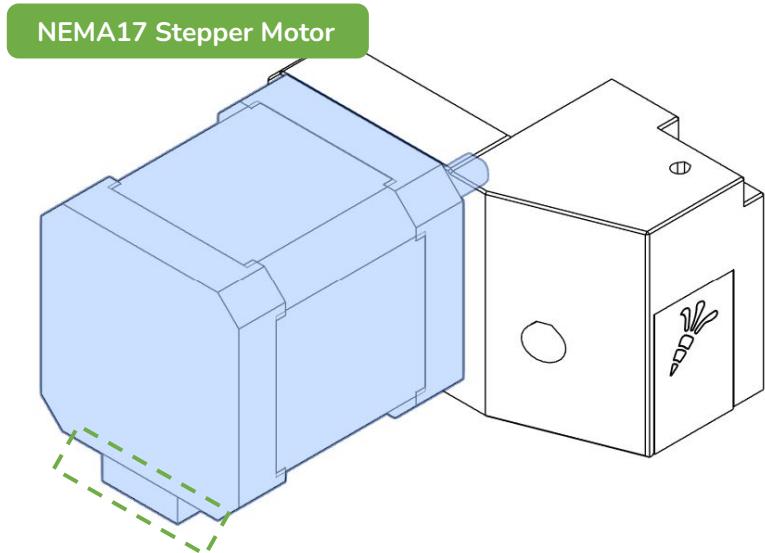
Insert the LED PCB into the **LED_Carrier**, so that the edges of the PCB clip into the **LED_Carrier**. Check the front of the **LED_Carrier** to make sure the LED is aligned with the window. The wires are omitted from the images for clarity.

Insert the combined part into the **Motor_Mount** from the bottom. Use an Allen key or screwdriver to push the combined part up as far as it can go.

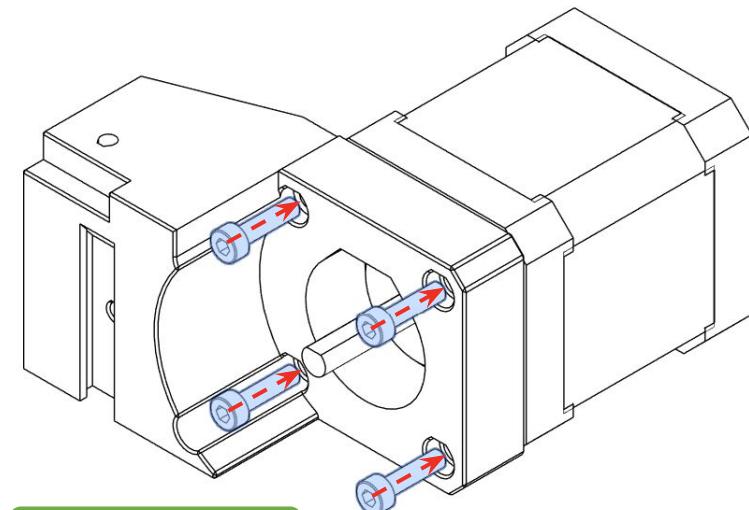
If you need to recover the LED for any reason, insert an Allen key into the hole in the roof of the **Motor_Mount** to push the **LED_Carrier** back out of the bottom.



MOTOR MOUNT (DIRECT)



DRIVE MOTOR

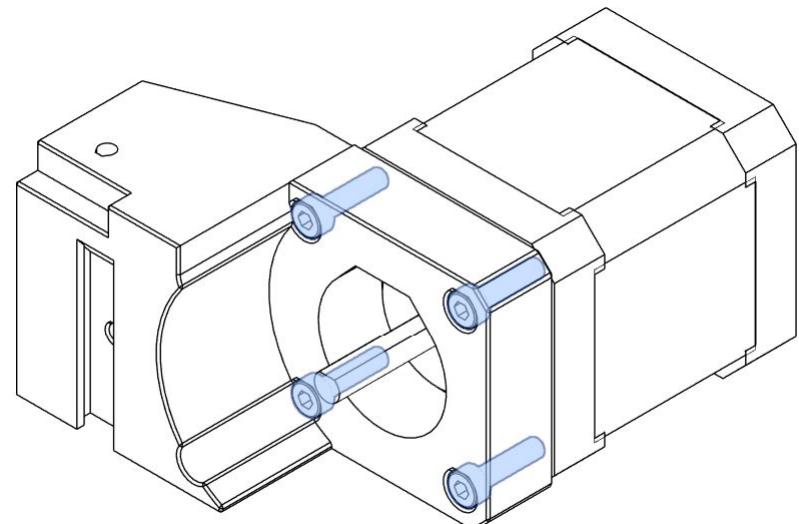


2.1 INSTALLING THE DRIVE MOTOR

Align the NEMA17 Motor with the [Motor_Mount](#) so that the wires or connector is facing down.

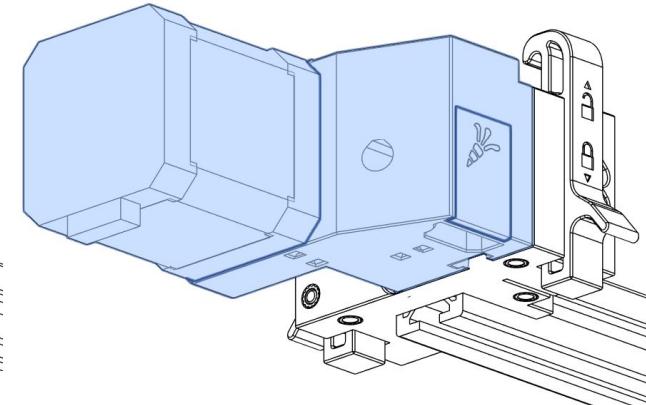
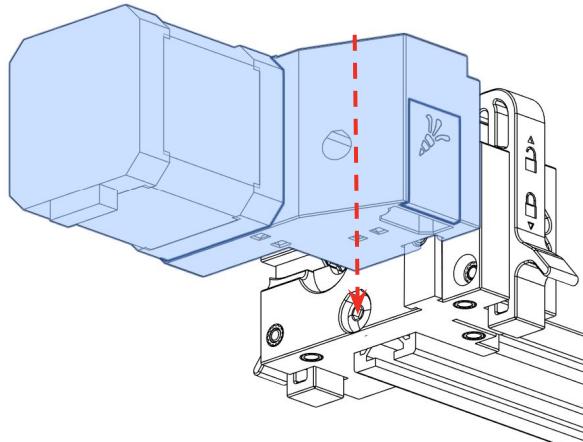
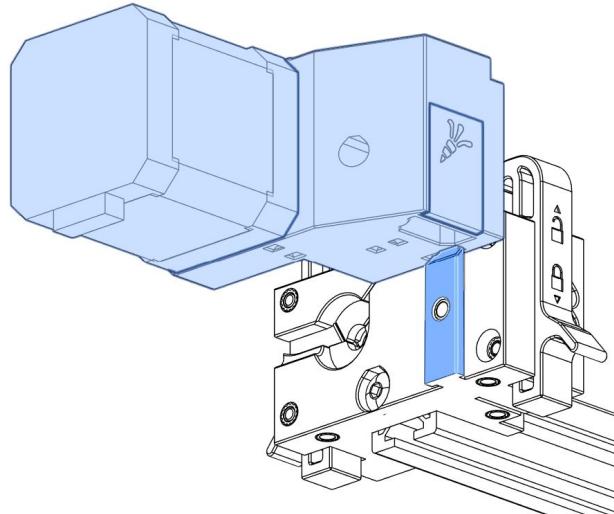
Insert four M3x12mm bolts into the [Motor_Mount](#) and tighten them in an alternating pattern until they are all very snug.

If you are using an alternative 5mm shaft coupler, you should install it loosely onto the motor shaft now.



MOTOR MOUNT (DIRECT)

INSTALLING MOTOR MOUNT



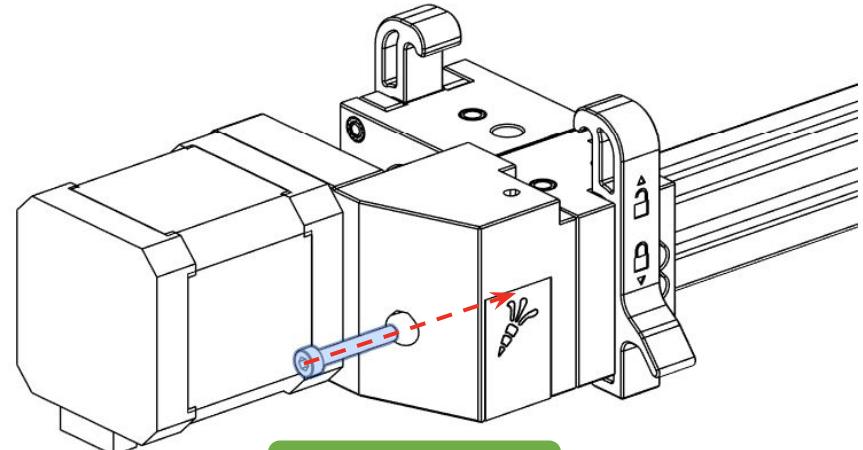
2.1 INSTALLING THE MOTOR MOUNT

Align the slot in the **Motor_Mount** with the dovetail on the **Gearbox**.

Press down on the **Motor_Mount**. It should be a snug fit. If it's too tight, take the pieces back apart and make sure the slot and dovetail are clear and smooth. If it's a really tight fit, you may need to take a file to the slot and/or dovetail, or reprint one or both of the pieces with more printer tuning.

Keep going until the bottom of the **Motor_Mount** is flush with the bottom of the **Gearbox**.

Install the M3x20mm screw to keep everything in place.



MOTOR MOUNT (DIRECT)

PREP DRIVE SHAFT

PREP THE DRIVE SHAFT

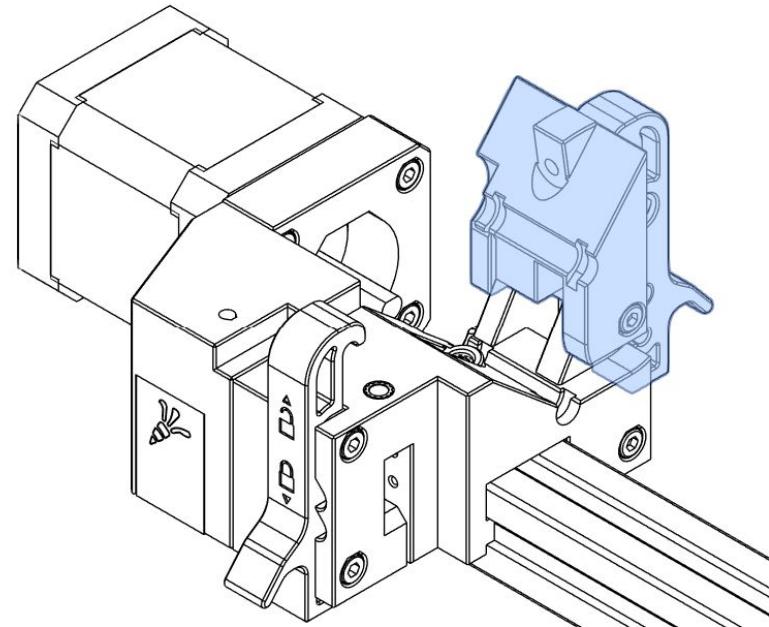
Take the Gearbox assembly and open the [Side_Latch_v2](#) on the side that shares a hinge with the [Hatch](#). Next, flip open the [Hatch](#).

Take the 5mm D-Cut Shaft and insert it into two MR85ZZ bearings.

If your D-Cut Shaft is rough or at-spec (4.98-5.00mm), it will be difficult to insert and move the bearings. It is important that we be able to move the shaft along its axis during assembly, so if this is a problem for you, this must be addressed.

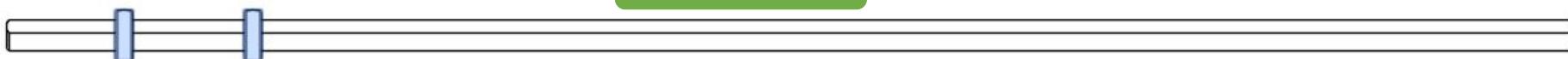
For many D-cut shafts, degreasing them with your favorite household cleaner can make the difference between a too-tight fit and a snug fit. If that doesn't work, follow up with a light-duty abrasive pad.

If you still find that your D-Cut Shaft is too tight on the bearings, take a high-grit sandpaper (at least 300 grit) and sand the shaft. Use a light oil, wear gloves and take appropriate precautions while sanding. You barely want to take any material away at all.



MR85ZZ Bearings

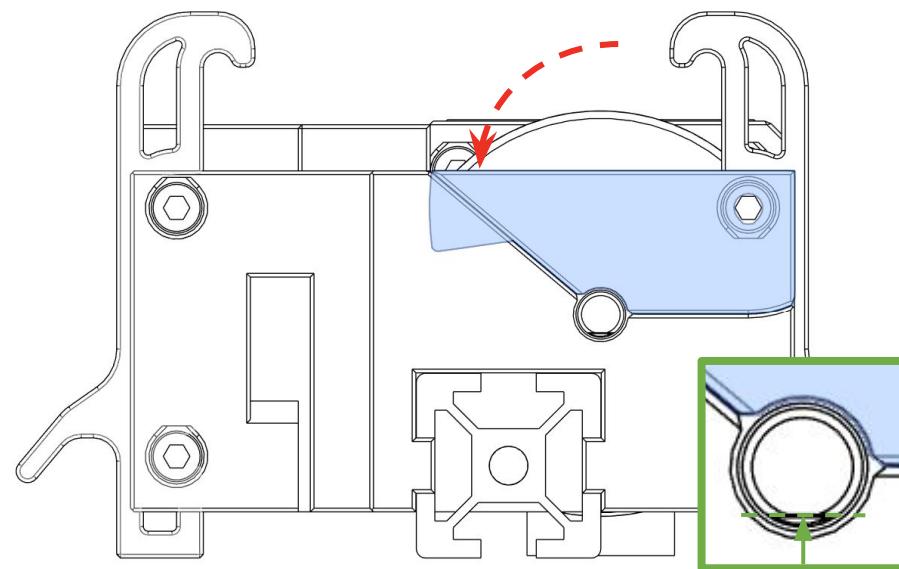
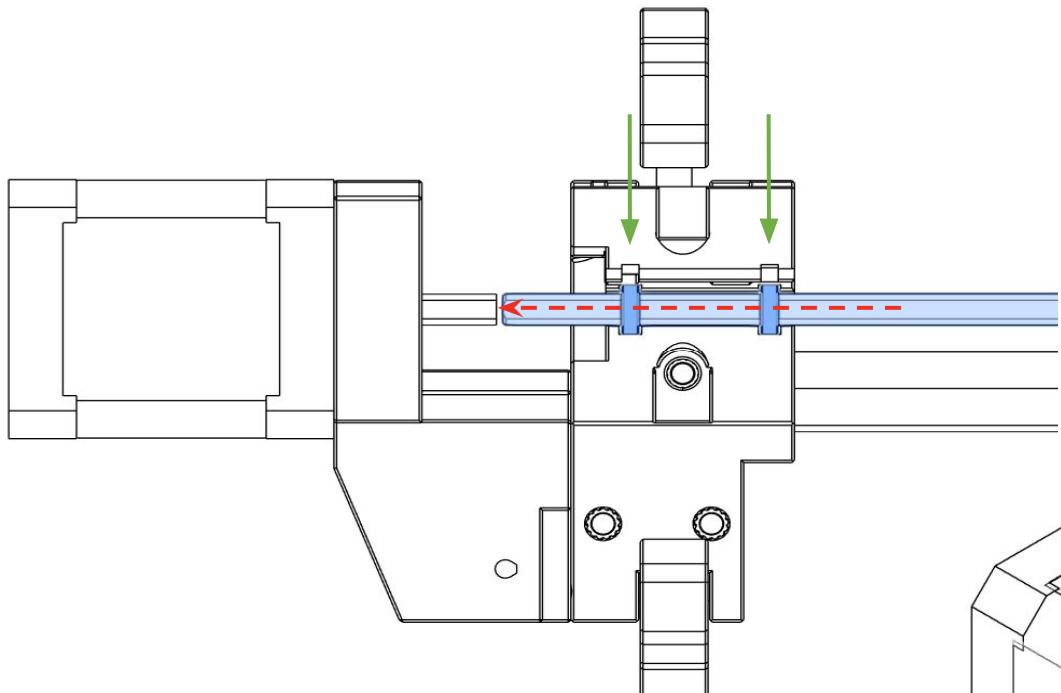
5mm D-Cut Shaft



| Channels | N | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|-----------------------|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| D-Cut Rod Length (mm) | $72 + 23N$ | 164 | 187 | 210 | 233 | 256 | 279 | 302 | 325 | 348 | 371 | 394 | 417 |

MOTOR MOUNT (DIRECT)

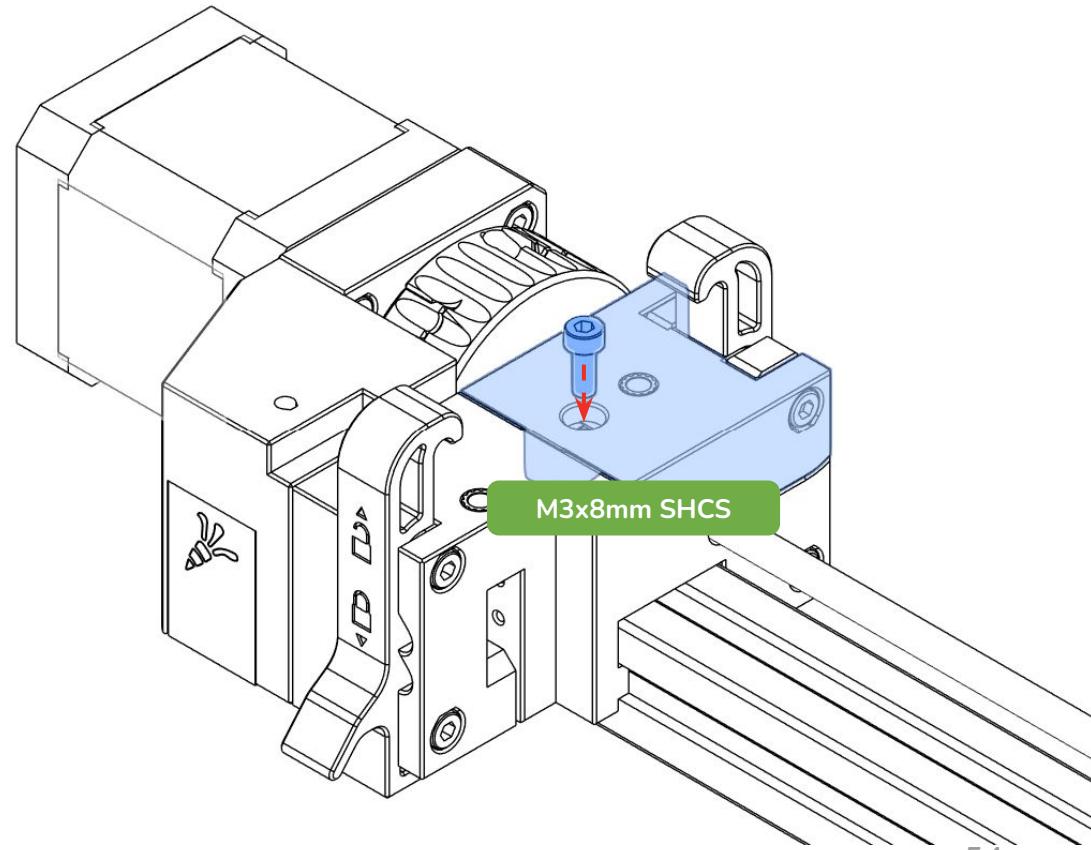
INSTALLING DRIVE SHAFT



2.3 INSTALLING THE DRIVE SHAFT

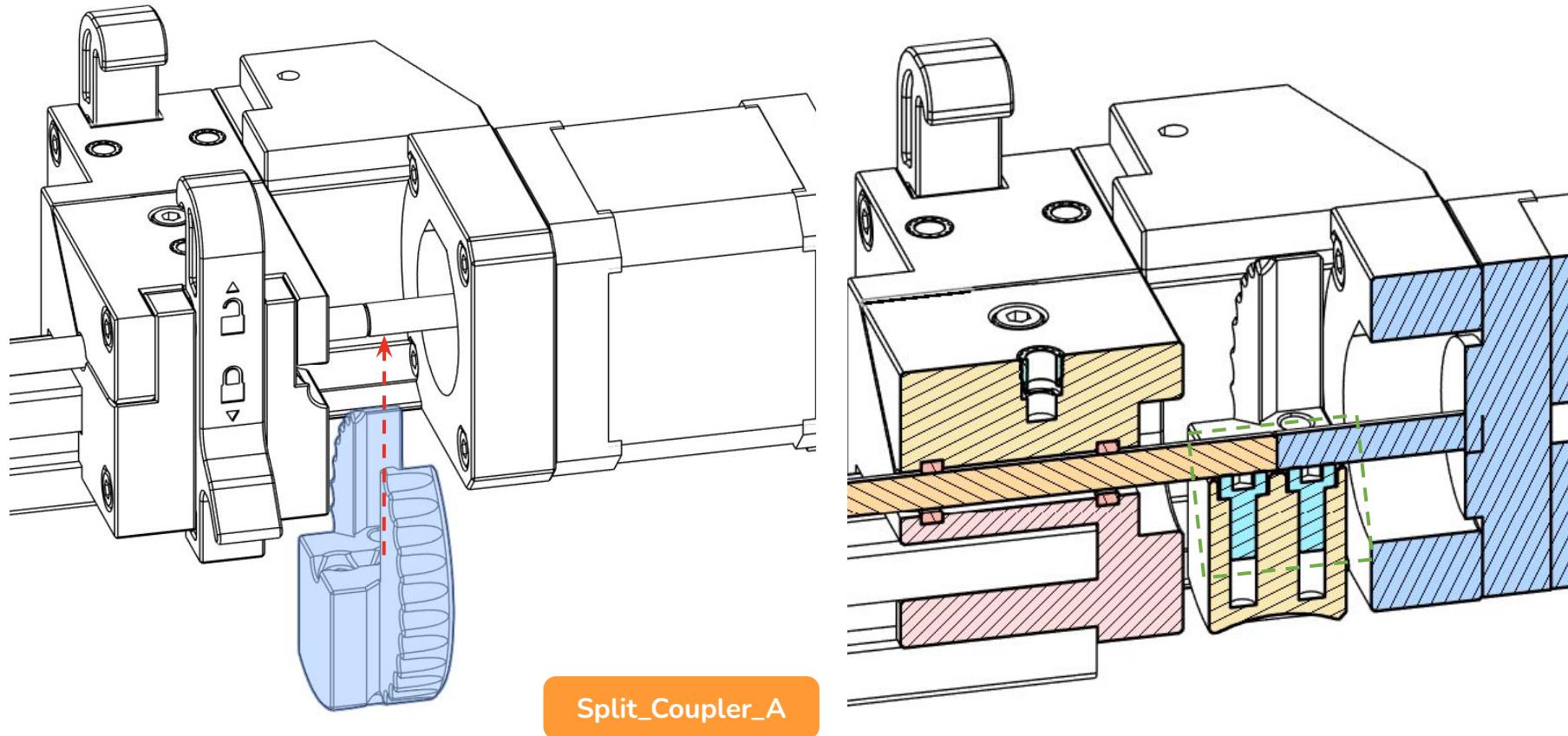
Align the bearings and shaft with the slots in the **Gearbox**. Close the **Hatch** over the bearings, and close the **Side_Latch_v2**. Slide the Drive Shaft down until it meets the motor shaft. Align both the motor shaft and the drive shaft with the flat facing down for the next steps.

Install an M3x8mm bolt to hold the **Hatch** shut. It doesn't need to be super tight - it just holds the MR85ZZ bearings in place.



MOTOR MOUNT (DIRECT)

INSTALLING COUPLER

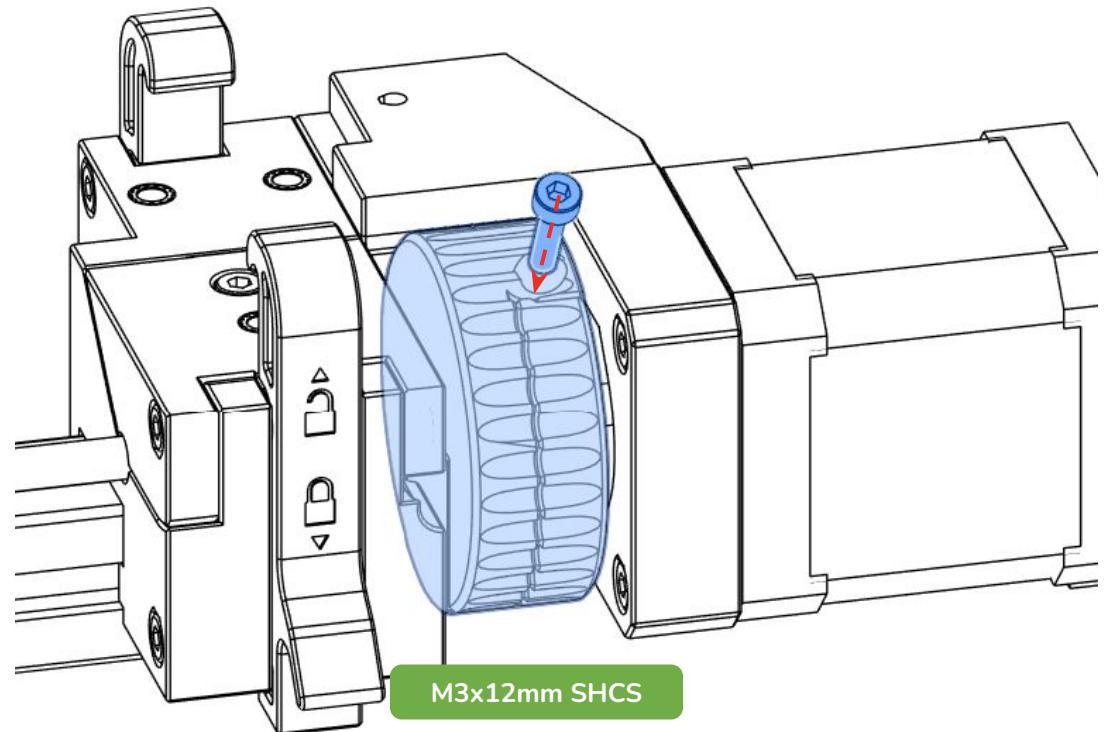
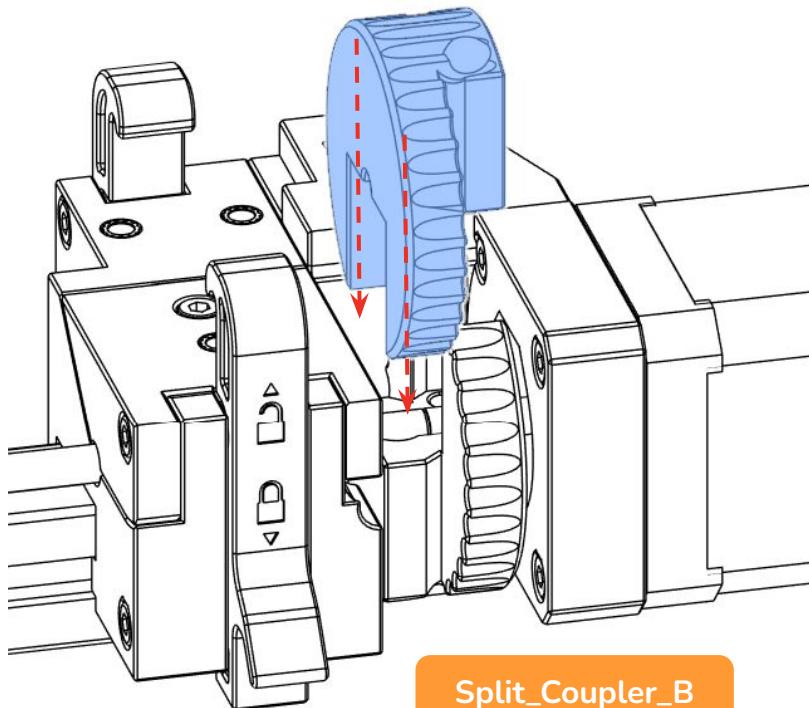


2.3 INSTALLING THE COUPLER

Lift up the main assembly and place the **Split_Coupler_A** onto the Drive Shaft. Align the screwheads in the **Split_Coupler_A** (that you prepared earlier) with the flats of the motor shaft and Drive Shaft.

MOTOR MOUNT (DIRECT)

INSTALLING COUPLER



2.3 INSTALLING THE COUPLER

Next, slide the [Split_Coupler_B](#) onto the [Split_Coupler_A](#). Insert an M3x12mm bolt into the hole in the [Split_Coupler_B](#). Tighten it down until it is fully mated. The [Split_Coupler_B](#) should fully align with the [Split_Coupler_A](#). Make sure that the screwheads from the previous step stay pushed against the flats of the motor shaft and the Drive Shaft.

The drive shaft should now be tightly coupled to the motor shaft. If there is still slop, tighten the M3x12mm bolt more. Give the Coupler a spin. The shaft should spin freely, and be nicely centered on the bearings in the [Gearbox](#). If the Coupler needs to be adjusted or removed, loosen the M3x12mm.

If you're using an alternative 5mm coupler to the Split Coupler (and you put it on the motor on [Page 51](#)), you can simply slide it over onto the Drive Shaft and tighten it up.

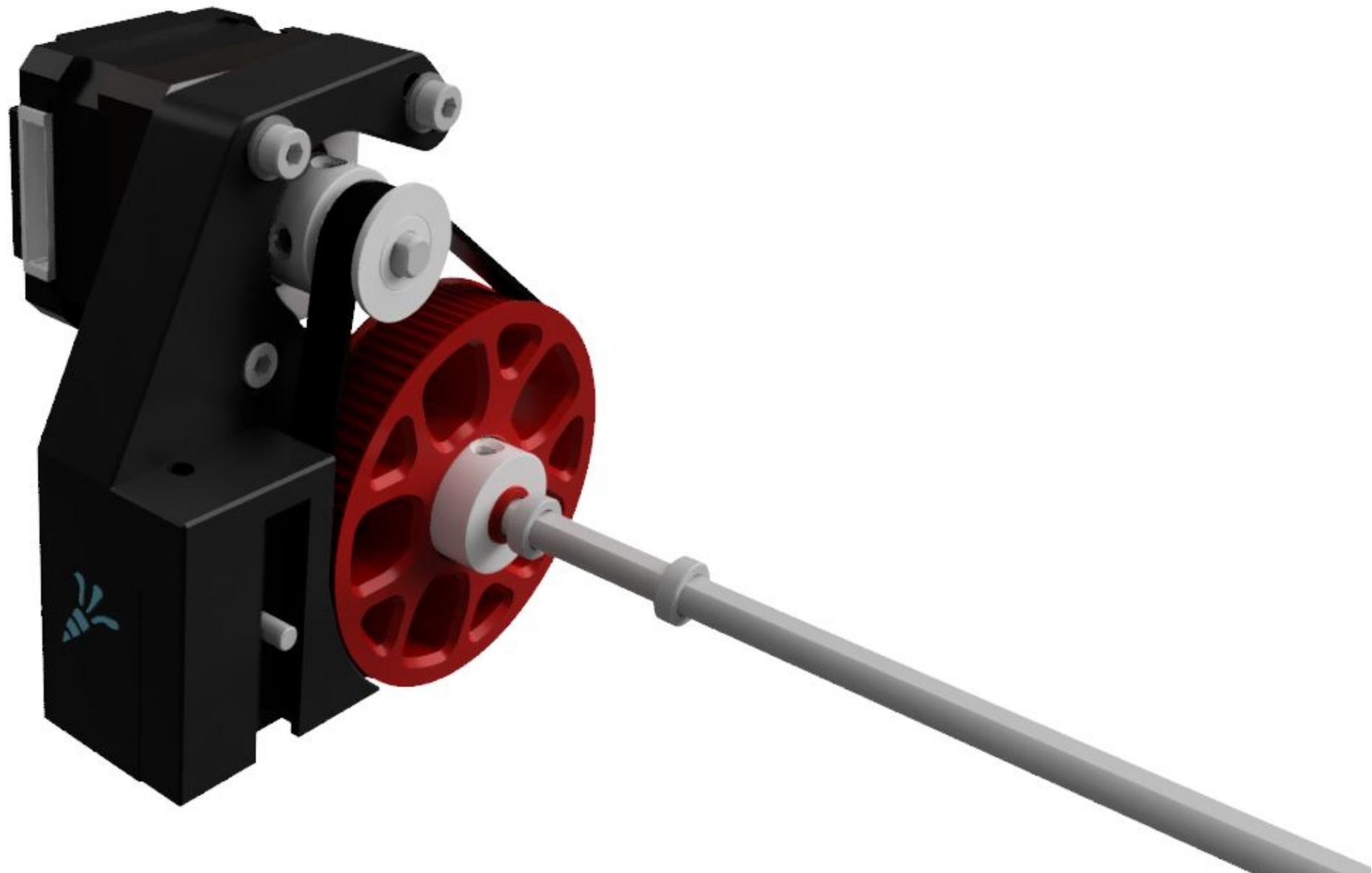
Heft your mighty Rabbit Hammer to the sky and rejoice. You're done with motor mounting! Skip to [Page 75](#).

ERCF in space?

The first 3D printer in space was installed on the International Space Station in 2014 and used by astronauts to create tools and parts, demonstrating the potential of this technology for long-duration space missions and even interplanetary travel.

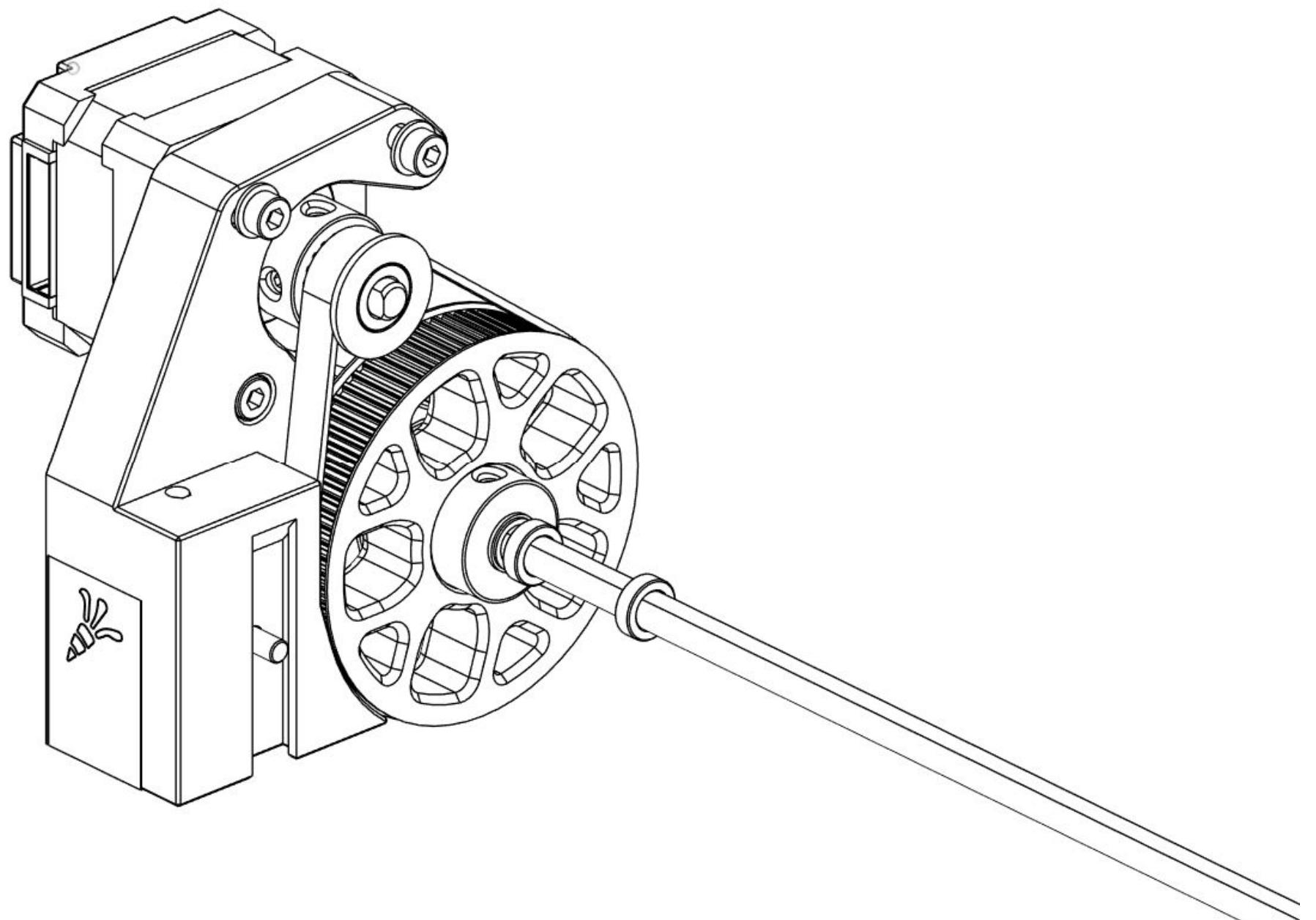
*MOTOR MOUNT (GEARED)

OVERVIEW



*MOTOR MOUNT (GEARED)

OVERVIEW



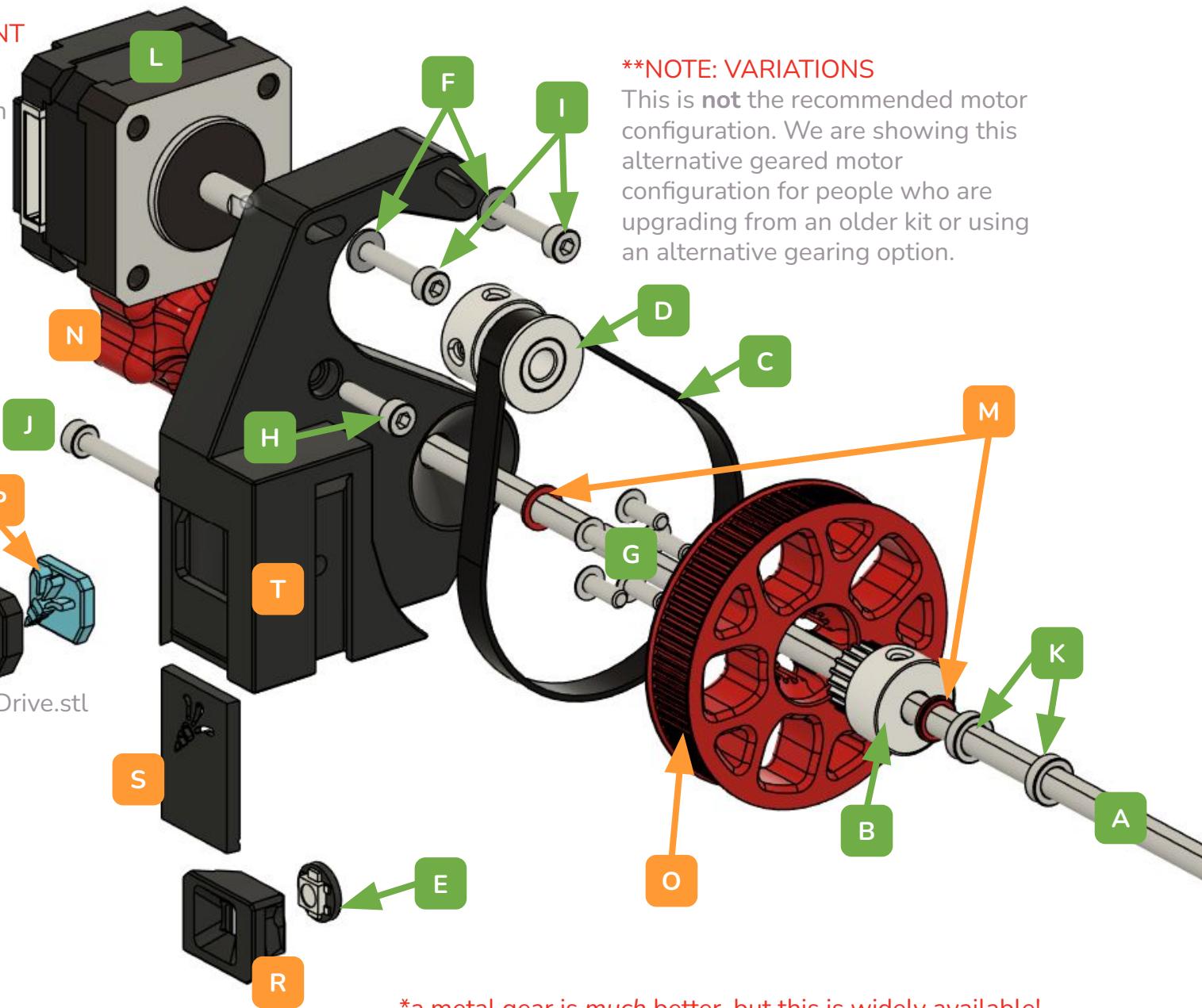
*MOTOR MOUNT (GEARED)

EXPLODED VIEW

GEARBOX SUB-BOM FOR MOTOR MOUNT

| | |
|---|----------------------------------|
| A | 1x 5mm D-Cut Shaft |
| B | 1x Deflanged GT2 Pulley 20-tooth |
| C | 1x GT2 Belt Loop, 188mm |
| D | 1x GT2 Pulley 20-tooth |
| E | 1x LED PCB |
| F | 2x M3 Washers |
| G | 5x M3x8mm BHCS |
| H | 1x M3x12mm SHCS |
| I | 2x M3x16mm SHCS |
| J | 1x M3x20mm SHCS |
| K | 2x MR85ZZ Bearing |
| L | 1x NEMA14 Stepper Motor** |

| | |
|---|--|
| M | 1x [a]_Bearing_Spacer_x2.stl † |
| N | 1x [a]_Knob.stl † |
| O | 1x [a]_M4_80T_Wheel.stl † * |
| P | 1x [c]_Logo_Diffuser.stl |
| Q | 1x [o]_Diffuser_Mask.stl |
| R | 1x LED_Carrier.stl |
| S | 1x Logo_Mask.stl |
| T | 1x Motor_Mount_NEMA17_Direct_Drive.stl |



*a metal gear is much better, but this is widely available!

**NOTE: VARIATIONS

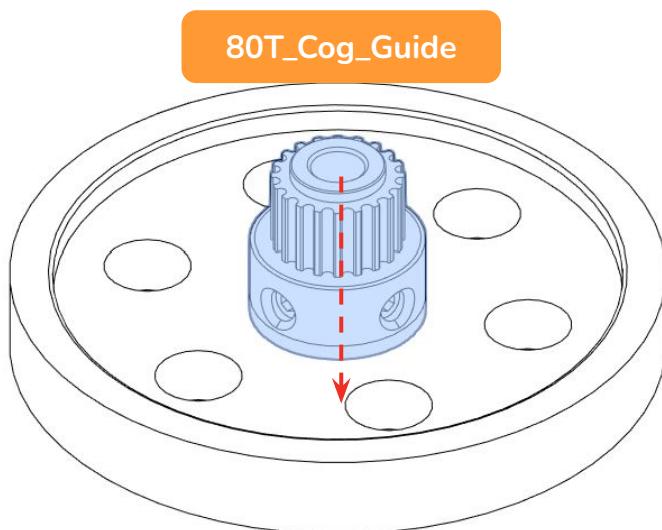
This is **not** the recommended motor configuration. We are showing this alternative geared motor configuration for people who are upgrading from an older kit or using an alternative gearing option.

*MOTOR MOUNT (GEARED)

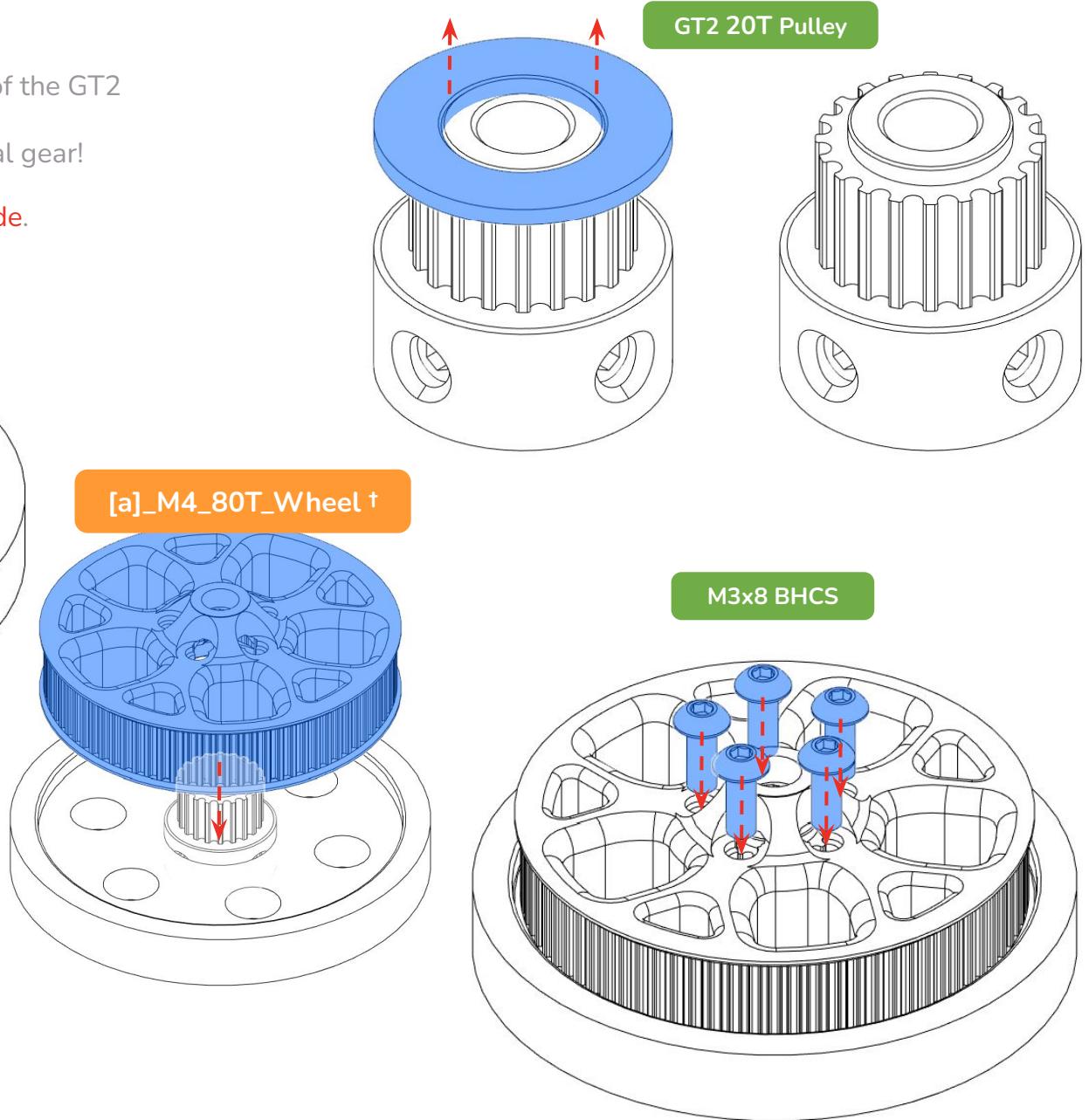
REMOVE FLANGE

Use pliers to gently remove the top flange of the GT2 pulley. Most kits either provide the pulley pre-deflanged, or even better, a whole metal gear!

Place the GT2 pulley into the [80T_Cog_Guide](#).



80T GEAR ASSEMBLY



FINISH MOUNTING

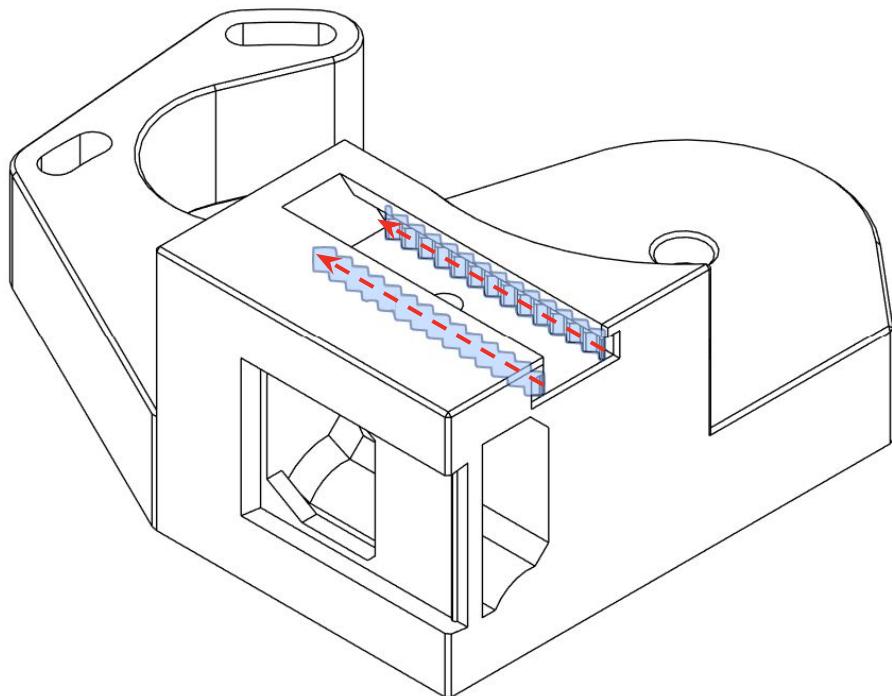
Insert the [M4_80T_Wheel](#) onto the GT2 pulley and press it flat to the guide.

Add 5 M3x8 BHCS to secure the wheel in place. Gently tighten the screws in a star pattern (skipping every other screw) until the hub is snug. Don't overtighten, you'll strip the plastic, or worse, the pulley!

Set the [M4_80T_Wheel](#) aside for now.

*MOTOR MOUNT (GEARED)

GEARED MOTOR MOUNT PREPARATION



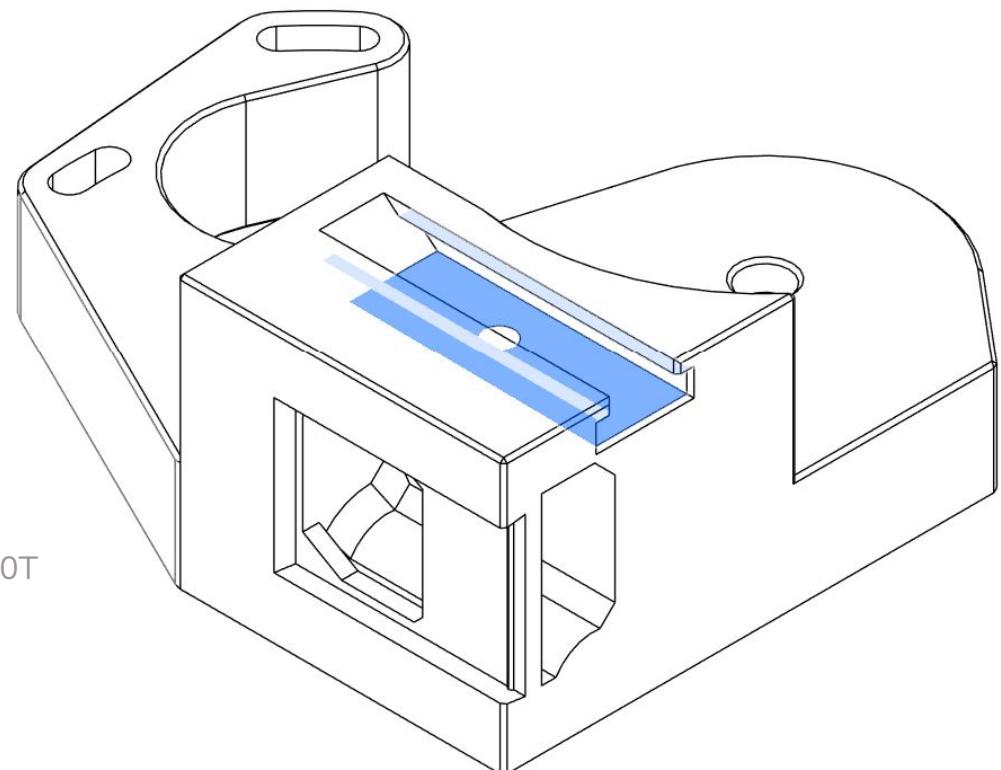
Shown: an alternative NEMA14 Motor Mount for a Metal 80T gear.

GEARED MOTOR MOUNT SUPPORTS

This step is only necessary for the alternative Geared Motor Mounts.

Take a small flathead screwdriver or Allen wrench, and remove the print-in-place supports out of the dovetail of the [Motor_Mount](#).

You may need to use a file or hobby knife to clean up any remaining residue from the print-in-place supports on the roof and floor, so that the dovetail is smooth. Or just YOLO it in the next step.



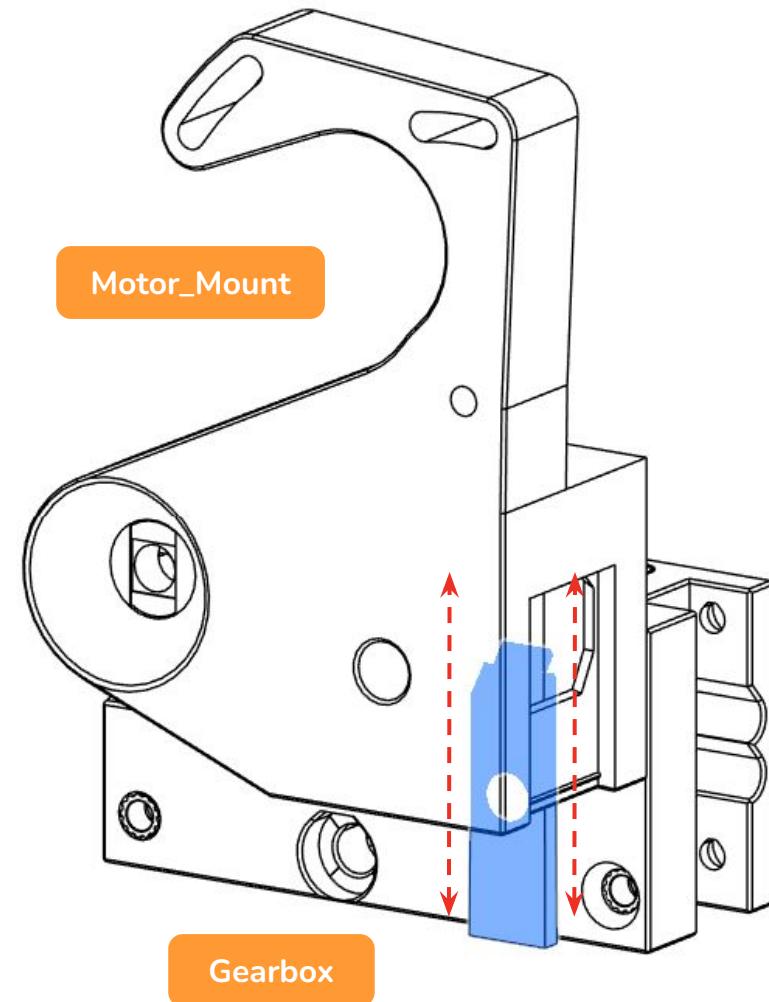
2.1 MOTOR MOUNT MESHING

Take your choice of **Motor_Mount** and carefully mate the dovetail on the **Gearbox** to the slot in the **Motor_Mount**. If it is a tight fit, take sandpaper, a file, or a hobby knife to the parts that are rubbing so that it meshes and unmaches without too much force. We want this dovetail to mesh with little effort so that later assembly steps are easy.

If the fit between these parts is too tight to put together or pull apart, it's a good sign that you either need to reprint the parts, or possibly tune your printer more, especially the Extrusion Multiplier. The parts are designed to fit together and come apart with your hands alone, and without straining. It is normal for the first 3-4 times fitting together to be "sticky," but simply meshing and remeshing the dovetail several times should smooth things out. It is also normal for the area around the dovetail to wear!

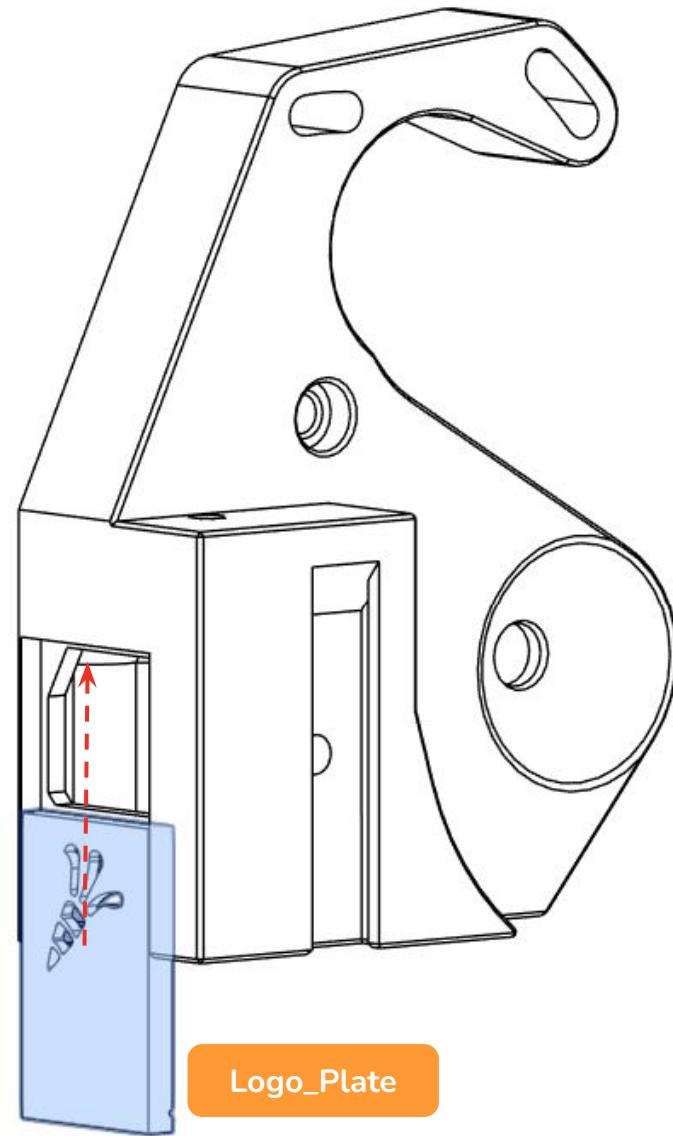
Unmesh and set aside the **Motor_Mount** for now.

Shown: an alternative NEMA17 Motor Mount for a Metal 60T gear.



*MOTOR MOUNT (GEARED)

Motor_Mount_NEMA14_Printed_80T

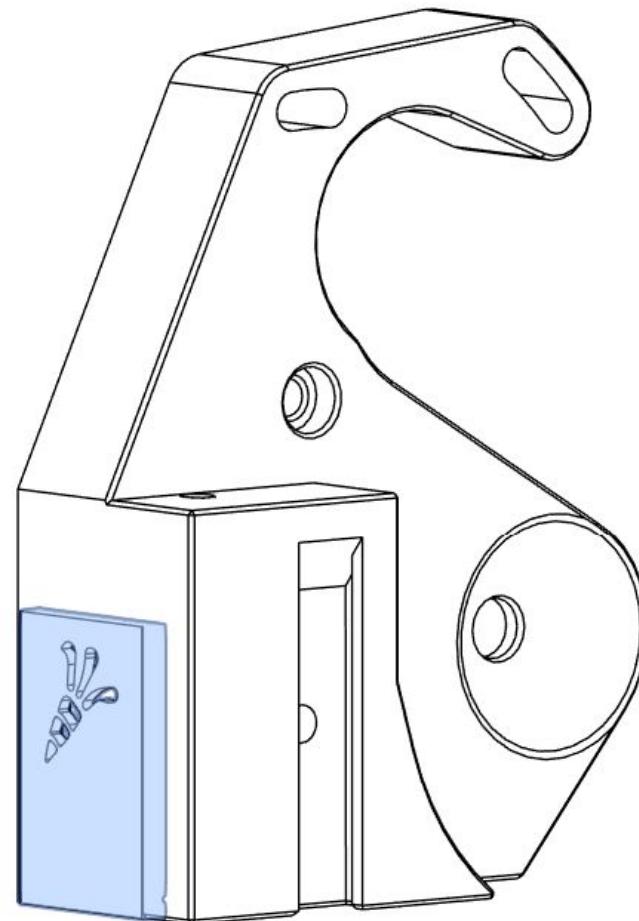


LOGO PLATE

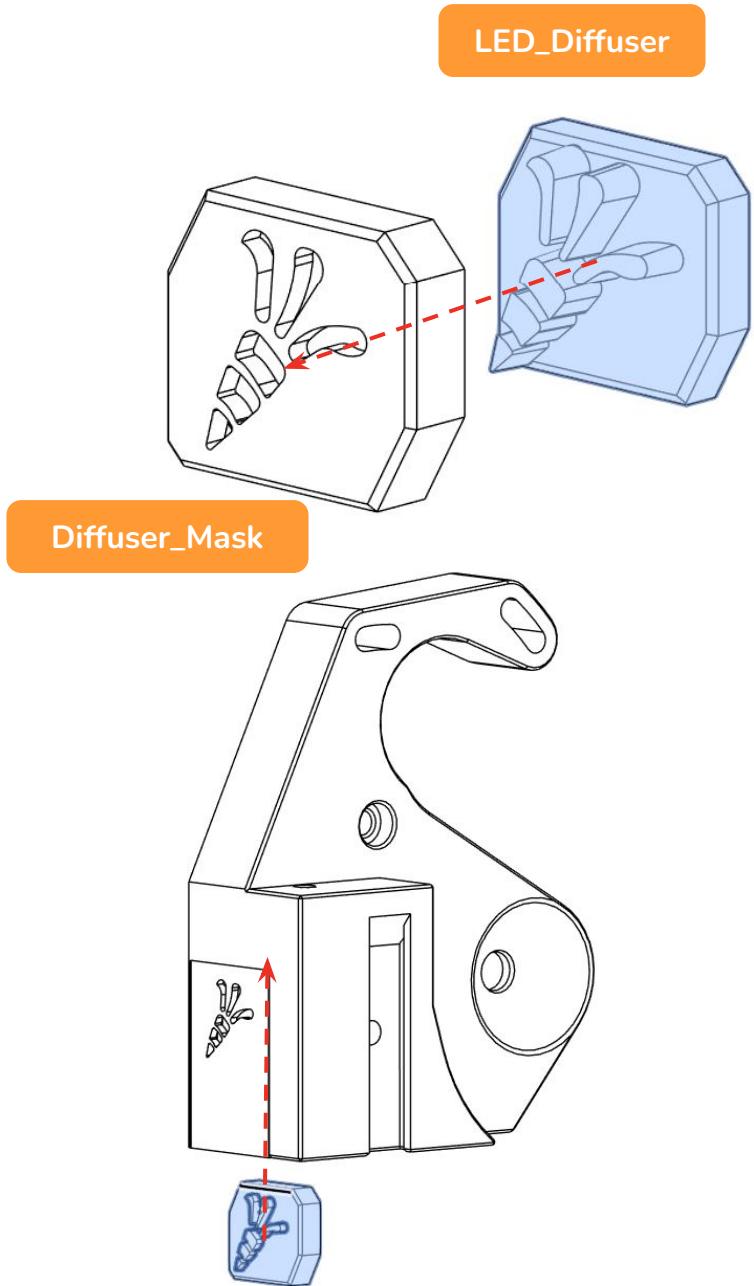
2.2 INSTALLING THE LOGO PLATE

The Logo_Plate interlocks with the LED_Diffuser and Diffuser_Mask, so it must be installed first.

Align the Logo_Plate with the slot in the bottom of the Motor_Mount, and slide it upwards until it clips into place.



*MOTOR MOUNT (GEARED)

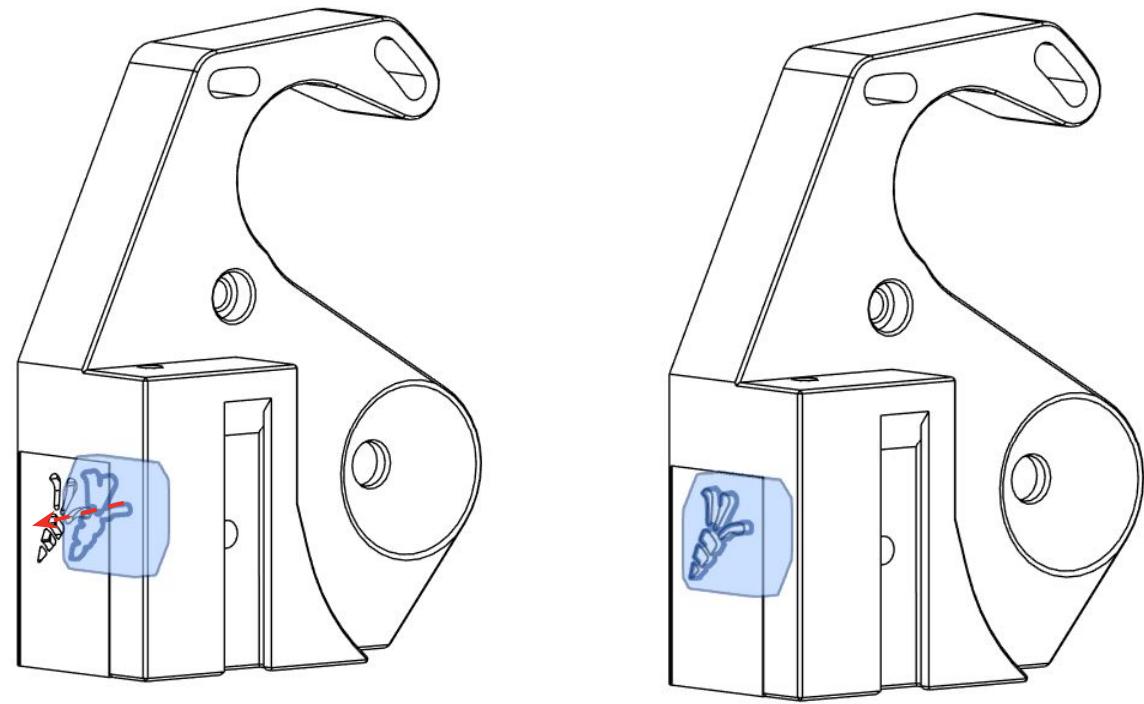


LED DIFFUSER

2.2 INSTALLING THE LED DIFFUSER

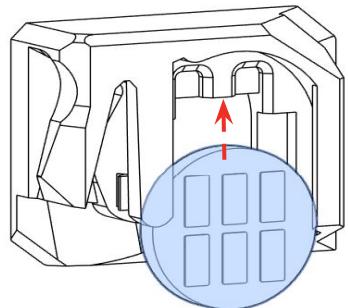
Insert the [LED_Diffuser](#) into the [Diffuser_Mask](#), so that the carrot logo pokes through the [Diffuser_Mask](#).

Insert the combined part into the [Motor_Mount](#) from the bottom. Once the combined part is as far up as it can go, use an Allen key or screwdriver to push it into the [Logo_Plate](#).

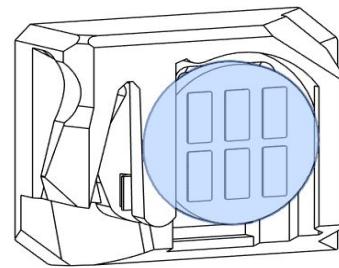


*MOTOR MOUNT (GEARED)

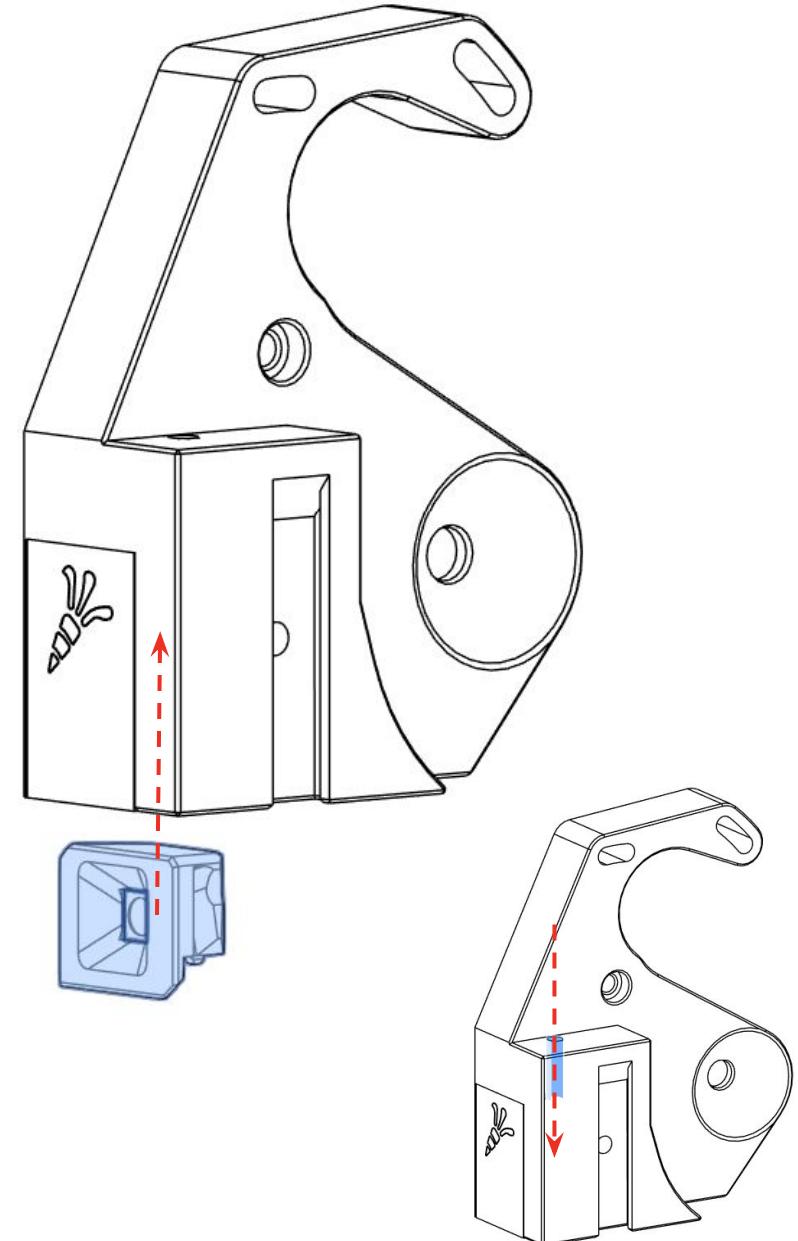
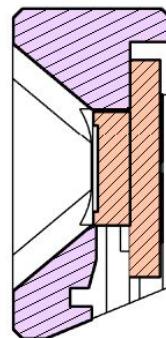
LED_Carrier



LED PCB



LED CARRIER



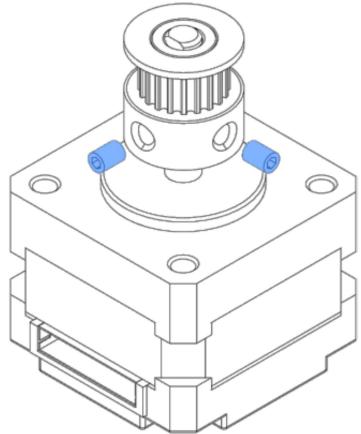
2.2 INSTALLING THE LED CARRIER

Insert the LED PCB into the [LED_Carrier](#), so that the edges of the PCB clip into the [LED_Carrier](#). Check the front of the [LED_Carrier](#) to make sure the LED is aligned with the window. The wires are omitted from the images for clarity.

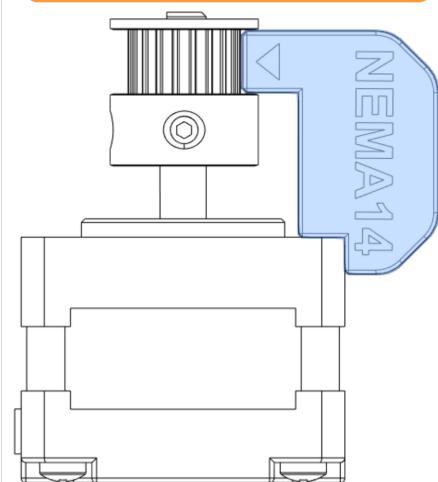
Insert the combined part into the [Motor_Mount](#) from the bottom. Use an Allen key or screwdriver to push the combined part up as far as it can go.

If you need to recover the LED for any reason, insert an Allen key into the hole in the roof of the [Motor_Mount](#) to push the [LED_Carrier](#) back out of the bottom.

*MOTOR MOUNT (GEARED)



Pulley_Tool_NEMA14 †



MOTOR PREPARATION

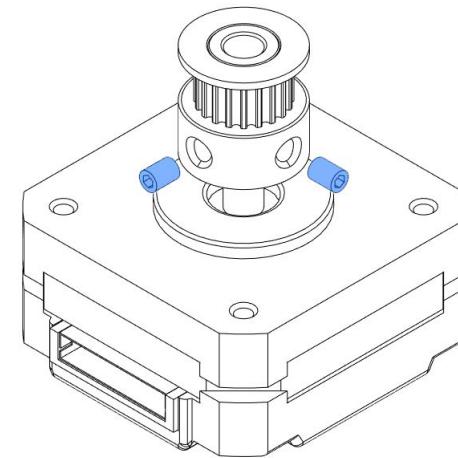
MOTOR VARIATIONS

While the NEMA 17 motor is what is called for in the BOM, we also support NEMA 14 motors for those who are sourcing their own parts or upgrading from a previous version. NEMA 17 motors tend to have more torque but need to run at lower speeds compared to NEMA 14 motors, so NEMA 17 motors are preferred.

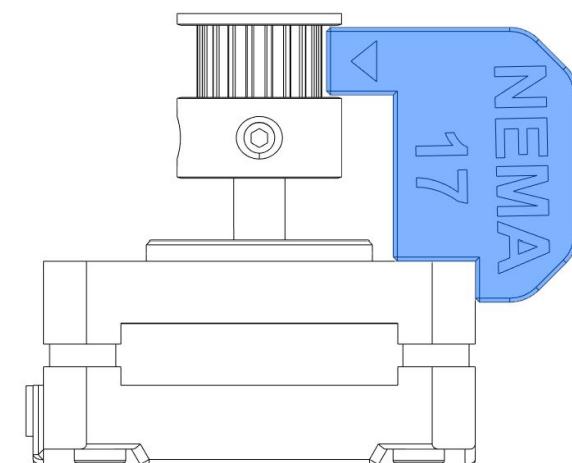
SET SCREWS

Insert both M3 set screws and use thread locker on them.

Use the appropriate pulley tool to install the pulley at the correct height on the motor shaft.



Pulley_Tool_NEMA17 †

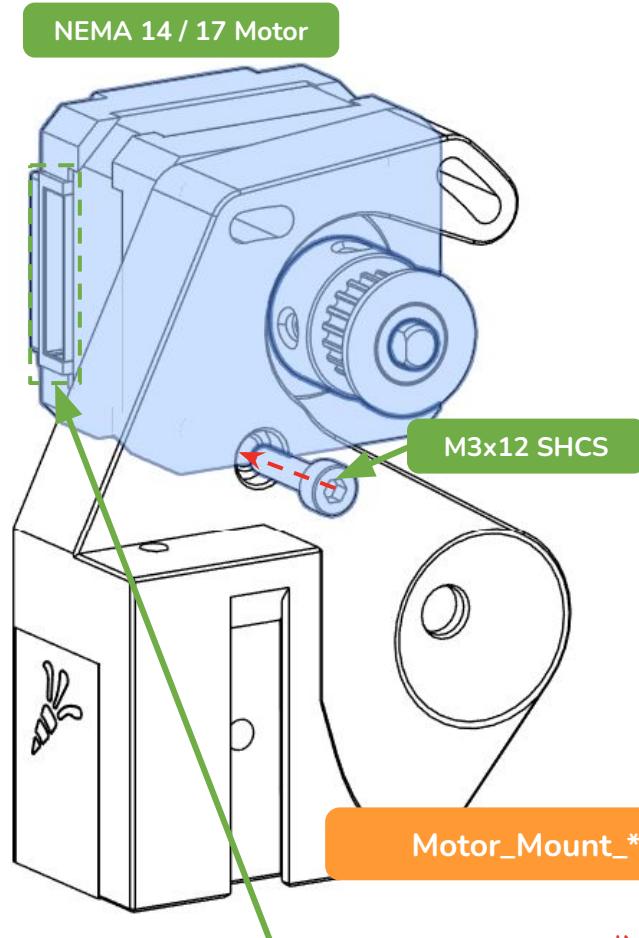


PULLEY HEIGHT

Use the [Pulley_Tool_NEMA17 †](#) to set the correct height of the GT2 20T gear.

If you are using a NEMA 17 motor for the gear axis, assembly is the same but you'll need to use [Pulley_Tool_NEMA14 †](#) and print a different Motor Arm to mount it.

*MOTOR MOUNT (GEARED)



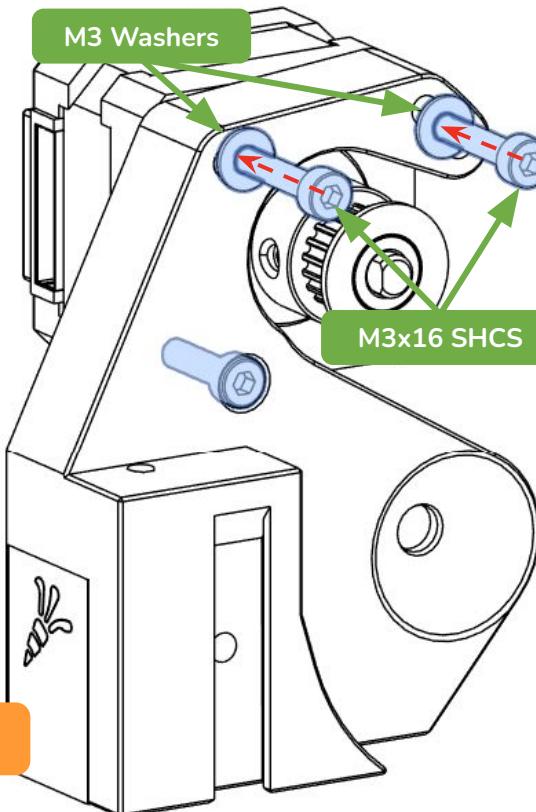
MOTOR WIRES

Make sure the wires of the motor come out on this side.

MOTOR MOUNT

ALTERNATIVE MOTOR MOUNTS

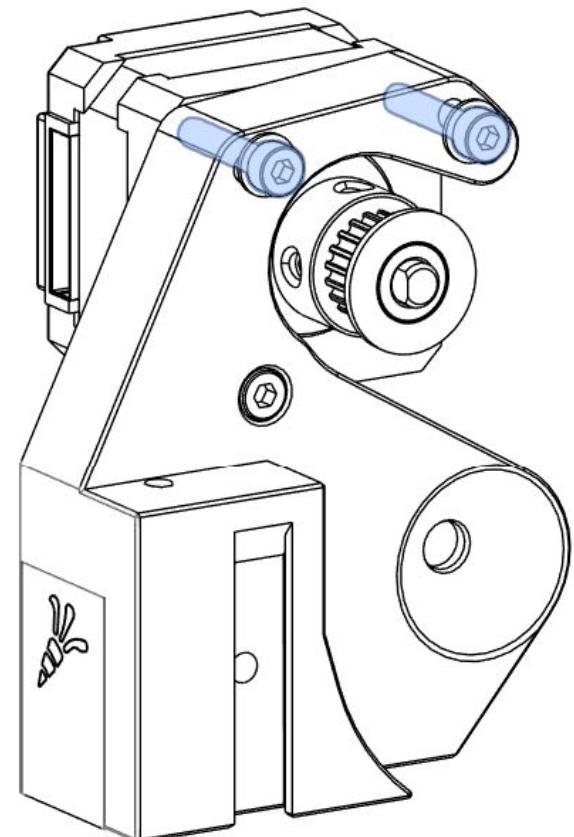
If you look in the User Mods on Github, there is a version for every combination of: Motor type (NEMA 14 and NEMA 17), Gear type (Printed and metal), and gear ratio (gears with 60 teeth and 80 teeth). Assembly uses identical parts.



INSTALLING THE MOTOR

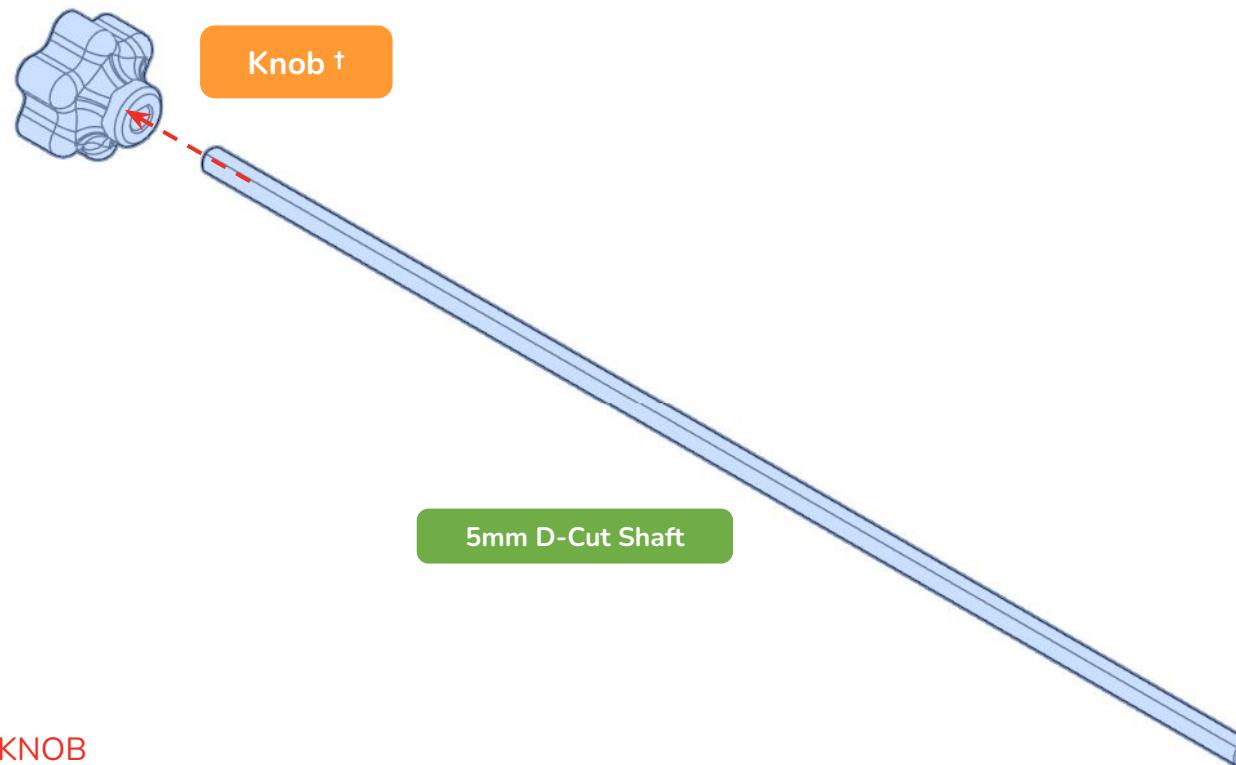
Align the motor to the **Motor_Mount** with the wires or connector facing left. Start by adding the M3x12mm bolt. Leave the bolt loose enough to use as a hinge.

Next add the M3x16 bolts, adding an M3 washer to each. Leave these loose enough to allow the motor to rotate easily.



*MOTOR MOUNT (GEARED)

DRIVE SHAFT AND KNOB



2.3 INSTALLING THE KNOB

Insert the 5mm D-cut shaft into the Knob. You may want to use a hammer on the Knob to ensure a snug fit. You don't want the Knob to come off later!

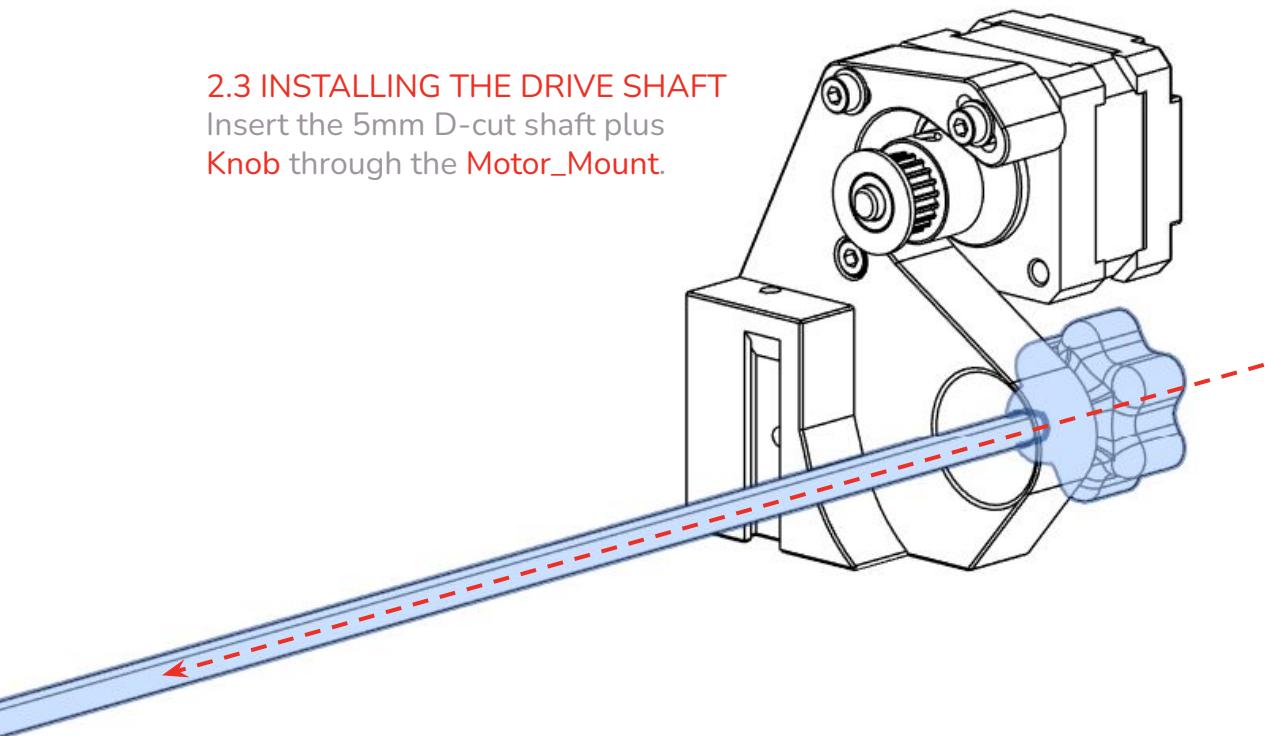
| Channels | N | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|-----------------------|----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| D-Cut Rod Length (mm) | 72 + 23N | 164 | 187 | 210 | 233 | 256 | 279 | 302 | 325 | 348 | 371 | 394 | 417 |

*MOTOR MOUNT (GEARED)

2.3 INSTALLING THE DRIVE SHAFT

Insert the 5mm D-cut shaft plus Knob through the Motor_Mount.

DRIVE SHAFT ASSEMBLY



If your D-Cut Shaft is rough or at-spec (4.98-5.00mm), it will be difficult to insert and move the bearings. It is important that we be able to move the shaft along its axis during assembly, so if this is a problem for you, this must be addressed.

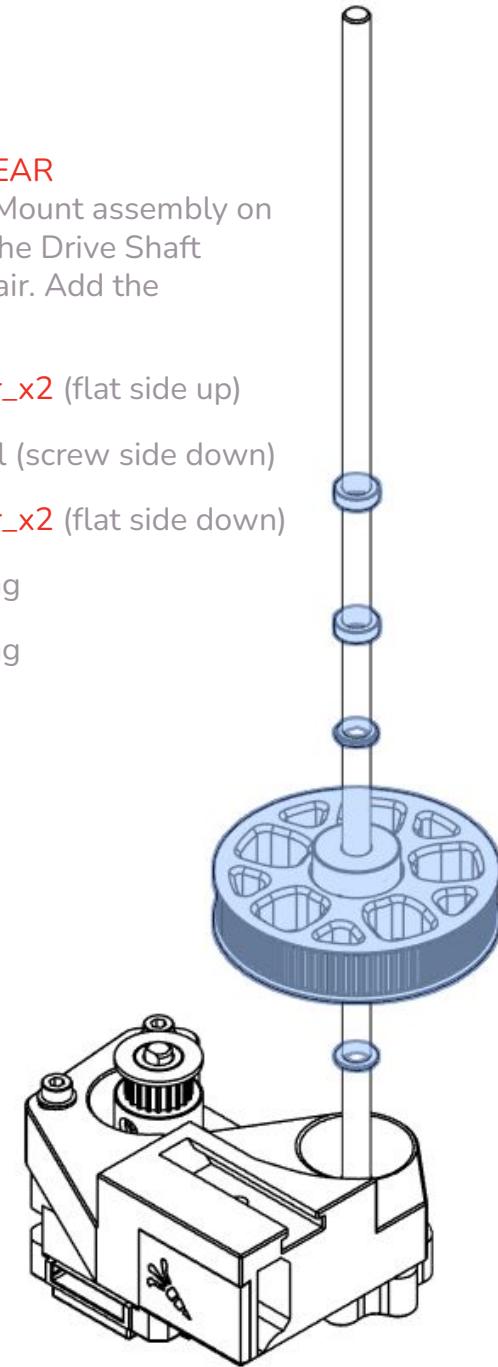
For many D-cut shafts, degreasing them with your favorite household cleaner can make the difference between a too-tight fit and a snug fit. If that doesn't work, follow up with a light-duty abrasive pad.

If you still find that your D-Cut Shaft is too tight on the bearings, take a high-grit sandpaper (at least 300 grit) and sand the shaft. Use a light oil, wear gloves and take appropriate precautions while sanding. You barely want to take any material away at all.

ADDING THE GEAR

Turn the Motor_Mount assembly on its' side so that the Drive Shaft points up in the air. Add the following parts:

- Bearing_Spacer_x2 (flat side up)
- M4_80T_Wheel (screw side down)
- Bearing_Spacer_x2 (flat side down)
- MR85ZZ Bearing
- MR85ZZ Bearing



*MOTOR MOUNT (GEARED)

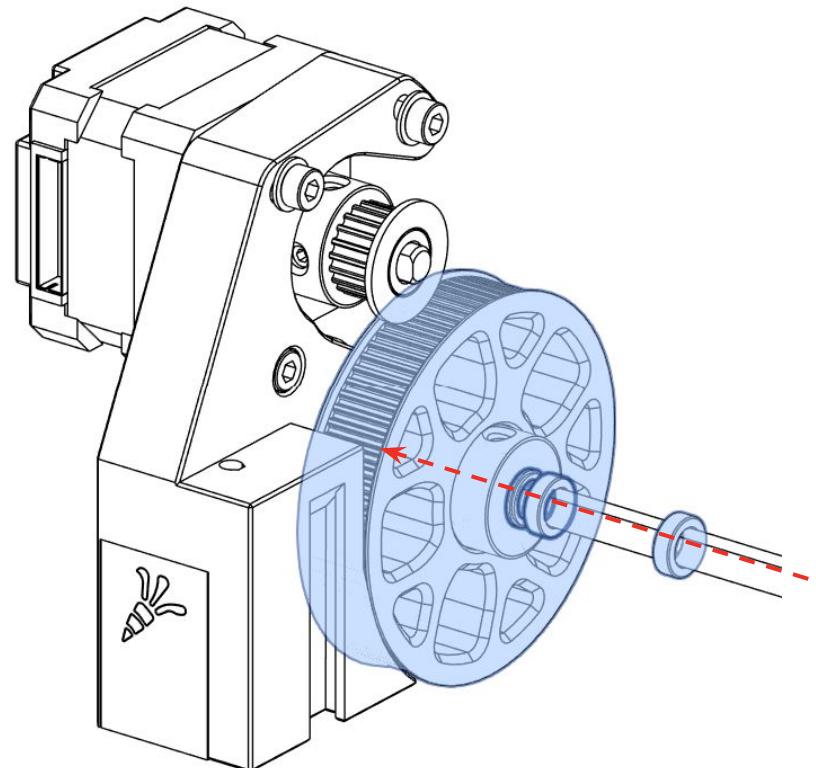
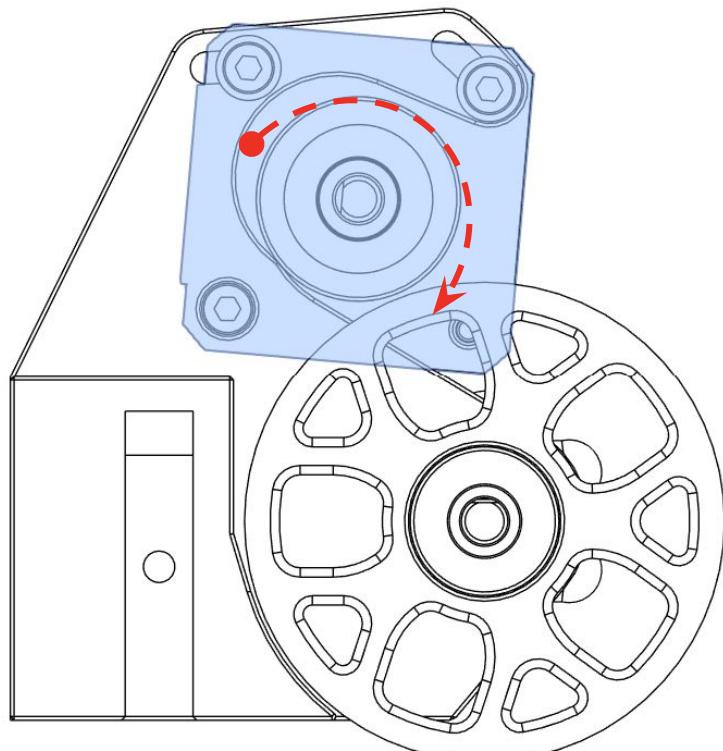
DRIVE SHAFT ASSEMBLY

2.3 SNUG UP THE GEAR

Push the **M4_80T_Wheel** to the end of its' travel, making sure the Knob is snug against the Motor_Mount. Make sure that the **Bearing_Spacer_x2** is against the metal pulley part of the **M4_80T_Wheel**.

Leave some space between the two MR85ZZ bearings.

Metal wheels do not use the **Bearing_Spacer_x2**, they are only for the printed gears.



PREP TO ADD THE BELT LOOP

Twist the motor clockwise so that the GT2 Pulley is as close to the **M4_80T_Wheel** as possible.

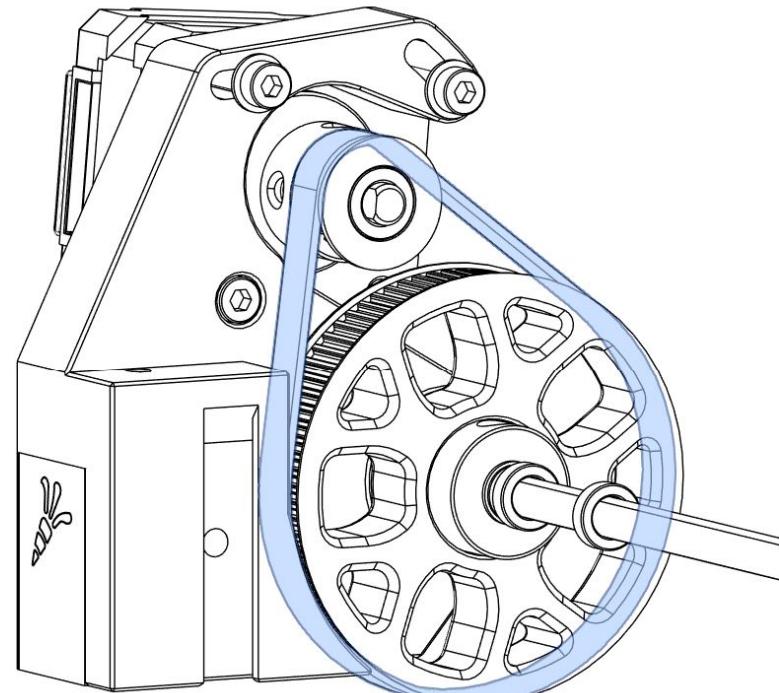
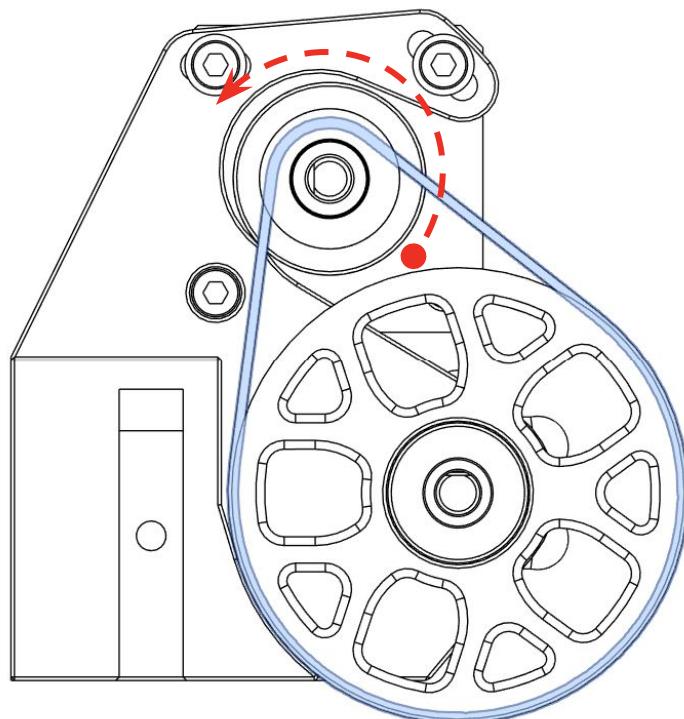
*MOTOR MOUNT (GEARED)

DRIVE SHAFT ASSEMBLY

2.3 ADD THE BELT LOOP

Add the 188mm GT2 belt loop to the [M4_80T_Wheel](#). It is usually easiest to start by putting the belt loop on the gear first, then the motor pulley.

With the belt installed, lightly twist the motor counter-clockwise to tension the belt loop. Then snug the screws that mount the motor. Do not tighten them yet - we will adjust the belt tension soon. We just need the motor to stay in place to keep the belt attached for the next steps.

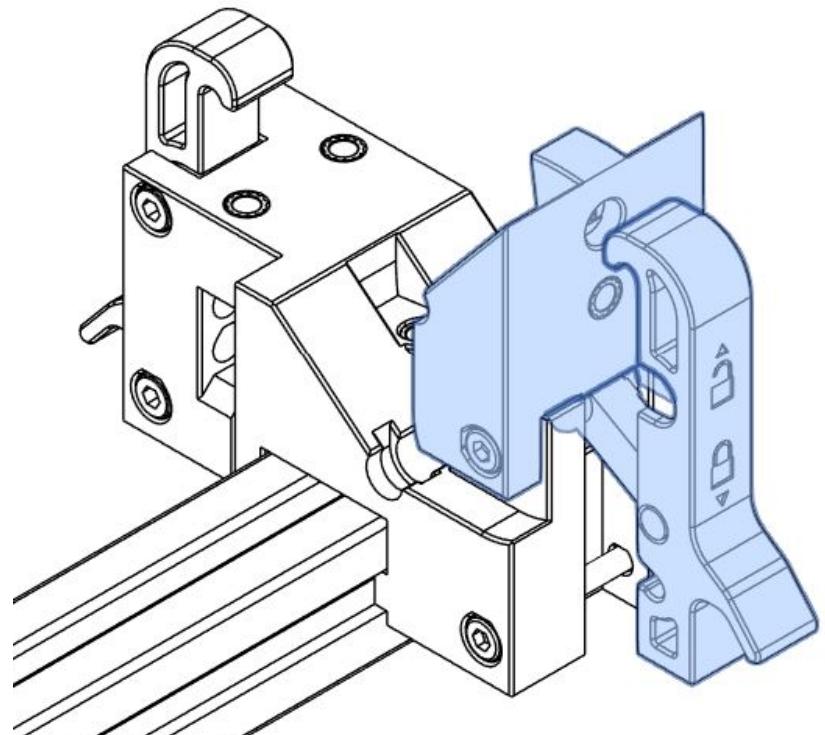
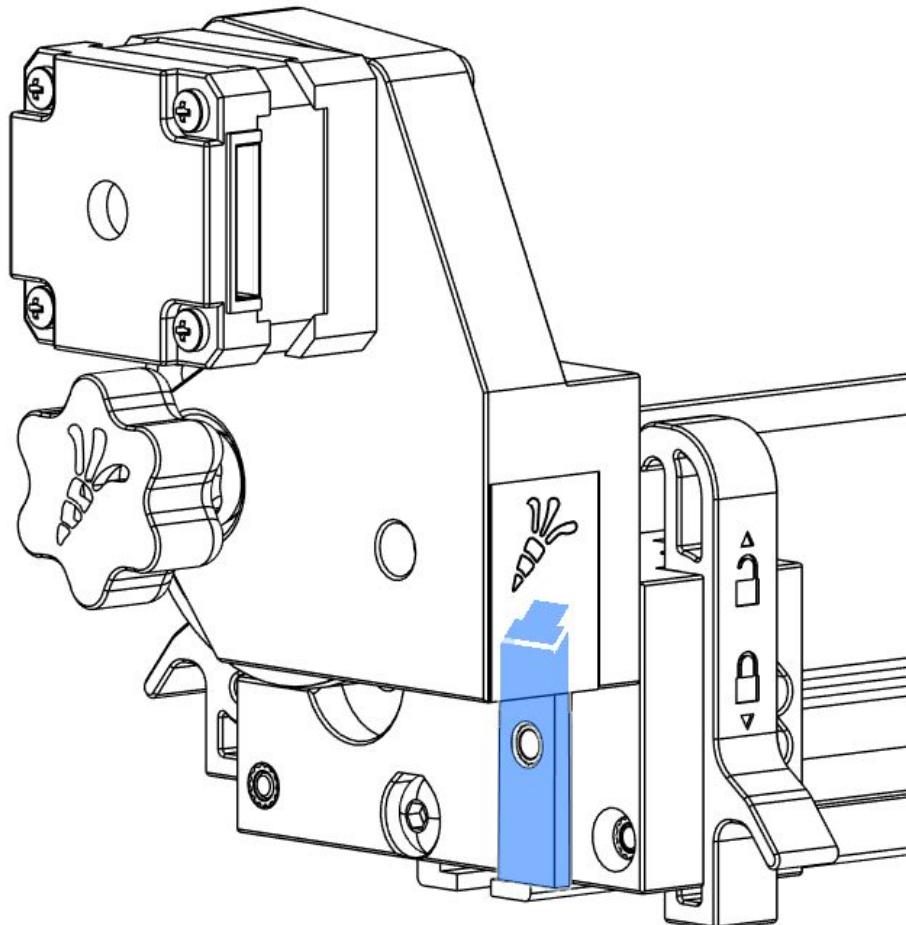


*MOTOR MOUNT (GEARED)

INSTALLING MOTOR MOUNT

2.1 PREP TO INSTALL THE MOTOR MOUNT

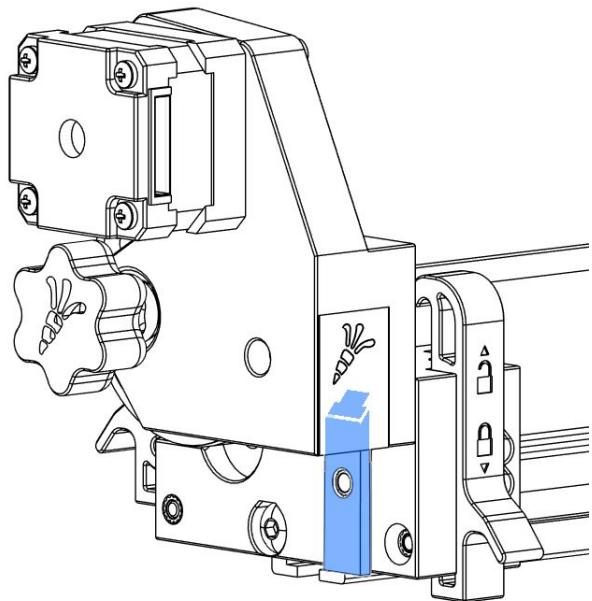
Take the Gearbox assembly and open the [Side_Latch_v2](#) on the side that shares a hinge with the [Hatch](#). Next, flip open the [Hatch](#).



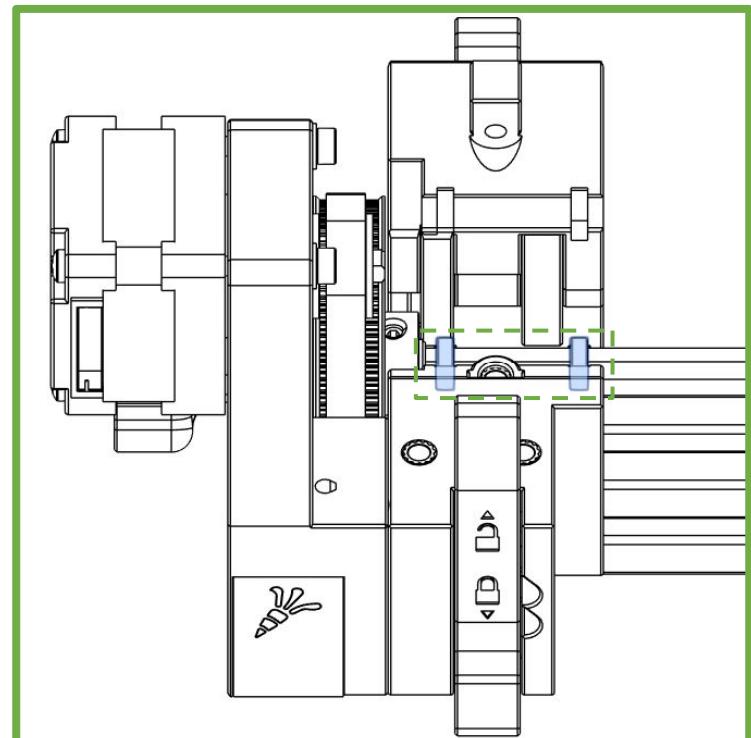
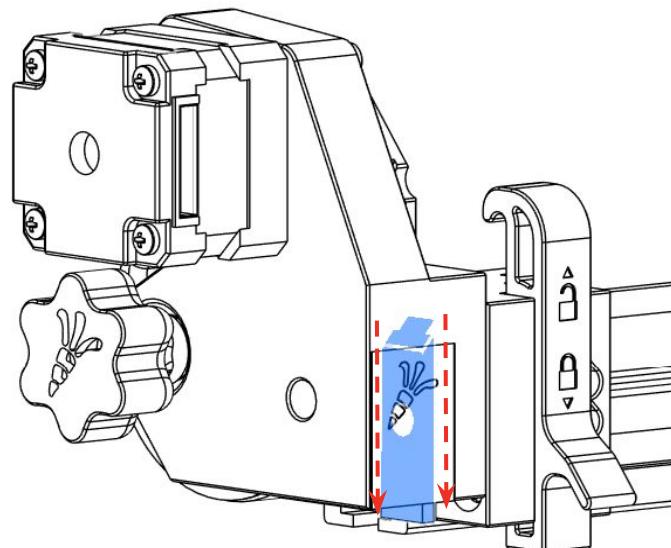
INSTALL THE MOTOR MOUNT

Mate the slot on the [Motor_Mount](#) to the dovetail on the [Gearbox](#). Just get it started, then proceed to the next page.

*MOTOR MOUNT (GEARED)



INSTALLING MOTOR MOUNT

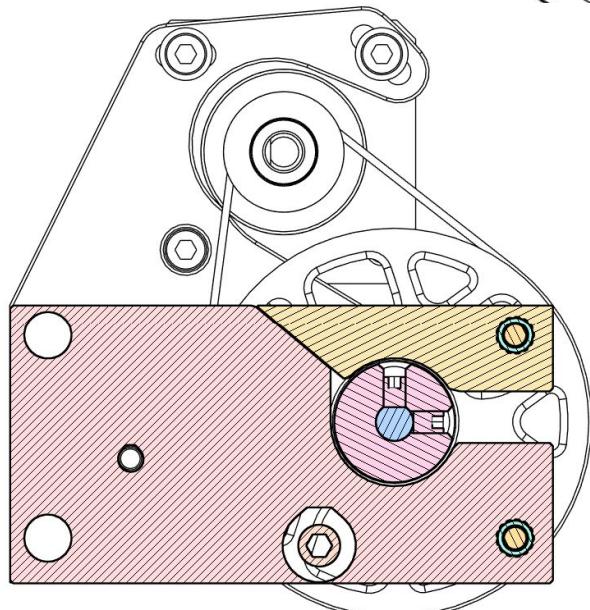
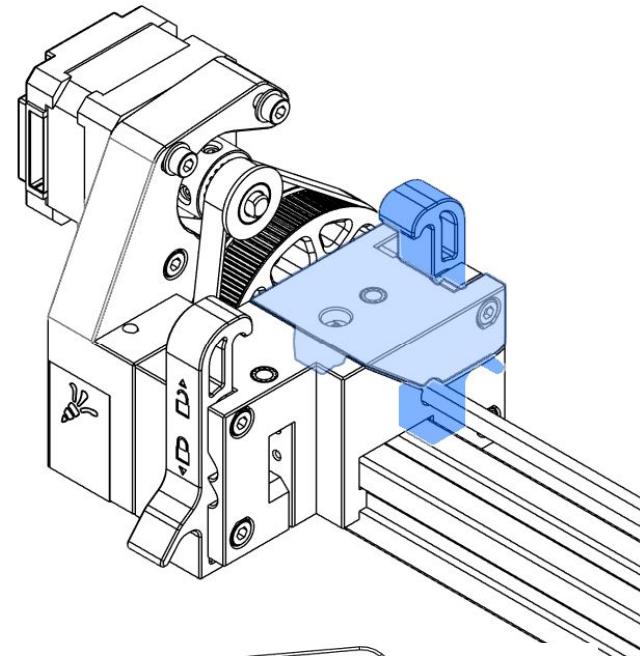


2.1 INSTALLING THE MOTOR MOUNT

Press down on the **Motor_Mount**. It should be a snug fit. As you come to the last ~5mm of travel, double-check to make sure that the MR85ZZ bearings are aligned to their slots.

Keep going until the bottom of the **Motor_Mount** is flush with the bottom of the **Gearbox**.

*MOTOR MOUNT (GEARED)



FINISHING THE MOTOR MOUNT

FINISHING THE MOTOR MOUNT

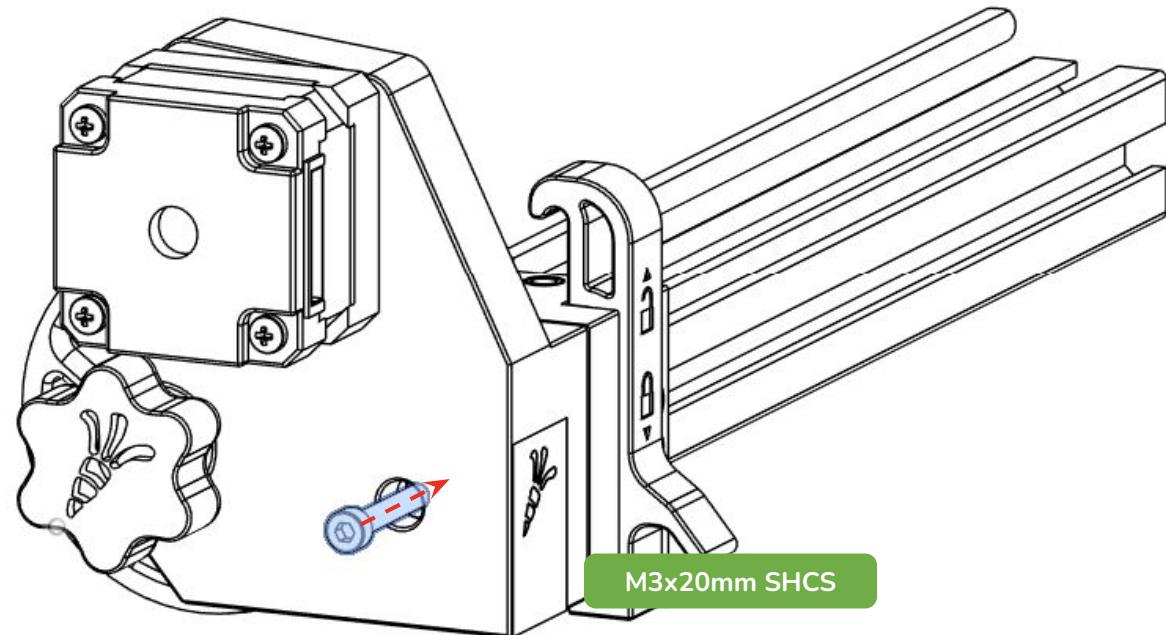
Close the **Hatch** and **Side_Latch_v2**. Install an M3x8mm bolt to hold the **Hatch** shut. It doesn't need to be tight - it just holds the MR85ZZ bearings in place.

Then, make sure that the grub screws on the pulley part of the **M4_80T_Wheel** are fully tightened, with one to the flat of the Drive Shaft.

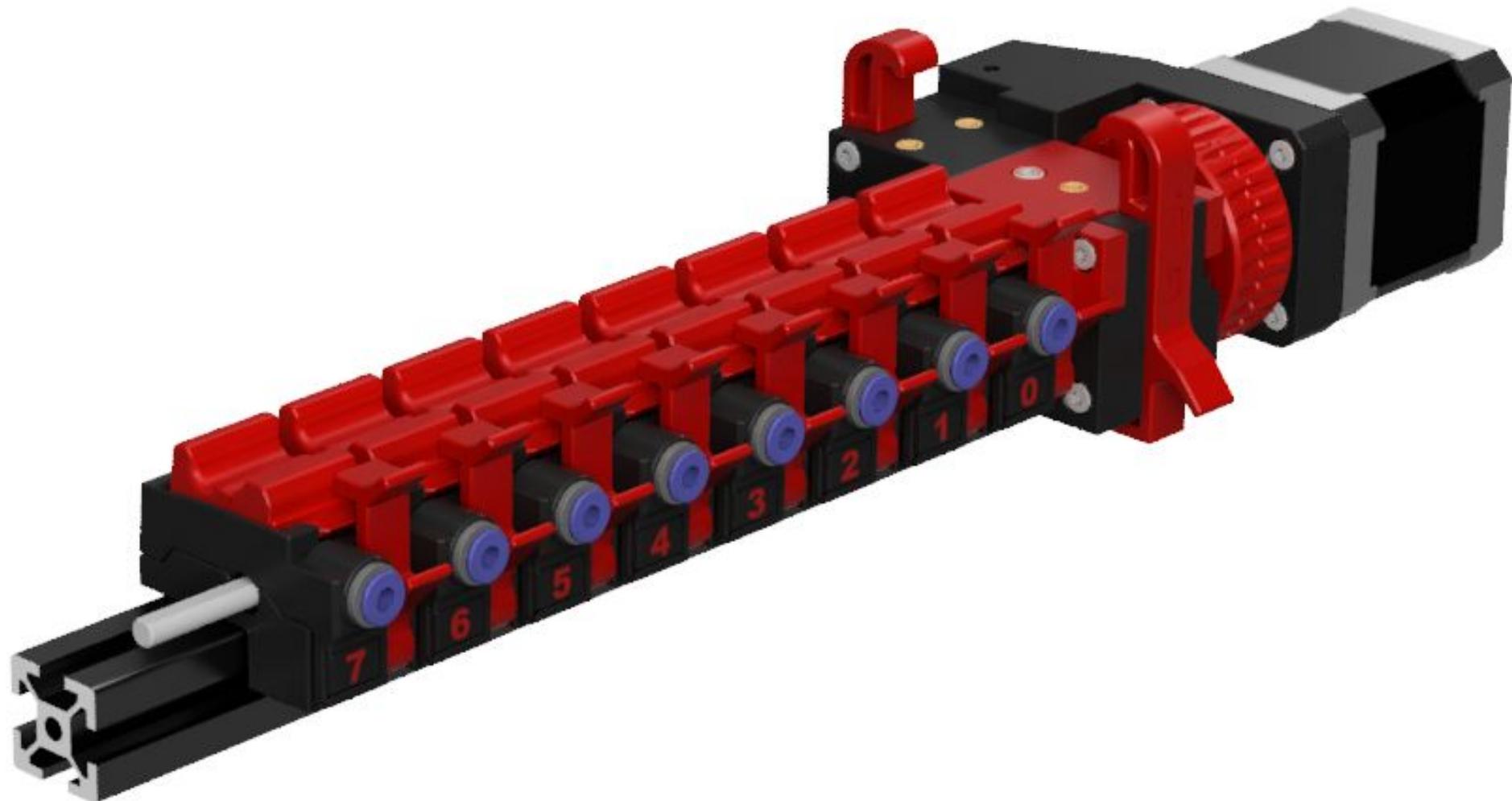
Next, tension the 188mm GT2 belt loop by lightly twisting the motor counter-clockwise, and give the screws going into the Motor a final tighten. Triple-check that the Drive Shaft spins freely and smoothly.

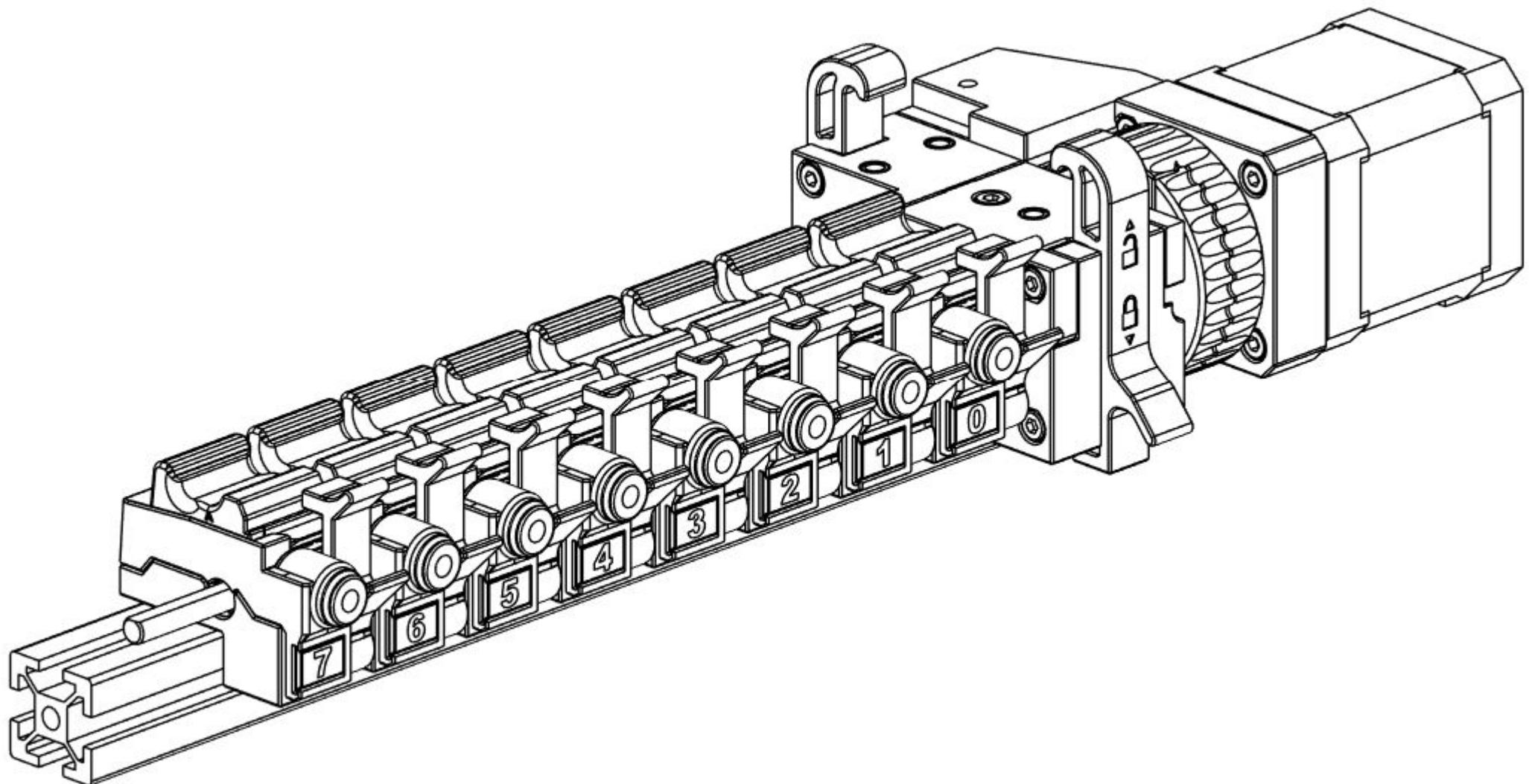
If the Drive Shaft isn't running smoothly at any point, undo your most recent assembly step and try again. It is normal for the motor and gear to add some drag.

Finally, install an M3x20mm bolt to hold the **Motor_Mount** to the **Gearbox**.



From here, the instructions converge. All the steps will be the same regardless of your motor configuration. Therefore we will go back to showing the recommended Direct Drive option.





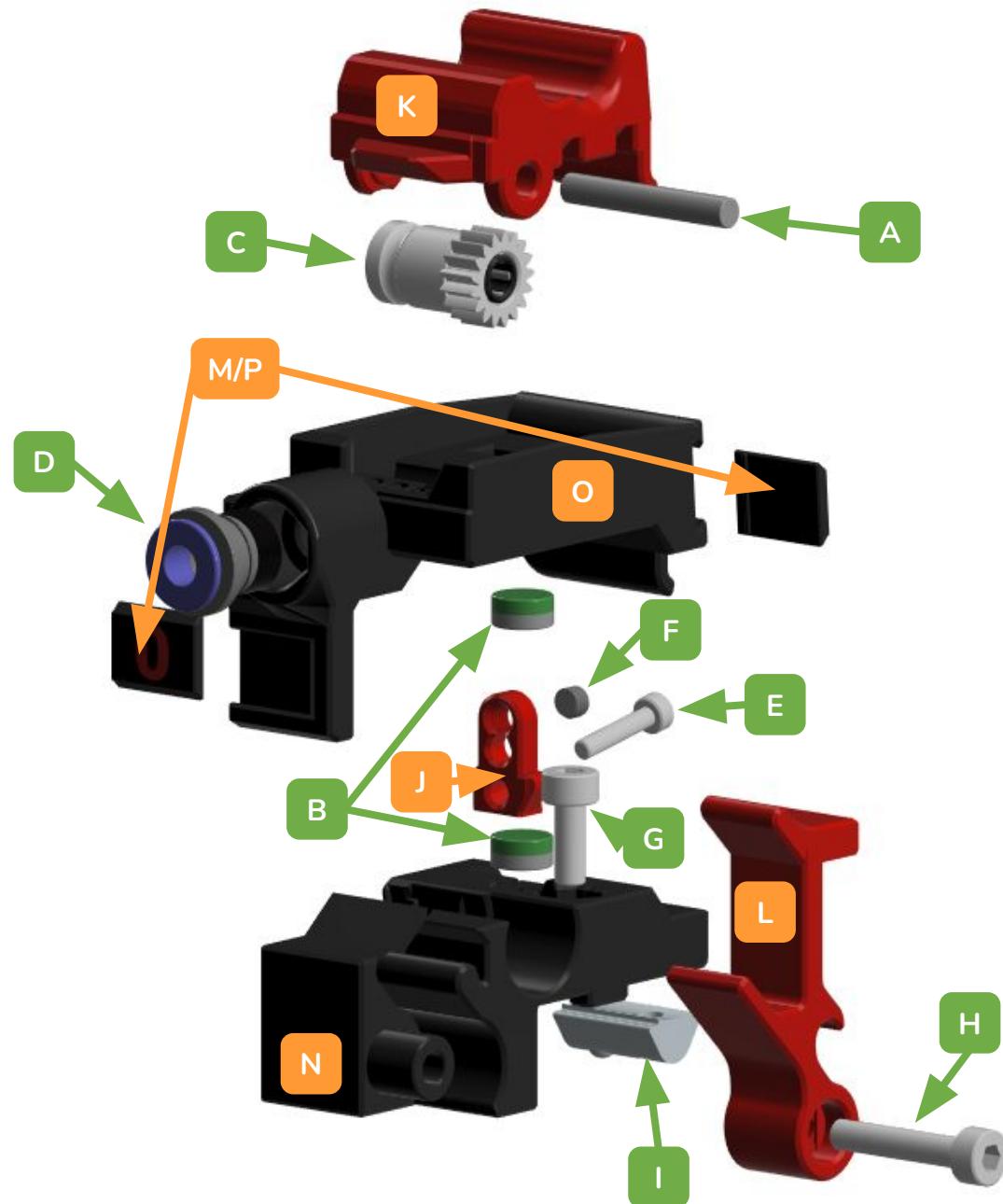
FILAMENT BLOCKS

EXPLODED VIEW

FILAMENT BLOCK SUB-BOM (PER FILAMENT BLOCK)

| | |
|---|------------------------------|
| A | 1x 3mm x 20mm pin |
| B | 2x 6x3mm Magnets |
| C | 1x BMG Idler Gear & Bearings |
| D | 1x ECAS Coupler (2 piece) |
| E | 1x M2x10mm SHCS |
| F | 1x M3x3mm Flat-Tip Set Screw |
| G | 1x M3x8mm SHCS |
| H | 1x M3x16mm SHCS |
| I | 1x M3 Roll-In T-Nut |

| | |
|---|-----------------------------|
| J | 1x [a]_Base_Trap_M3_xN.stl |
| K | 1x [a]_Tophat_xN.stl |
| L | 1x [a]_Latch_xN.stl |
| M | 2x [a]_Tag_plates_N_x2.stl |
| N | 1x Base_xN.stl |
| O | 1x Filament_Path_xN.stl |
| P | 2x Tag_plates_DigitN_x2.stl |

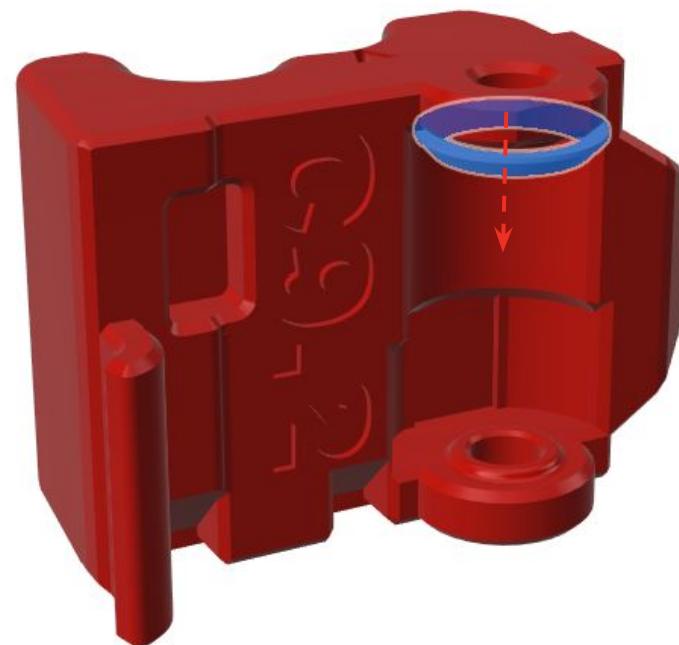
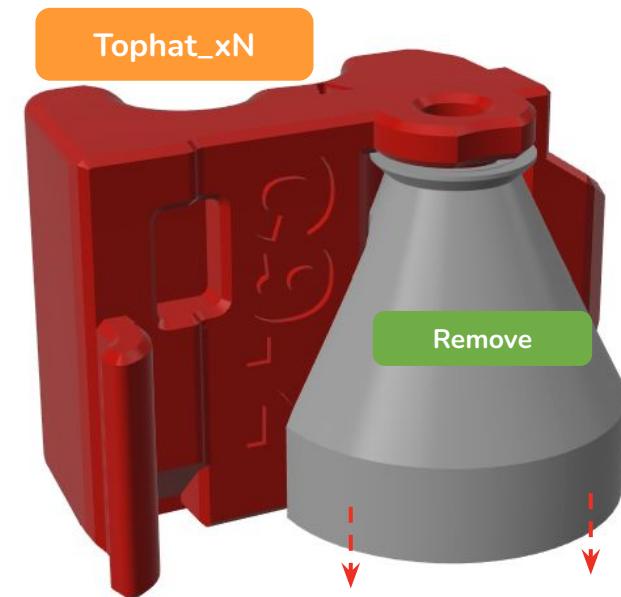


3.1 PRINT IN PLACE SUPPORTS

Before you begin you will need to remove all of the print-in-place supports from the **Tophats**.

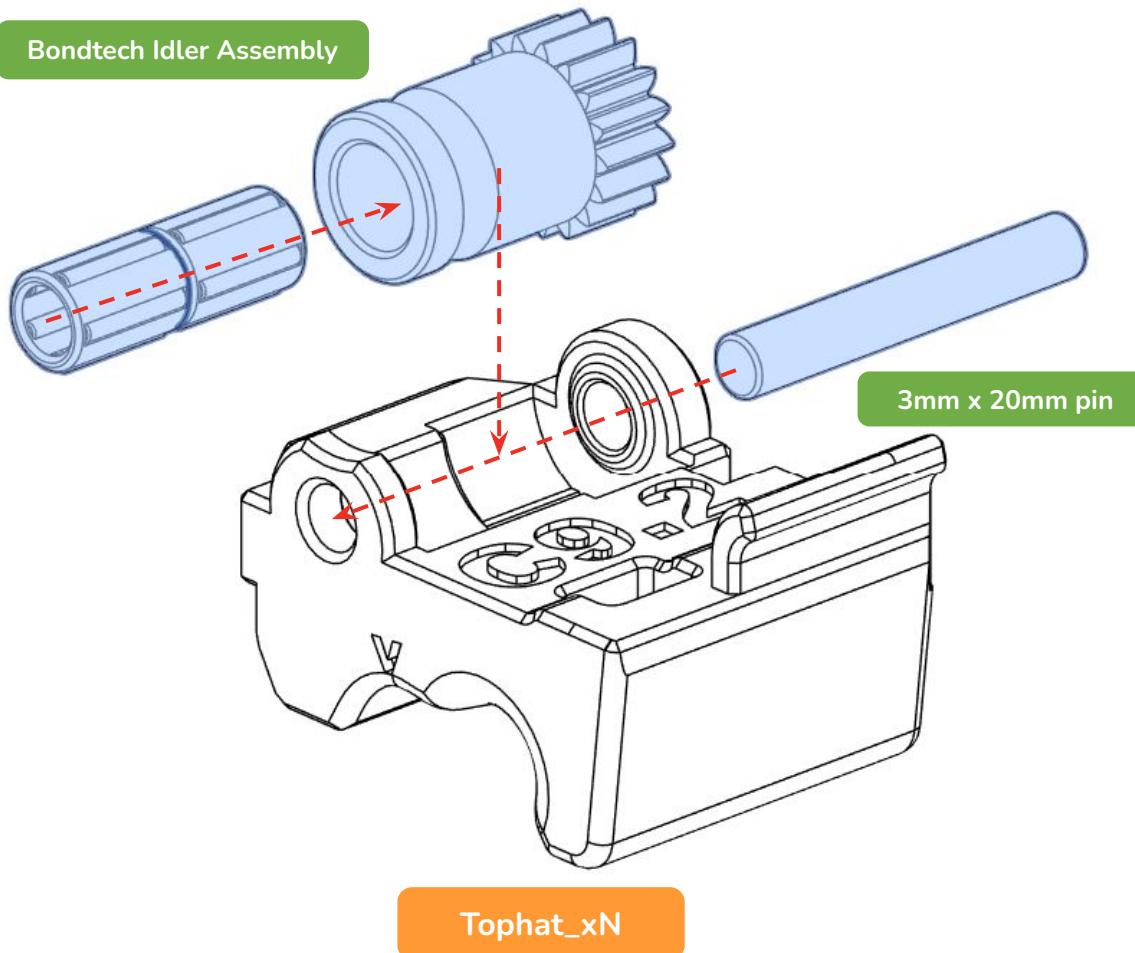
Using a small screwdriver may help. Please take care that you don't accidentally damage the part (or yourself!). Make sure that the ring of support at the top is fully removed and the surfaces are clean.

Repeat this for all of the **Tophats**.



FILAMENT BLOCKS

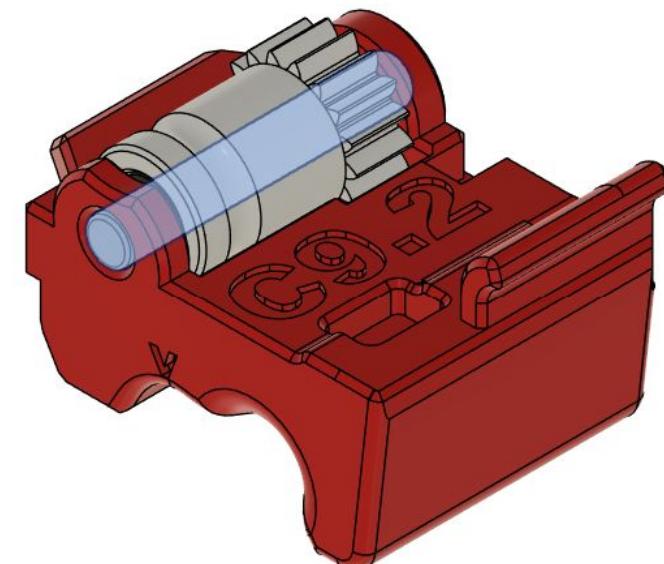
TOP HATS



3.1 INSTALL BONDTECH IDLER GEAR

Lightly grease the bearings with EP1/EP2 or Superlube before inserting the pin. Once assembled, make sure the Bondtech idler spins freely.

Repeat for all Tophats.



FILAMENT BLOCKS

BASE

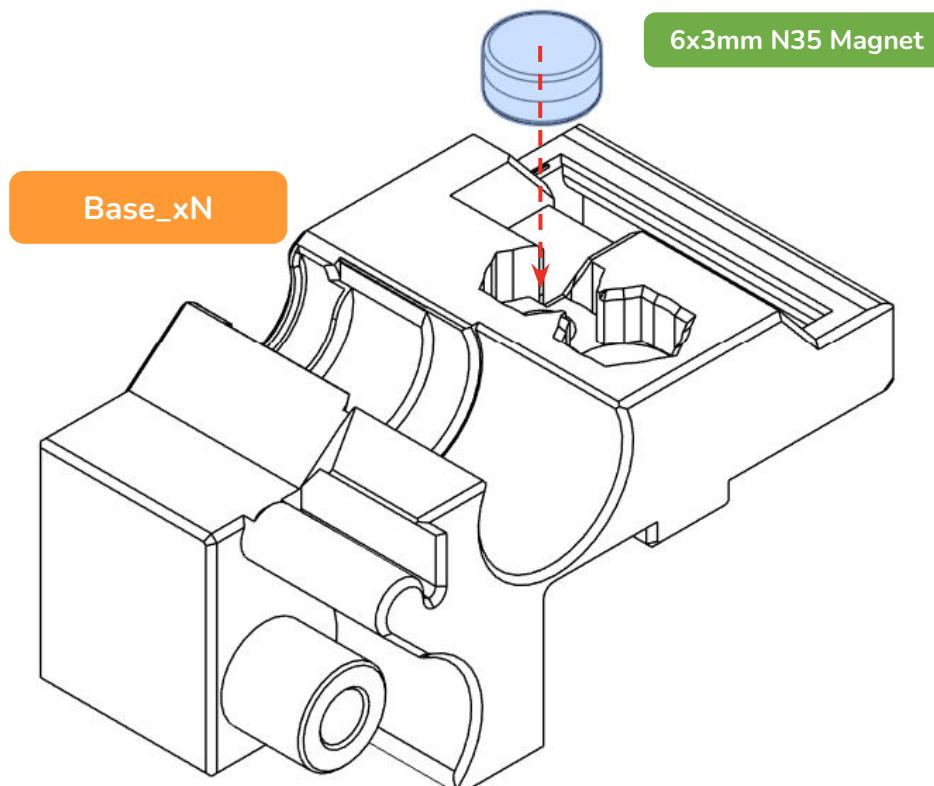
3.2 MAGNET ORIENTATION

Polarity matters. Install the magnets in the middle recess so they repel against the magnets in the **Filament_Path**, e.g. same poles facing each other on both magnets. Add a dab of superglue to the bottom of the centered recess, to hold the magnet securely.

It's recommended you assemble all **Filament_Path** and **Base** parts at the same time to ensure all of the magnet polarities match.

If you want to use dual magnets, hold off on installing the second magnet into the other recess until you finish attaching all the **Bases** to the 2020, because we need access to the bolt hole.

Repeat for all of the **Bases**.



FILAMENT BLOCKS

LATCH

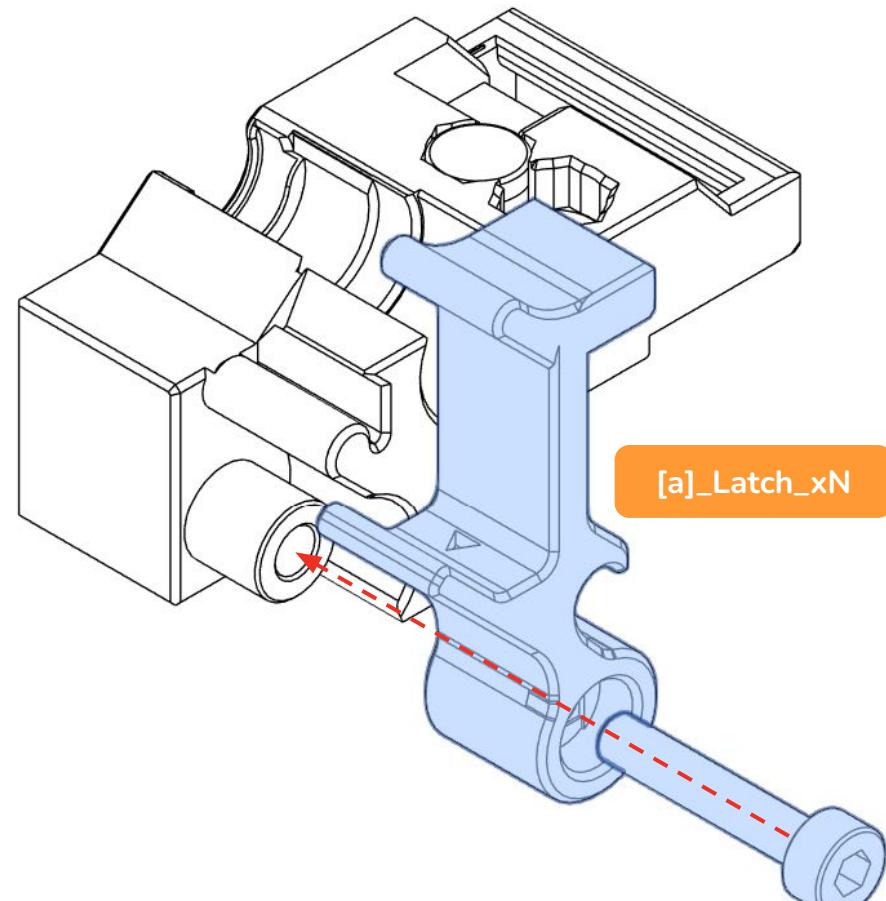
3.3 LATCH SCREW

Resist the urge to close the **Latch** before installing the screw. You'll break the pivot off.

Drive the M3x16mm screw into the **Base**. The screw taps directly into the plastic, so don't overtighten or it will strip!

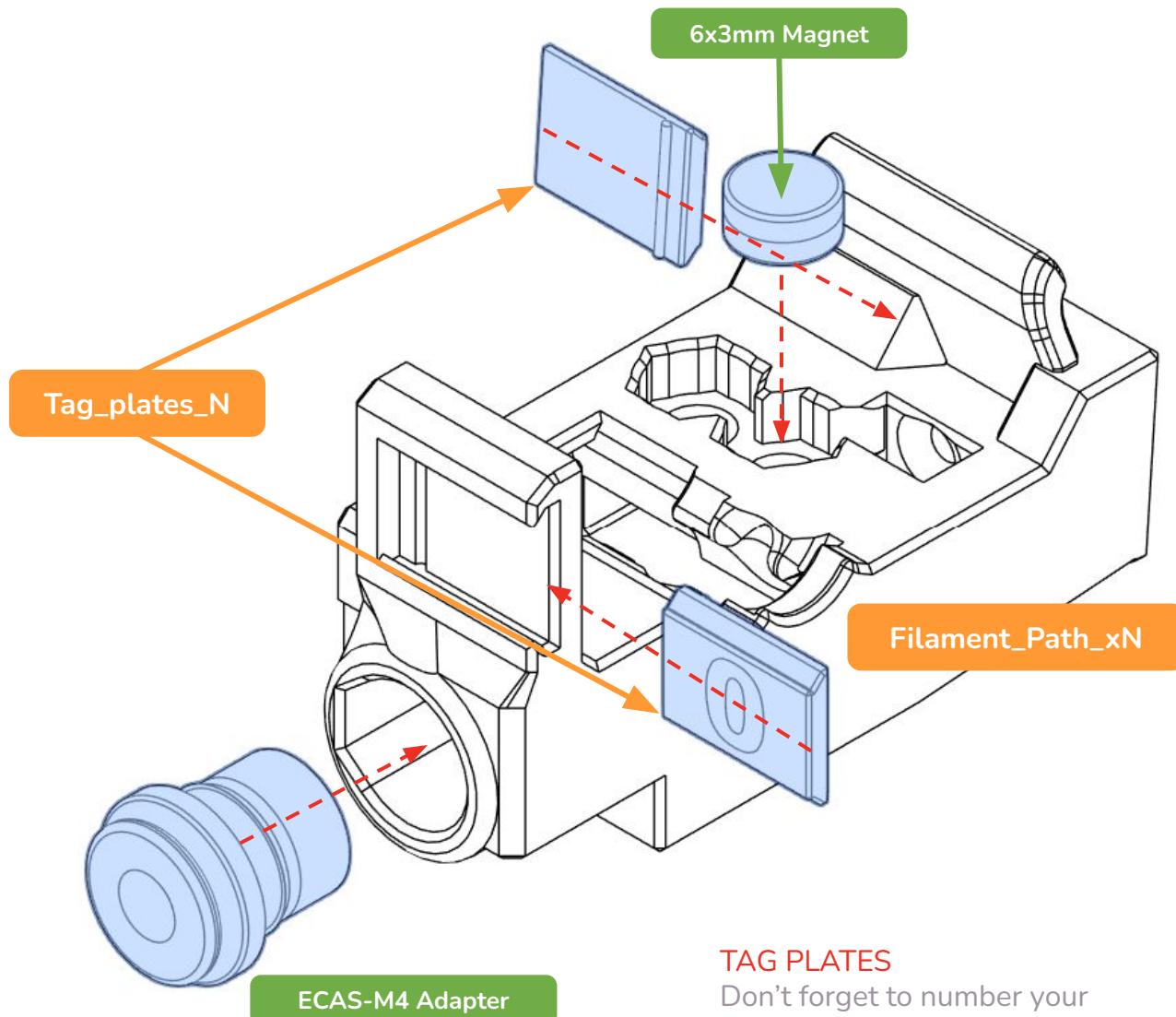
Once the screw is in, you can close the **Latch** with a satisfying click.

Repeat for all of the **Bases**.



FILAMENT BLOCKS

FILAMENT PATH



TAG PLATES

Don't forget to number your **Filament_Paths** with both tags, starting with 0!

3.4 MAGNET ORIENTATION

Polarity matters. Install the magnets in the centered recess so they repel against the magnets in the **Base**, e.g. same poles facing each other on both magnets.

It's recommended that you assemble all of the **Filament_Path** and **Base** parts at the same time to ensure all of the magnet polarities match.

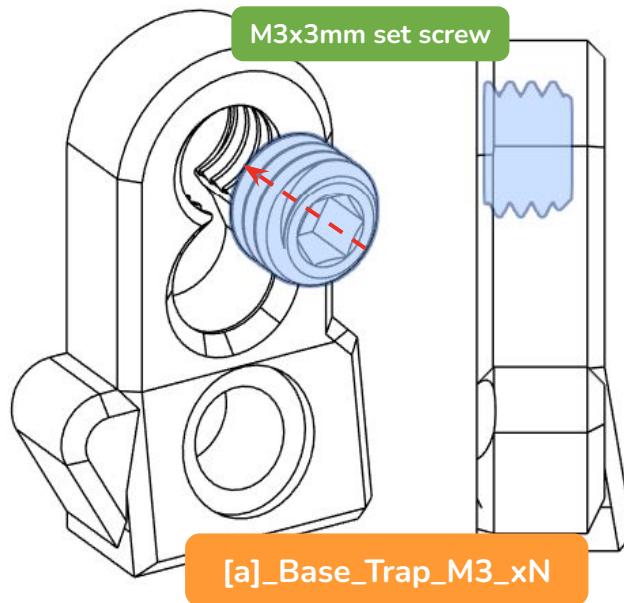
6x3 Magnet thickness can vary. In case your magnets are a little loose, add a drop of CA glue to hold them in place.

Install the ECAS fitting.

Install both the front and back Tag number plates.

Repeat for all of the **Filament_Paths**.

FILAMENT BLOCKS



TRAP ASSEMBLY

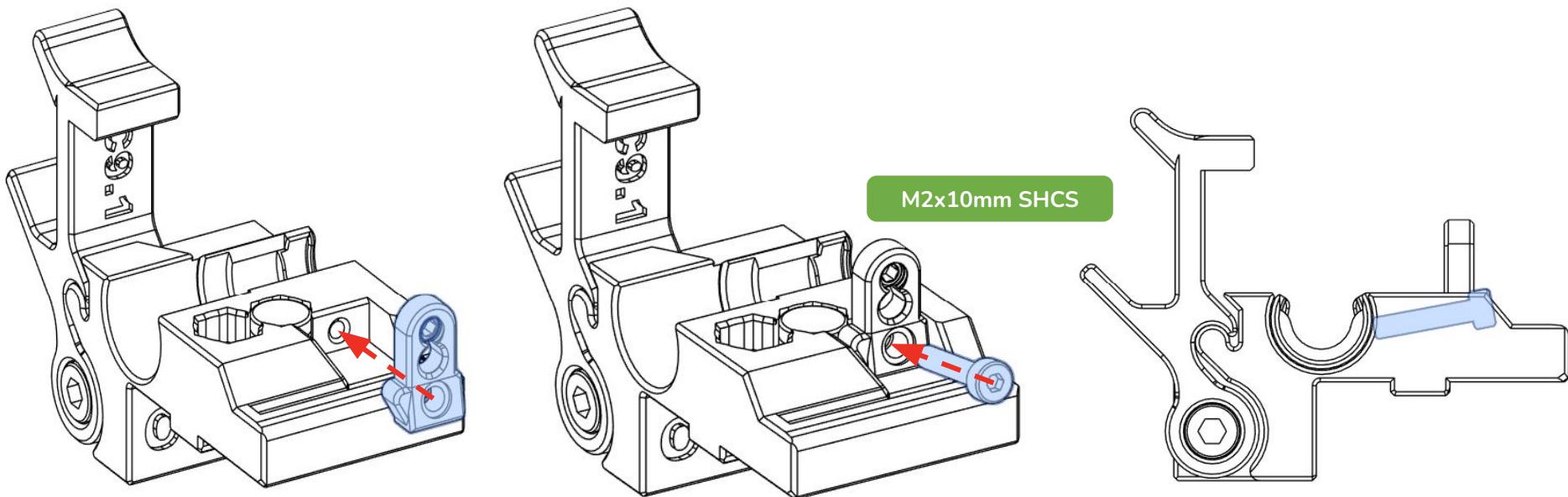
3.5 FILAMENT TRAP (BRAKE)

This traps the filament when it is not in use so it doesn't fall out of the **Base**. If you choose to use the M3 set screw version of the **Trap** (recommended), make sure the flat end of the set screw is screwed in slightly more than flush into the **Trap**. Also make sure the filament hole in the **Trap** is clear and free of stringing.

Next, slide the **Trap** into the **Base**. It should be snug but not super tight.

Finally, add the M2x10mm SHCS by threading it through the **Trap** into the **Base**. The bolt should be snug, but not super tight.

No, it is not your imagination. The bolt has a 10 degree tilt to avoid hitting the gears.



FILAMENT BLOCKS

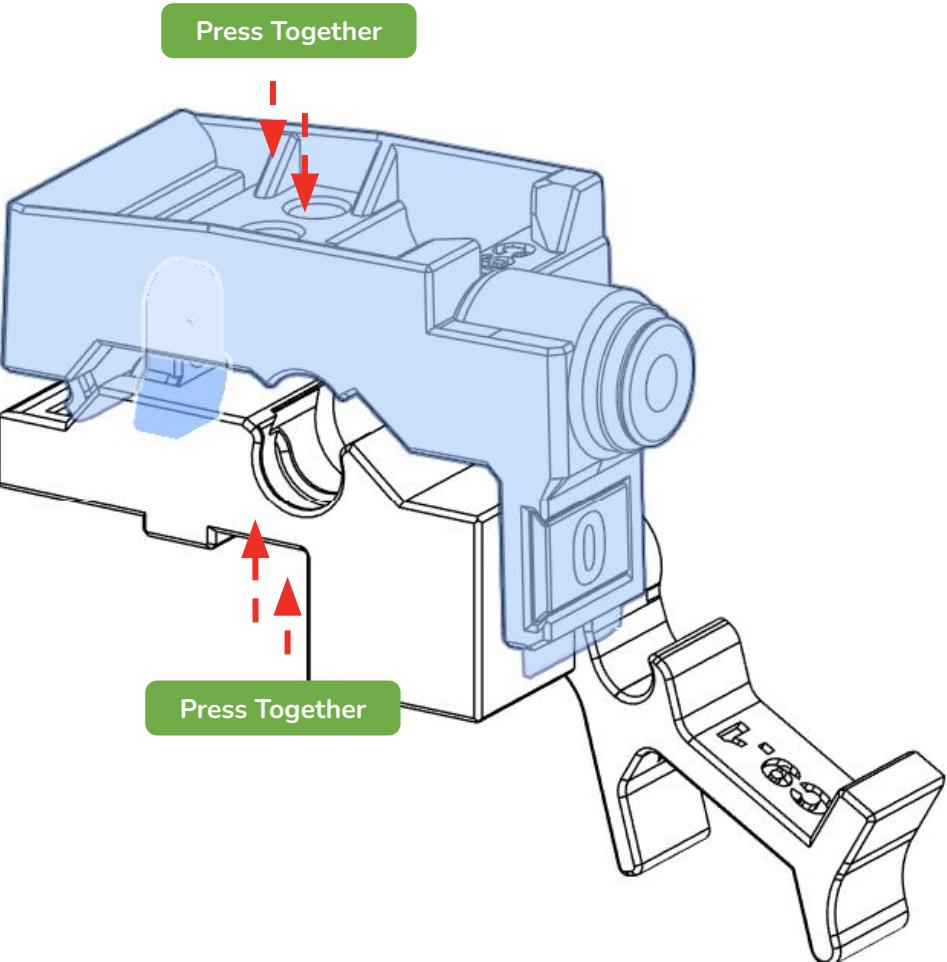
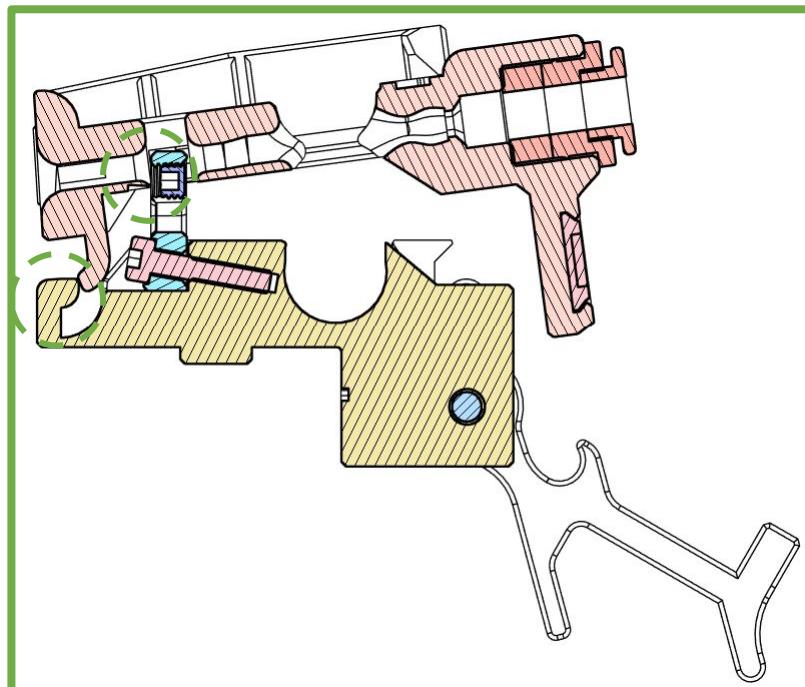
BLOCK ASSEMBLY

ASSEMBLY

Open the **Latch**. Next, line up the **Filament_Path** vertically with the **Base**. Angle the **Filament_Path** a little, so that the **Base_Trap** fits into its slot on the **Filament_Path**, and that the tongue on the **Filament_Path** is aligned with its slot on the **Base**. Squeeze them together until they snap together. Close the **Latch**.

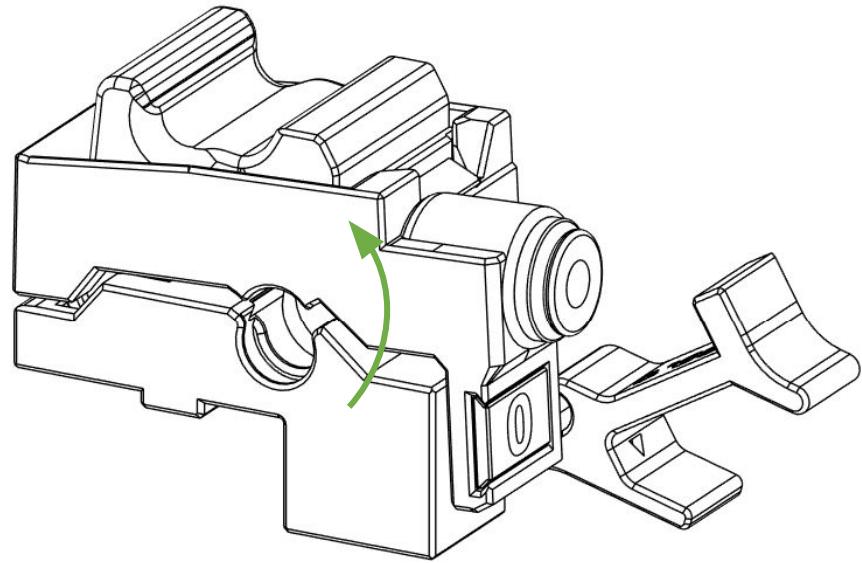
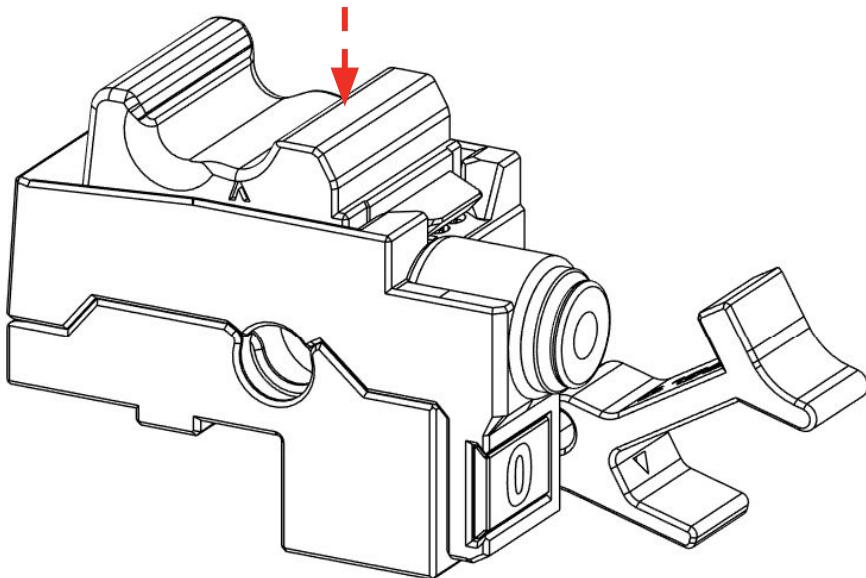
Repeat assembly of all of the parts into Filament Blocks.

To separate, pull apart at a slight angle.



FILAMENT BLOCKS

FIT CHECK



FIT CHECK

Add the [Tophat](#) on top of the [Filament_Path](#).

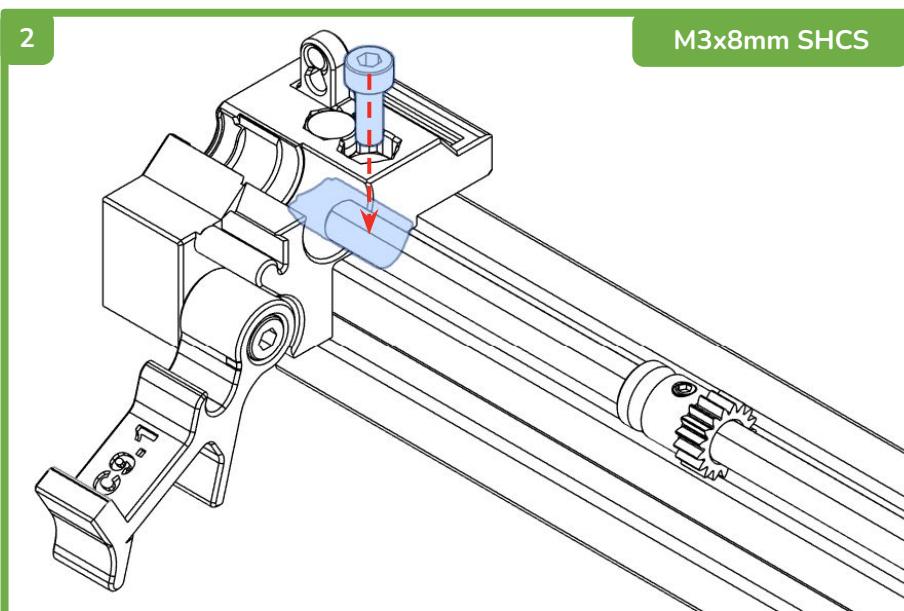
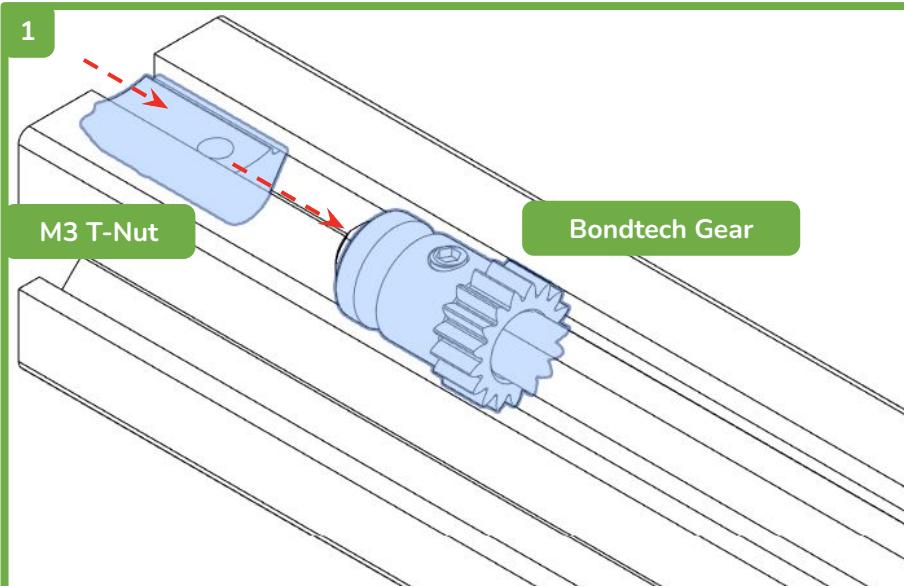
When assembled, the filament block parts should pivot freely on the [Filament_Path](#) hinge, repelled by the magnetic spring. The parts should move smoothly without anything preventing the parts from closing or opening. The difference between being engaged and disengaged is only a little more than the width of filament (1.75mm).

If the parts interfere or bind as you press them together, then you will need to disassemble them. Use a small file or hobby knife to clean out any stringing in the [Base_Trap](#) slot, and square up its corners. Depending on how well calibrated your printer is, you might also need to lightly sand or file the sides of the [Base_Trap](#) to improve fit until the the parts move freely.

Remove the [Filament_Path](#) from the [Base](#) and and set it aside. Repeat the fit check for all Filament Blocks.

FILAMENT BLOCKS

FILAMENT BLOCK ARRAY ASSEMBLY



1. PREPARATION

Slide a Bondtech gear onto the D-Cut shaft. Be aware of its orientation, gear side first. Then slide a roll-in T Nut into the top channel of the 2020 extrusion, with the M3 mounting hole toward the Gearbox.

1B. BEARINGS

Every third Filament Block, or as desired, add an MR85ZZ Bearing to the **Base** before sliding it onto the Drive Shaft.

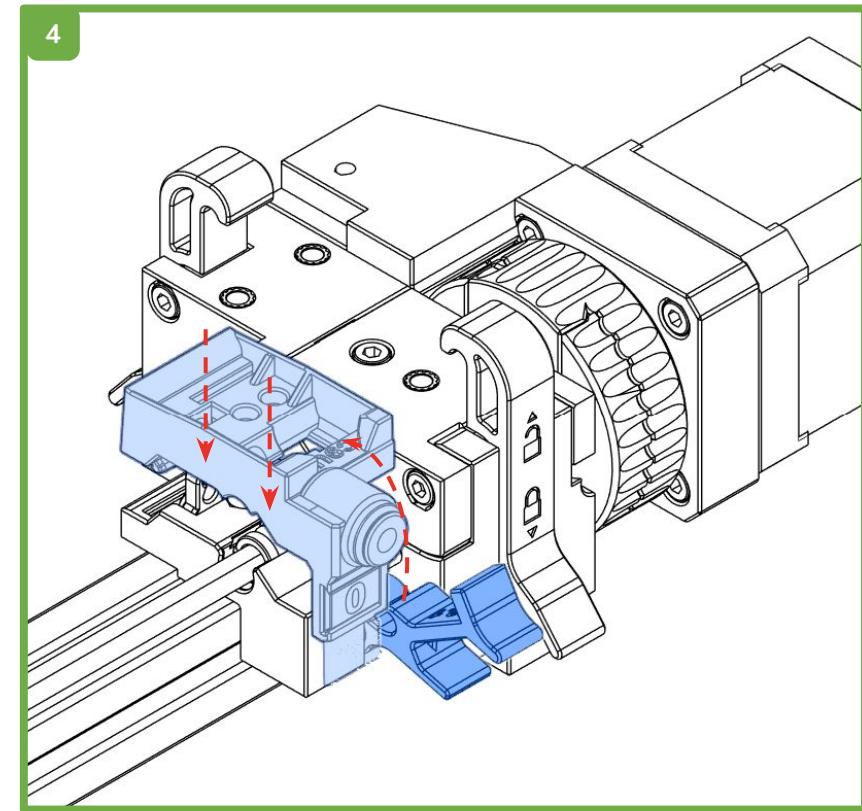
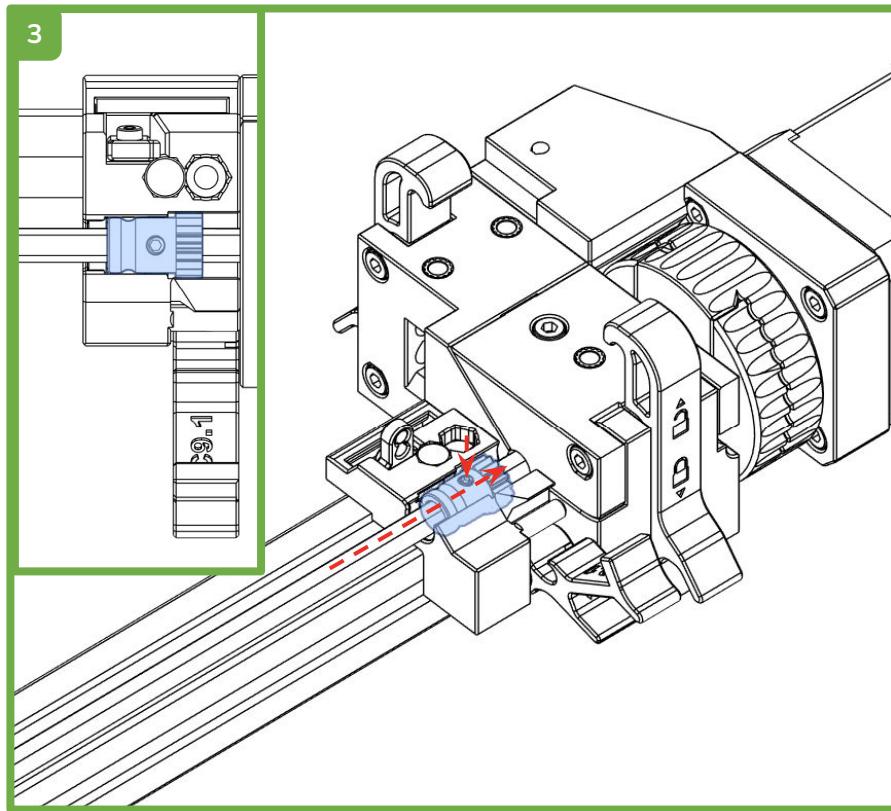
| # Channels | # MR85ZZ Bearings | Base # with Bearings |
|------------|-------------------|----------------------|
| 4 | 2 | 2, 3 |
| 5 | 2 | 2, 4 |
| 6 | 2 | 2, 5 |
| 7 | 3 | 2, 5, 6 |
| 8 | 3 | 2, 5, 7 |
| 9 | 3 | 2, 5, 8 |
| 10 | 4 | 2, 5, 8, 9 |
| 11 | 4 | 2, 5, 8, 10 |
| 12 | 4 | 2, 5, 8, 11 |
| 13 | 5 | 2, 5, 8, 11, 12 |
| 14 | 5 | 2, 5, 8, 11, 13 |
| 15 | 5 | 2, 5, 8, 11, 14 |

2. FILAMENT BLOCK INSERTION

Attach the **Base** labelled 0 to the T Nut with an M3x8mm screw. Leave it loose enough that the **Base** can still slide on the 2020.

FILAMENT BLOCKS

FILAMENT BLOCK ARRAY ASSEMBLY



FILAMENT BASE MOUNTING

Push the Bondtech gear and **Base** to the Gearbox. The Drive Shaft should not bind on the bearings.

Snug the Bondtech gear's set screw in a central location. **Do not apply threadlocker yet.** We will do fine adjustment later, but we need the gear to rotate smoothly for the array alignment step.

FILAMENT PATH MOUNTING

Push the **Filament_Path** labelled 0 straight down onto the **Base**. It should seat without much force. Close the **Latch**.

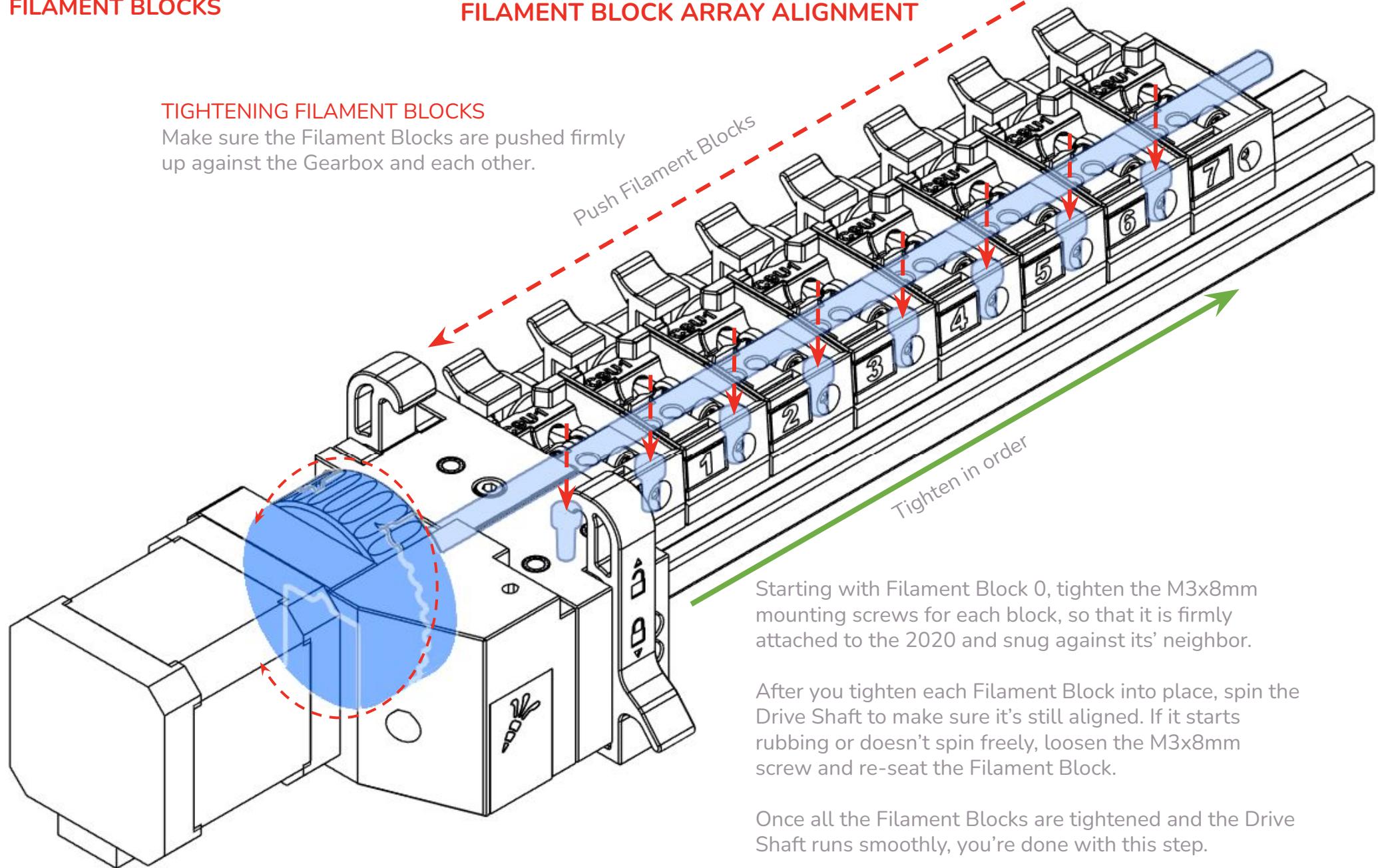
Repeat these 4 steps for all of the **Bases** and **Filament_Paths**.

FILAMENT BLOCKS

FILAMENT BLOCK ARRAY ALIGNMENT

TIGHTENING FILAMENT BLOCKS

Make sure the Filament Blocks are pushed firmly up against the Gearbox and each other.



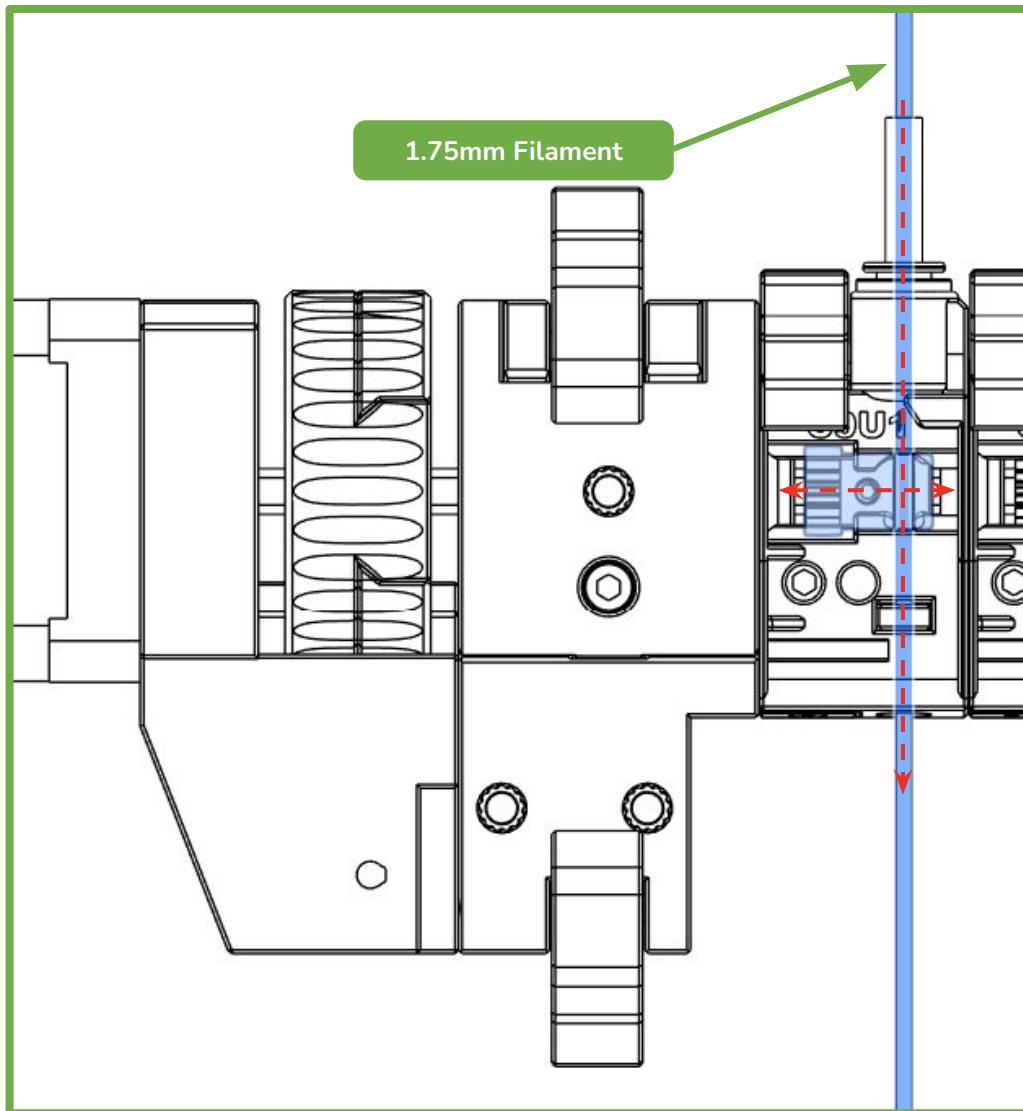
Starting with Filament Block 0, tighten the M3x8mm mounting screws for each block, so that it is firmly attached to the 2020 and snug against its' neighbor.

After you tighten each Filament Block into place, spin the Drive Shaft to make sure it's still aligned. If it starts rubbing or doesn't spin freely, loosen the M3x8mm screw and re-seat the Filament Block.

Once all the Filament Blocks are tightened and the Drive Shaft runs smoothly, you're done with this step.

FILAMENT BLOCKS

BONDTECH GEAR ALIGNMENT



View from the top of the ERCF.

BONDTECH GEAR ALIGNMENT

Insert a small piece of PTFE tube (a few centimeters is enough) into the Filament Block ECAS. Insert a piece of filament through the block until it comes out the other side. (Depending on the shape of the filament end, it may get caught by the trap. In that case push the back of the filament path down to release the trap. Now the filament should go out the other side.)

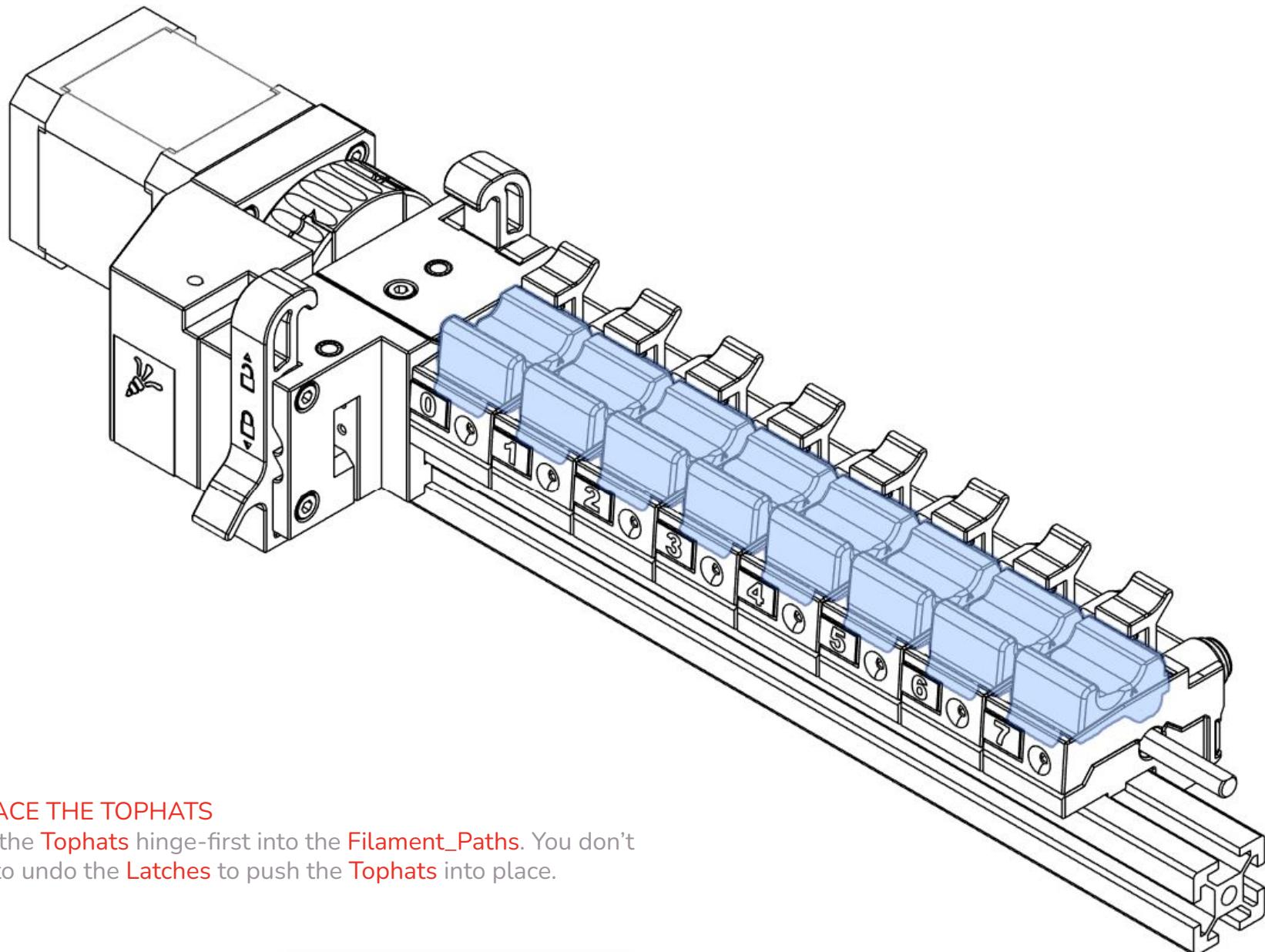
Make sure the flat surface of the Drive Shaft is facing up towards the Bondtech M3 set screw. Press down on the **Filament_Path** and use the filament to align and centre the gear with the groove, then tighten the set screw.

Don't forget to use a little thread locker on the set screw, but be careful not to get it on printed parts. If you do, clean it immediately, because thread locker degrades ABS.

Repeat this process for all the Filament Blocks.

FILAMENT BLOCKS

REPLACE TOPHATS

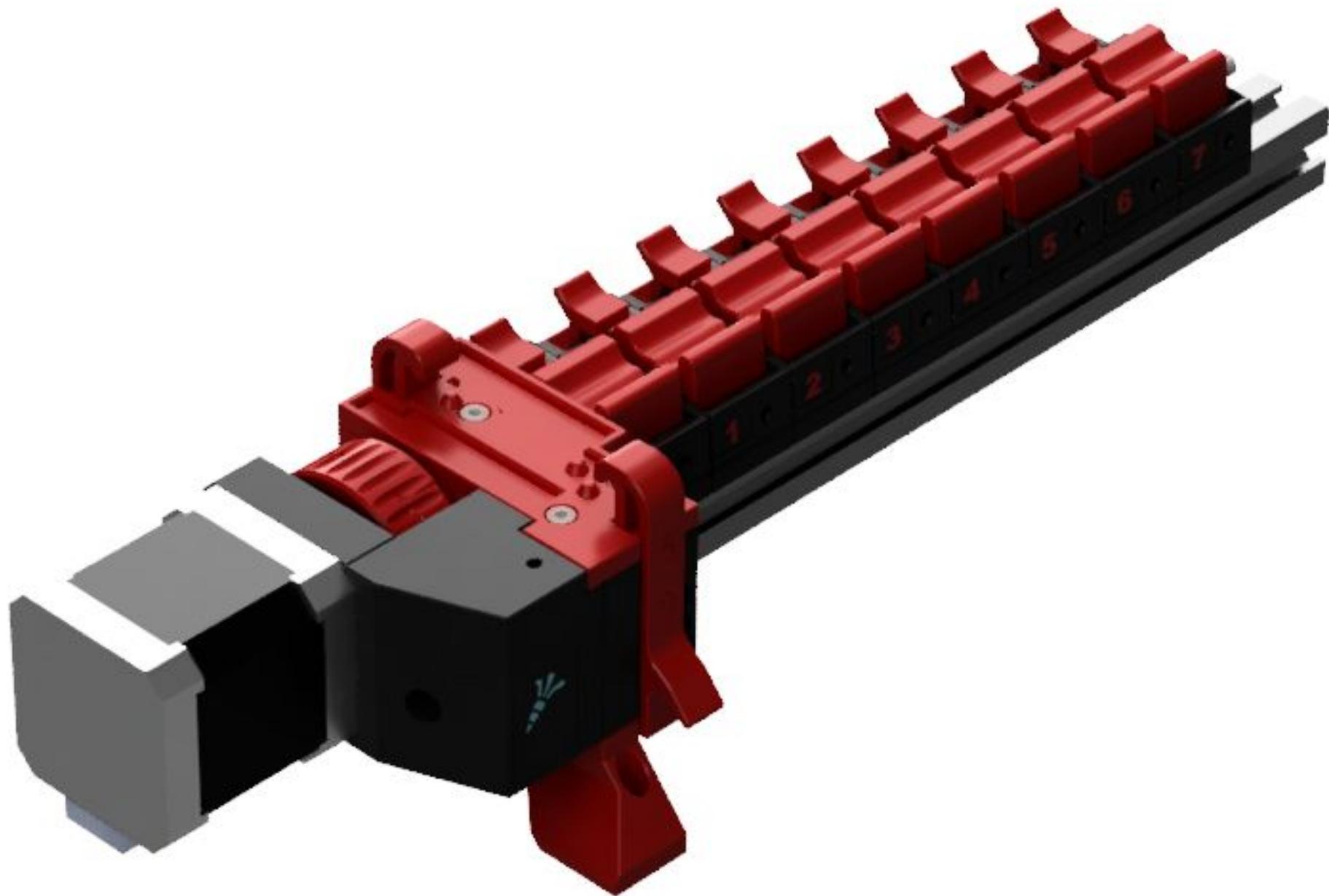


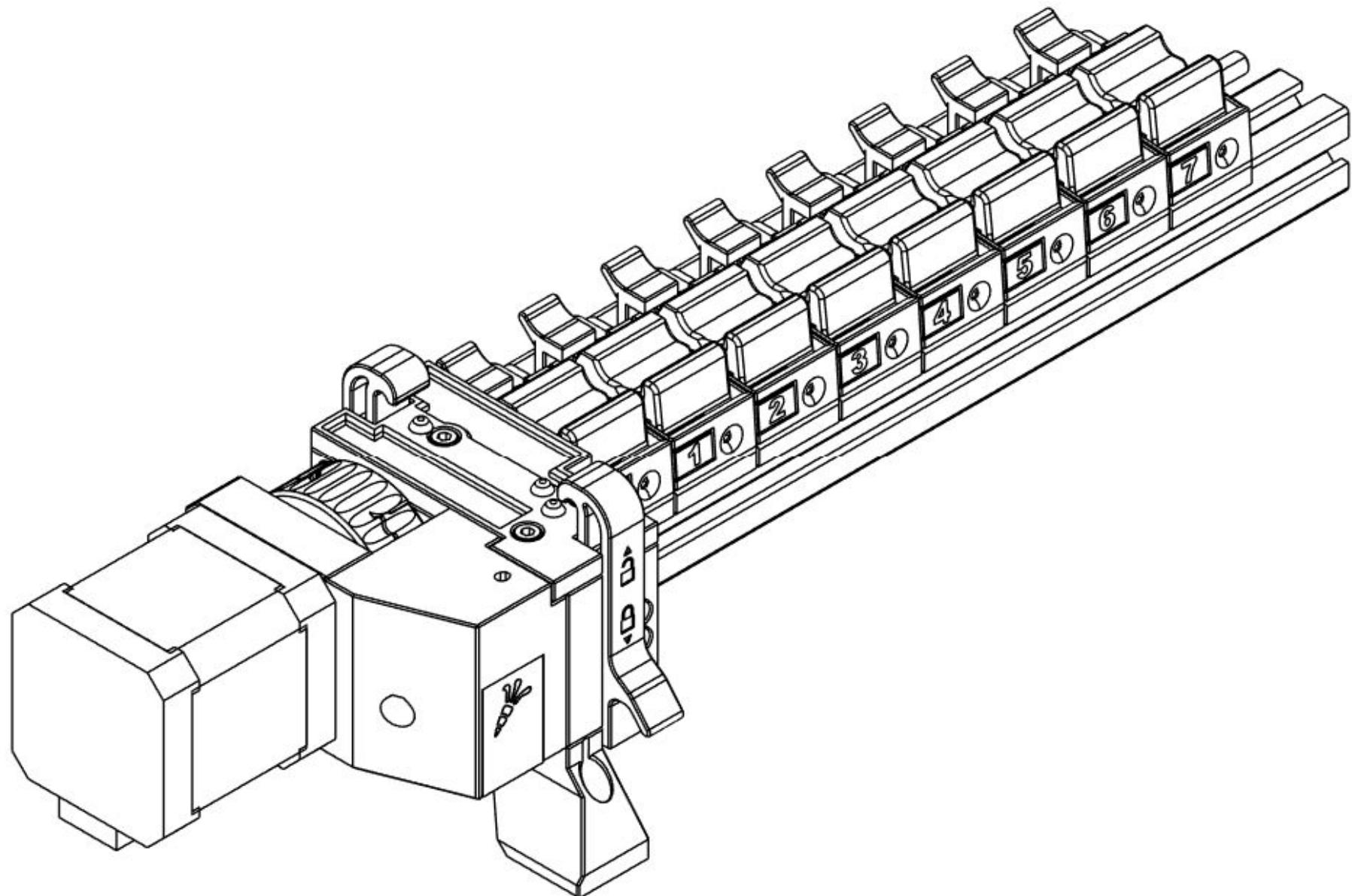
REPLACE THE TOPHATS

Place the **Tophats** hinge-first into the **Filament_Paths**. You don't need to undo the **Latches** to push the **Tophats** into place.

Surface finish can be improved by using multi-material techniques. Some materials are better suited for creating smooth, detailed surfaces, while others provide strength or flexibility. By mixing materials, the final product can have both an excellent surface finish and desirable mechanical properties.

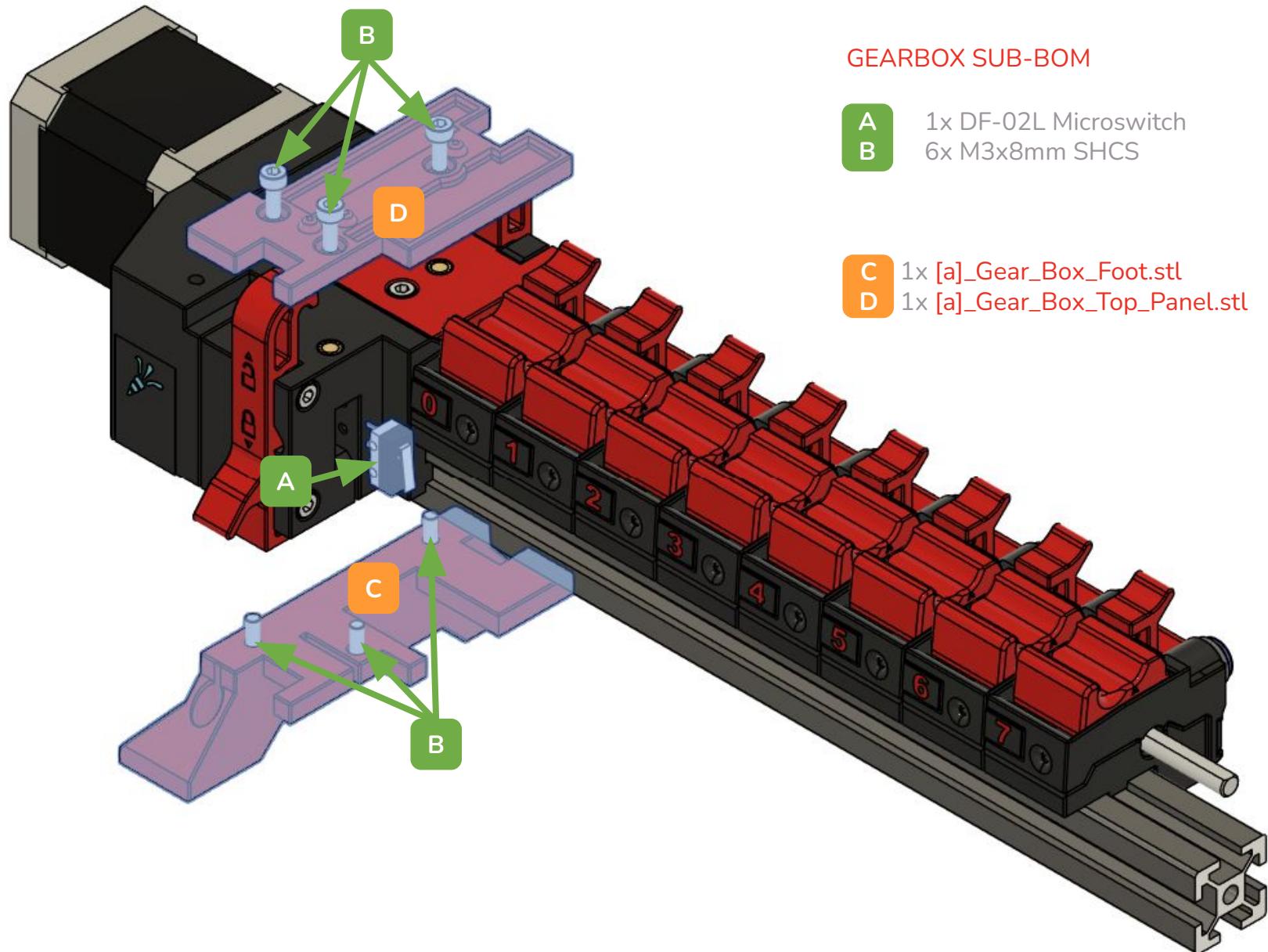
One example of this is a part made out of glass-fiber reinforced ABS, with a cosmetic outer shell of red ABS.

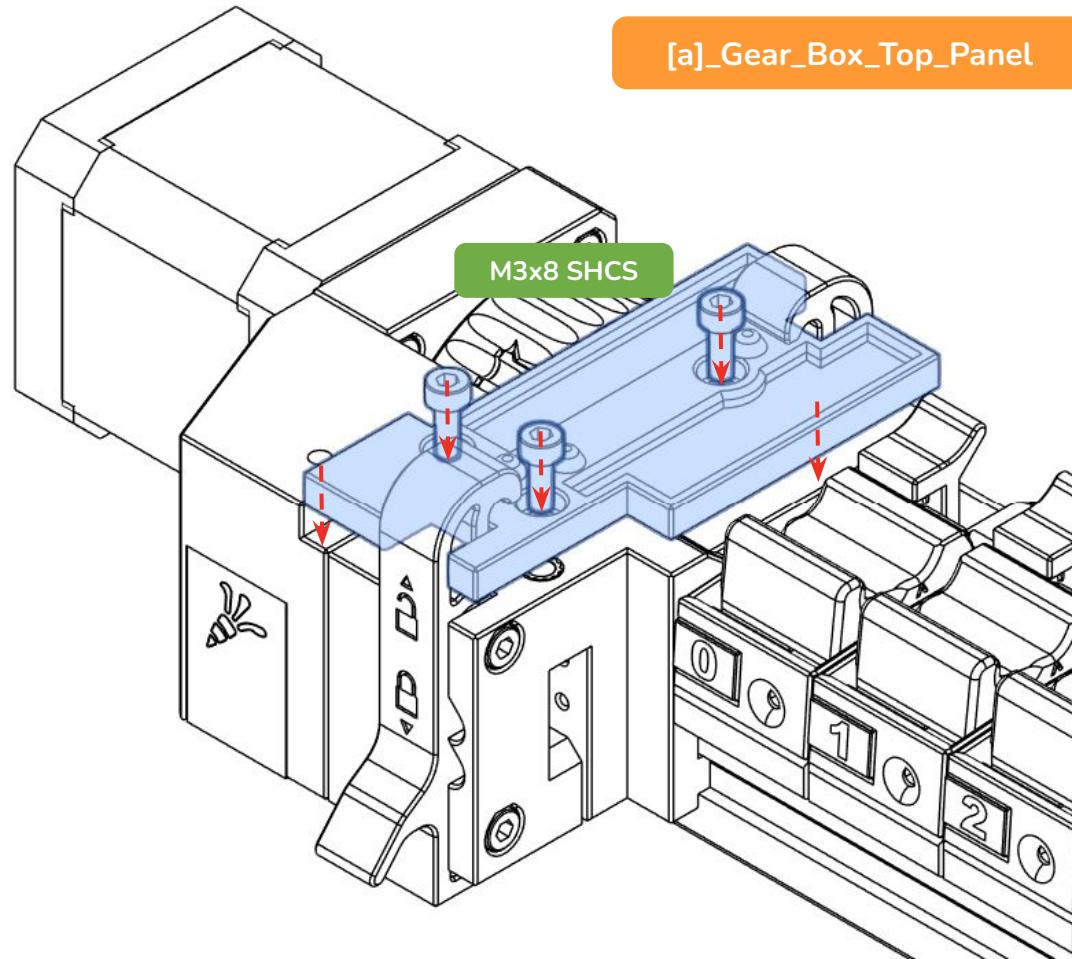




GEARBOX PART 2

EXPLODED VIEW



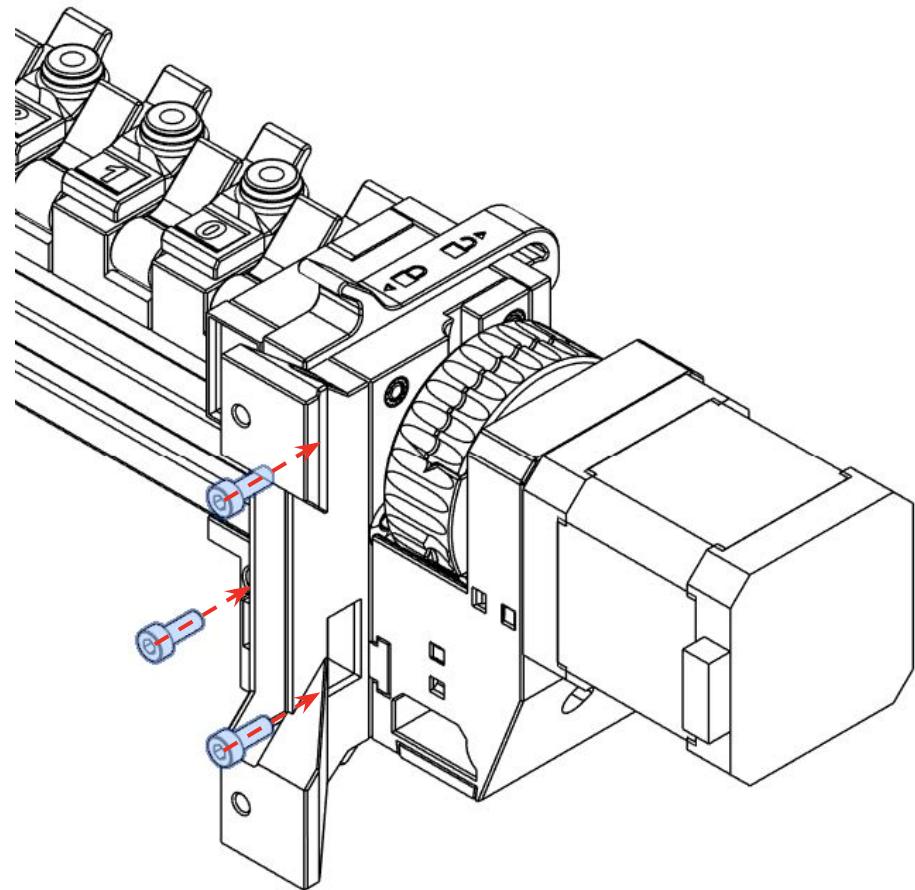
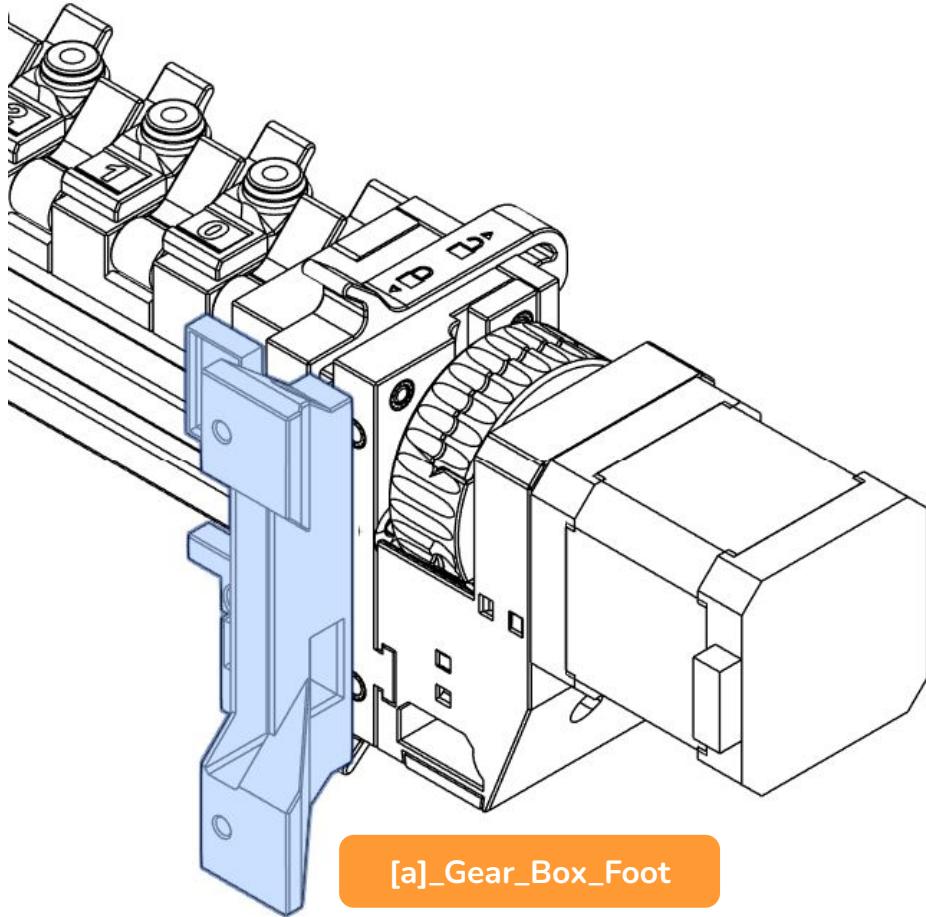


4.1 TOP PANEL

Install the Gear_Box_Top_Panel of the Gearbox using 3 M3x8mm screws.

GEARBOX PART 2

FOOT



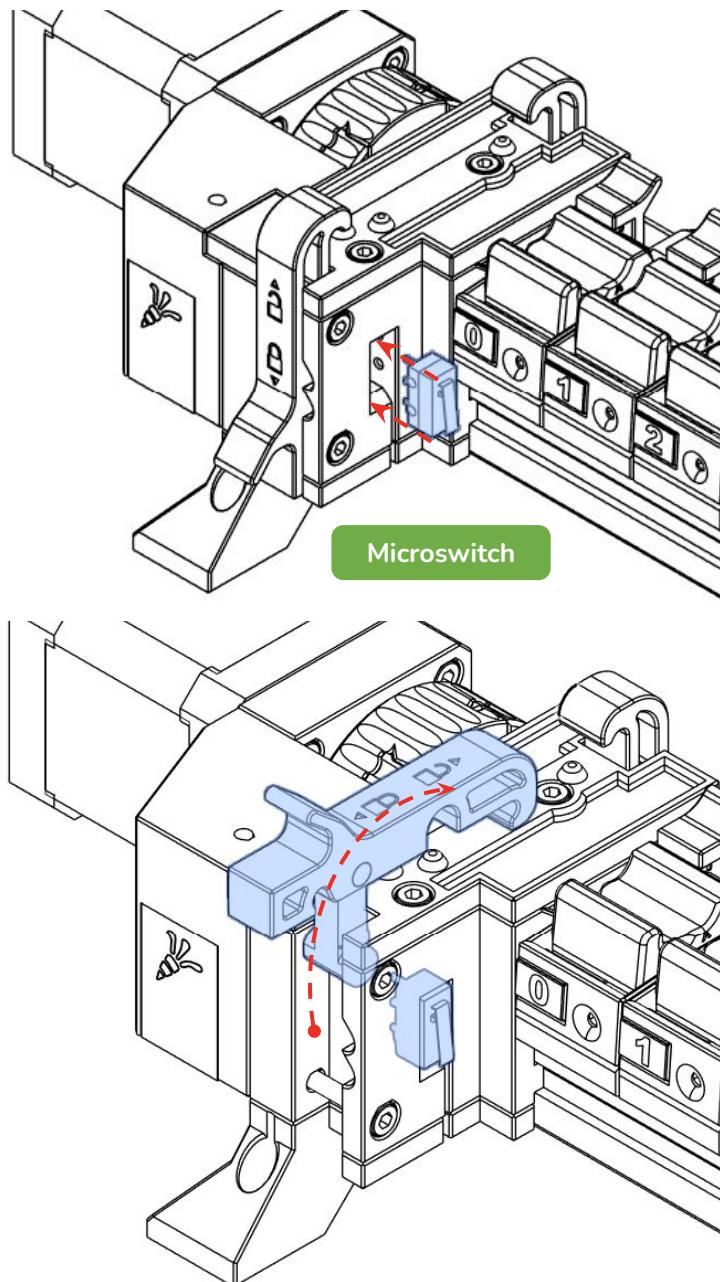
4.2 INSTALL THE FOOT

Align the **Gear_Box_Foot** with the **Gearbox**.

Use three M3x8mm bolts to secure the **Gear_Box_Foot**.

Wires are omitted from the diagrams for clarity.

GEARBOX PART 2



ENDSTOP SWITCH

4.3 INSTALL THE ENDSTOP SWITCH

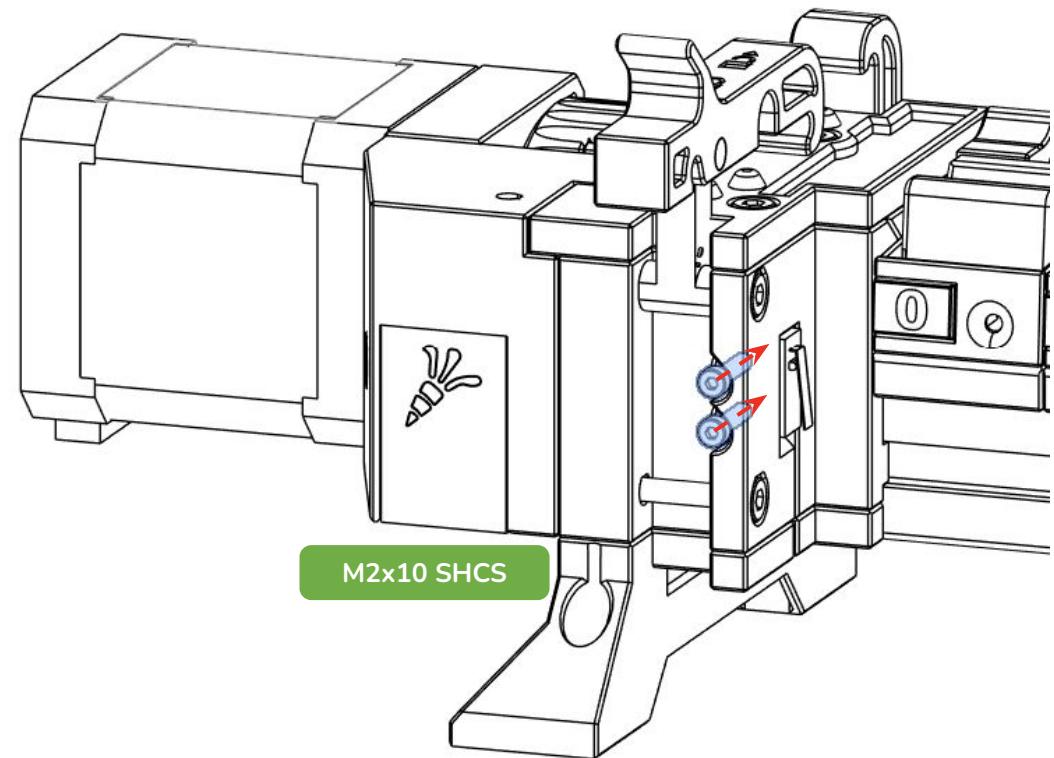
There is a cutout in the **Gearbox** for the microswitch and its' wires. Line up the microswitch with the cutout as shown. Wires omitted for clarity.

Open the **Side_Latch** and swing it up and out of the way.

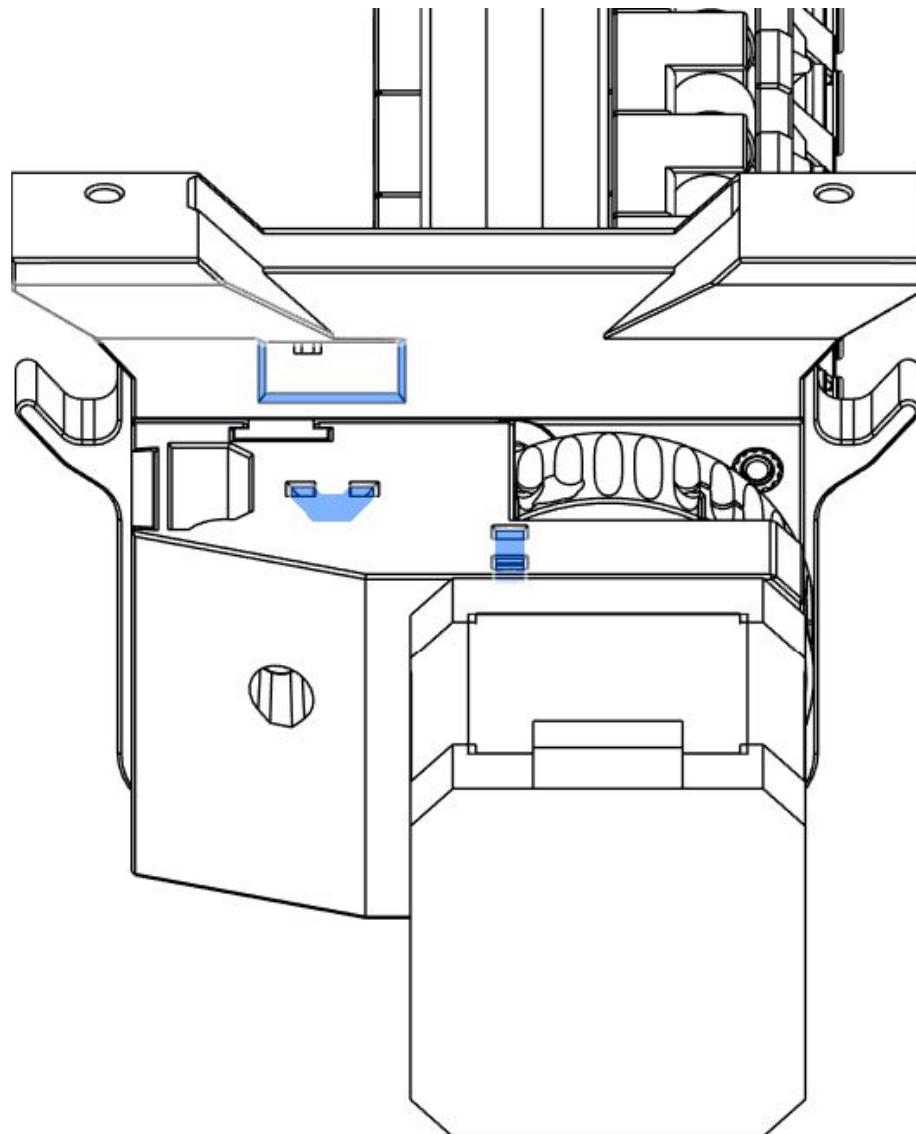
Push the microswitch into its cutout. Route the wires into the slot. The slot is sized to accept wires up to 16ga.

Insert two M2x10mm bolts and drive them through the microswitch into the **Gearbox**. They only need to be snug enough to hold the microswitch.

Close the **Side_Latch**.



GEARBOX PART 2



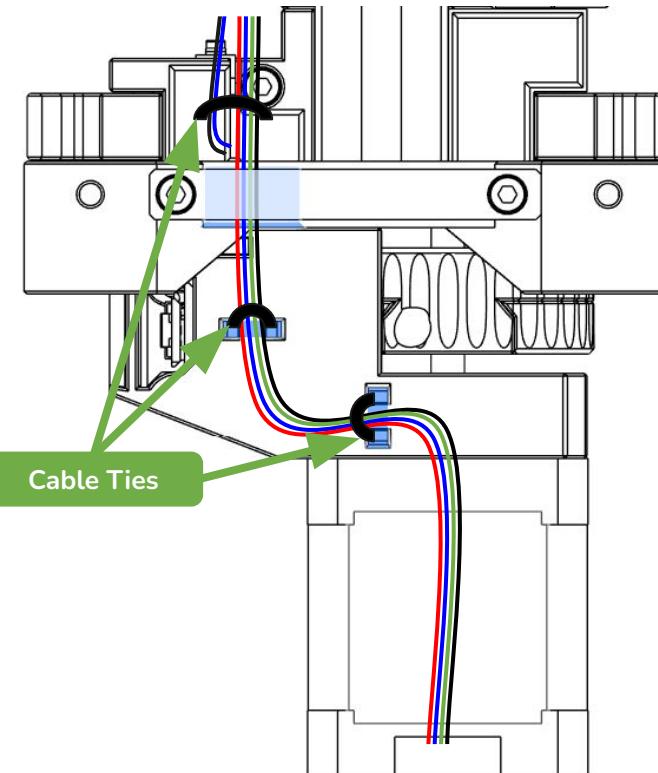
CABLE MANAGEMENT

CABLE MANAGEMENT

There is a cutout in the **Gear_Box_Foot** for the motor wires to fit through. Start by feeding the motor wiring through that cutout.

There are two cable tie slots on the bottom of the **Motor_Mount**. Use cable ties to secure the motor wiring to both of the slots. Don't skip this step - this is to prevent the motor wiring from getting wrapped onto the Drive Shaft.

Optionally, use a cable tie to bundle together the Endstop wires with the motor wires. This is just for neatness.

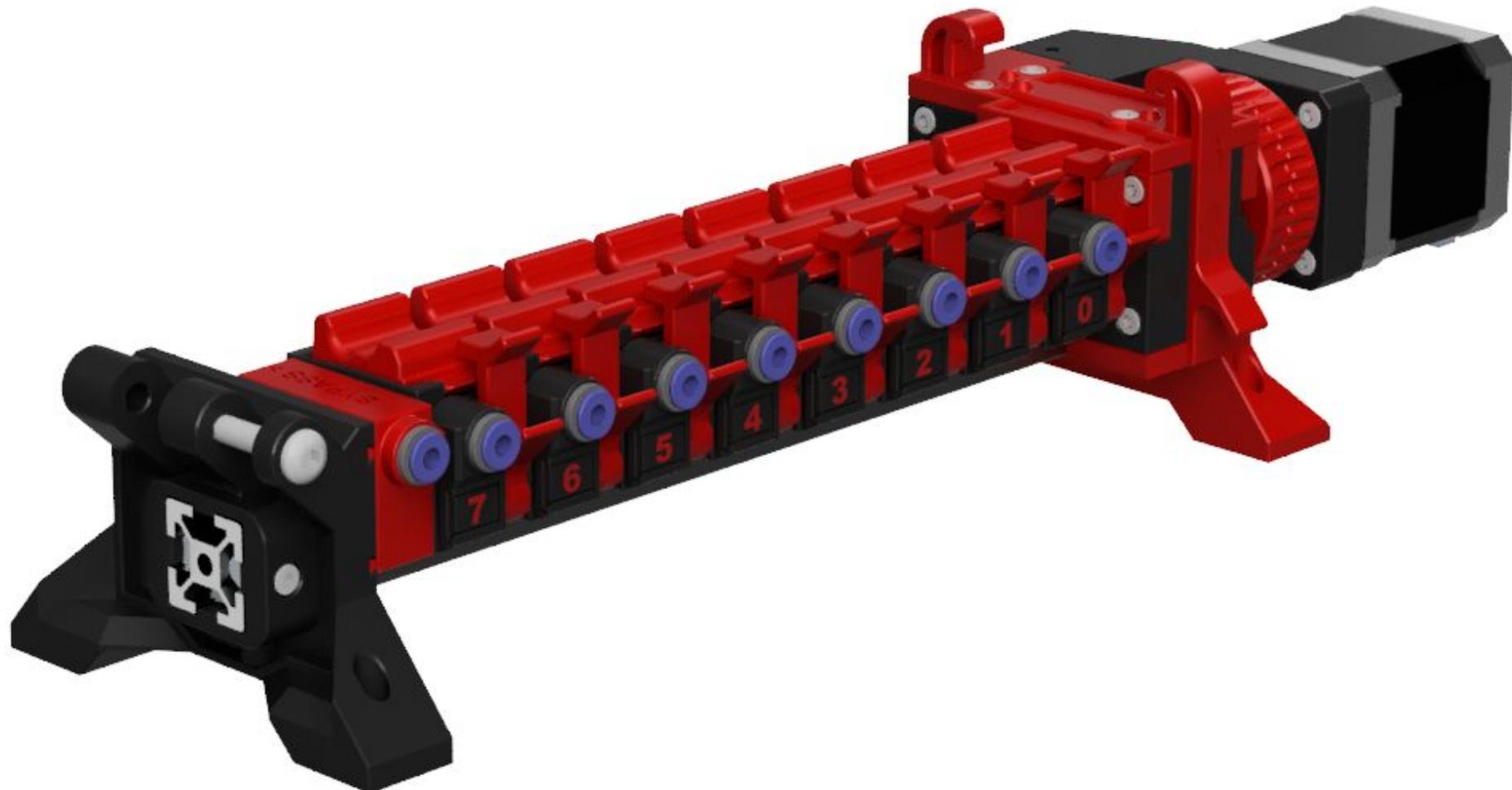


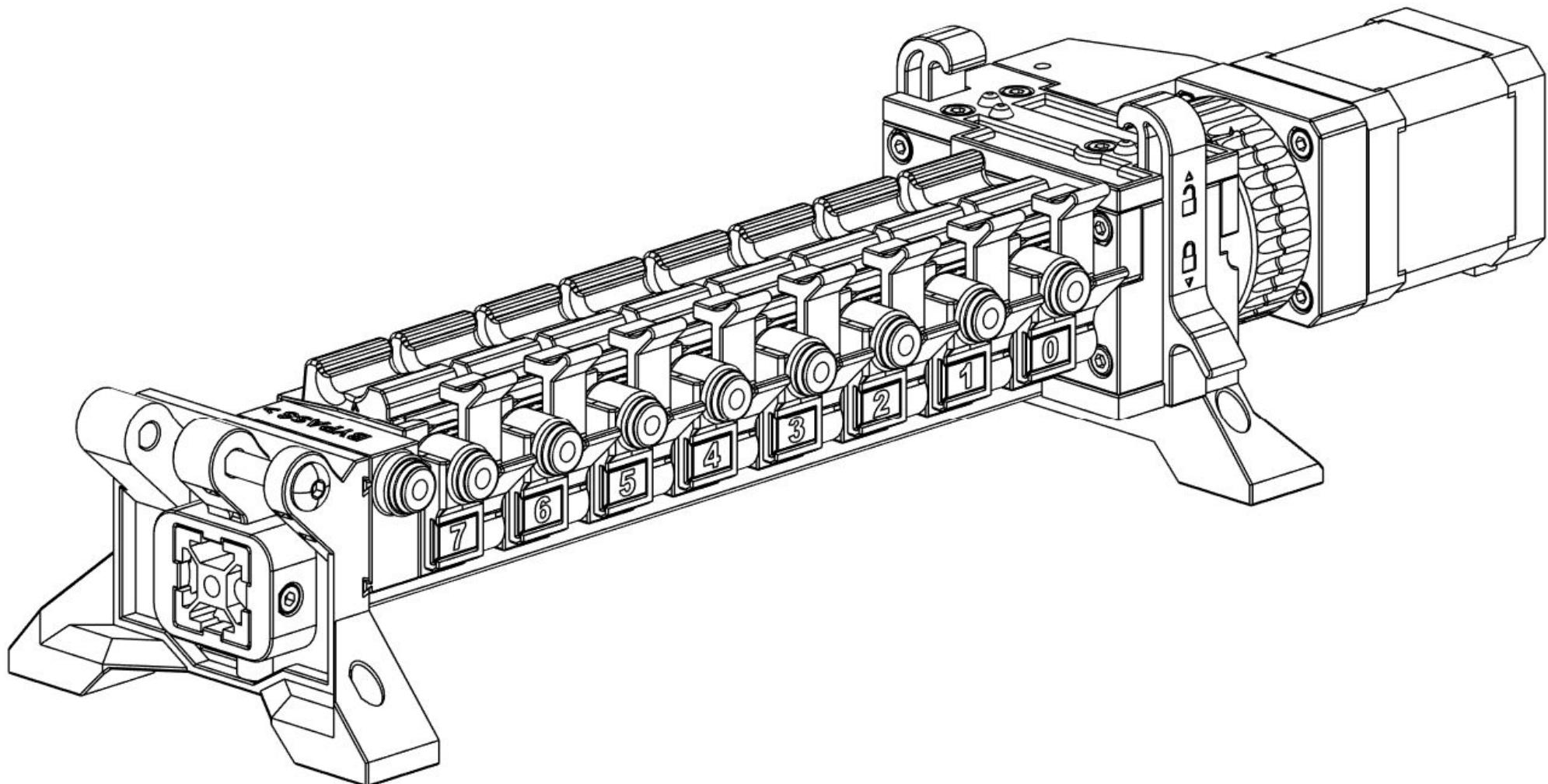
Support structures benefit from multi-material printing. In multi-material setups, one material can be used for the object itself and another for supports, such as water-soluble PVA, which can be dissolved away after printing, leaving cleaner results.

Another option is to use materials that do not bond together as supports, such as PLA supports with PETG objects.

END BLOCK

OVERVIEW





END BLOCK

EXPLODED VIEW

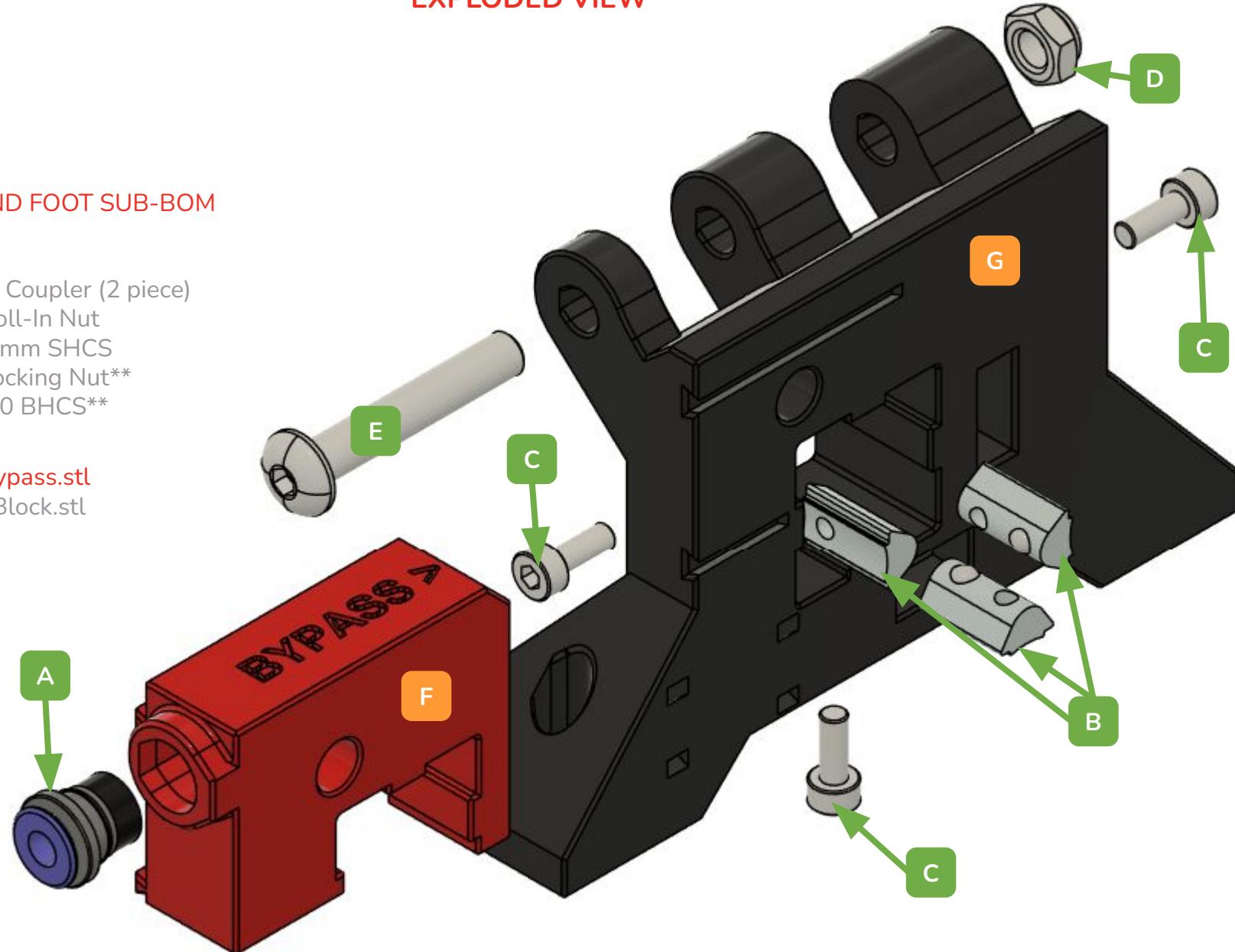
END BLOCK AND FOOT SUB-BOM

A
B
C
D
E

1x ECAS Coupler (2 piece)
3x M3 Roll-In Nut
3x M3x8mm SHCS
1x M5 Locking Nut**
1x M5x30 BHCS**

F
G

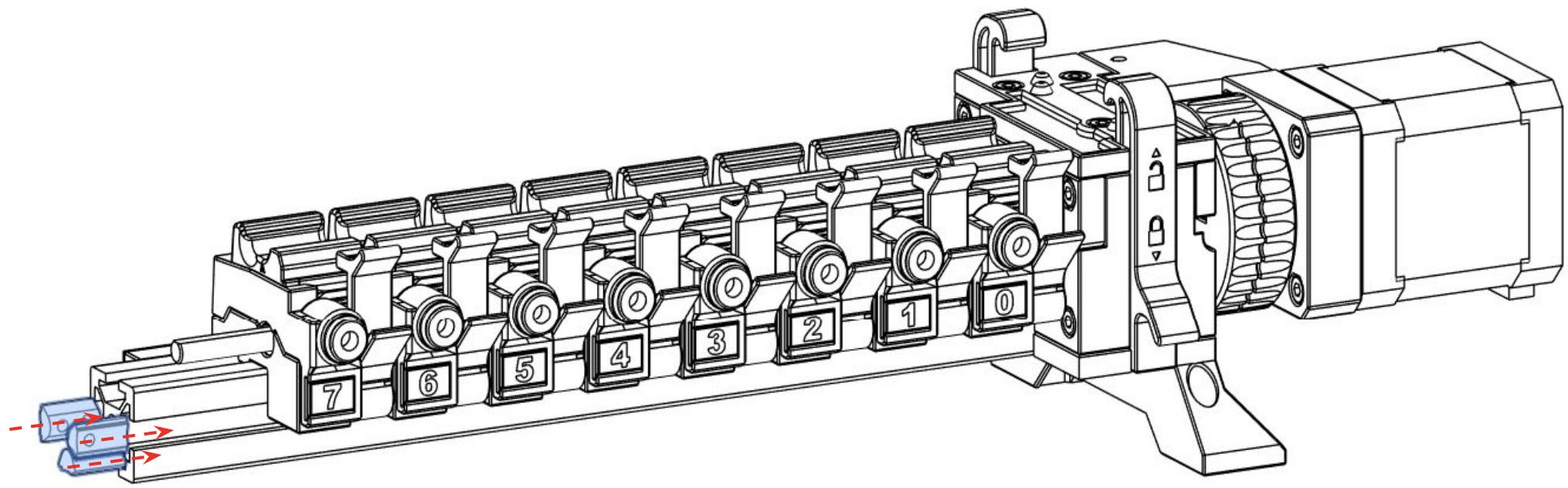
1x [a]_Bypass.stl
1x End_Block.stl



**M5 screw and nut shown for completeness, but not used until Final Assembly.

END BLOCK

PREP END BLOCK



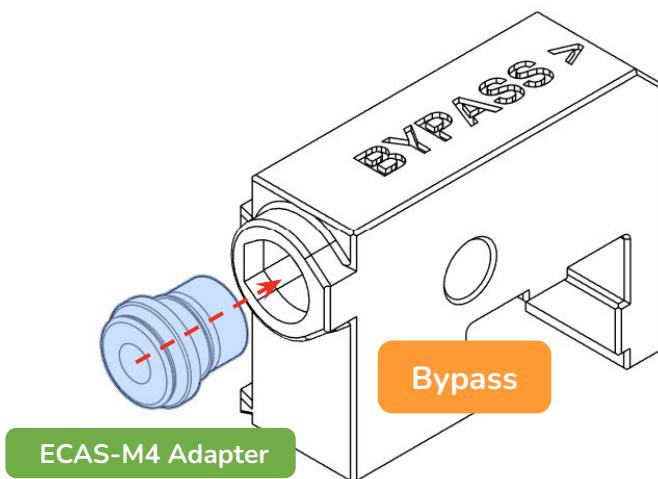
M3 T Nuts

PREP END BLOCK

Insert two M3 T Nuts into the side channels of the 2020 extrusion as shown, with the mounting hole toward the end of the 2020.

Insert the bottom M3 T Nut in the opposite orientation, with the mounting hole toward the Filament Blocks.

END BLOCK



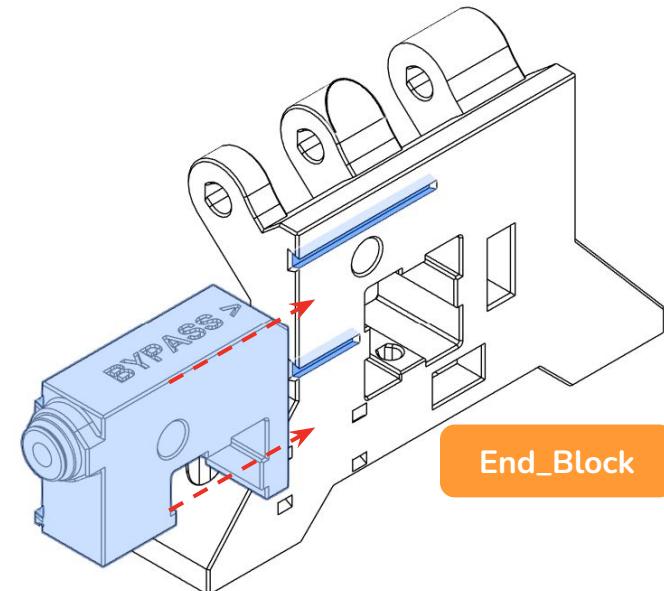
INSTALL END BLOCK

5.2 PREP BYPASS

Insert an ECAS-M4 adapter into the **Bypass**.

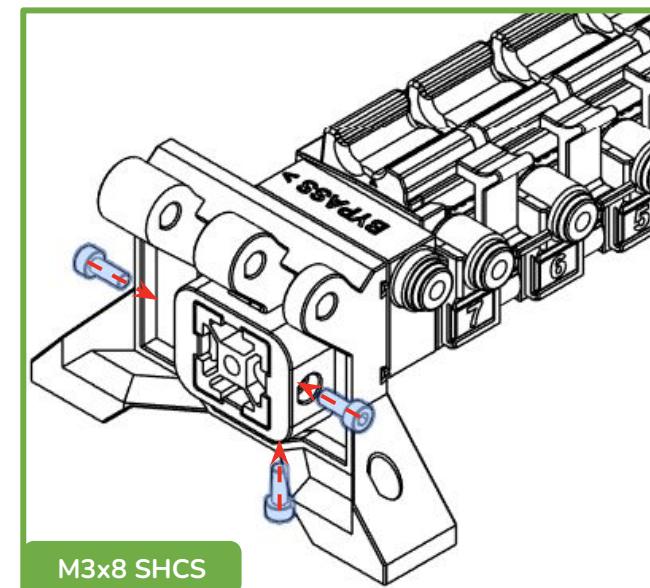
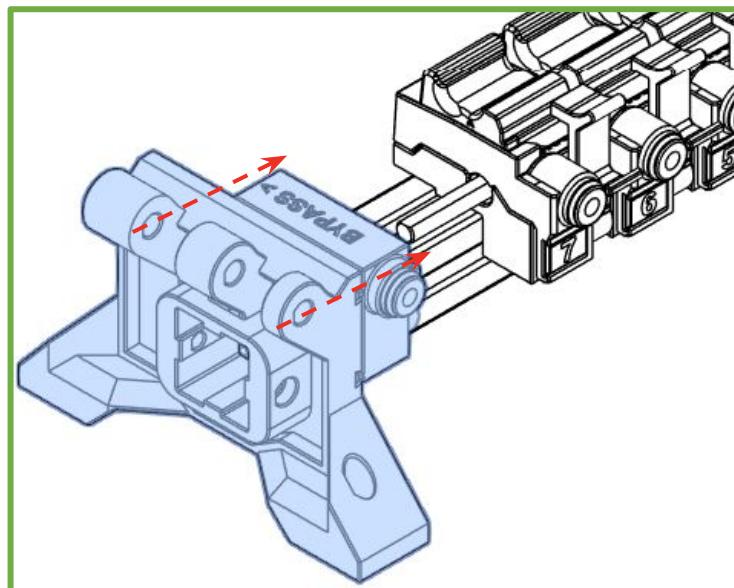
Slide the **Bypass** dovetails into the **End_Block** slots.

The **Bypass** dovetails are very sensitive to your printer's tuning, particularly the extrusion multiplier, and the layer cooling time / fan settings. If you are having trouble printing this part, start there.



INSTALL END BLOCK

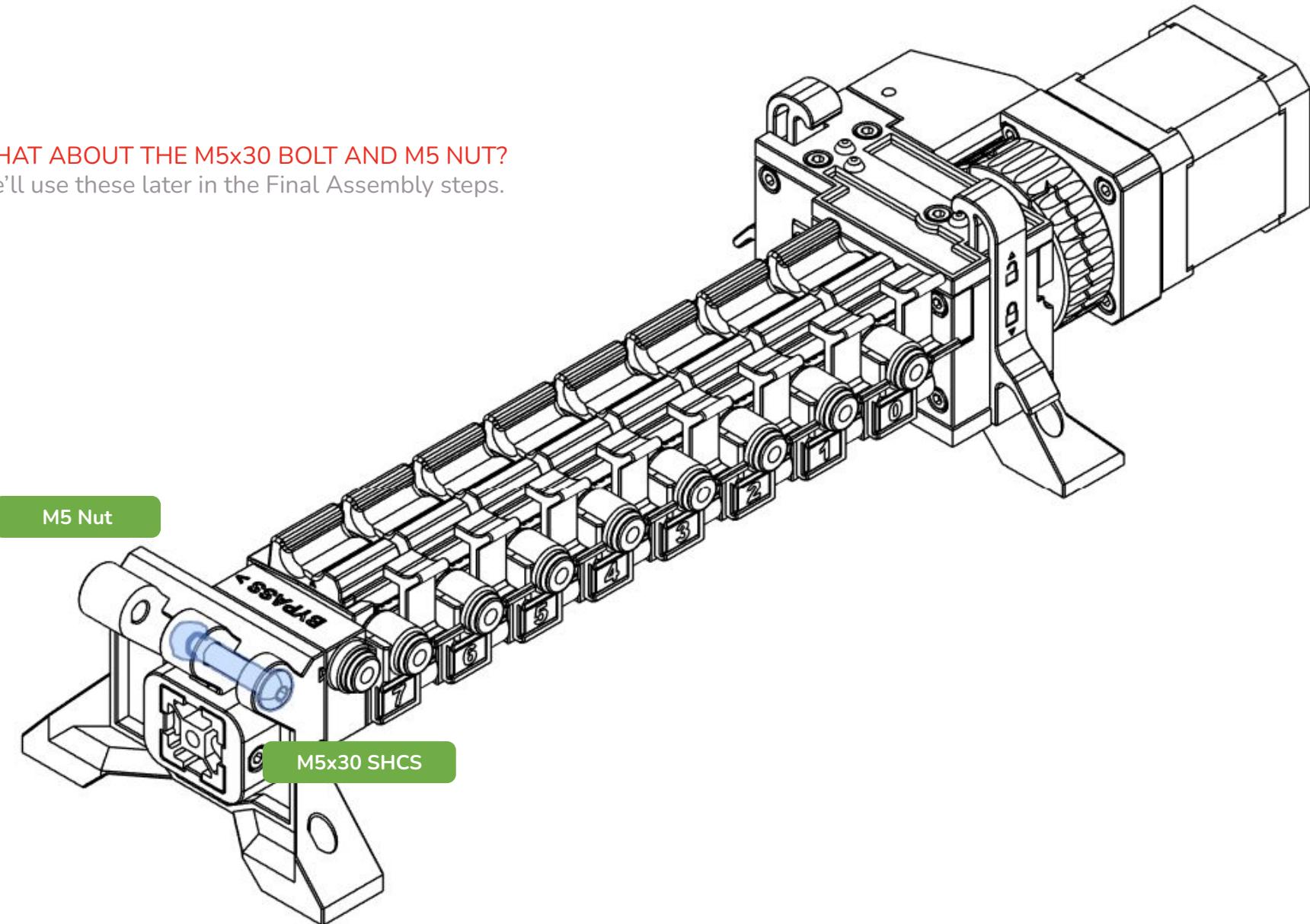
Slide the **End_Block** assembly onto the 2020 and secure with 3 M3x8 SHCS screws.



END BLOCK

END BLOCK M5 HARDWARE

WHAT ABOUT THE M5x30 BOLT AND M5 NUT?
We'll use these later in the Final Assembly steps.



Different material properties can improve functionality in a single print. Combining rigid and flexible materials, for instance, allows for integrated hinges, gaskets, or soft-touch surfaces, reducing the need for assembly in complex mechanical parts.

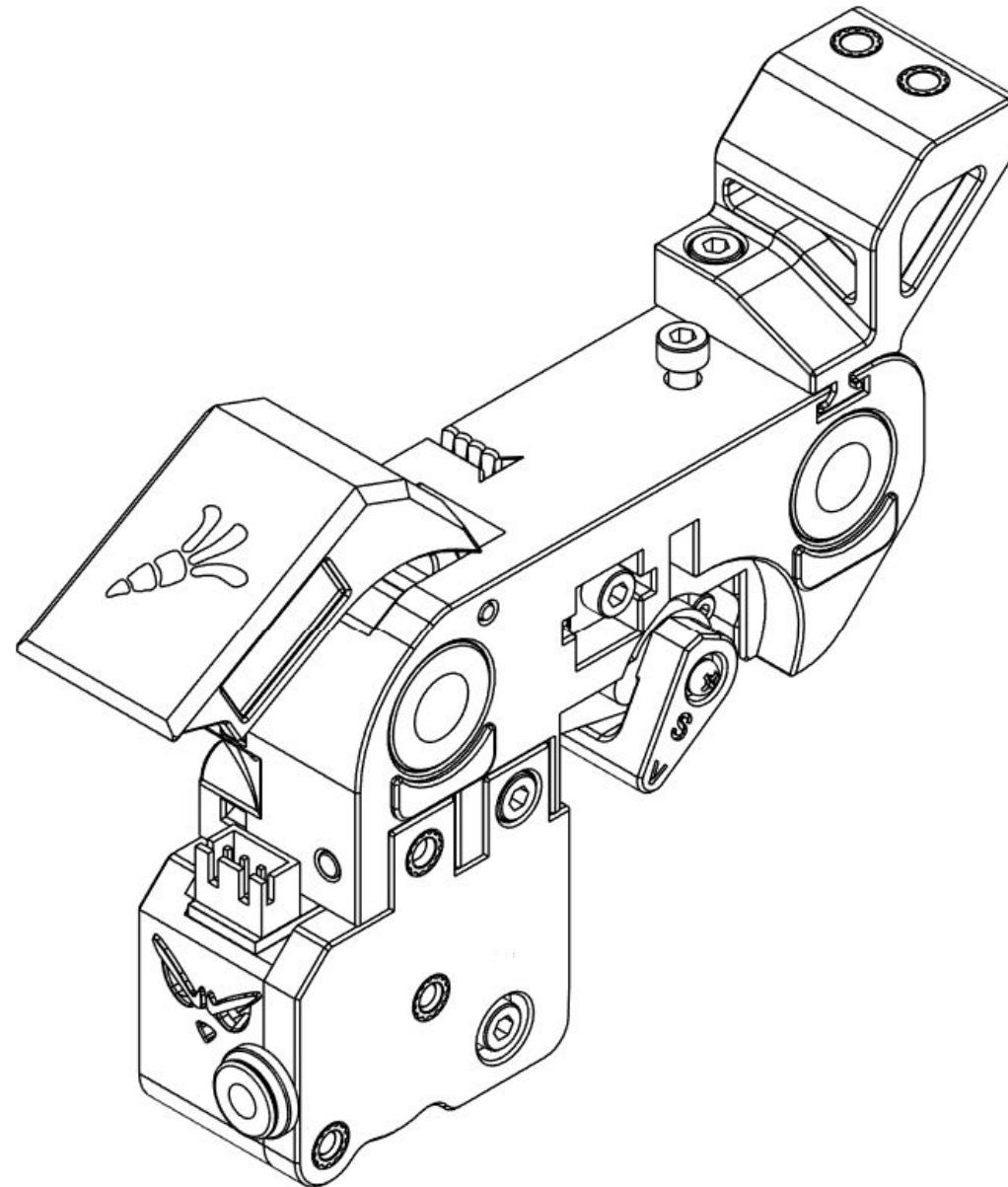
SELECTOR

OVERVIEW



SELECTOR

OVERVIEW



SELECTOR

EXPLODED VIEW

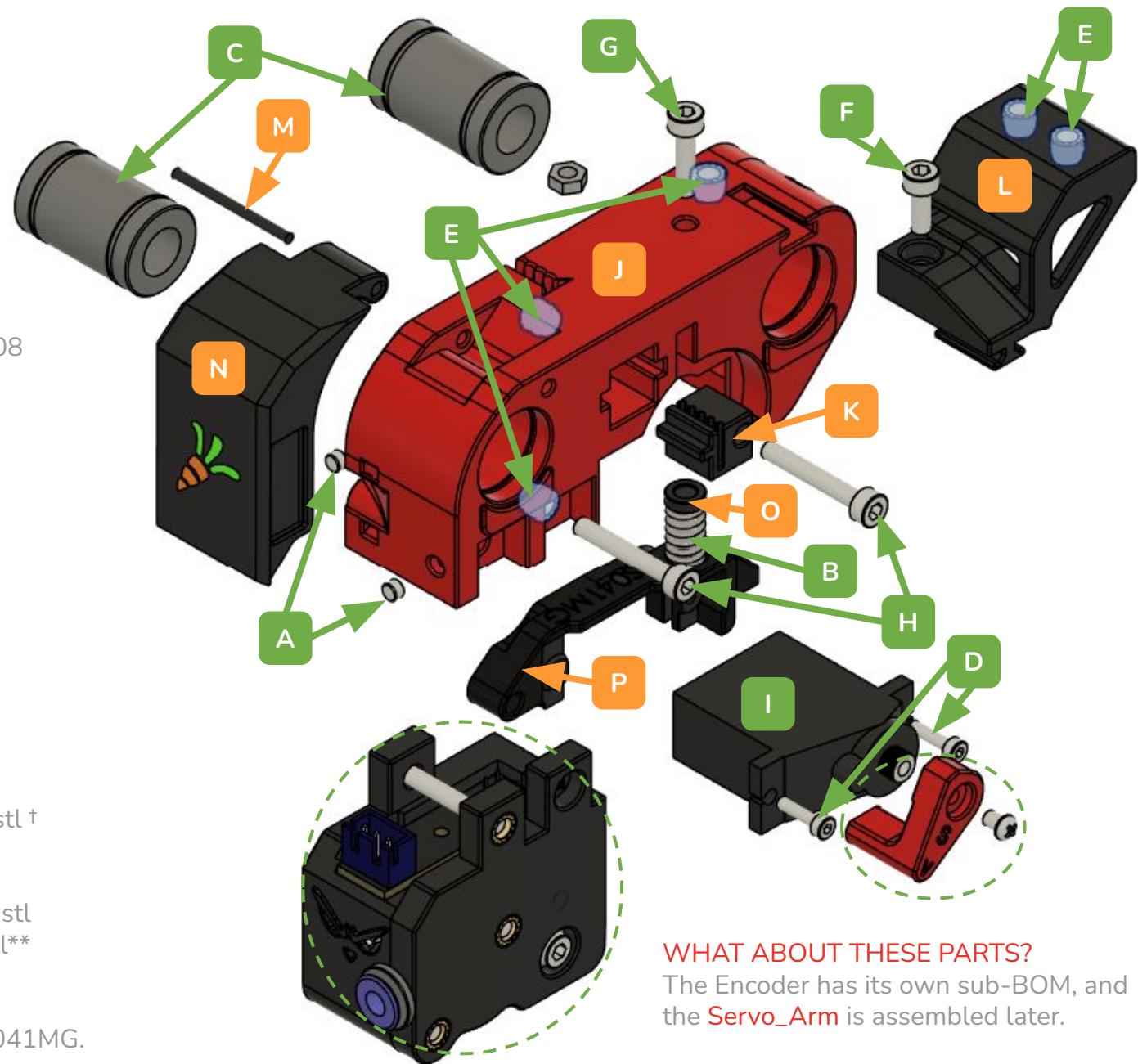
SELECTOR SUB-BOM

A
B
C
D
E
F
G
H
I

- 2x 3x2mm Magnet
- 1x 6x12x1mm Spring
- 2x LM8UU or RJ4JP-01-08
- 2x M2x8mm SHCS
- 6x M3 Threaded Inserts
- 1x M3x8mm SHCS
- 1x M3x12mm SHCS
- 3x M3x20mm SHCS
- 1x Servo**

J
K
L
M
N
O
P

- 1x [a]_Selector_Cart.stl
- 1x Belt_Tensioner.stl †
- 1x Drag_Chain_Anchor.stl †
- 1x Piece of Filament
- 1x Selector_Door.stl
- 1x Selector_Spring_Cap.stl
- 1x Servo_Mount_XXX.stl**



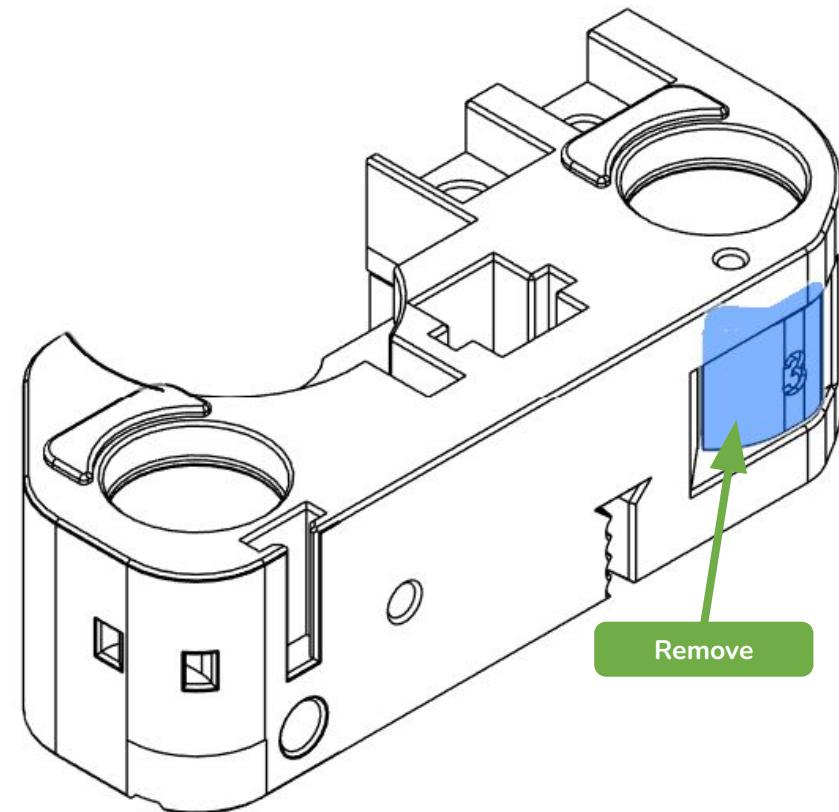
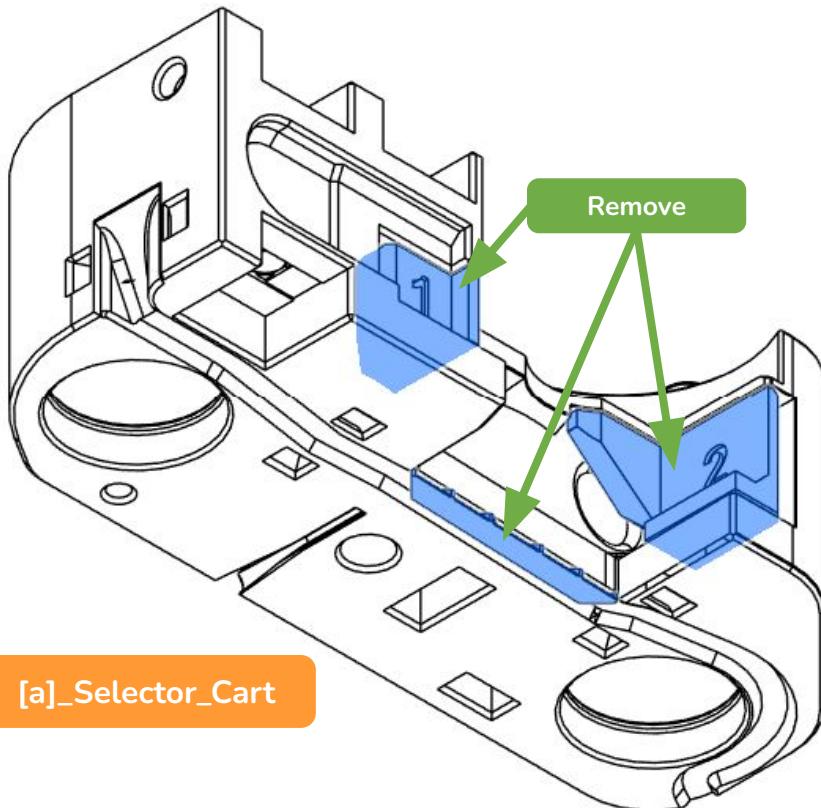
**MG90S, Savox, or DS041MG.

WHAT ABOUT THESE PARTS?

The Encoder has its own sub-BOM, and the Servo_Arm is assembled later.

SELECTOR

SELECTOR CART PREPARATION



6.1 REMOVE BUILT-IN SUPPORTS

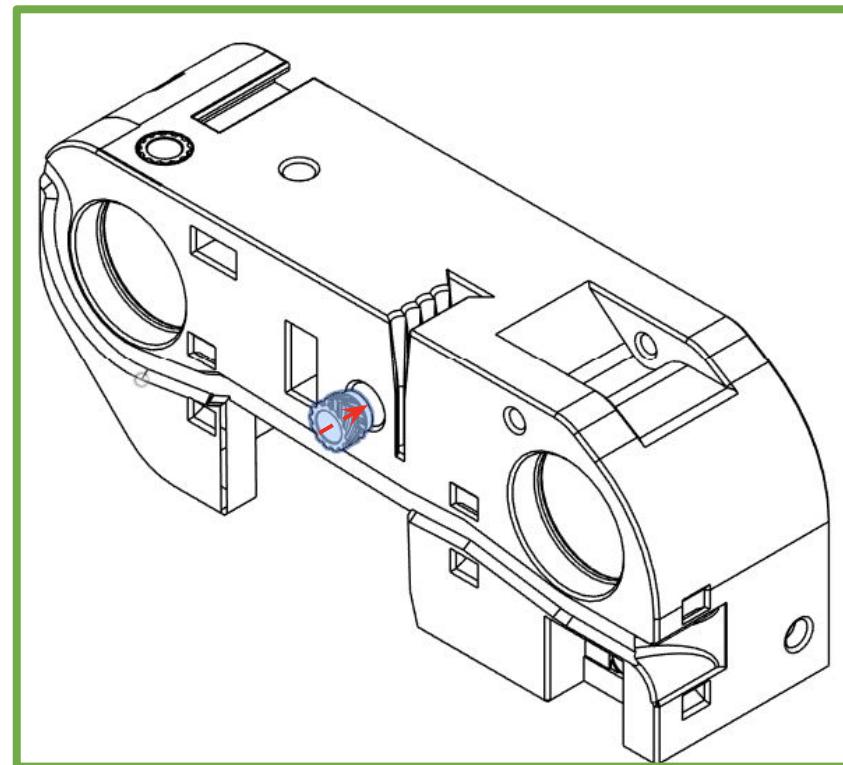
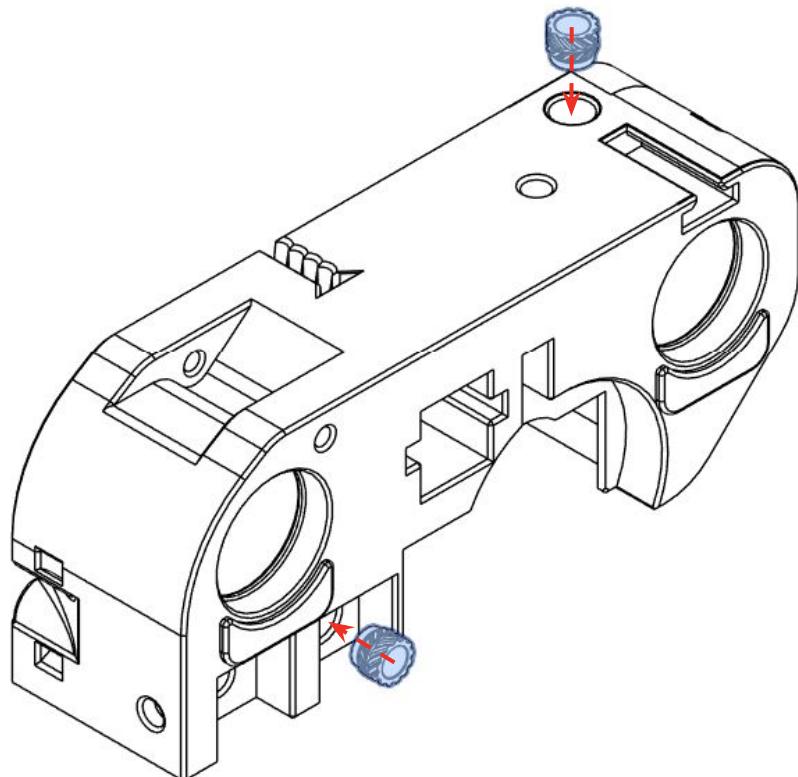
Use a small tool, like a small flat screwdriver, to carefully remove the built-in supports.

SELECTOR

SELECTOR CART heatset INSERTS

6.1 HEATSET INSERTS

The list of pages with heatset inserts is on [Page 15](#).

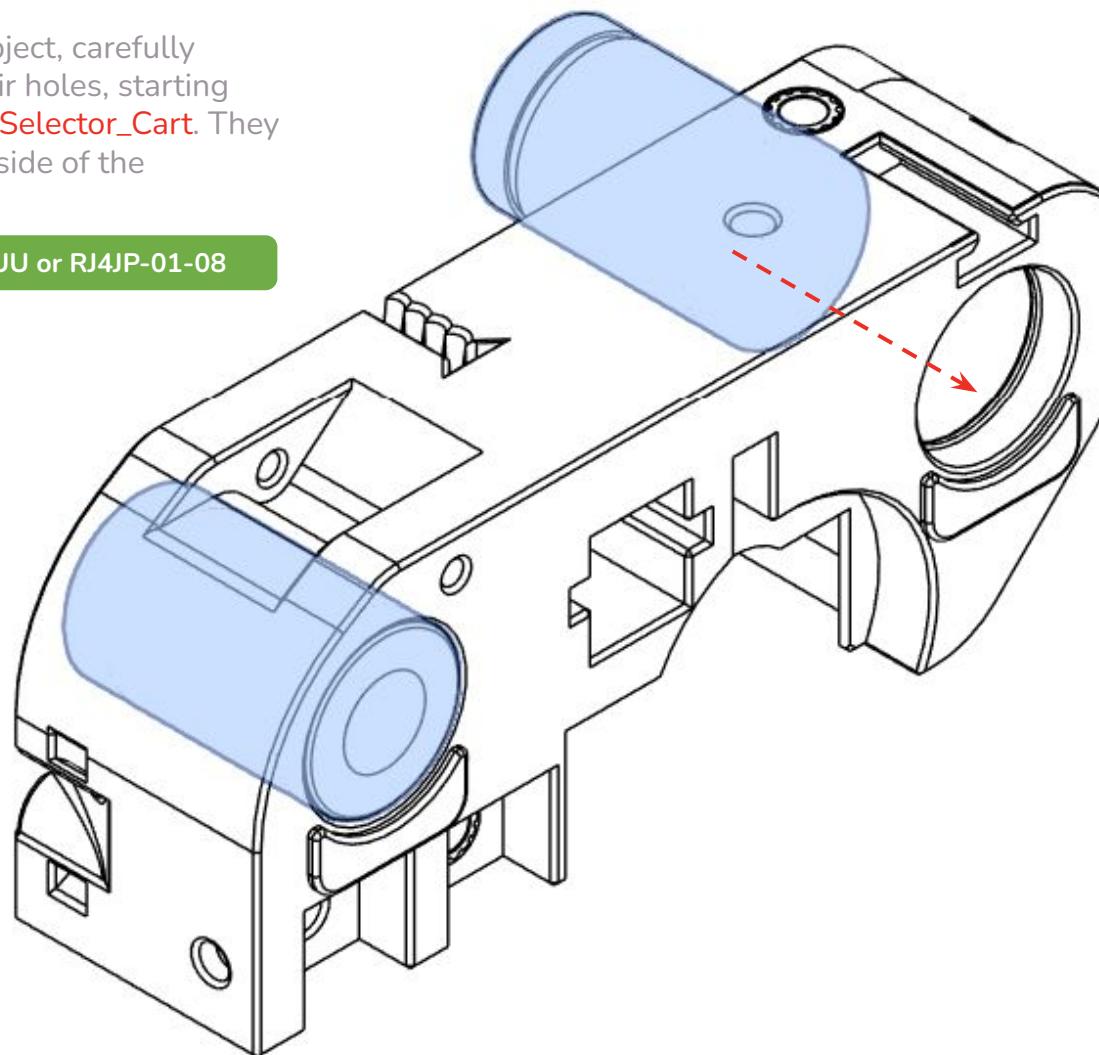


M3 Heatset Inserts

6.1 BEARING INSERTION

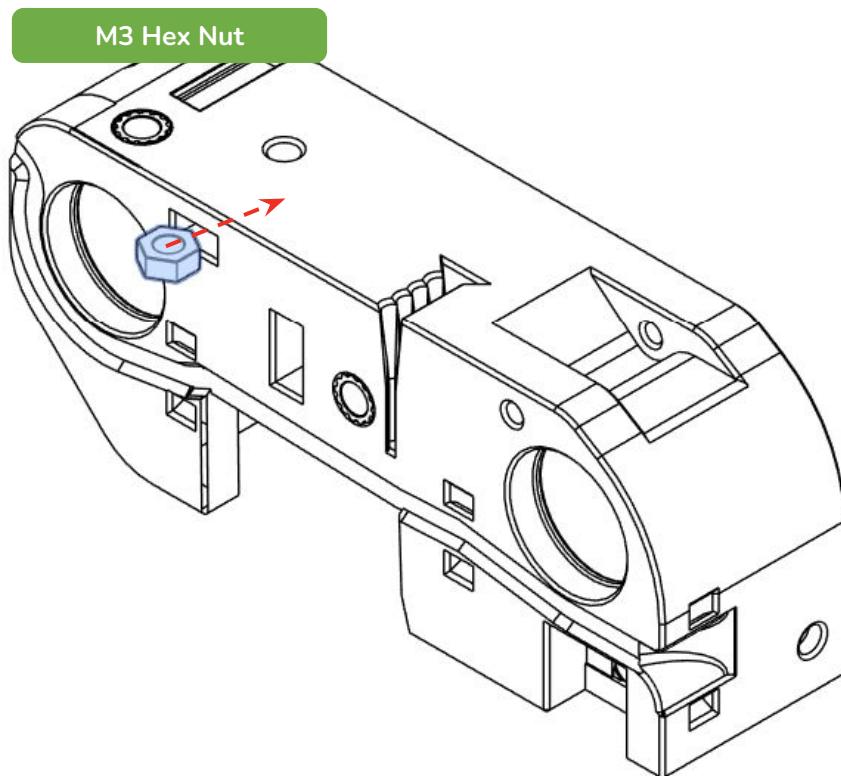
Using a soft jaw vice or flat object, carefully press-fit the bearings into their holes, starting from the print bed side of the [Selector_Cart](#). They should be flush with the that side of the [Selector_Cart](#).

LM8UU or RJ4JP-01-08



SELECTOR

SELECTOR CART HEX NUT



6.1 HEX NUT INSERTION

Using a pair of pliers, insert the hex nut point-first. Once the nut is partially inserted, switch to an Allen wrench or small flathead screwdriver to fully insert the nut.

SELECTOR

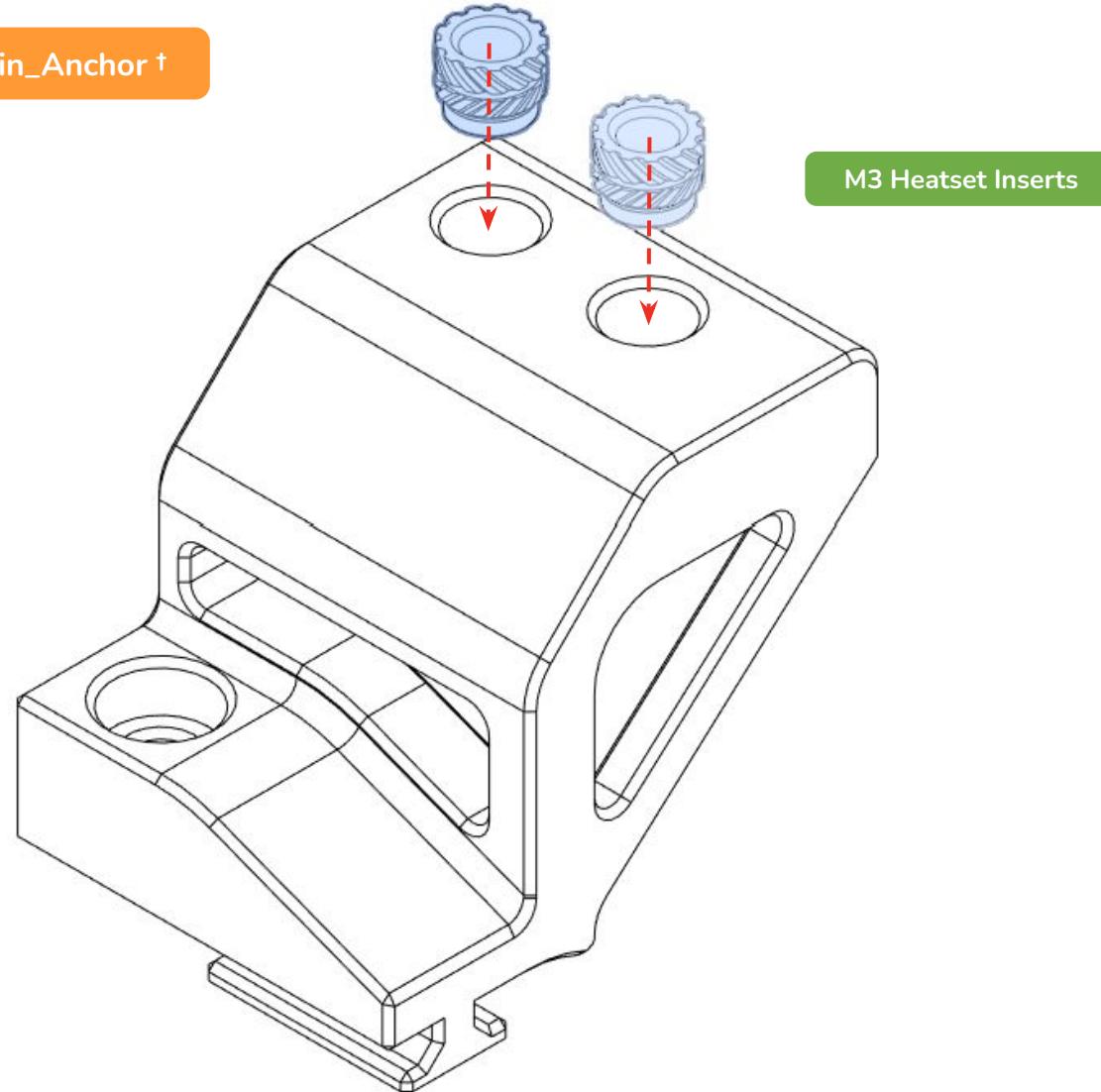
DRAG CHAIN ANCHOR heatset INSERTS

6.2 HEATSET INSERTS

The list of pages with heatset inserts is on [Page 15](#).

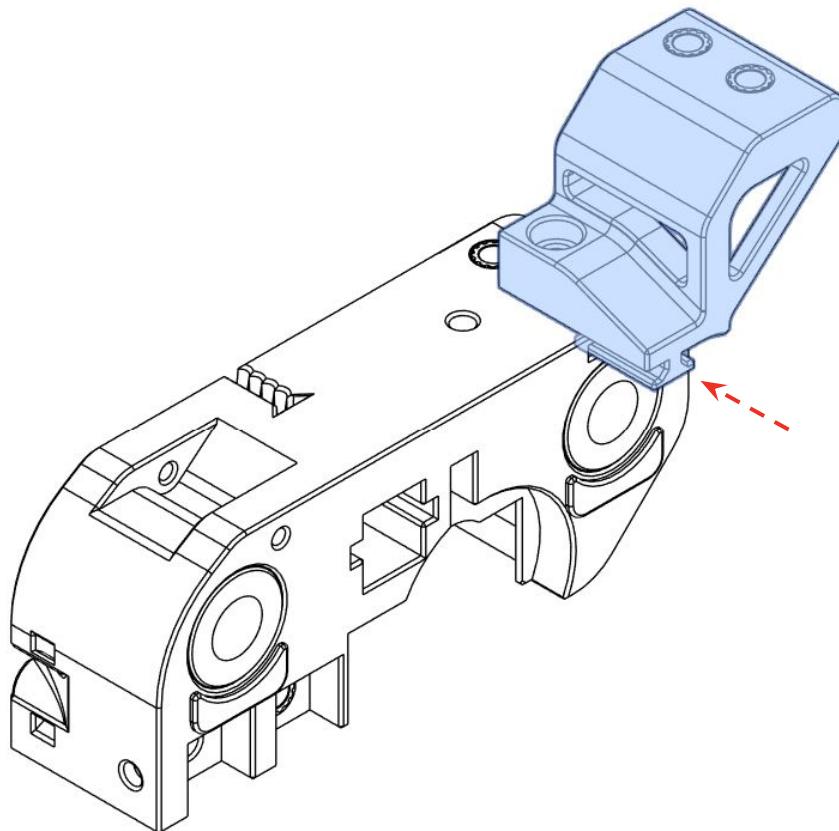
Drag_Chain_Anchor †

M3 Heatset Inserts

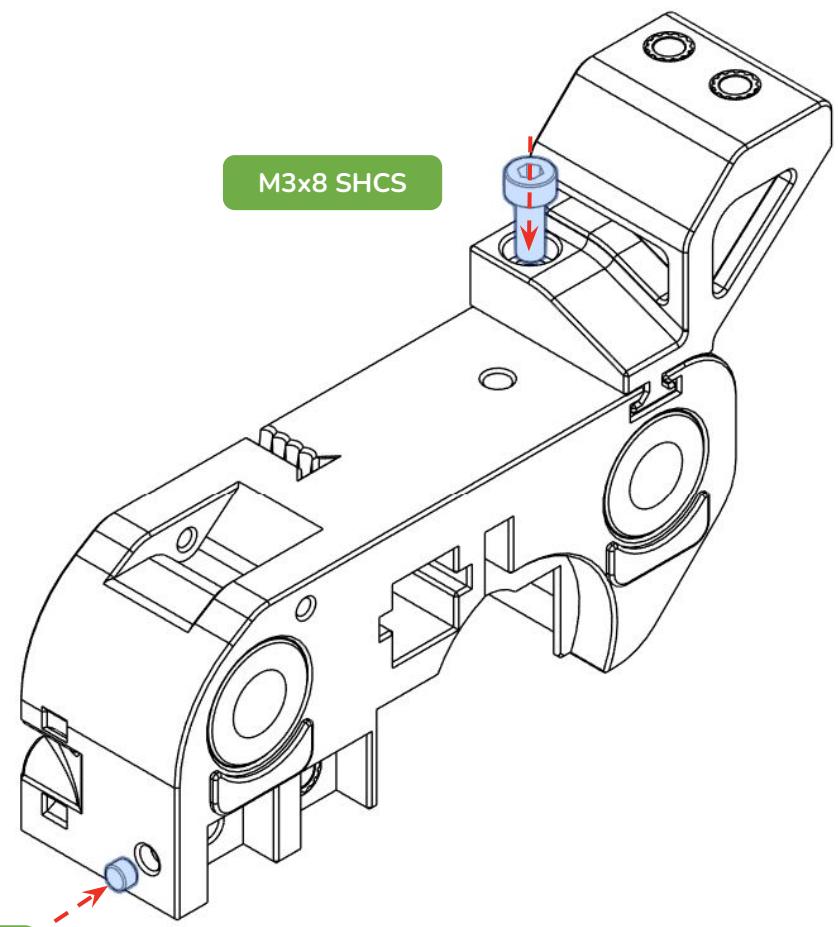


SELECTOR

DRAG CHAIN ANCHOR



Drag_Chain_Anchor †



6.2 DRAG CHAIN AND MAGNET

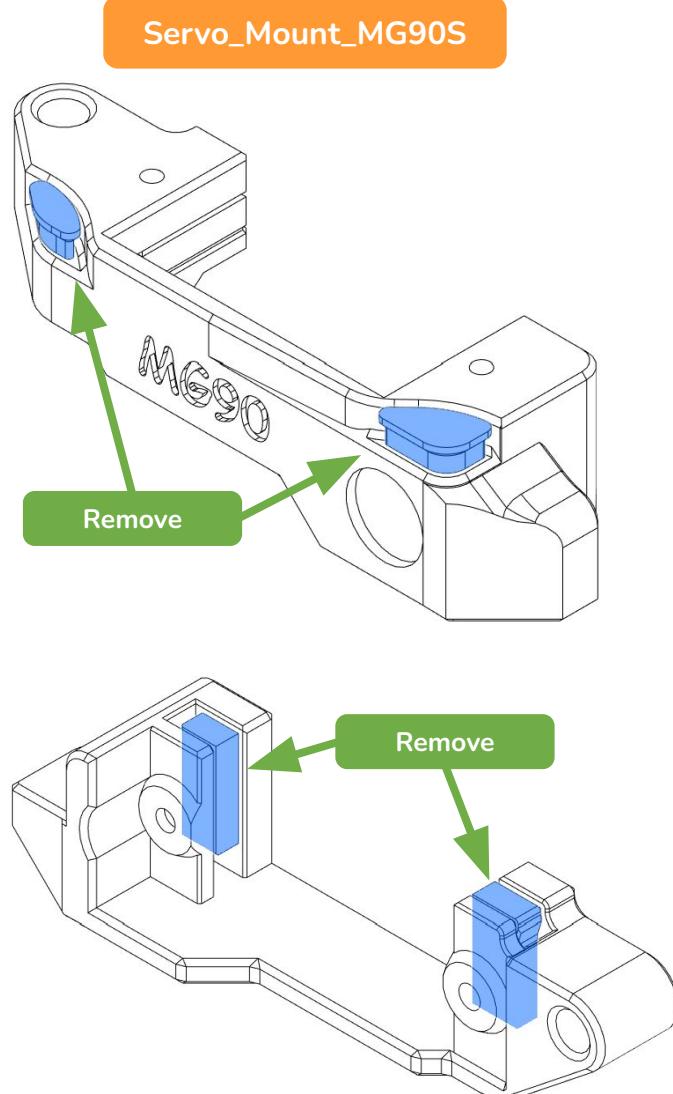
Slide the **Drag_Chain_Anchor †** into the dovetail groove on the **Selector_Cart** and install with an **M3x8 SHCS** screw.

Add a drop of CA glue and Insert the **3x2mm magnet** into its slot.

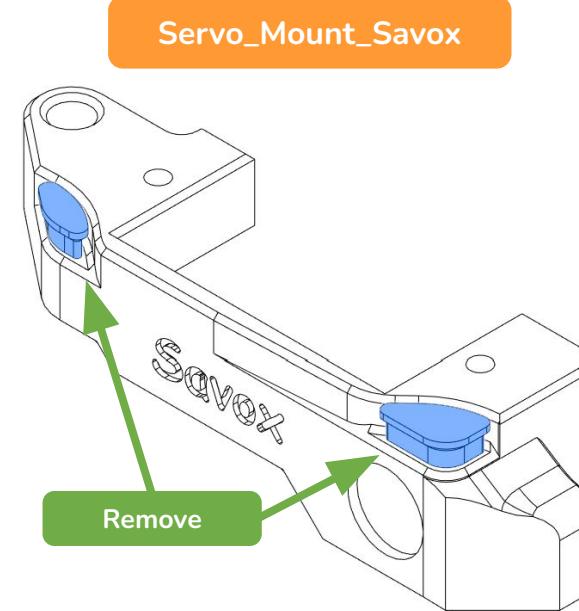
3x2mm Magnet

SELECTOR

SERVO MOUNT PREPARATION



Servo_Mount_MG90S



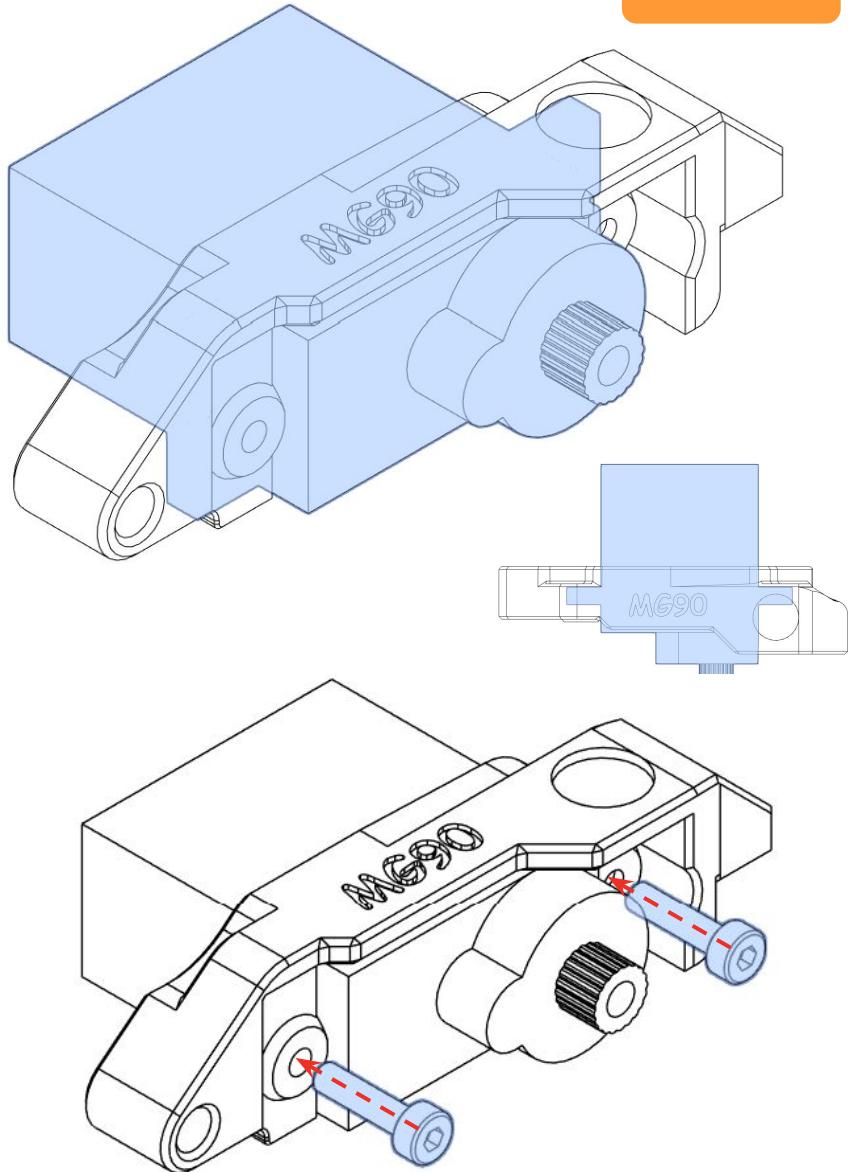
Servo_Mount_Savox

6.3 SERVO MOUNT PRINT IN PLACE SUPPORTS

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

The Towerpro MG90S and DS410MG versions have 4 supports. If the inner supports don't break out cleanly, you may need to clean up the slot with a file or hobby knife to get a good fit.

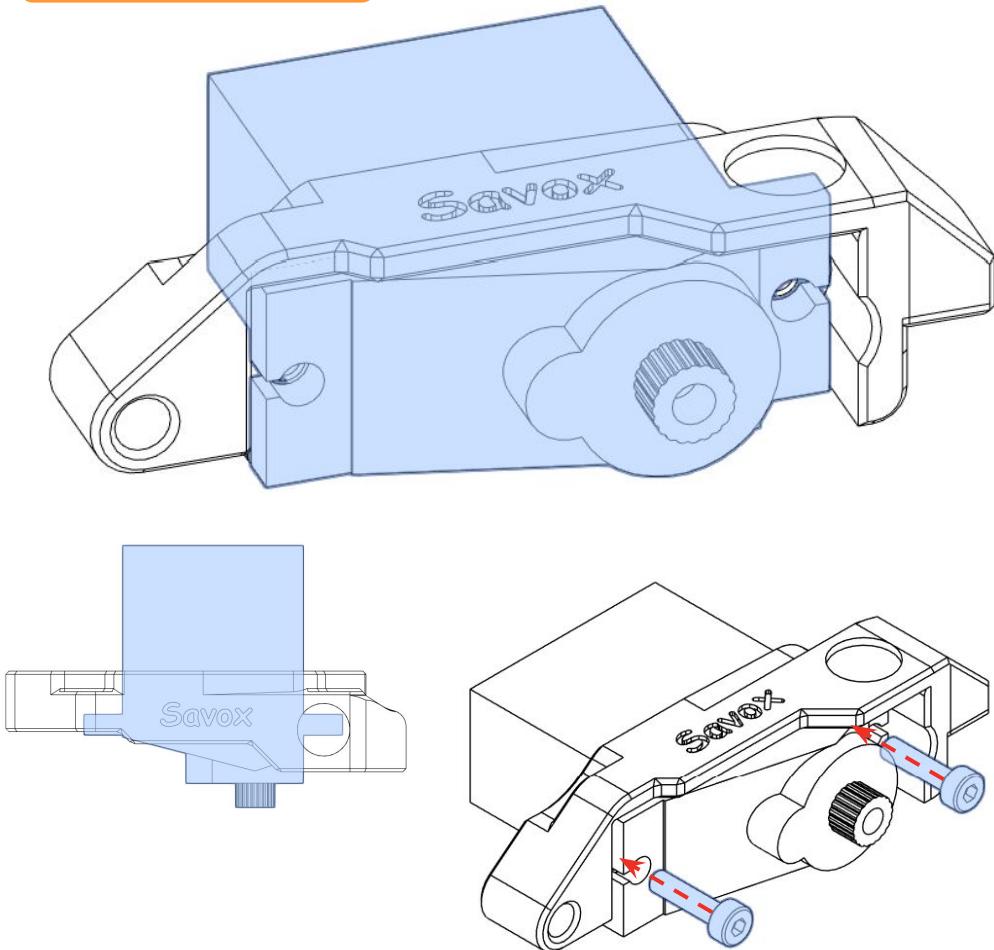
SELECTOR



SERVO MOUNTING

MG90S

Savox SH0255MGP



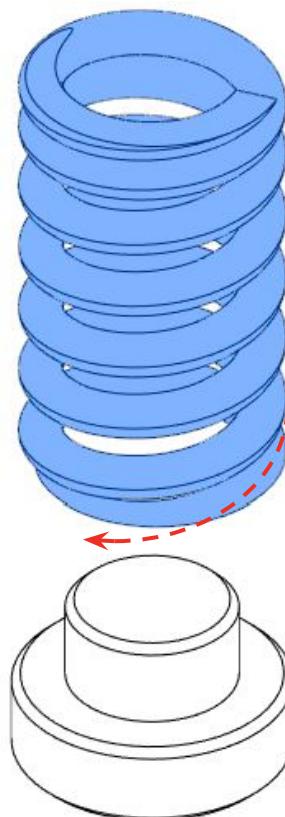
6.3 SERVO SCREWS

Use M2x8mm SHCS to attach the servo to its mount.

SELECTOR

SPRING INSTALL

12x6mm 1mm OD
Compression Spring



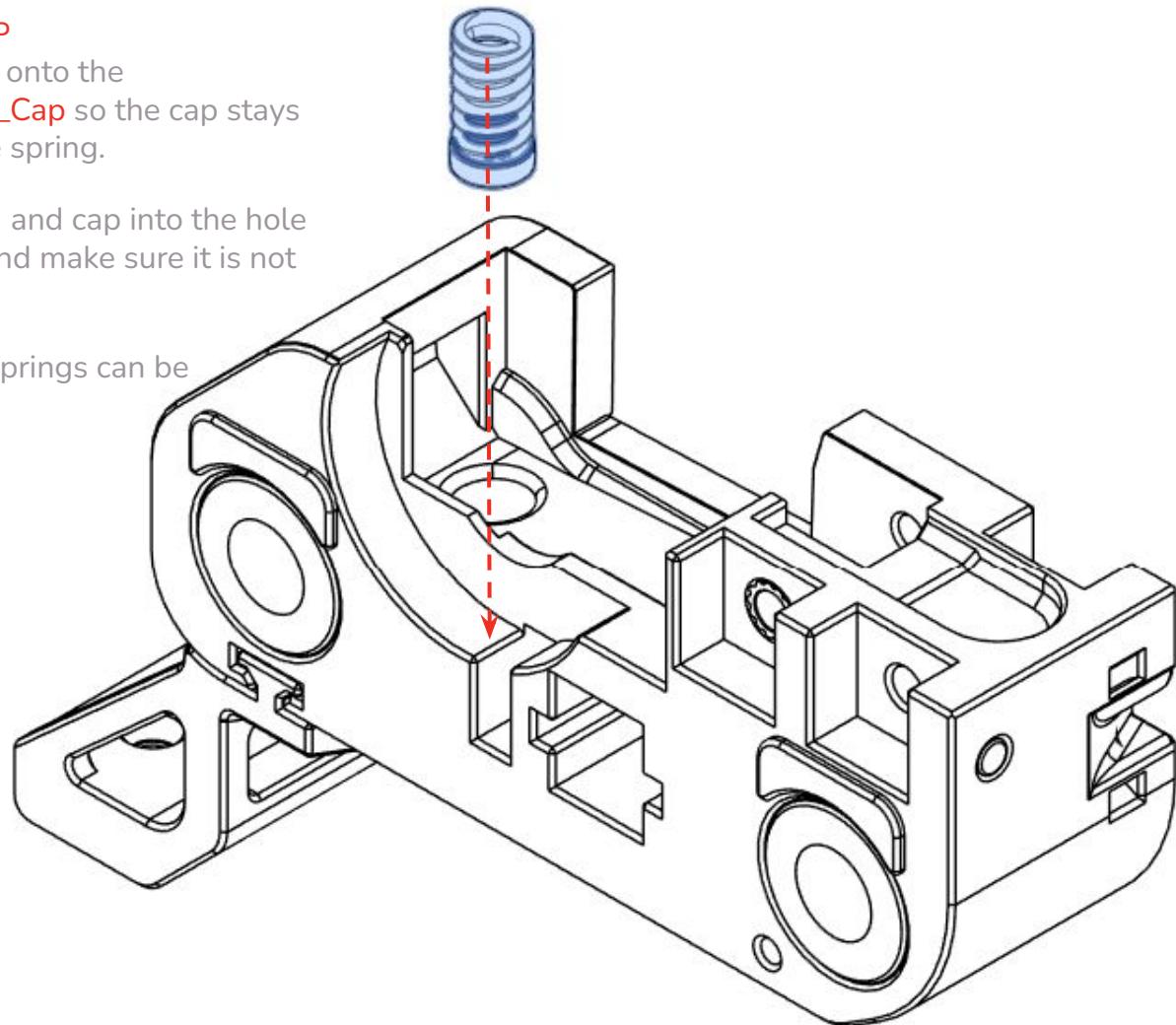
Selector_Spring_Cap

6.3 SPRING CAP

Twist the spring onto the [Selector_Spring_Cap](#) so the cap stays inserted into the spring.

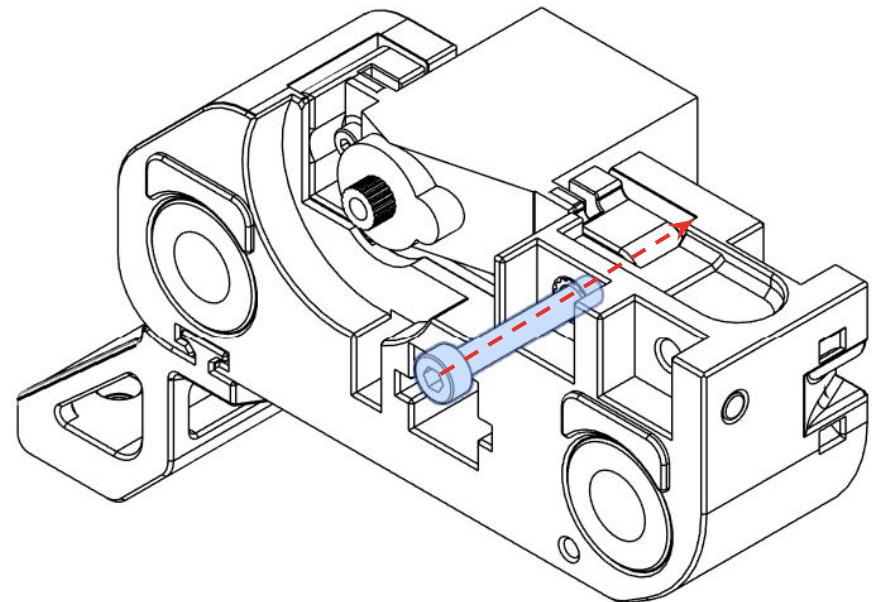
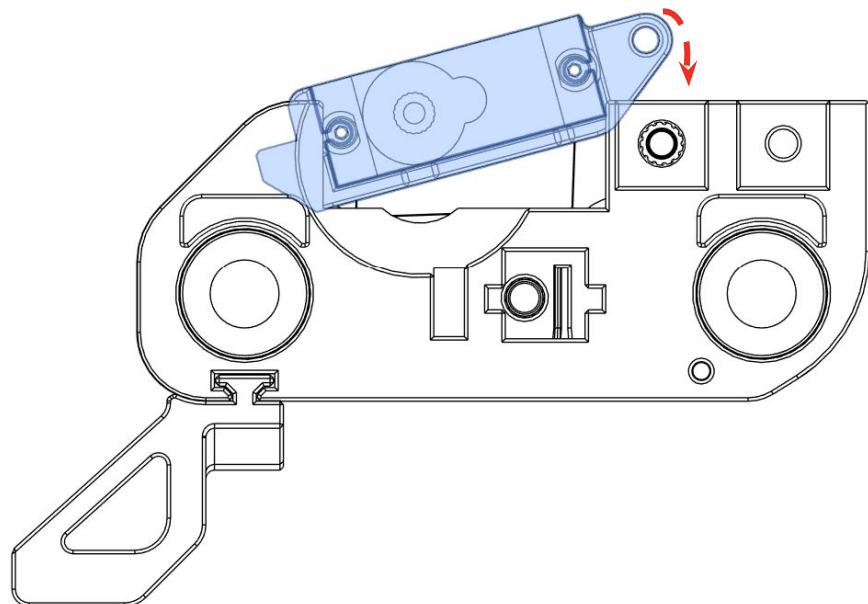
Insert the spring and cap into the hole in the selector and make sure it is not obstructed.

Shorter 10mm springs can be used as well.



SELECTOR

SERVO INSTALLATION



M3x20 SHCS

6.3 SERVO INSTALLATION

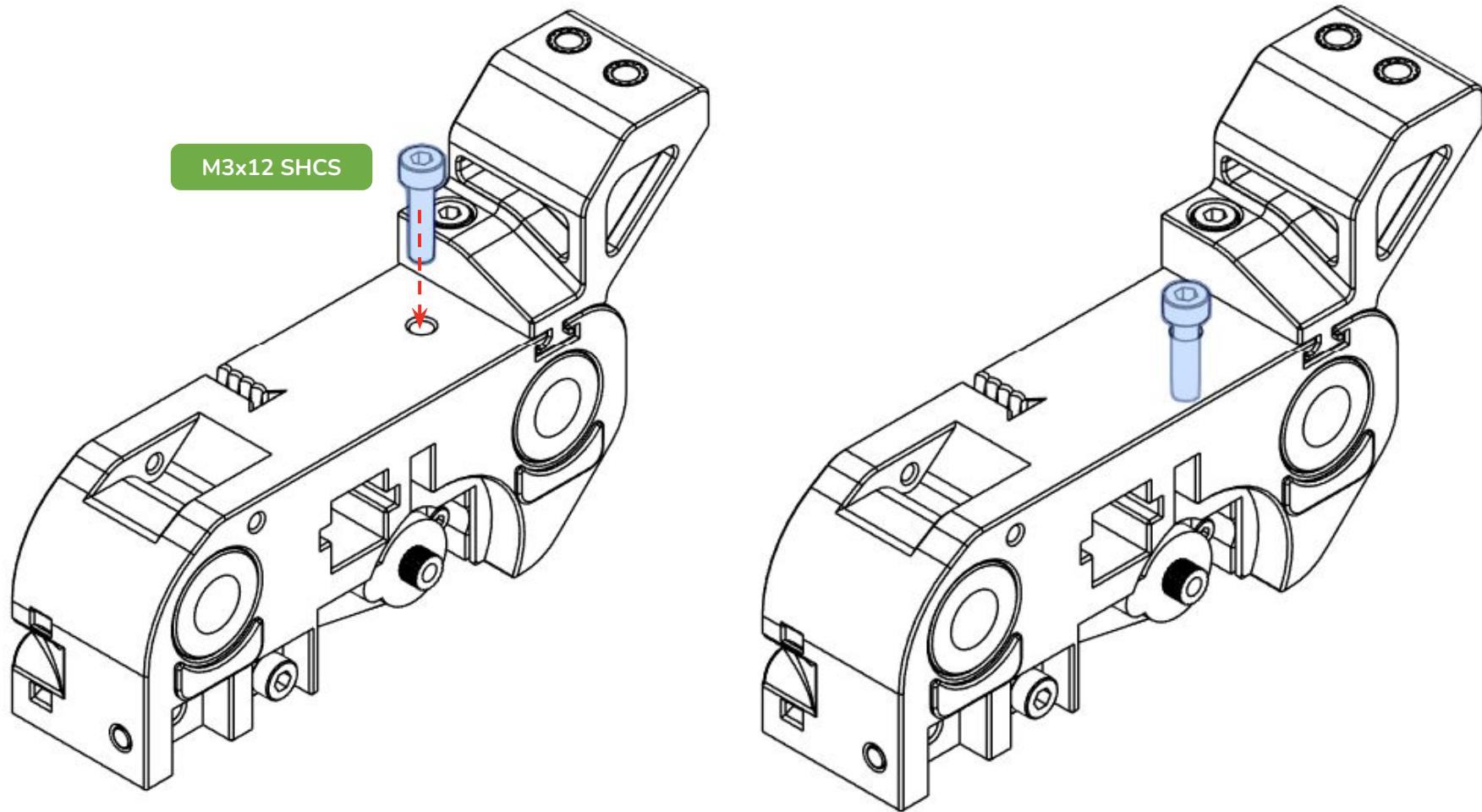
Angle the **Servo_Mount**, insert it into the captive channel in the **Selector_Cart** and press down into the pivot point. The spring should push against the **Servo_Mount** preventing it from fully seating.

Push the **Servo_Mount** into place and temporarily secure it with an M3x20 screw used for mounting the encoder.

SAVOX SH-0255MGP servo option shown, installation is identical for the Towerpro MG90S servo and DS041MG..

SELECTOR

TENSION SCREW INSTALLATION

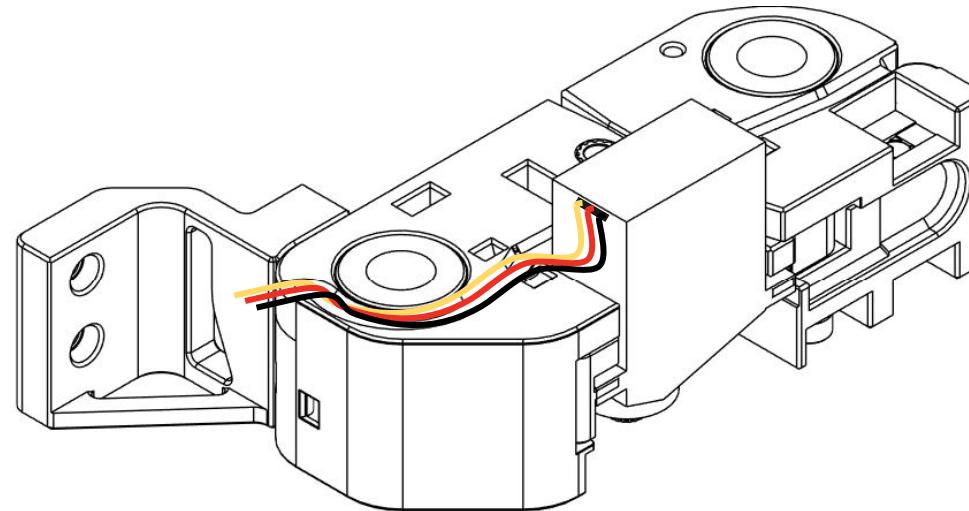


6.1 SPRING TENSION SCREW INSTALLATION

Install the servo spring tension screw. Only tighten until it touches the [Selector_Spring_Cap](#) - we will adjust and tension it later.

SELECTOR

SERVO WIRES

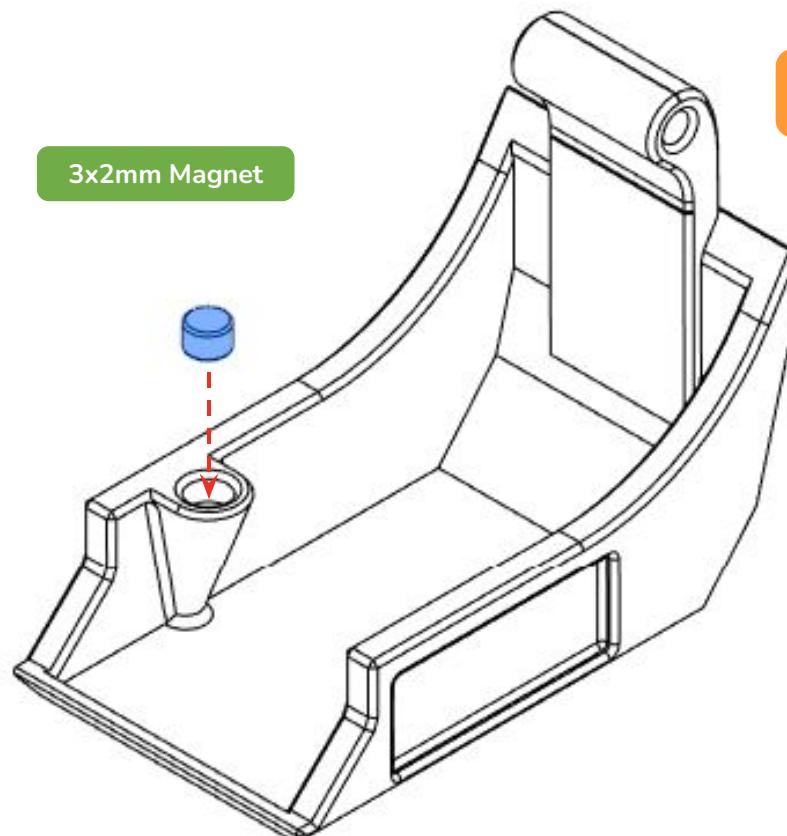


SERVO WIRES

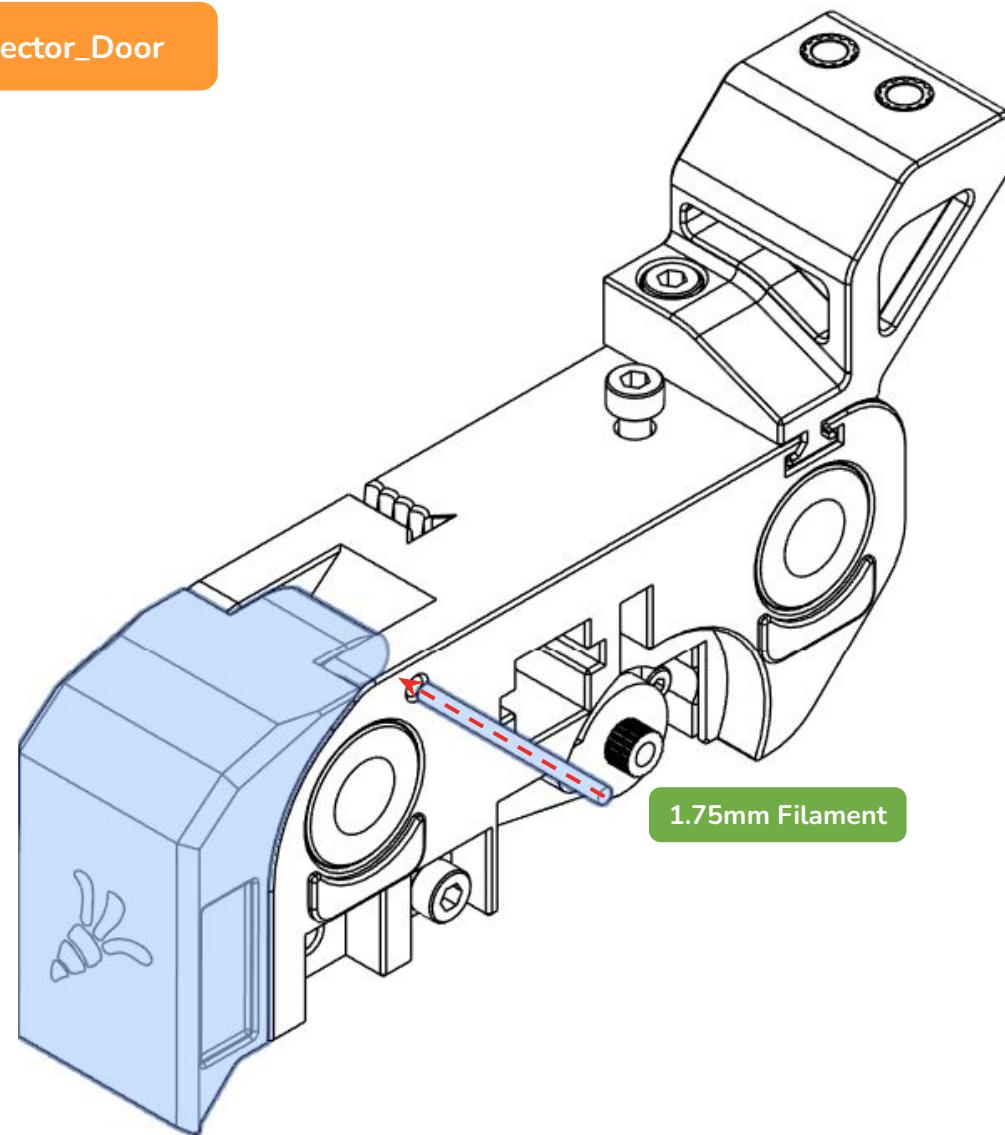
Route the servo wires as shown. Don't cable tie the wires yet unless you're willing to redo it soon to add wires.

SELECTOR

DOOR INSTALLATION



Selector_Door



6.4 DOOR INSTALLATION

Add a drop of CA glue and install the 3x2mm magnet into the door recess so that the Selector magnet attracts the door magnet as a magnetic latch.

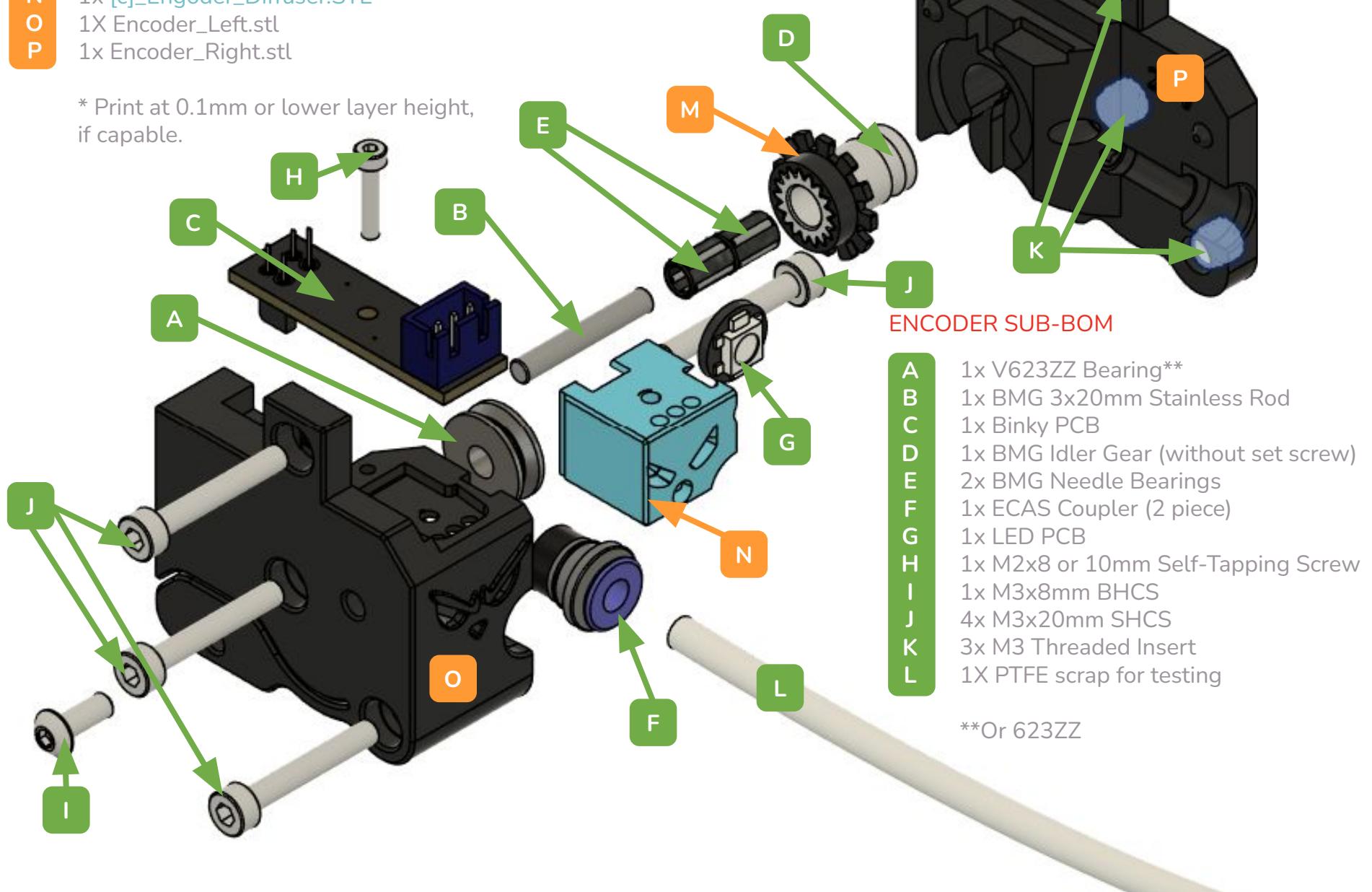
Attach the [Selector_Door](#) to the [Selector_Cart](#) using a piece of 1.75mm Accent filament & trim to length.

SELECTOR : ENCODER

M
N
O
P
1x [black]_Encoder_Slotted_Wheel.stl*
1x [c]_Engoder_Diffuser.STL
1X Encoder_Left.stl
1x Encoder_Right.stl

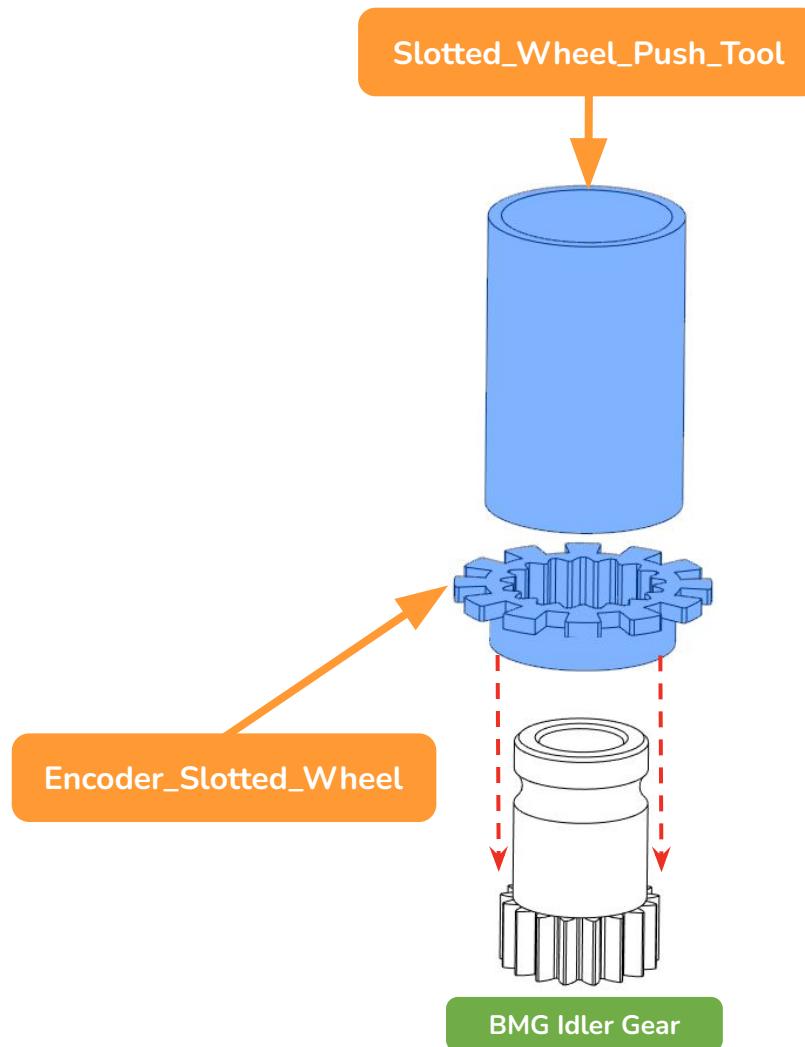
* Print at 0.1mm or lower layer height,
if capable.

ENCODER EXPLODED VIEW



SELECTOR : ENCODER

ENCODER PREPARATION



7.1 INSTALL ENCODER WHEEL

Before fitting the **Encoder_Slotted_Wheel** to the Bondtech gear, make sure the top surface of the wheel and its vanes are smooth and clean. If there are “blobs” from printing, carefully sand or trim them so they are flush.

Place the Bondtech gear as shown in the diagram on a hard surface and slide the **Encoder_Slotted_Wheel** onto the gear until it reaches the teeth.

Use the **Slotted_Wheel_Push_Tool** to **gently** push the **Encoder_Slotted_Wheel** into place until it is flush with the end of the gear using a small hammer.

The **Encoder_Slotted_Wheel** should fit firmly on the Bondtech gear. Make sure its undamaged, isn't cracked and doesn't move easily.

NOTE The **Encoder_Slotted_Wheel** must be printed in black to prevent light shining through the vanes of the wheel to avoid false readings!

SELECTOR : ENCODER

7.3 V623ZZ VS MR623ZZ BEARINGS

There are two versions of the Encoder:

One using the rarer, but better-performing V623ZZ bearing. This is our default, preferred option.

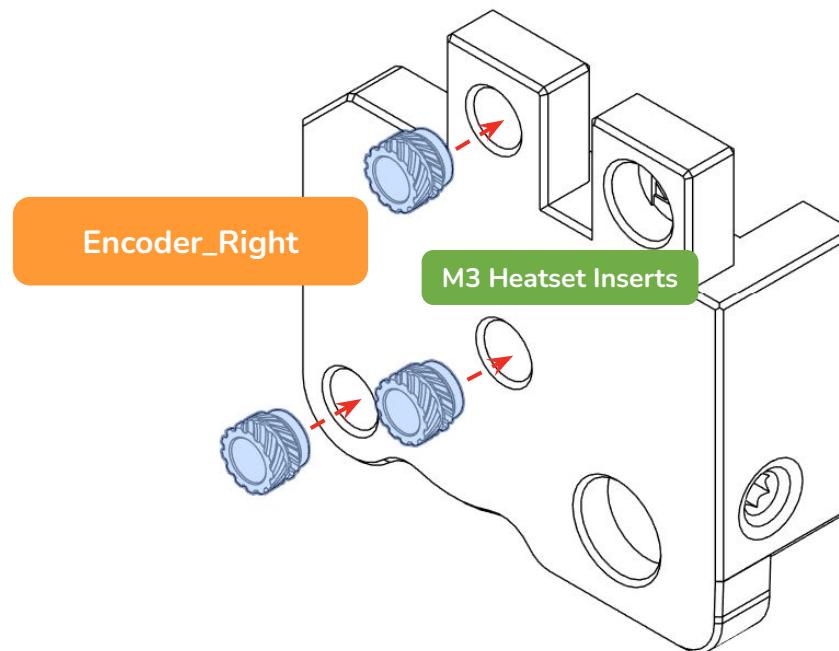
One using the much more easily-sourced 623ZZ flat bearing. These files are in the folder:

[ERCF_v2 / Stls / Selector / Encoder_Flat_Bearing_Option](#)

We will show the V623ZZ version of the Encoder. Installation is virtually identical for the 623ZZ option.

We are also showing the optional LED and diffuser. Versions of both the V623ZZ and 623ZZ encoders are available with the LED and diffuser.

ENCODER PREPARATION



7.2 HEATSET INSERTS

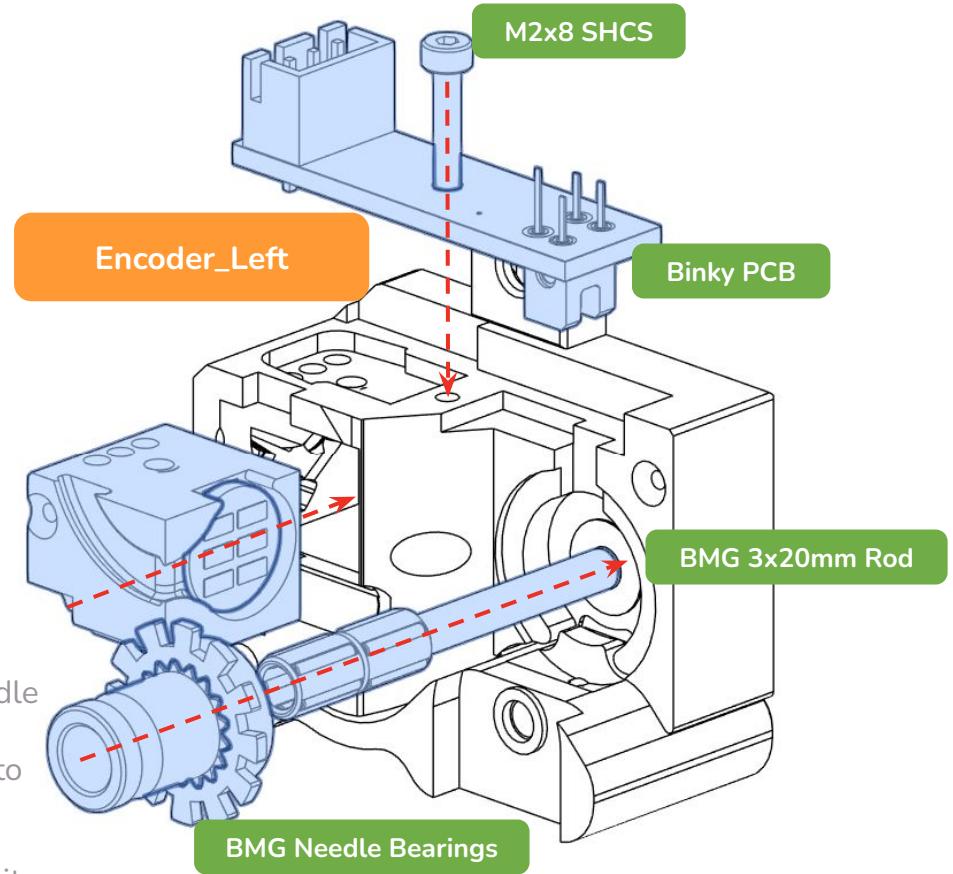
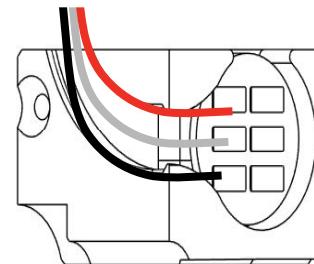
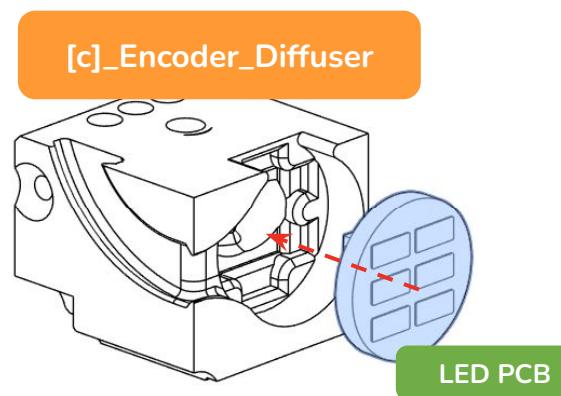
The list of pages with heatset inserts is on [Page 15](#).

SELECTOR : ENCODER

ENCODER ASSEMBLY

7.3 ASSEMBLE ENCODER DIFFUSER

Take the LED PCB (wiring omitted in the first diagram for clarity) and insert it into the [Encoder_Diffuser](#), with the wires pushed into the channel as shown.



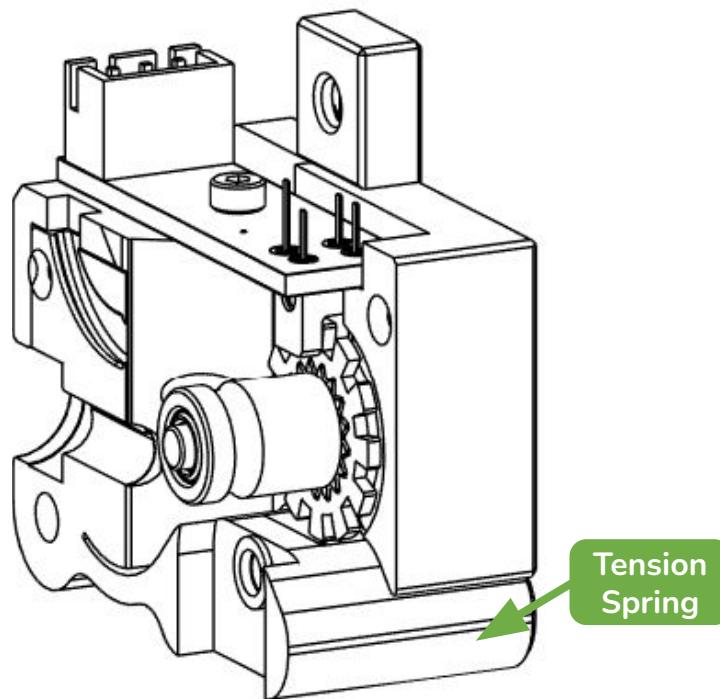
ASSEMBLY

Start by fitting the 20mm rod into [Encoder_Left](#). Next, slide on the needle bearings and the idler gear. Add a small dab of grease (EP1/EP2 or Superlube) on the bearings. Slide the gear / slotted wheel assembly into place.

The slotted wheel should sit almost flush with the housing. Make sure it doesn't rub on the [Encoder_Left](#).

Insert and secure the Binky PCB with an M2x8mm screw. The sensor should fit snugly in the cutout provided.

Insert the [Encoder_Diffuser](#) into the cavity in the [Encoder_Left](#).



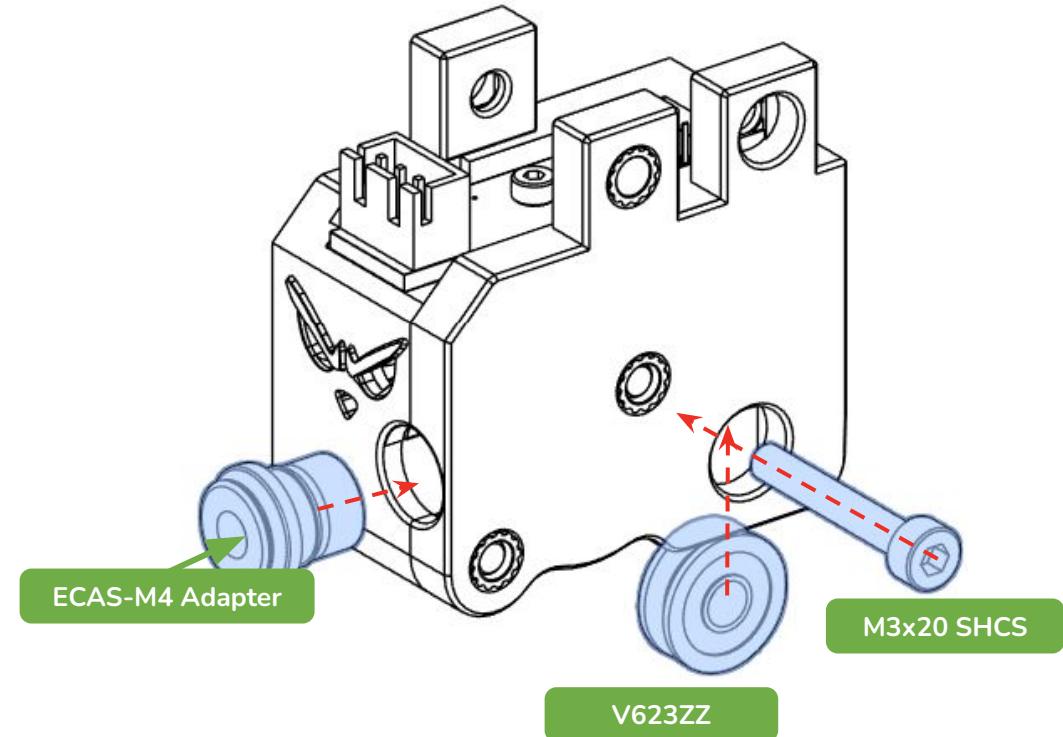
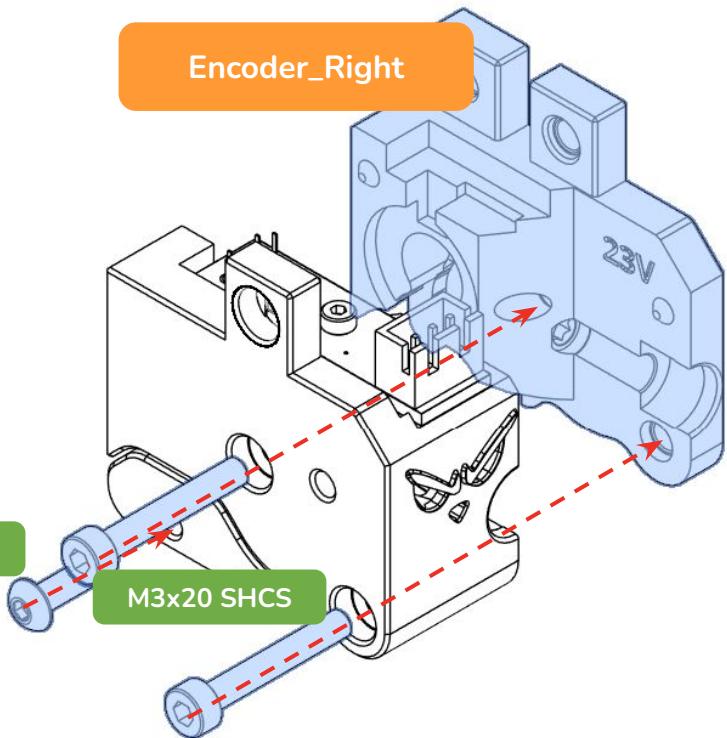
7.3 CHECK POINT

With the first half assembled, gently pull down and hold the Tension Spring to release the brake that prevents the encoder wheel from free spinning when filament is ejected.

The wheel should rotate easily and not rub on the Encoder housing or Binky optical sensor.

SELECTOR : ENCODER

ENCODER ASSEMBLY



7.1 ASSEMBLY

Align the two halves of the encoder and press them together. Make sure the wires from the LED are aligned in their channel. Attach the two sides firmly with two M3x20 SHCS screws.

Screw and self-tap the M3x8 BHCS into the plastic hole on the Tension Spring as the plunger for the homing endstop located in the gearbox housing. You can adjust the screw in or out to calibrate the home position during software setup. One full rotation of the screw will move it in or out 0.5mm.

Insert the ECAS Bowden Collet from the back and tighten the two M3x20 SHSC screws you inserted earlier.

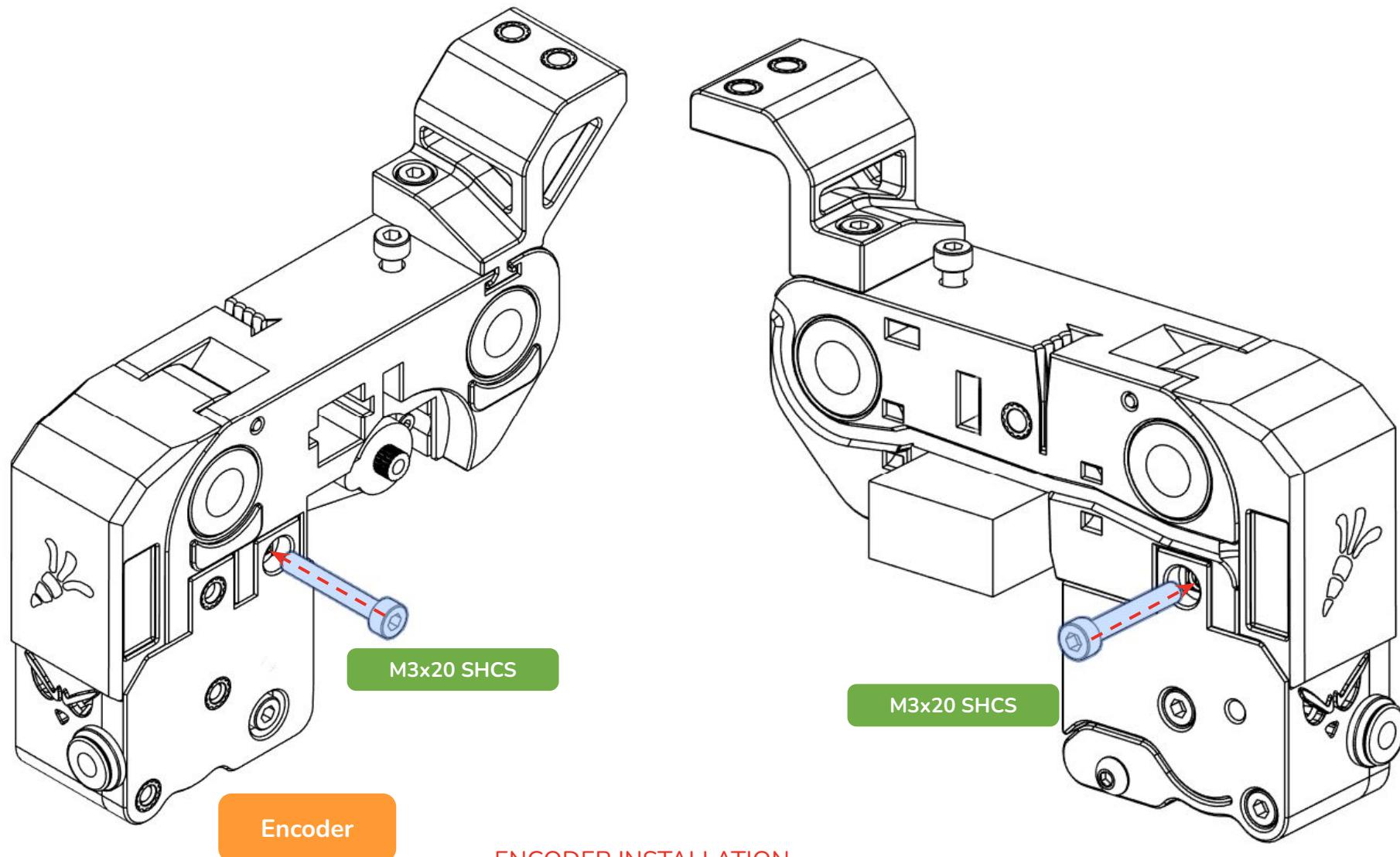
Slide the V623ZZ Filament Bearing in from the bottom and fasten with a M3x20 SHCS screw.

At this point, insert a scrap of PTFE into the ECAS, then use a length of filament to verify everything runs smoothly and the [Encoder_Slotted_Wheel](#) doesn't rub on the Encoder body or Binky PCB Optical Sensor.

If you notice any issues, disassemble the Encoder & recheck. Adjust the position of the [Encoder_Slotted_Wheel](#) on the gear, being careful not to damage it or its vanes.

SELECTOR

ENCODER INSTALLATION

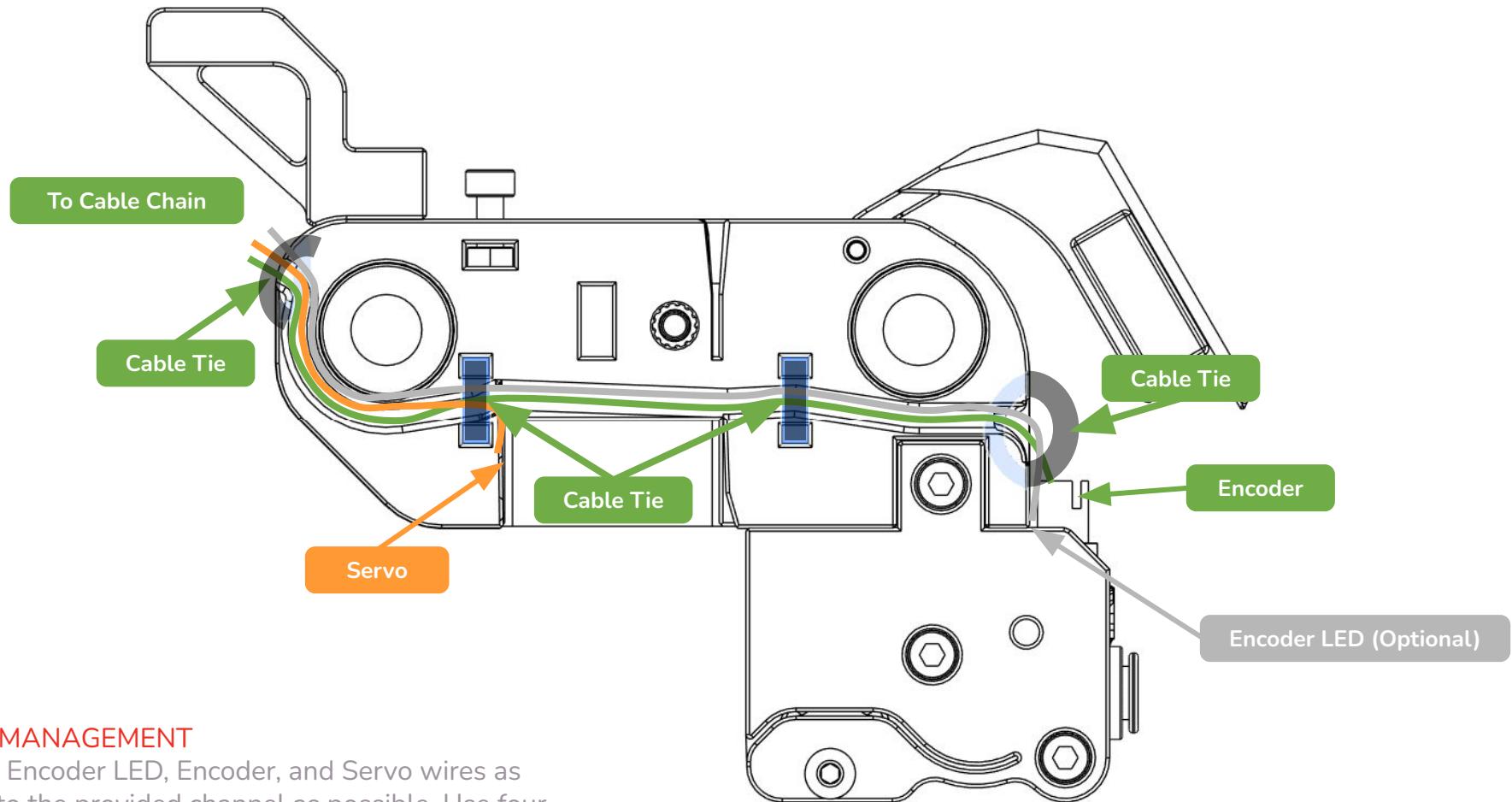


ENCODER INSTALLATION

Remove the M3x20 SHCS that you inserted on page [119](#) to hold the servo mount. Then secure the Encoder to the **Selector_Cart** with two M3x20 SHCS screws.

SELECTOR

CABLE MANAGEMENT



CABLE MANAGEMENT

Run the Encoder LED, Encoder, and Servo wires as closely to the provided channel as possible. Use four cable ties, starting at the Encoder side, to secure the wiring to the Selector_Cart.

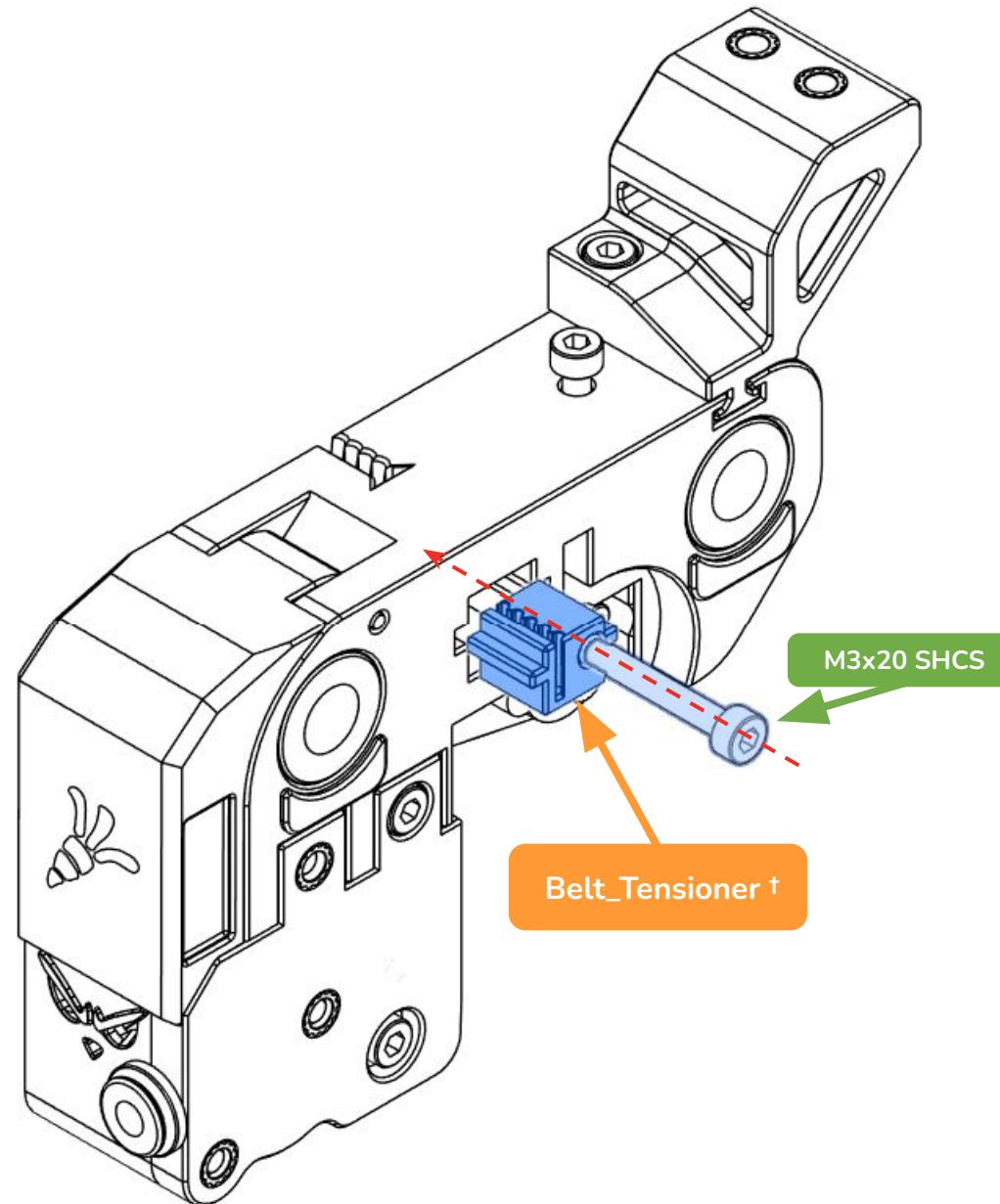
Each bundle of wires is represented by a single colored line for simplicity.

SELECTOR

BELT TENSIONER

TENSIONER INSTALLATION

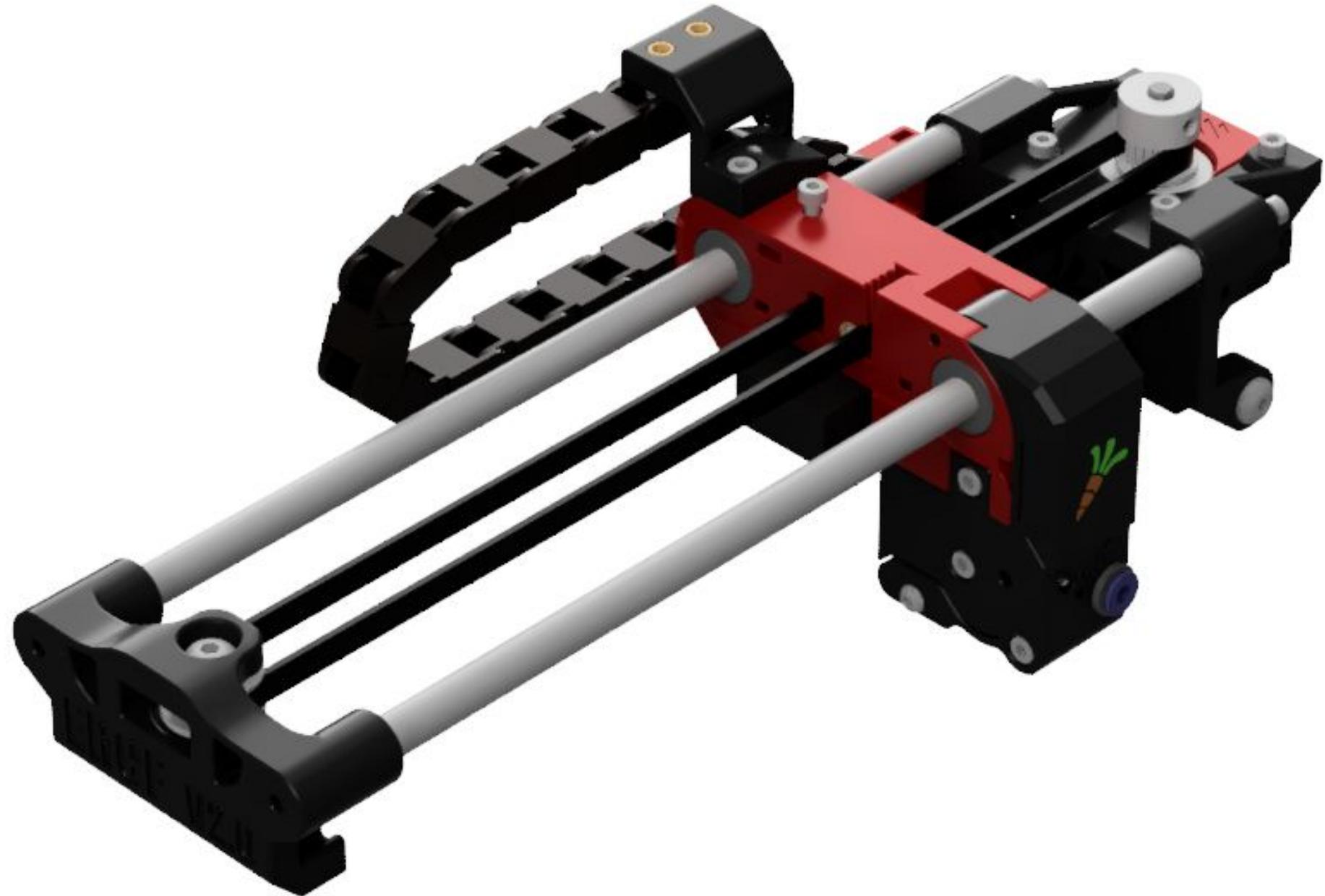
Insert the *Belt_Tensioner* into the side of the Selector and fasten it with a M3x20 screw. We don't need to tighten it all the way yet, just 1-2 turns is fine.

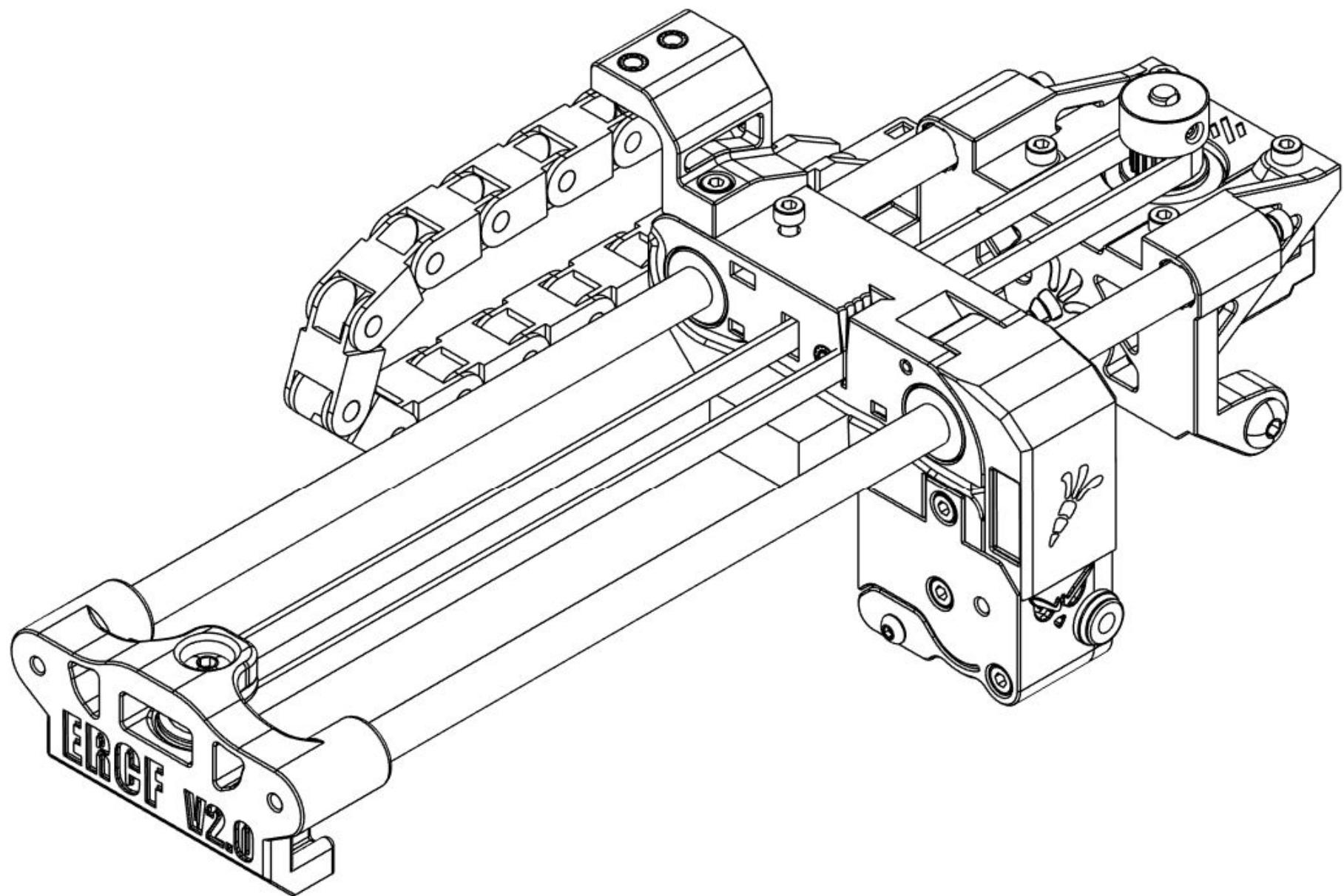


Infill patterns can vary between materials in multi-material prints. Using a stiffer material for the outer shell of an object and a lighter, more flexible material for the internal structure can reduce weight while maintaining strength, optimizing designs for performance.

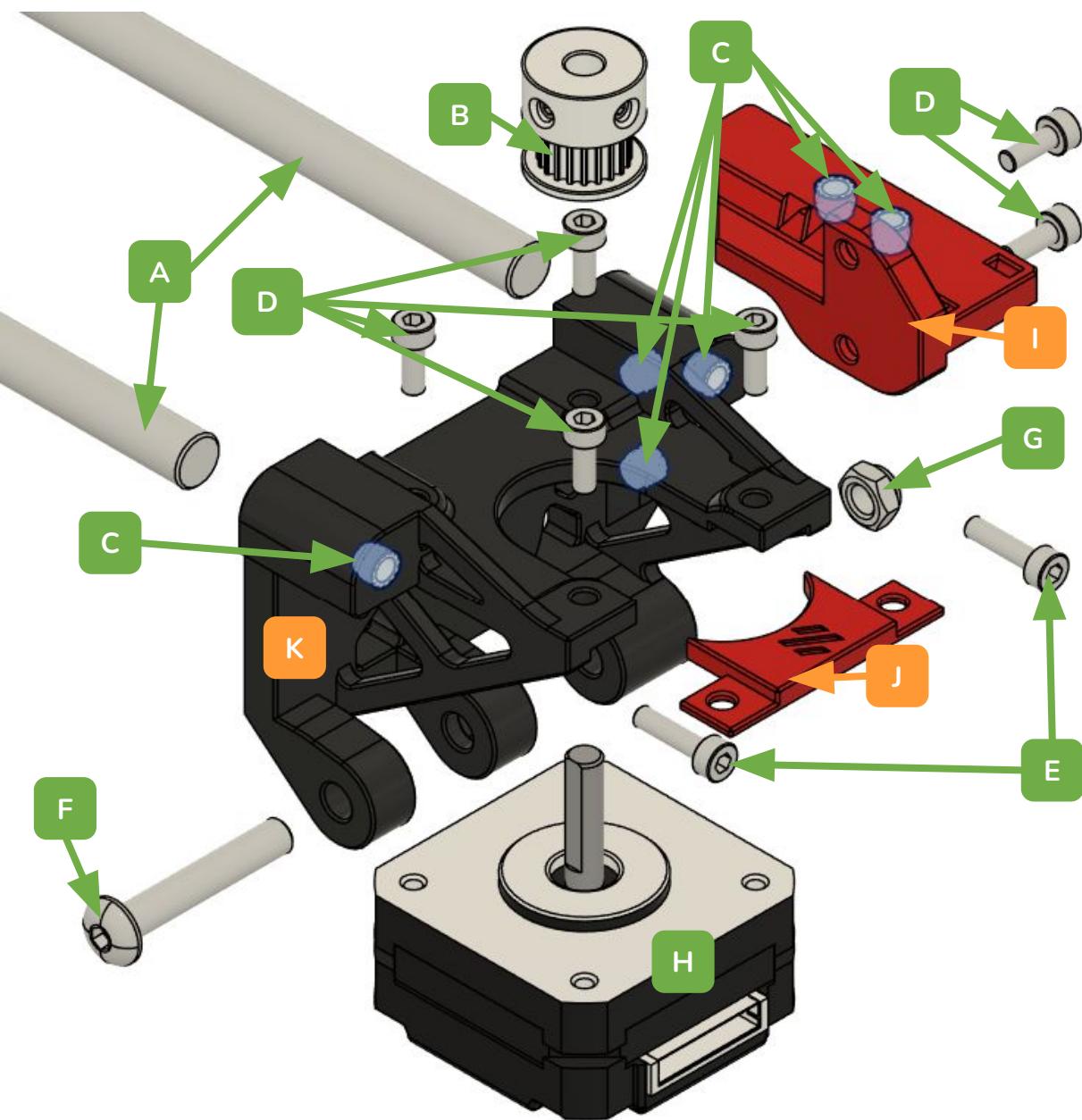
LINEAR AXIS

OVERVIEW





LINEAR AXIS HINGE



LINEAR AXIS HINGE EXPLODED VIEW

LINEAR AXIS HINGE SUB-BOM

A 2x 8mm rods
 B 1x GT2 20T pulley
 C 6x M3 Heatset Inserts
 D 6x M3x8mm SHCS
 E 2x M3x12mm SHCS**
 F 1x M5x30mm BHCS**
 G 1x M5 Nylock nut**
 H 1x NEMA17 Pancake Motor

| Channels | Rod Length (mm) |
|----------|-----------------|
| N | 53 + 23N |
| 4 | 145 |
| 5 | 168 |
| 6 | 191 |
| 7 | 214 |
| 8 | 237 |
| 9 | 260 |
| 10 | 283 |
| 11 | 306 |
| 12 | 329 |
| 13 | 352 |
| 14 | 375 |
| 15 | 398 |

I 1x [a]_Drag_Chain_Anchor_Bottom.stl †
 J 1x [a]_Motor_Lock.stl †
 K 1x Linear_Axis_Selector_Motor_Support.stl

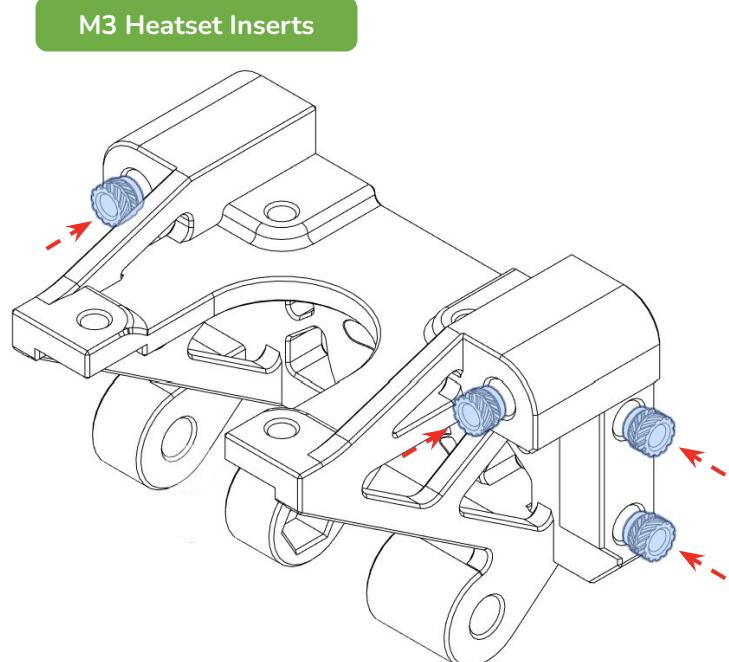
**M3 screws, M5 screw, and nut shown for completeness, but not used until Final Assembly..

LINEAR AXIS HINGE

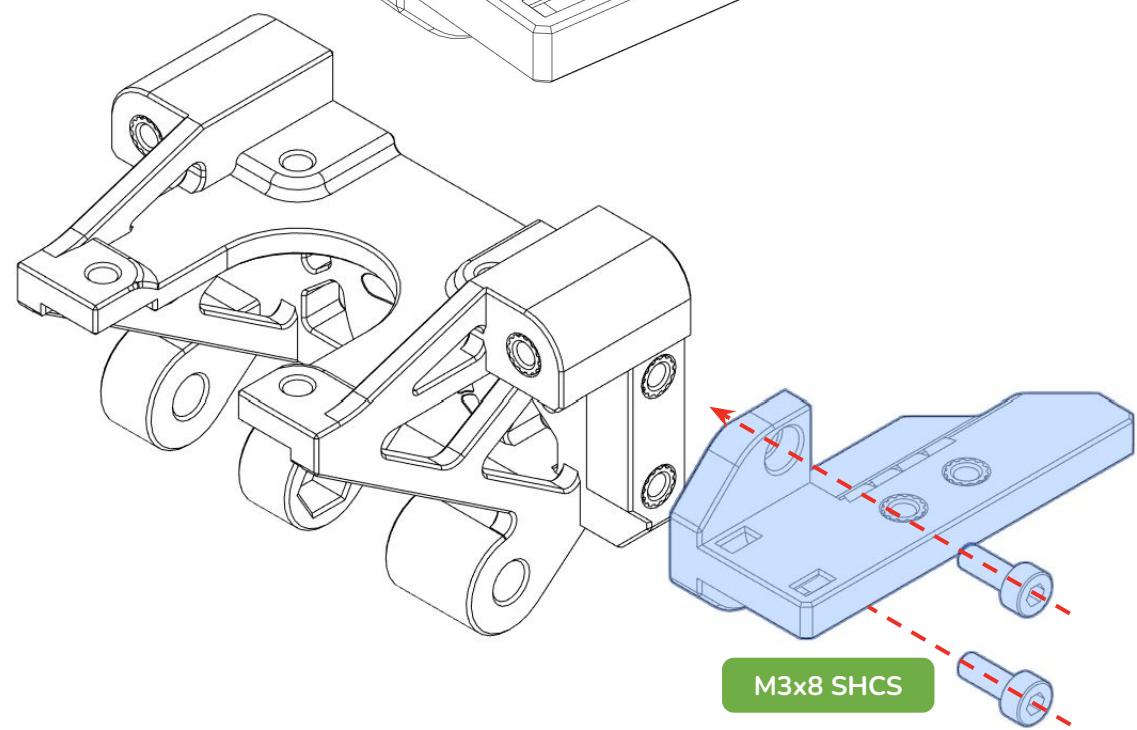
SELECTOR MOTOR SUPPORT

8.1 HEATSET INSERTS

The list of pages with heatset inserts is on [Page 15](#).



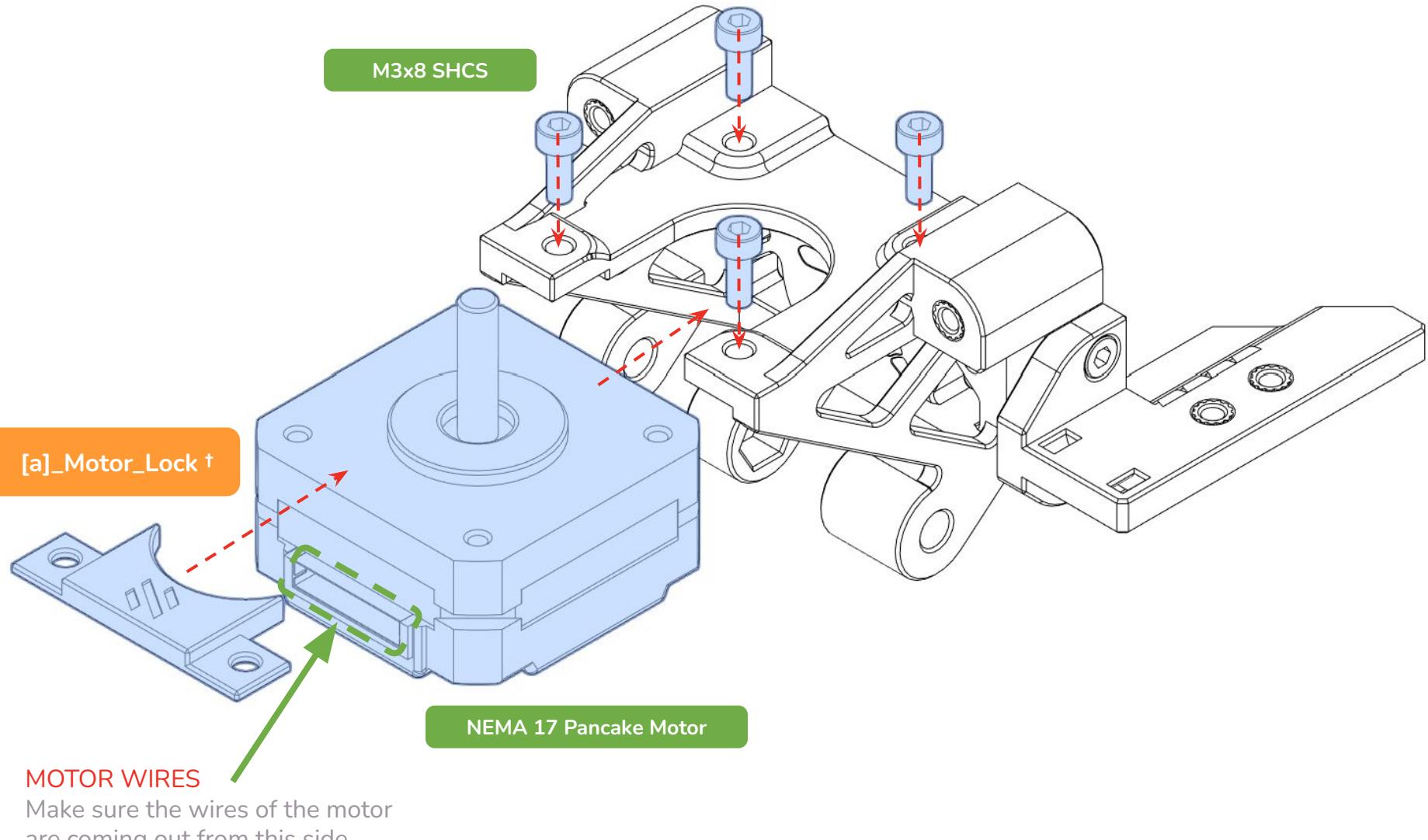
Linear_Axis_Selector_Motor_Support



[a]_Drag_Chain_Anchor_Bottom †

LINEAR AXIS HINGE

SELECTOR MOTOR SUPPORT



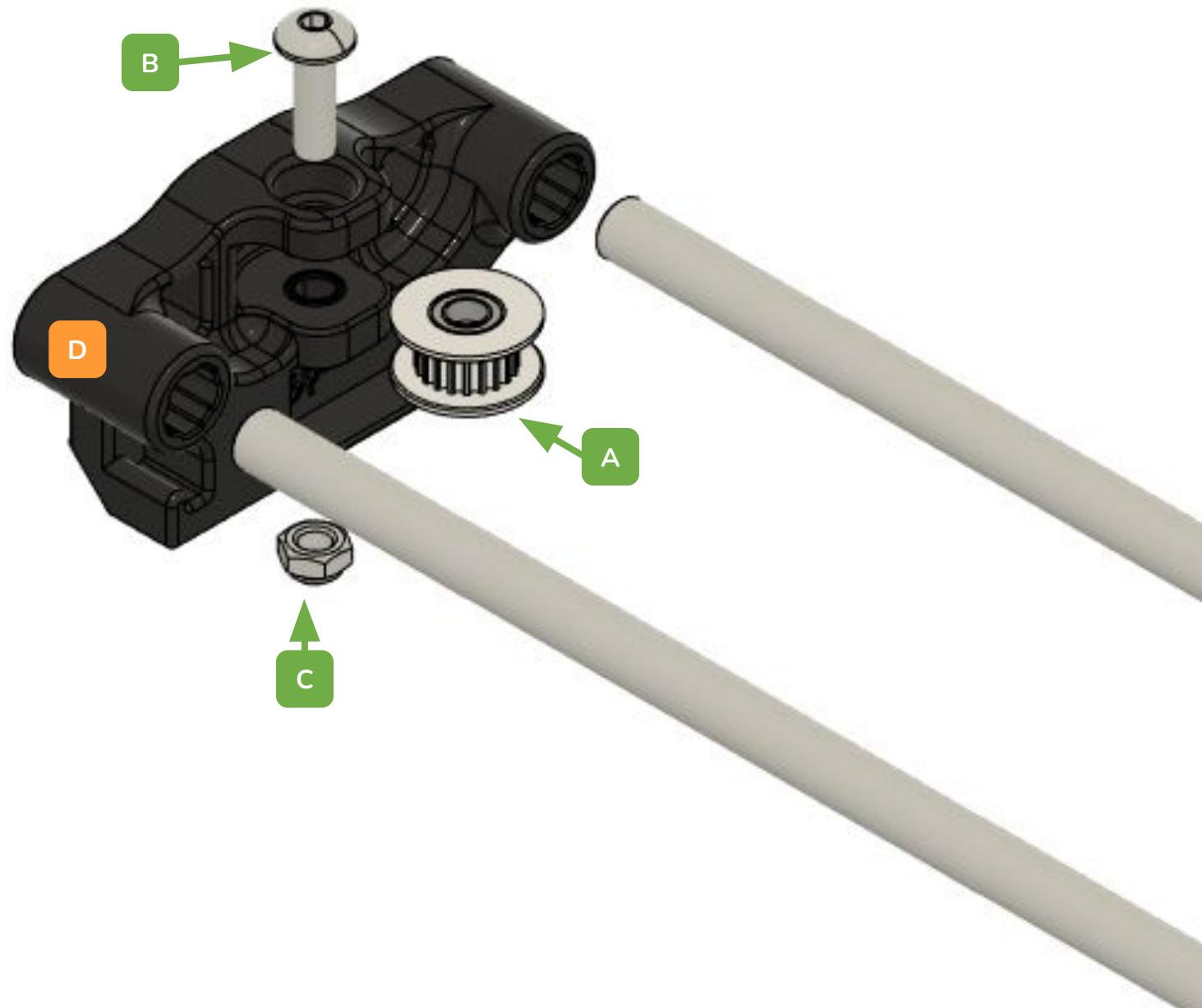
LINEAR AXIS IDLER

LINEAR AXIS IDLER SUB-BOM

A
B
C

- 1x GT2 20T toothed idler
- 1x M5x16mm BHCS
- 1x M5 Nylock nuts

LINEAR AXIS IDLER EXPLODED VIEW

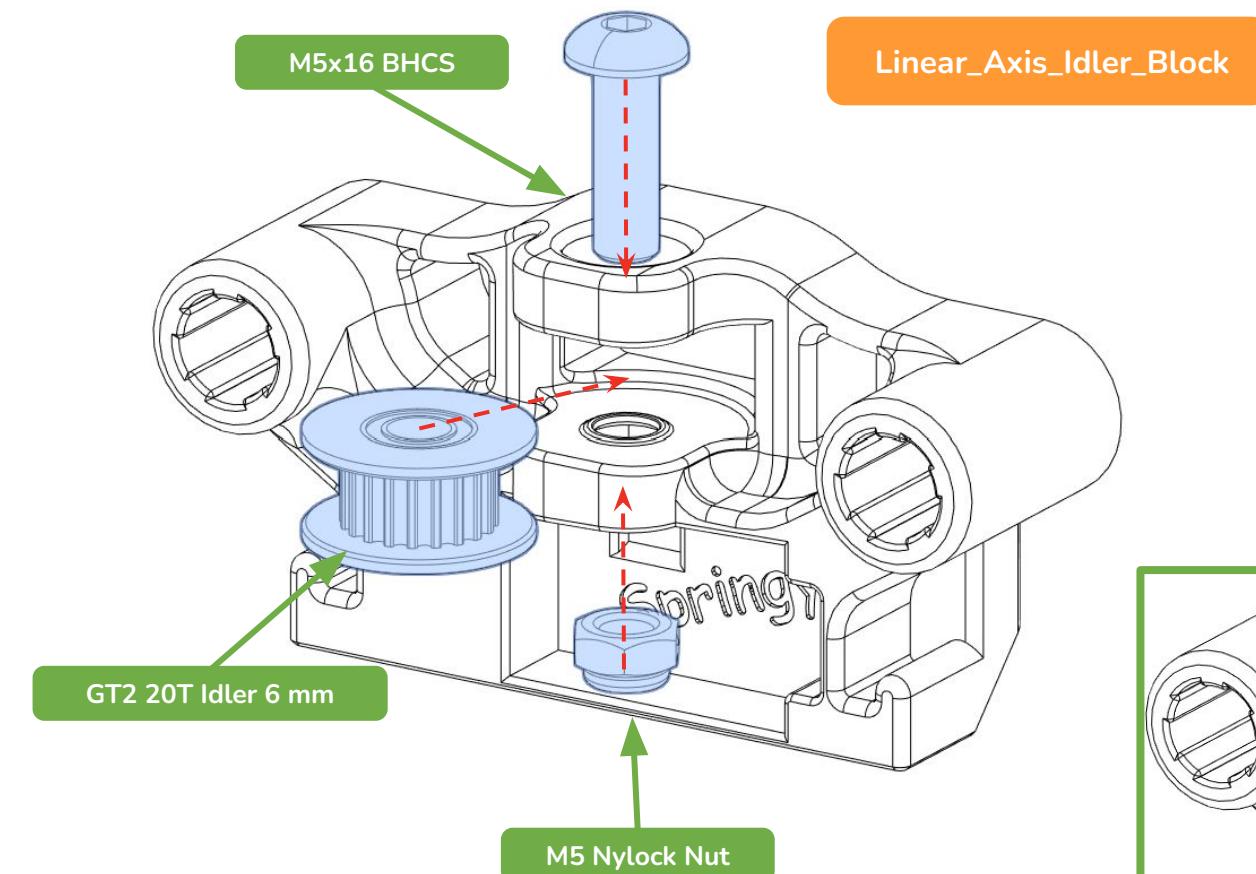


D

1x Linear_Axis_Idler_Block.stl

LINEAR AXIS IDLER

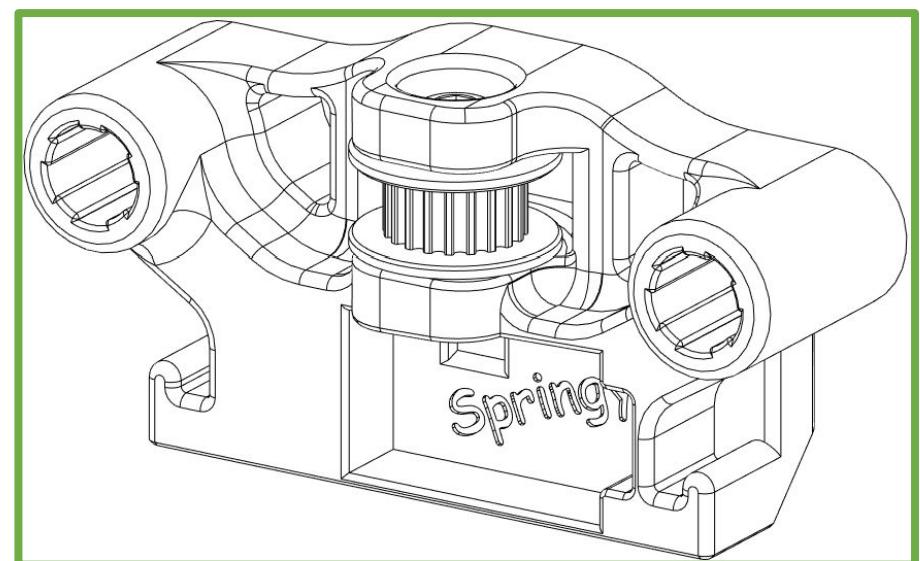
IDLER BLOCK



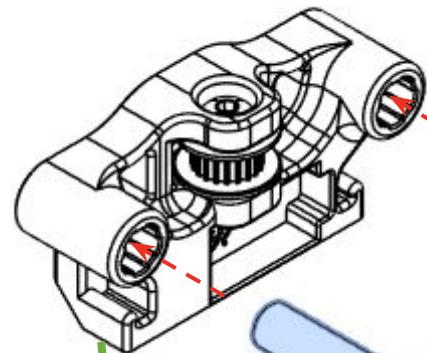
8.2 ASSEMBLE IDLER BLOCK

Fully insert the M5 locking nut into its cavity. Slide the GT2 Idler into its cavity.

Insert the M5x16mm bolt and tighten it until snug, but not super tight. It's an idler, it needs to spin freely.



LINEAR AXIS



AXIS ASSEMBLY

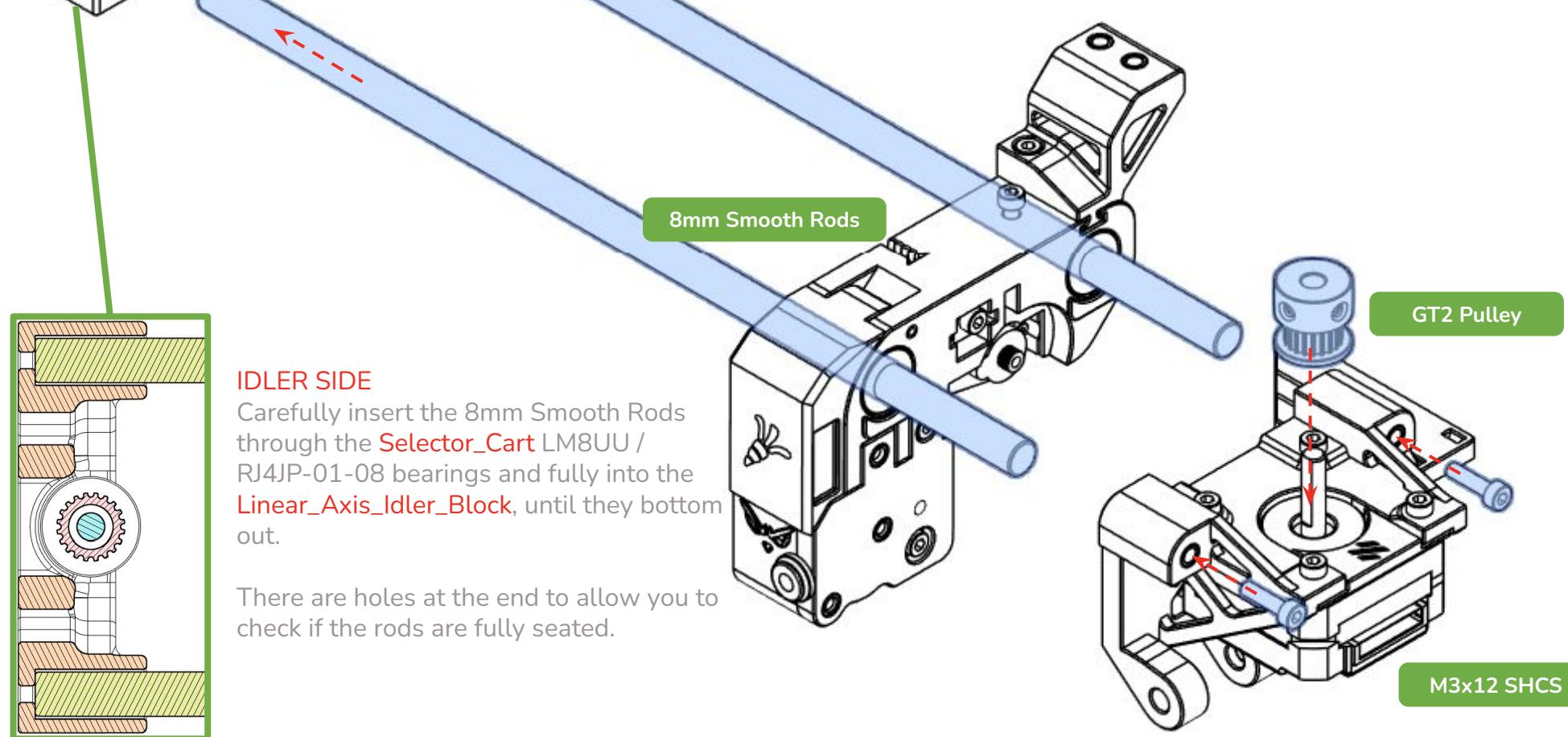
BEARING PREPARATION

If using LM8UU bearings, lightly grease them using EP1/EP2 or Superlube grease. Drylin RJ4JP-01-08 style bearings do not need to be lubricated.

MOTOR SIDE

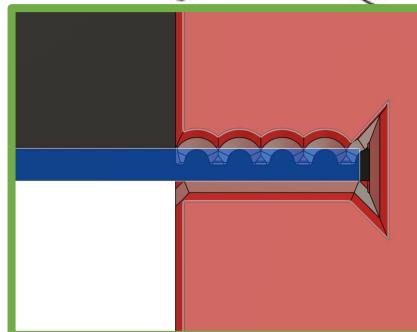
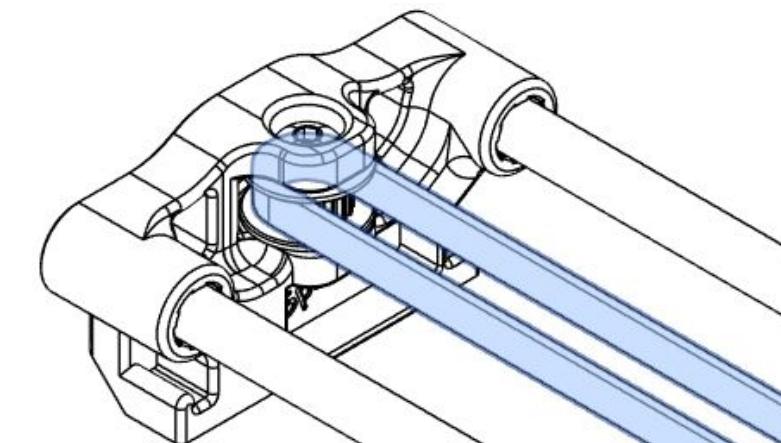
Fully insert the rods on the motor side for now, and just get the 2 M3x12 SHCS screws to contact the rods.

Add the GT2 pulley and snug the grub screw. We will adjust it soon.



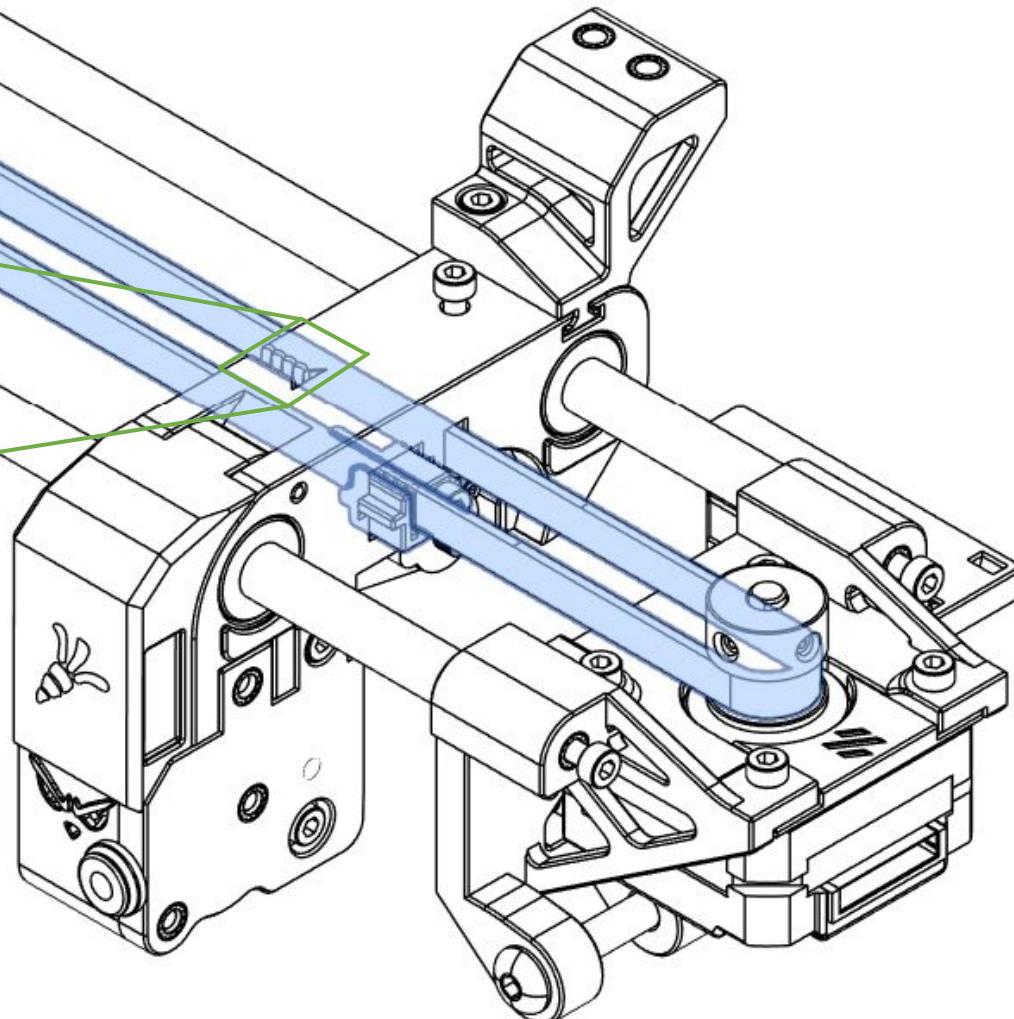
LINEAR AXIS

PULLEY AND BELT INSTALLATION



BELT INSTALLATION

First, install the belt into the [Selector_Cart](#) by pushing the end of the belt into the toothed slot on the top of the [Selector_Cart](#). You may need to use a flathead screwdriver to push the belt fully into place.



Next, wrap the belt clockwise around the Idler, back through the hole in the [Selector_Cart](#), around the GT2 pulley, and finally to the [Belt_Tensioner](#).

Mark the belt length with a paint pen or marker. Now measure an additional 15mm of length, and cut the belt to the new mark. This ensures room for adjustment in a later step.

Attach the [Belt_Tensioner](#) to the [Selector_Cart](#) with an M3x20mm screw, but only tighten it 1-2 turns.

Multi-material bioprinting is being explored for medical applications. Researchers are developing methods to print with biological materials like hydrogels and living cells, allowing for the creation of complex tissues that mimic the structure of human organs.

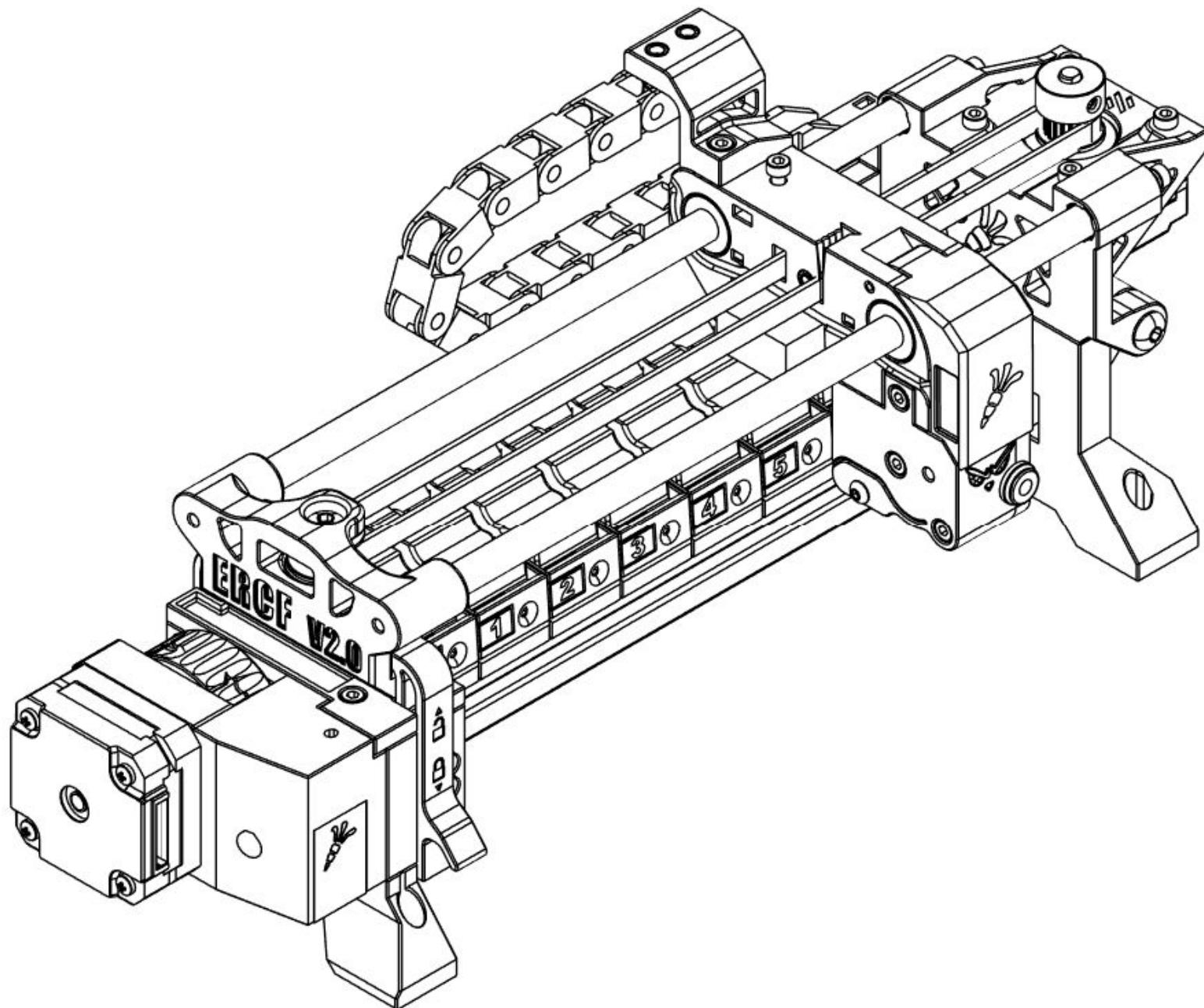
FINAL ASSEMBLY

OVERVIEW



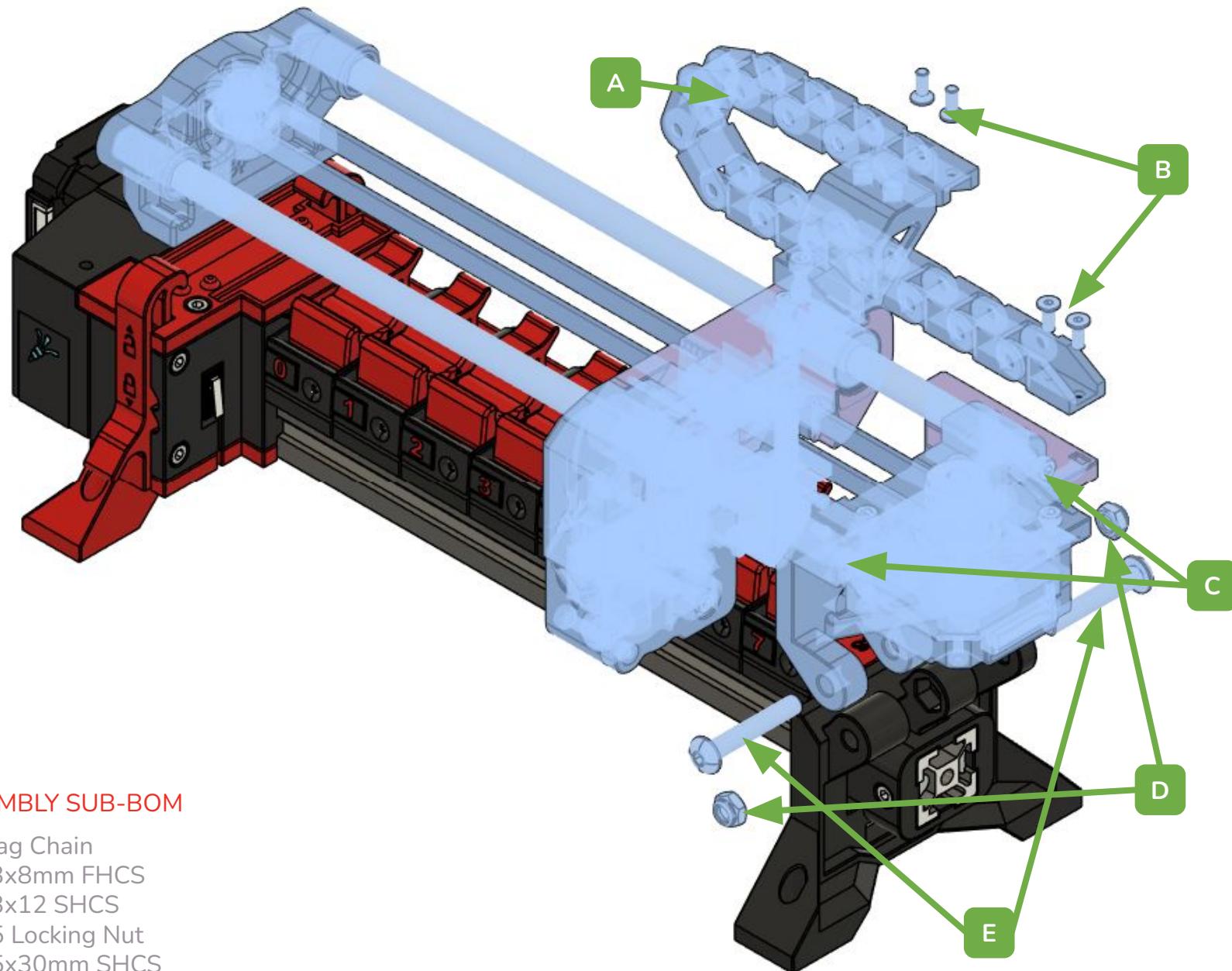
FINAL ASSEMBLY

OVERVIEW



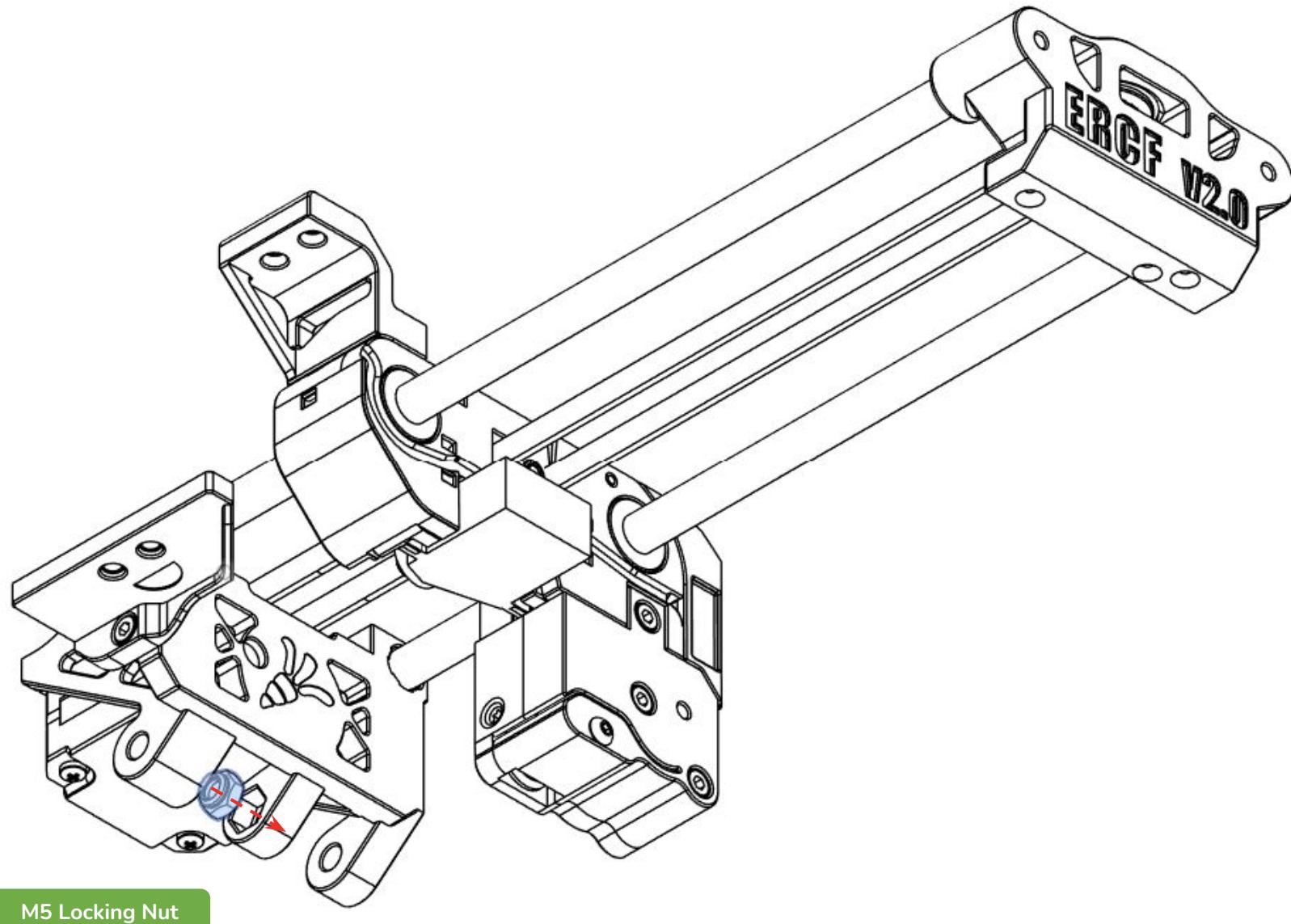
FINAL ASSEMBLY

EXPLODED VIEW



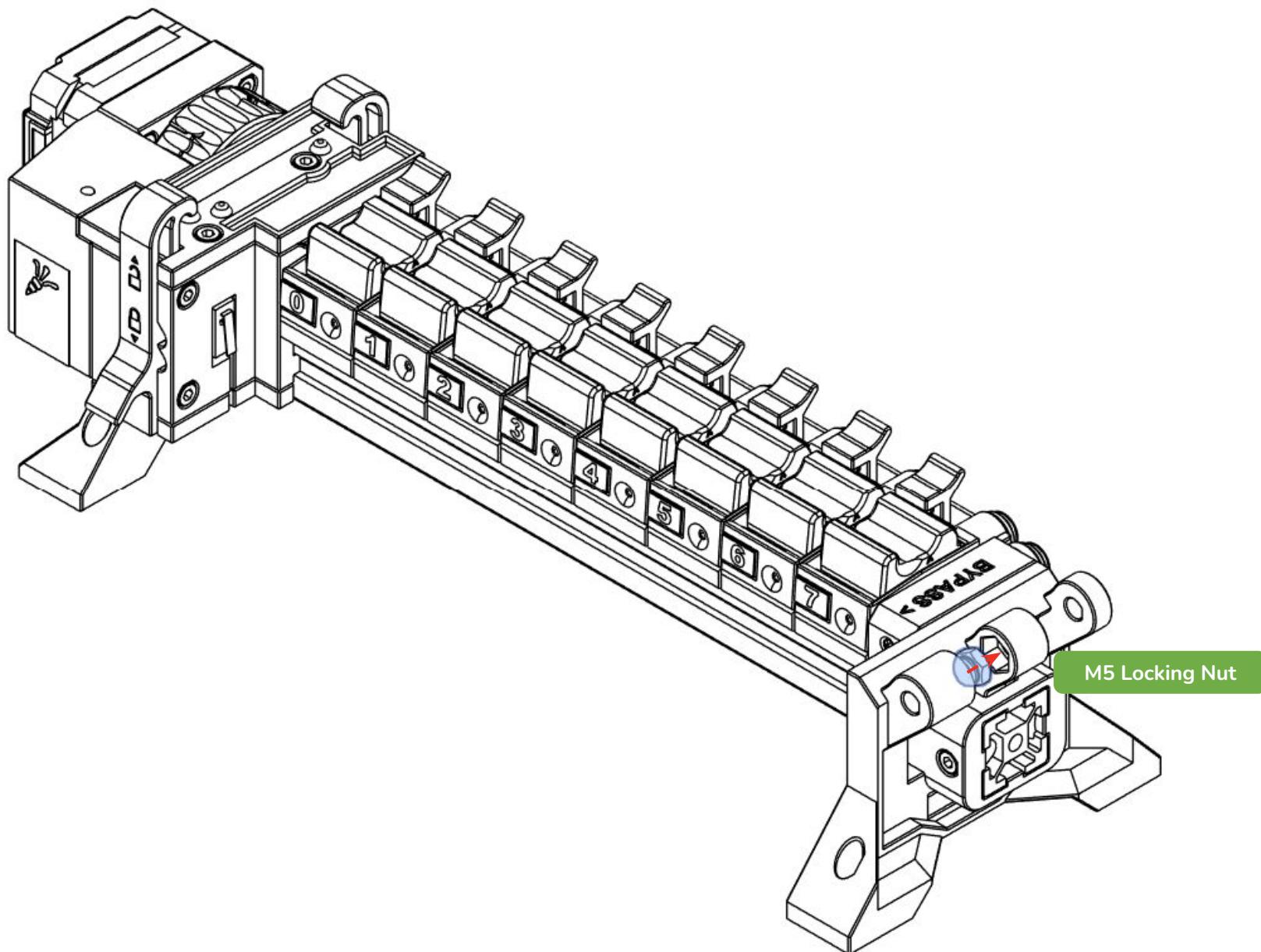
FINAL ASSEMBLY

ADDING THE LOCKING NUTS



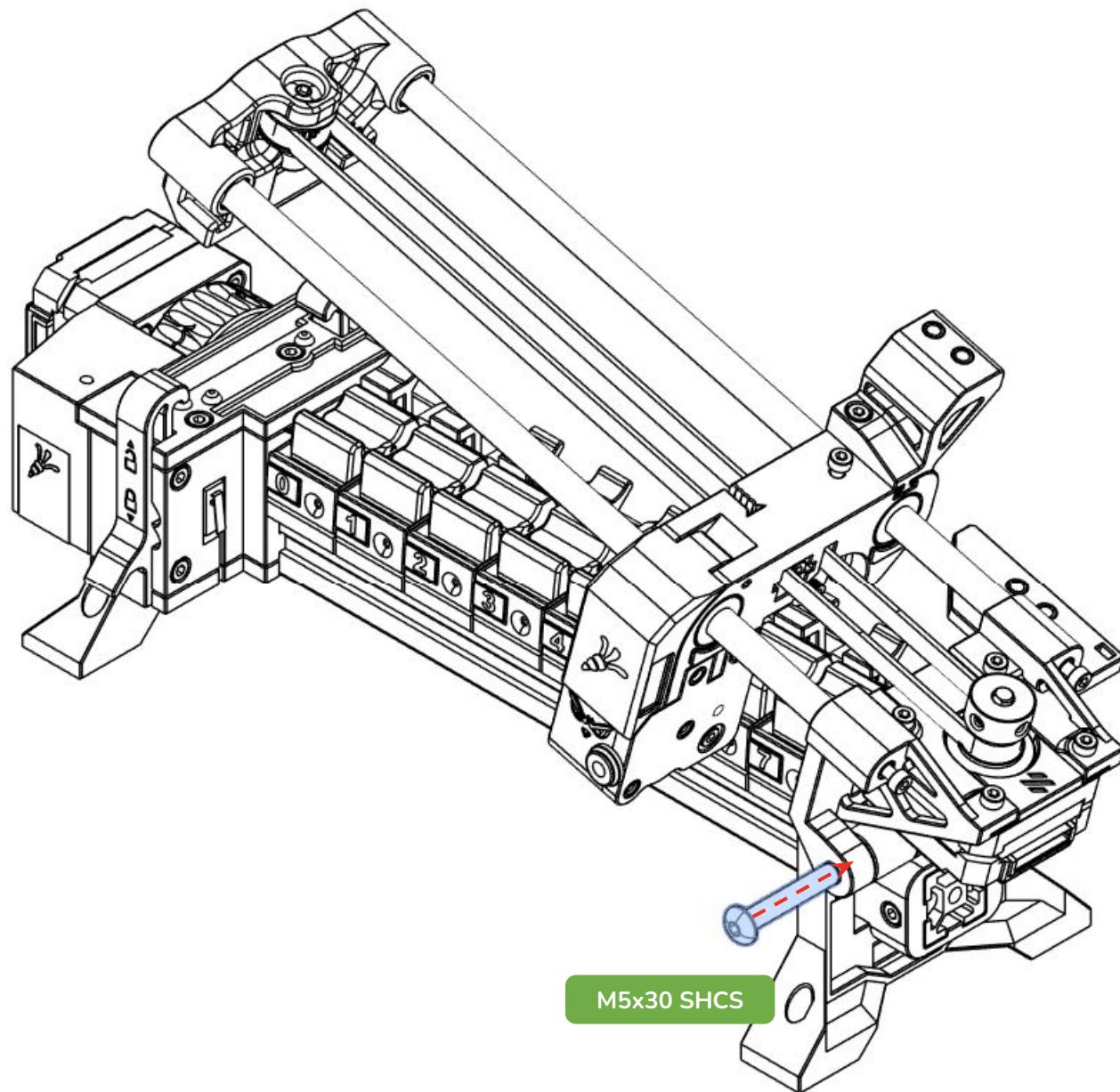
FINAL ASSEMBLY

ADDING THE LOCKING NUTS



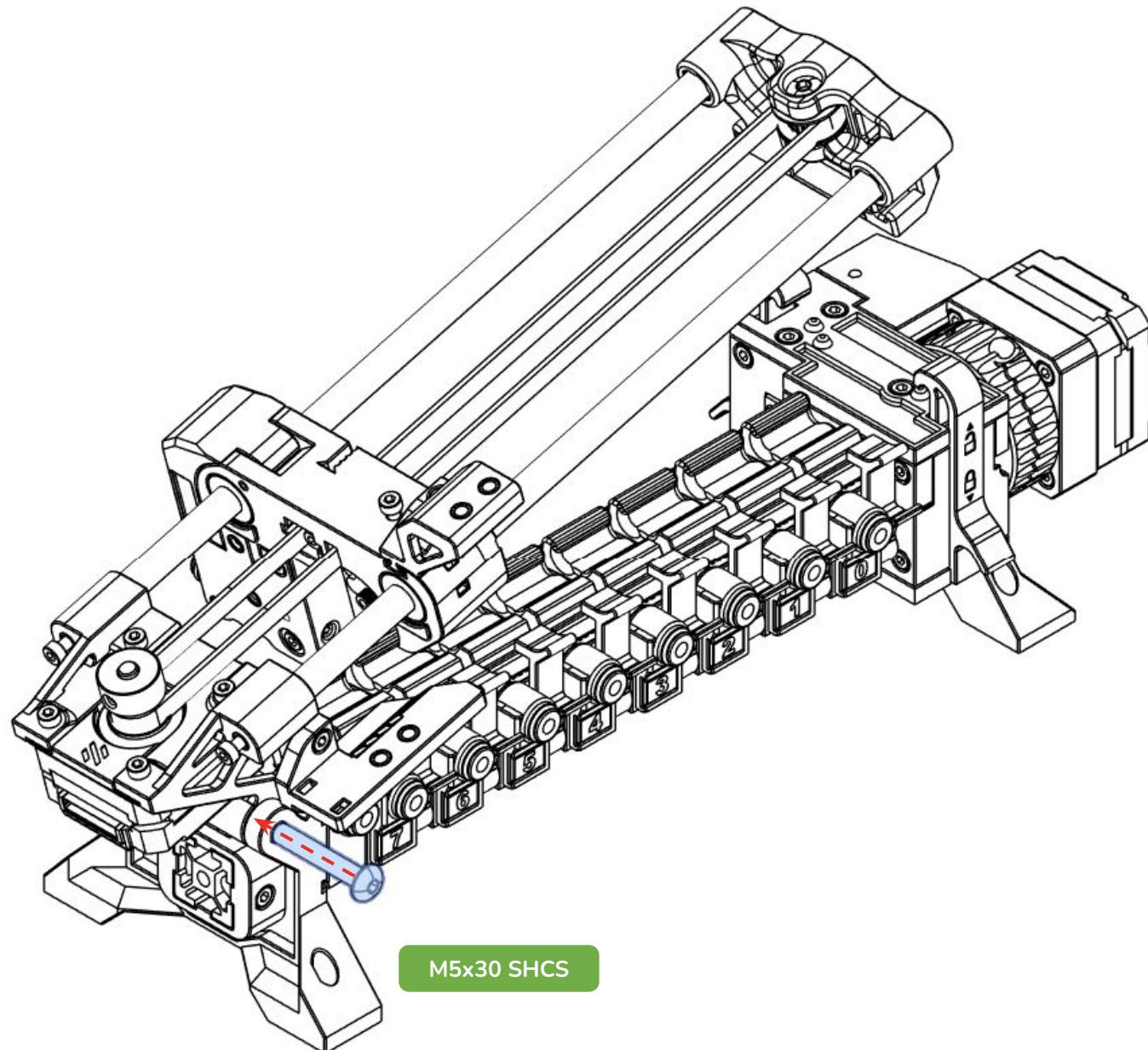
FINAL ASSEMBLY

JOINING THE TWO BLOCKS



FINAL ASSEMBLY

JOINING THE TWO BLOCKS



FINAL ASSEMBLY

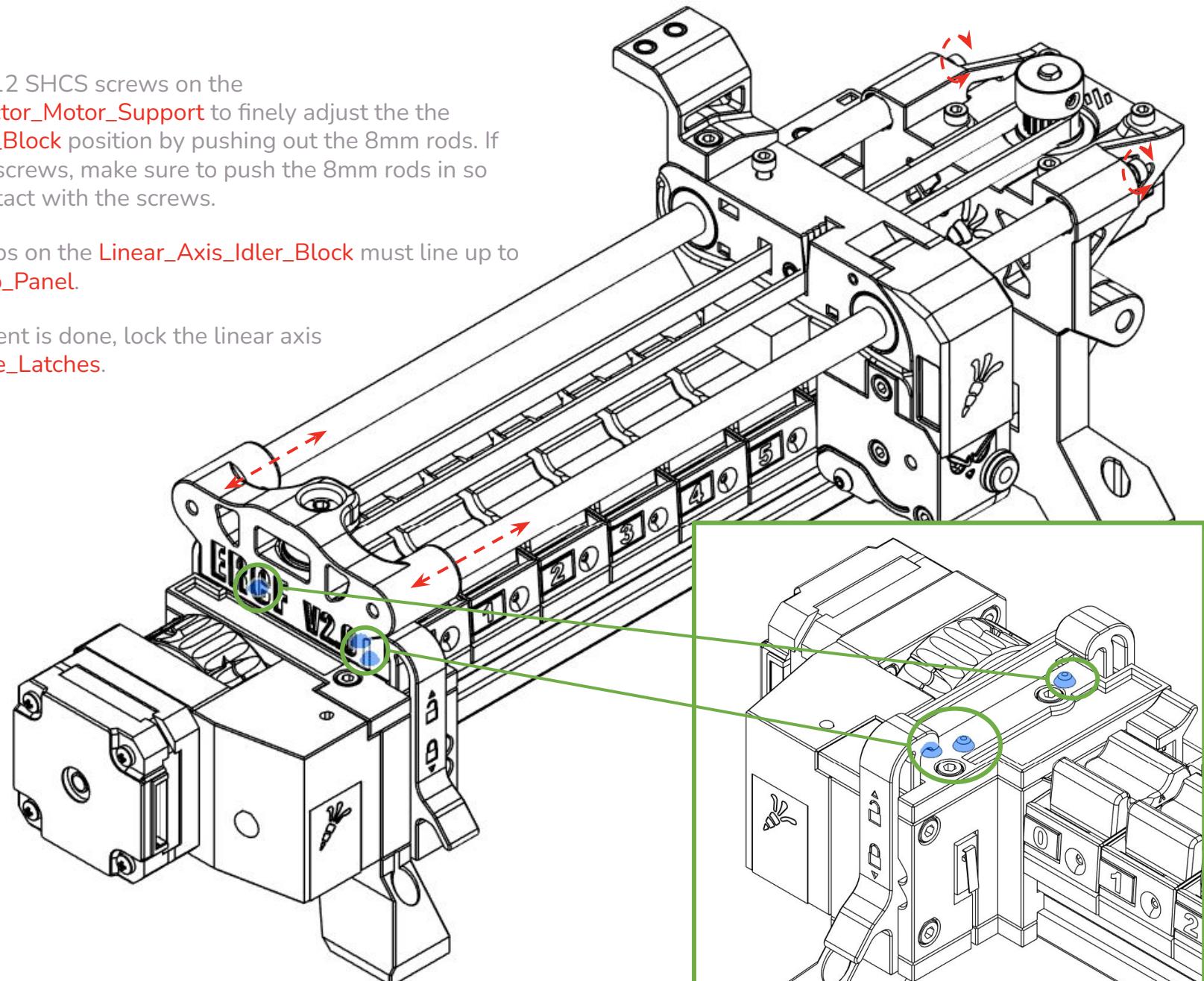
IDLER ADJUSTMENT

IDLER POSITION

Use the two M3x12 SHCS screws on the [Linear_Axis_Selector_Motor_Support](#) to finely adjust the the [Linear_Axis_Idler_Block](#) position by pushing out the 8mm rods. If you loosen these screws, make sure to push the 8mm rods in so they're still in contact with the screws.

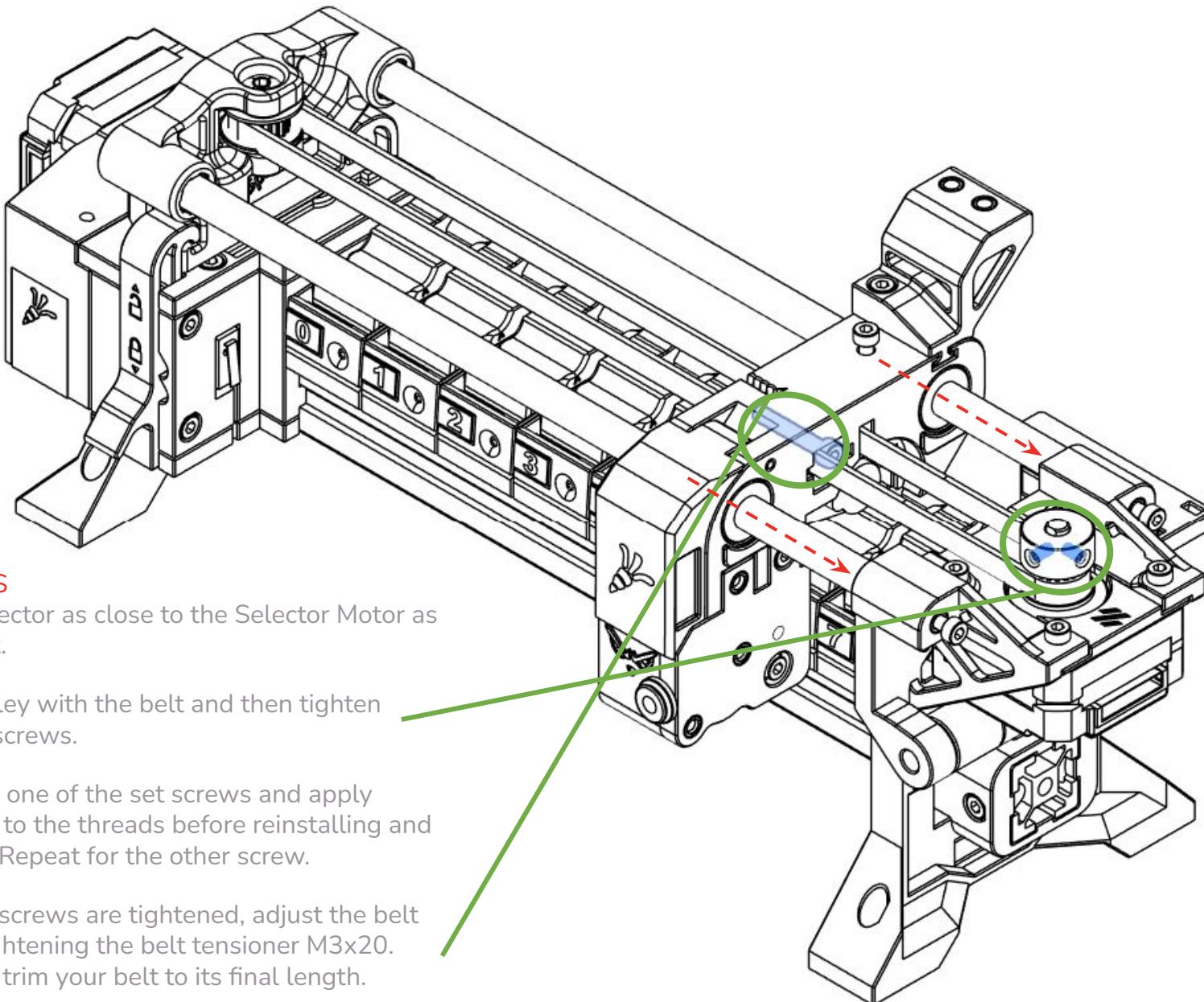
The locating bumps on the [Linear_Axis_Idler_Block](#) must line up to the [Gear_Box_Top_Panel](#).

Once the adjustment is done, lock the linear axis using the two [Side_Latches](#).



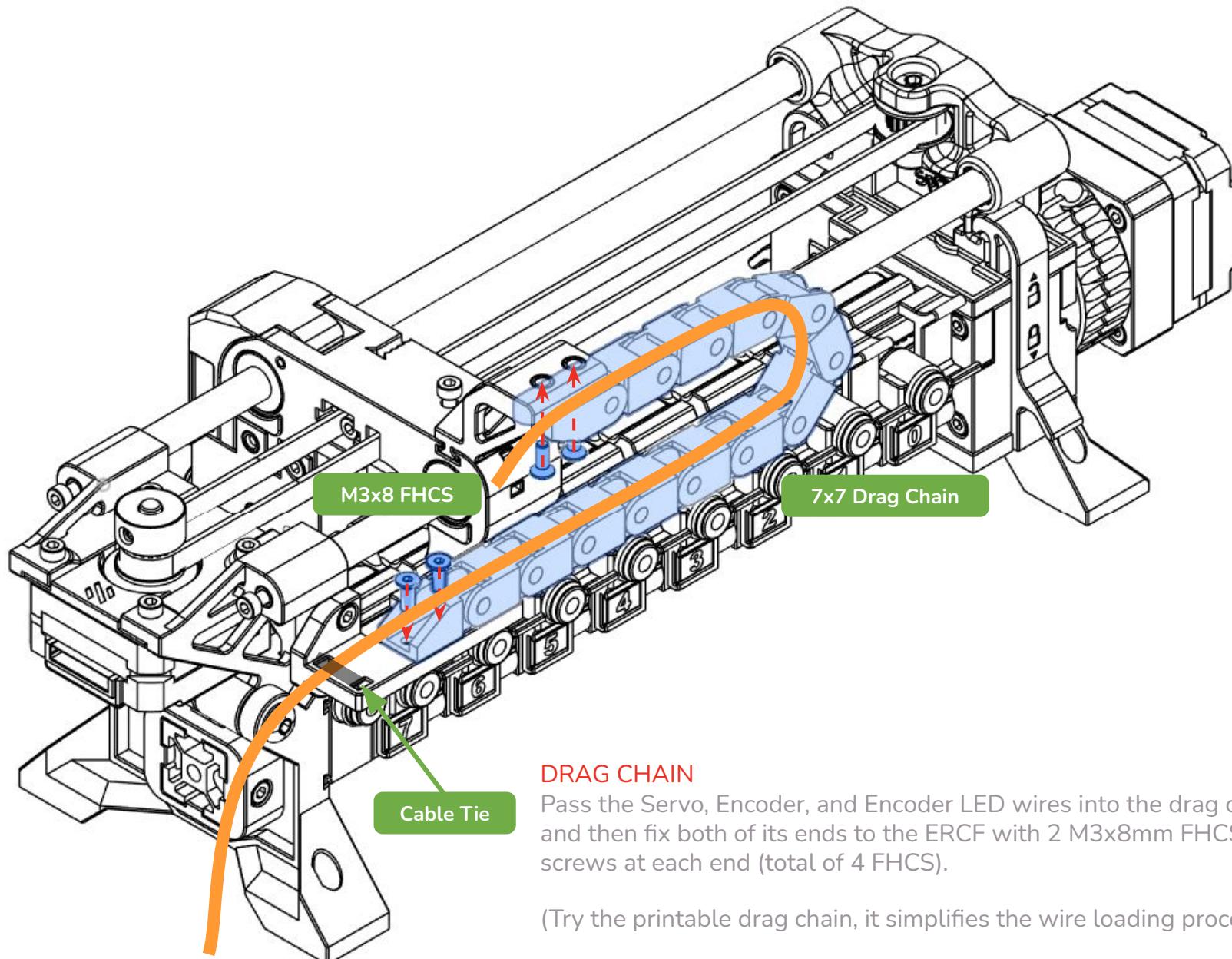
FINAL ASSEMBLY

TENSIONING THE BELT



FINAL ASSEMBLY

DRAG CHAIN



DRAG CHAIN

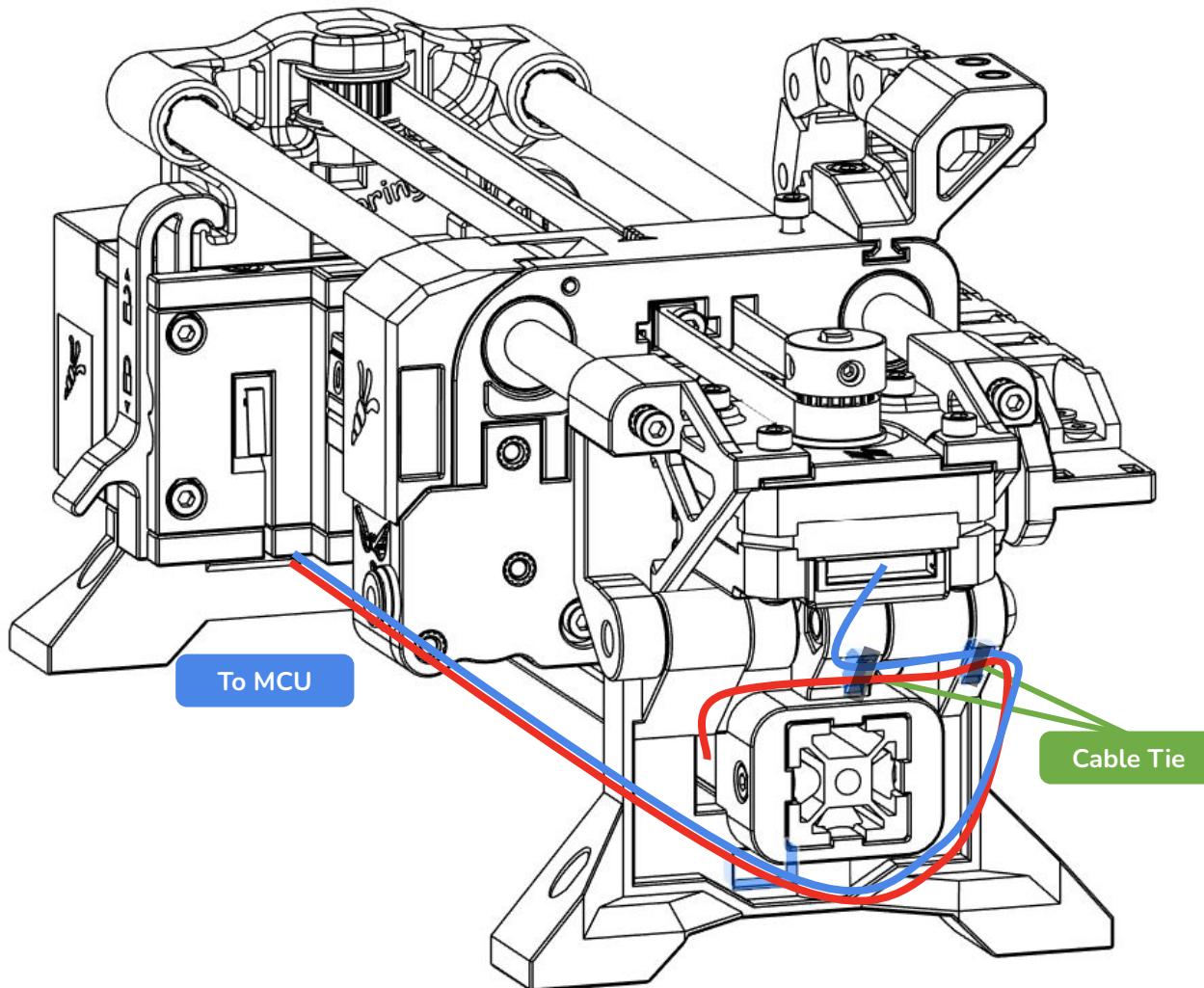
Pass the Servo, Encoder, and Encoder LED wires into the drag chain, and then fix both of its ends to the ERCF with 2 M3x8mm FHCS screws at each end (total of 4 FHCS).

(Try the printable drag chain, it simplifies the wire loading process.)

Add a cable tie to the Drag_Chain_Anchor_Bottom to secure the wires.

FINAL ASSEMBLY

CABLE MANAGEMENT



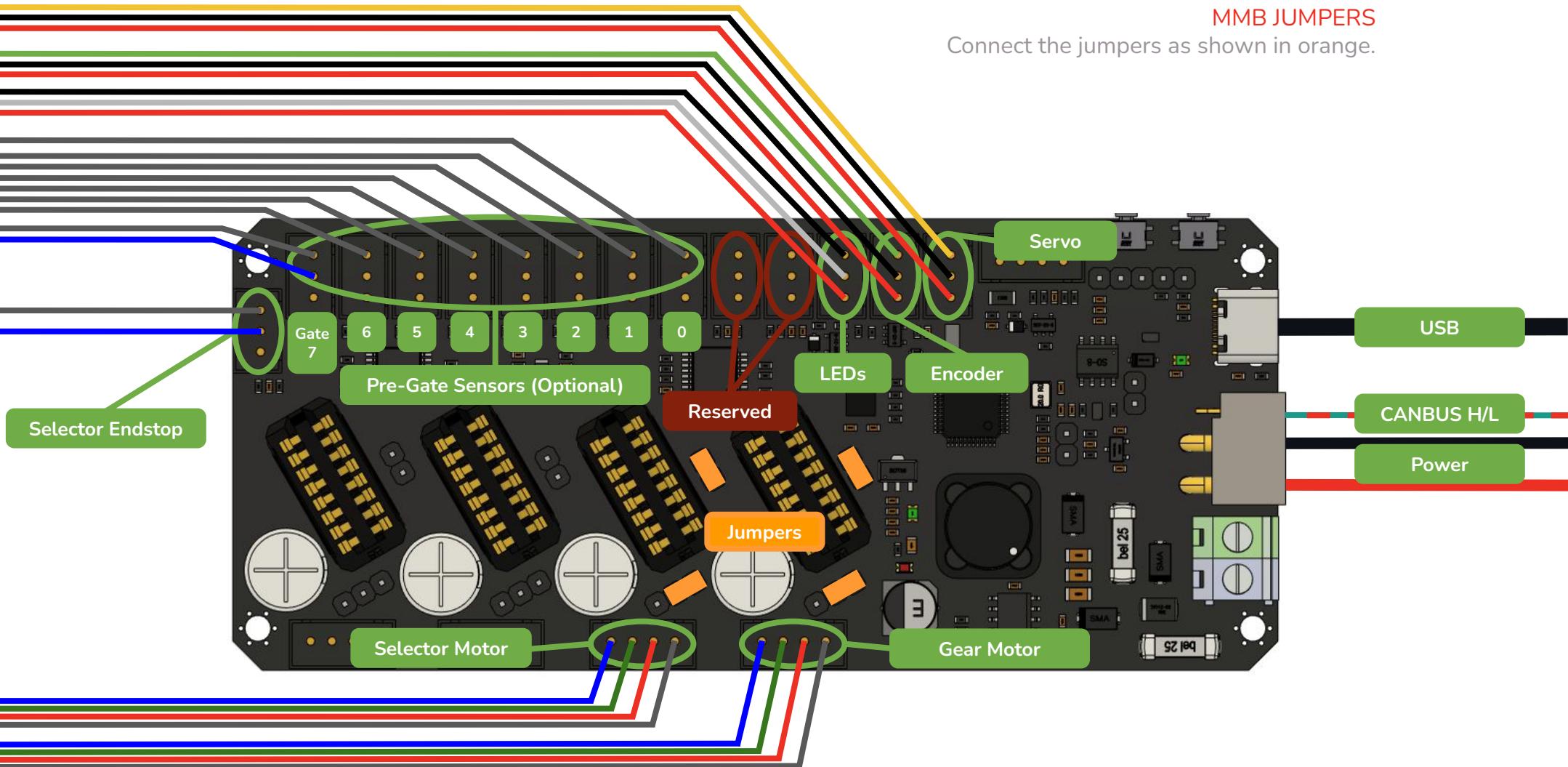
CABLE MANAGEMENT

Run the Selector Motor wires (blue) and optional LED wires (red) as shown, looping clockwise around the end of the 2020, through the keyhole in the End_Block, and along the underside of the 2020 to the MCU.

Use cable ties to secure the wires in place. This is particularly important for the Selector Motor wiring, to prevent pinching the wires when opening the Linear Axis.

WIRING

WIRING THE MMB



MMB WIRING

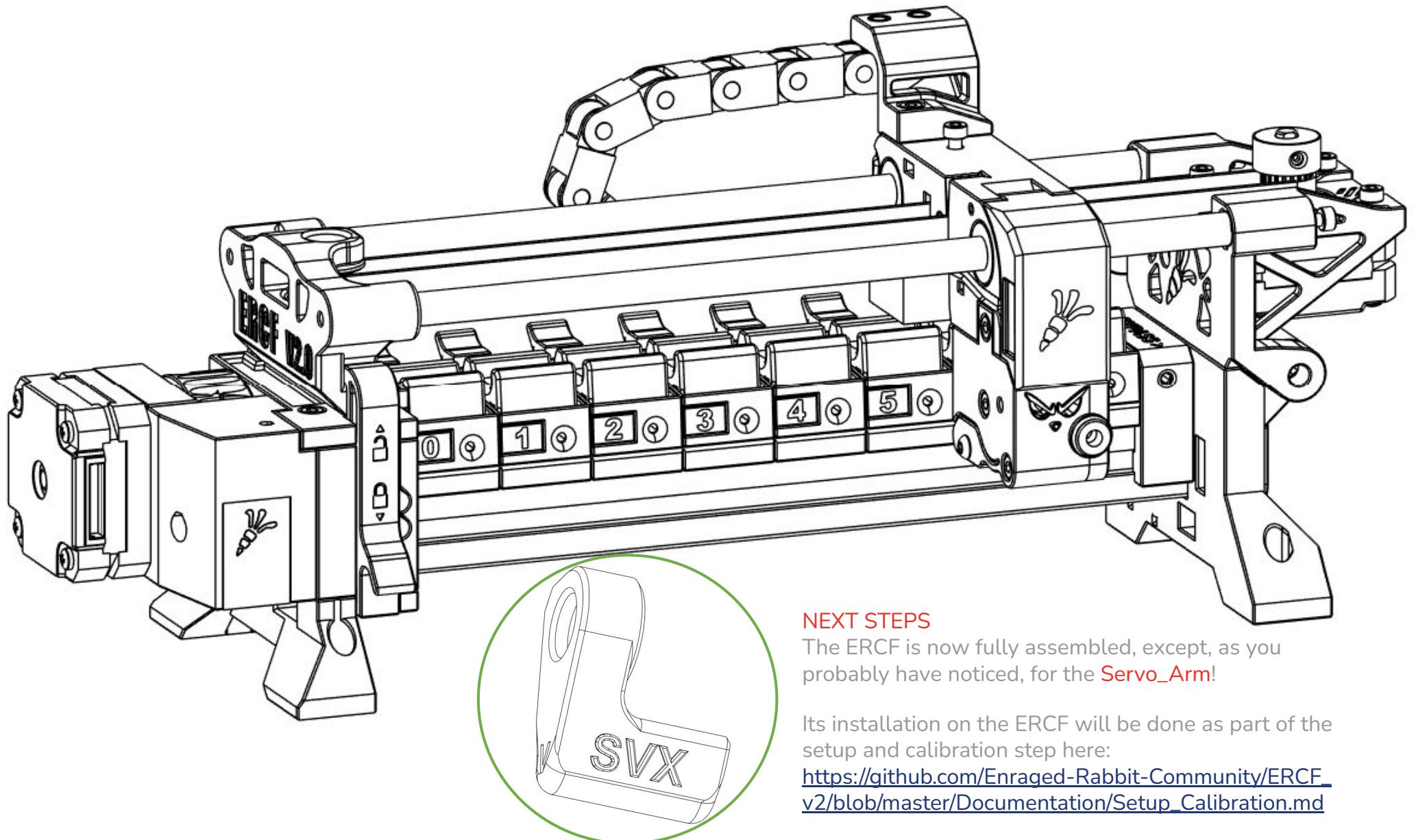
Connect the Selector Endstop and optional Pre-Gate Sensor wires (**do not use reserved ports**). Connect the Servo and Encoder wires. Connect the Selector Motor and Gear Motor wires. Wiring color order may vary between manufacturers for stepper motors. Keep a few cms of wires in the MMB box, it will be helpful in case you have to disassemble/reassemble.

MMB JUMPERS

Connect the jumpers as shown in orange.

FINAL ASSEMBLY

THE END! ... OR ALMOST :D



NEXT STEPS

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

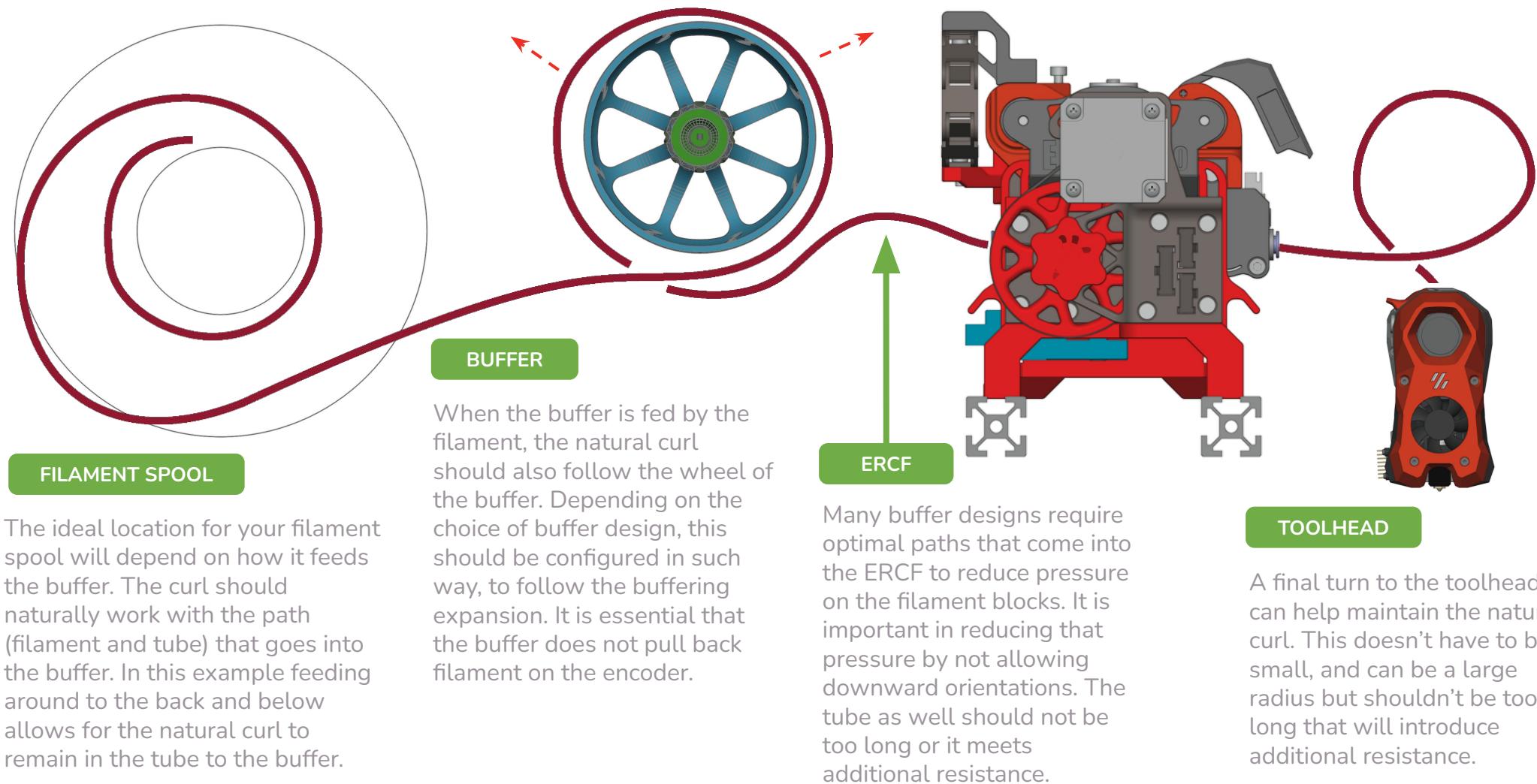
Its installation on the ERCF will be done as part of the setup and calibration step here:

https://github.com/Enraged-Rabbit-Community/ERCF_v2/blob/master/Documentation/Setup_Calibration.md

FILAMENT TUBE MANAGEMENT

BEST PRACTICES FOR FILAMENT TUBE MANAGEMENT

It is important to optimize your tube path to reduce any resistance for your MMU setup. This is to ensure that the path you choose does not go against the natural curl of your filament. ERCT, as an example is designed to support many of these best practices.



SOFTWARE SETUP AND CALIBRATION

ASSEMBLY COMPLETED! ... NEXT STEP: SETUP & CALIBRATION

This manual is designed to be a reference manual for the build process of an Enraged Rabbit Carrot Feeder v2 MultiMaterial System. Additional details about the build and background on advanced topics can be found on our documentation page linked below. The software setup and other initial setup steps with your new printer can also be found on our documentation page. We recommend starting here.



https://github.com/moggieuk/Happy-Hare/blob/main/doc/ercf_v2.md

REPORTING ISSUES

Should you find an issue in this document or have a suggestion for an improvement please consider opening an issue on GitHub:

(https://github.com/Enraged-Rabbit-Community/ERCF_v2/issues).

When raising an issue please include the relevant page numbers and a short description; annotated screenshots are also very welcome.

We will update the manual based on the feedback we get for the next release.

INTRODUCTION

HOW TO GET HELP

If you need assistance with your build you can head over the new ERCF Discord group. 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.

If you need help making ERCF work with your VORON printer, head to the VORON Discord group and post your questions in the ercf_questions channel.

ERCF



<https://discord.com/channels/1267663557999329371/>

GitHub

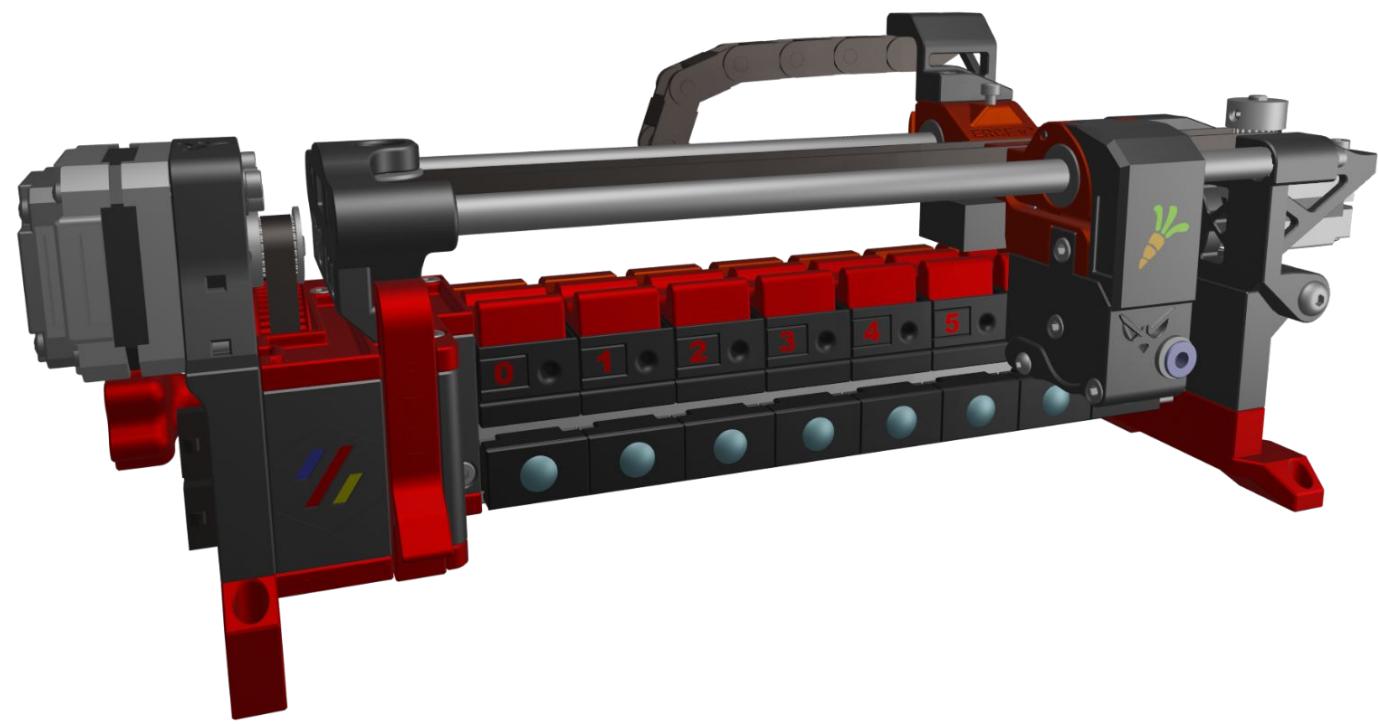
https://github.com/Enraged-Rabbit-Community/ERCF_v2

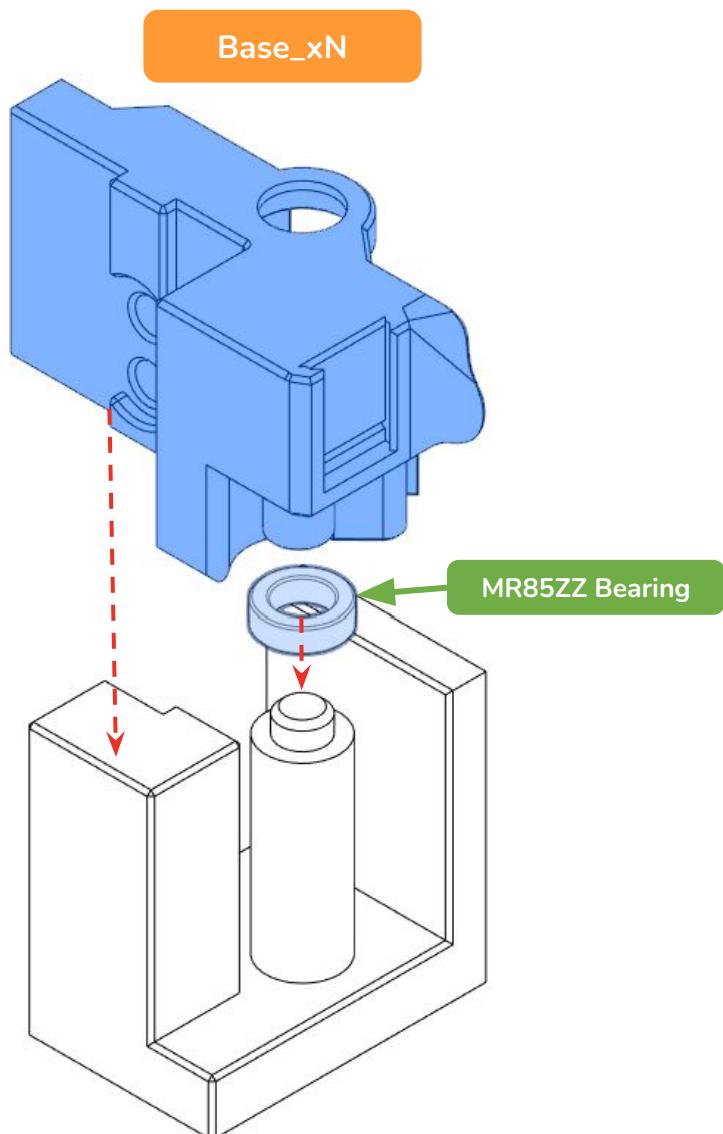
VORON



<https://discord.com/channels/460117602945990666/909743915475816458>

Enjoy your MMU.





DRIVE SHAFT BEARINGS

A printed jig is provided to help you with bearing insertion on the **Bases**. You can find it in the in [ERCF_v2/Stls/Tools/Bearing_Install_Tool.stl](#).

First, add an MR85ZZ bearing to the bearing insert tool. Then, slide the **Base** down onto the bearing as shown, so that the 2020 mounting groove in the **Base** mates with the groove in the **Bearing_Install_Tool**. The bearing should seat and remain in the **Base** when you pull the **Base** off of the **Bearing_Install_Tool**.

Install them into at least every 3rd **Base** and make sure you have one in the final **Base**. Optionally, bearings may be be installed into every **Base** but there is no net benefit in doing so.

| | Build Size | Min | Block # needing Bearings |
|----|------------|-----|--------------------------|
| 4 | 2 | | 2, 3 |
| 5 | 2 | | 2, 4 |
| 6 | 2 | | 2, 5 |
| 7 | 3 | | 2, 5, 6 |
| 8 | 3 | | 2, 5, 7 |
| 9 | 3 | | 2, 5, 8 |
| 10 | 4 | | 2, 5, 8, 9 |
| 11 | 4 | | 2, 5, 8, 10 |
| 12 | 4 | | 2, 5, 8, 11 |
| 13 | 5 | | 2, 5, 8, 11, 12 |
| 14 | 5 | | 2, 5, 8, 11, 13 |
| 15 | 5 | | 2, 5, 8, 11, 14 |

MOTOR MOUNT (DIRECT)

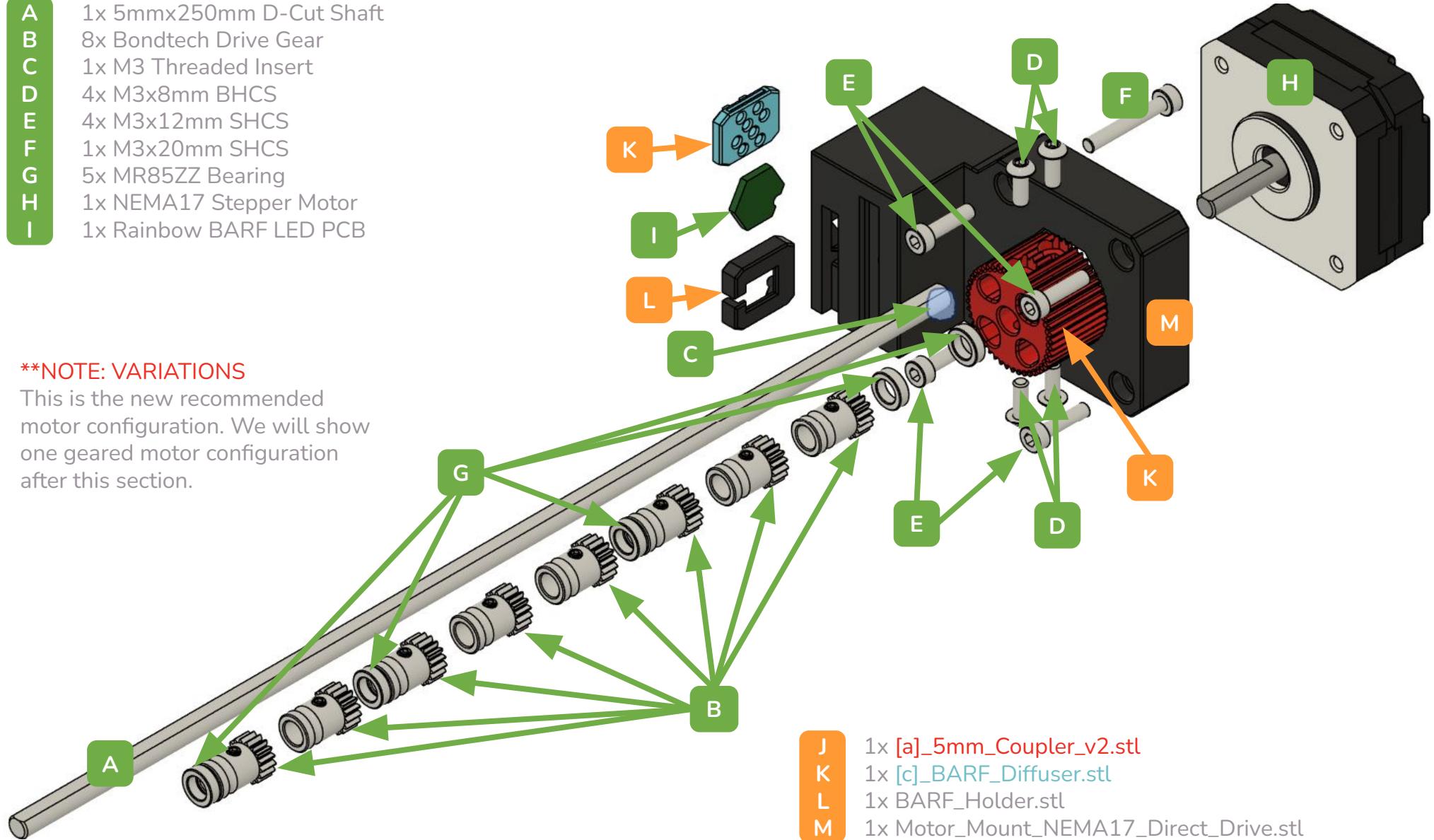
EXPLODED VIEW

GEARBOX SUB-BOM FOR PART 2

- A 1x 5mmx250mm D-Cut Shaft
- B 8x Bondtech Drive Gear
- C 1x M3 Threaded Insert
- D 4x M3x8mm BHCS
- E 4x M3x12mm SHCS
- F 1x M3x20mm SHCS
- G 5x MR85ZZ Bearing
- H 1x NEMA17 Stepper Motor
- I 1x Rainbow BARF LED PCB

**NOTE: VARIATIONS

This is the new recommended motor configuration. We will show one geared motor configuration after this section.



FILAMENT BLOCKS

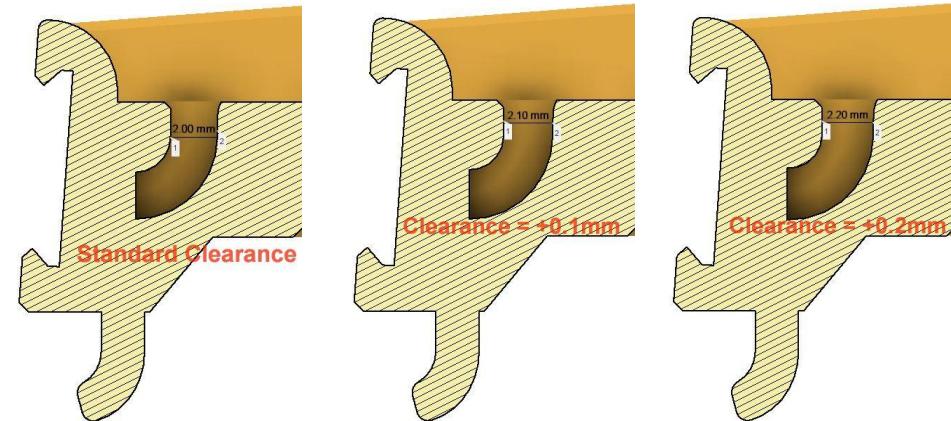
TOP HAT CLEARANCE OPTIONS

TOLERANCES

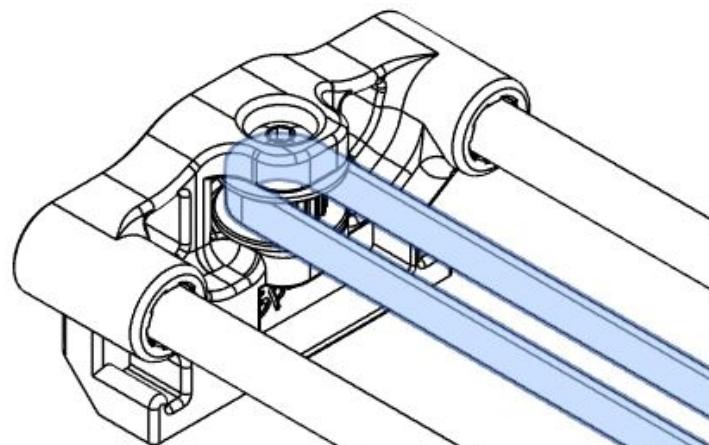
If you have trouble with the fitment process and can't get the **Tophat** to lock in place, there are two alternate **Filament_Path** parts provided with additional clearance built in (+0.1mm & +0.2mm).

These can be found in the following folder:

[ERCF_v2/Stls/Filament_Blocks/Clearance_Options/](#)



LINEAR AXIS



| Channels | Approx Belt Length (mm) |
|----------|-------------------------|
| N | 165 + 46N |
| 4 | 349 |
| 5 | 395 |
| 6 | 441 |
| 7 | 487 |
| 8 | 533 |
| 9 | 579 |
| 10 | 625 |
| 11 | 671 |
| 12 | 717 |
| 13 | 763 |
| 14 | 809 |
| 15 | 855 |

(Includes 10mm spare length)

PULLEY AND BELT INSTALLATION

BELT INSTALLATION

First, install the belt into the [Selector_Cart](#) by pushing the end of the belt into the toothed slot on the top of the [Selector_Cart](#). You may need to use a flathead screwdriver to push the belt fully into place.

Next, wrap the belt clockwise around the Idler, back through the hole in the [Selector_Cart](#), around the GT2 pulley, and finally to the [Belt_Tensioner](#).

Mark the belt length with a paint pen or marker. Now measure an additional 10mm of length, and cut the belt to the new mark. This ensures room for adjustment in a later step.

