ERCF v2.5 BUILD GUIDE

v2.5 EDITION

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

VERSION 2025-03-20

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

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WARNING

BEWARE

This project requires a well-tuned printer and ABS 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 19. You may need to tune your printer or printing profile before you print the rest of the parts!

Easily half of problems with this build that we see reported 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 calibration

-Your Pressure Advance setting

-Your Extrusion Multiplier, and

-Your Cooling and Layer Time settings

We can't speak highly enough of the Tuning Guide that Andrew Ellis has put together. The other steps are optional. If you encounter problems, try his Troubleshooting Guide!

PRINT GUIDELINES

PART PRINTING GUIDELINES

The Voron Team has provided the following print guidelines. The ERCF Team have added our own recommendations atop their guidelines. Please 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: Slicer default width, or 0.4mm

Arachne is the preferred slicing engine.

INFILL TYPE

Rectilinear, Honeycomb, Triangle or Cubic.

Grid and Gyroid are specifically **not recommended**.

INFILL PERCENTAGE

Recommended: 40%

WALL COUNT

Recommended : 4

SOLID TOP/BOTTOM LAYERS

Recommended : 5 or more

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

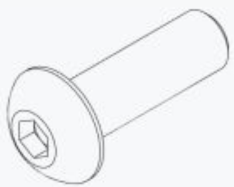
These files have an "**[o]**"prefix to denote that they need to be printed in an **opaque** material light can't penetrate, preferably black.

OPTIONAL MULTIMATERIAL

Example
[mm]_Selector_Door.3mf

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.

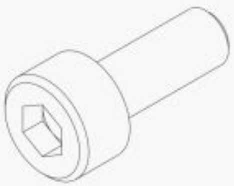
HARDWARE REFERENCE



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



SOCKET HEAD CAP SCREW (SHCS)

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

ISO 4762

FLAT HEAD COUNTERSUNK SCREW (FHCS)

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

ISO 10642

SELF TAPPING SCREW

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

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

MAGNETS

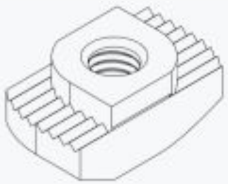
How do they work?

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.

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."

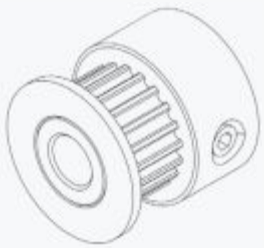


HAMMERHEAD NUT

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

HARDWARE REFERENCE

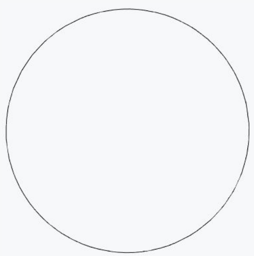
625 BEARING
A ball bearing used on the Encoder.



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.

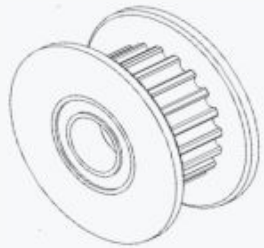
ISO 4026



5.5MM BALL BEARING
A ball bearing used in the CottonTail Buffer (optional).

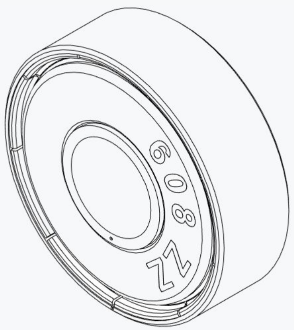
WASHER
Plain metal stamped washer.

DIN 125



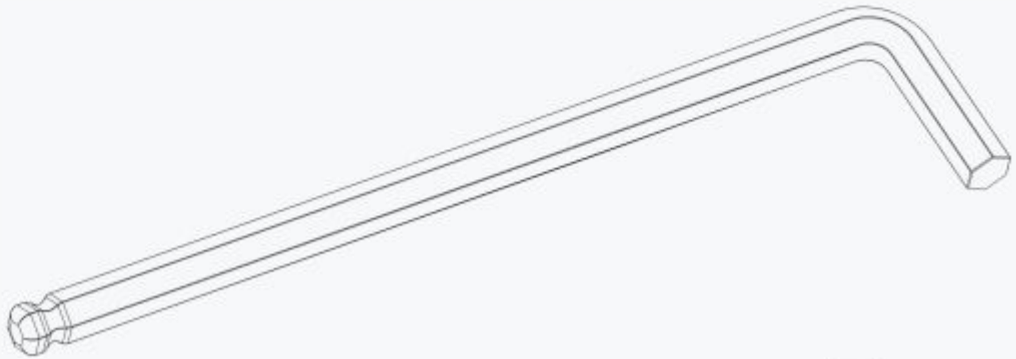
IDLER
GT2 idler used in the linear motion system of the ERCF.

HEATSET INSERT
These are made of brass , threaded on the inside and 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 CottonTail Buffer (optional),

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 4mm.

2.5MM HEX DRIVER

The 2.5mm hex driver will see a lot of use in this build. A quality straight 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](https://vorondesign.com/sourcing_guide) and switch to the "Voron Tools" tab at the bottom of the page.

TOOLS

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

WIRING CRIMPER
You'll need this to terminate your wiring. There are also turnkey wiring solutions out there you can buy, check Discord.

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.

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
(Optional) 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 †
(Optional) 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.

PRINTED PART TRACKER SPREADSHEET
There is a helpful interactive Printed Part Tracker for ERCFv2.5 here:

[Printed Parts Tracker Google Sheet]

THE ENRAGED RABBIT PROJECT

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.

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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)
- @mneuhaus 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)
- @kierantheman (Thumper Designer)
- @silverback_attack (Gearbox Feet Redesigner, Videographer)
- @skibikemake (Filametrix Designer)

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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 DISCORD https://discord.com/channels/1267663557999329371/

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

VORON DISCORD https://discord.com/channels/460117602945990666/909743915475816458

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, the only foolish question is the one left unasked!

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!

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HEATSET INSERTS

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=cyof7fYFcuQ

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 33 (Gearbox, 3 heatset inserts)
- Page 34 (Gearbox, 7 heatset inserts)
- Page 35 ([a]_Hatch, 2 heatset inserts)
- Page 99 ([a]_Selector_Cart, 3 heatset inserts)
- Page 102 (Drag_Chain_Anchor †, 2 heatset inserts)
- Page 113 (Encoder_Right, 3 heatset inserts)
- Page 124 (Linear_Axis_Selector_Motor_Support and [a]_Drag_Chain_Anchor_Bottom †, 4 and 2 heatset inserts)

USING THE CAD FILE

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.

UPGRADING FROM EARLIER VERSIONS

If you are upgrading from ERCFv1.1 or v2.0, 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 of all the reusable parts:

ERCF_v2.5 / STLs / 0._Tools
- Pulley_Tool_NEMA14.stl †
- Pulley_Tool_NEMA17.stl †
- 80T_Cog_Guide.stl †
- LED_Soldering_Tool_24mm.stl †
- Slotted_Wheel_Push_Tool.stl †

ERCF_v2.5 / STLs / 2._Motor_Mounts_Drive_Shaft / 2.3_Drive_Shaft
- [a]_Bearing_Spacer_x2.stl †
- [a]_Knob.stl †
- [a]_M4_80T_Wheel.stl †
- [a]_Side_Latch_x2.stl †

ERCF_v2.5 / STLs / 4._Gear_Box_Part_2 / 4.3_Apron_Leds
- [c]_Cover_Lens_xN.stl †
- Cover_Body_xN.stl †
- Holder_COAS_x2.stl †

/ Options
- [c]_Cover_Lens_No_Support_xN.stl †
- Cover_Body_No_Support_xN.stl †
- Holder_PCB_LED_xN.stl †
- Holder_SIBOOR_LEDs.stl †
- Holder_Strip_Leds_xN.stl †

ERCF_v2.5 / STLs / 6._Selector
- Belt_Tensioner.stl †
- Drag_Chain_Anchor.stl †
- Selector_Door.stl †
- Selector_Spring_Cap.stl †

ERCF_v2 / STLs / Supports / Adjustable_Mount
- [a]_Screw_x3.stl †
- Junction_Plate_Flat_x2.stl †
- Junction_Plate_Gear_Box.stl †

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 †

TOPHAT

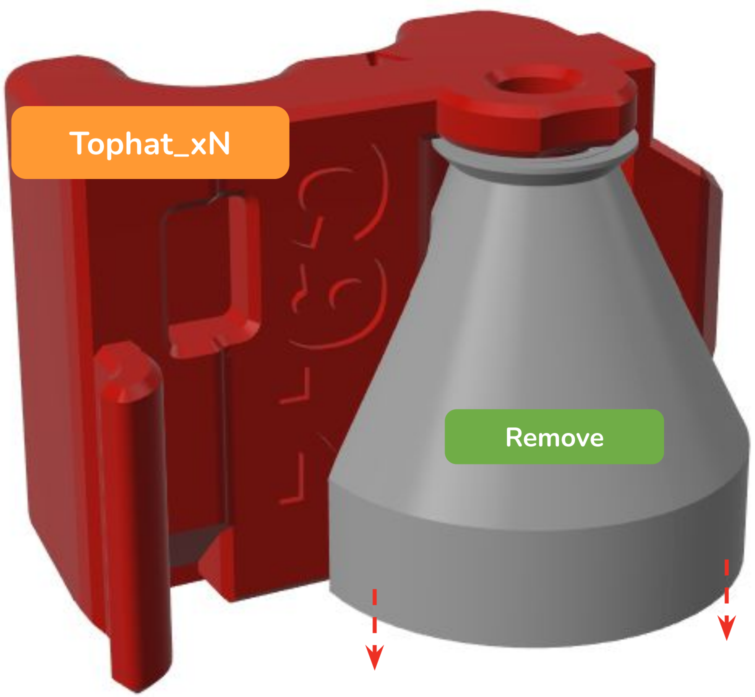
Print the calibration piece (Calib_test_For_C9.stl) and a single Tophat to ensure your printer and slicing profile are tuned.

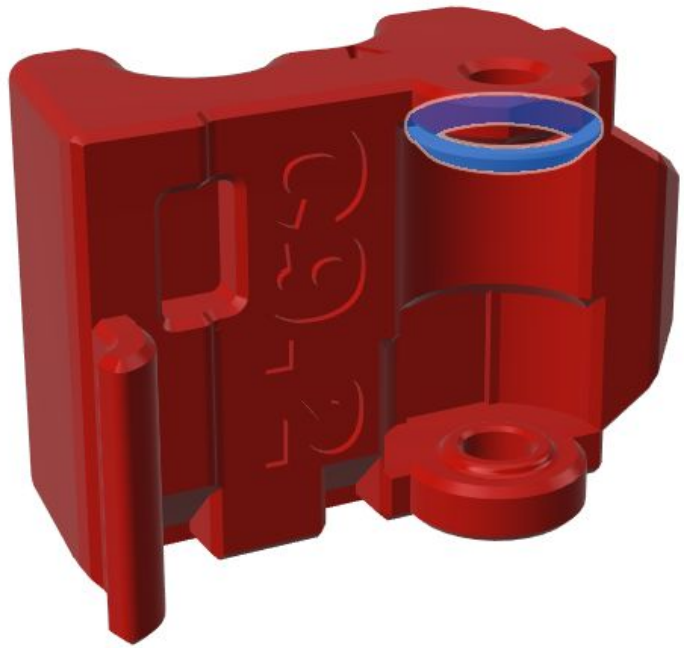
Before you begin you will need to remove the print-in-place support from your Tophat.

Using a small screwdriver may help. Please take care that you don't accidentally damage the part (or yourself!). Make sure that the ring at the top is clear of any stuck support..

Proceed to the next page to test your print calibration.

[These graphics will be updated soon]





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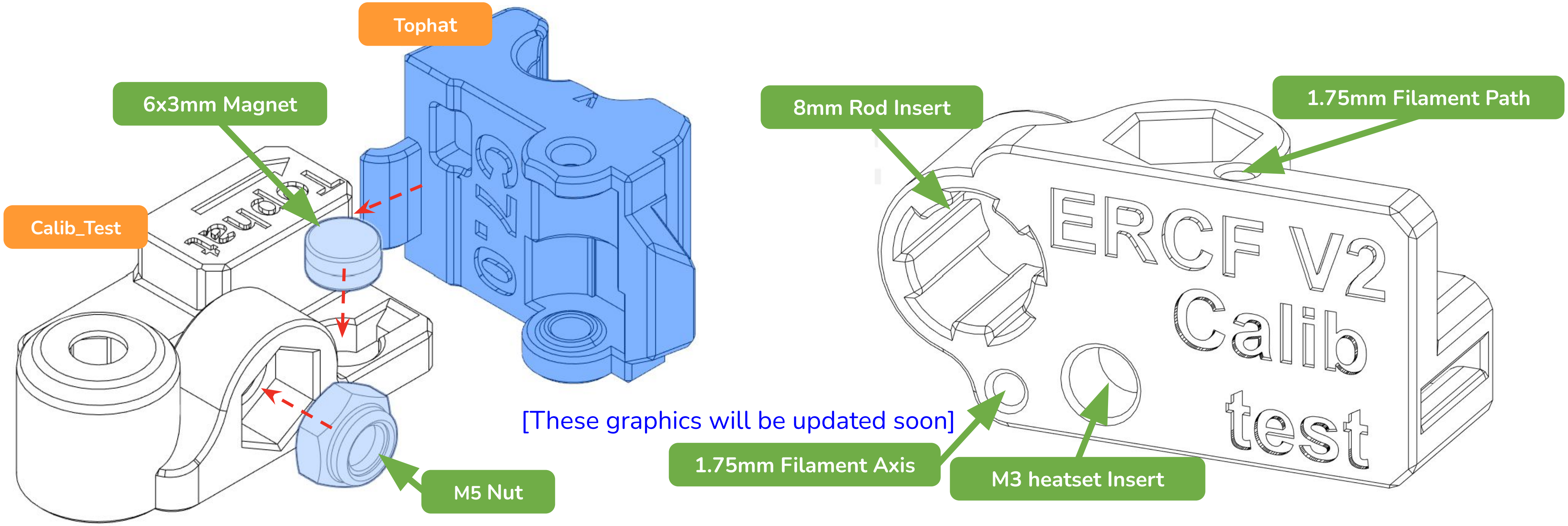
CALIBRATION TOOL

Print the calibration piece (Calib_test_For_C9.stl) and a single Tophat to ensure your printer and slicing profile are tuned.



[These graphics will be updated soon]

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. There should not be any “squish out” around the insert.

Use the Filament Path to check that 1.75mm filament slides through without friction. The Filament Axis should have some light friction. It is normal for the horizontal hole not to be round, this is simply due to layer height / resolution.

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.

If these tests fail, **stop and tune your filament profile**. 50%+ of issues we see on Discord are due to poorly printed parts.

LOCAL MCU VS REMOTE MCU

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 MMBv2 (our preferred option) and the EASY BRD.

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 setup or one of the “XL” mainboards like Octopus or Leviathan. If that’s you, then you can save some money on the buddy board by using this option.

Remote MCU setup has been moved to its’ own sub-manual to avoid confusion.

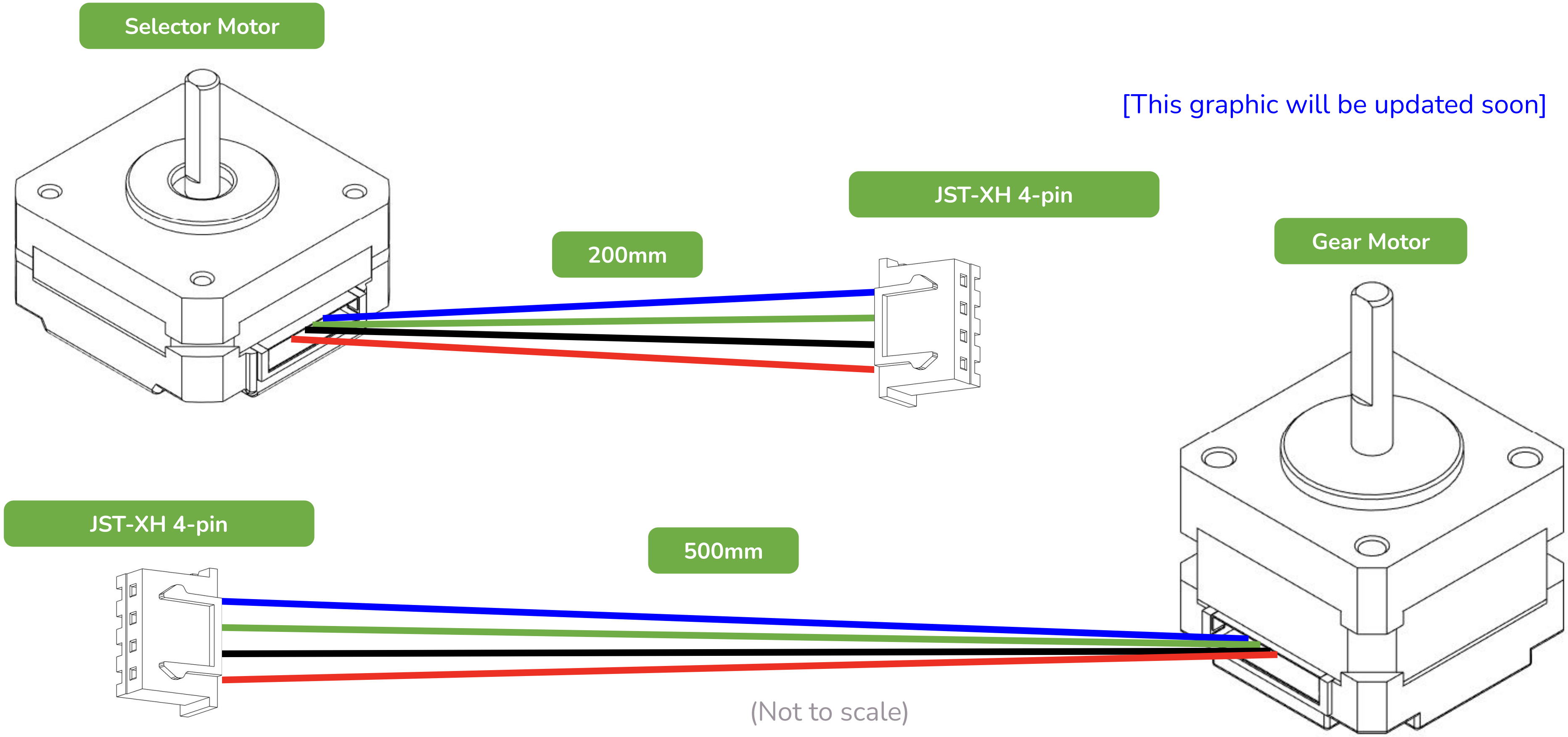
GEAR MOTOR WIRE

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, NEMA17 recommended).



(Not to scale)

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LED WIRING

WIRING THE LEDS

If you are using NeoPixels or individual LED PCBs, we provide a wiring jig with instructions on the next page. 22-24ga silicone wire is recommended for this use.

To prep for the soldering step, cut a length of wire for the run from your local MCU to the Logo LED according to the table on the right. Then cut a 100mm length of wire for the connection between the Logo LED and the Gate LEDs.

Next, cut your Gate LED connection wires to 22mm +/- 1.5mm. You need the same number of inter-LED wires as your number of filament channels, minus one. That's seven wires for the standard 8-channel build.

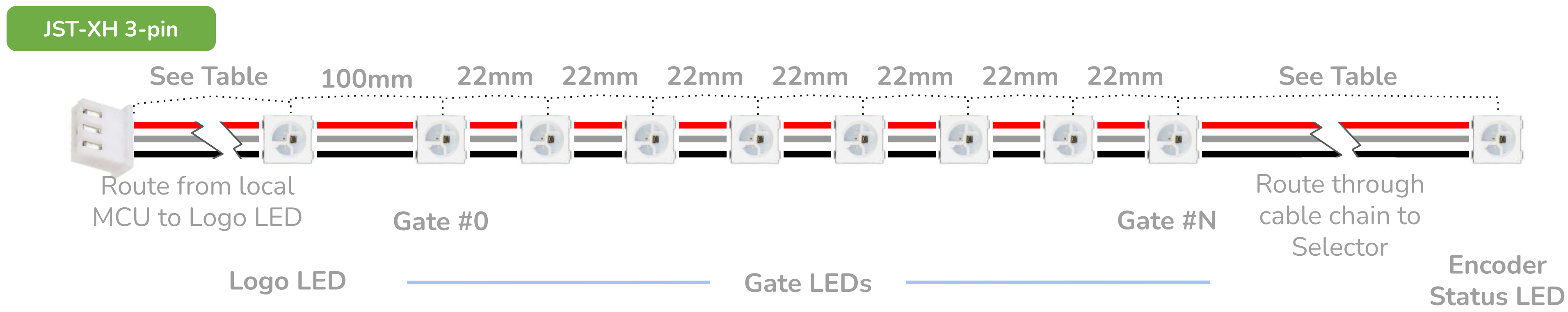
(If you're using the experimental Encoder LED, cut another length of wire for the run to the Encoder LED according to the table on the right.)

Now repeat the all of the steps above, preferably using two more colors of wire.

Strip back the ends of all of the wires between 1.5 and 3mm.

Crimp the Logo LED wires for JST-XH and insert the crimps into the connector.

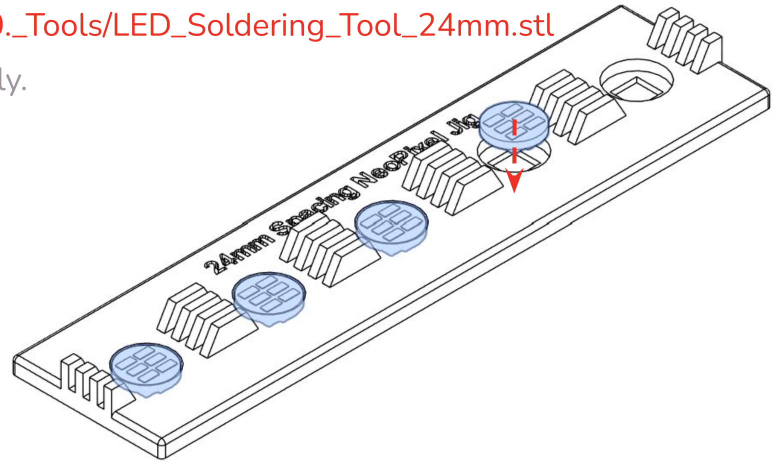
Channels	Logo LED Wire Length (mm)	Encoder LED Wire Length (mm)
N	175 + 25N	150 + 50N
4	275	350
5	300	400
6	325	450
7	350	500
8	375	550
9	400	600
10	425	650
11	450	700
12	475	750
13	500	800
14	525	850
15	550	900



SOLDERING THE LEDS

WIRING UP THE LEDS

There is a jig for wiring the LED PCBs together in the Tools folder: /STLs/0._Tools/LED_Soldering_Tool_24mm.stl



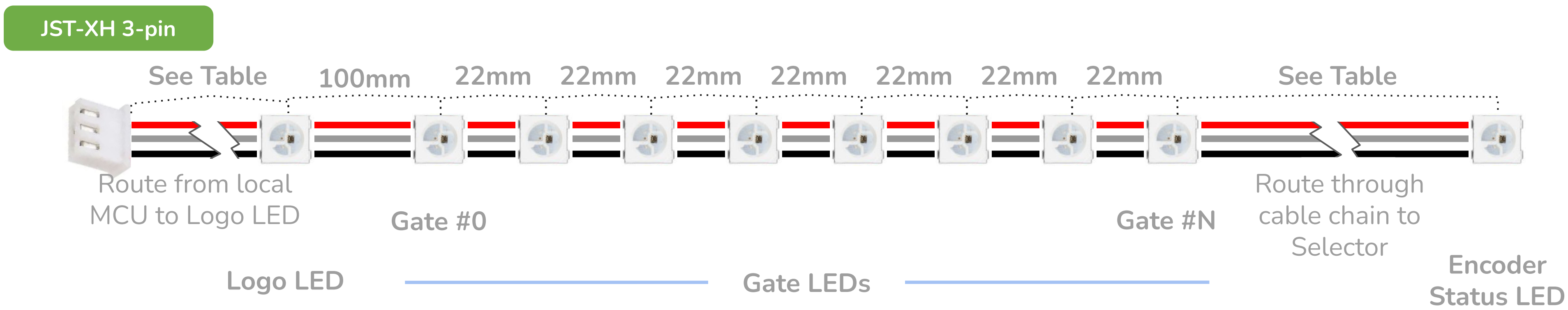
It is spaced to 24mm instead of 23mm to allow for the wires to flex slightly.

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

1. Place the first Logo LED into the jig. Make sure the LEDs are always positioned with the input (Din) on the left side.
2. Position your input wire with connector on the left of the first LED, and position the 100mm wire on the right. Solder all of the connections and unload the jig.
3. Load the jig with 4 LEDs and position the wires from the previous step on the left. Add the pre-cut 22mm wires between each LED. Solder all the connections. Unload the jig.
4. Repeat Step 3. You should now have 9 LEDs wired in a chain.

If you're using the experimental Encoder LED:

5. Place the last LED in the chain into the first slot. Position the long Encoder LED wires on the right and solder them in place.
6. Put the final Encoder LED into the jig, and position the end of the long Encoder LED wires to the right.



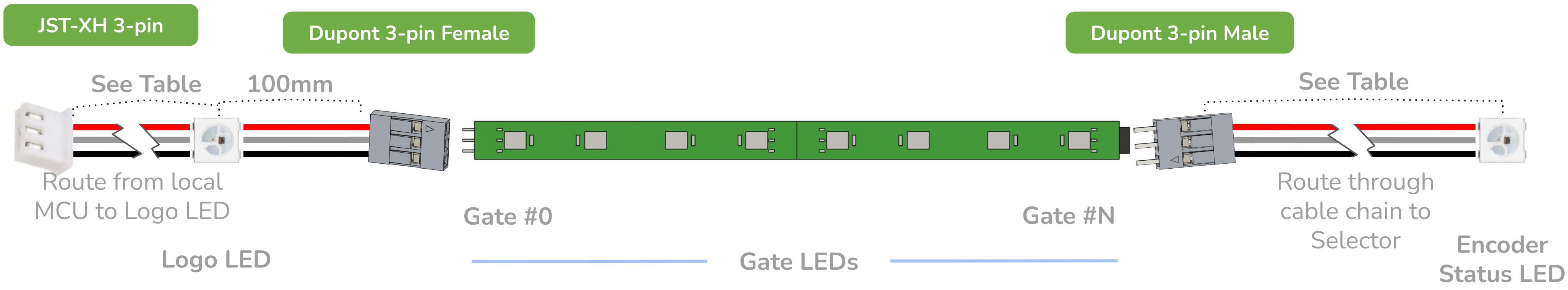
CARROT ON A STICK WIRING

CARROT ON A STICK

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

We still need one or two wiring pigtails: one to feed the Carrots on a Stick through the Logo LED, and one coming off of the Carrot on a Stick to the experimental Encoder LED. If you bought a kit, the wiring should be preassembled and ready to use. If not, you will need to crimp and solder the pigtails as shown.

Channels	Logo LED Wire Length (mm)	Encoder LED Wire Length (mm)
N	175 + 25N	150 + 50N
4	275	350
5	300	400
6	325	450
7	350	500
8	375	550
9	400	600
10	425	650
11	450	700
12	475	750
13	500	800
14	525	850
15	550	900



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.

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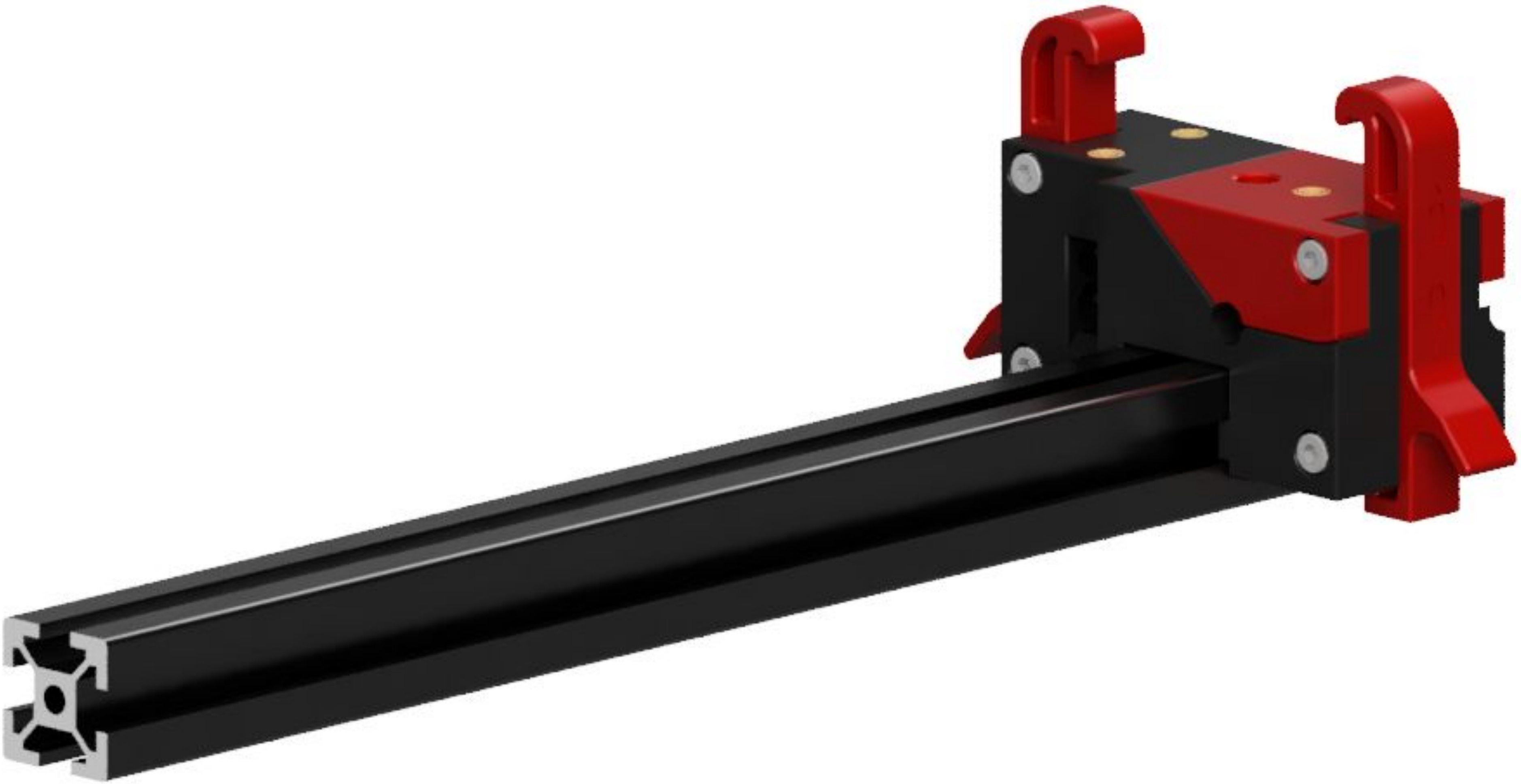
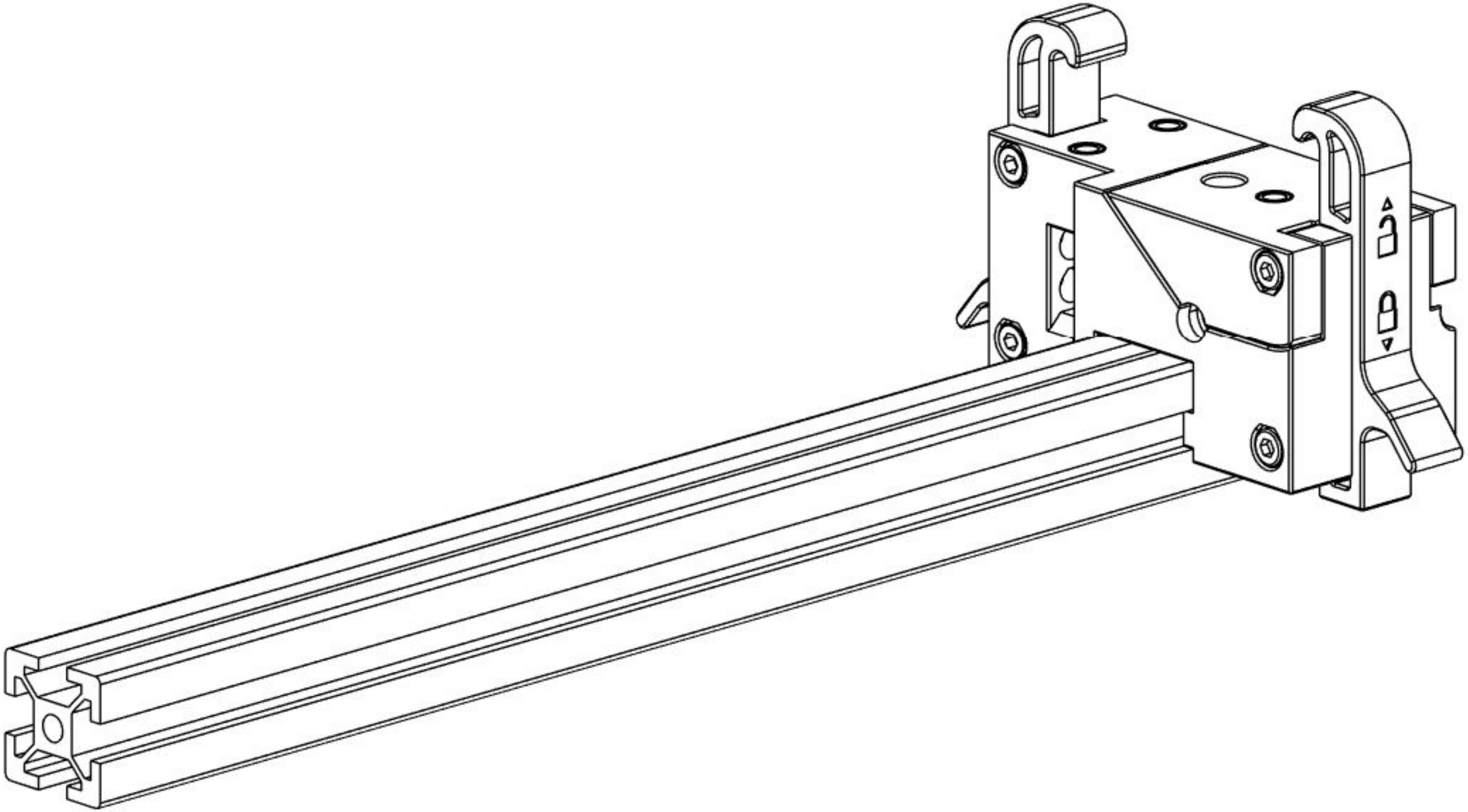
OVERVIEW



OVERVIEW



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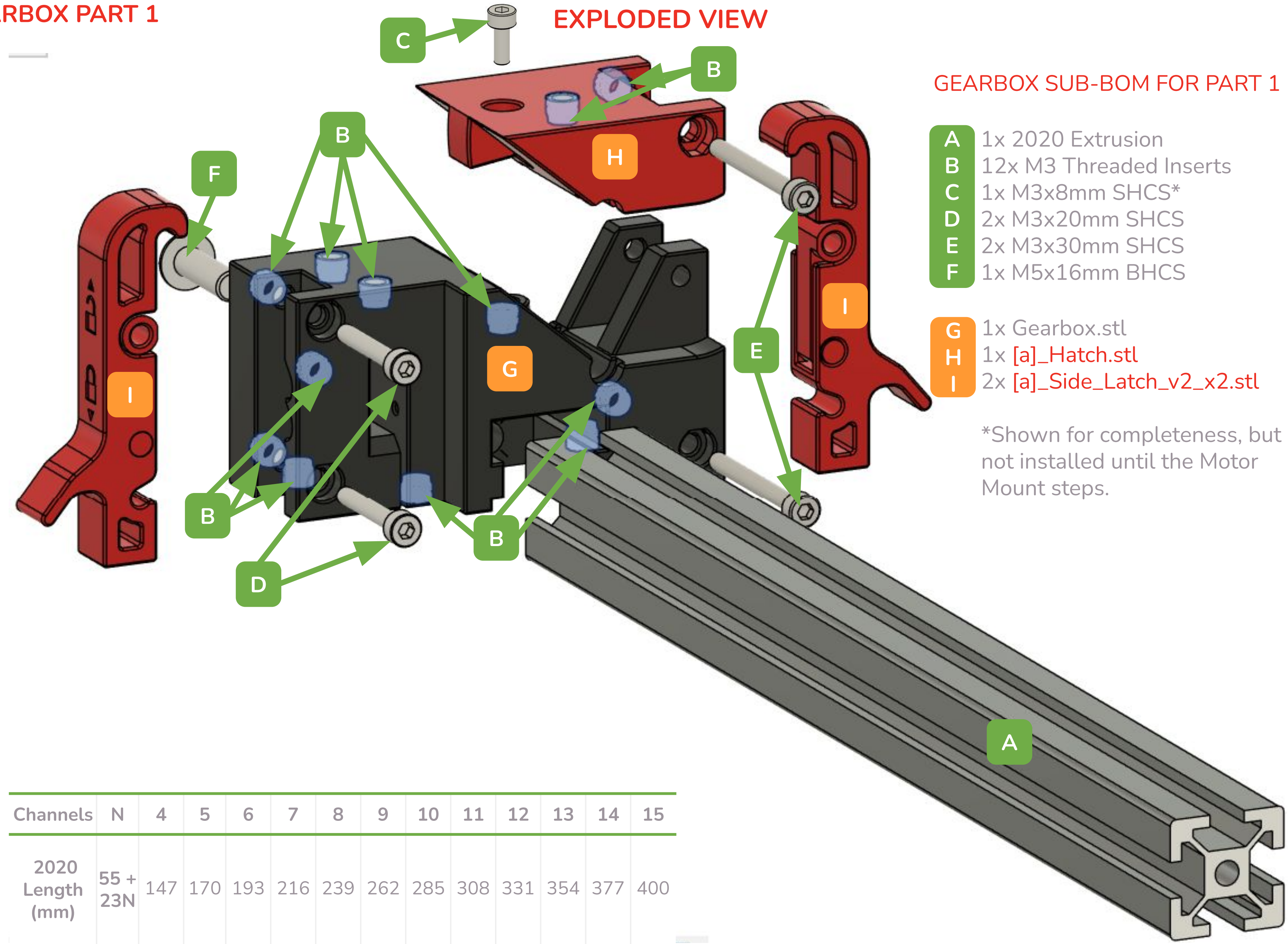
GEARBOX PART 1

EXPLODED VIEW



GEARBOX SUB-BOM FOR PART 1

- A 1x 2020 Extrusion
- B 12x M3 Threaded Inserts
- C 1x M3x8mm SHCS*
- D 2x M3x20mm SHCS
- E 2x M3x30mm SHCS
- F 1x M5x16mm BHCS

- G 1x Gearbox.stl
- H 1x [a]_Hatch.stl
- I 2x [a]_Side_Latch_v2_x2.stl

*Shown for completeness, but not installed until the Motor Mount steps.

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

2020 PREPARATION

1.1 2020 EXTRUSION PREPARATION

If you bought a v2.5 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. An M5 taper tap is perfect for this. The hole in your 2020 must be 4.4mm of lower in diameter.

Do not attempt to tap 2020 while there are things mounted to it, especially not your old ERCF. Take everything off first, or you will get tapping oil on your parts, and will have a hard time using the jig.

Use appropriate PPE such as gloves and safety glasses. Use oil and take care to tap the threads straight, preferably using a hand tap and *not* a drill. 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 to the 2020, with thanks to 2nd Layer Printing Designs: https://www.printables.com/model/1008892

Remember, if you mess up the first hole, you can usually flip the 2020 and try the other side. Just don't break your tap!

If your 2020 extrusion already has a hole that is 5mm or more, 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 for $7-8!

[A graphic will be added soon]

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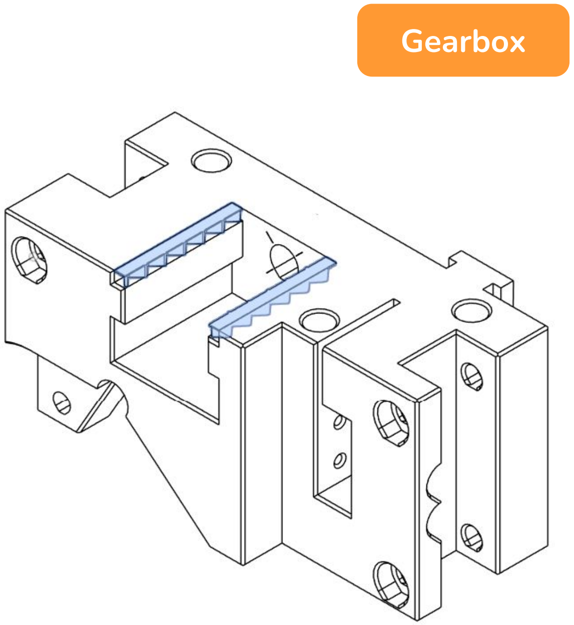
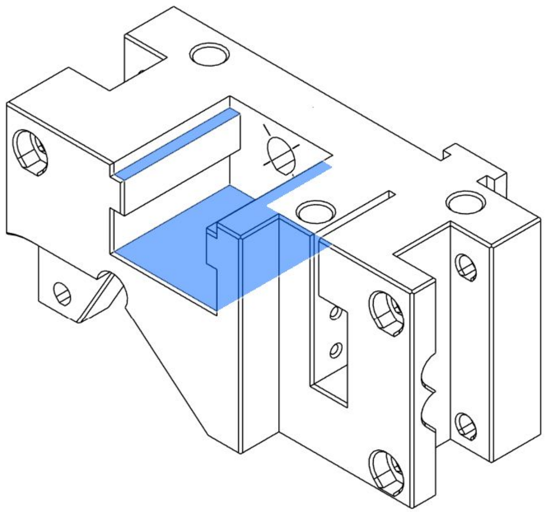
GEARBOX PREPARATION





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.

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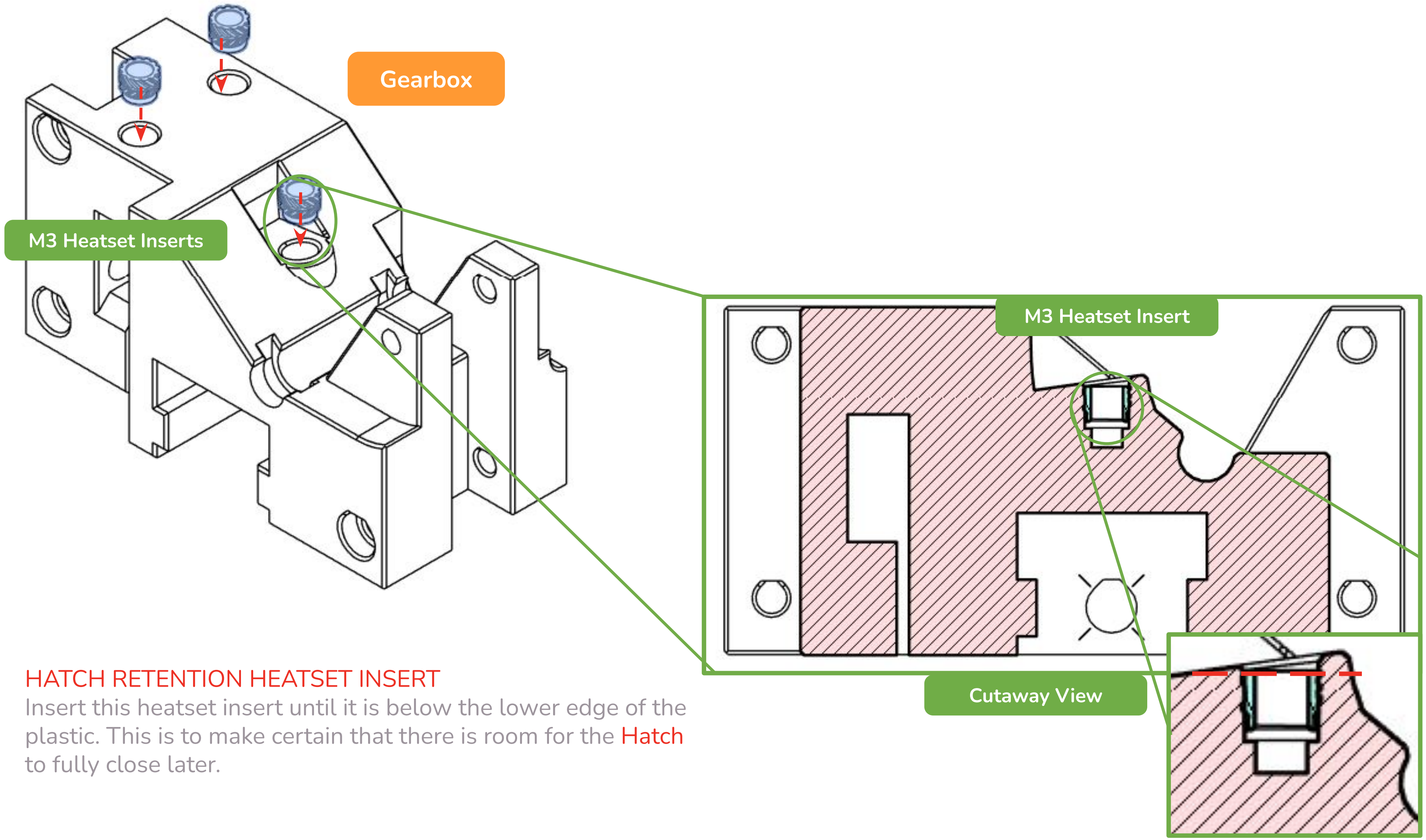
GEARBOX PREPARATION

1.2 HEATSET INSERTS

The list of pages with heatset inserts is on Page 16.



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.

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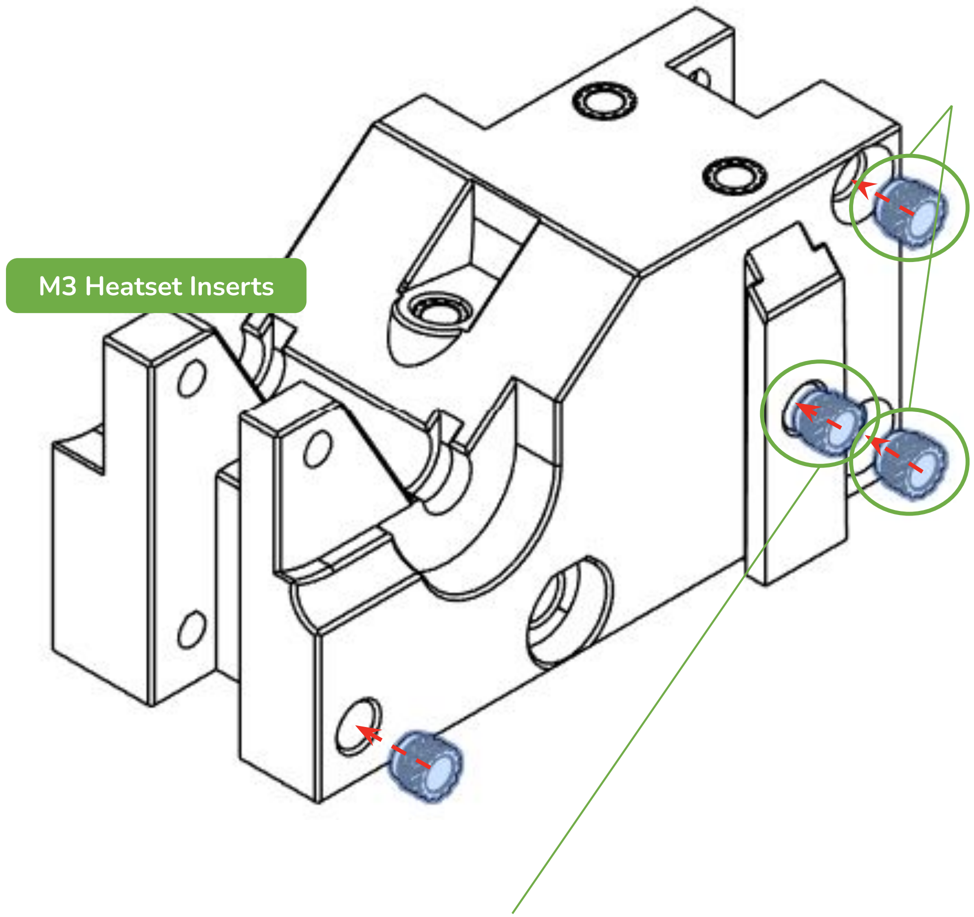
GEARBOX PREPARATION

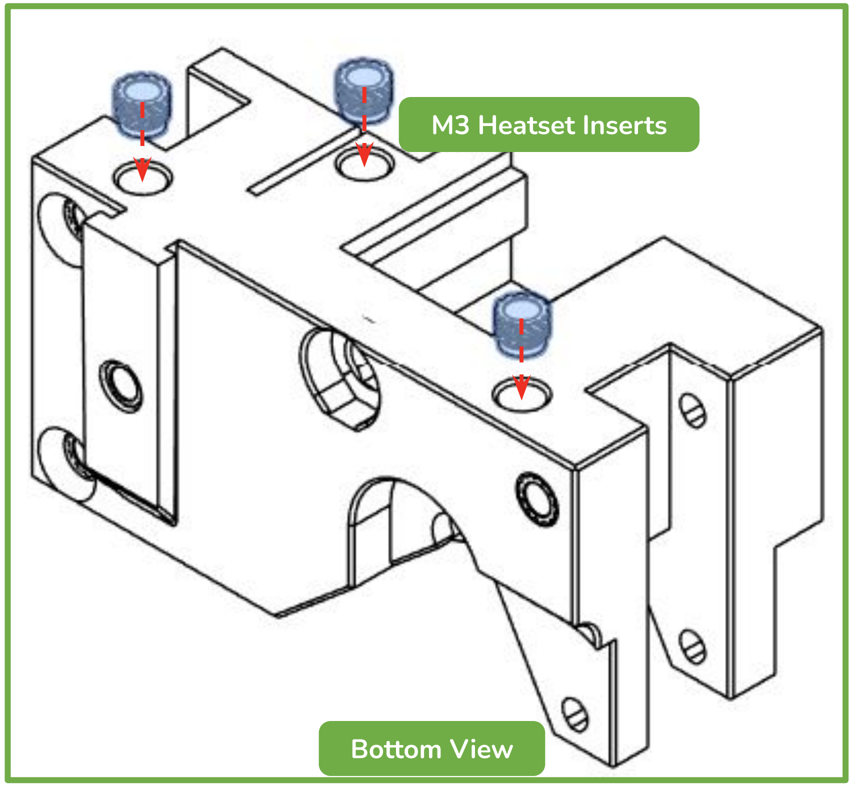
1.2 HEATSET INSERTS

The list of pages with heatset inserts is on Page 16.



DEEP HEATSET INSERTS

These inserts are set deeply into the Gearbox. This is so that we don't need to add new screws to the BOM, and also so that there is plenty of clearance for the motor mount to slide past these heatsets. The outer edges of the heatset should become invisible at the correct depth, but don't sweat it, this isn't an area that needs high precision.



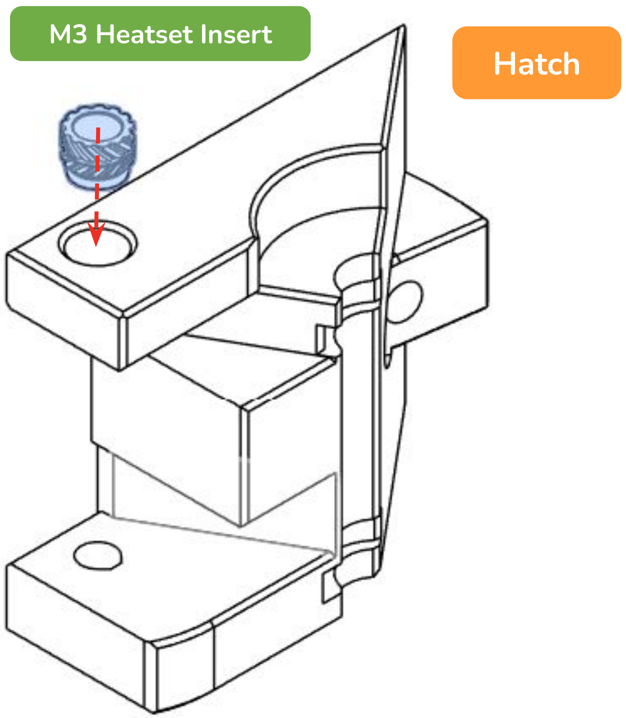
DOVETAIL HEATSET INSERT

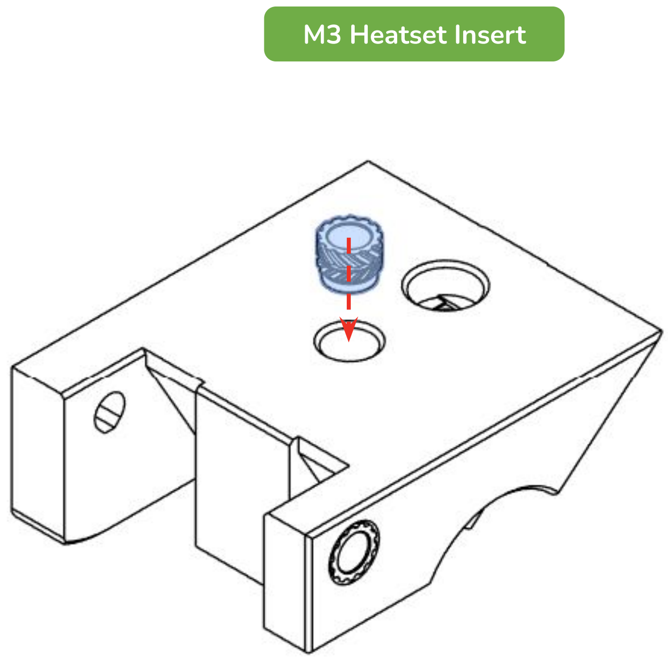
Insert this heatset insert until it is just below the edge of the plastic. This is to make certain that the dovetail for the Motor Mount works smoothly and doesn't catch on the heatset insert.

HATCH PREPARATION

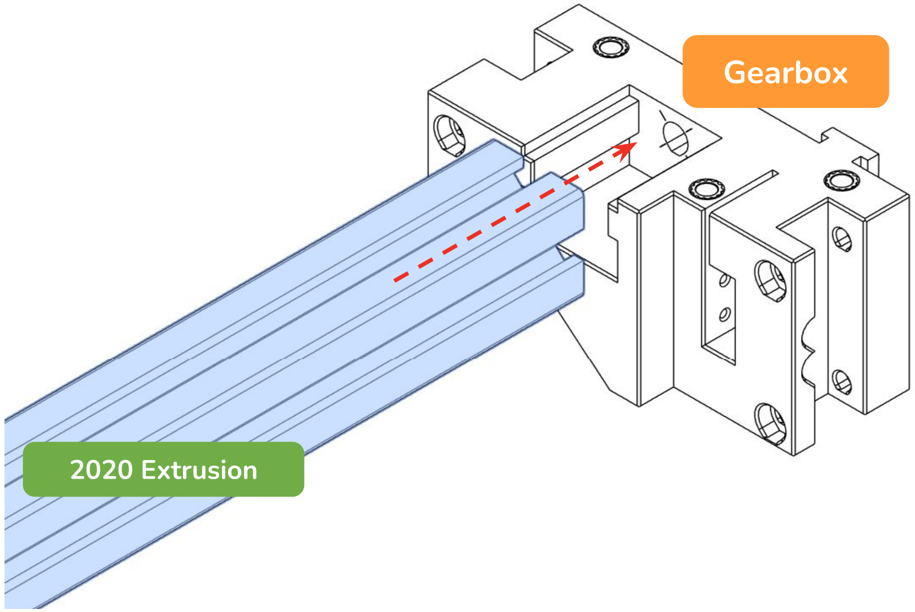
1.3 HEATSET INSERTS

The list of pages with heatset inserts is on Page 16.



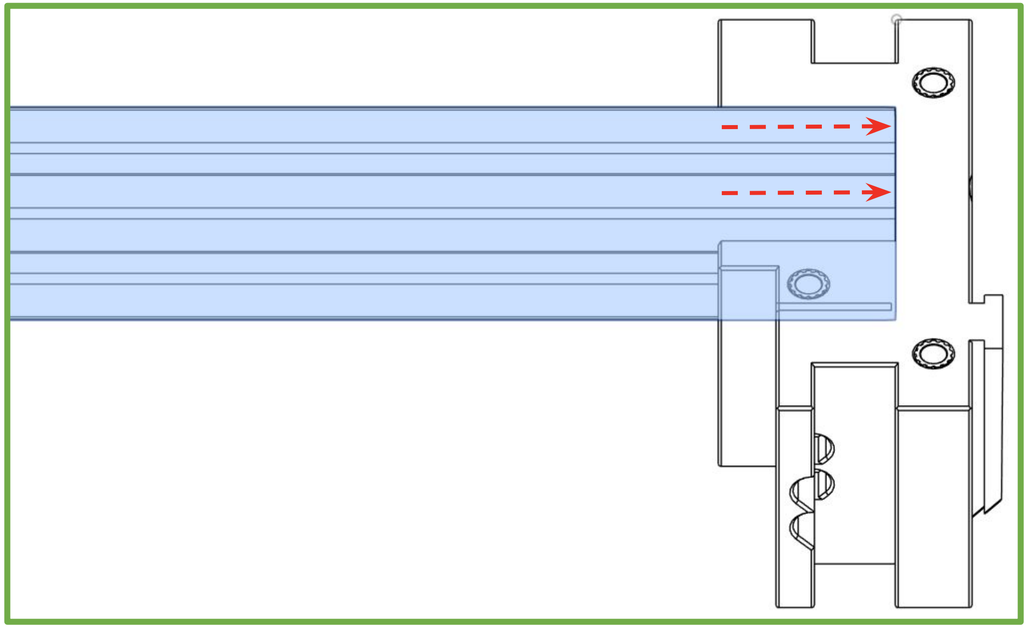


2020 INSTALLATION

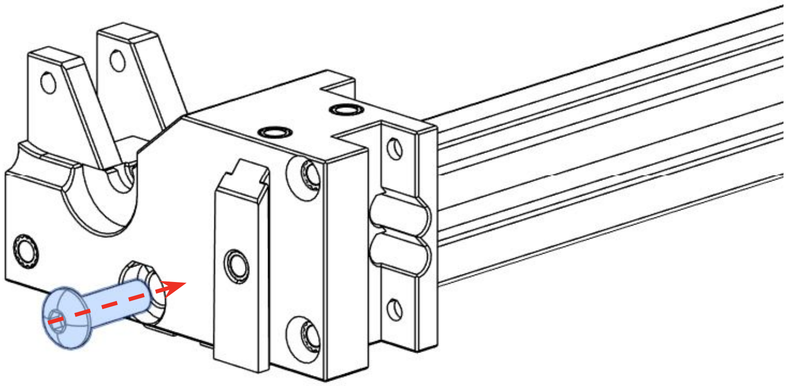


1.2 SEAT THE 2020

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.



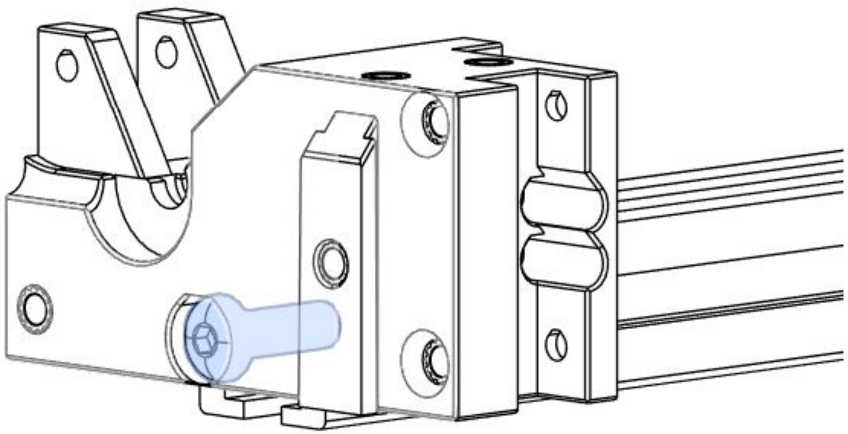
2020 INSTALLATION

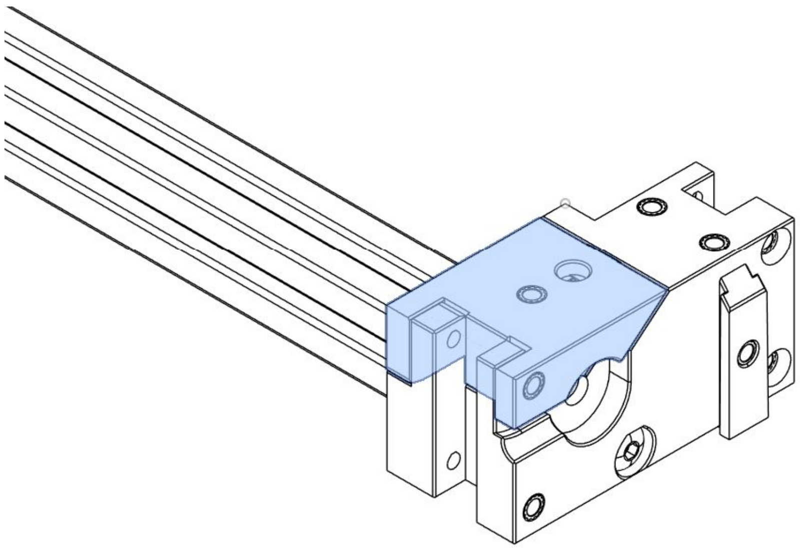


M5x16mm BHCS

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.

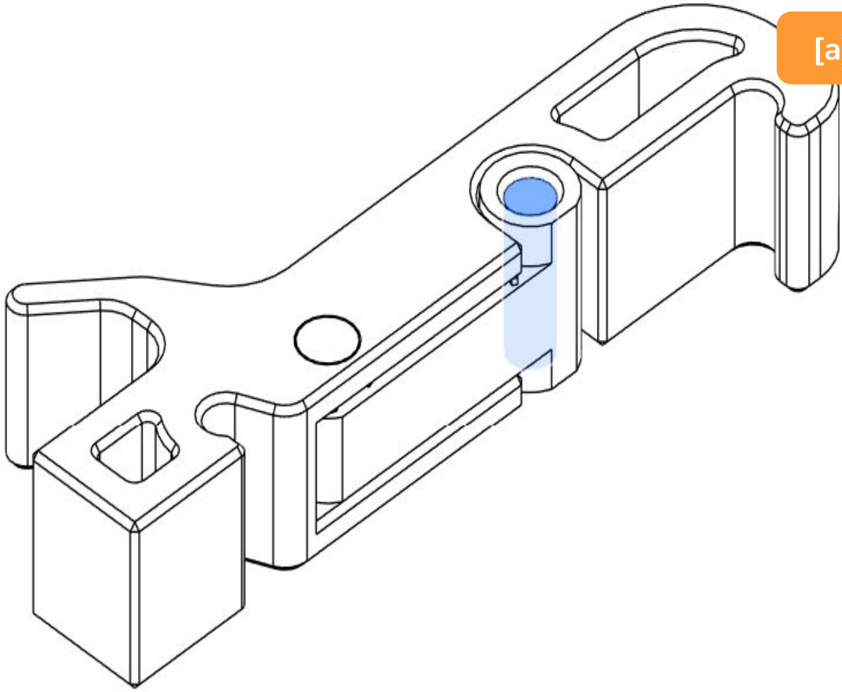


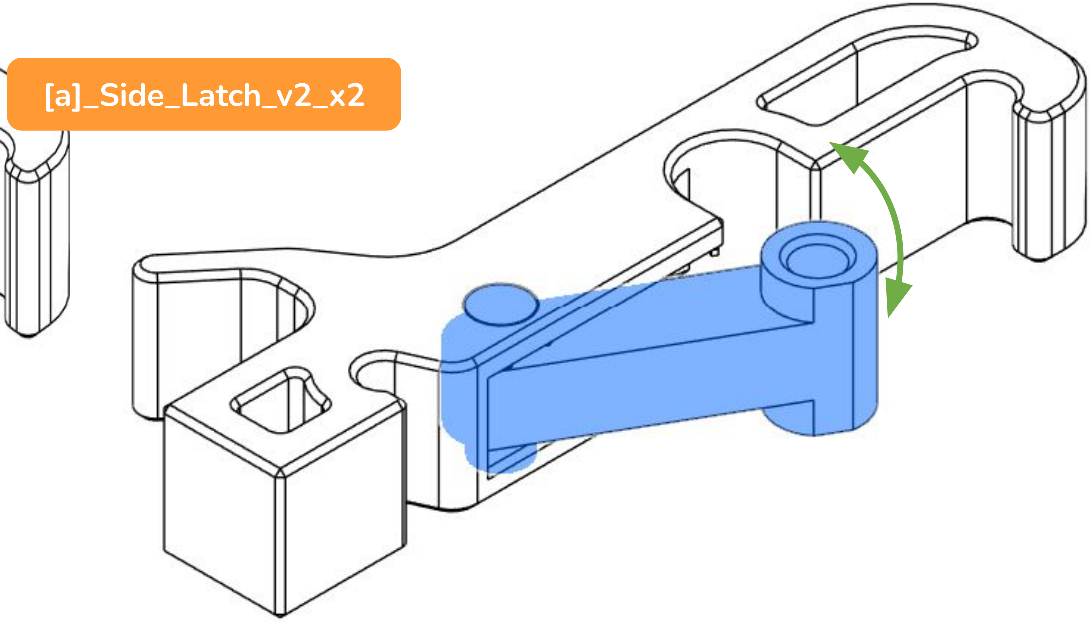


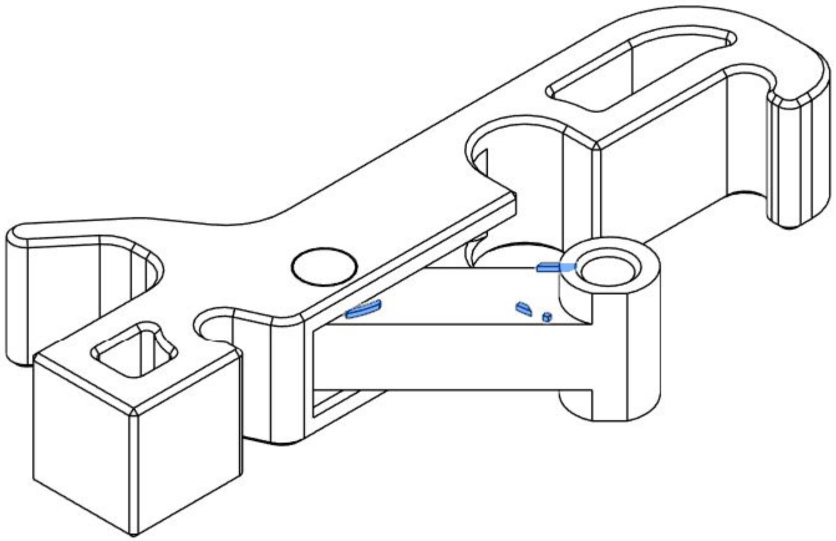
1.3 ADD THE HATCH

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

LATCH PREPARATION







1.4 HINGE UNLOCK

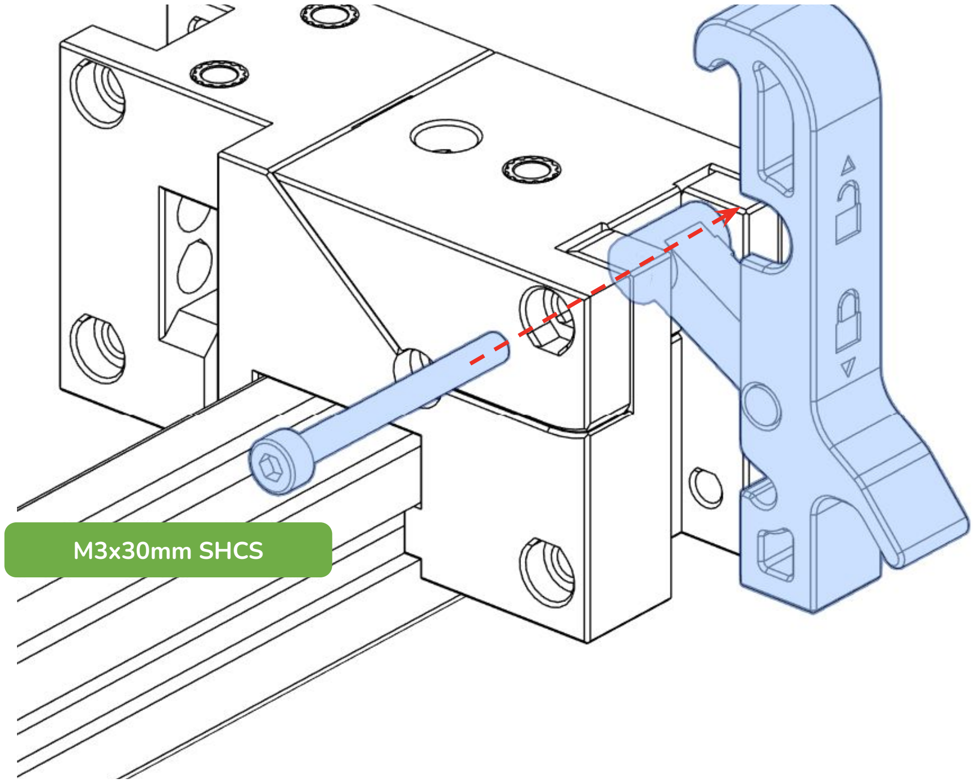
Use a small tool like an allen key or an M3x30mm SHCS inserted into the hinge hole to free the print-in-place mechanism and ensure it rotates freely. You may need to scrape the micro-supports off of the arm if the fit is too tight, but they are designed to either break off or be unobtrusive.

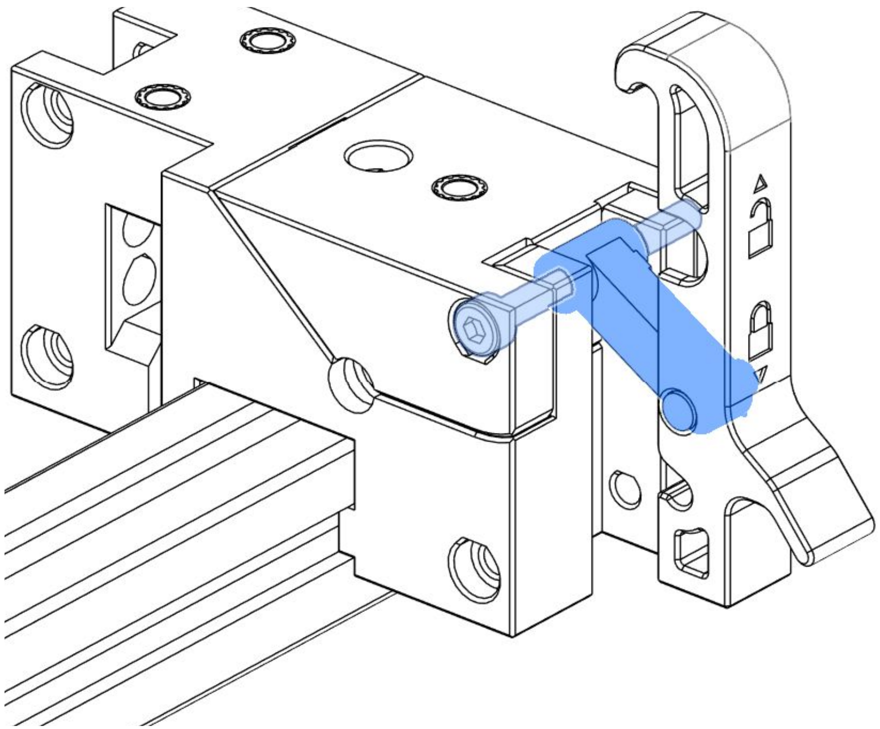
Do this for both of the Side_Latch_v2.

HATCH AND LATCH INSTALLATION

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.



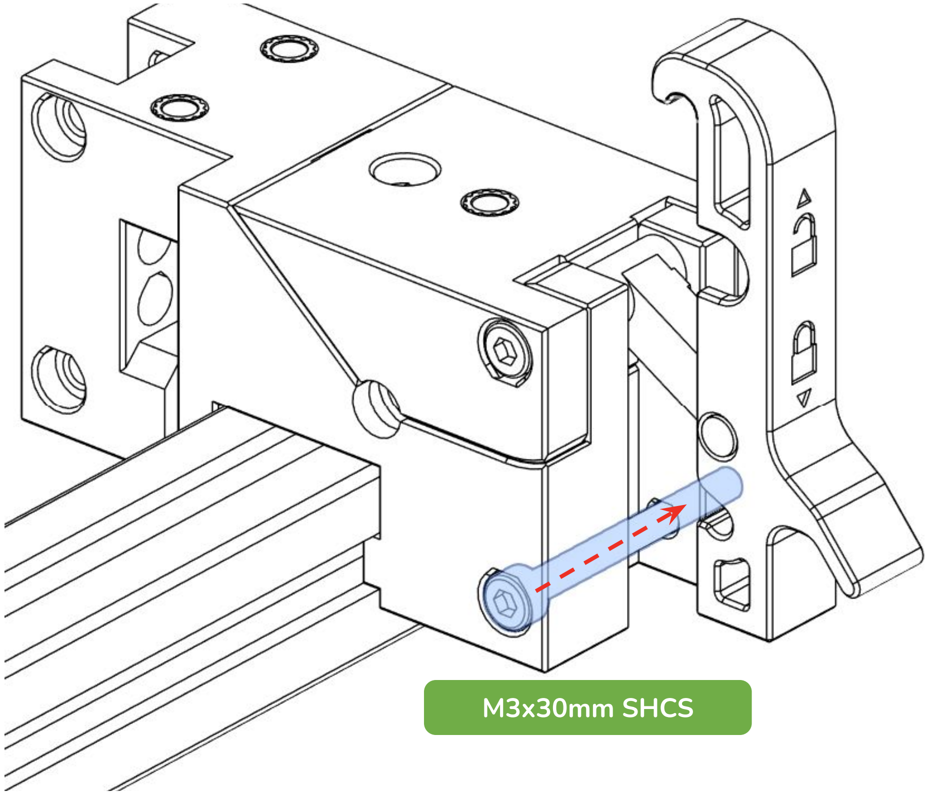


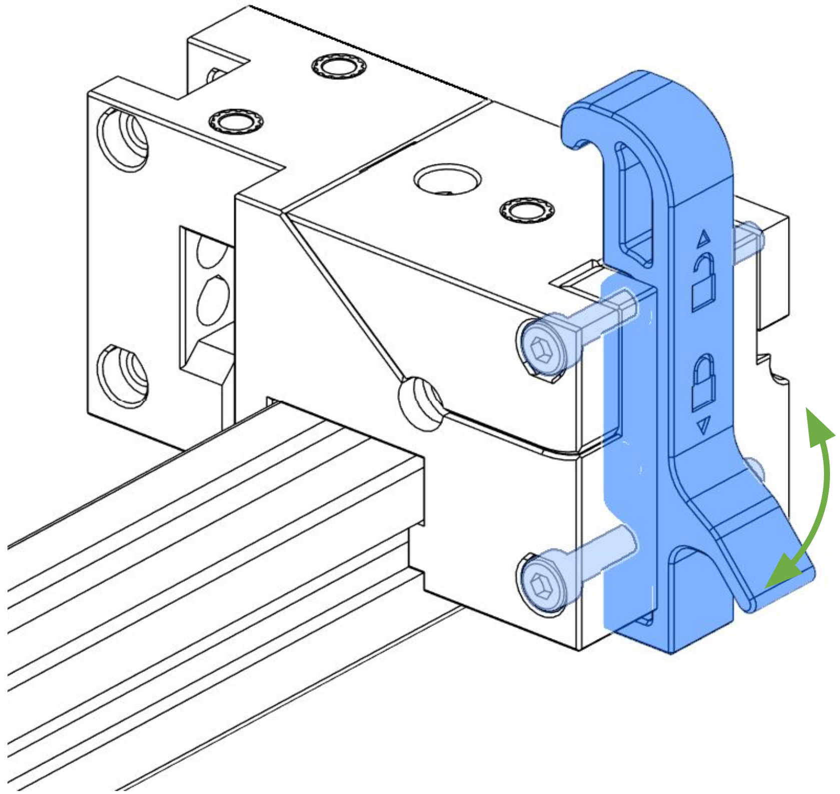
FINISH LATCH INSTALLATION

1.4 FINISH MOUNTING SIDE_LATCH_v2

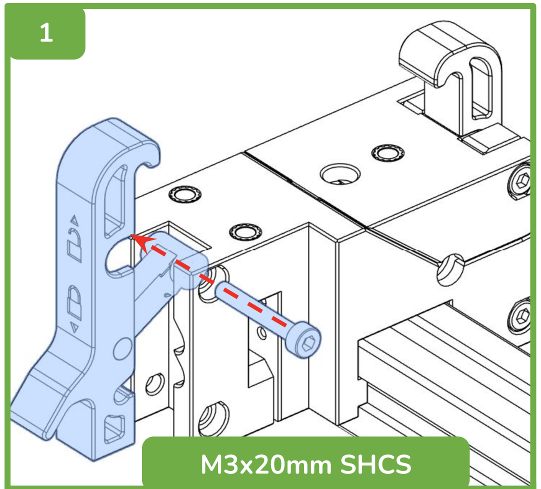
Line up another M3x30mm SHCS on the bottom hole and snug it into place.

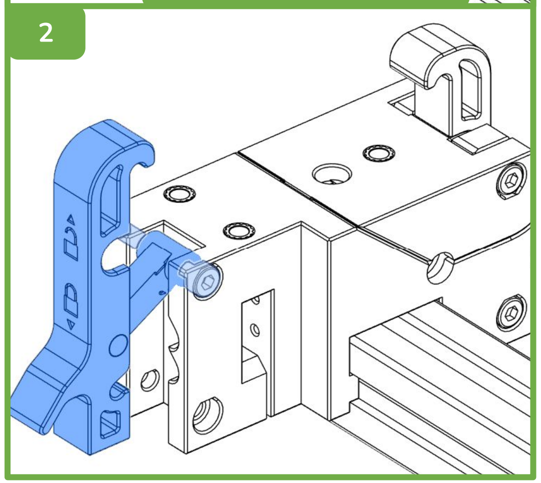
You should be able to swing the Side_Latch_v2 down and snap it into place. Practice opening it with the lever arm - If your bolts are too tight, or it's going to break, it's easier to fix now.





SECOND LATCH INSTALLATION





1.4 MOUNT THE SECOND SIDE_LATCH_v2

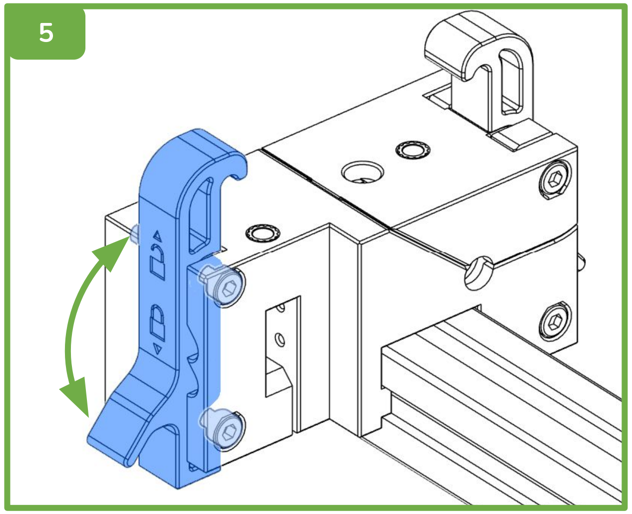
1. Line up an M3x20mm SHCS with the hole in the Side_Latch_v2 arm.

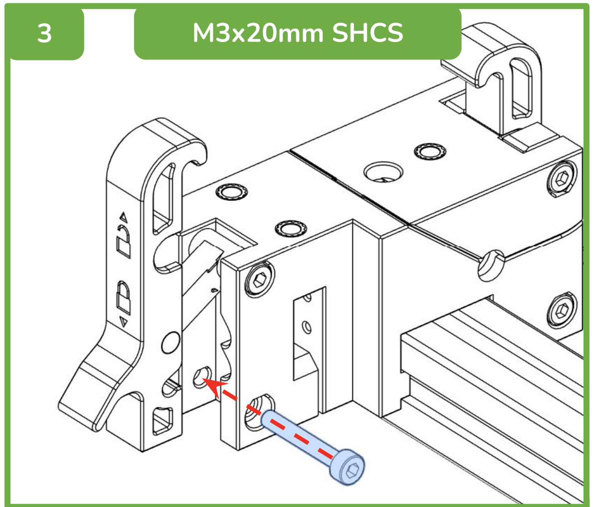
2. Snug the bolt into place. It doesn't need to be very tight - this bolt functions as a hinge for the Side_Latch_v2.

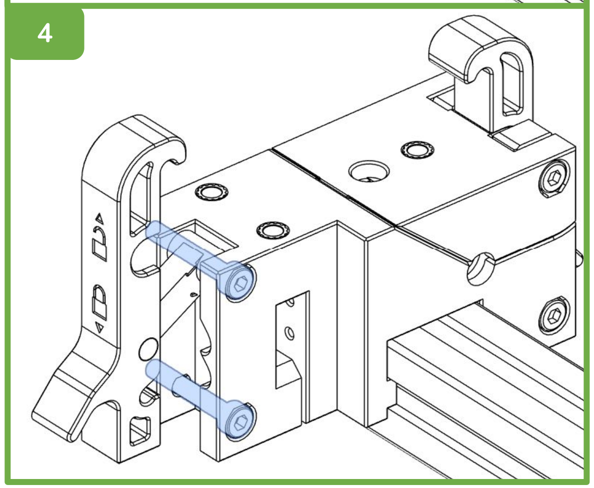
3. Line up another M3x20mm SHCS on the bottom hole.

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".

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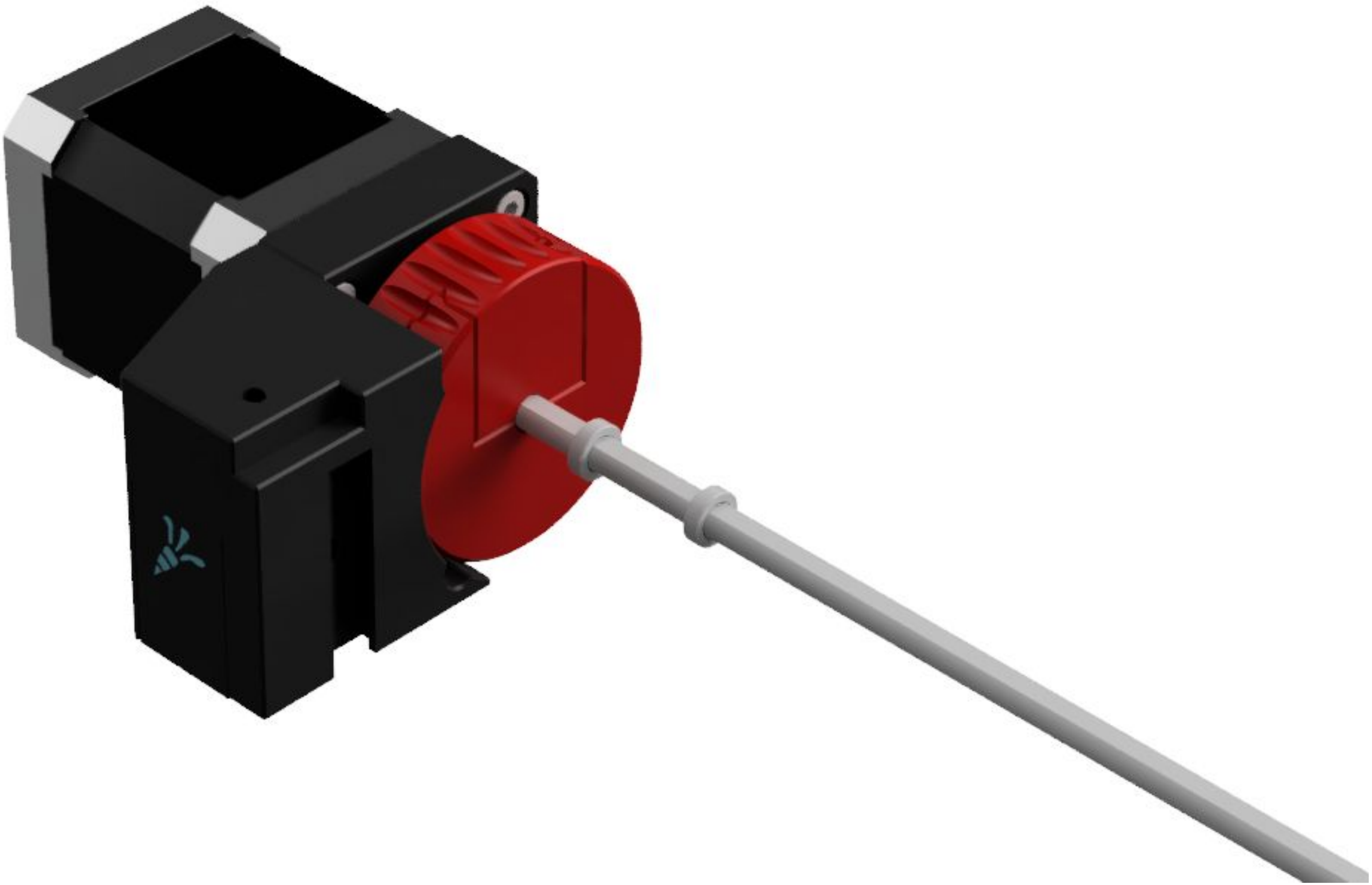
OVERVIEW



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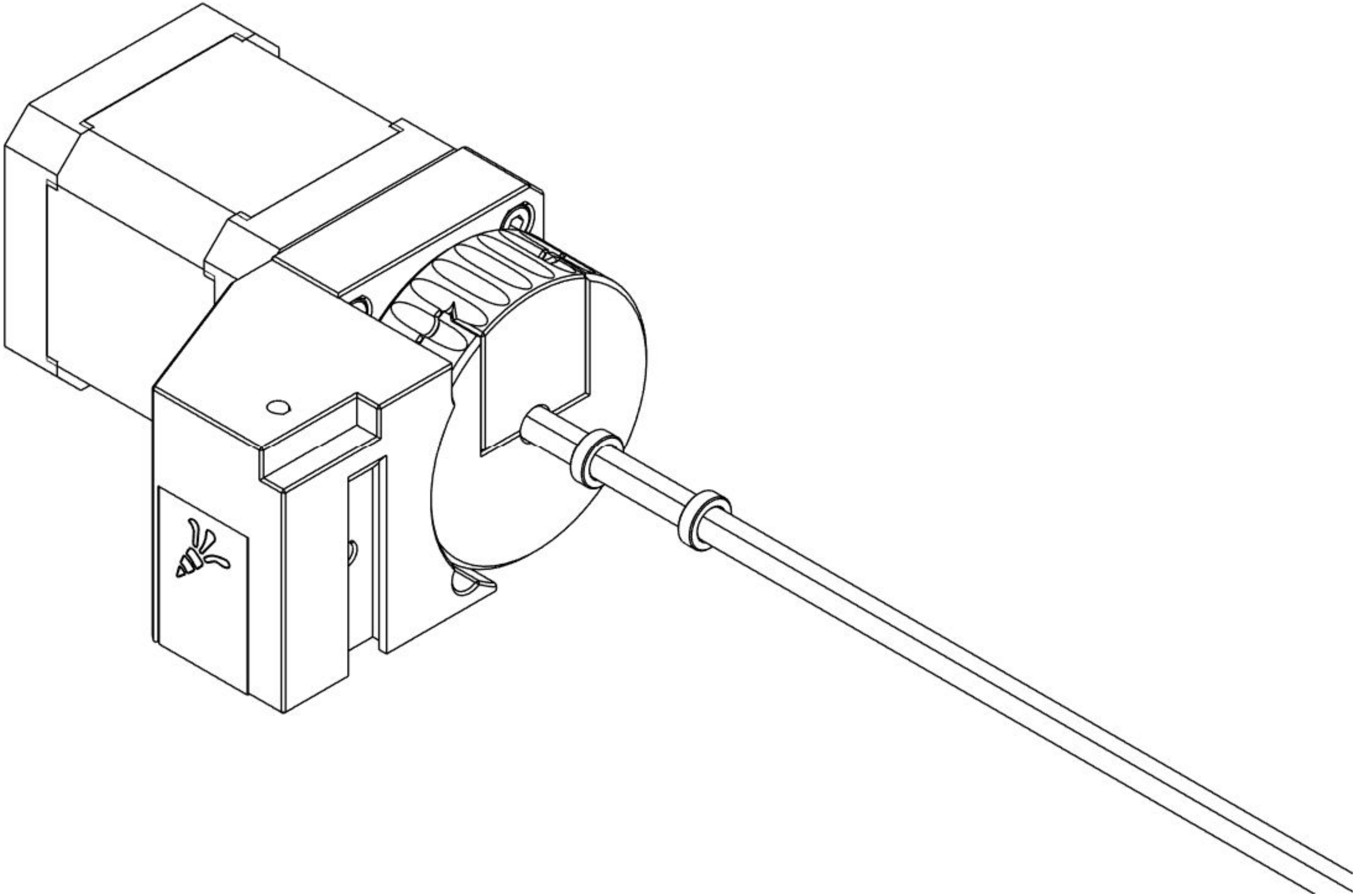
OVERVIEW



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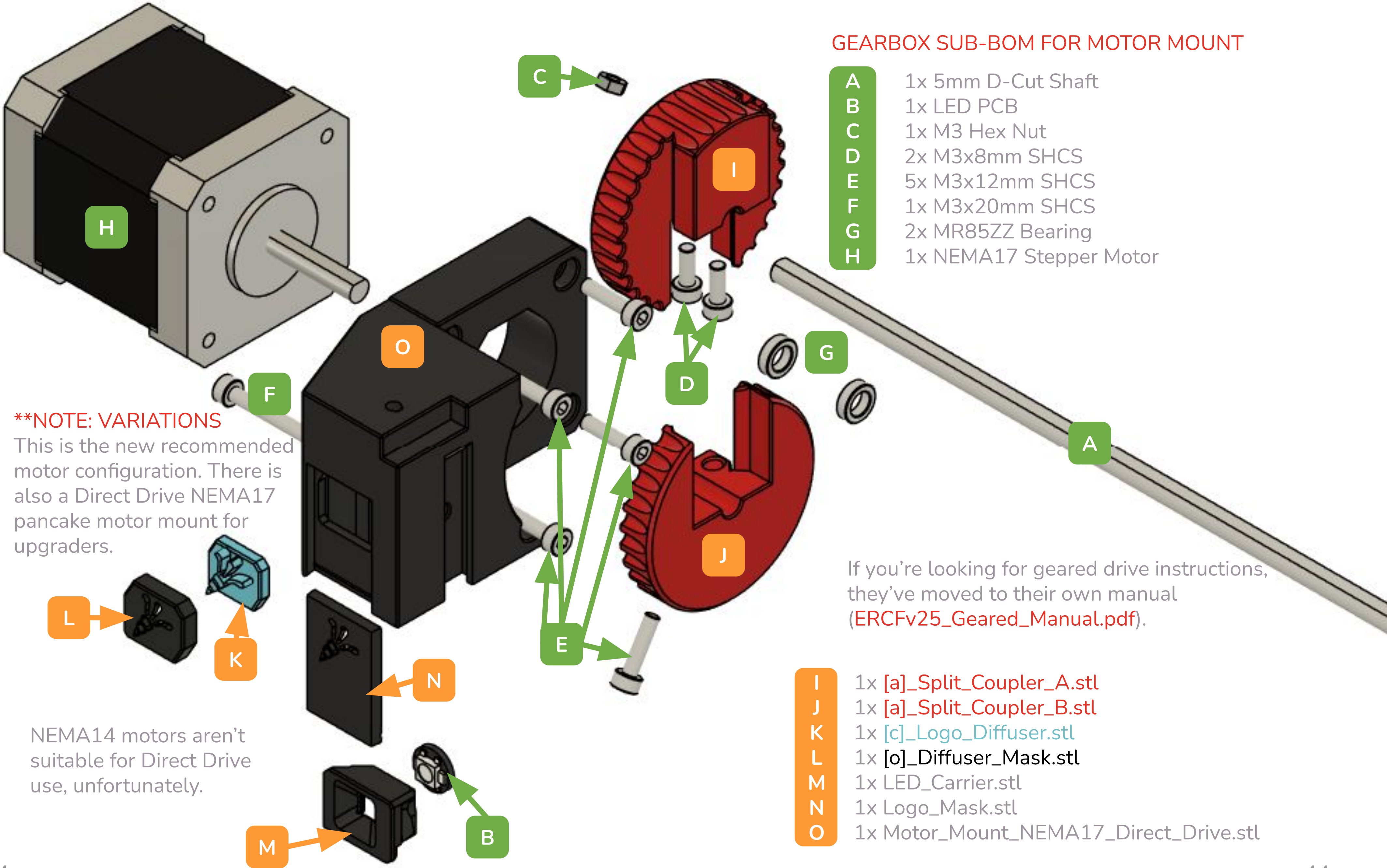
MOTOR MOUNT (DIRECT)

EXPLODED VIEW



GEARBOX SUB-BOM FOR MOTOR MOUNT

A	1x 5mm D-Cut Shaft
B	1x LED PCB
C	1x M3 Hex Nut
D	2x M3x8mm SHCS
E	5x M3x12mm SHCS
F	1x M3x20mm SHCS
G	2x MR85ZZ Bearing
H	1x NEMA17 Stepper Motor

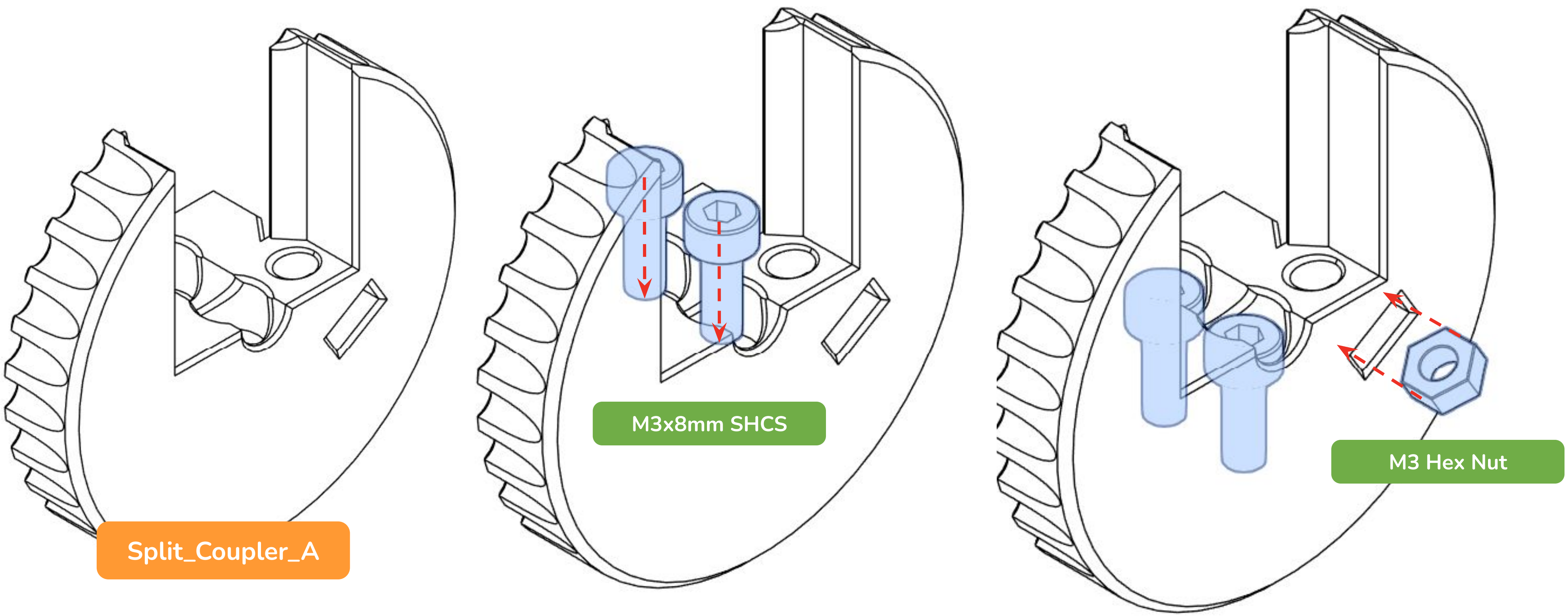
**NOTE: VARIATIONS
This is the new recommended motor configuration. There is also a Direct Drive NEMA17 pancake motor mount for upgraders.

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

If you're looking for geared drive instructions, they've moved to their own manual (ERCFv25_Geared_Manual.pdf).

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

PREP COUPLER



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.

GEARBOX PREPARATION

2.1 MOTOR MOUNT MESHING

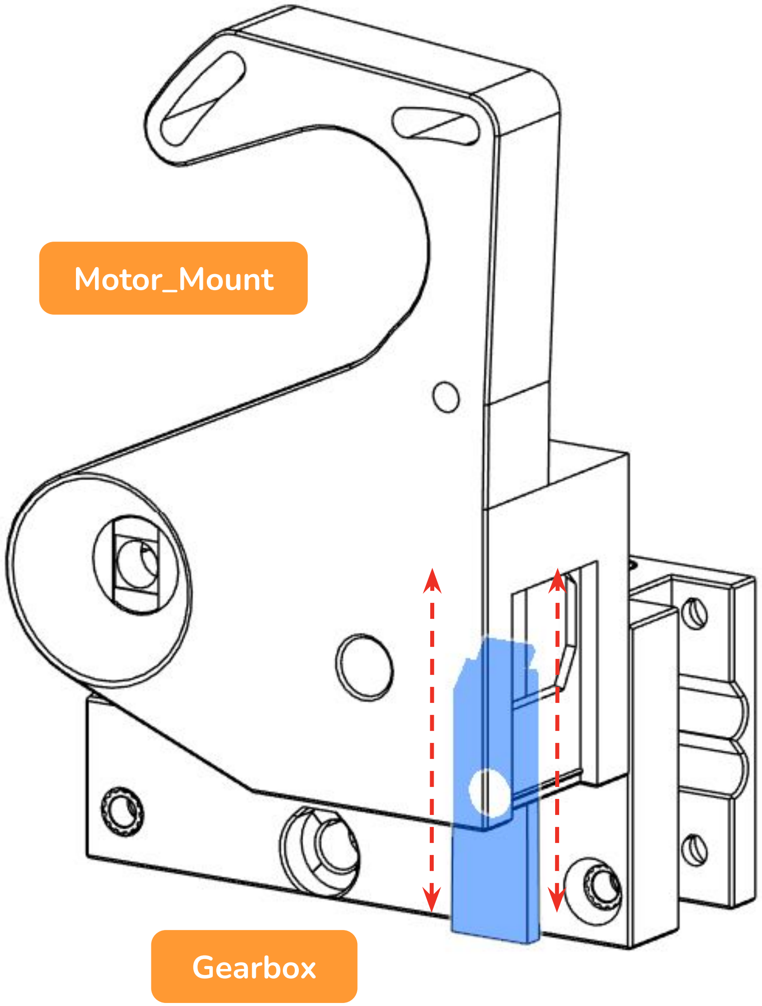
Take your choice of Motor_Mount and carefully mate the dovetail on the Gearbox to the slot in the Motor_Mount. One face of this dovetail is a zero-tolerance fit, so print defects will matter here! If it is a very tight fit, take sandpaper, a file, or a hobby knife to the parts that are rubbing so that it meshes and unmeshes without too much force. We want this dovetail to mesh with only a little effort so that later assembly steps are easy. It should take both hands to put together and take apart, but it shouldn't hurt your hands or stick so much that it comes apart violently.

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.

[These graphics will be updated soon]



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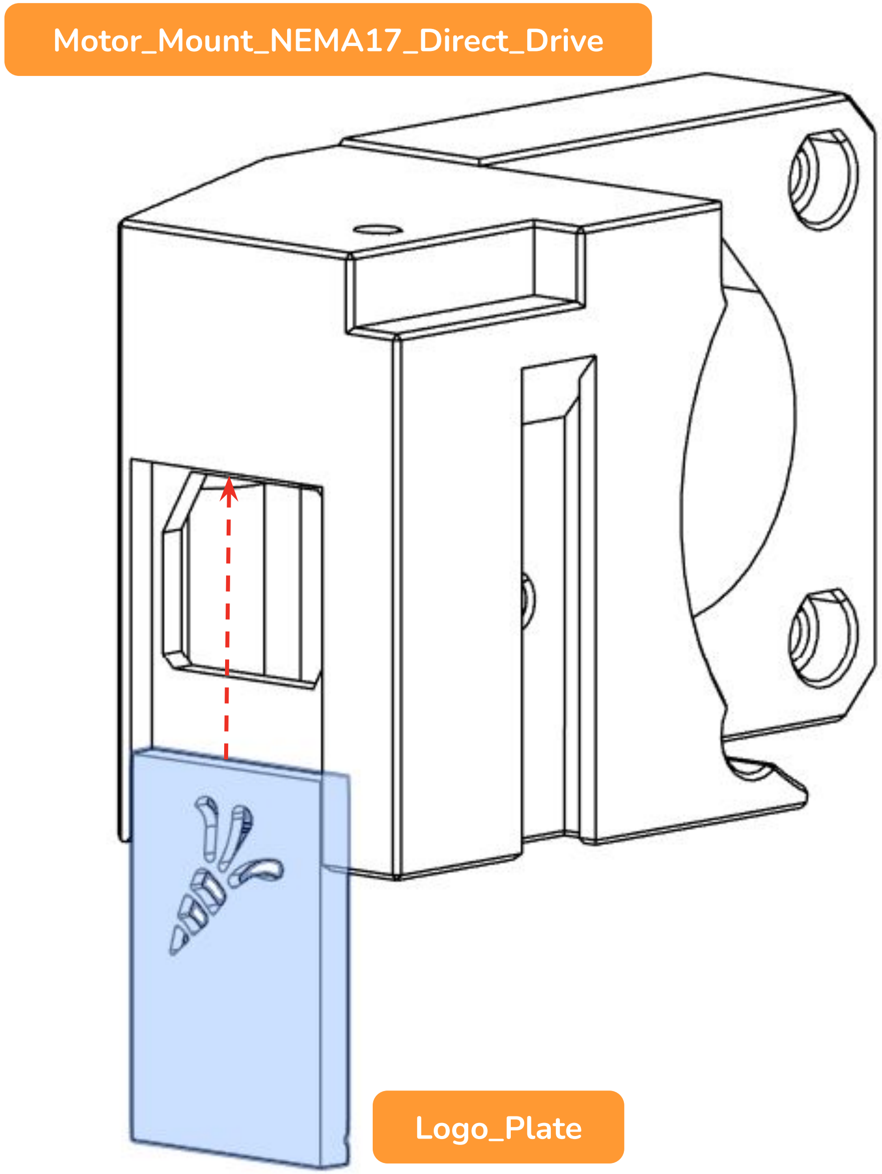


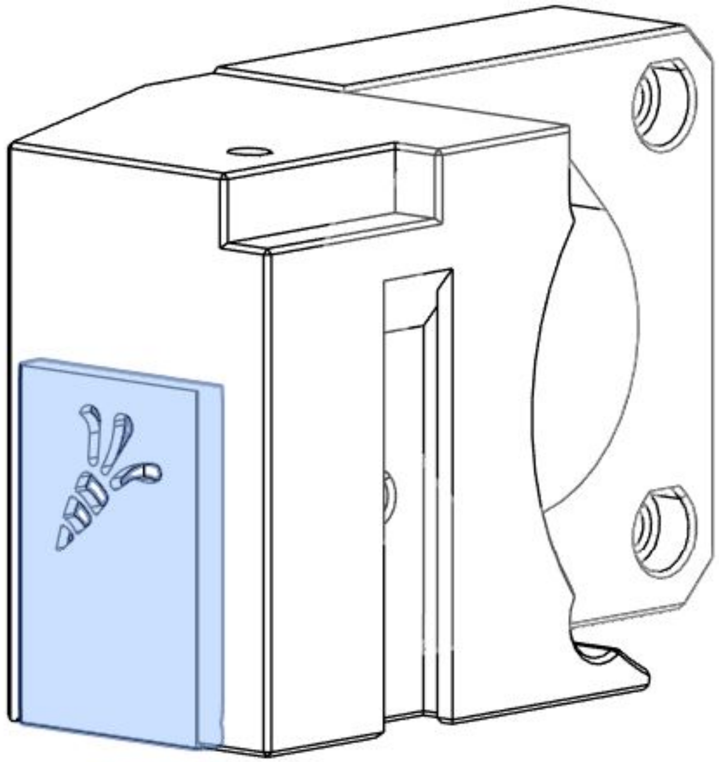
LOGO PLATE

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.

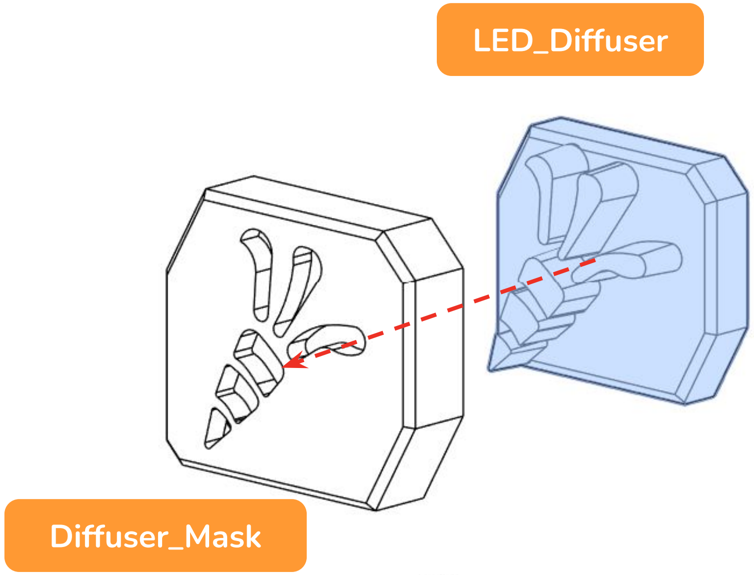
Align the Logo_Plate with the slot in the bottom of the Motor_Mount, and slide it upwards until it clips into place.

[These graphics will be updated soon]



MOTOR MOUNT (DIRECT)

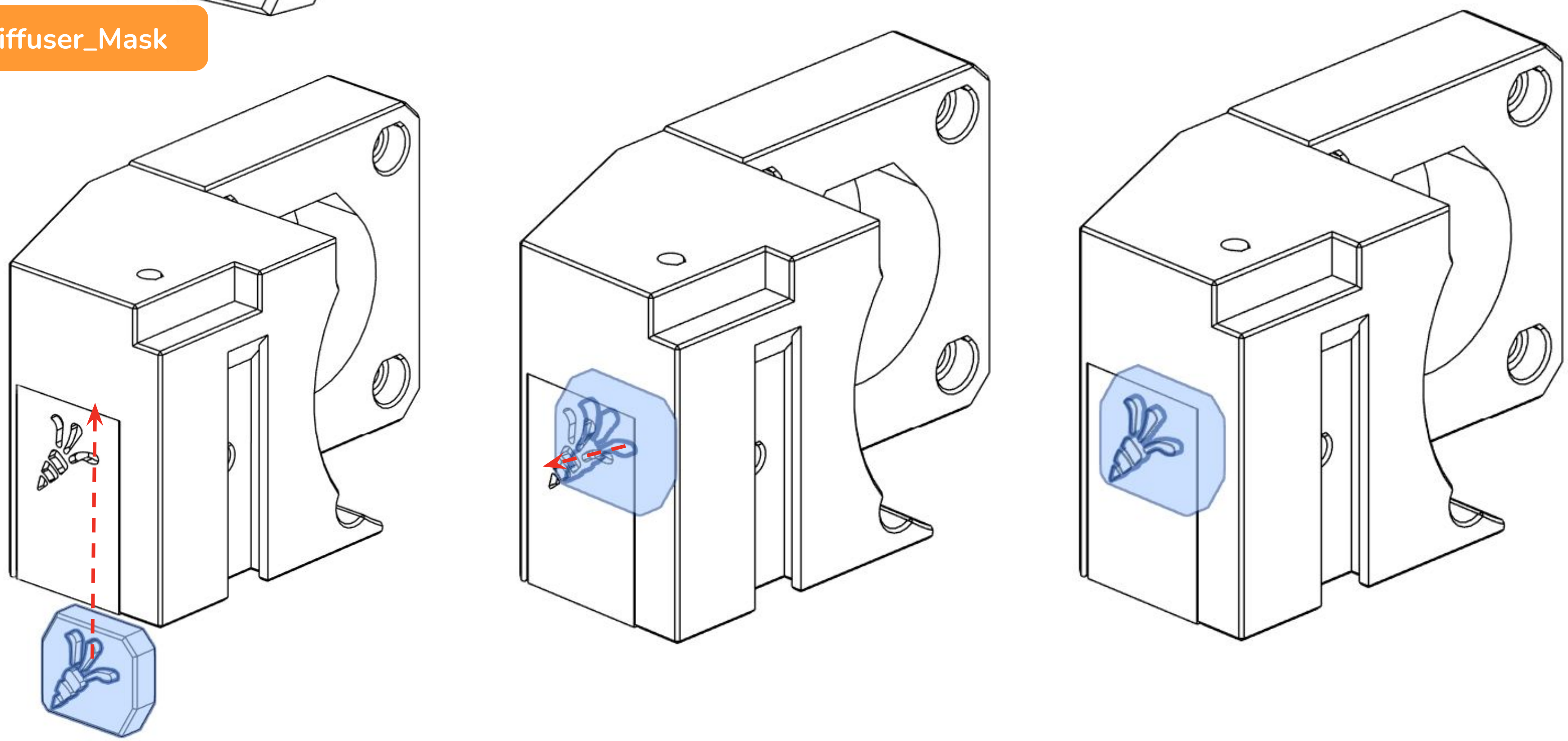
LED DIFFUSER



2.2 INSTALLING THE LED DIFFUSER

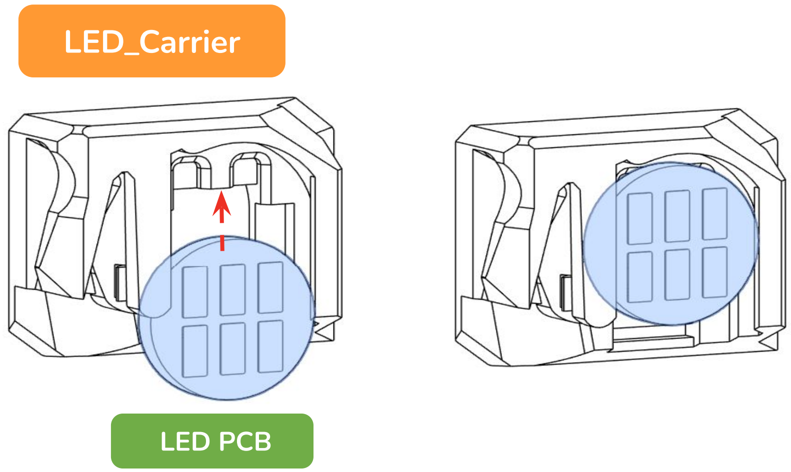
Insert the LED_Diffuser into the Diffuser_Mask, so that the carrot logo pokes through the Diffuser_Mask.

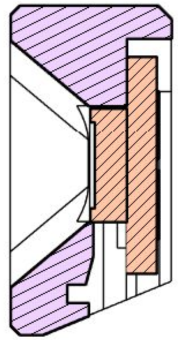
Insert the combined part into the Motor_Mount from the bottom. Once the combined part is as far up as it can go, use an Allen key or screwdriver to push it into the Logo_Plate.

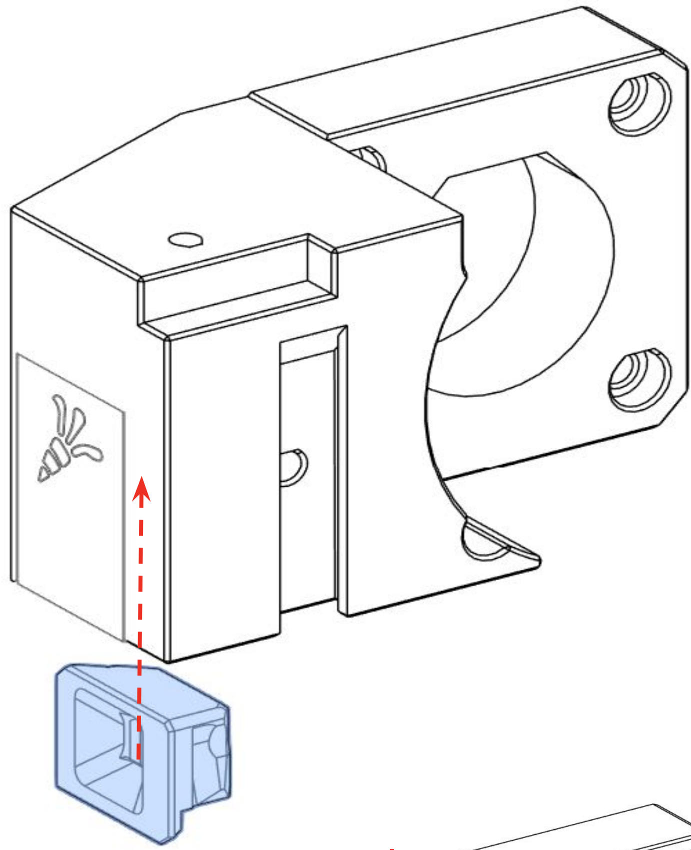


MOTOR MOUNT (DIRECT)

LED CARRIER





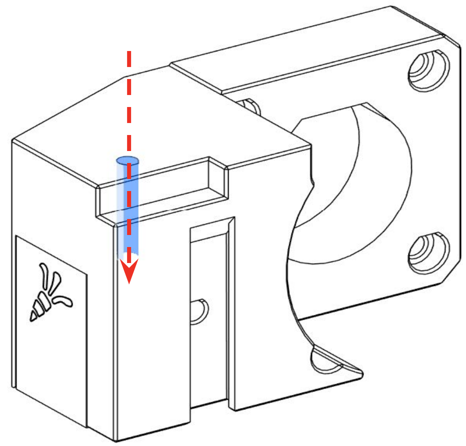


2.2 INSTALLING THE LED CARRIER

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 ro 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.



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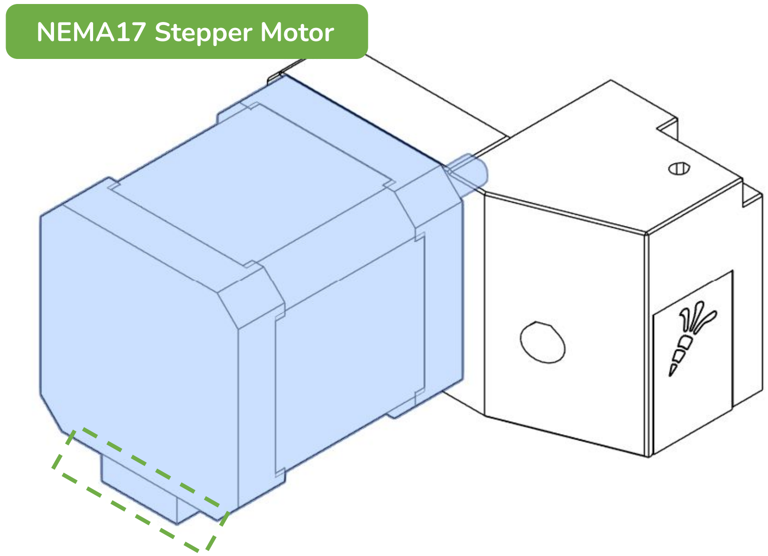
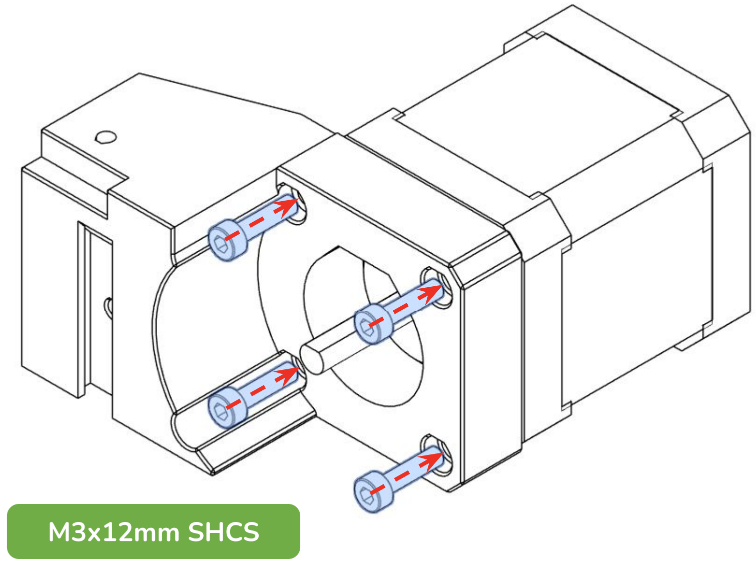
MOTOR MOUNT (DIRECT)

DRIVE MOTOR



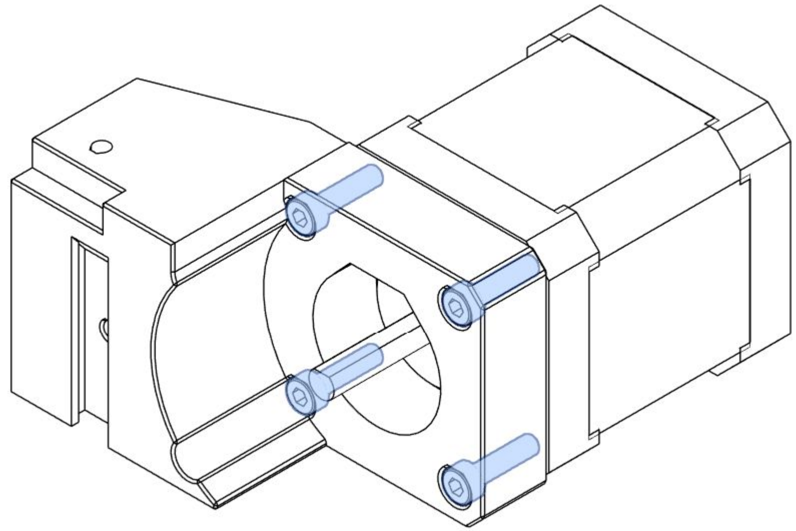


2.1 INSTALLING THE DRIVE MOTOR

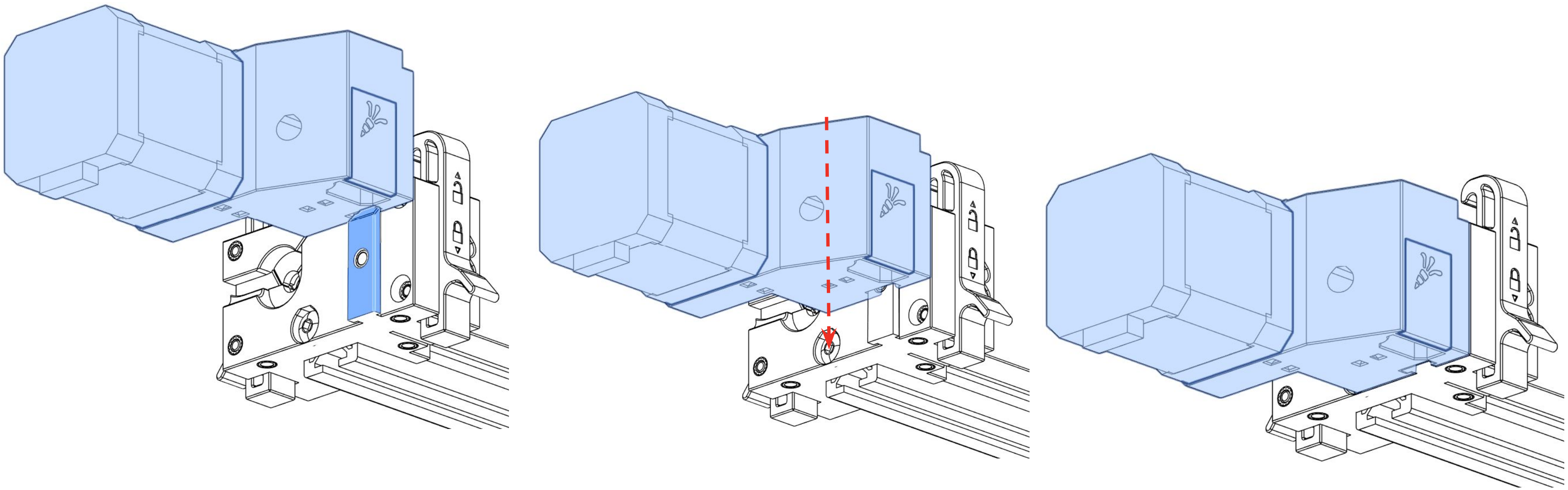
Align the NEMA17 Motor with the Motor_Mount so that the wires or connector is facing down.

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.



INSTALLING MOTOR MOUNT



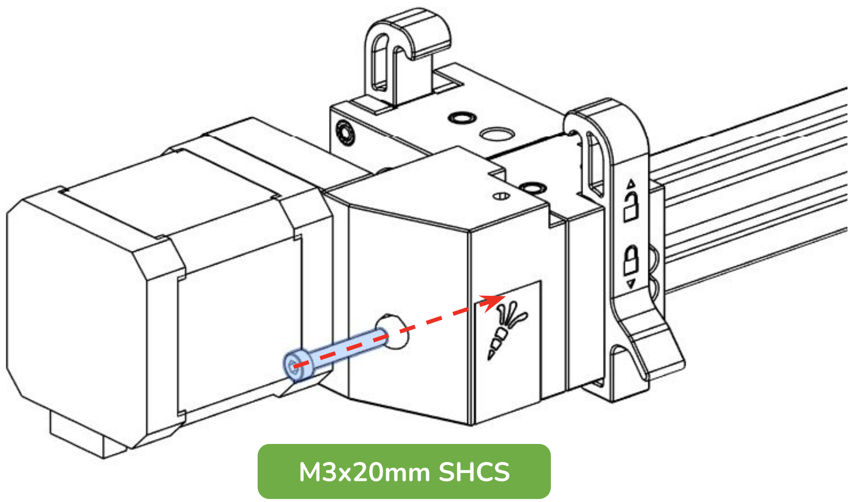
2.1 INSTALLING THE MOTOR MOUNT

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

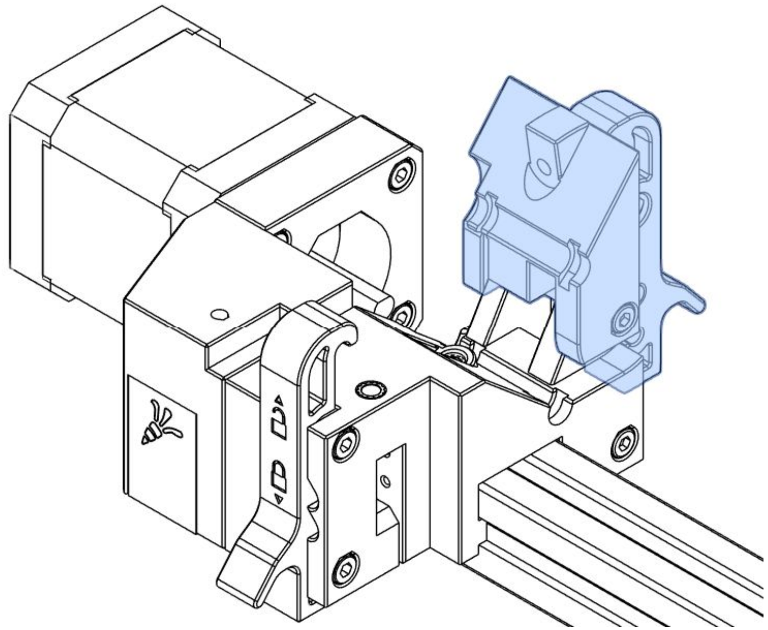
Press down on the Motor_Mount. It should be a snug fit. If it's too tight, take the pieces back apart and make sure the slot and dovetail are clear and smooth. If it's a really tight fit, you may need to take a file to the slot and/or dovetail, or reprint one or both of the pieces with more printer tuning.

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.



PREP DRIVE SHAFT



PREP THE DRIVE SHAFT

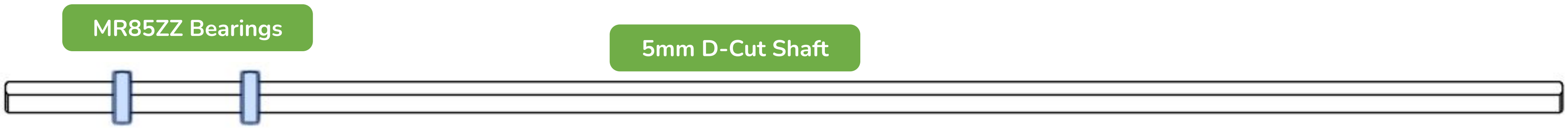
Take the Gearbox assembly and open the Side_Latch_v2 on the side that shares a hinge with the Hatch. Next, flip open the Hatch.

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.

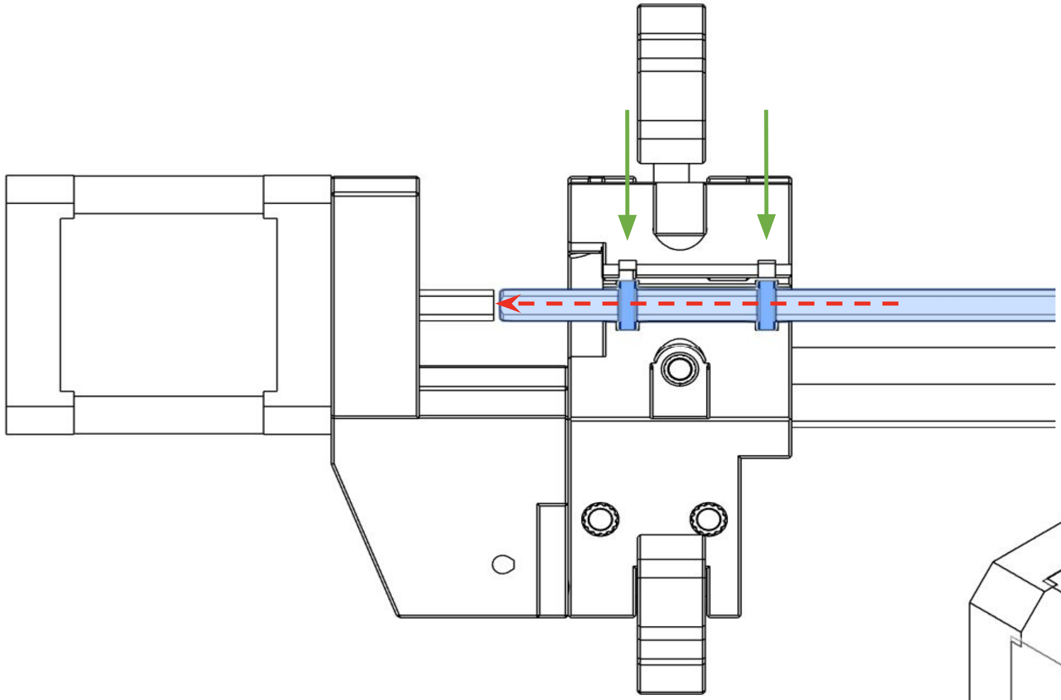
For many D-cut shafts, degreasing them with your favorite household cleaner can make the difference between a too-tight fit and a snug fit. If that doesn't work, follow up with a light-duty abrasive pad.

If you still find that your D-Cut Shaft is too tight on the bearings, take a high-grit sandpaper (at least 300 grit, preferably 1000-1500) 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.



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

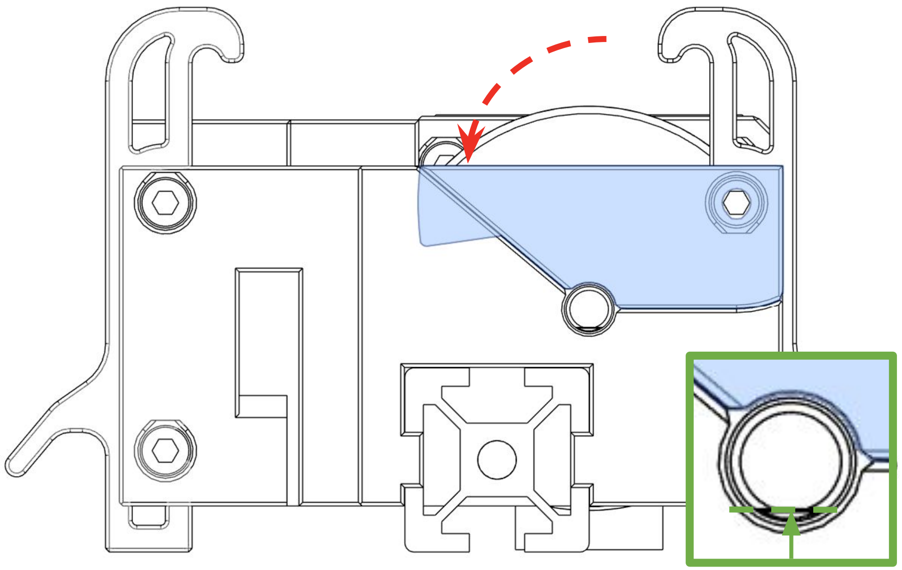
INSTALLING DRIVE SHAFT

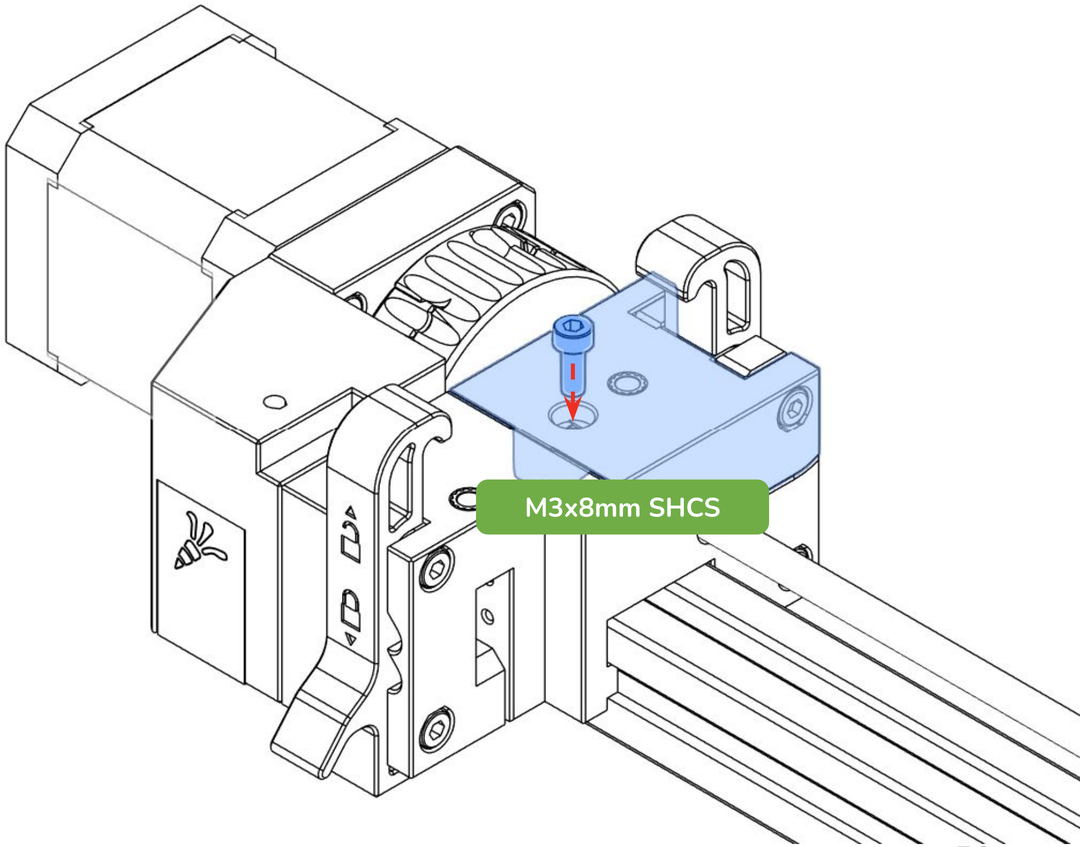


2.3 INSTALLING THE DRIVE SHAFT

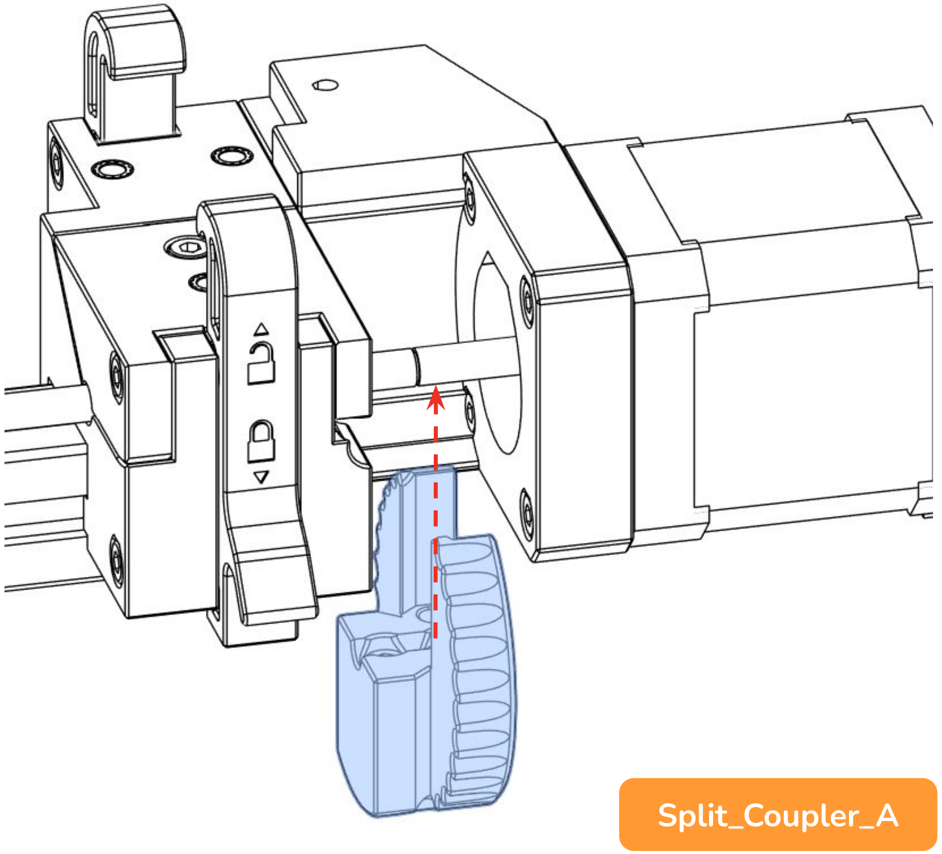
Align the bearings and shaft with the slots in the Gearbox. Close the Hatch over the bearings, and close the Side_Latch_v2. Slide the Drive Shaft down until it meets the motor shaft. Align both the motor shaft and the drive shaft with the flat facing down for the next steps.

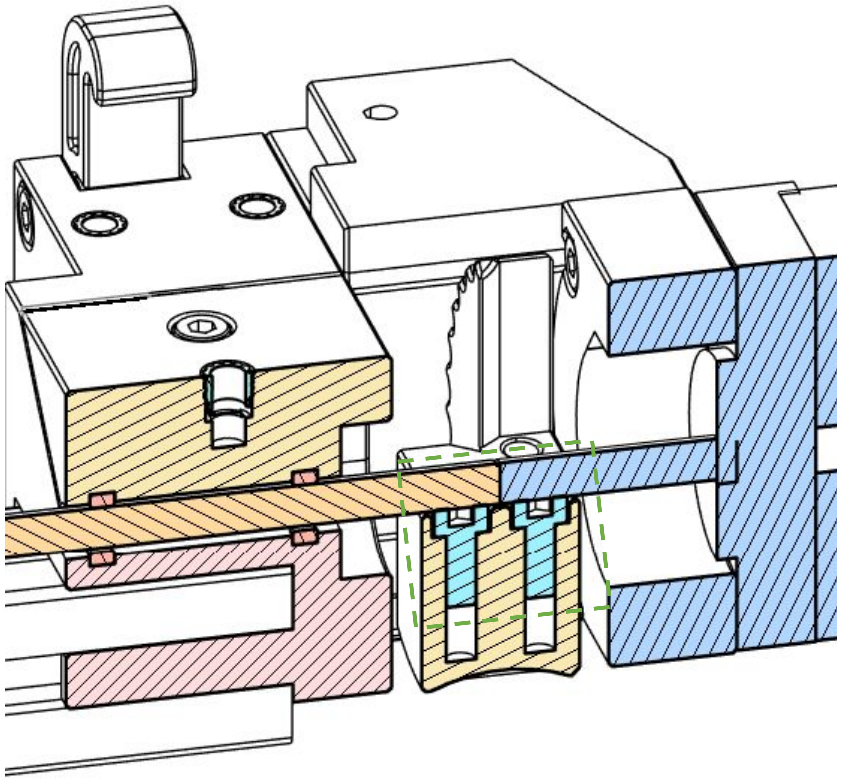
Install an M3x8mm bolt to hold the Hatch shut. It doesn't need to be super tight - it just holds the MR85ZZ bearings in place.





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.

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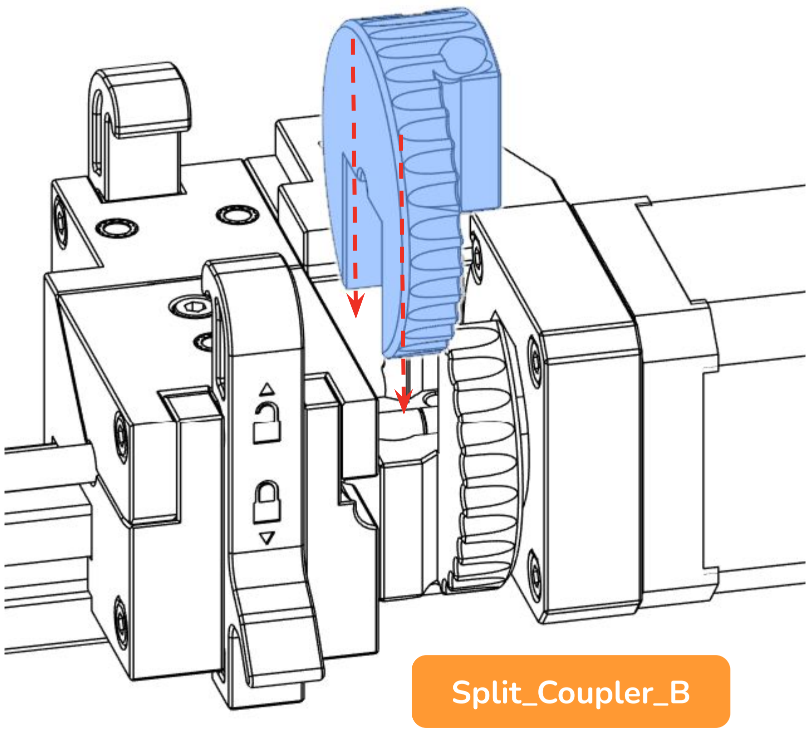
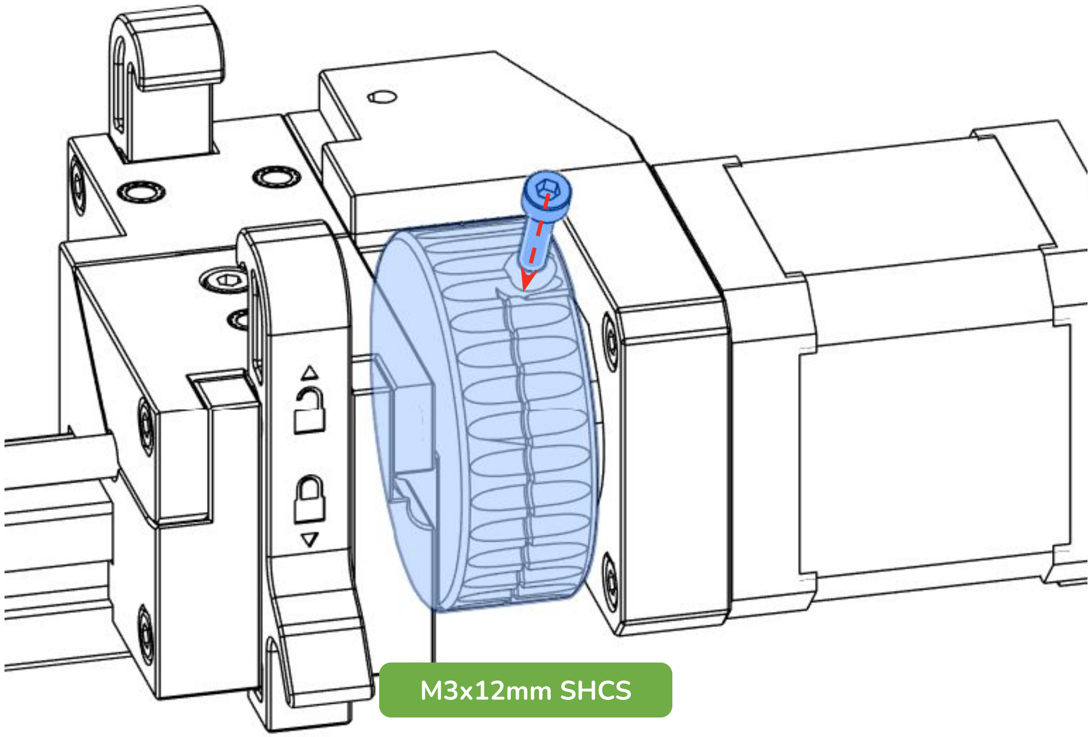
INSTALLING COUPLER





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.

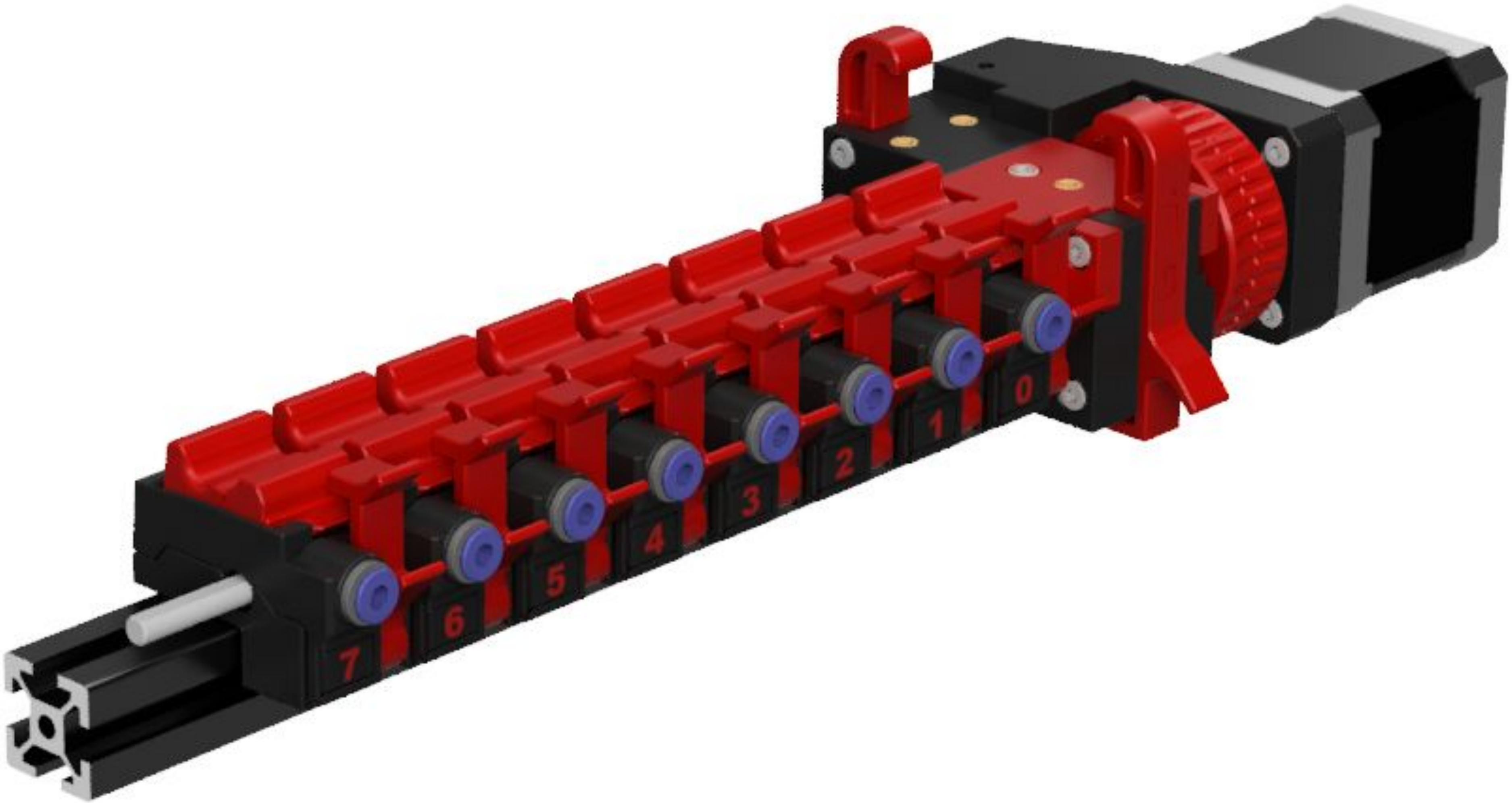
If you're using an alternative 5mm coupler to the Split Coupler (and you put it on the motor shaft on Page 51), you can simply slide it over onto the Drive Shaft and tighten it up.

Heft your mighty Rabbit Hammer to the sky and rejoice. You're done with motor mounting!

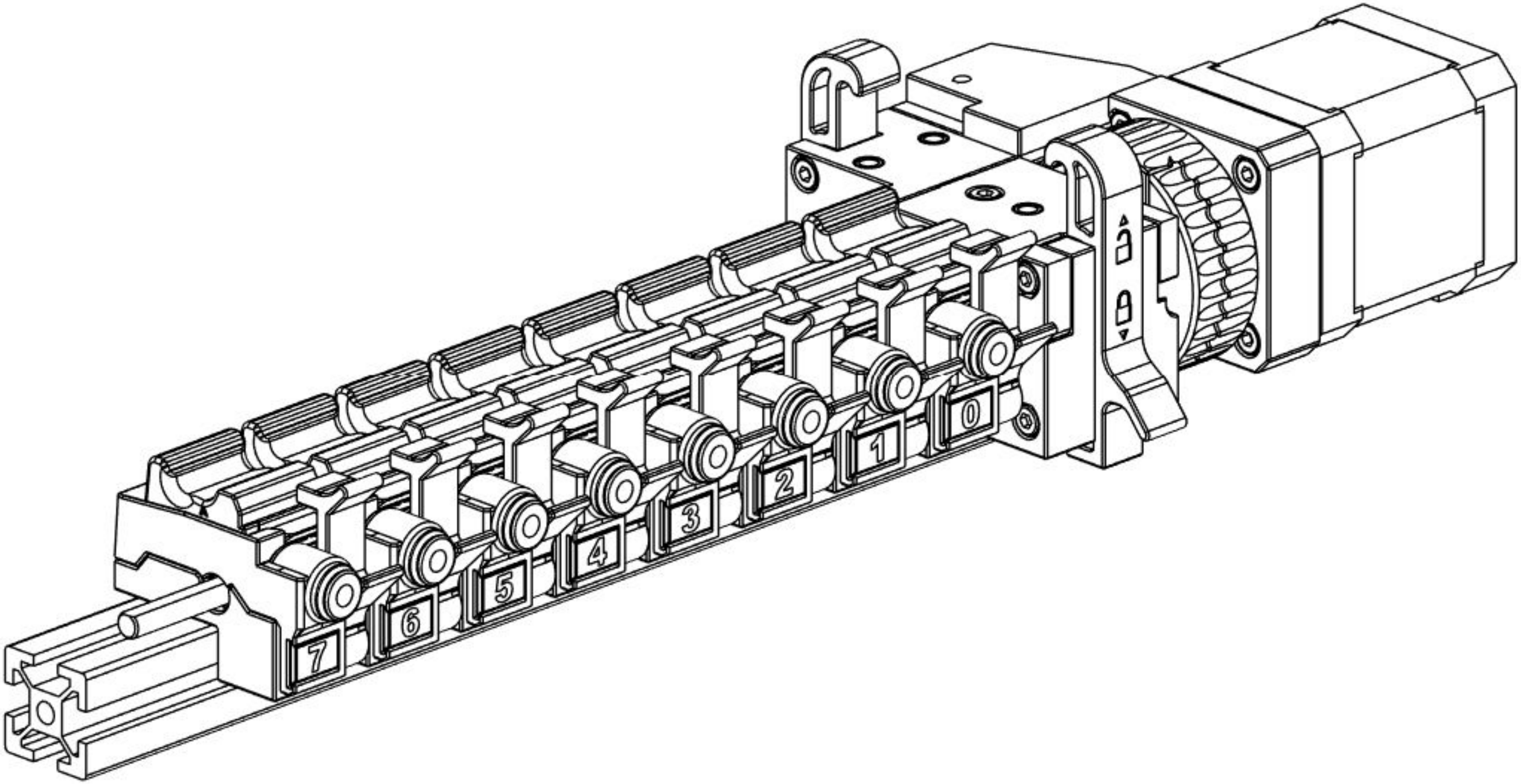
ERCF in space?

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.

OVERVIEW



OVERVIEW



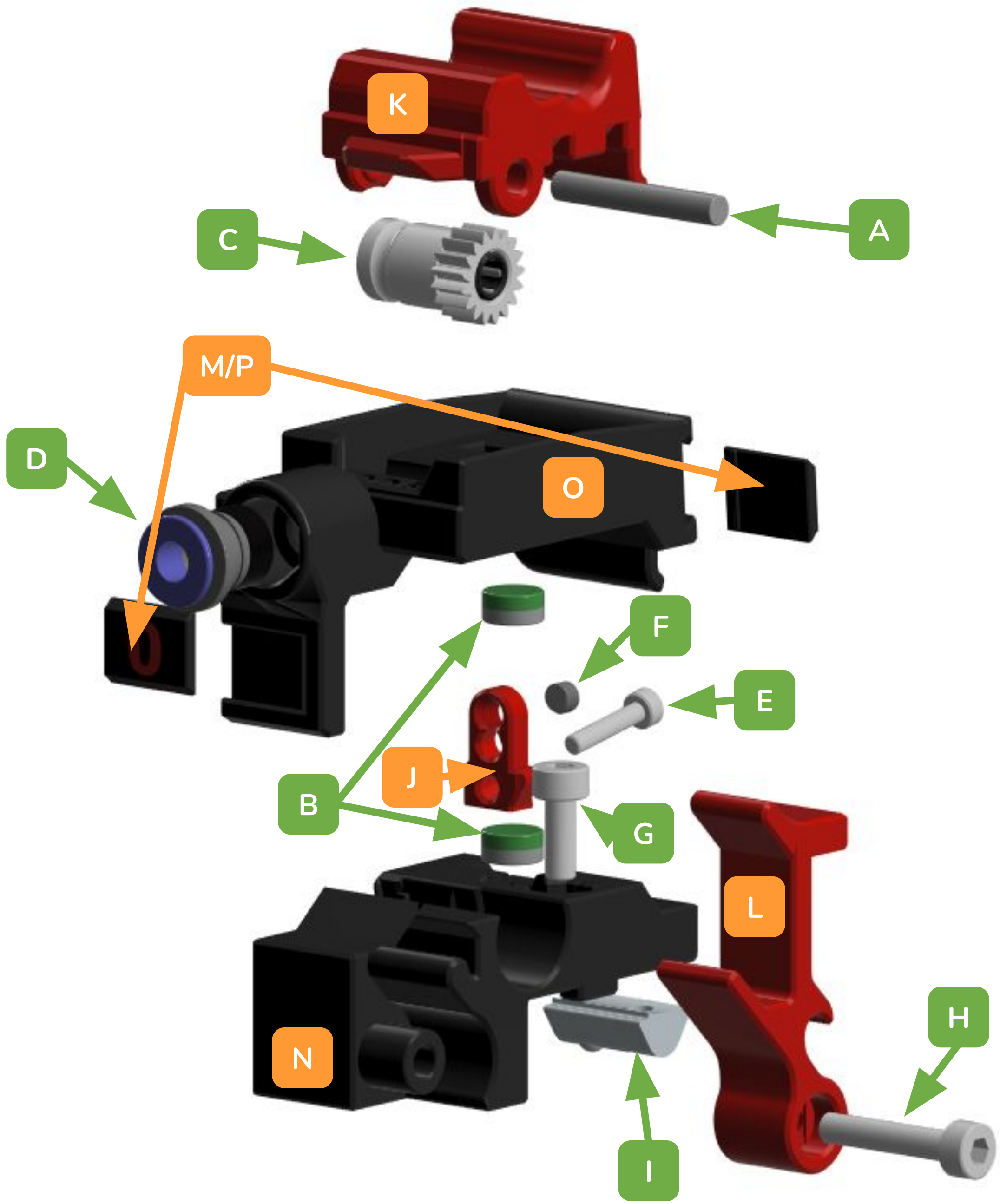
FILAMENT BLOCKS

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

EXPLODED VIEW

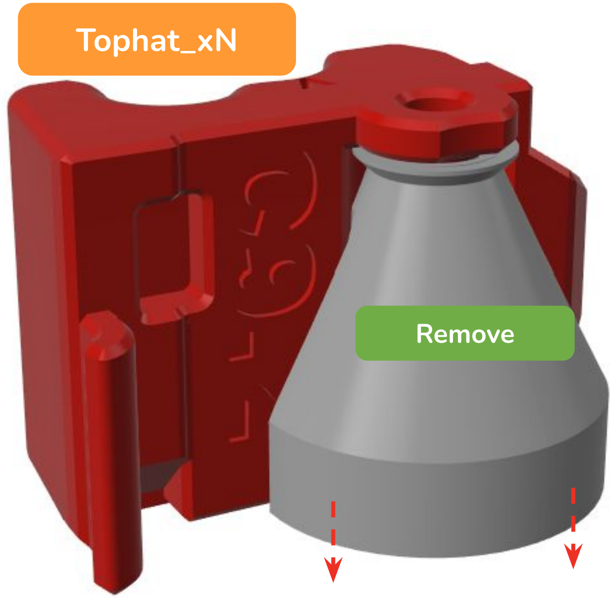


3.1 PRINT IN PLACE SUPPORTS

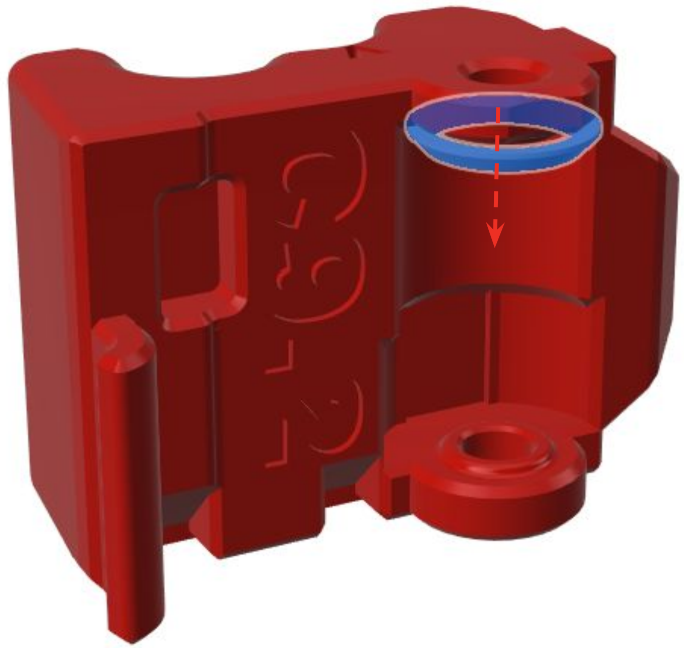
Before you begin you will need to remove all of the print-in-place supports from the Tophats.

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.

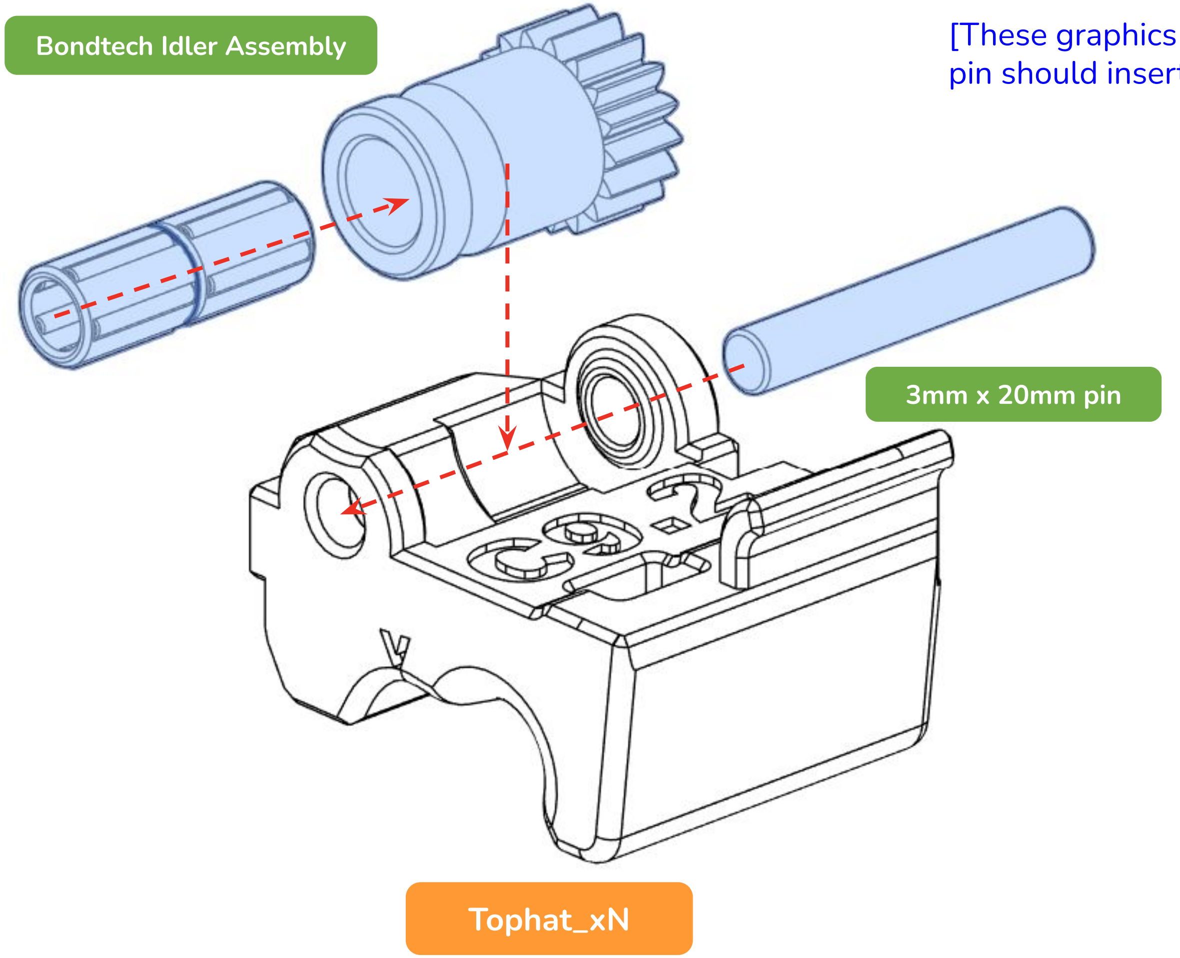


[These graphics will be updated soon]



TOP HATS

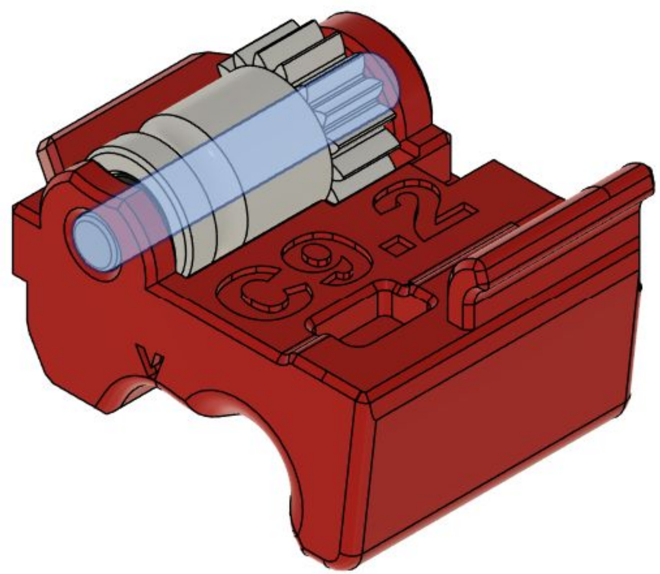
[These graphics will be updated soon - The pin should insert from the other side]



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.



BASE

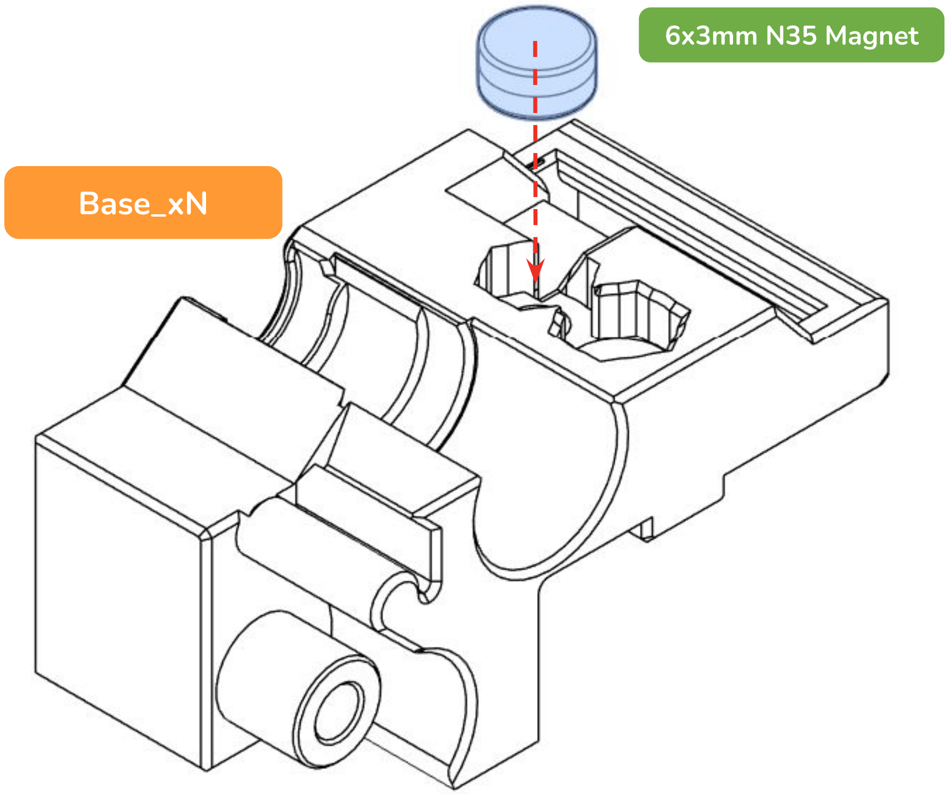
3.2 MAGNET ORIENTATION

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.



LATCH

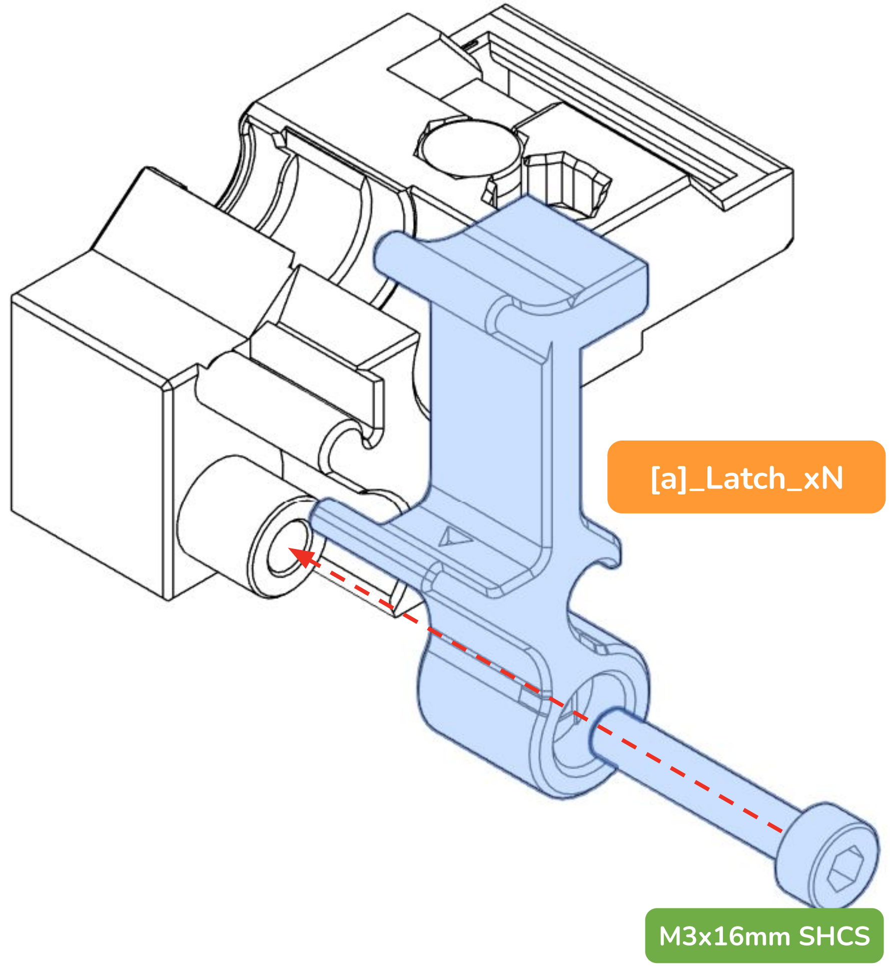
3.3 LATCH SCREW

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.



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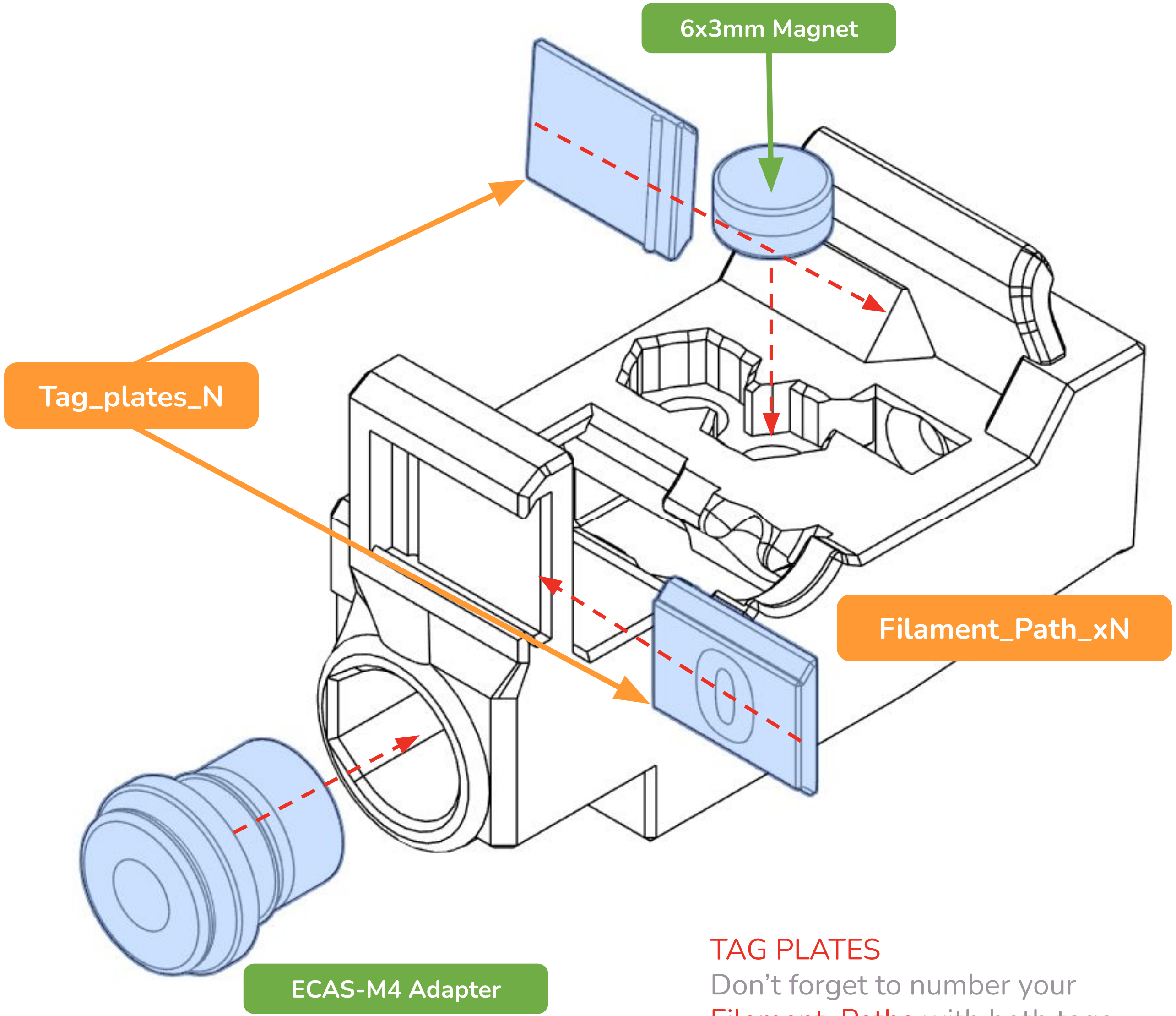
FILAMENT PATH



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.

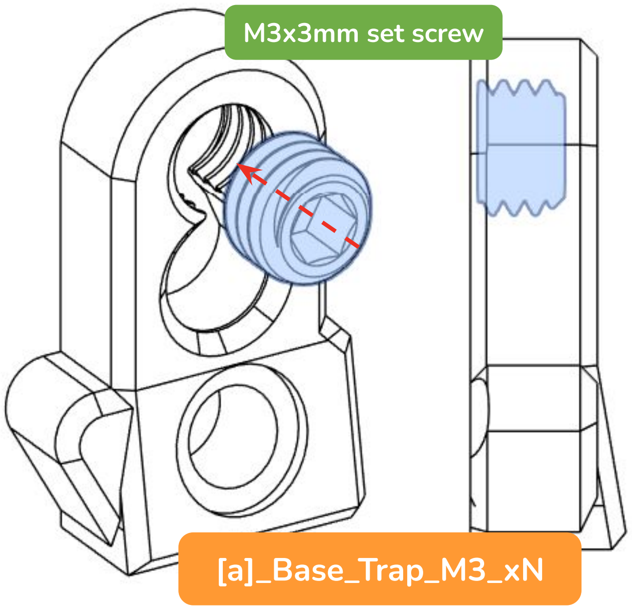
Install the ECAS fitting.

Install both the front and back Tag number plates.

Repeat for all of the Filament_Paths.

TAG PLATES

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



TRAP ASSEMBLY

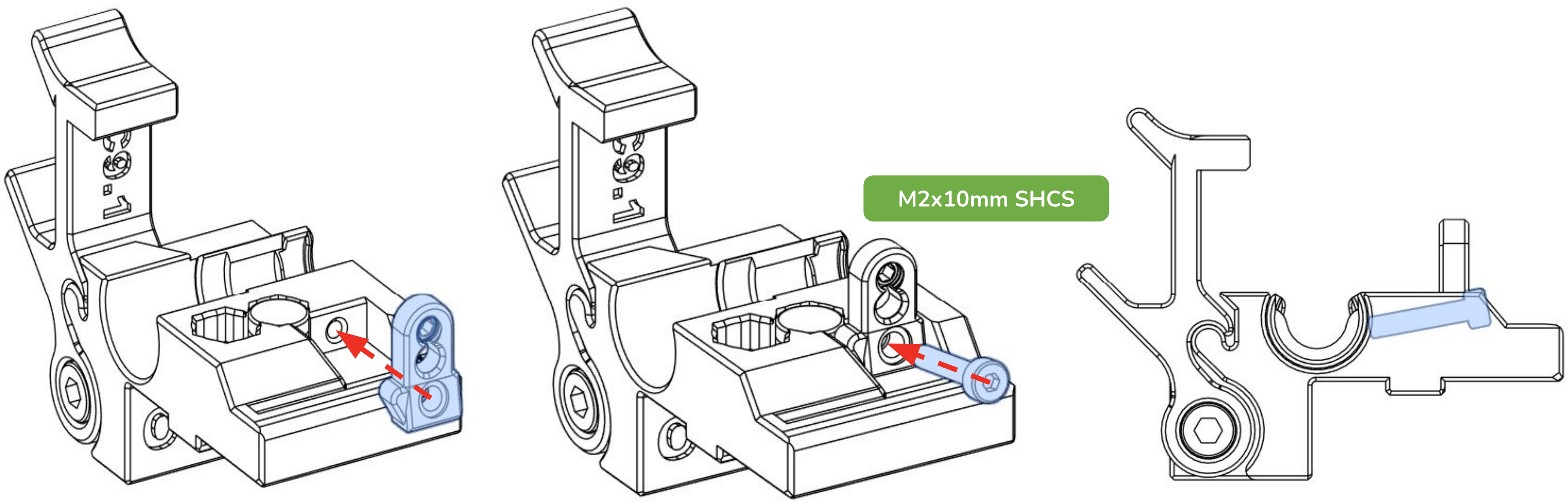
3.5 FILAMENT TRAP (BRAKE)

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.



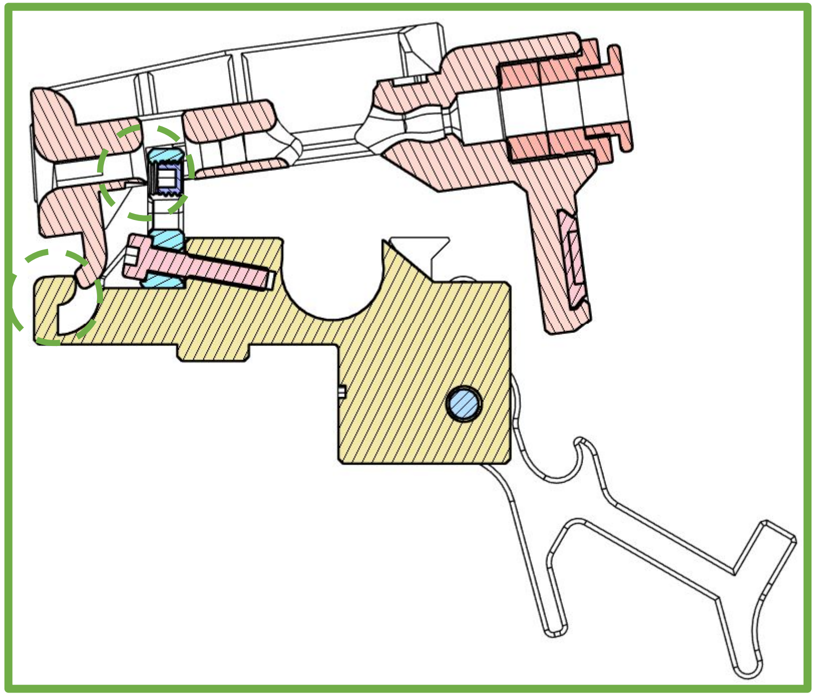
FILAMENT BLOCKS

BLOCK ASSEMBLY

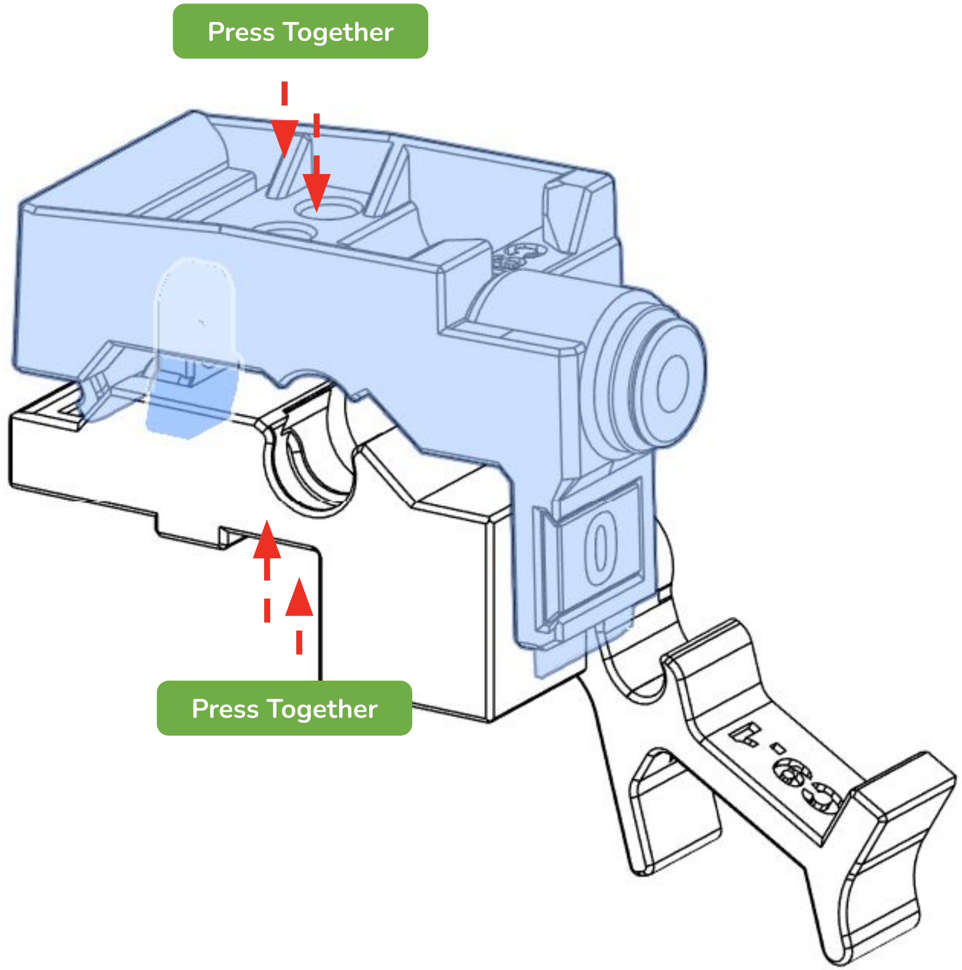
Open the Latch. Next, line up the Filament_Path vertically with the Base. Angle the Filament_Path a little, so that the Base_Trap fits into its slot on the Filament_Path, and that the tongue on the Filament_Path is aligned with its slot on the Base. Squeeze them together until they snap together. Close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

Repeat assembly of all of the parts into Filament Blocks.

To separate, pull apart at a slight angle.



FIT CHECK



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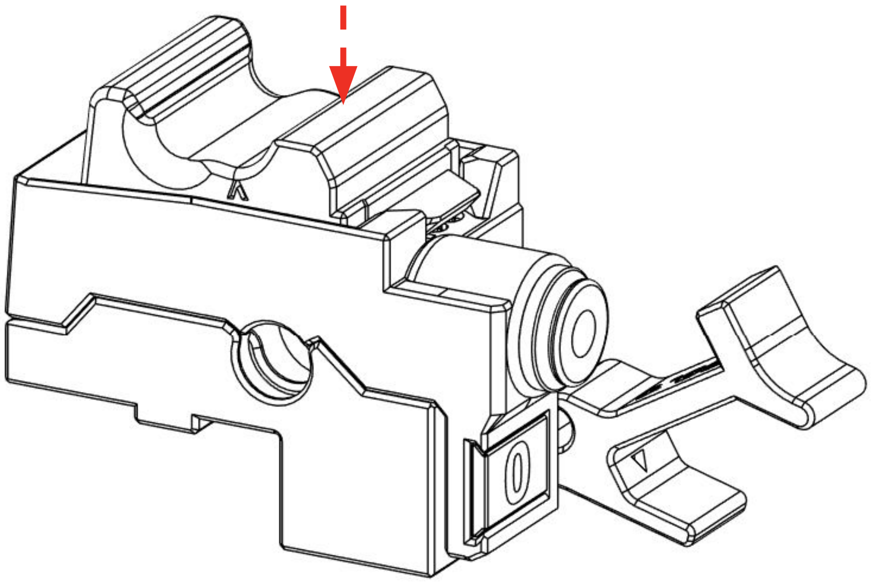
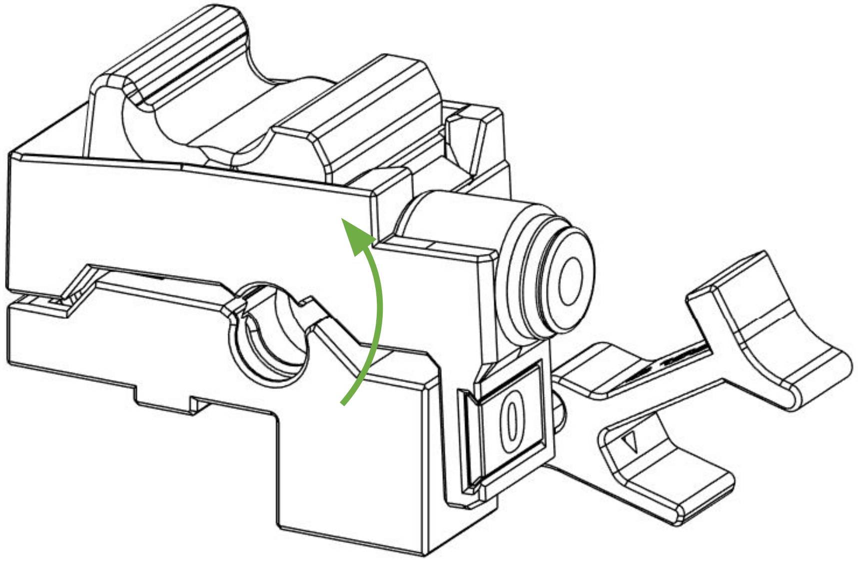
FIT CHECK





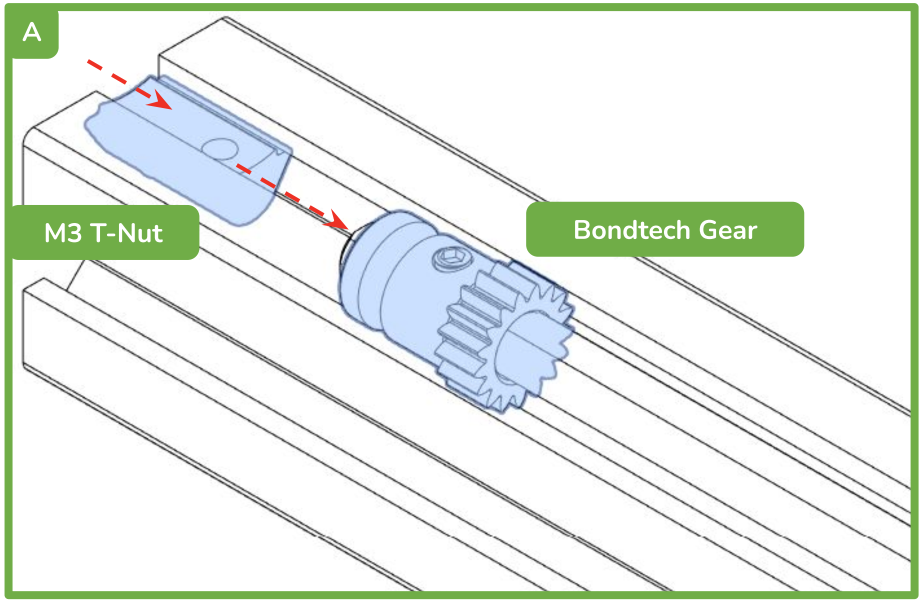
FIT CHECK
Add the Tophat on top of the Filament_Path.

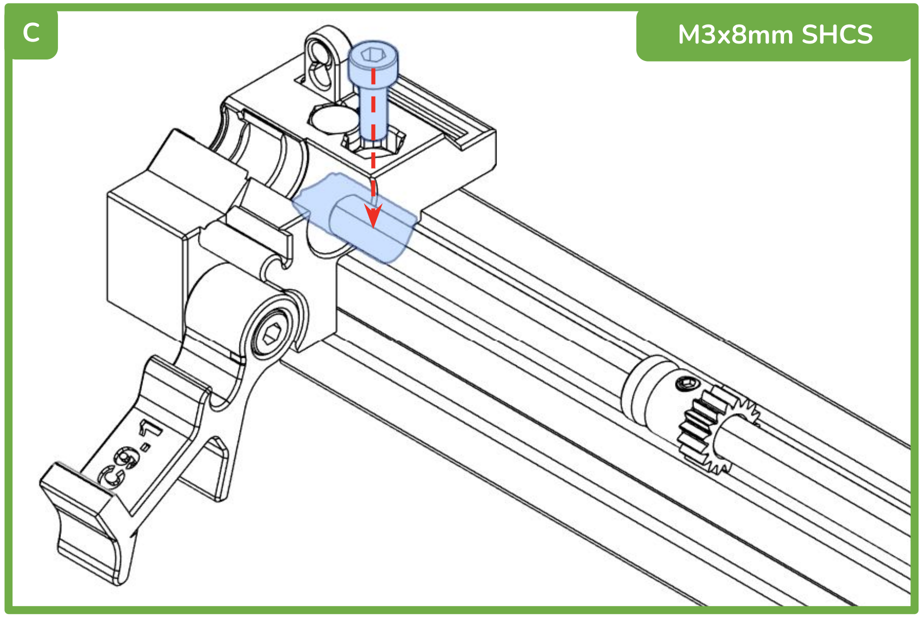
When assembled, the filament block parts should pivot freely on the Filament_Path hinge, repelled by the magnetic spring. The parts should move smoothly without anything preventing the parts from closing or opening. The difference between being engaged and disengaged is only a little more than the width 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 BLOCK ARRAY ASSEMBLY





A. PREPARATION

Slide a Bondtech gear onto the D-Cut shaft. Be aware of it's 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.`

B. BEARINGS

[More graphics will be added soon]

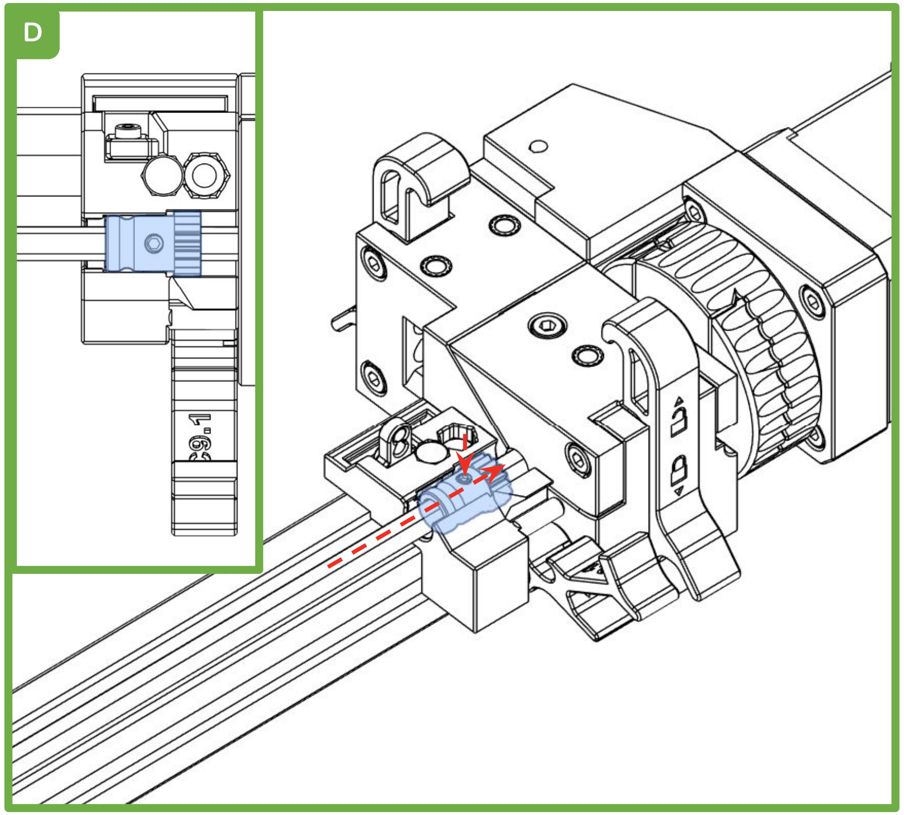
Every third Filament Block, or as desired, add an MR85ZZ Bearing to the Base before sliding it onto the Drive Shaft.

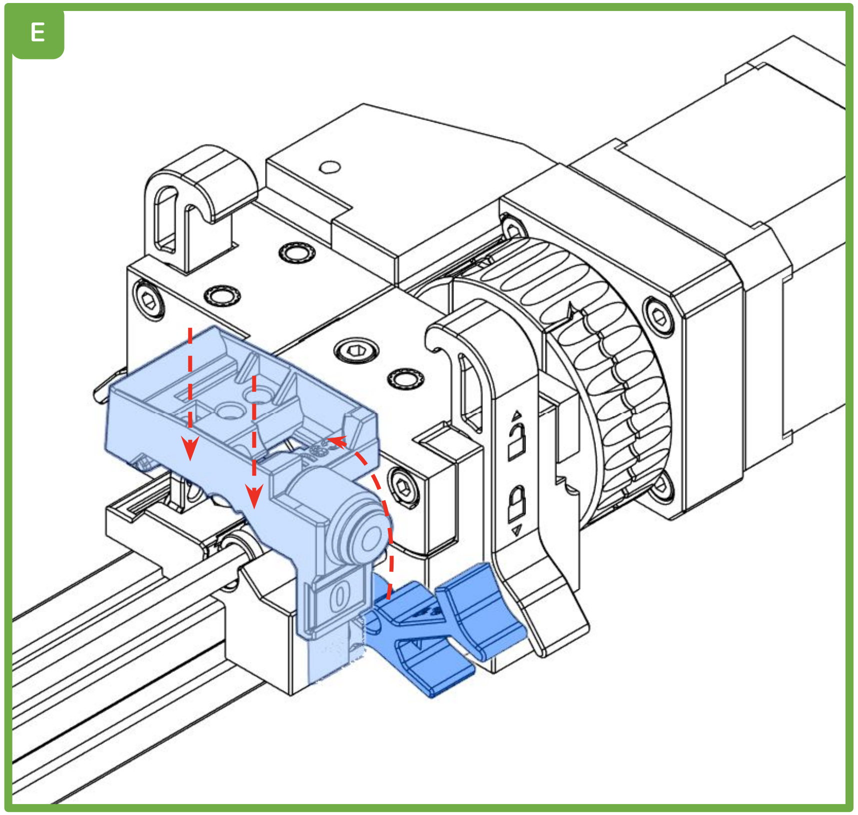
# Channels	# MR85ZZ Bearings	Base # with Bearings
4	2	2, 3
5	2	2, 4
6	2	2, 5
7	3	2, 5, 6
8	3	2, 5, 7
9	3	2, 5, 8
10	4	2, 5, 8, 9
11	4	2, 5, 8, 10
12	4	2, 5, 8, 11
13	5	2, 5, 8, 11, 12
14	5	2, 5, 8, 11, 13
15	5	2, 5, 8, 11, 14

C. 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 BLOCK ARRAY ASSEMBLY





D. 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.

E. FILAMENT PATH MOUNTING

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

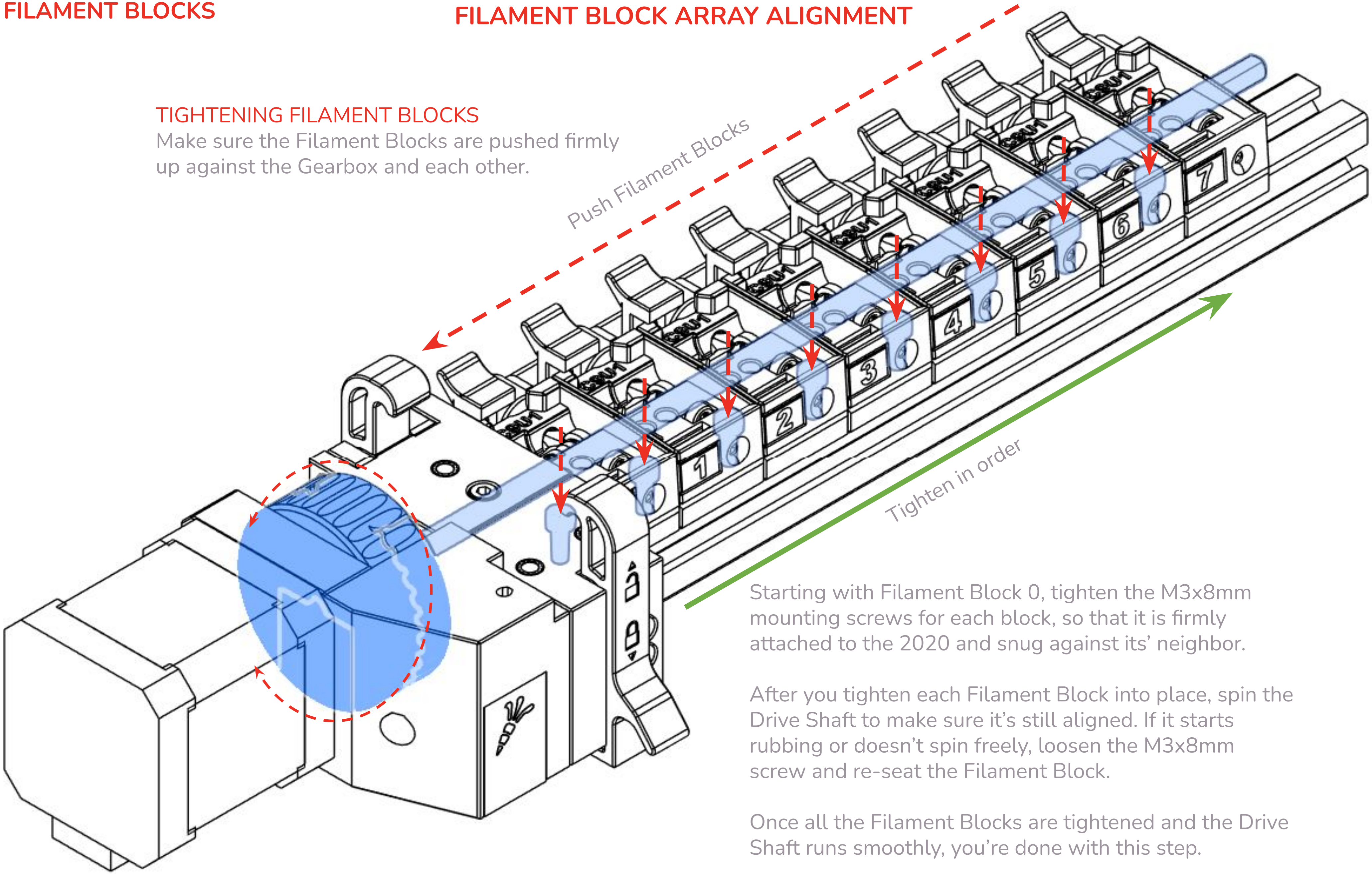
Repeat these 5 steps for all of the Bases and Filament_Paths.

FILAMENT BLOCKS

FILAMENT BLOCK ARRAY ALIGNMENT

TIGHTENING FILAMENT BLOCKS

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

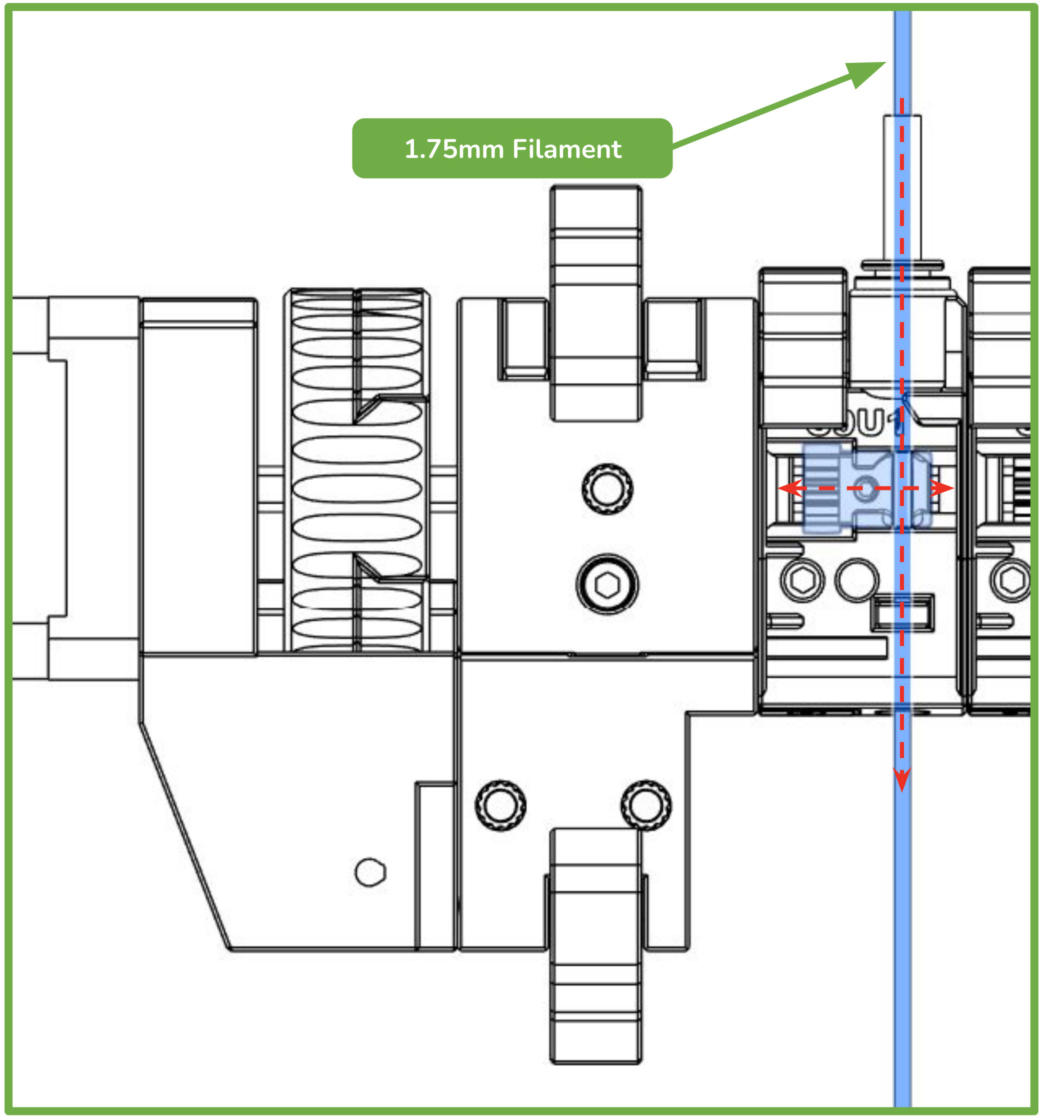


Starting with Filament Block 0, tighten the M3x8mm mounting screws for each block, so that it is firmly attached to the 2020 and snug against its' neighbor.

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.

BONDTECH GEAR CALIBRATION



View from the top of the ERCF.

BONDTECH GEAR ALIGNMENT

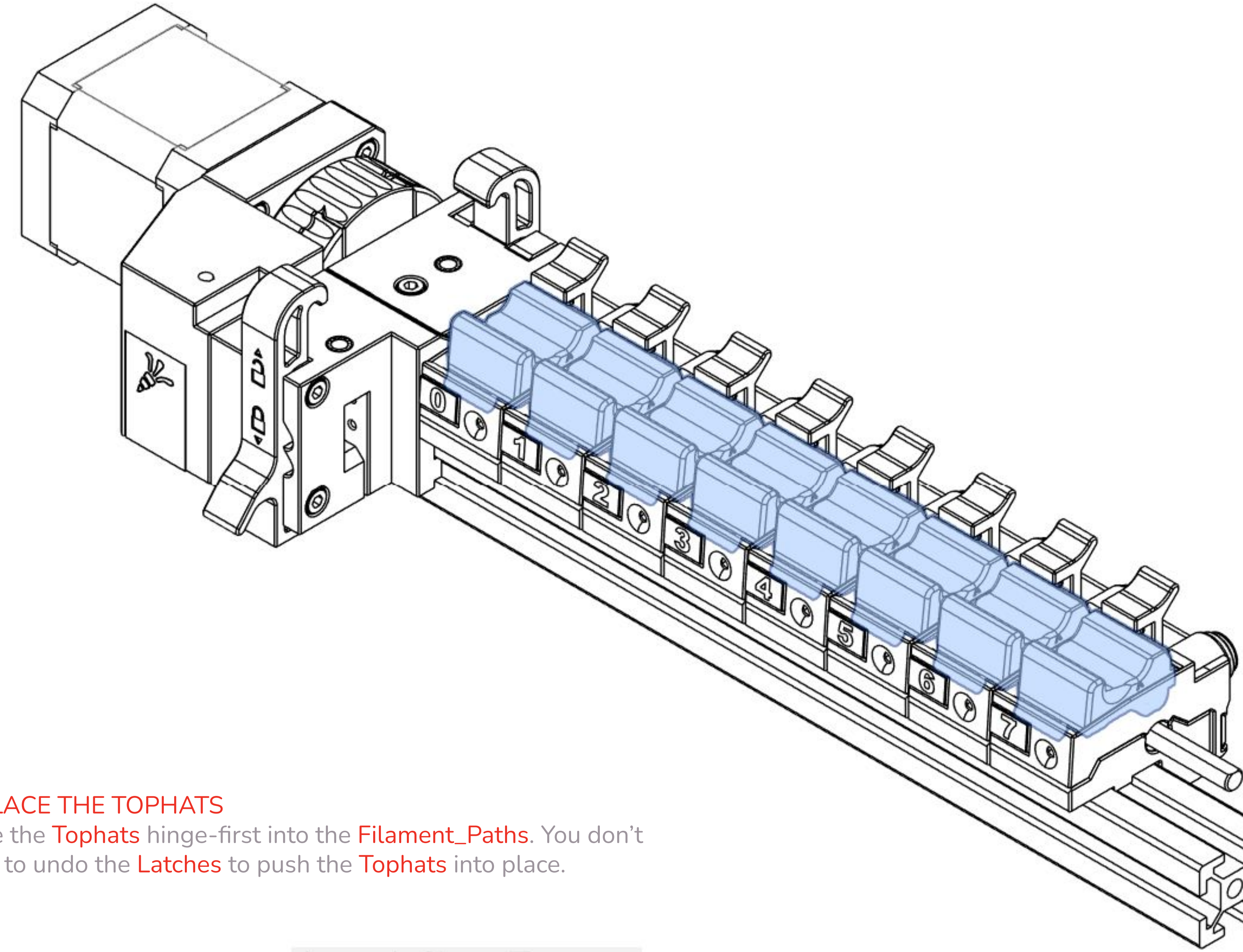
Insert a small piece of PTFE tube (a few centimeters is enough) into the Filament Block ECAS. Insert a clean piece of filament through the block until it comes out the other side. (Depending on the shape of the filament end, it may get caught by the trap. In that case push the back of the Filament_Path 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 and makes it brittle.

Repeat this process for all the 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.

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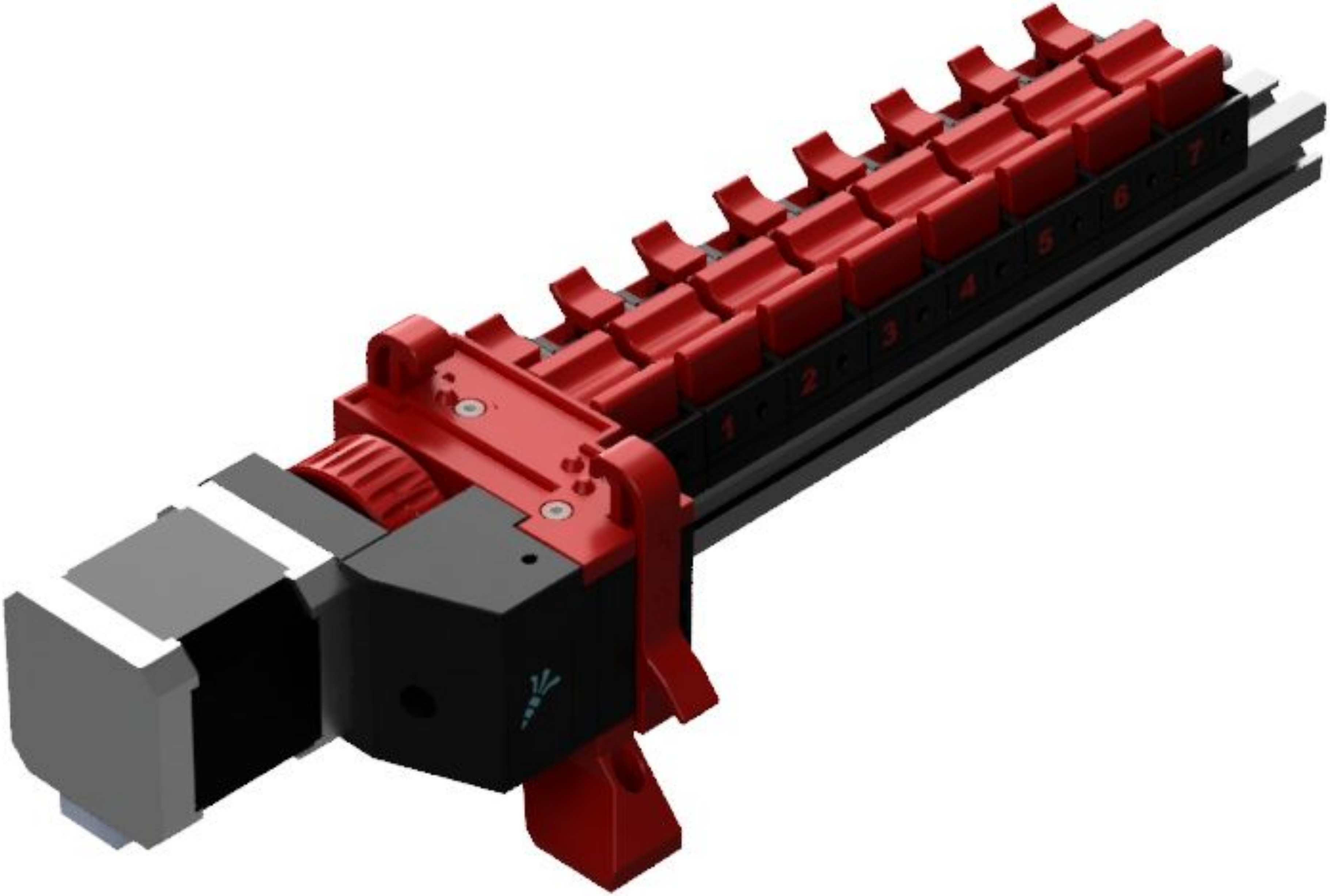
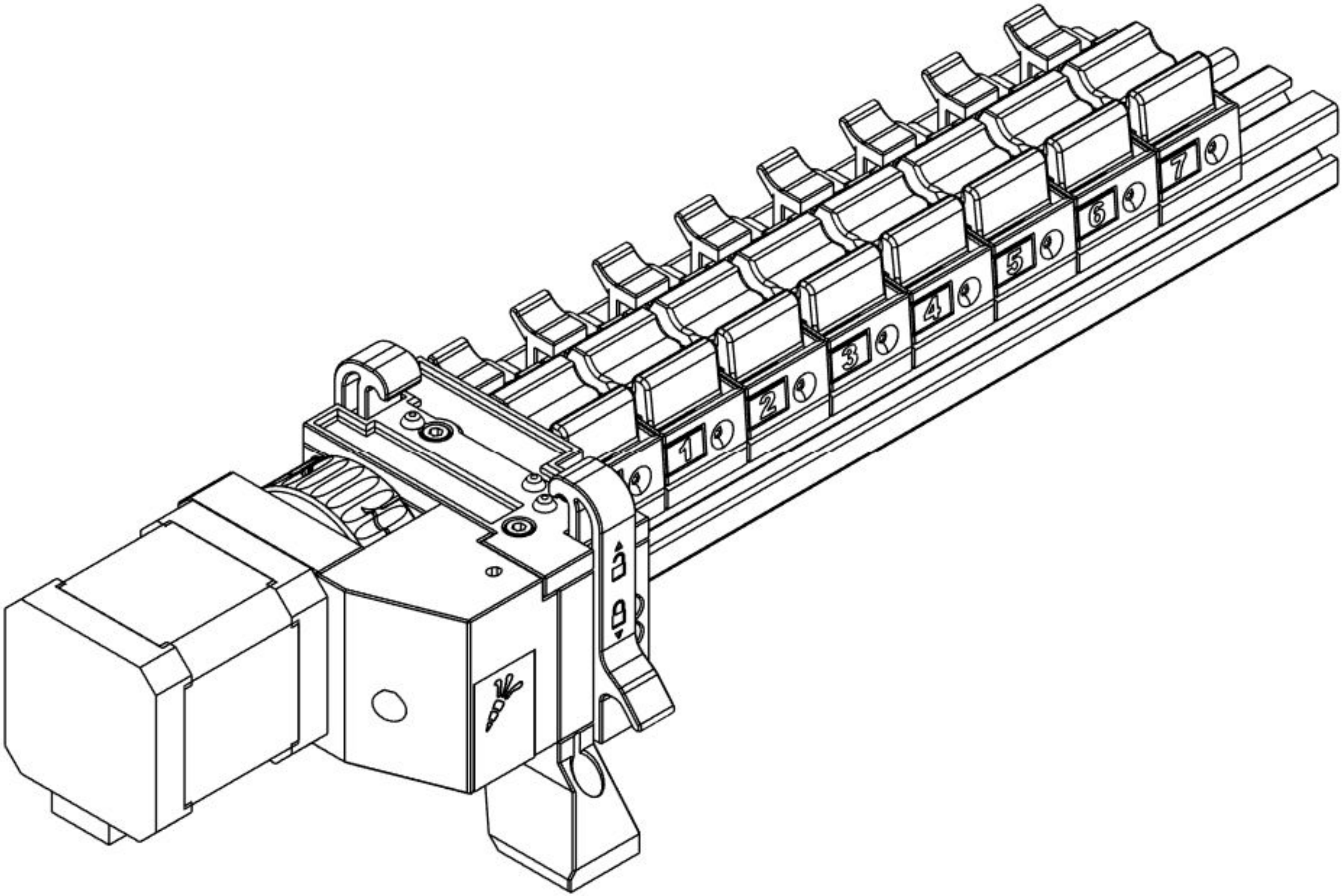
Surface finish can be improved by using multi-material techniques. Some materials are better suited for creating smooth, detailed surfaces, while others provide strength or flexibility. By mixing materials, the final product can have both an excellent surface finish and desirable mechanical properties.

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

OVERVIEW



OVERVIEW



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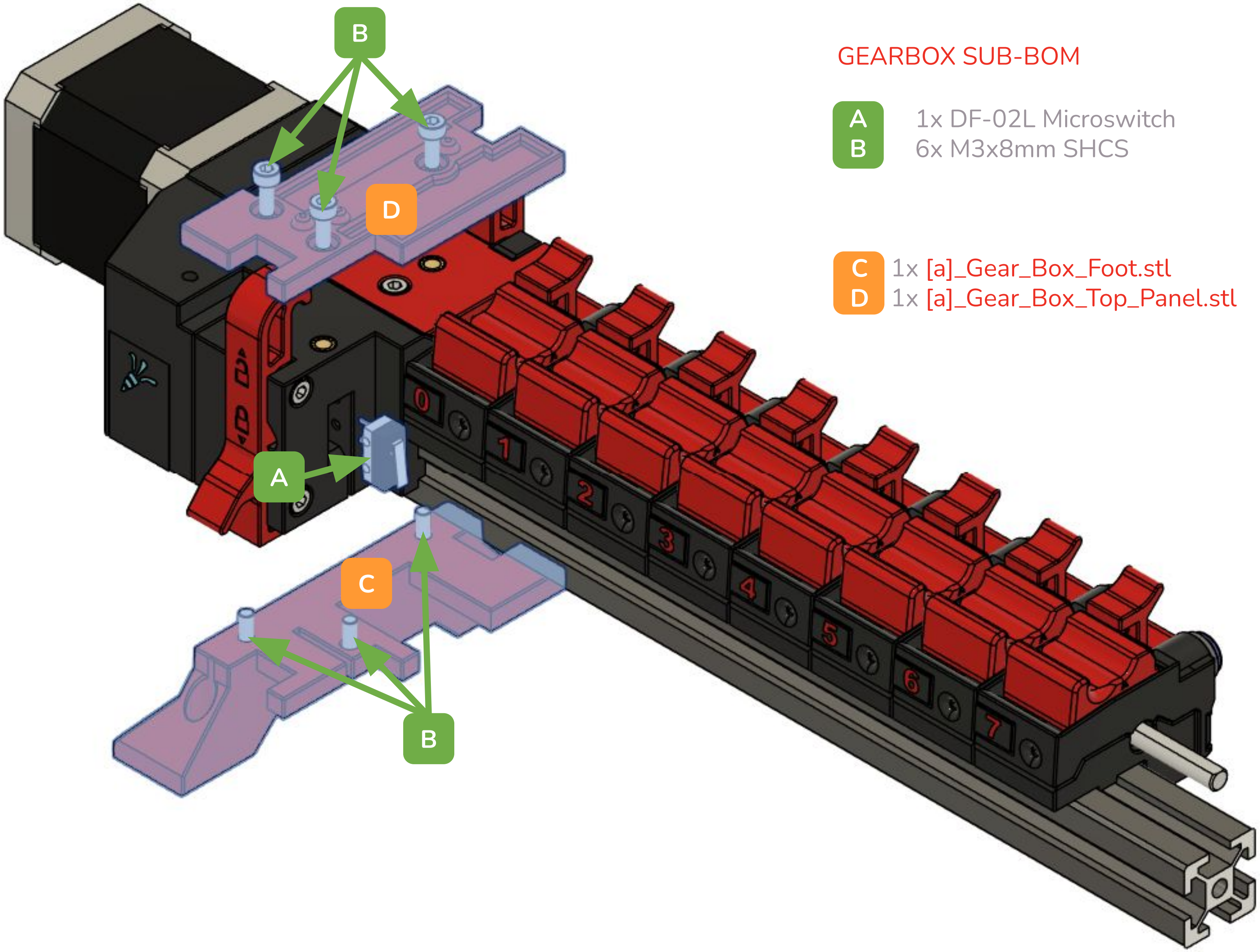
GEARBOX PART 2

EXPLODED VIEW

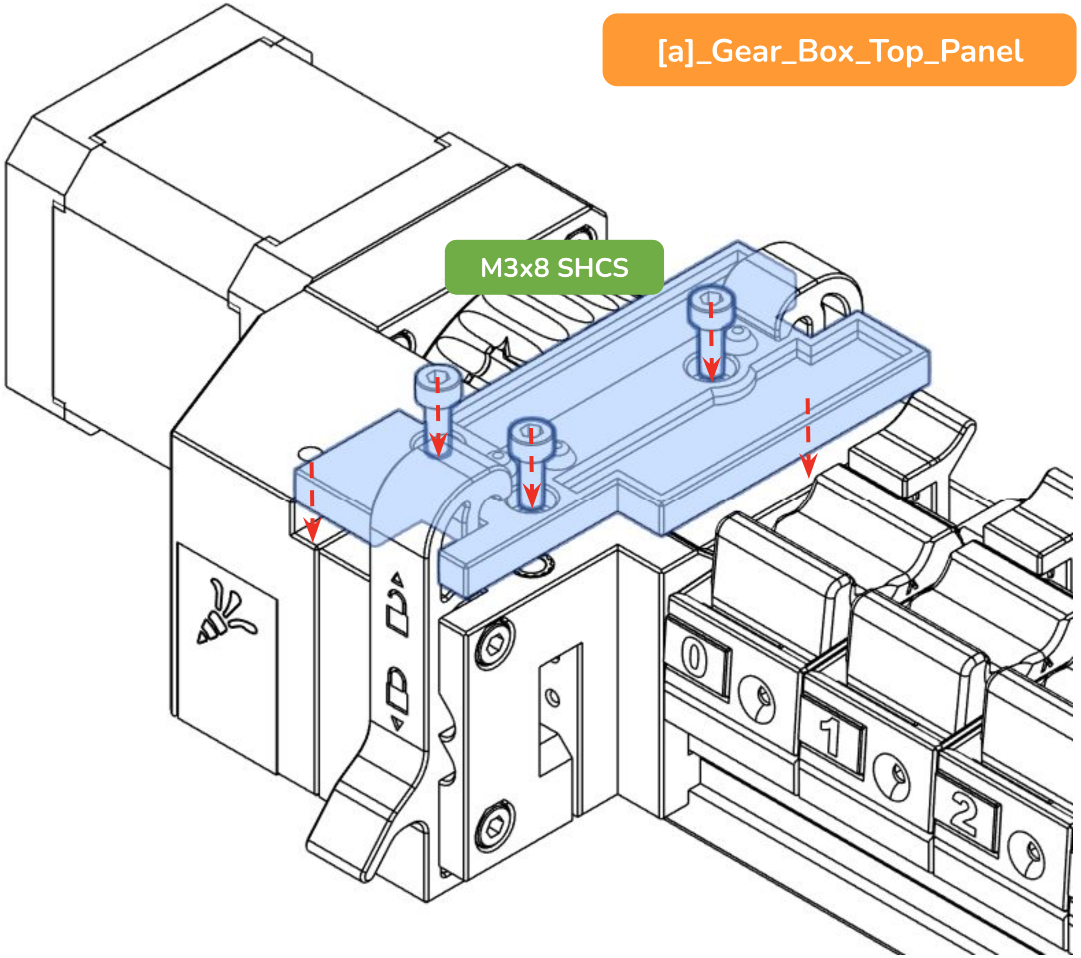


GEARBOX SUB-BOM

A 1x DF-02L Microswitch
B 6x M3x8mm SHCS

C 1x [a]_Gear_Box_Foot.stl
D 1x [a]_Gear_Box_Top_Panel.stl

TOP PANEL

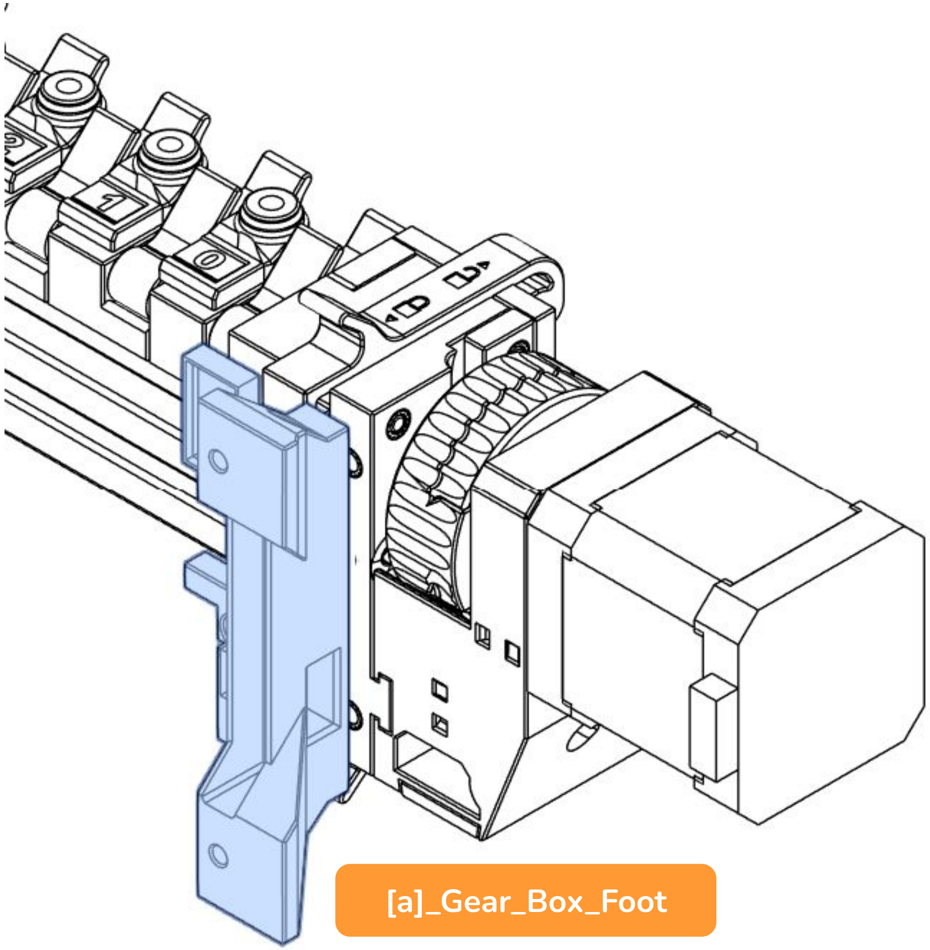


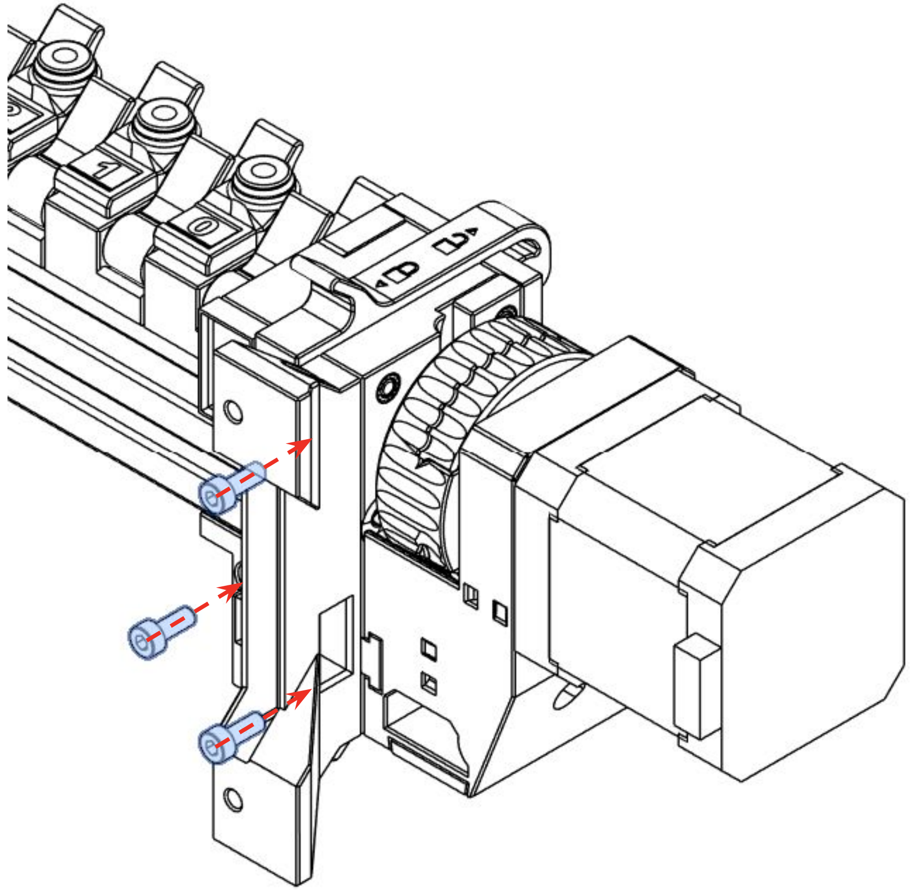
4.1 TOP PANEL

Install the Gear_Box_Top_Panel of the Gearbox using 3 M3x8mm screws.

GEARBOX PART 2

FOOT



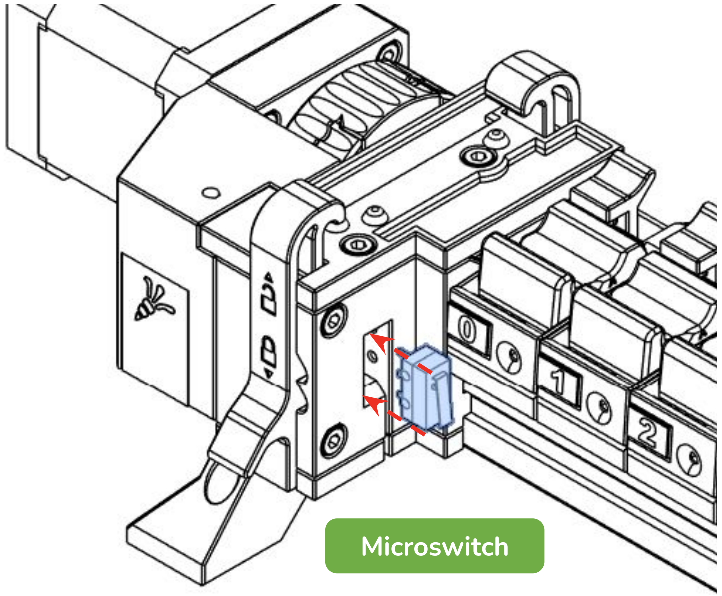


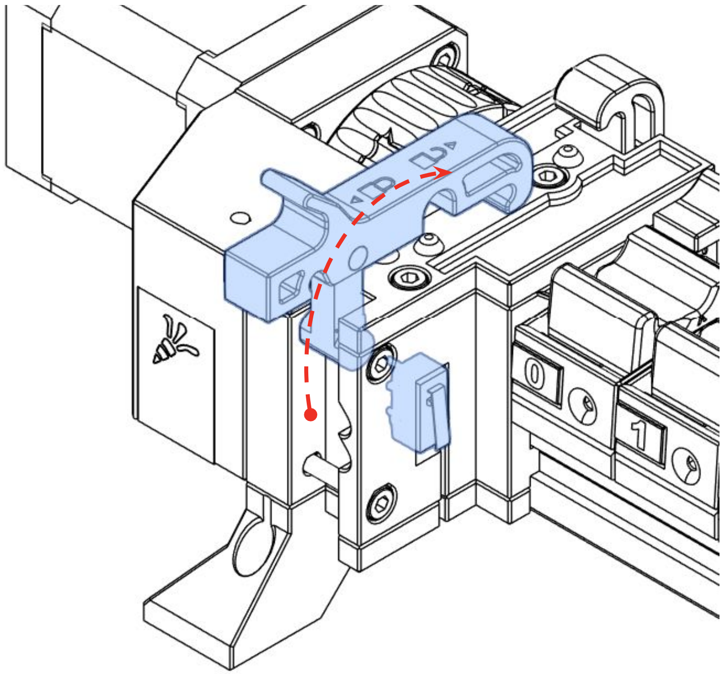
4.2 INSTALL THE FOOT

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.





ENDSTOP SWITCH

4.3 INSTALL THE ENDSTOP SWITCH

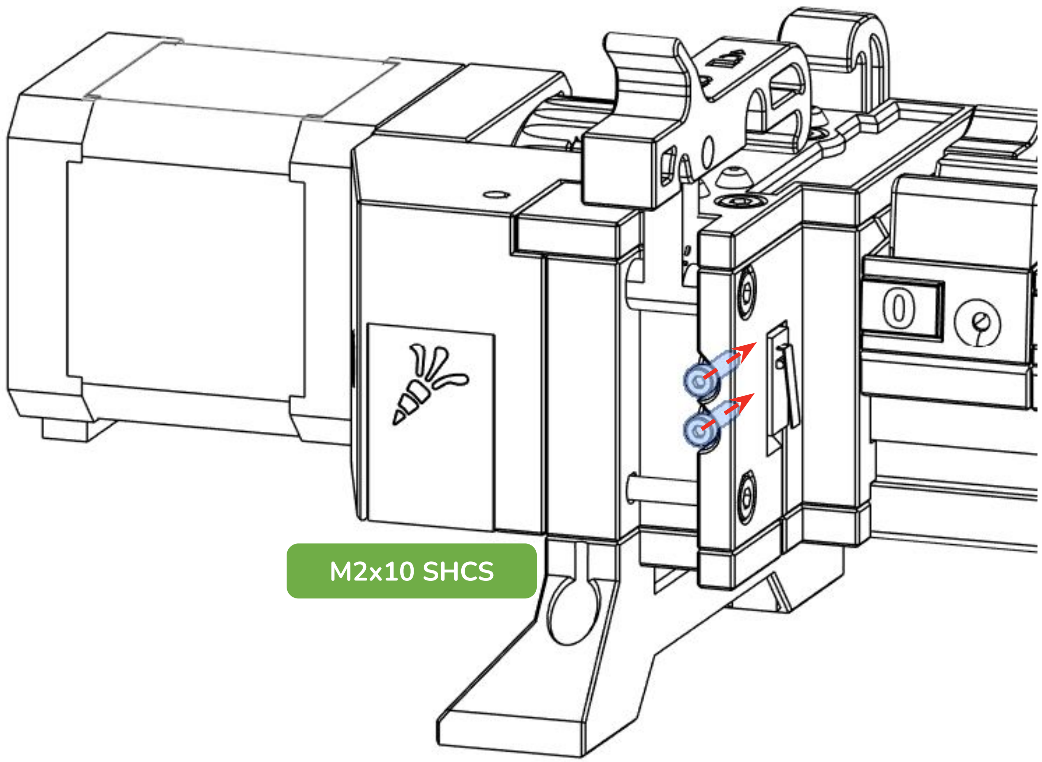
There is a cutout in the Gearbox for the microswitch and its' wires. Line up the microswitch with the cutout as shown. Wires omitted for clarity.

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

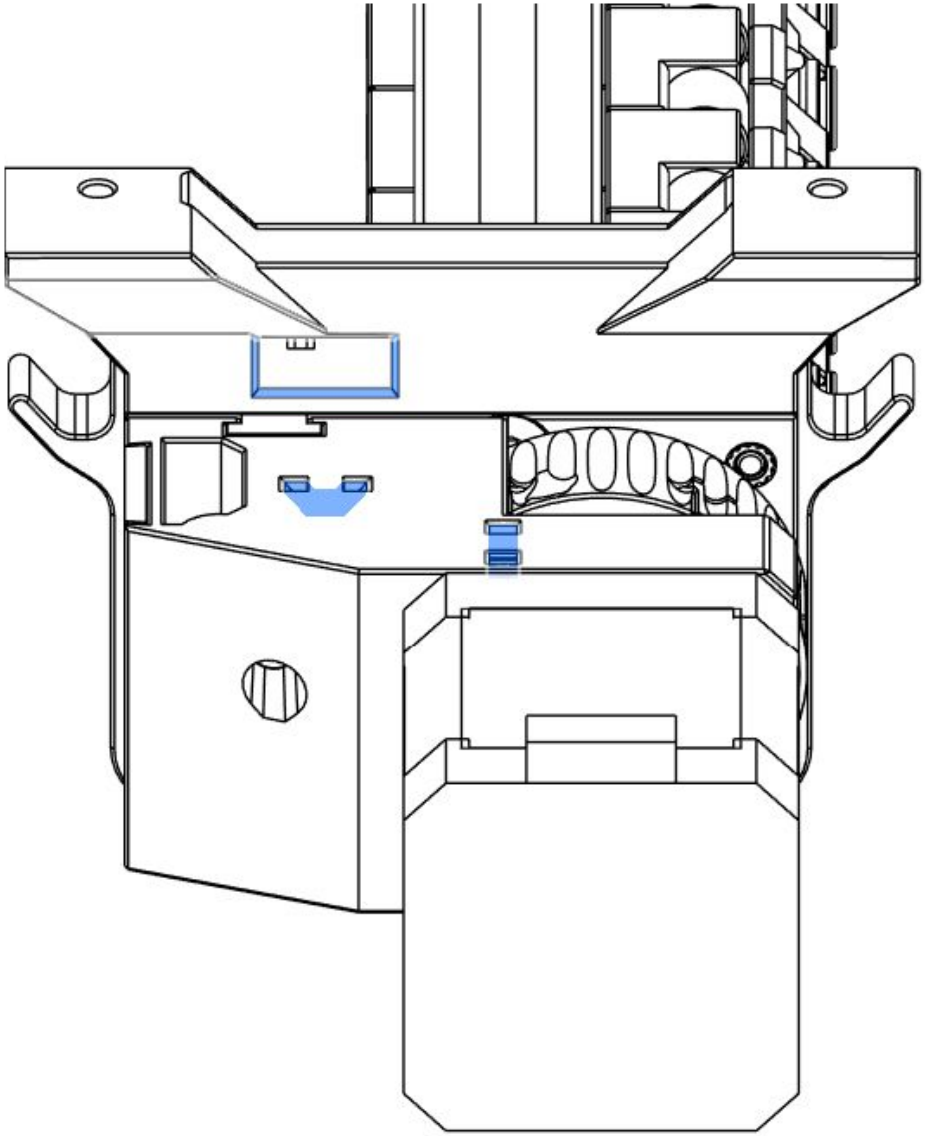
Push the microswitch into its cutout. Route the wires into the slot. The slot is sized to accept wires up to 16ga.

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.



CABLE MANAGEMENT

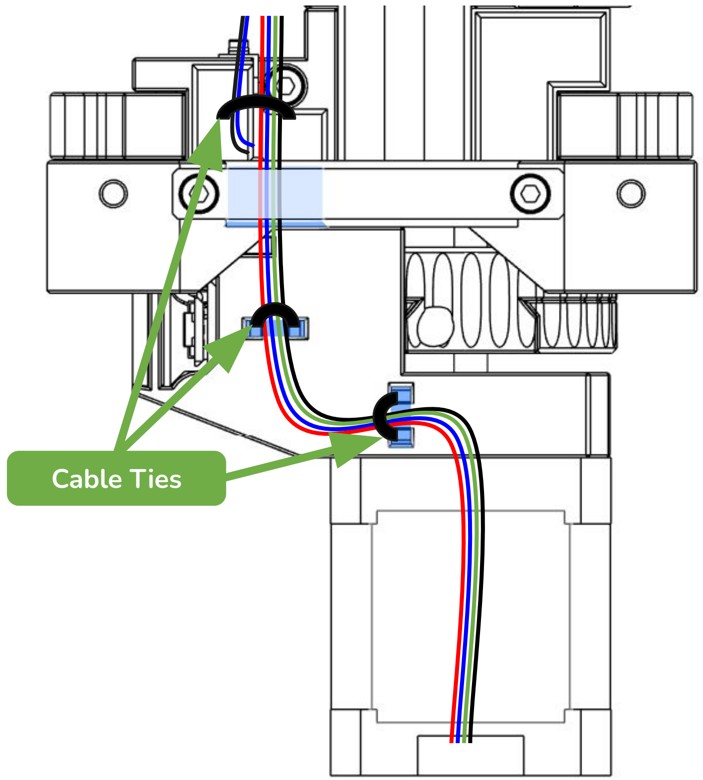


CABLE MANAGEMENT

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.

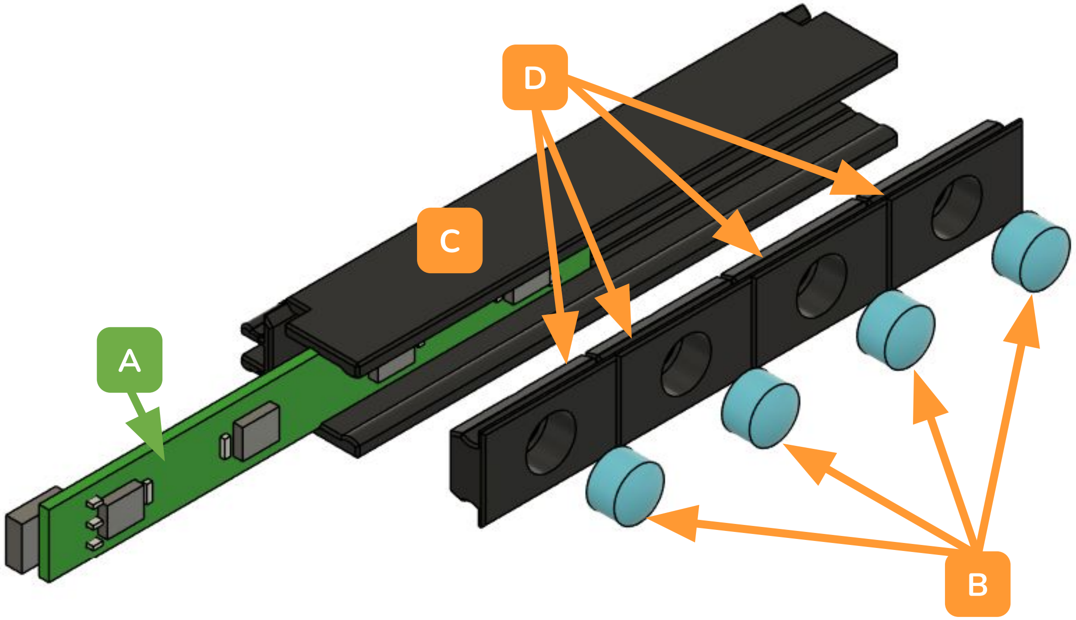
There are two cable tie slots on the bottom of the Motor_Mount. Use cable ties to secure the motor wiring to both of the slots. Don't skip this step - this is to prevent the motor wiring from getting wrapped onto the Drive Shaft.

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



CARROT ON A STICK EXPLODED VIEW

[These graphics will be updated soon with new new version of the COAS holder - I just have to invent it first]



COAS SUB-BOM

A 2x Carrot on a Stick PCB

B 8x [c]_Cover_Lens_xN.stl**
C 2x CoaS_Holder.stl
D 8x Cover_Body_xN.stl

One unit shown out of two.

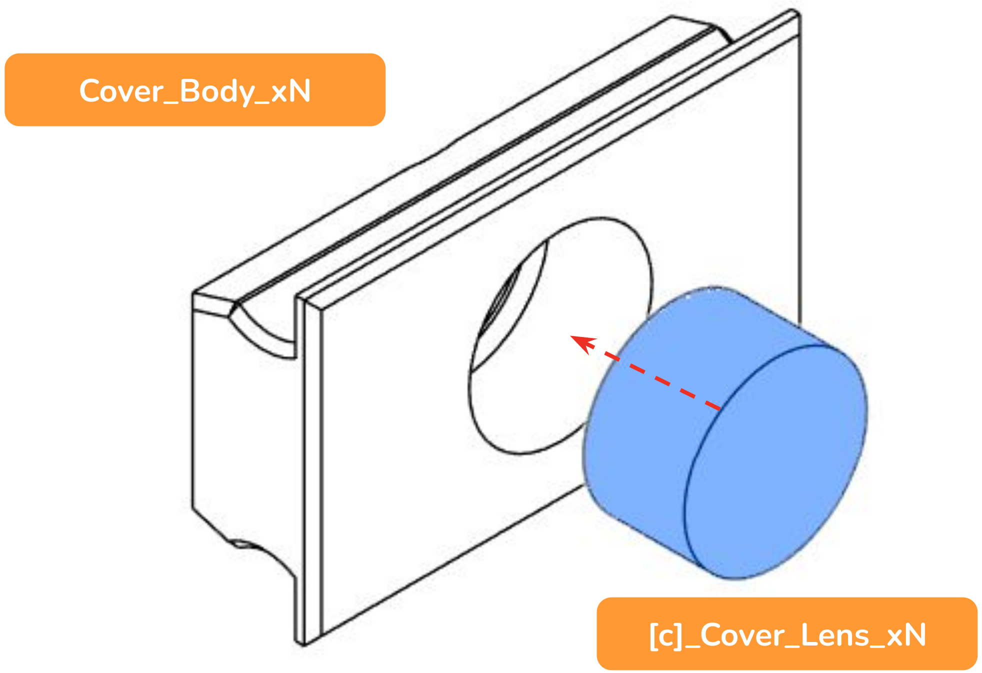
**See the note about multicolor printed parts vs single-color assembly.

COVERS LENS

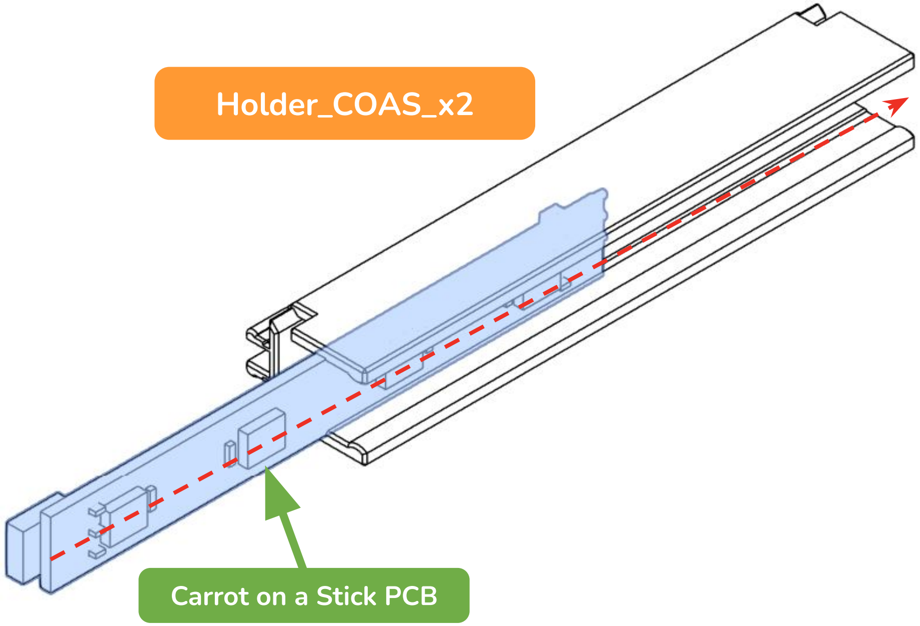
ASSEMBLED VS PRINTED COVER LENS

This part is cosmetic. You can either print the covers lens as separate single-color pieces and then assemble them, or print them as a multicolor print once you have your ERCF running.

If you elect to assemble the two pieces, print one set first to check the fit. You may need to play with the size of the lens to get it to fit snugly. Once you do, print the rest and use a drop of superglue to hold the lens into the cover.



CARROT ON A STICK

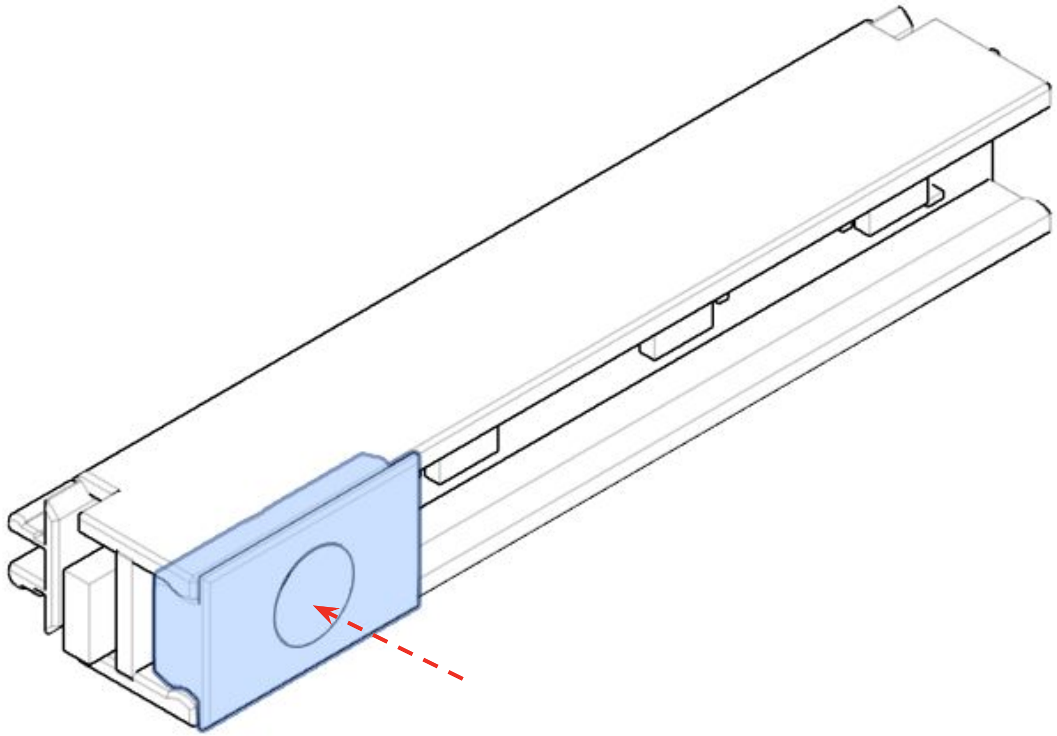


4.4 CARROT ON A STICK

There is a groove in the Holder_COAS_x2 for the Carrot on a Stick PCB to fit into. Start the PCB on one edge and it should slide along the groove into place.

Next, apply a drop of superglue to each Cover Lens assembly so that it doesn't slide around, and pop it into place on the Holder.

Repeat this for all four Cover Lens



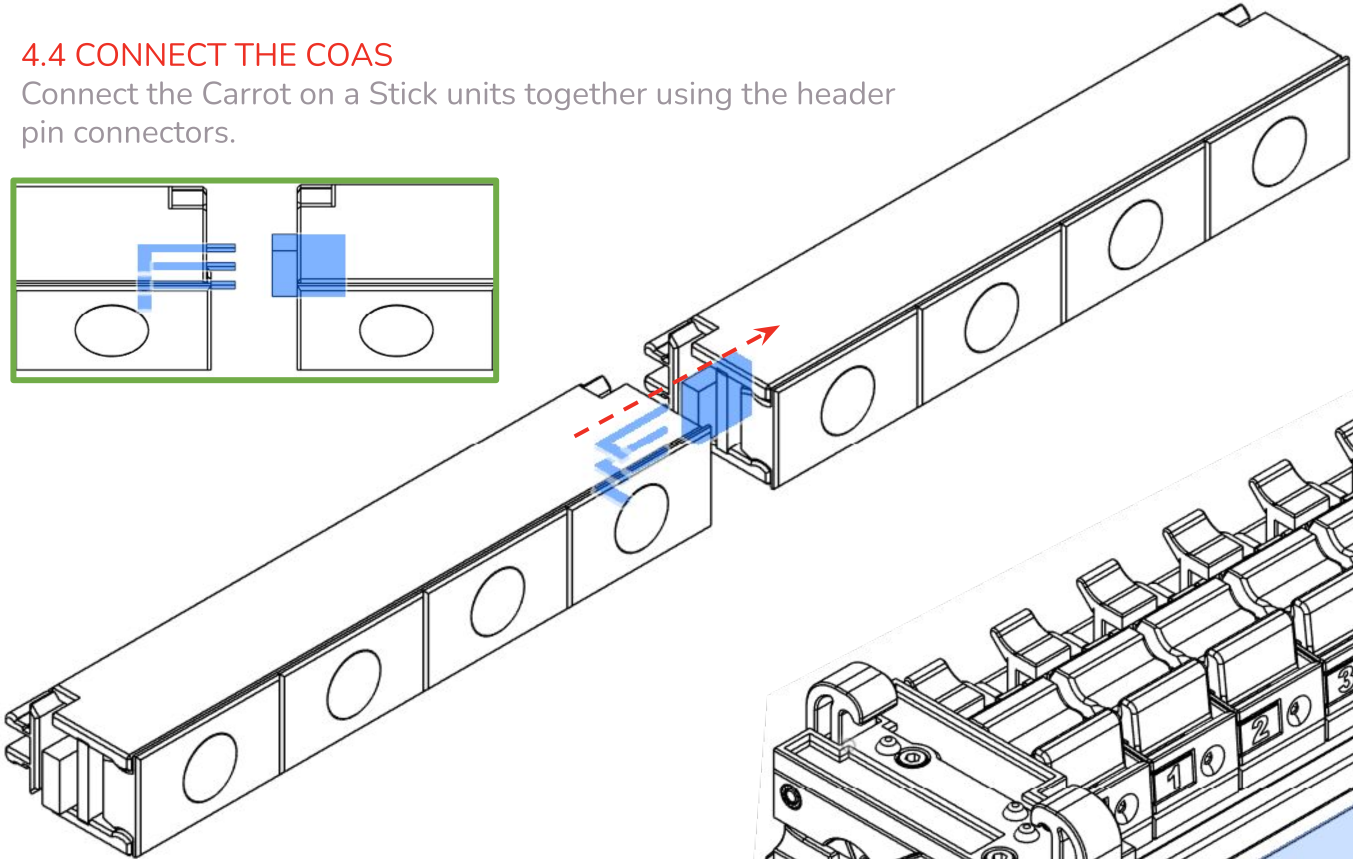
Repeat this for a second Carrot on a Stick assembly.

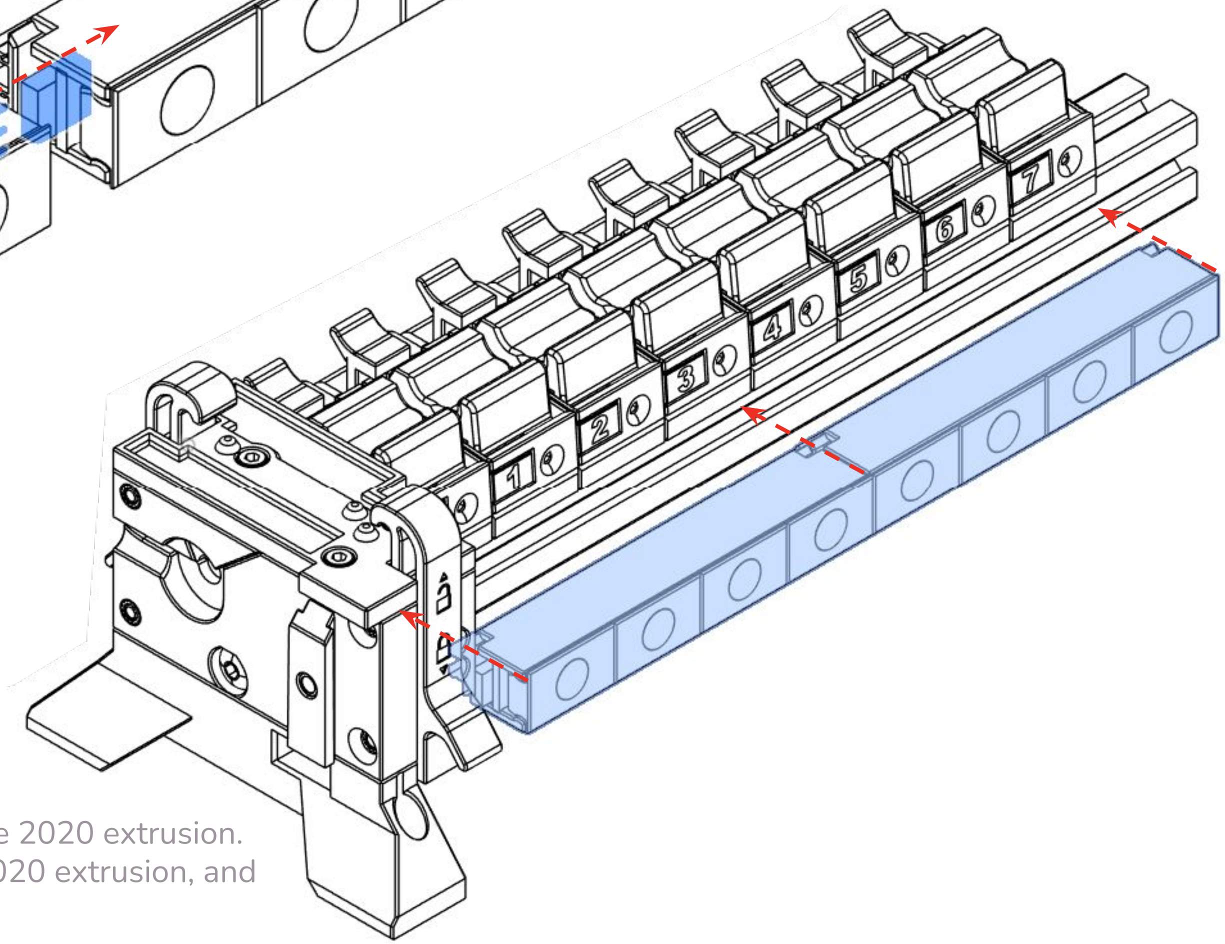
This assumes you are building the standard 8-channel setup. You can easily daisy-chain more or less assemblies to get to any even number of channels using the Carrot on a Twig, which is just two LEDs.

CARROT ON A STICK

4.4 CONNECT THE COAS

Connect the Carrot on a Stick units together using the header pin connectors.





INSTALL THE COAS

The COAS_Holder is designed to clip into the 2020 extrusion. Just line the clips up to the channel on the 2020 extrusion, and give the assembly a good push.

If you're using the alternative LED PCBs, install it the same way.

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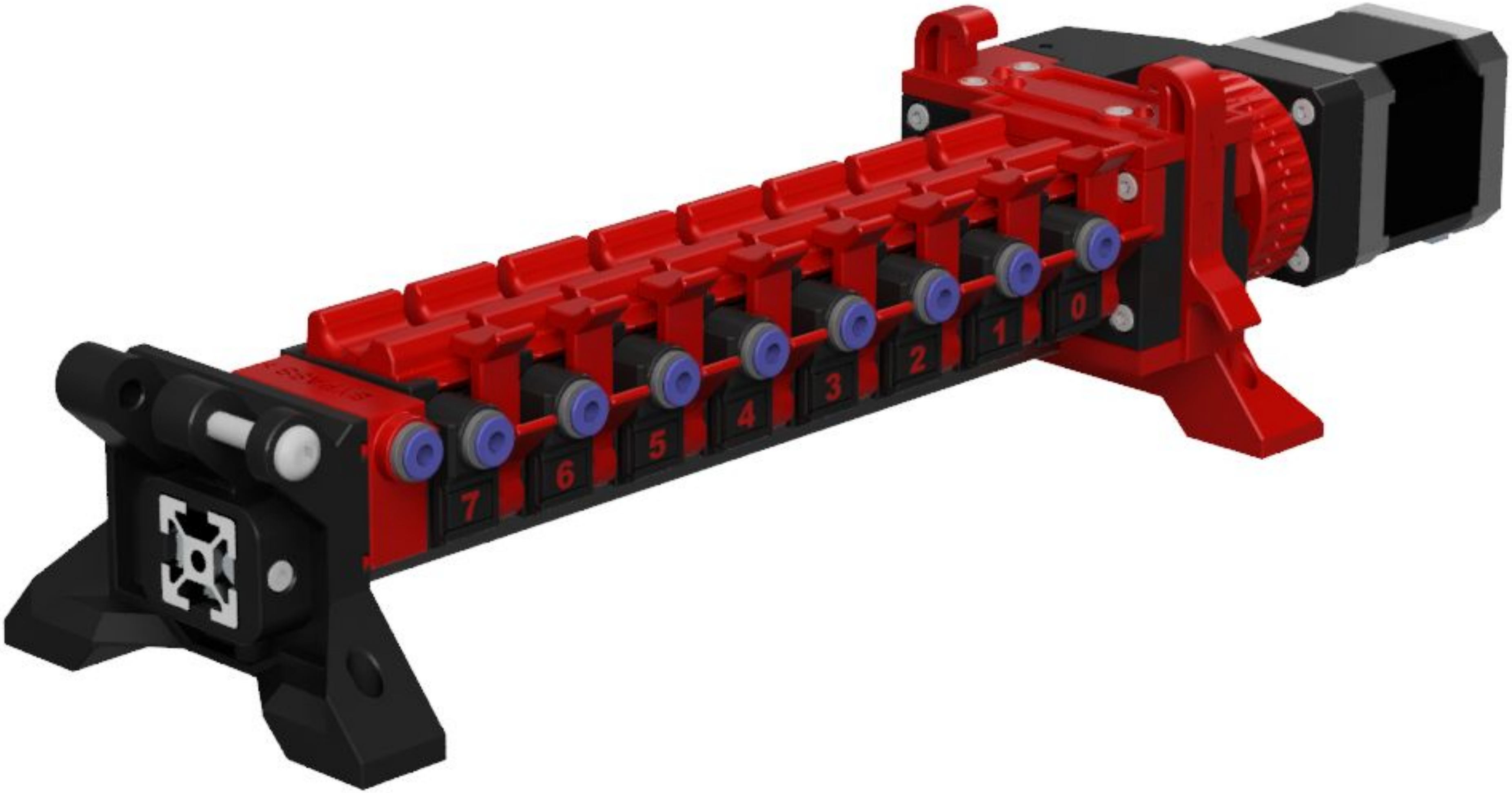
Support structures benefit from multi-material printing. In multi-material setups, one material can be used for the object itself and another for supports, such as water-soluble PVA, which can be dissolved away after printing, leaving cleaner results.

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

OVERVIEW



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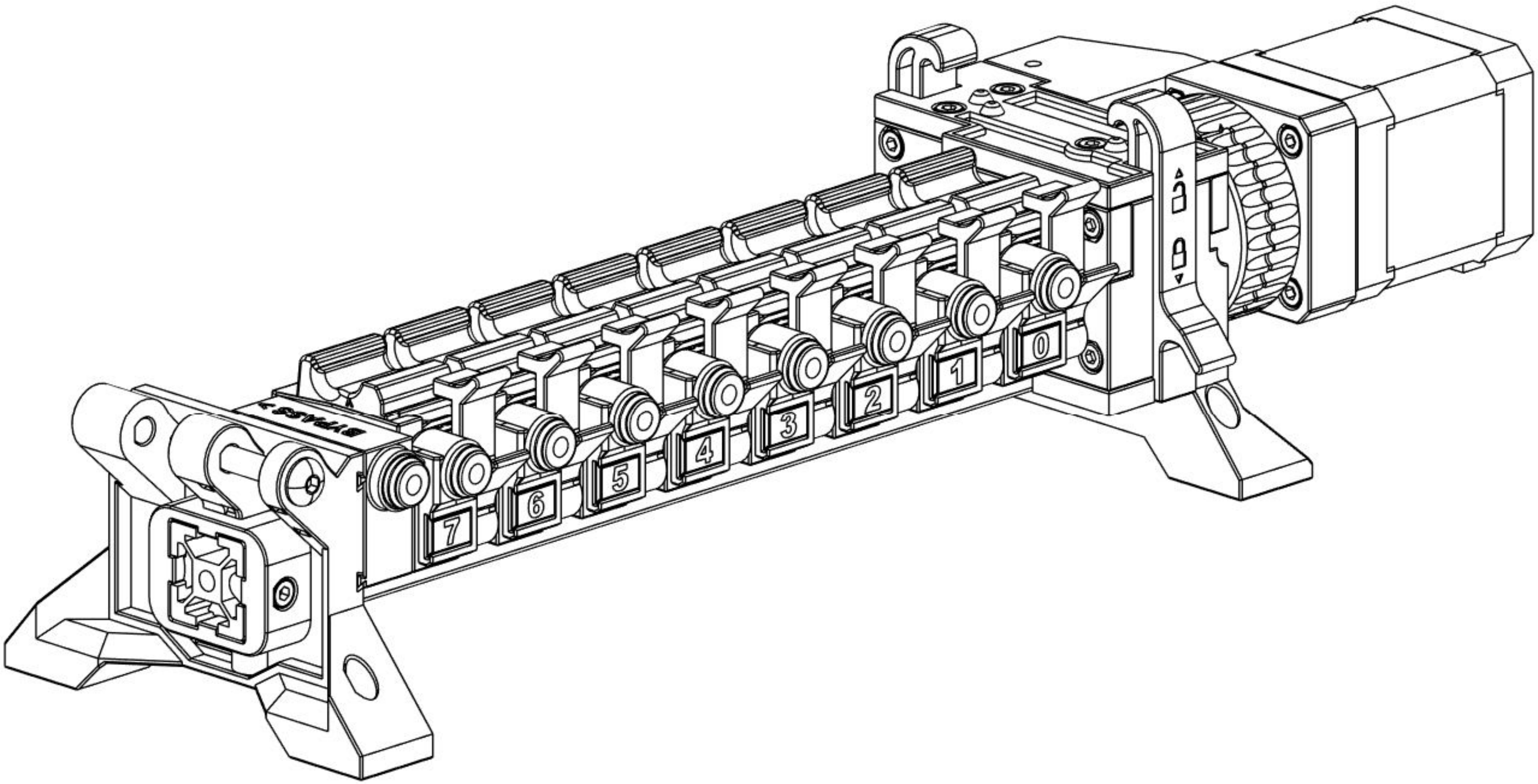
OVERVIEW

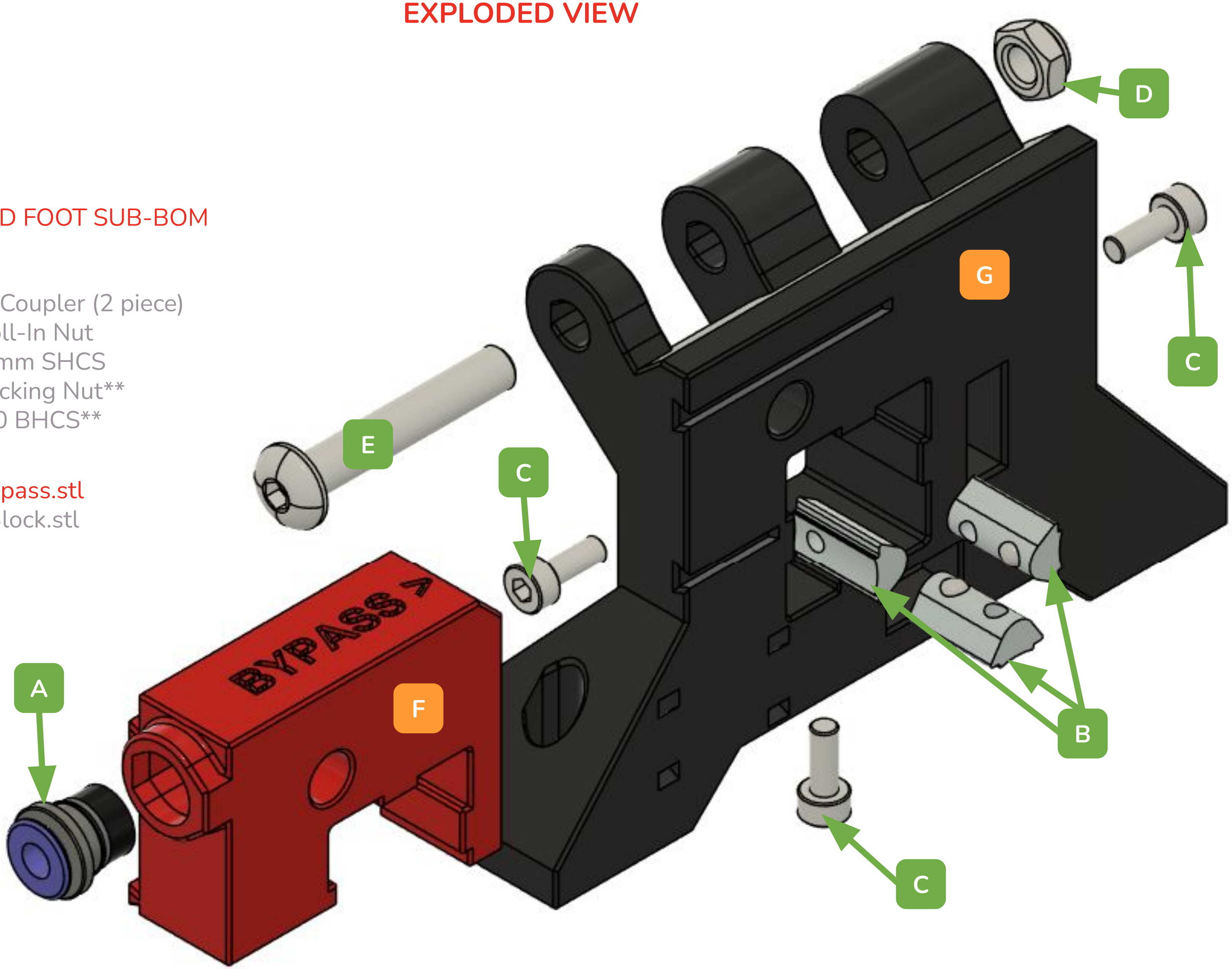


END BLOCK

EXPLODED VIEW

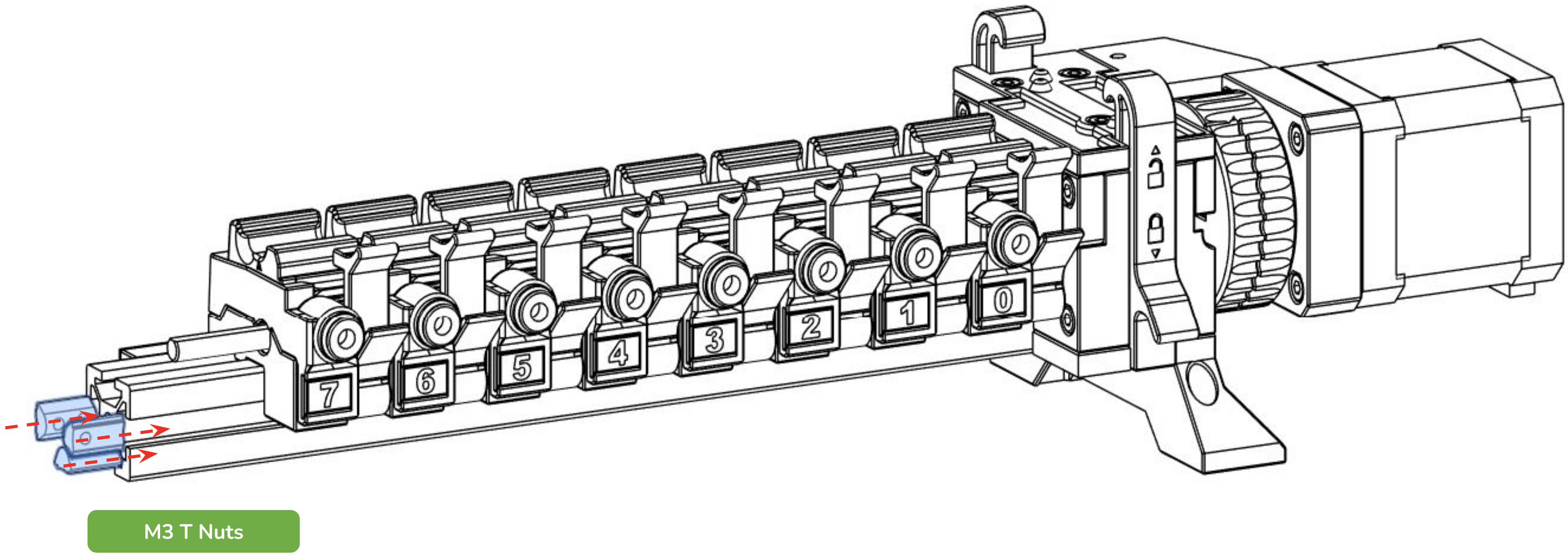
END BLOCK AND FOOT SUB-BOM

A	1x ECAS Coupler (2 piece)
B	3x M3 Roll-In Nut
C	3x M3x8mm SHCS
D	1x M5 Locking Nut**
E	1x M5x30 BHCS**
F	1x [a]_Bypass.stl
G	1x End_Block.stl



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

PREP END BLOCK

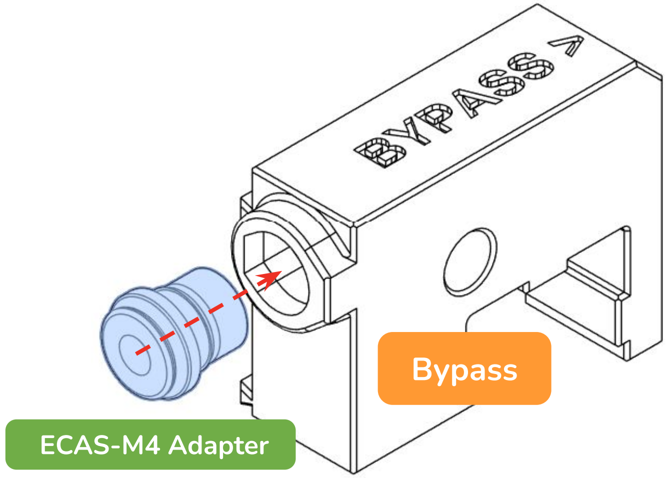


PREP END BLOCK

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.

INSTALL END BLOCK

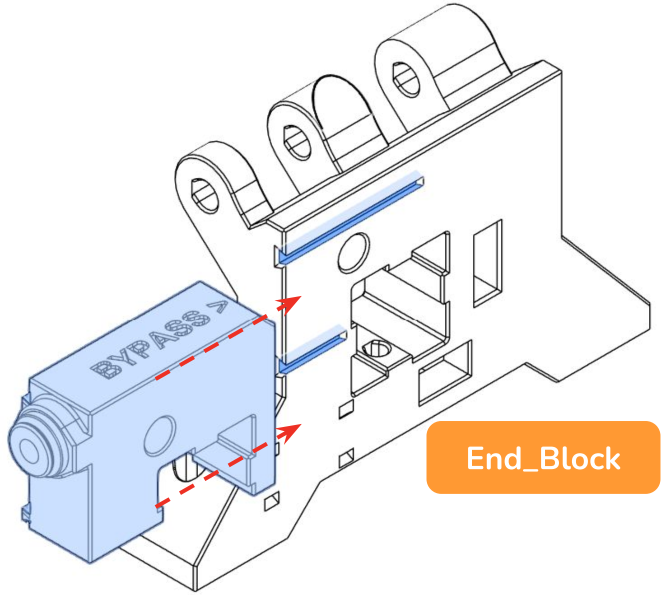


5.2 PREP BYPASS

Remove the rubber seal from the ECAS-M4 adapter and then Insert it into the Bypass.

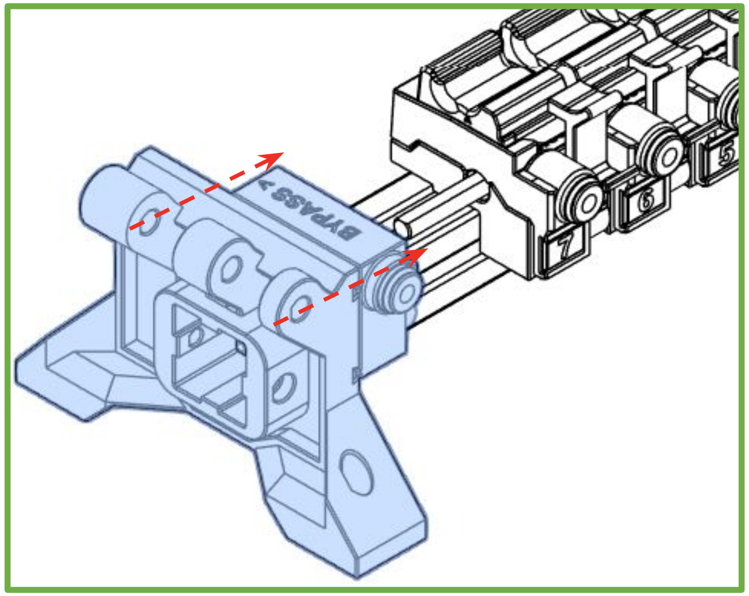
Slide the Bypass dovetails into the End_Block slots.

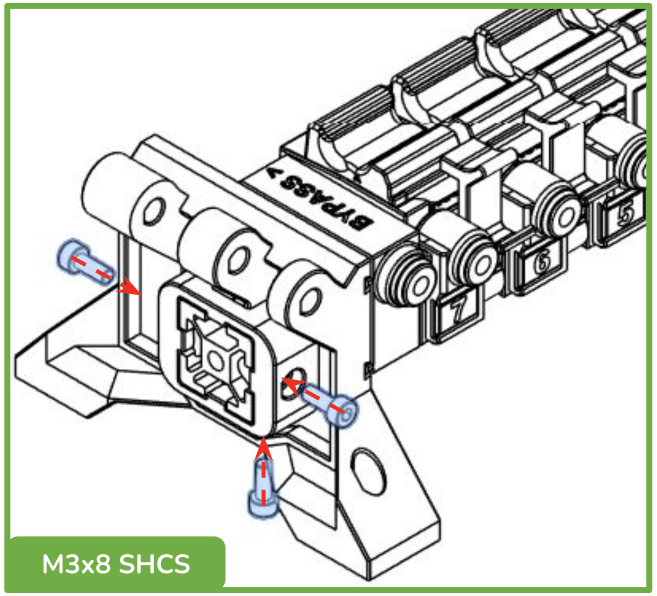
The Bypass dovetails are very sensitive to your printer's tuning, particularly the extrusion multiplier, and the layer cooling time / fan settings. If you are having trouble printing this part, start there.



INSTALL END BLOCK

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





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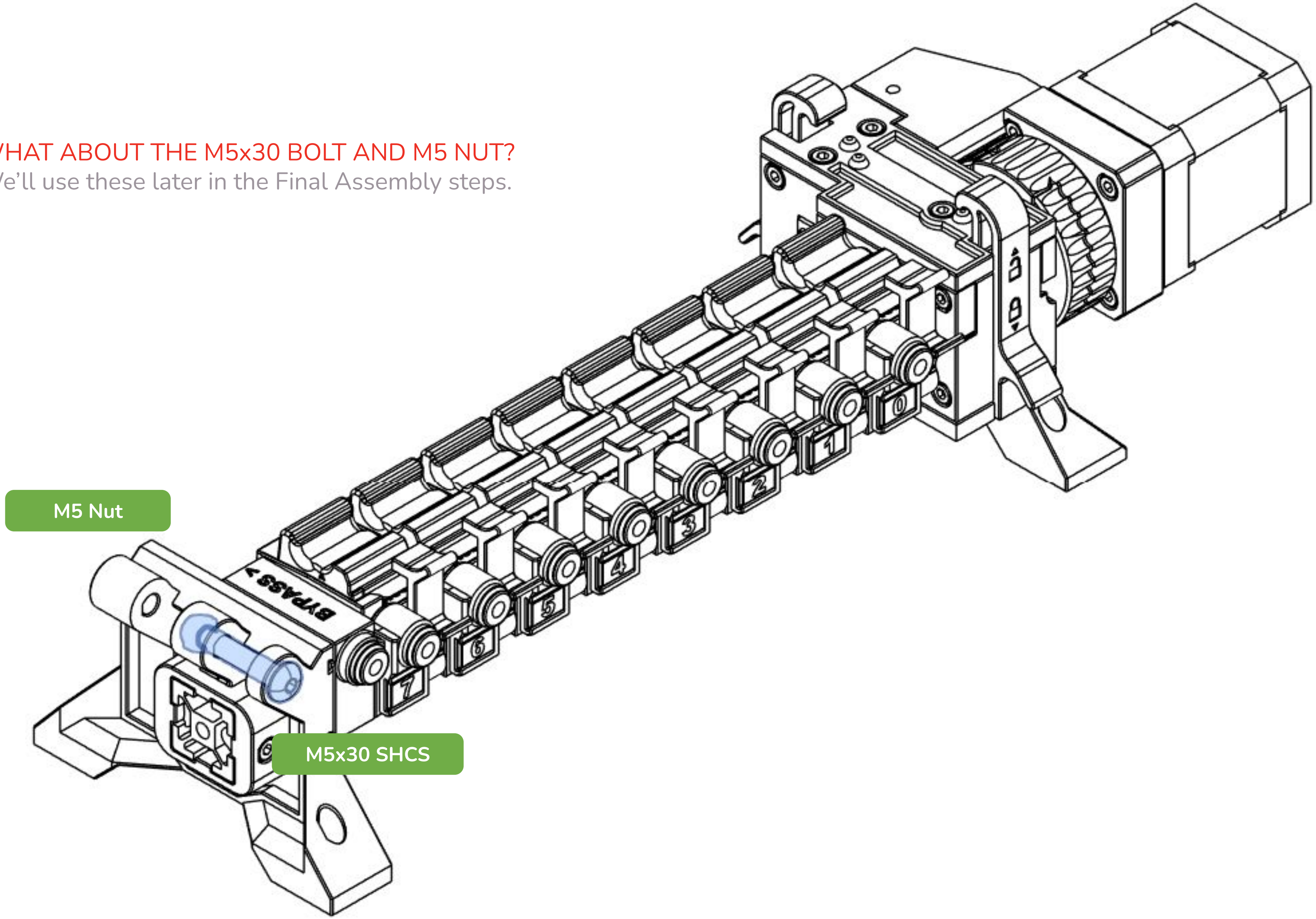
END BLOCK M5 HARDWARE

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.

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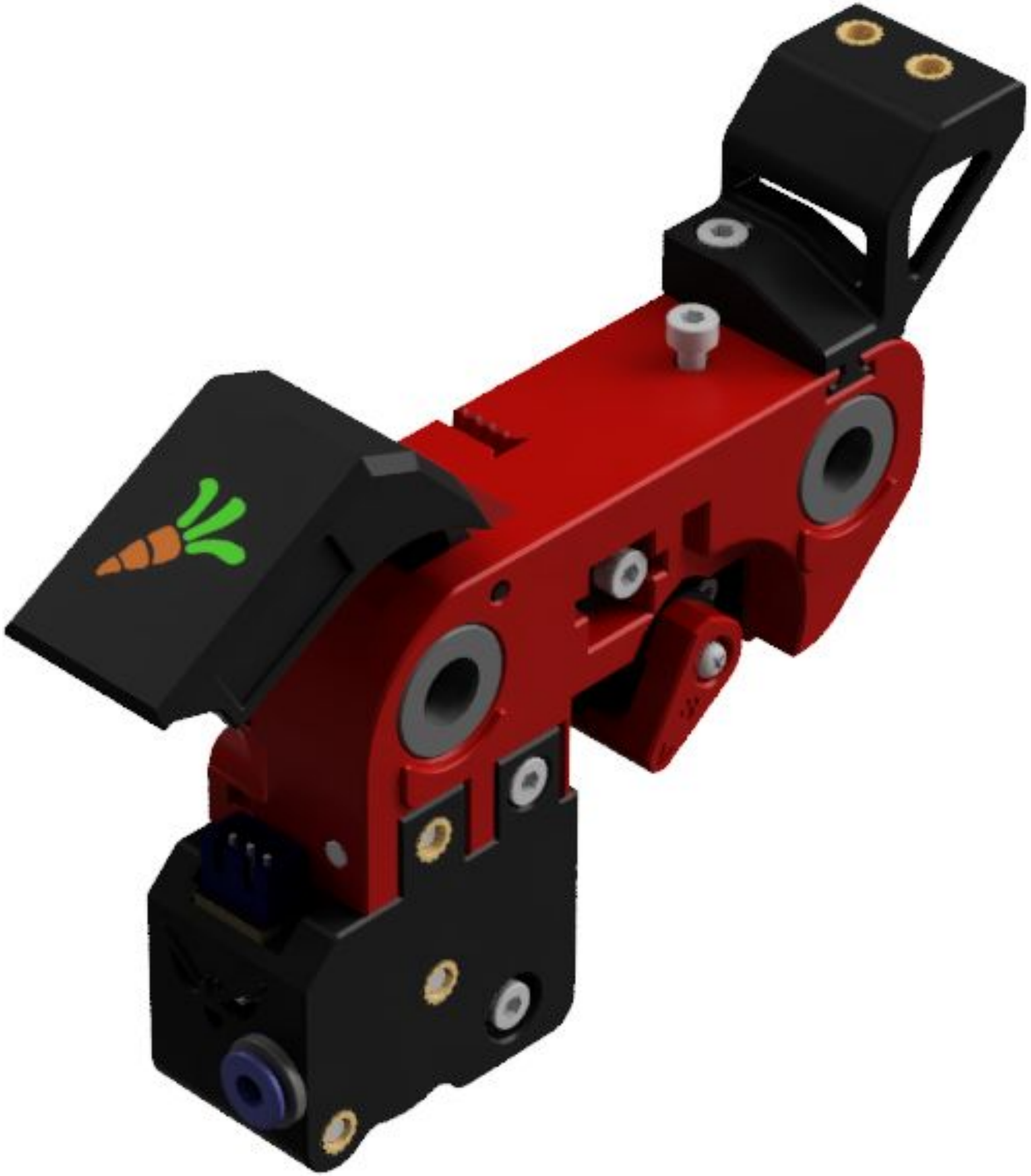
OVERVIEW



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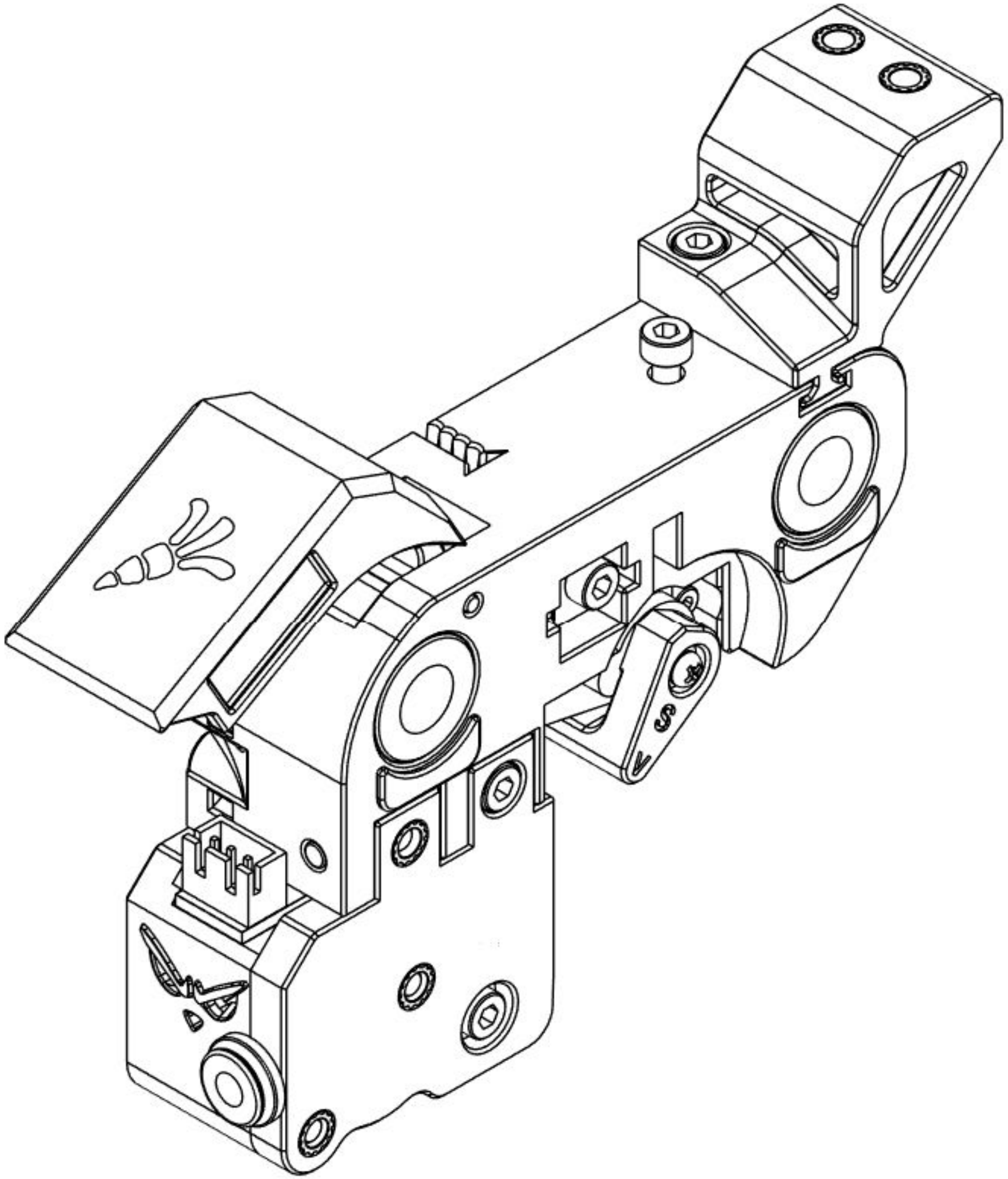
OVERVIEW



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SELECTOR

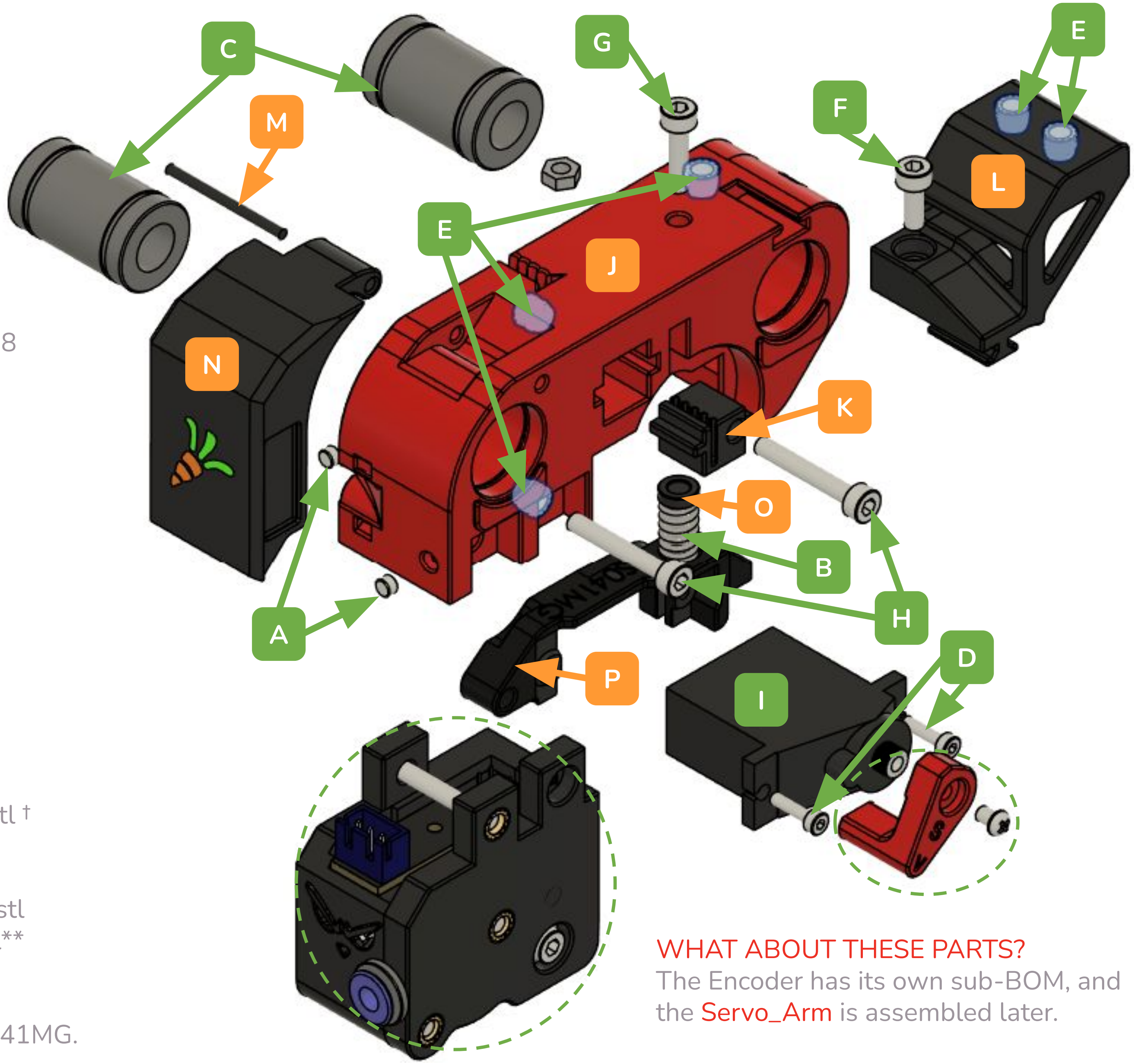
SELECTOR SUB-BOM

A	2x 3x2mm Magnet
B	1x 6x12x1mm Spring
C	2x LM8UU or RJ4JP-01-08
D	2x M2x8mm SHCS
E	5x M3 Threaded Inserts
F	1x M3x8mm SHCS
G	1x M3x12mm SHCS
H	3x M3x20mm SHCS
I	1x Servo**

J	1x [a]_Selector_Cart.stl
K	1x Belt_Tensioner.stl †
L	1x Drag_Chain_Anchor.stl †
M	1x Piece of Filament
N	1x Selector_Door.stl
O	1x Selector_Spring_Cap.stl
P	1x Servo_Mount_XXX.stl**

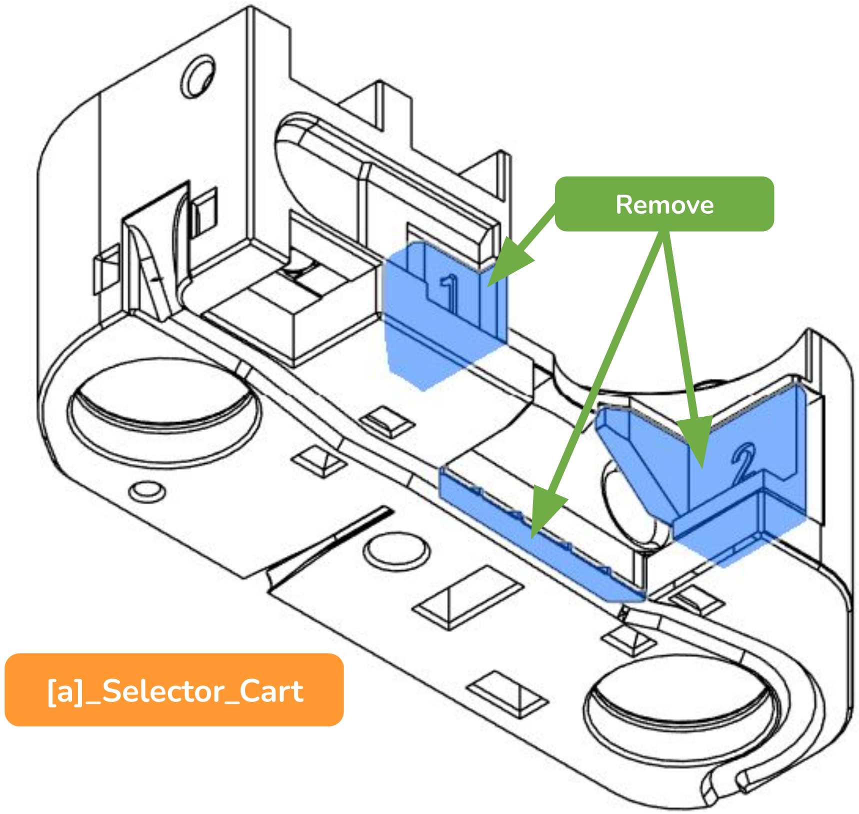
**MG90S, Savox, or DS041MG.

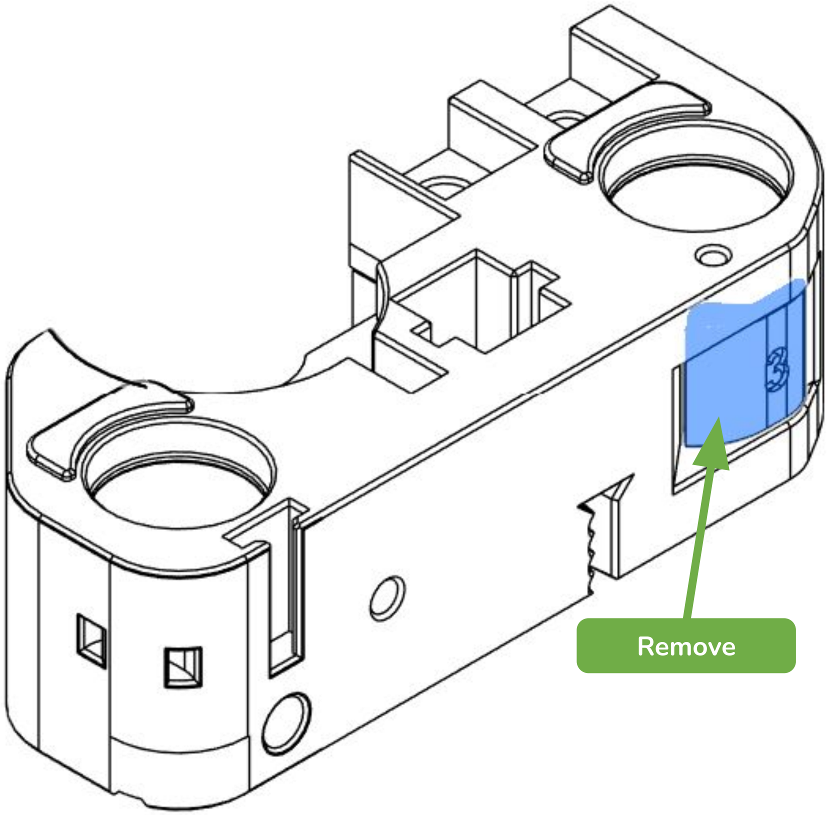
EXPLODED VIEW



WHAT ABOUT THESE PARTS?
The Encoder has its own sub-BOM, and the Servo_Arm is assembled later.

SELECTOR CART PREPARATION





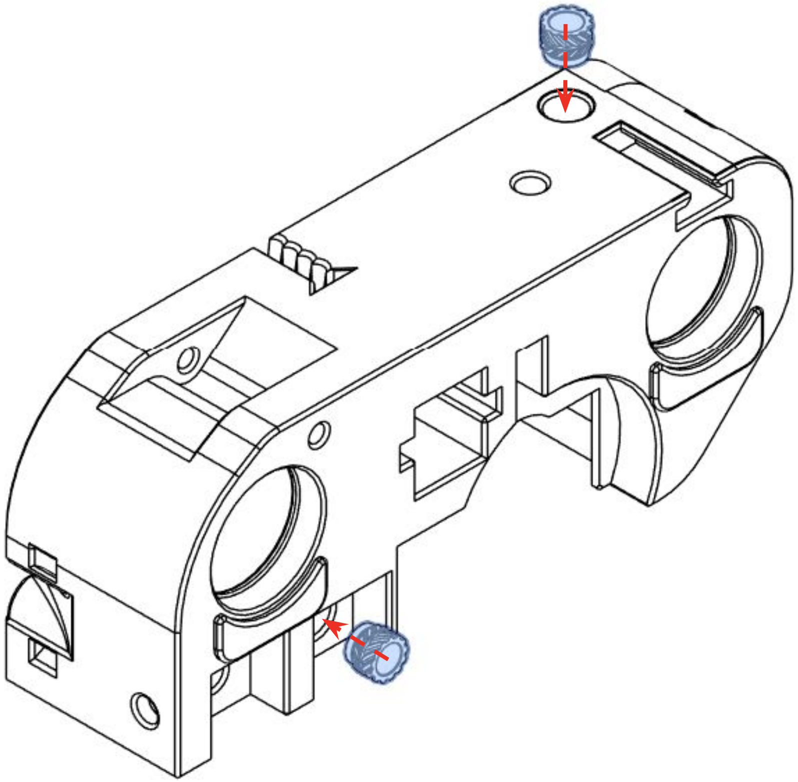
6.1 REMOVE BUILT-IN SUPPORTS

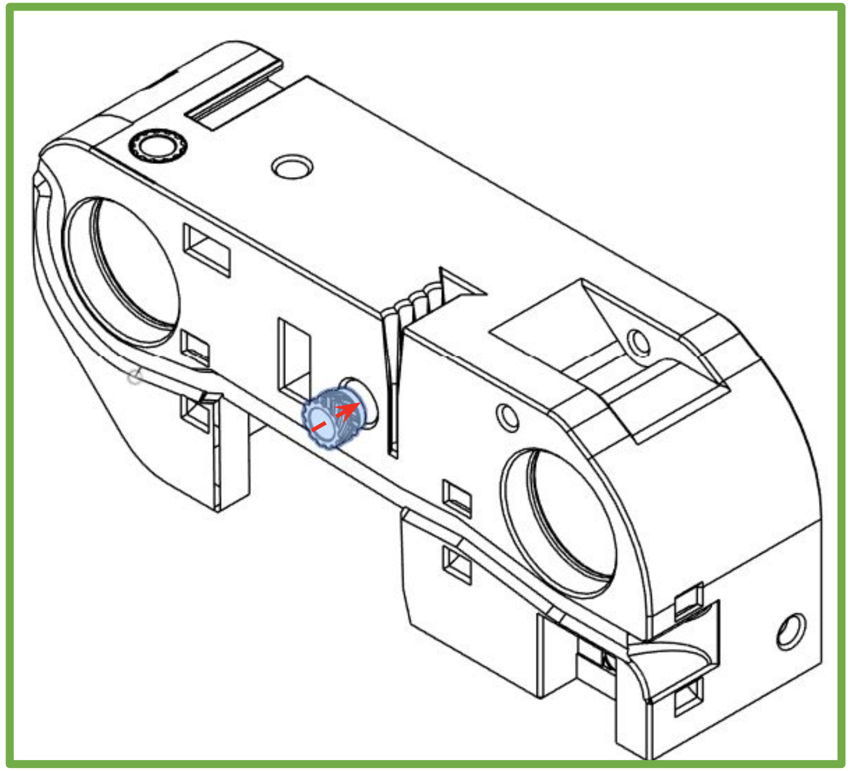
Use a small tool, like a small flat screwdriver, to carefully remove the built-in supports.

SELECTOR CART heatset INSERTS

6.1 HEATSET INSERTS

The list of pages with heatset inserts is on Page 16.





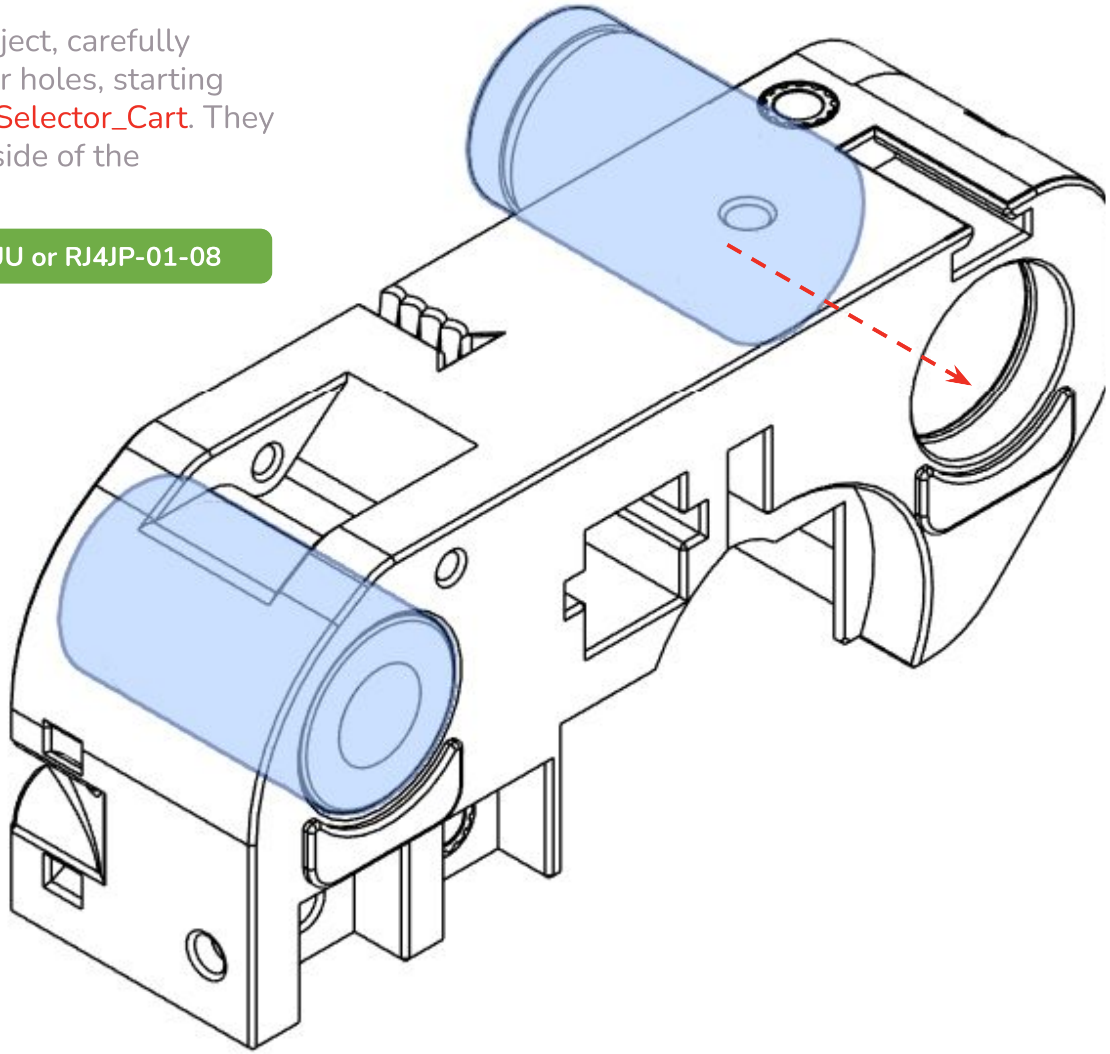
M3 Heatset Inserts

SELECTOR CART BEARINGS

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



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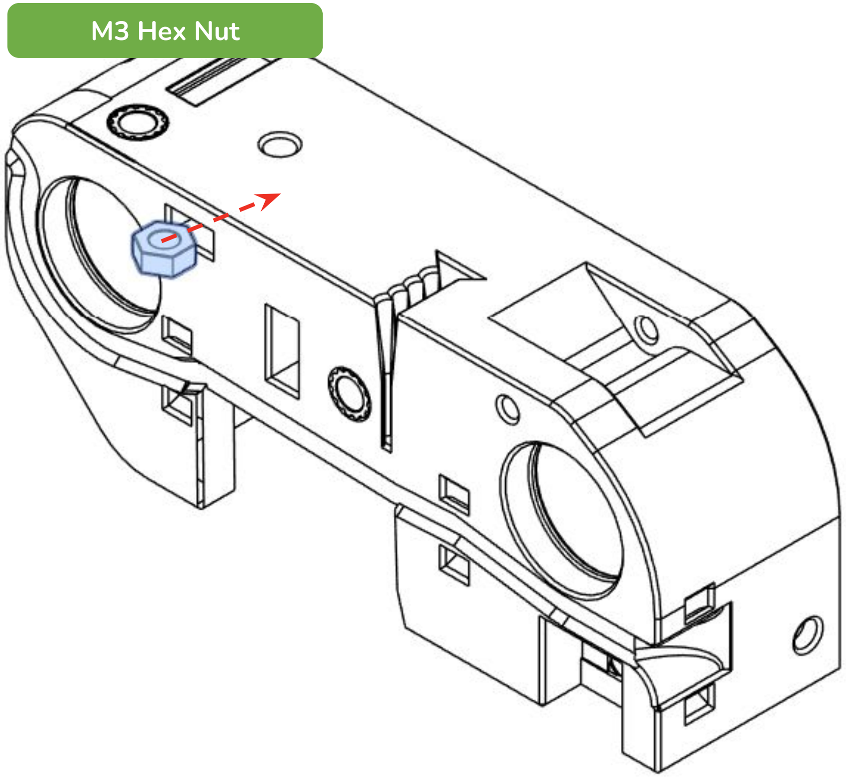
SELECTOR CART HEX NUT



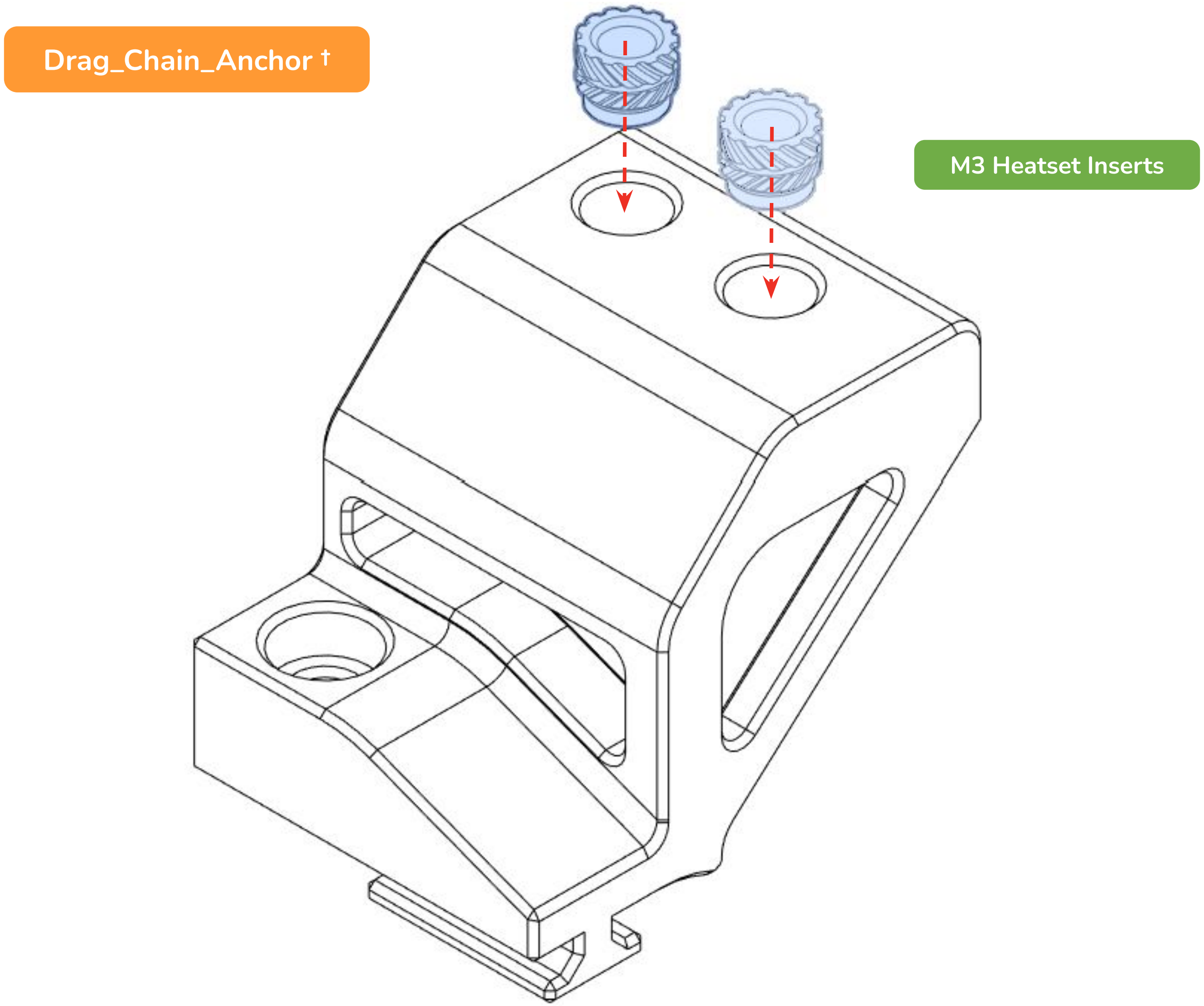
6.1 HEX NUT INSERTION

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.

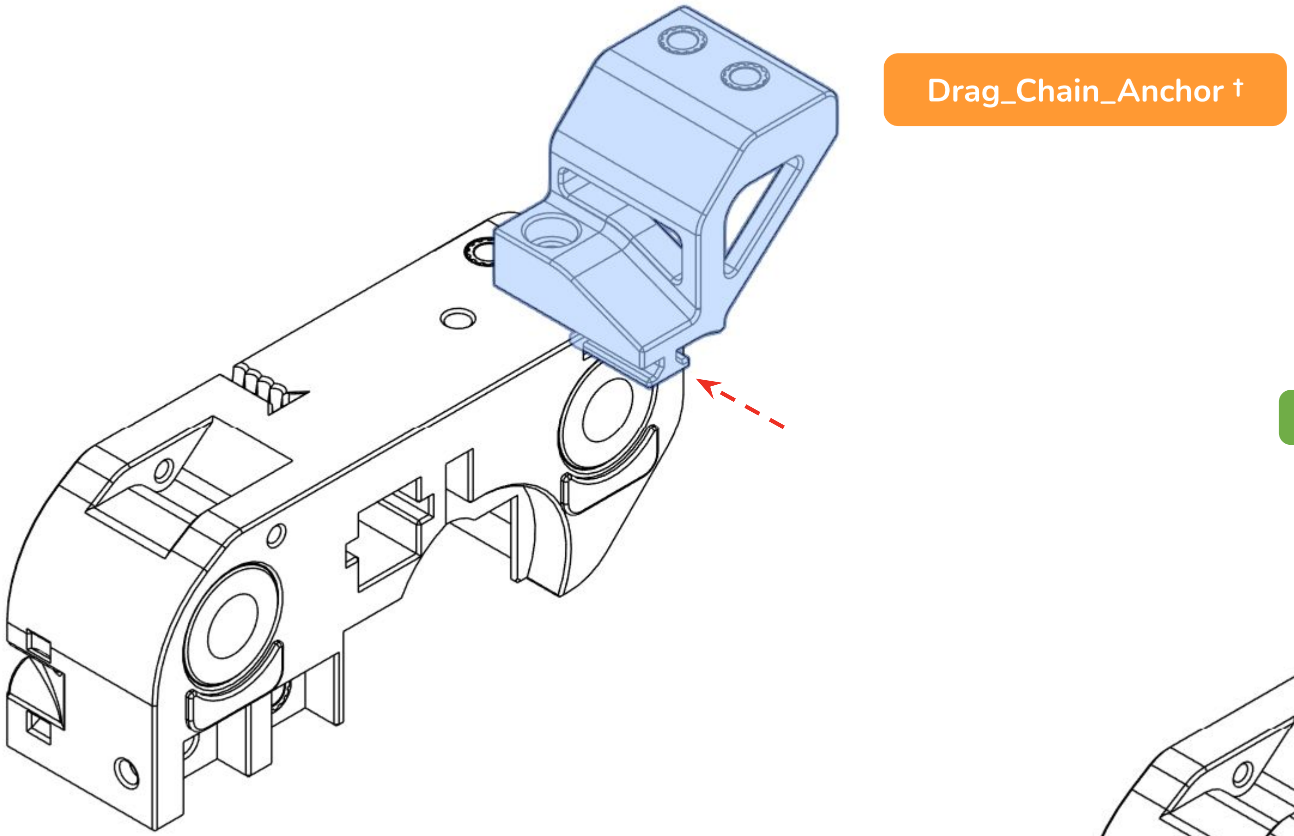
DRAG CHAIN ANCHOR HEATSET INSERTS

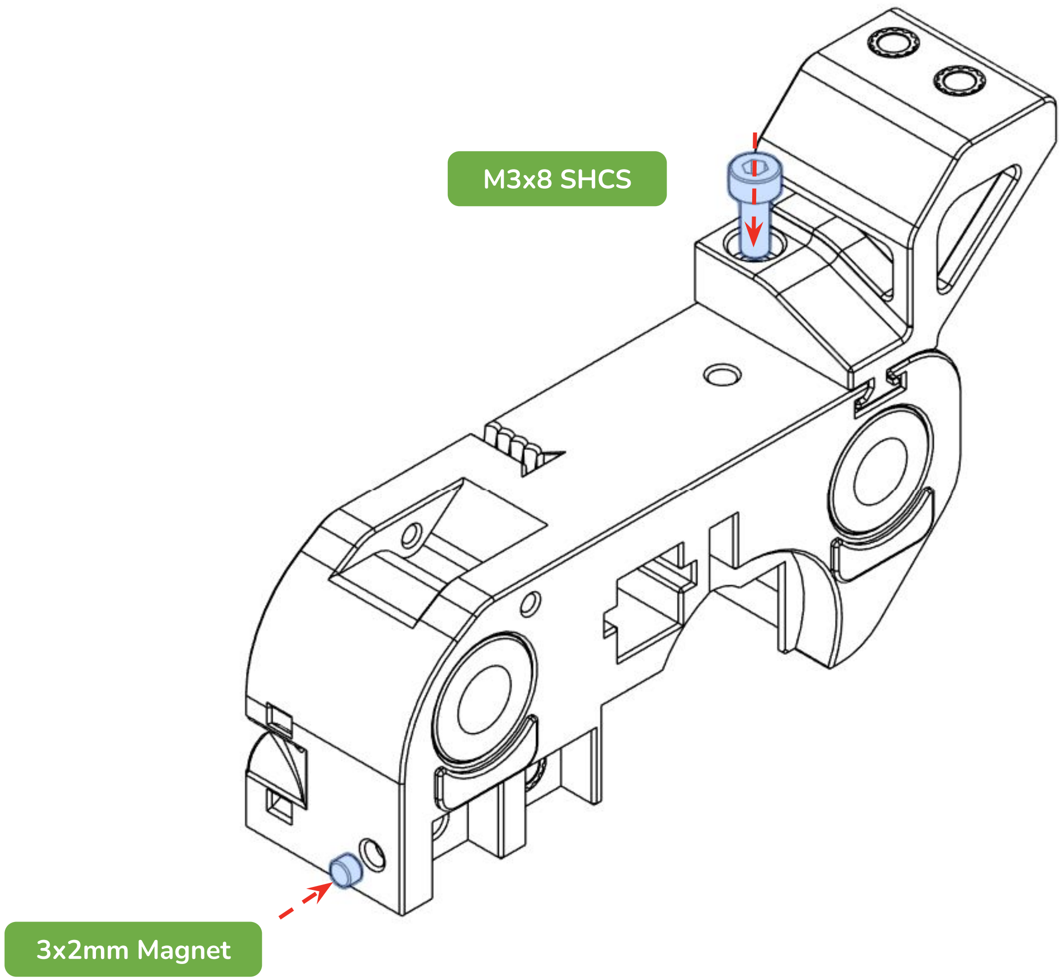
6.2 HEATSET INSERTS

The list of pages with heatset inserts is on Page 16.



DRAG CHAIN ANCHOR





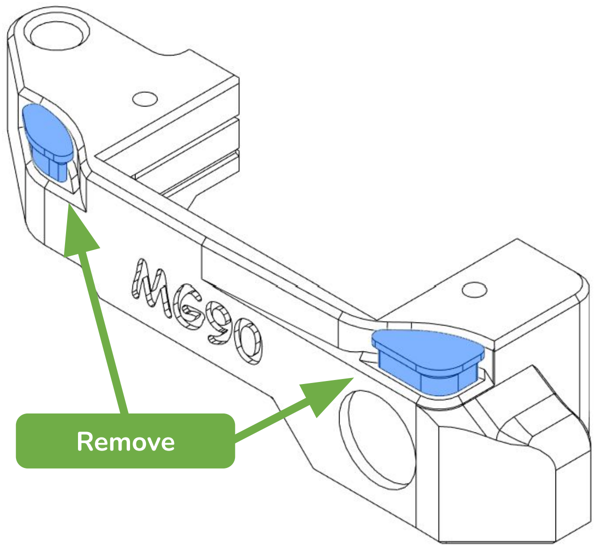
6.2 DRAG CHAIN AND MAGNET

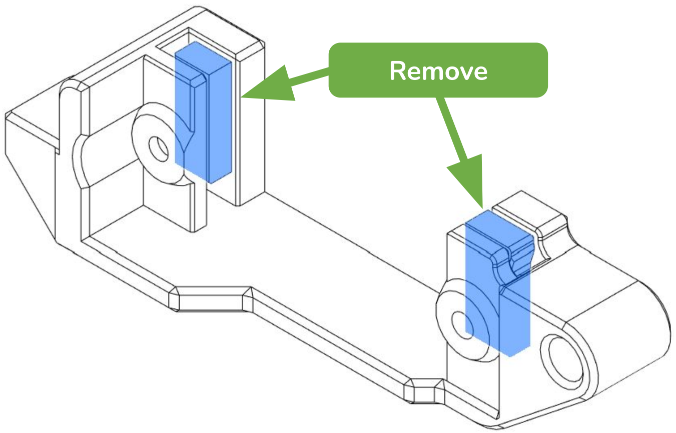
Slide the Drag_Chain_Anchor † into the dovetail groove on the Selector_Cart and install with an M3x8 SHCS screw.

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

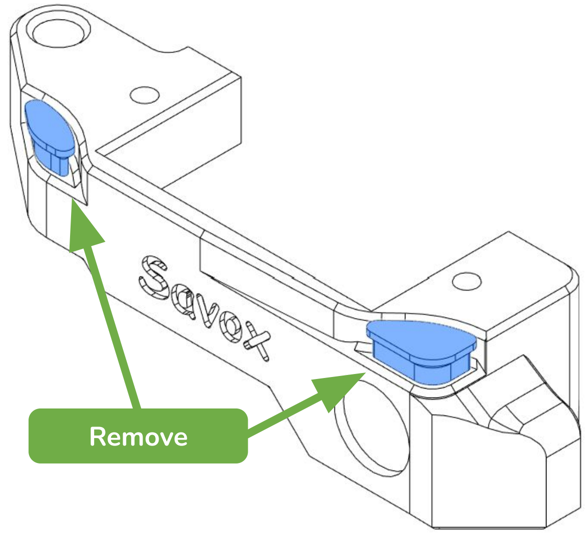
SERVO MOUNT PREPARATION

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.

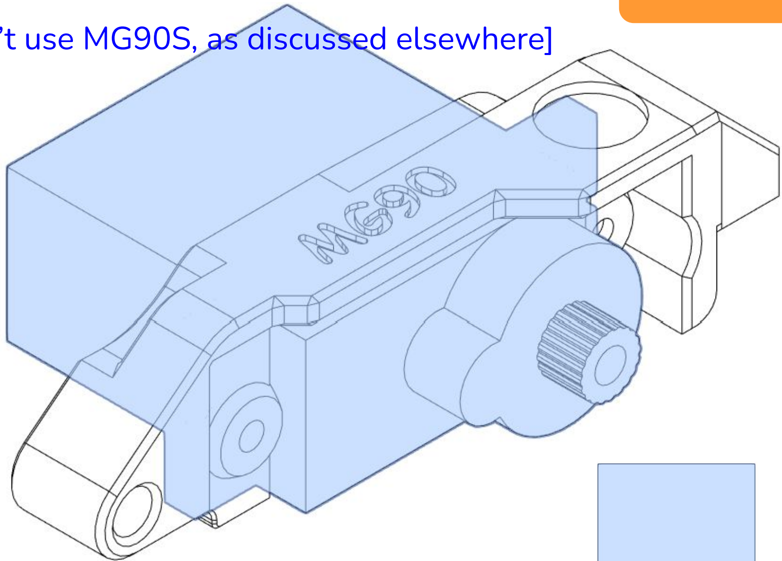
SELECTOR

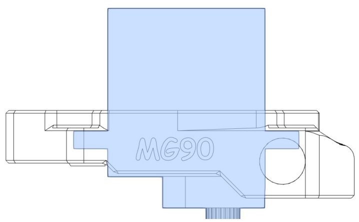
SERVO MOUNTING

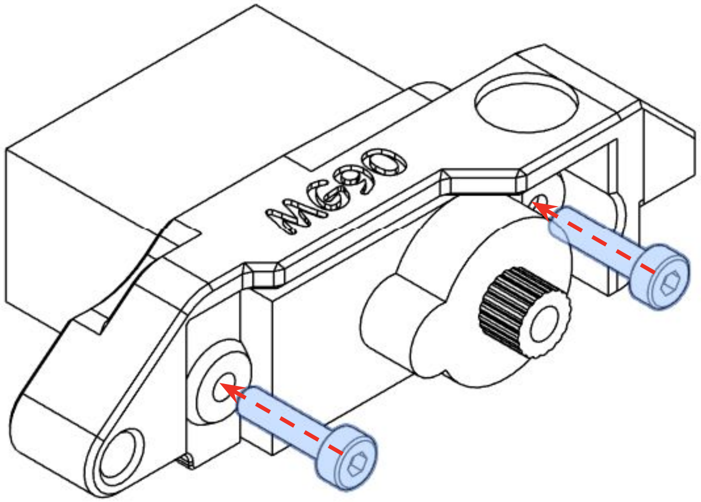
[These graphics will be updated soon.

Don’t use MG90S, as discussed elsewhere]

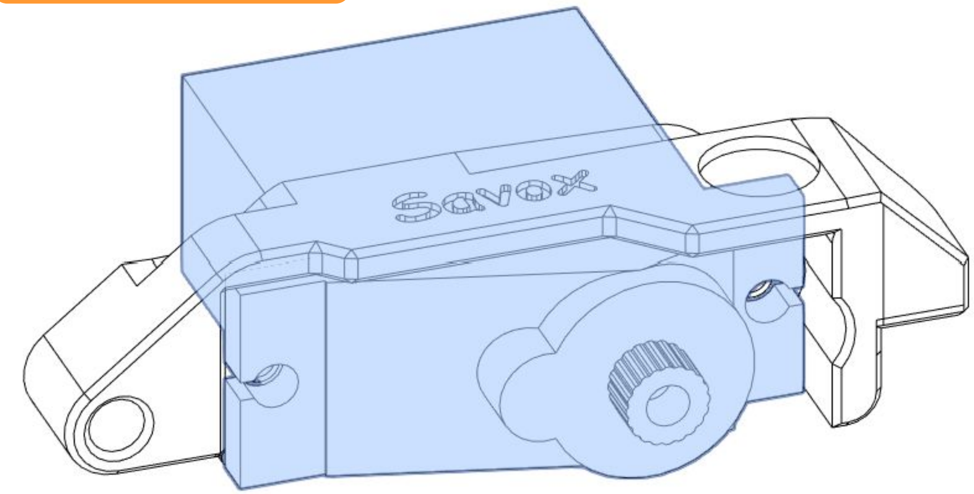
MG90S

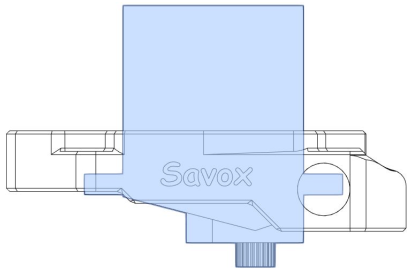


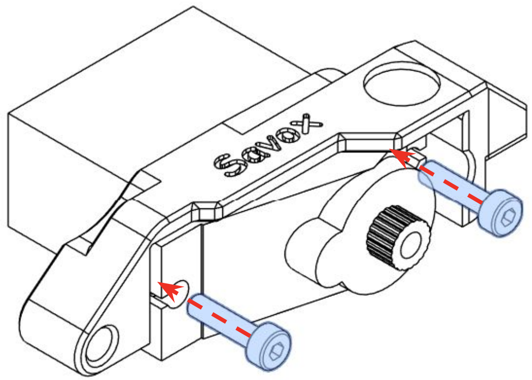




Savox SH0255MGP



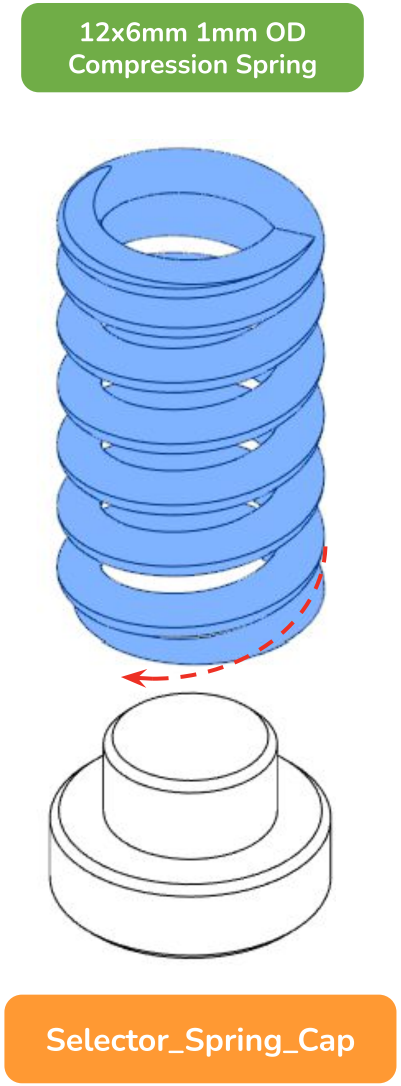




6.3 SERVO SCREWS

Use M2x8mm SHCS to attach the servo to its mount.

SPRING INSTALL

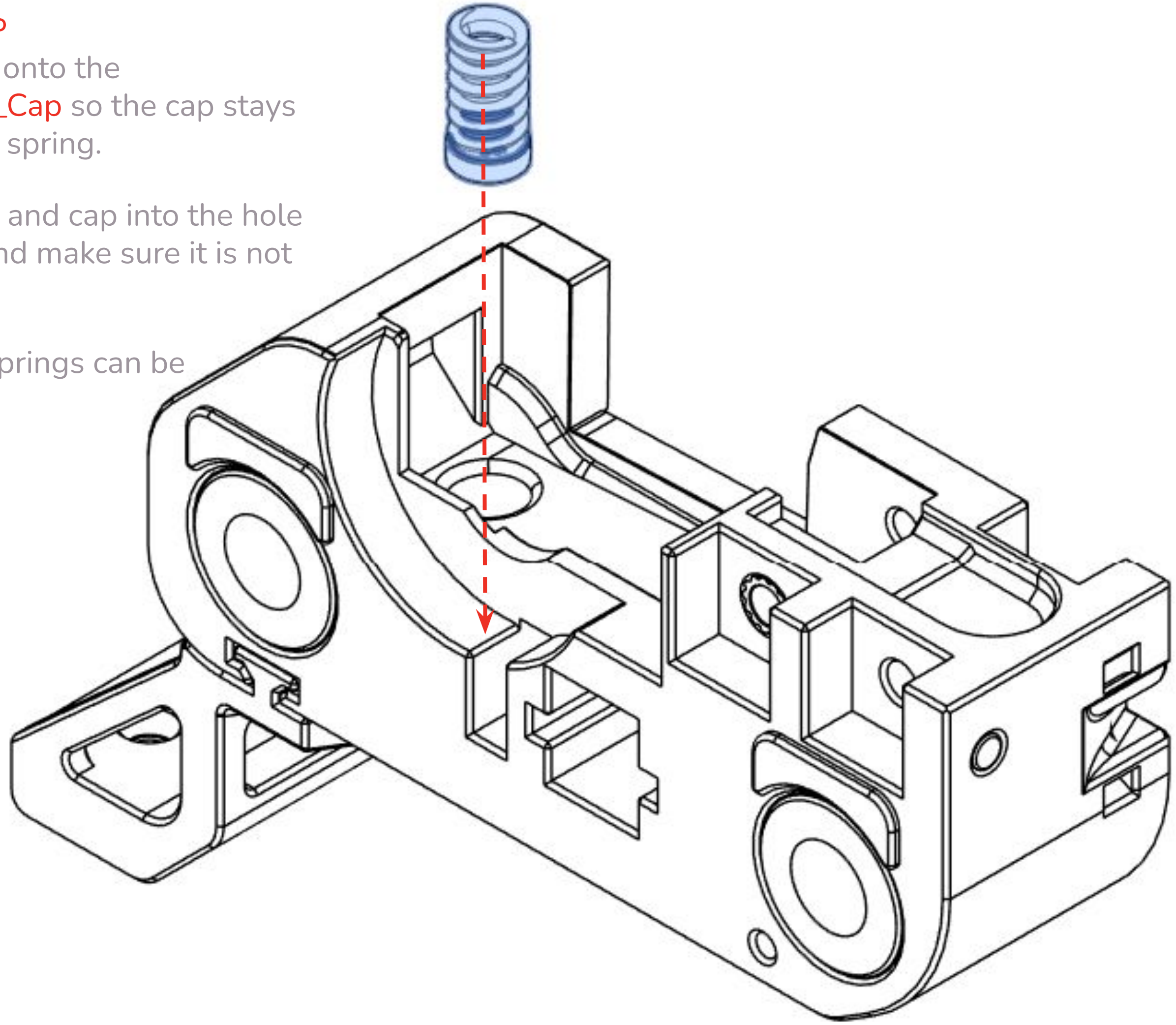


6.3 SPRING CAP

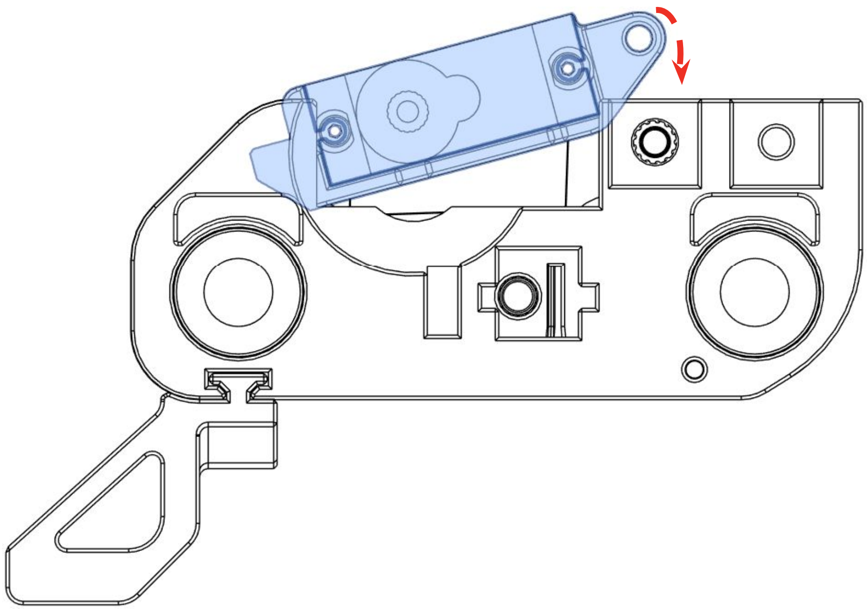
Twist the spring onto the Selector_Spring_Cap so the cap stays inserted into the spring.

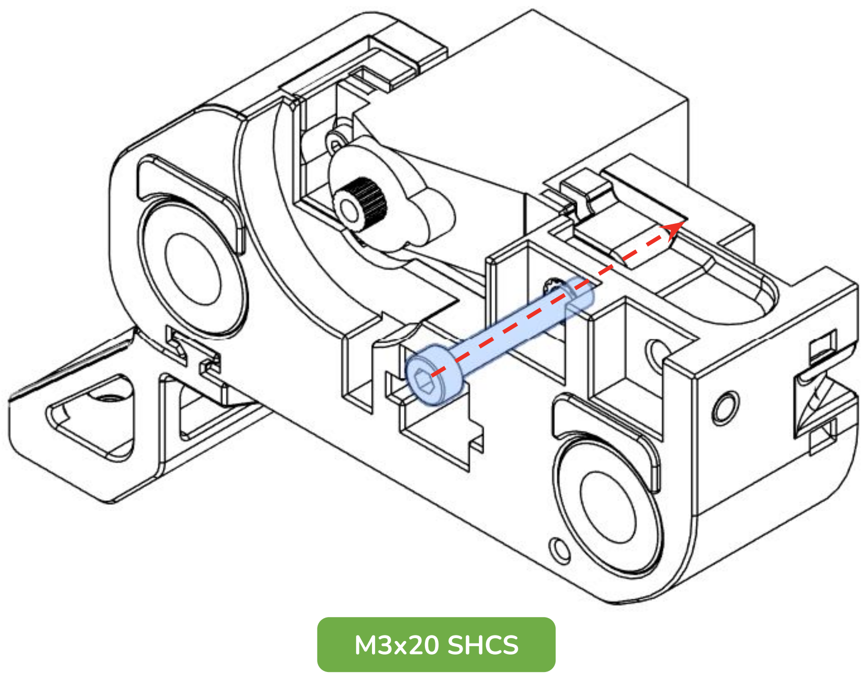
Insert the spring and cap into the hole in the selector and make sure it is not obstructed.

Shorter 10mm springs can be used as well.



SERVO INSTALLATION





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 lightly against the Servo_Mount, causing the to be sprung away from the fully seated position.

Push the Servo_Mount into place and temporarily secure it with an M3x20 screw used for mounting the encoder. *Do not tighten the screw all the way*, you will punch a hole in the Selector.

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

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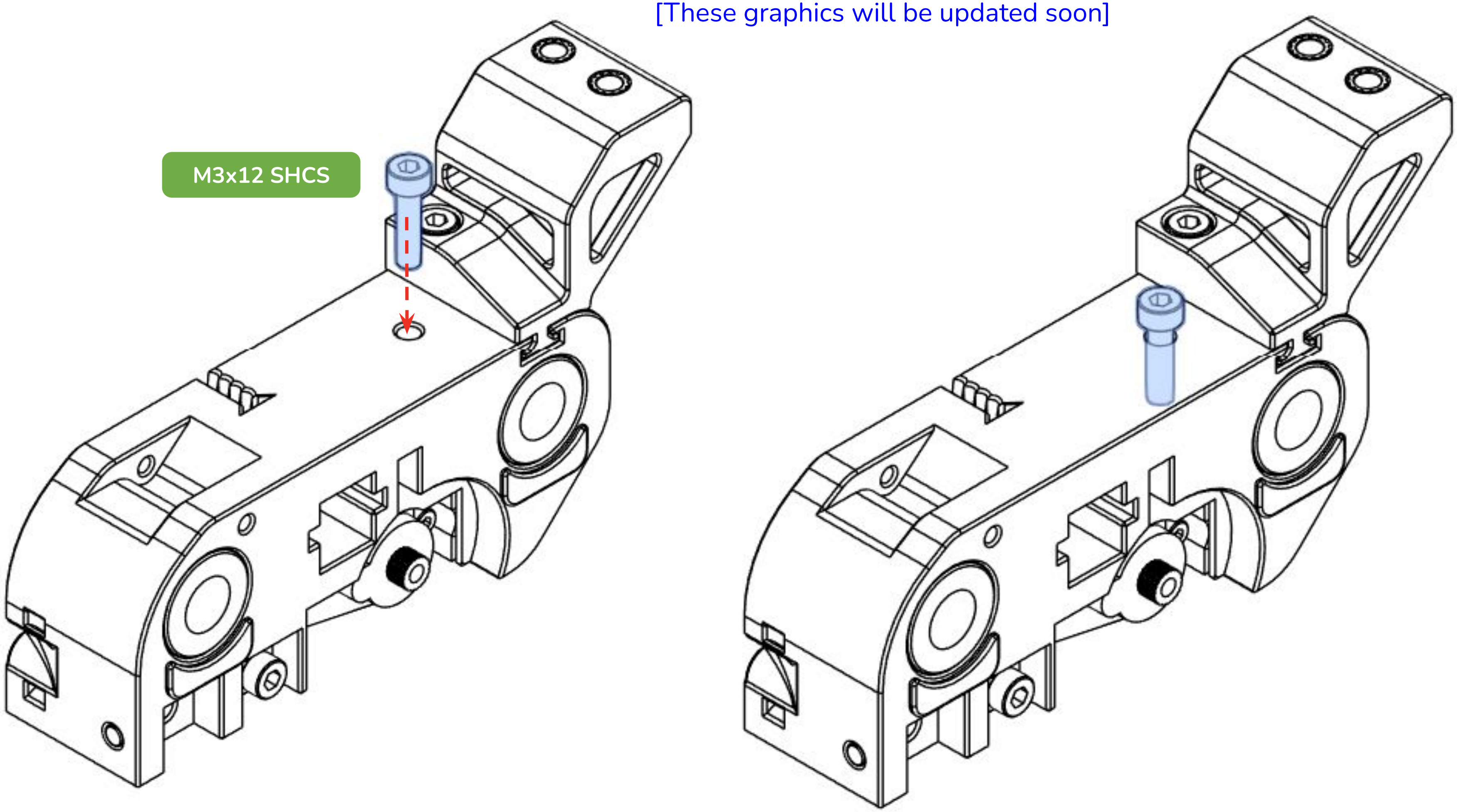
TENSION SCREW INSTALLATION

[These graphics will be updated soon]



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 after installing the Servo Arm.

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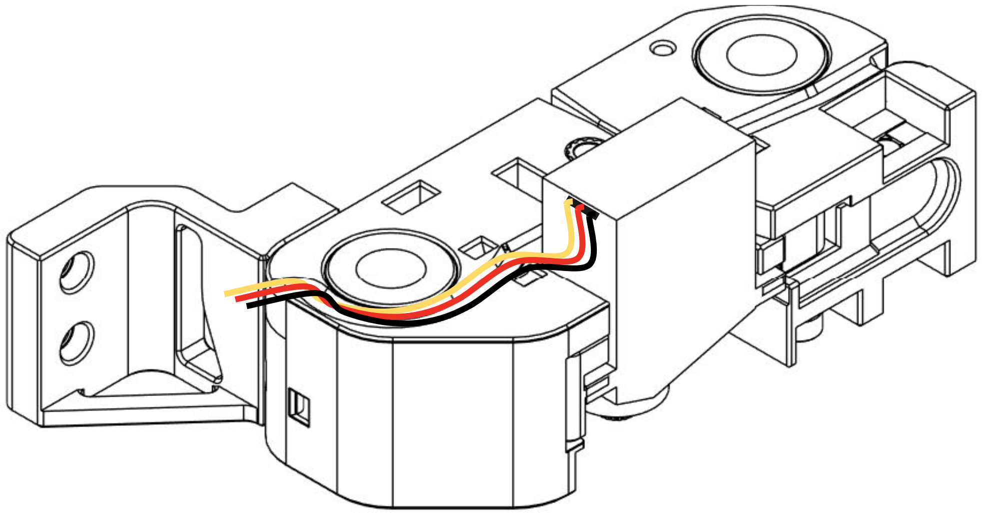
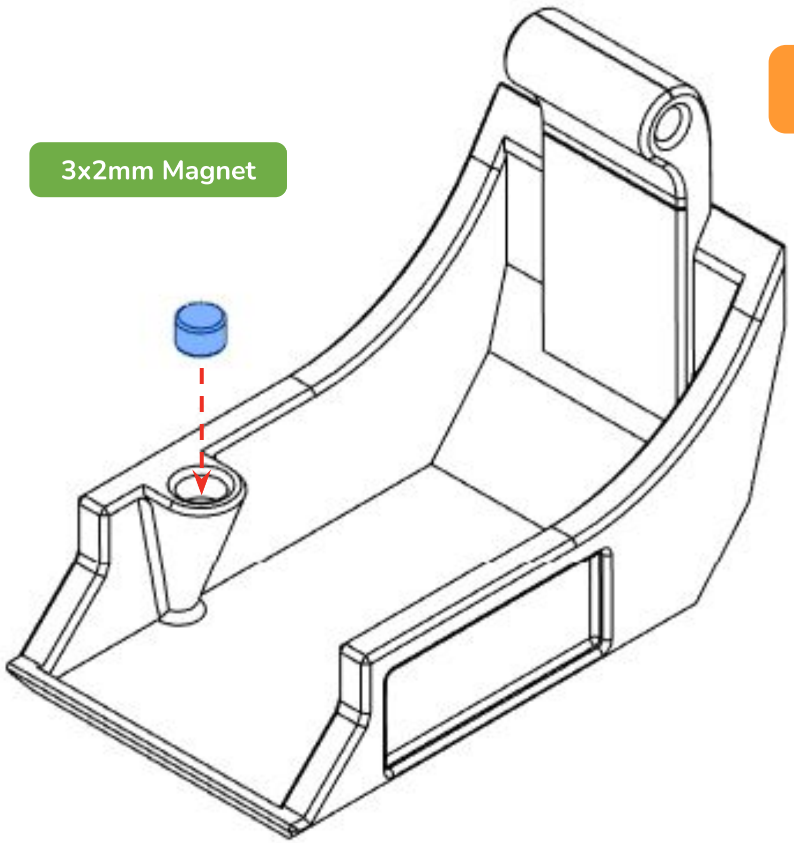
SERVO WIRES



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.

DOOR INSTALLATION

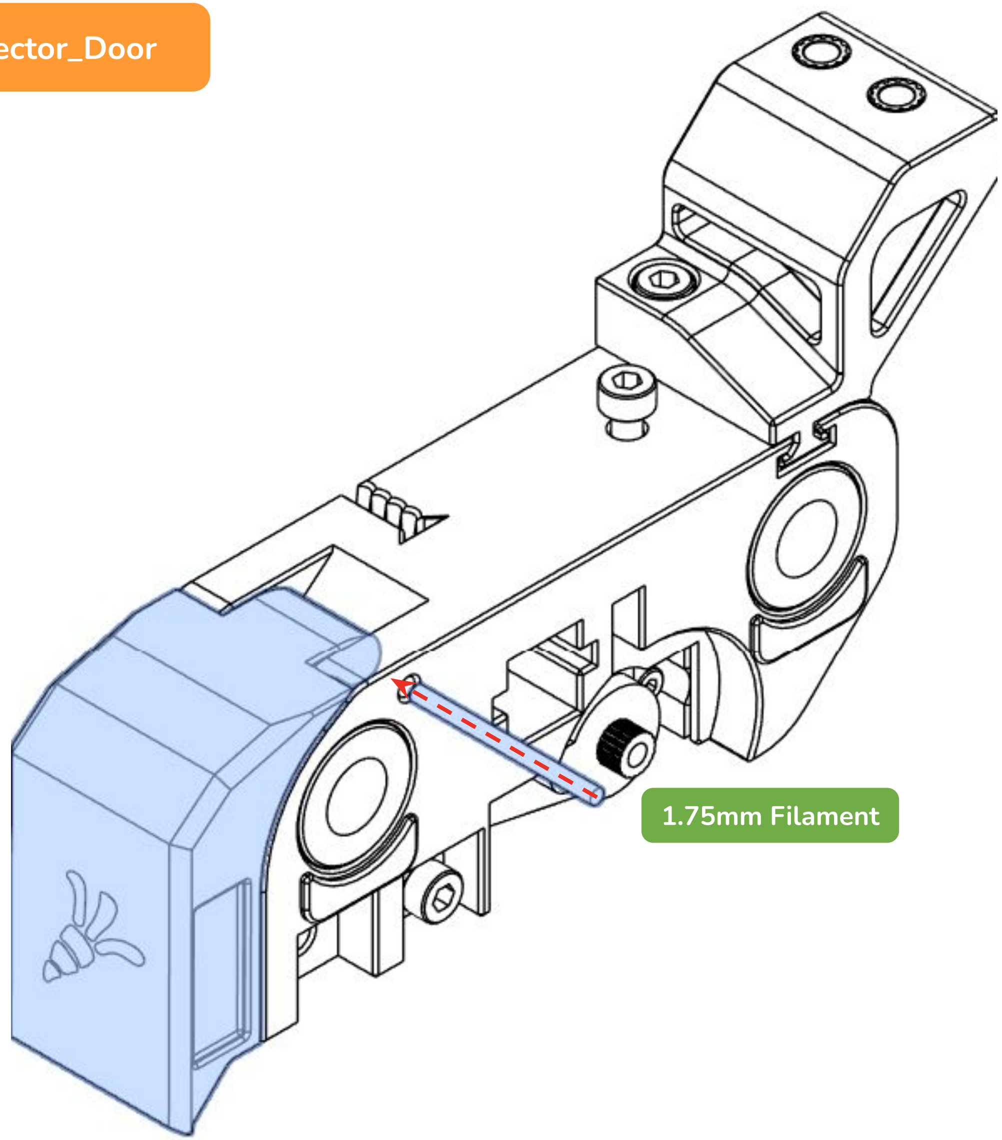


6.4 DOOR INSTALLATION

This part is cosmetic - you could leave it off and print it in multicolor after your ERCF is running.

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.

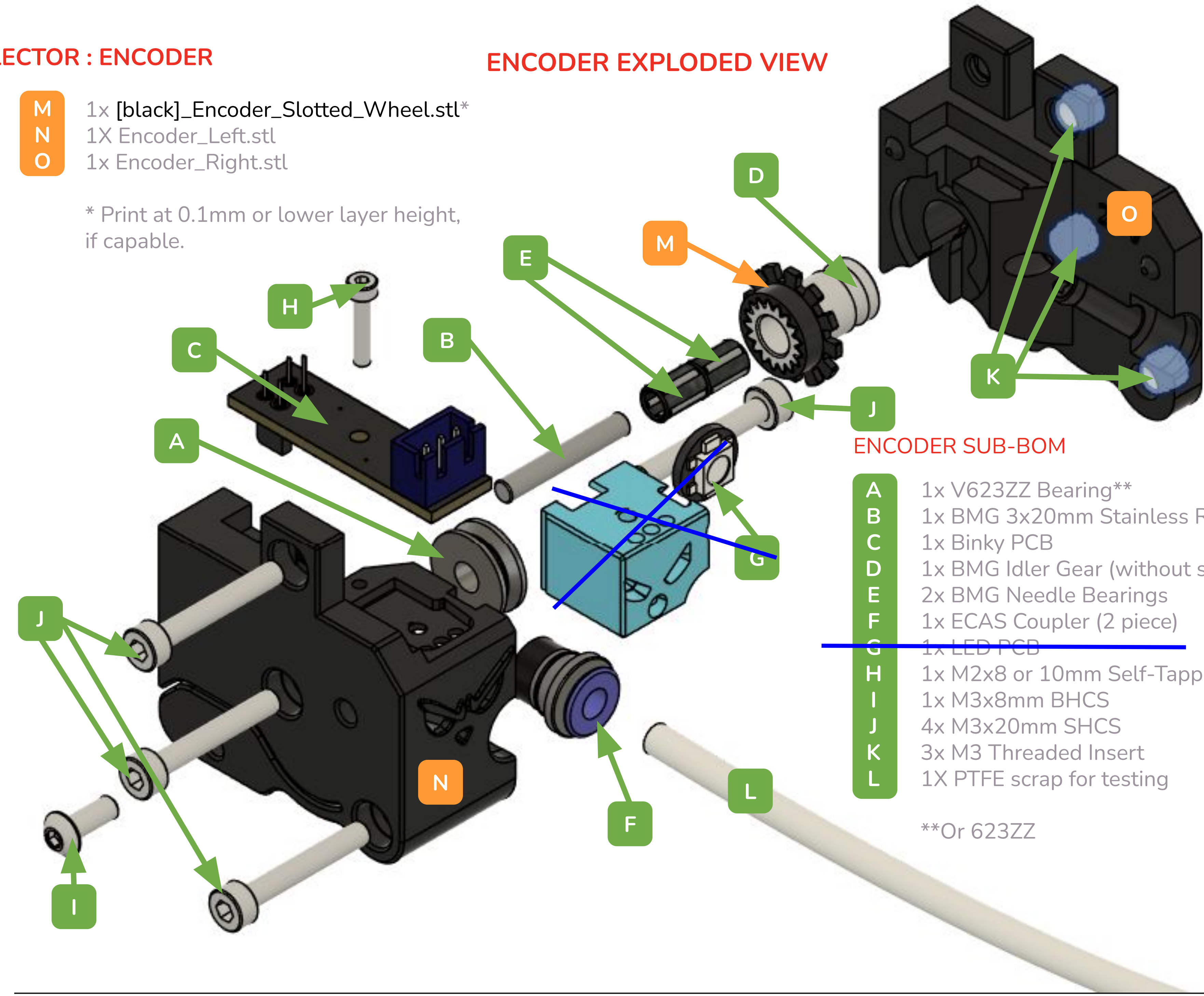


SELECTOR : ENCODER

M	1x [black]_Encoder_Slotted_Wheel.stl*
N	1X Encoder_Left.stl
O	1x Encoder_Right.stl

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

ENCODER EXPLODED VIEW

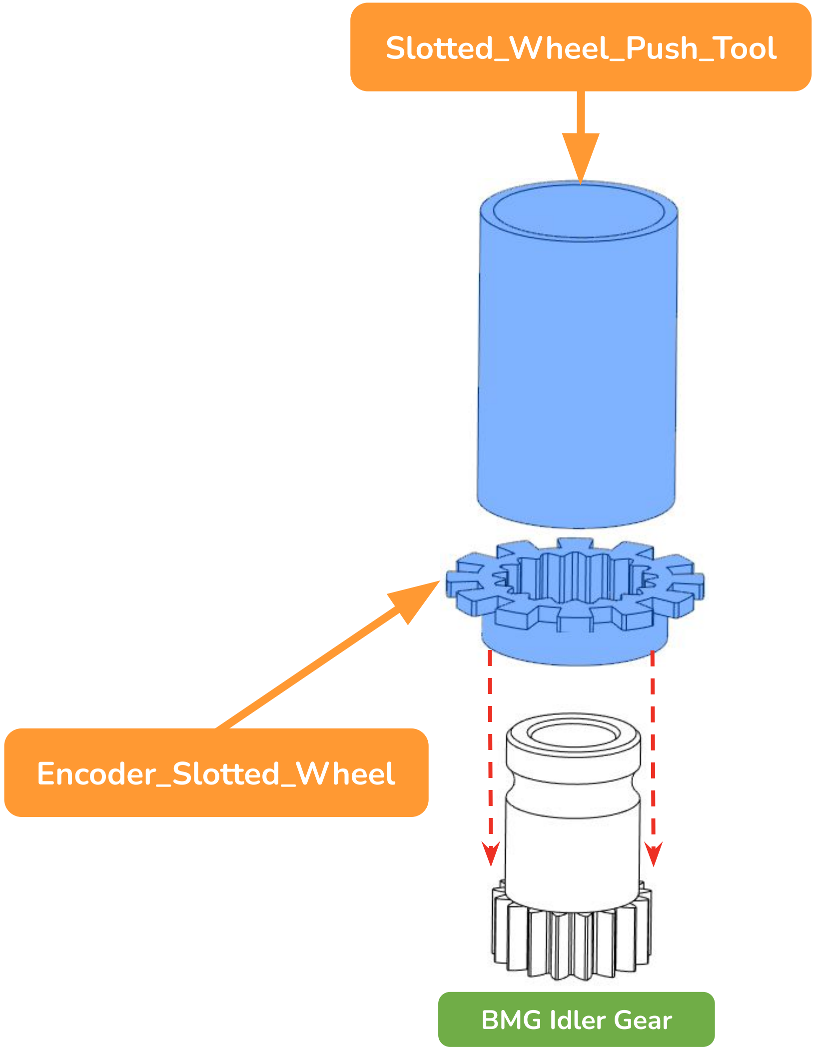


ENCODER SUB-BOM

A	1x V623ZZ Bearing**
B	1x BMG 3x20mm Stainless Rod
C	1x Binky PCB
D	1x BMG Idler Gear (without set screw)
E	2x BMG Needle Bearings
F	1x ECAS Coupler (2 piece)
G	~~1x LED PCB~~
H	1x M2x8 or 10mm Self-Tapping Screw
I	1x M3x8mm BHCS
J	4x M3x20mm SHCS
K	3x M3 Threaded Insert
L	1X PTFE scrap for testing

**Or 623ZZ

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 defects from printing, carefully sand or trim them so that 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. Gently use a small hammer if necessary.

The Encoder_Slotted_Wheel should fit firmly on the Bondtech gear. Make sure it isn't damaged or 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 and causing false readings!

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ENCODER PREPARATION

7.1 V623ZZ VS 623ZZ BEARINGS

There are two versions of the Encoder:

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

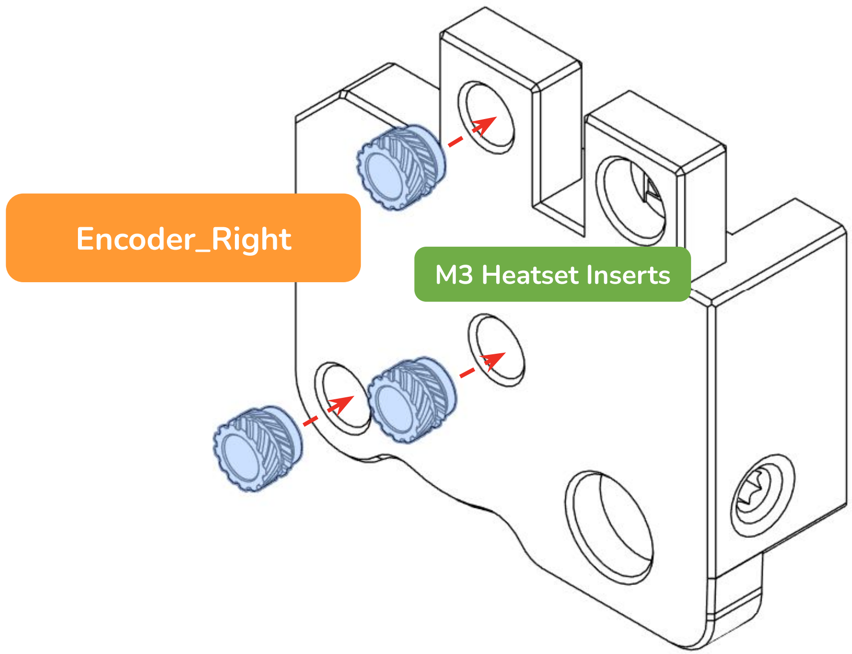
One using the much more easily-sourced 623ZZ flat bearing. These files are in the folder:

ERCF_v25 / Stls / Selector / Encoder_Flat_Bearing_Option

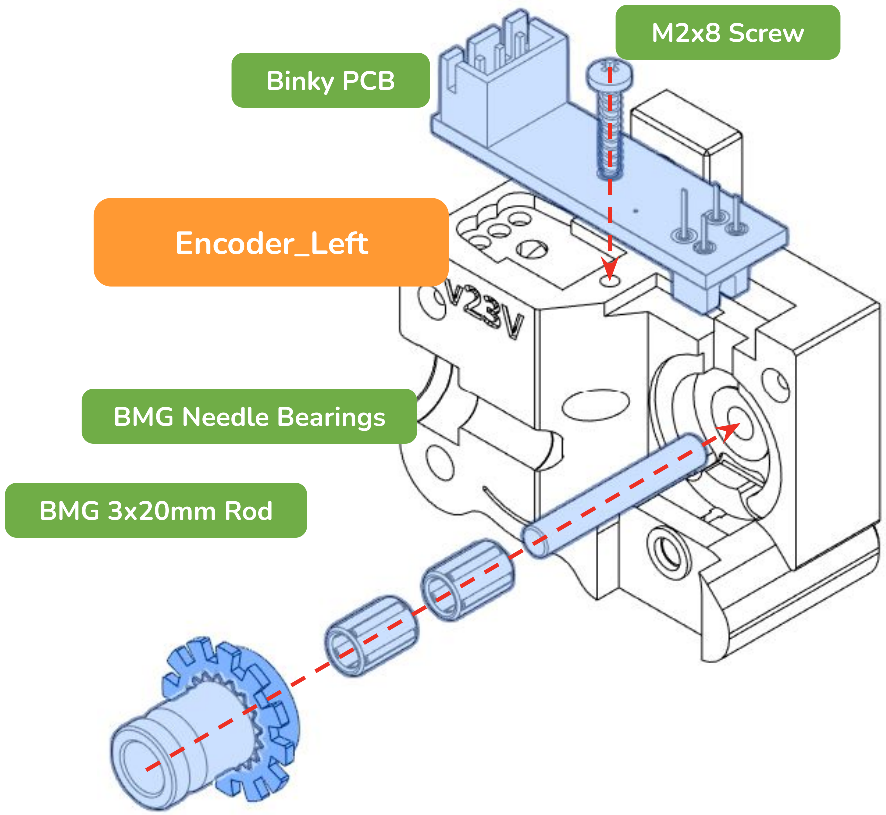
We will show the V623ZZ version of the Encoder. Installation is virtually identical for the 623ZZ option.

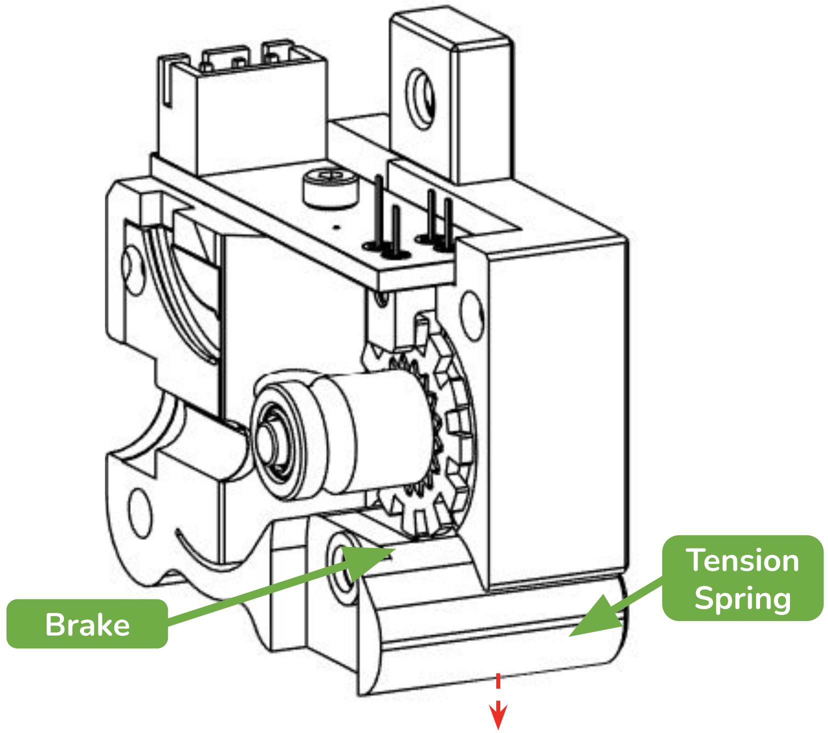
7.2 HEATSET INSERTS

The list of pages with heatset inserts is on Page 16.



ENCODER ASSEMBLY





ASSEMBLY

Start by fitting the metal rod into Encoder_Left. Next, slide on the needle bearings and the Bondtech idler gear. Add a small dab of grease (EP1/EP2 or Superlube) on the bearings for lubrication. Slide the gear / slotted wheel assembly into place. You must pull the tension spring down 1-2mm in order for the slotted wheel assembly to clear the brake and seat correctly..

The slotted wheel should sit almost flush with the housing, but make sure it doesn't rub on the printed part.

7.3 CHECK POINT

Next, Insert and secure the Binky PCB with either the provided Philips screw, or an M2x8 or 10mm SHCS. The sensor should fit snugly in the cutout provided.

Gently pull down and hold the Tension Spring to release the brake that prevents the encoder wheel from free spinning when filament is ejected. It only needs to move 1-2mm.

With the Tension Spring open, the wheel should rotate easily and not rub on the Encoder housing or Binky optical sensor.

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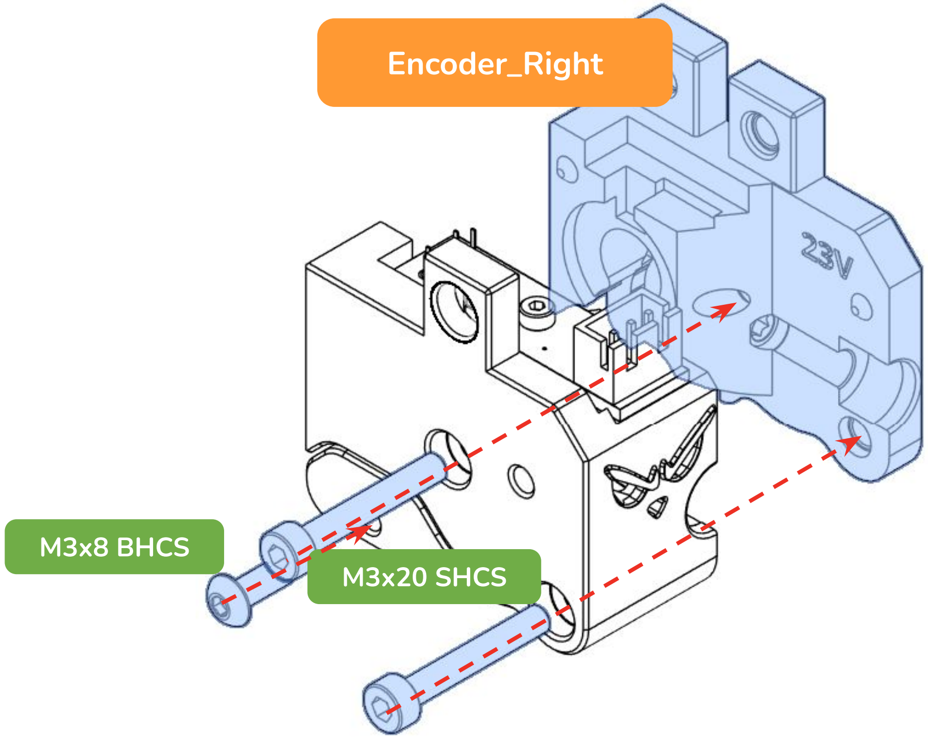
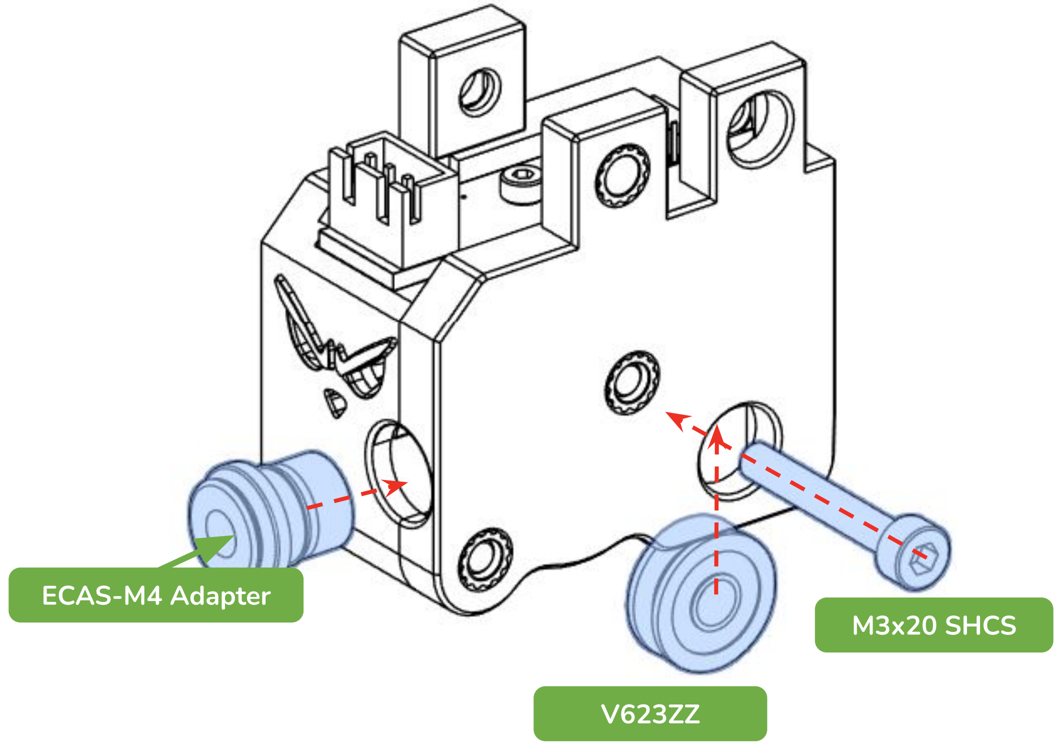
ENCODER ASSEMBLY





7.1 ASSEMBLY

Align the two halves of the encoder and press them together. Attach the two sides together with two M3x20 SHCS screws. These screws don't need to be super tight, just flush with the surface of the Encoder, and may cause problems if overtightened.

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. Tighten the screw all the way in, and then back it out about 2 turns. Later, during software setup, you can adjust the screw in or out to calibrate the home position. 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. Again, these screws do not need to be super tight, just flush with the surface of the Encoder.

ENCODER PATH CALIBRATION

Encoder_Right

[These graphics will be added soon]

M3x8 BHCS

M3x20 SHCS

ECAS-M4 Adapter

M3x20 SHCS

V623ZZ

7.1 ENCODER FILAMENT PATH

Insert a scrap of PTFE into the ECAS (a few centimeters is enough), then use a length of filament to verify that the filament path of the Encoder runs smoothly and the Encoder_Slotted_Wheel doesn't rub on the Encoder body or Binky Optical Sensor.

If you notice any issues, the first thing to check are overtightened M3x20 screws holding the Encoder together. If loosening the screws doesn't help, disassemble the Encoder. Adjust the position of the Encoder_Slotted_Wheel on the gear, being careful not to damage it or its vanes.

Once you have the Encoder running smoothly, it is ready to assemble onto the Selector!

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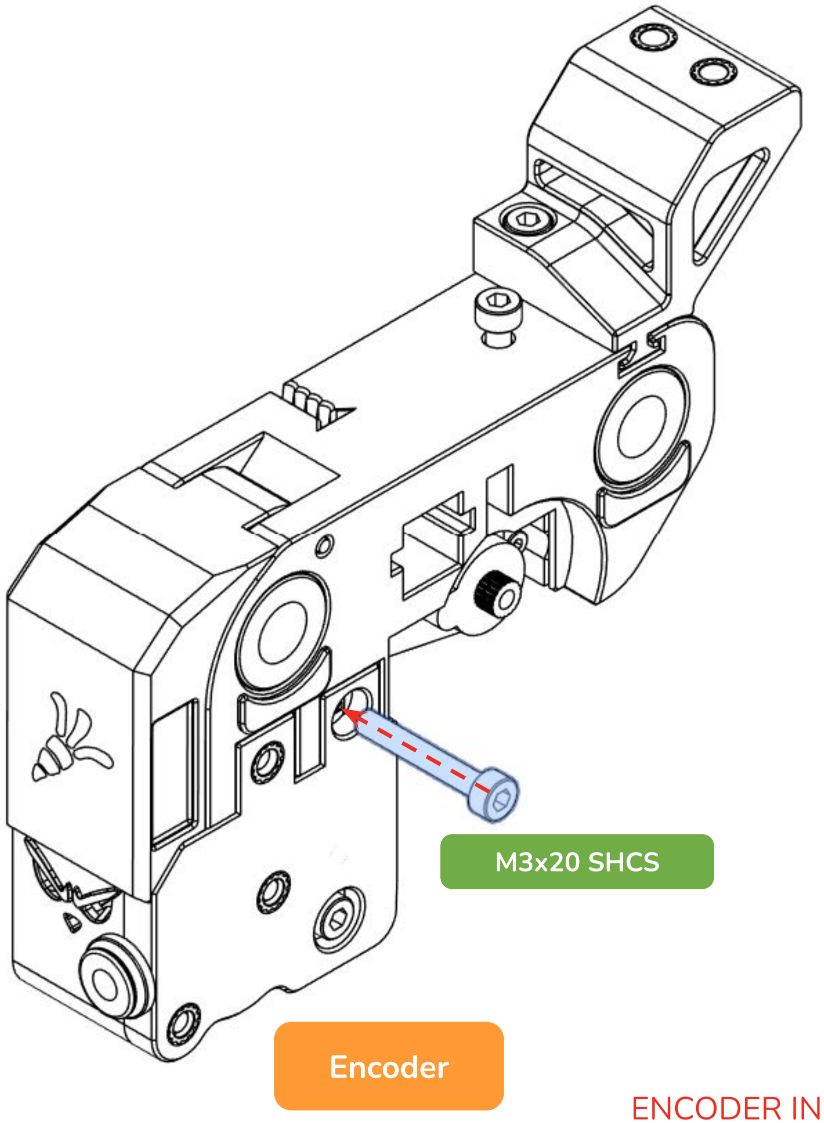
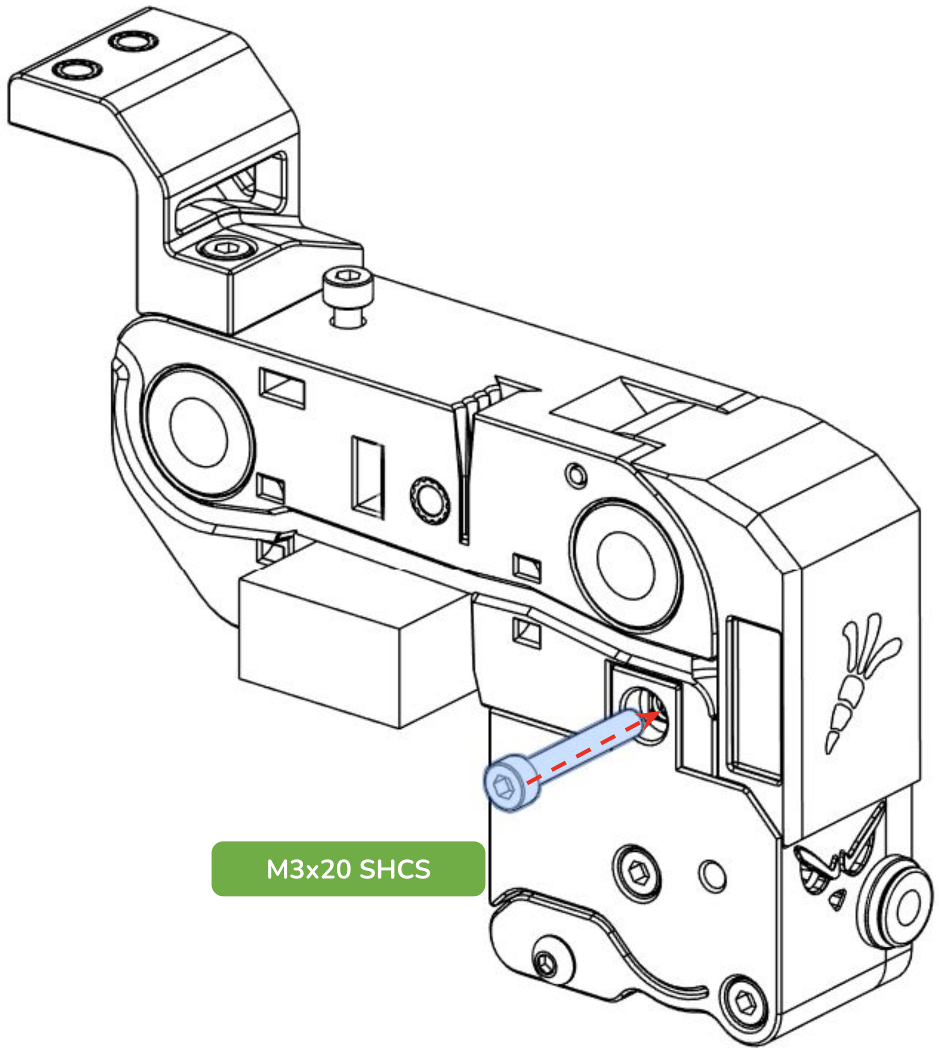
ENCODER INSTALLATION

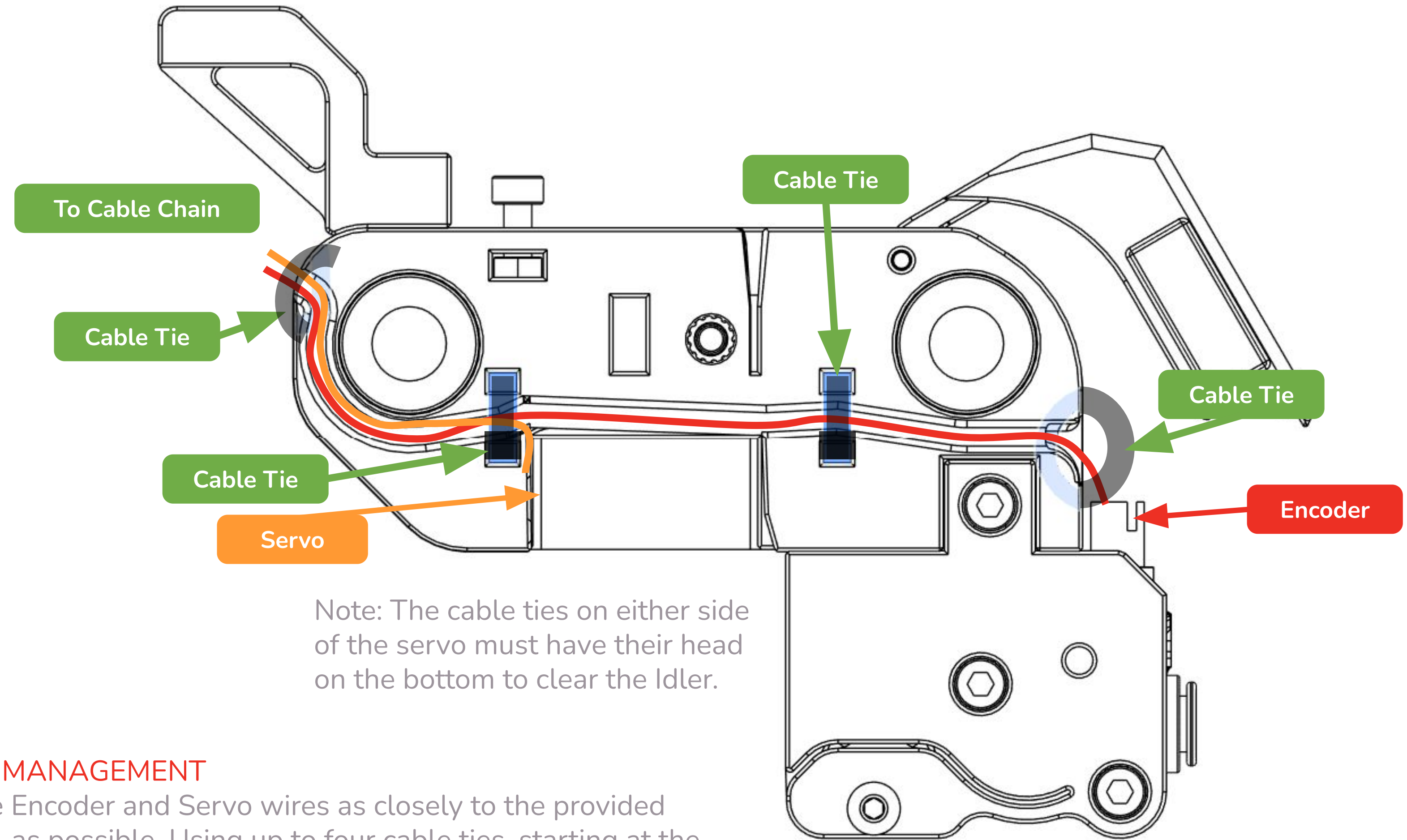




ENCODER INSTALLATION

Remove the M3x20 SHCS that you inserted on page 106 to hold the servo mount. Then secure the Encoder to the Selector_Cart with two M3x20 SHCS screws.

CABLE MANAGEMENT



Note: The cable ties on either side of the servo must have their head on the bottom to clear the Idler.

CABLE MANAGEMENT

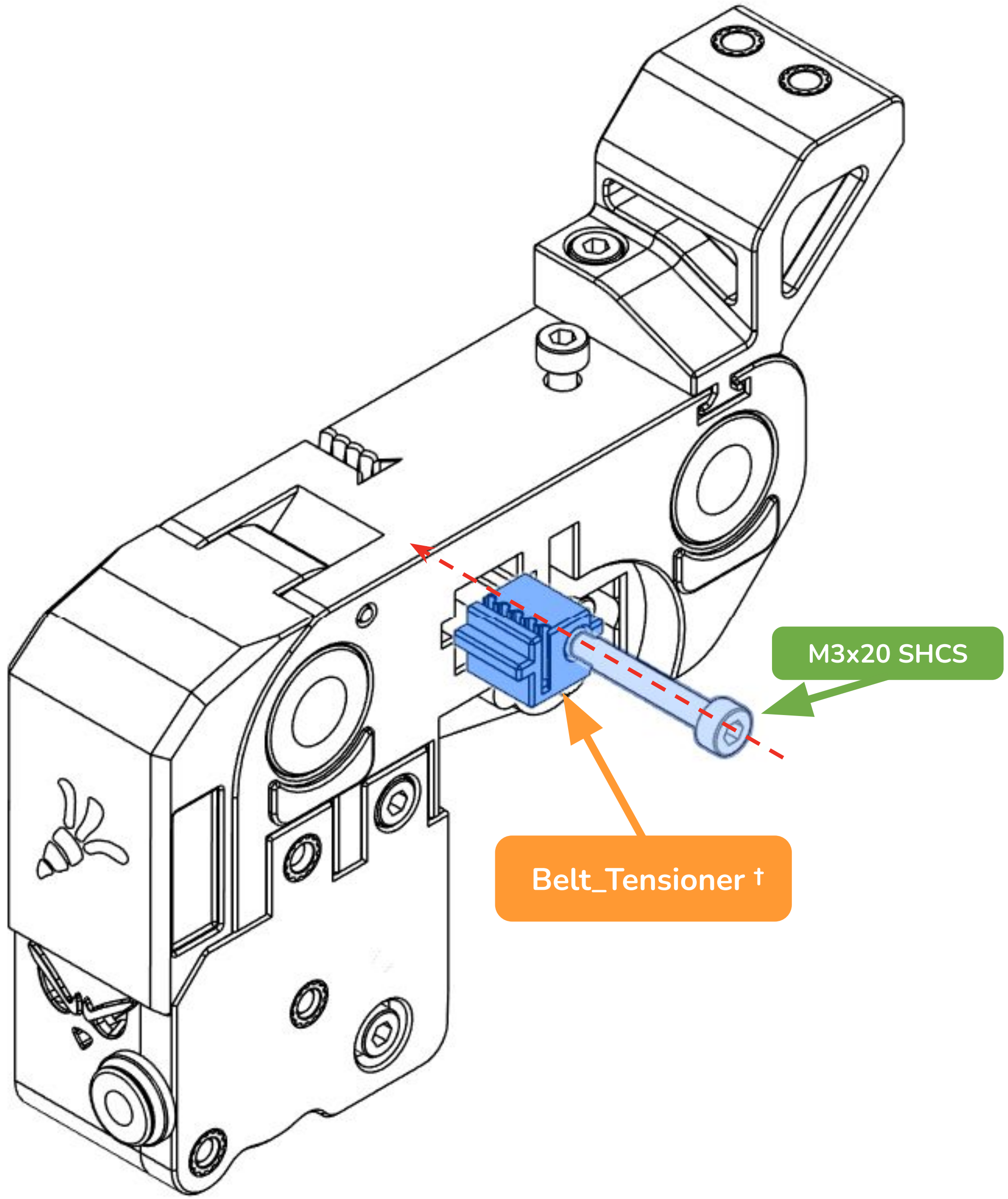
Run the Encoder and Servo wires as closely to the provided channel as possible. Using up to four cable ties, starting at the Encoder side, to secure the wiring to the Selector_Cart.

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

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.

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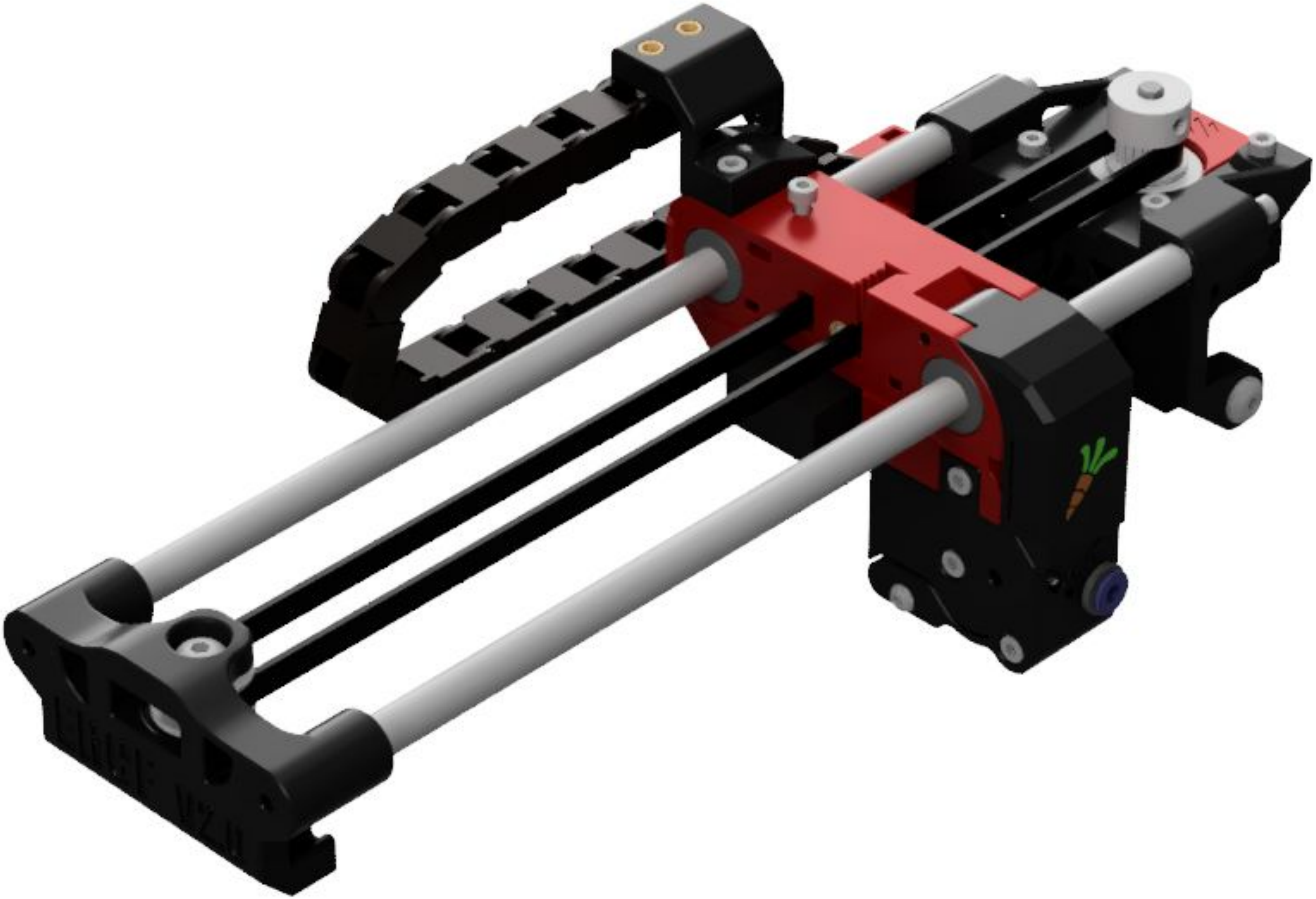
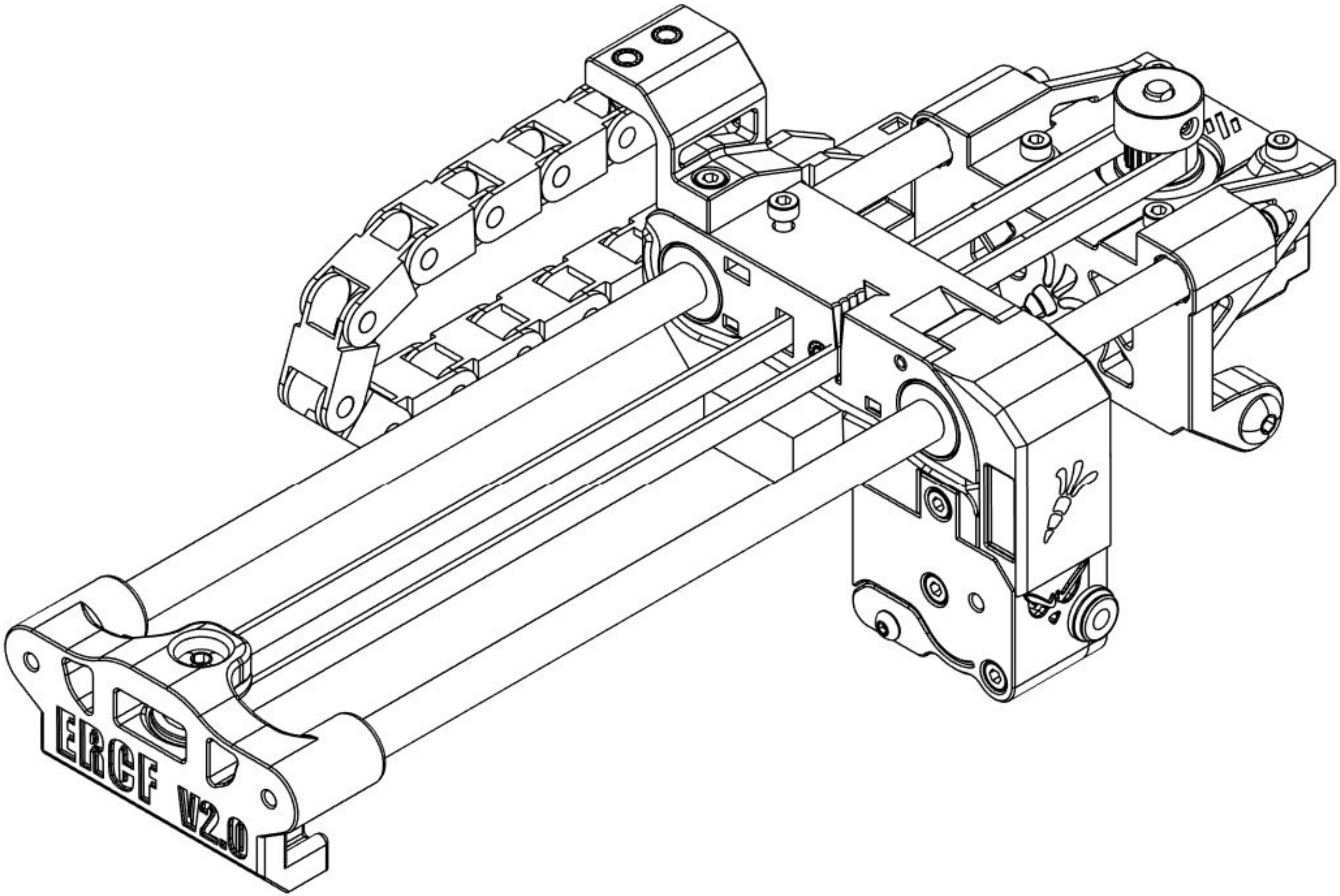
OVERVIEW



OVERVIEW



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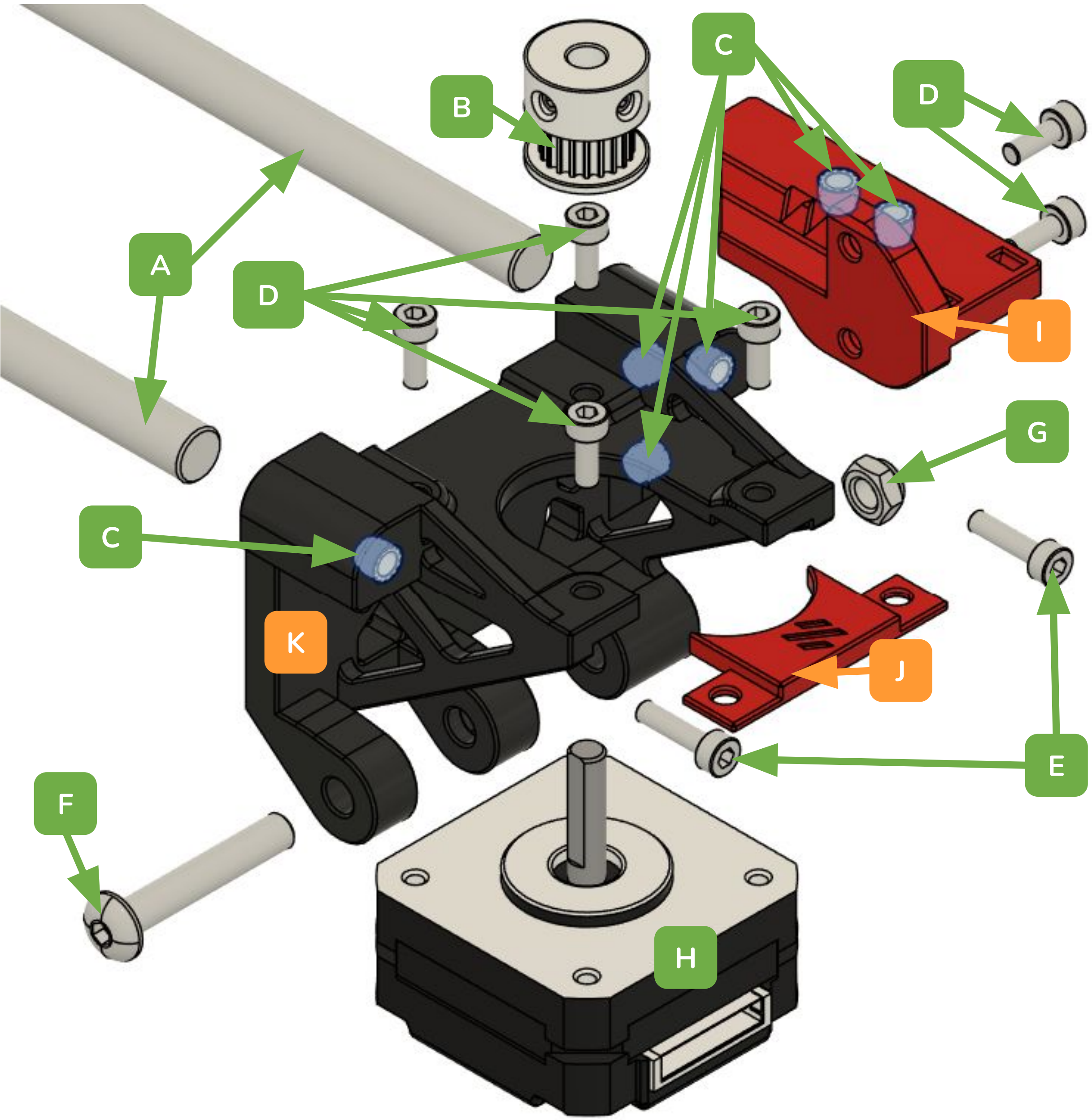
LINEAR AXIS HINGE

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

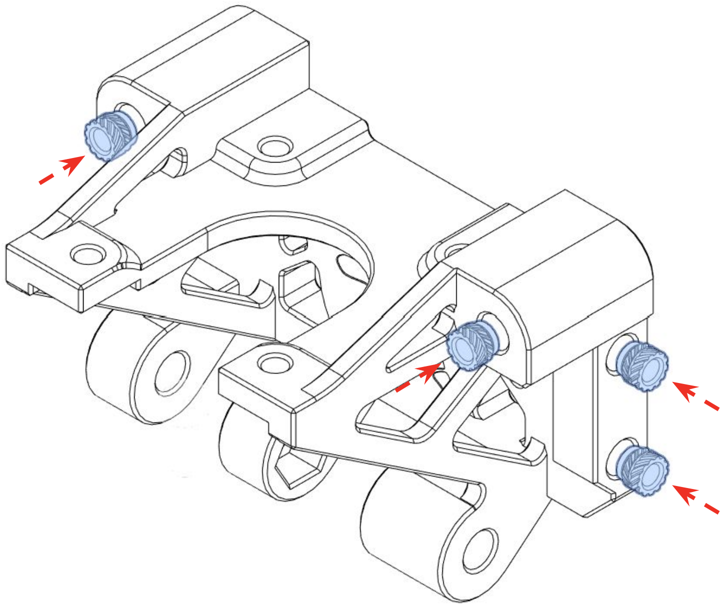
- I 1x [a]_Drag_Chain_Anchor_Bottom.stl †
- J 1x [a]_Motor_Lock.stl †
- K 1x Linear_Axis_Selector_Motor_Support.stl

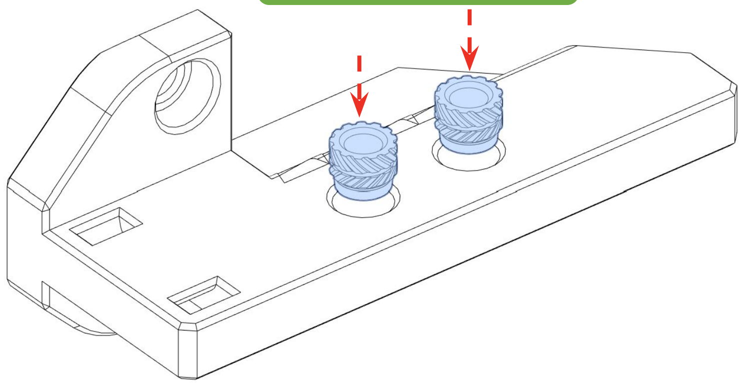
**M3x12mm screws, M5 screw, and nut shown for completeness, but not used until Final Assembly..

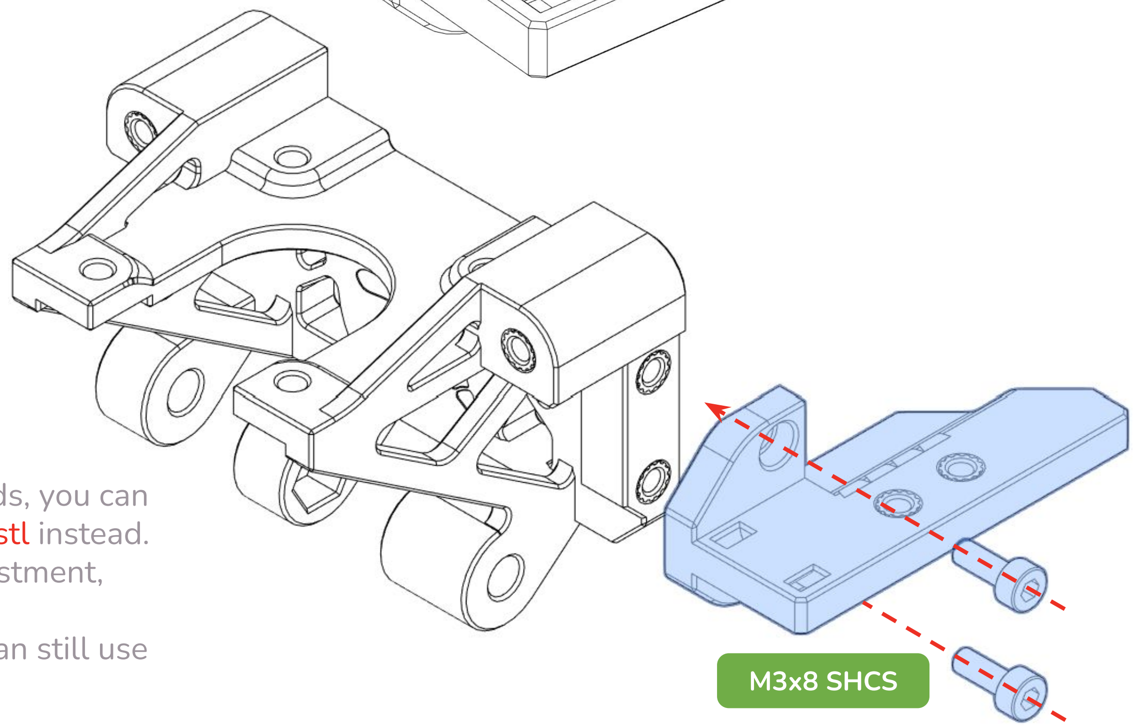
SELECTOR MOTOR SUPPORT

8.1 HEATSET INSERTS

The list of pages with heatset inserts is on Page 16.

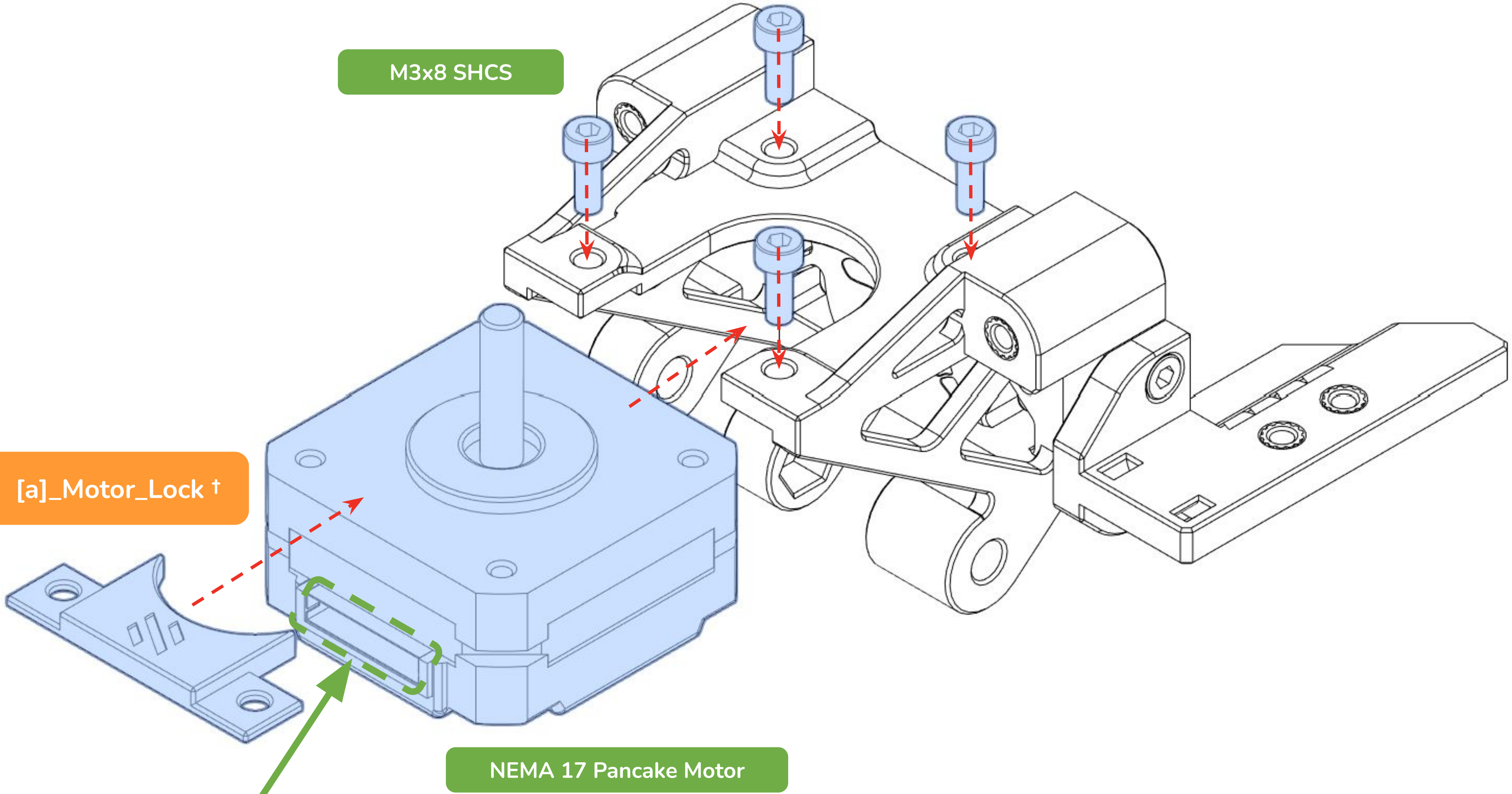






If you are using a kit or have precision-cut 8mm rods, you can use Linear_Axis_Selector_Motor_Support_Precise.stl instead. The “precise” version doesn’t have any length adjustment, which imprecise or self-cut rods need.
If you’ve already printed the original version, you can still use it,

SELECTOR MOTOR SUPPORT



MOTOR WIRES
Make sure the wires of the motor are coming out from this side.

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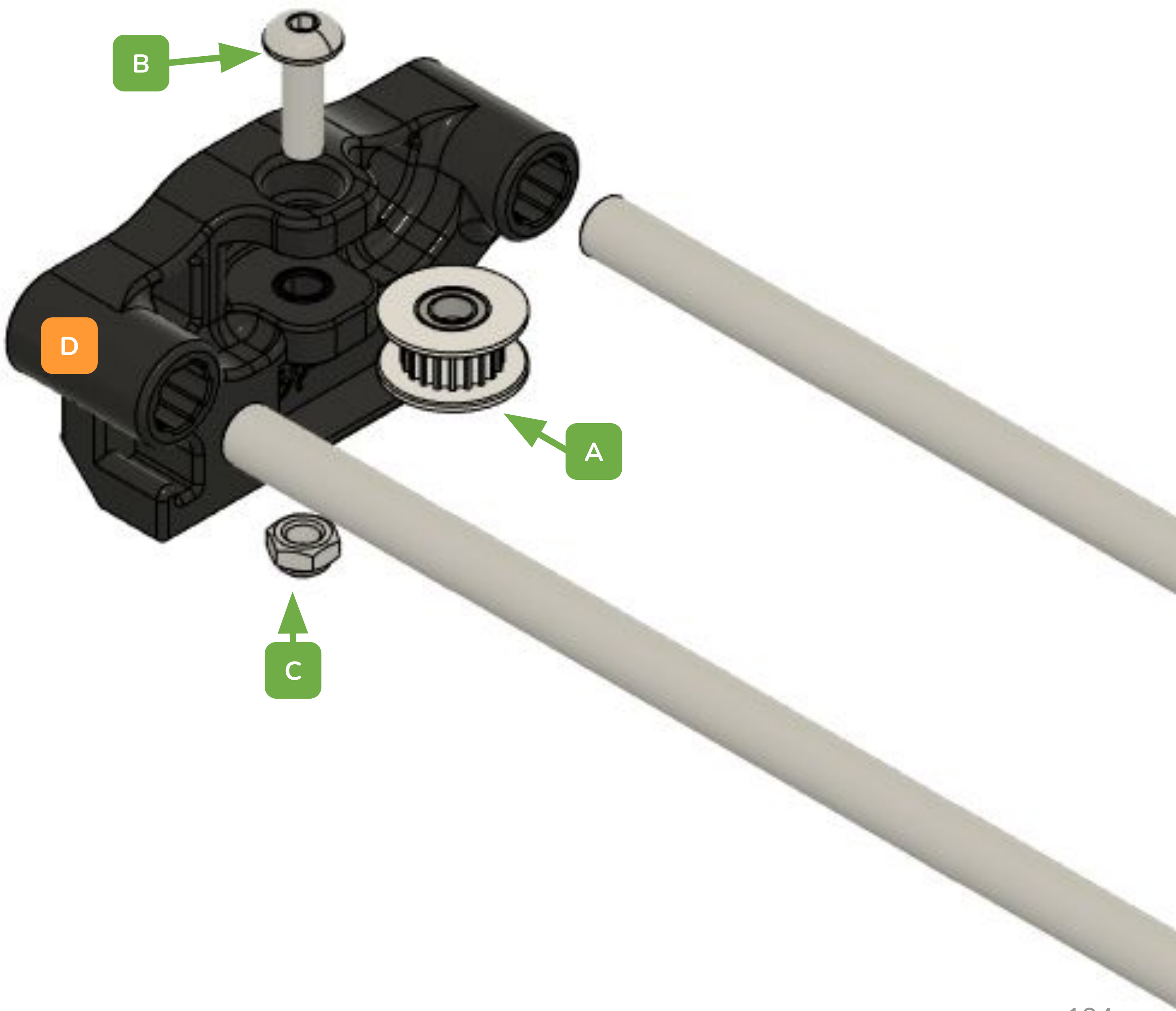
LINEAR AXIS IDLER

LINEAR AXIS IDLER SUB-BOM

A	1x GT2 20T toothed idler
B	1x M5x16mm BHCS
C	1x M5 Nylock nuts

LINEAR AXIS IDLER EXPLODED VIEW



D	1x Linear_Axis_Idler_Block.stl

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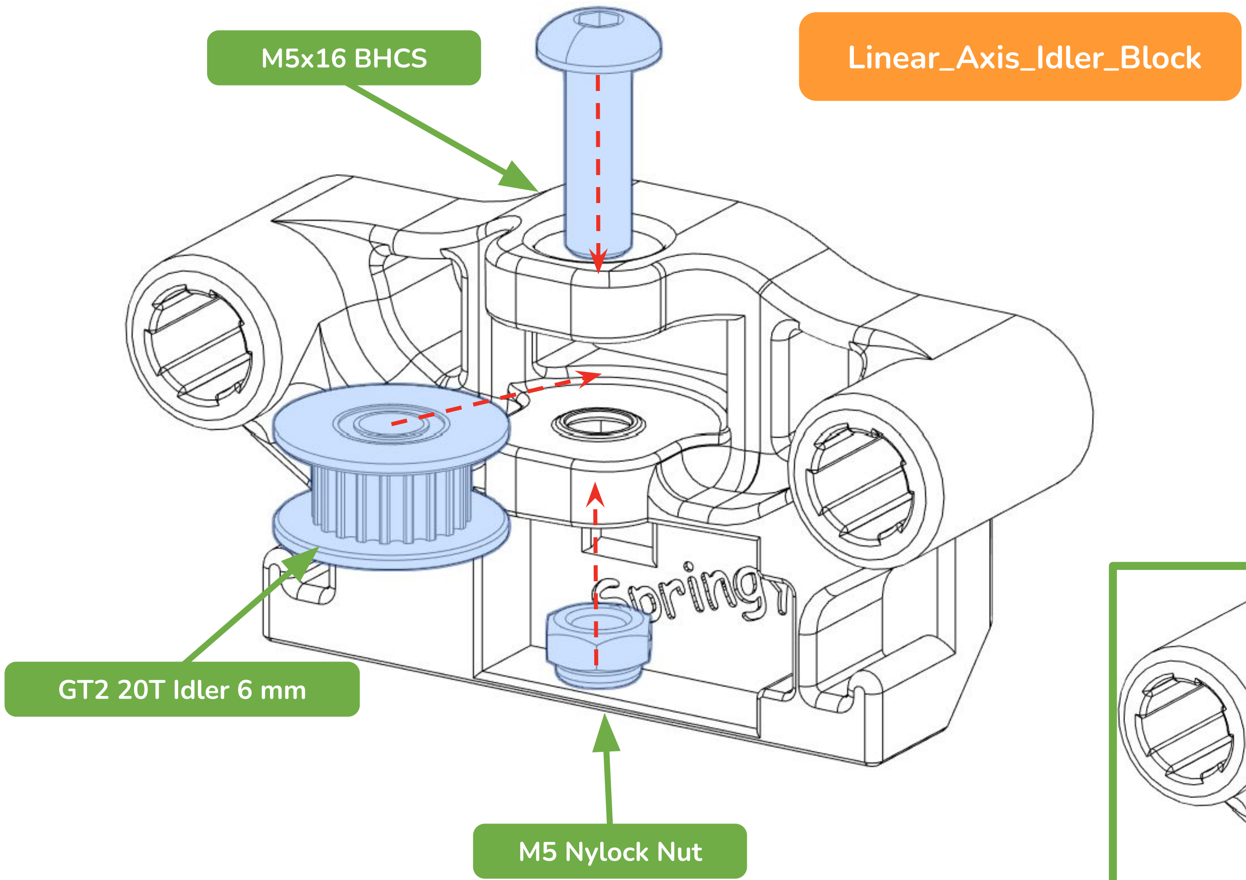
IDLER BLOCK

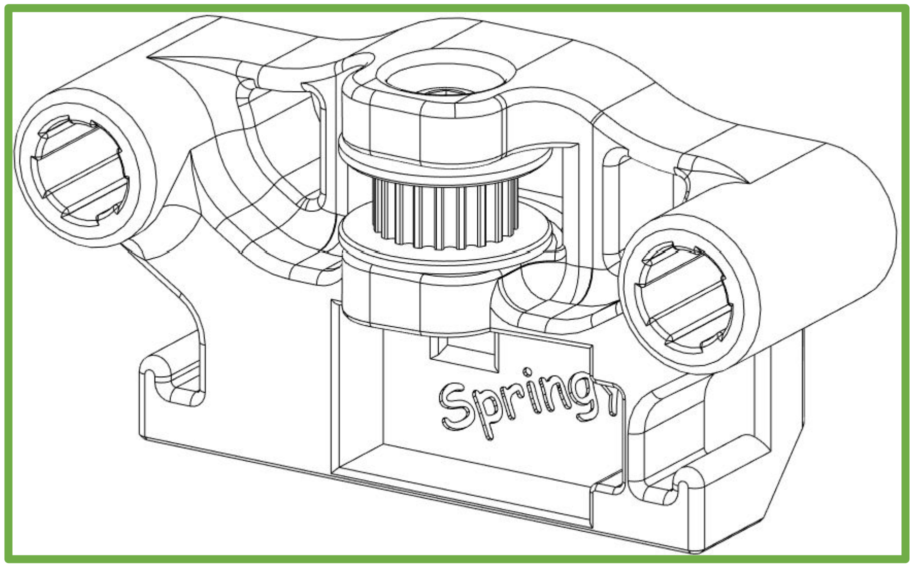


8.2 ASSEMBLE IDLER BLOCK

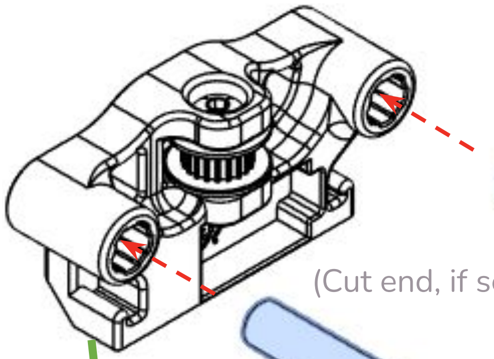
Fully insert the M5 locking nut into its cavity.
Slide the GT2 Idler into its cavity.

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

If you have a 10mm tall idler instead of a 9mm tall idler (such as provided in an LDO kit), there is a 10mm version of the Idler_Block.



AXIS ASSEMBLY



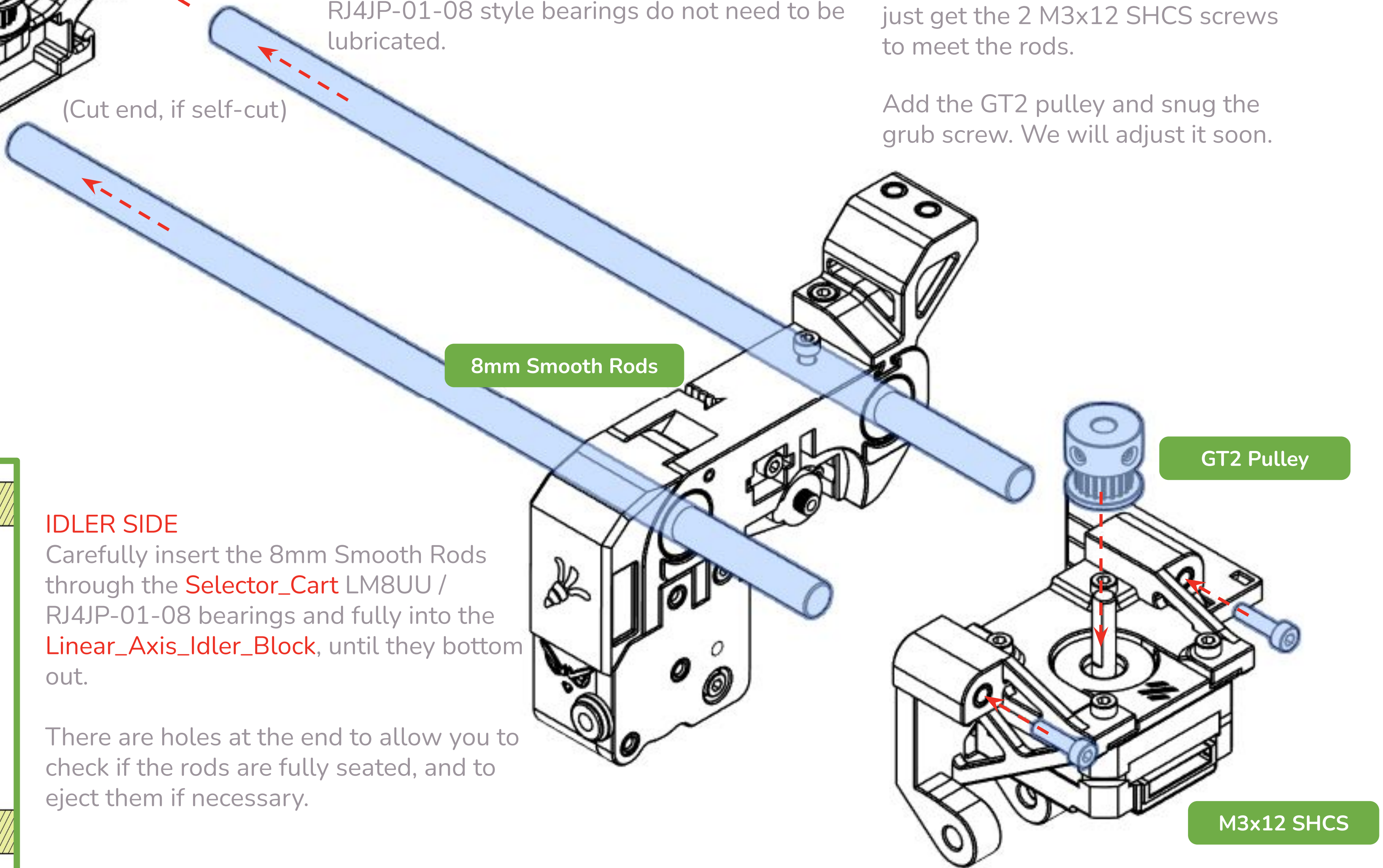
BEARING PREPARATION

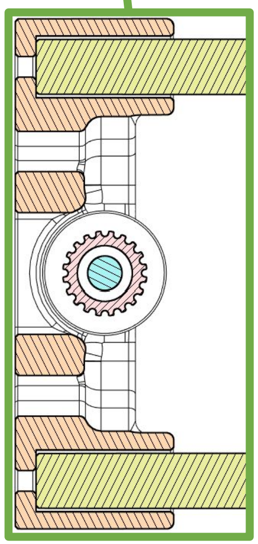
If using LM8UU bearings, lightly grease them using EP1/EP2 or Superlube grease. Drylin RJ4JP-01-08 style bearings do not need to be lubricated.

MOTOR SIDE

Fully insert the flat end of the rods into the motor side for now, and just get the 2 M3x12 SHCS screws to meet the rods.

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



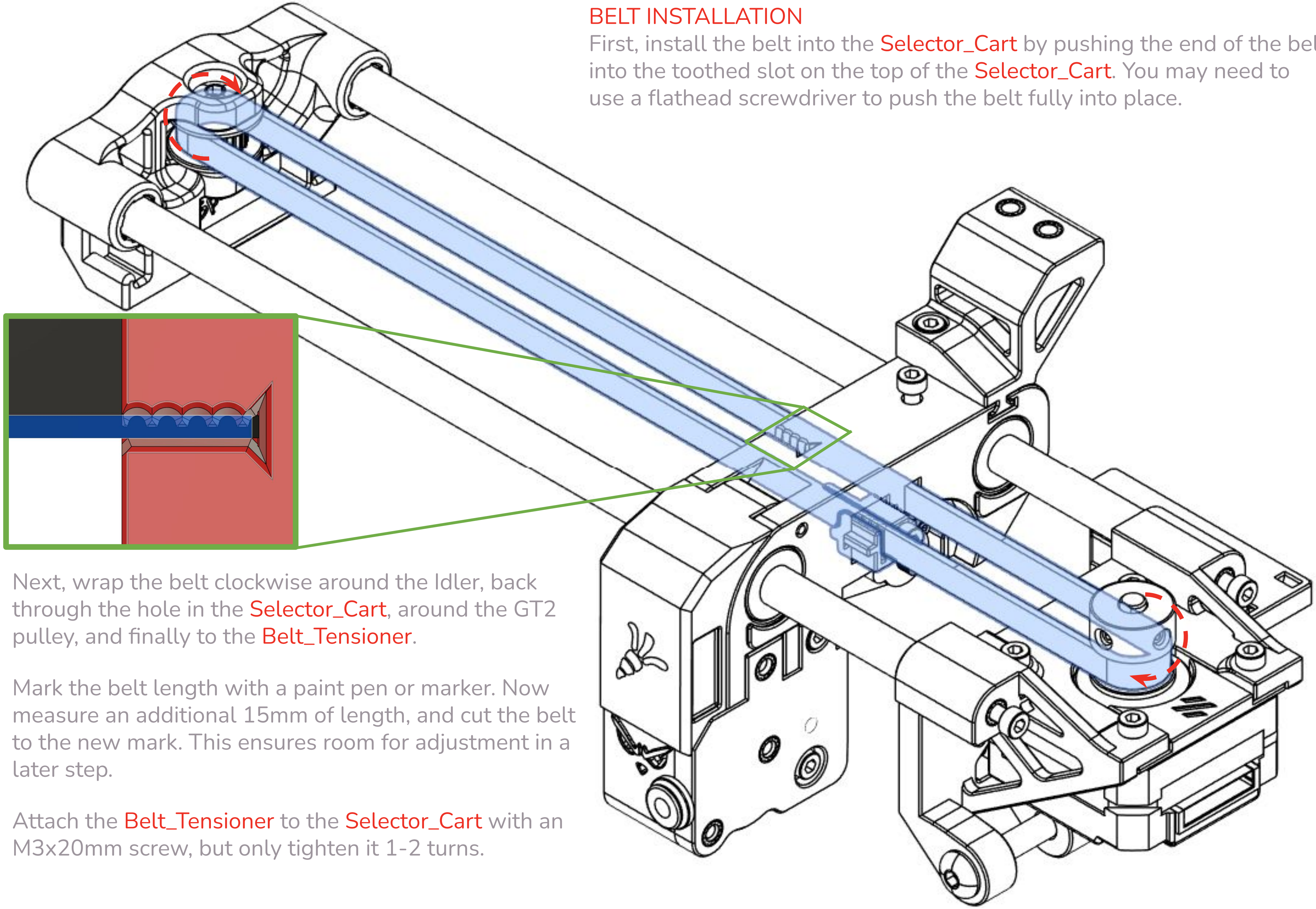


IDLER SIDE

Carefully insert the 8mm Smooth Rods through the Selector_Cart LM8UU / RJ4JP-01-08 bearings and fully into the Linear_Axis_Idler_Block, until they bottom out.

There are holes at the end to allow you to check if the rods are fully seated, and to eject them if necessary.

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.

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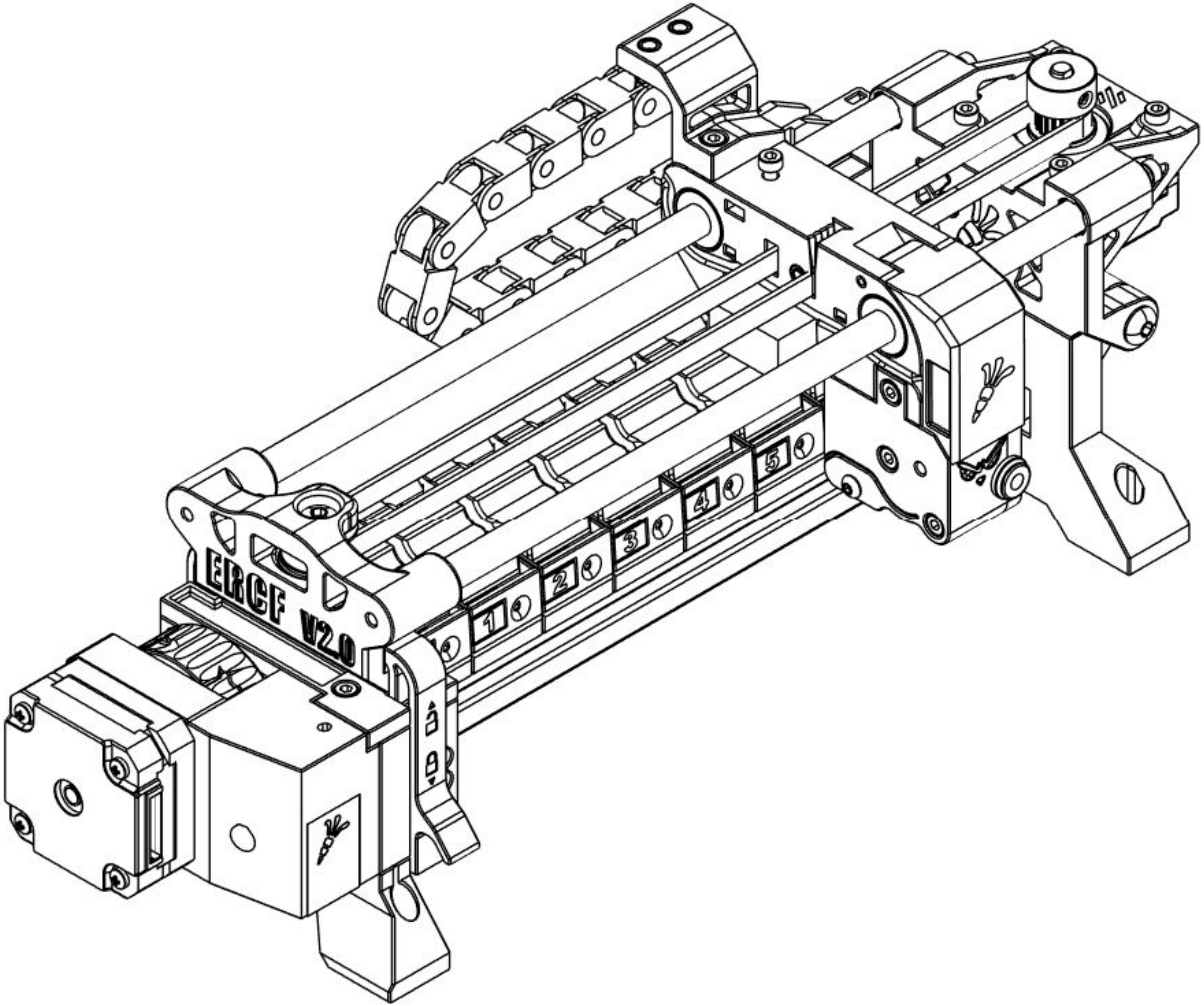
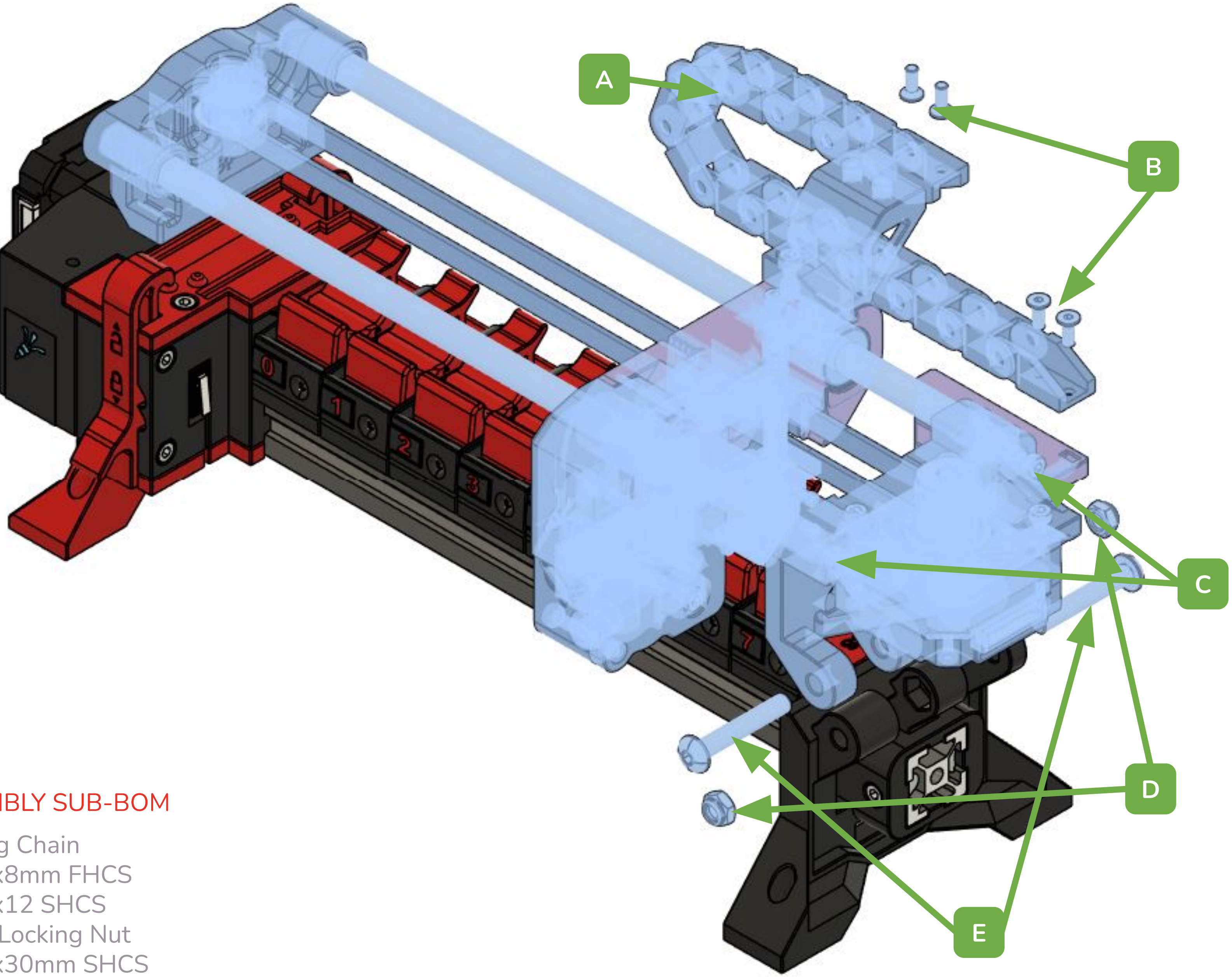
OVERVIEW

OVERVIEW



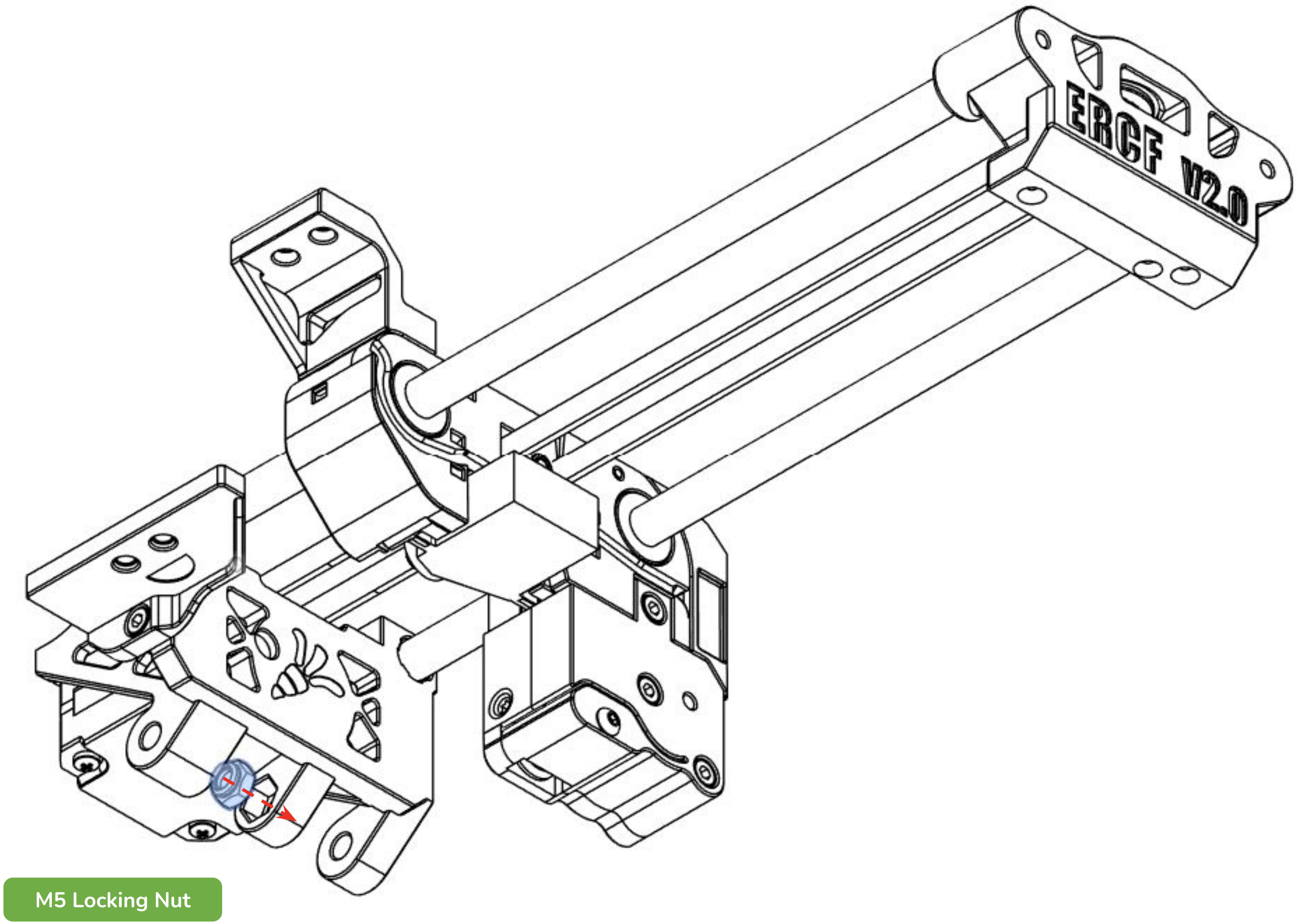
EXPLODED VIEW



FINAL ASSEMBLY SUB-BOM

A	1x Drag Chain
B	4x M3x8mm FHCS
C	2x M3x12 SHCS
D	2x M5 Locking Nut
E	2x M5x30mm SHCS

ADDING THE LOCKING NUTS



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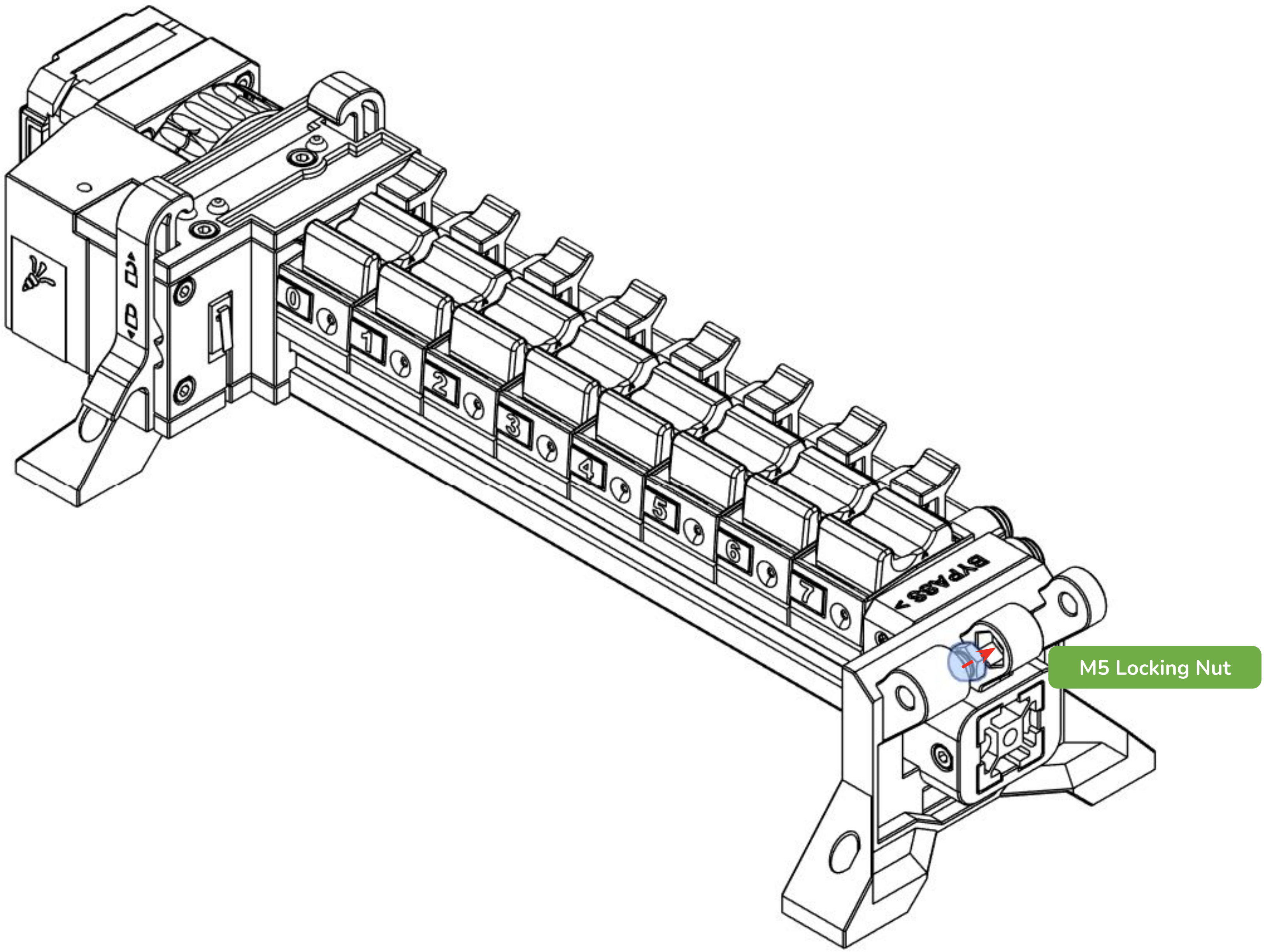
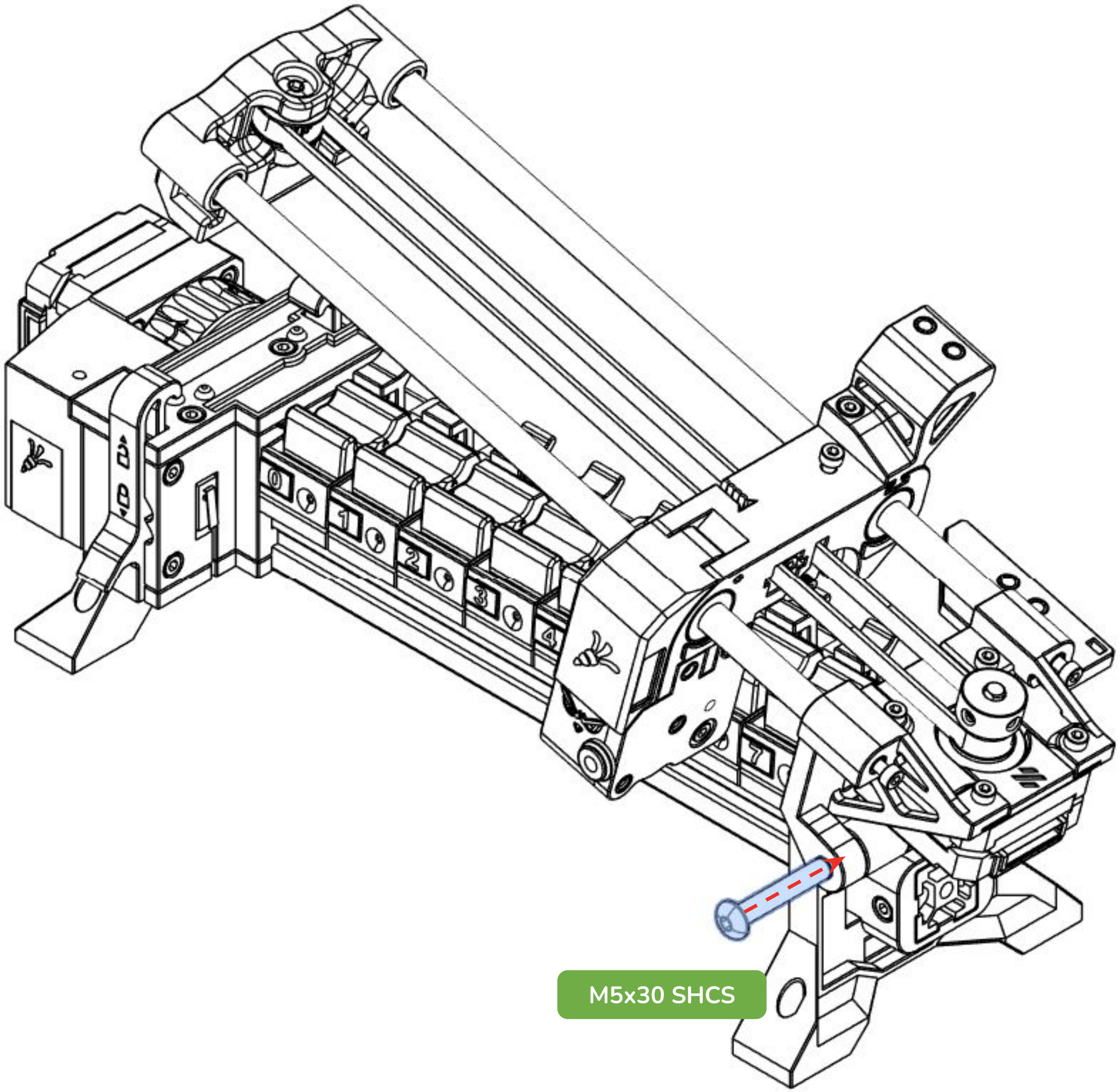
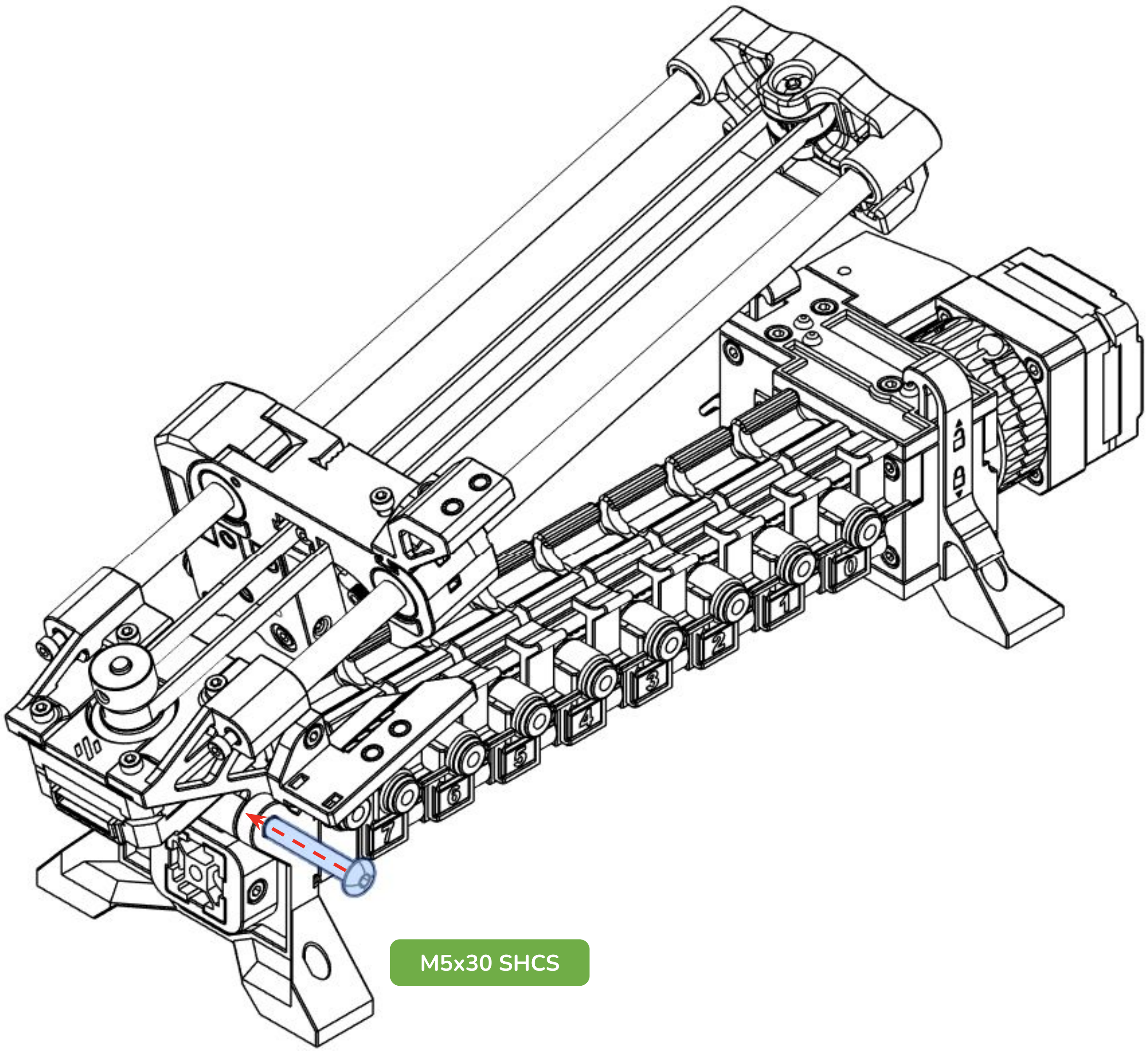
ADDING THE LOCKING NUTS



JOINING THE TWO BLOCKS



JOINING THE TWO BLOCKS



M5x30 SHCS

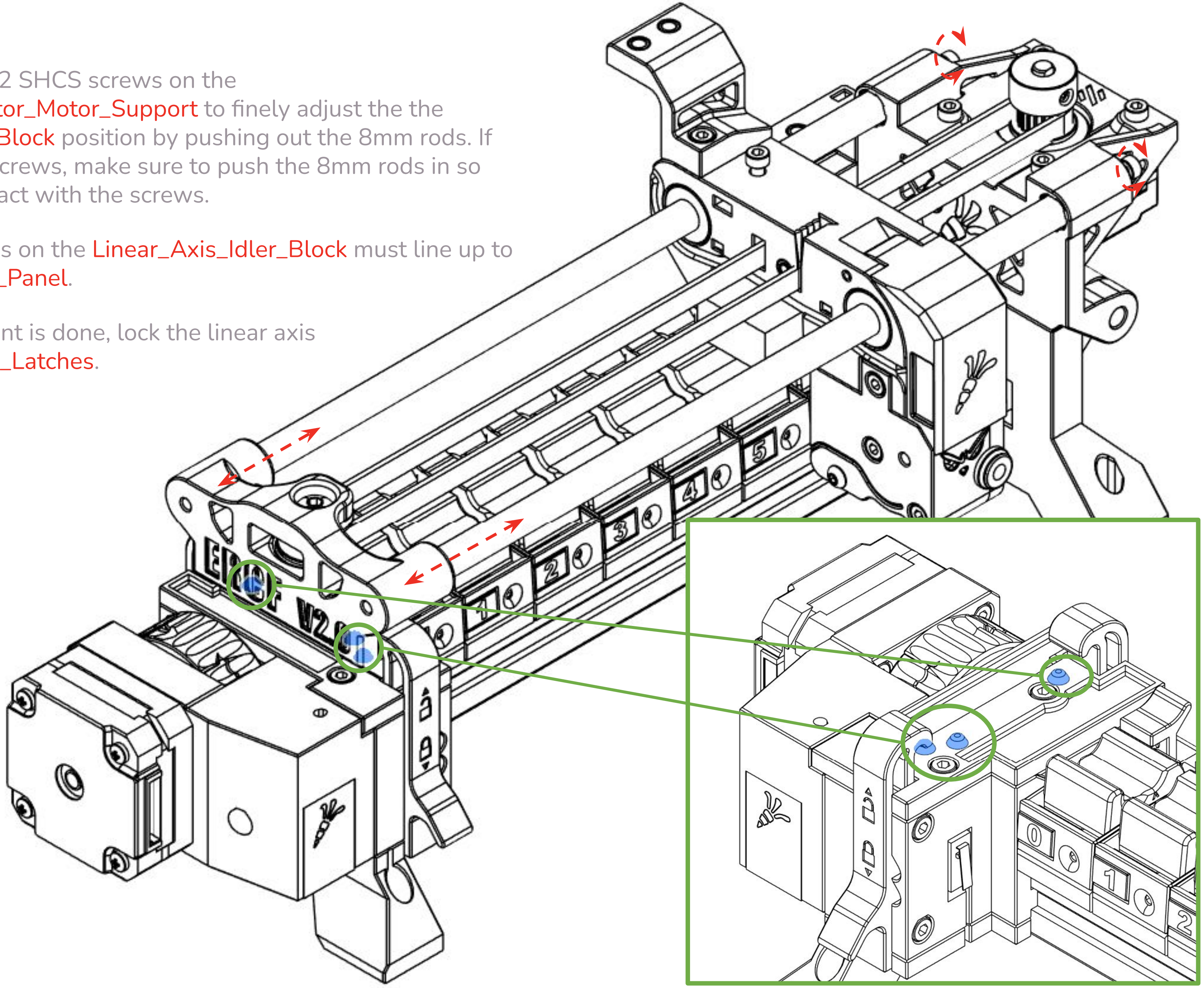
IDLER ADJUSTMENT

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.



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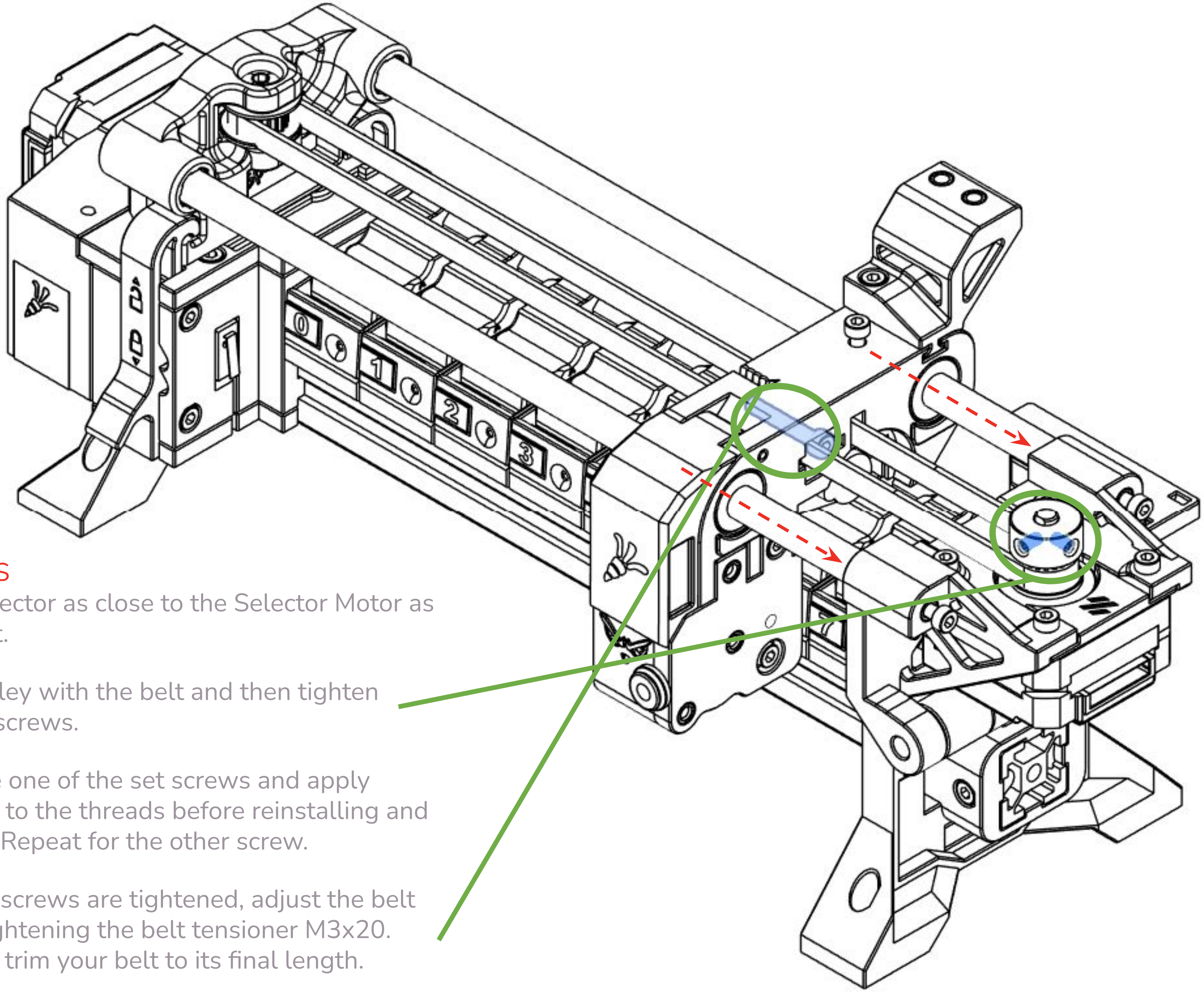
TENSIONING THE BELT



SET SCREWS

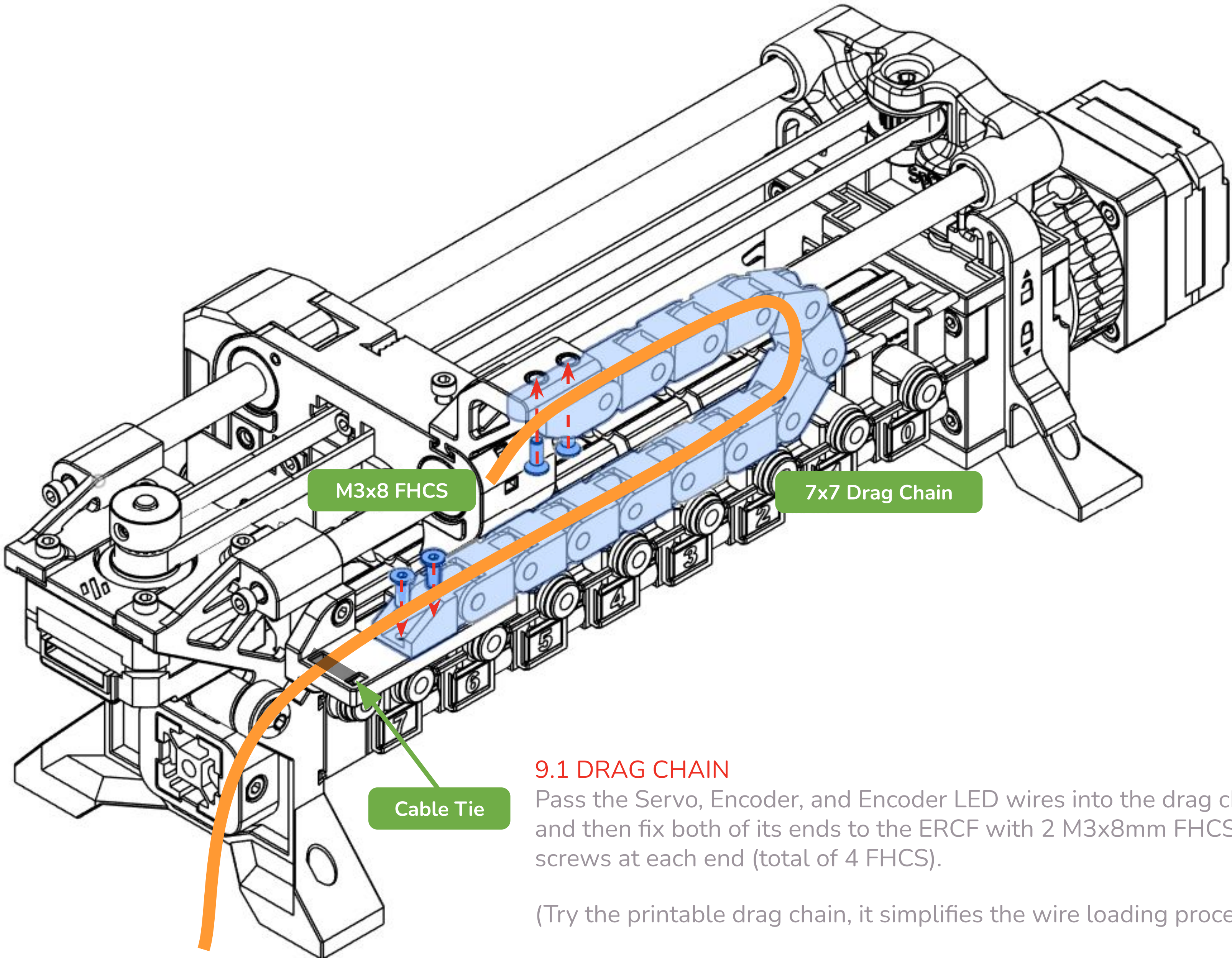
Move the Selector as close to the Selector Motor as you can get it.

Align the pulley with the belt and then tighten both M3 set screws.

Next, remove one of the set screws and apply thread locker to the threads before reinstalling and tightening it. Repeat for the other screw.

Once the set screws are tightened, adjust the belt tension by tightening the belt tensioner M3x20. Now you can trim your belt to its final length.

DRAG CHAIN



9.1 DRAG CHAIN

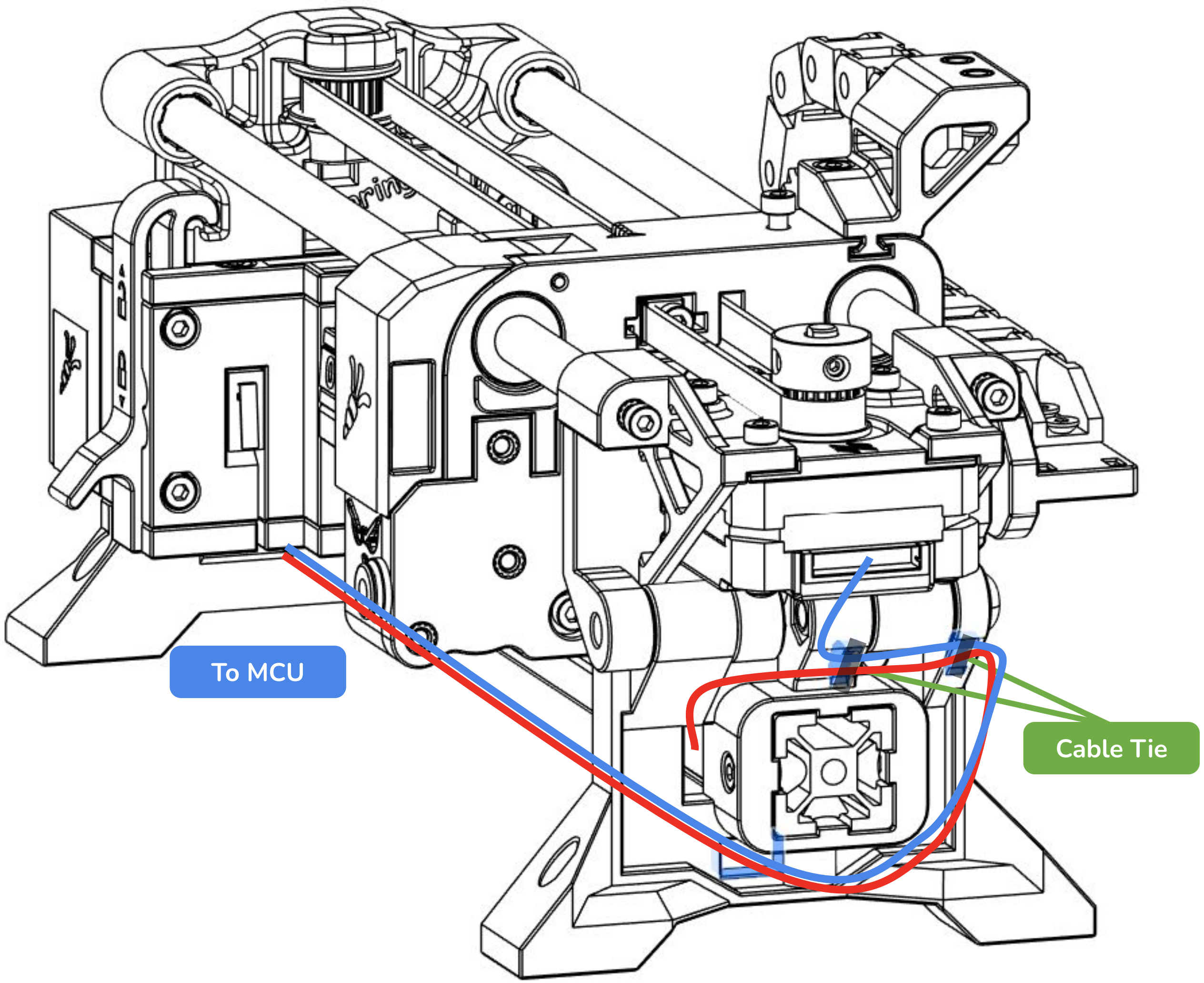
Pass the Servo, Encoder, and Encoder LED wires into the drag chain, and then fix both of its ends to the ERCF with 2 M3x8mm FHCS screws at each end (total of 4 FHCS).

(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.

CABLE MANAGEMENT

[These graphics will be updated soon]



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.

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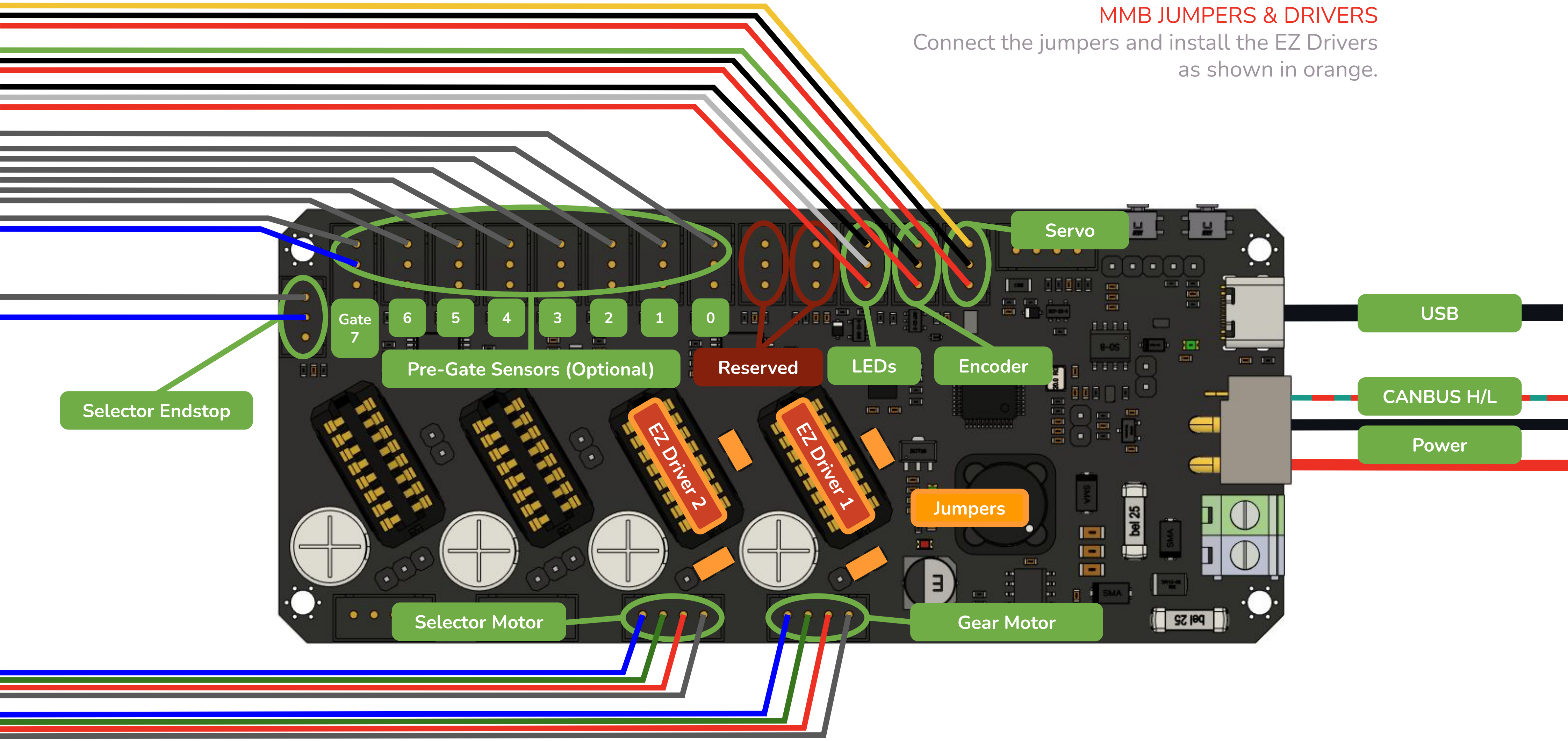
WIRING THE MMBv1

MMB JUMPERS & DRIVERS

Connect the jumpers and install the EZ Drivers as shown in orange.



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.

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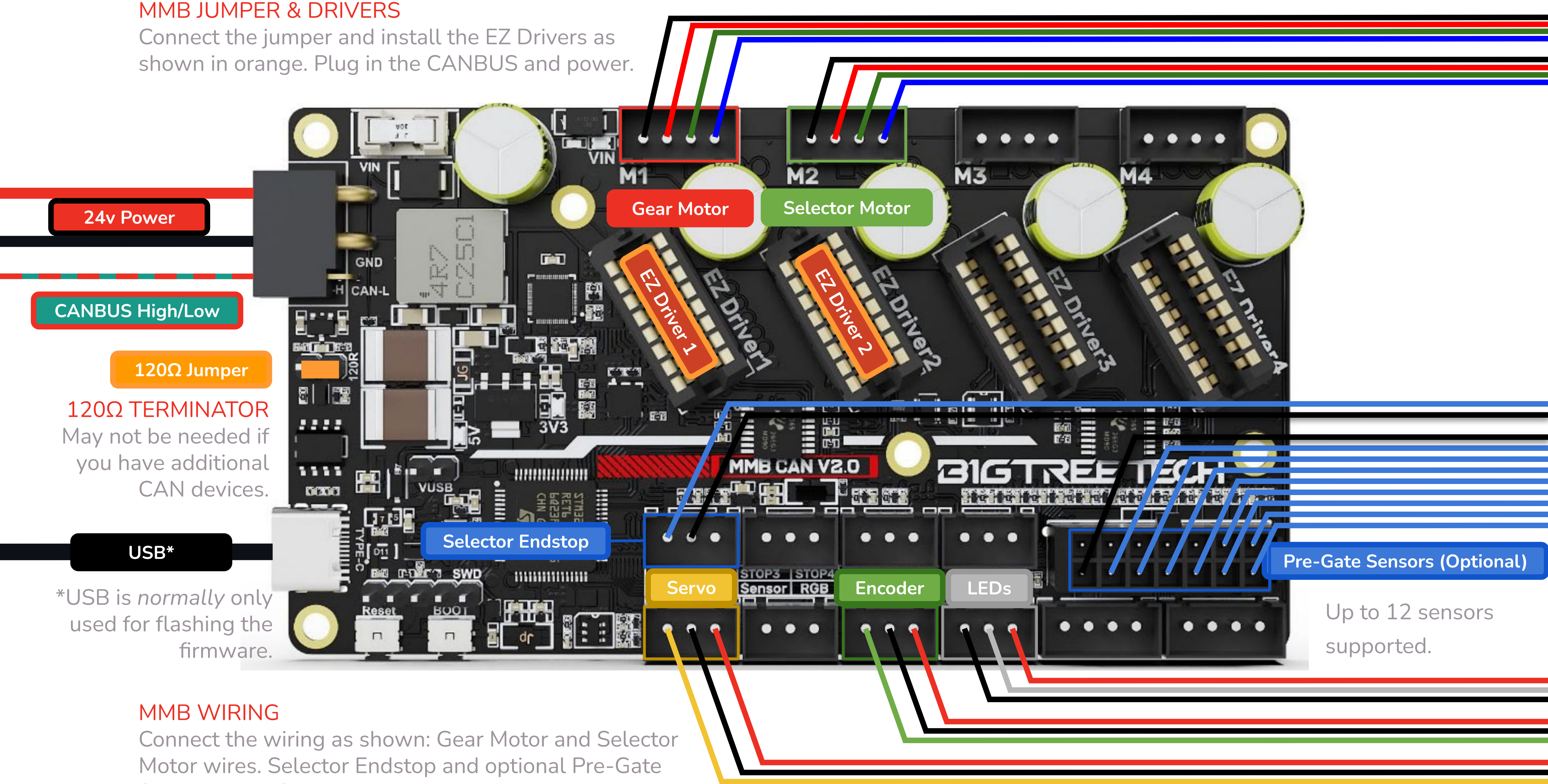
WIRING THE MMBv2

MMB JUMPER & DRIVERS

Connect the jumper and install the EZ Drivers as shown in orange. Plug in the CANBUS and power.



120Ω TERMINATOR

May not be needed if you have additional CAN devices.

*USB is *normally* only used for flashing the firmware.

Up to 12 sensors supported.

MMB WIRING

Connect the wiring as shown: Gear Motor and Selector Motor wires. Selector Endstop and optional Pre-Gate Sensor wires. Servo, Encoder, and LED wires.

Wiring color may vary between manufacturers for stepper motors and generally.

Keep a few cm of wiring slack in the MMB box, it will be very helpful for maintenance.

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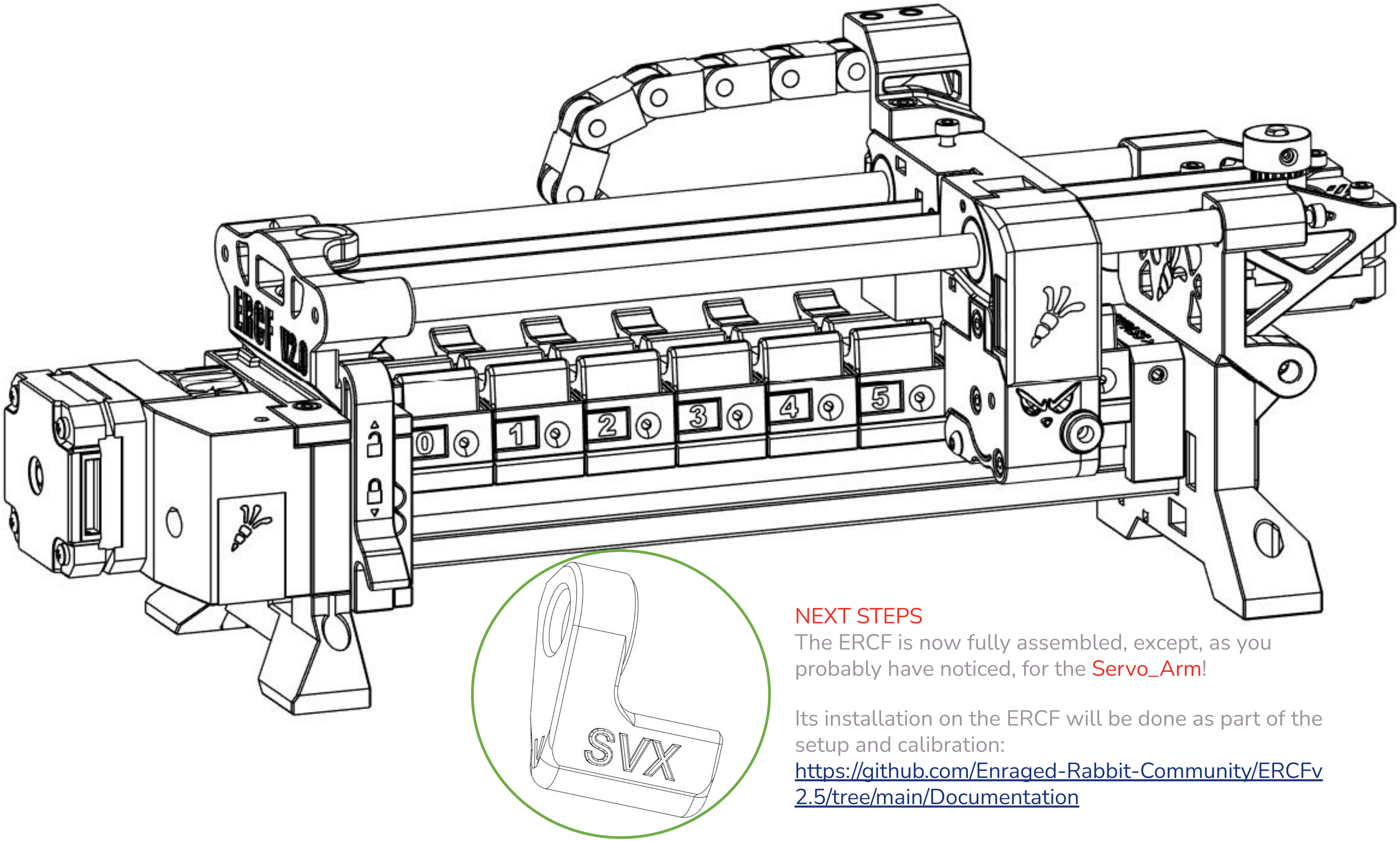
THE END! ... OR ALMOST :D



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: https://github.com/Enraged-Rabbit-Community/ERCFv2.5/tree/main/Documentation

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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 printer can also be found on our documentation page. We recommend starting here.

GitHub https://github.com/Enraged-Rabbit-Community/ERCFv2.5/tree/main/Documentation

GitHub https://github.com/moggieuk/Happy-Hare/wiki

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!.

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.

ERCF https://discord.com/channels/1267663557999329371/

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

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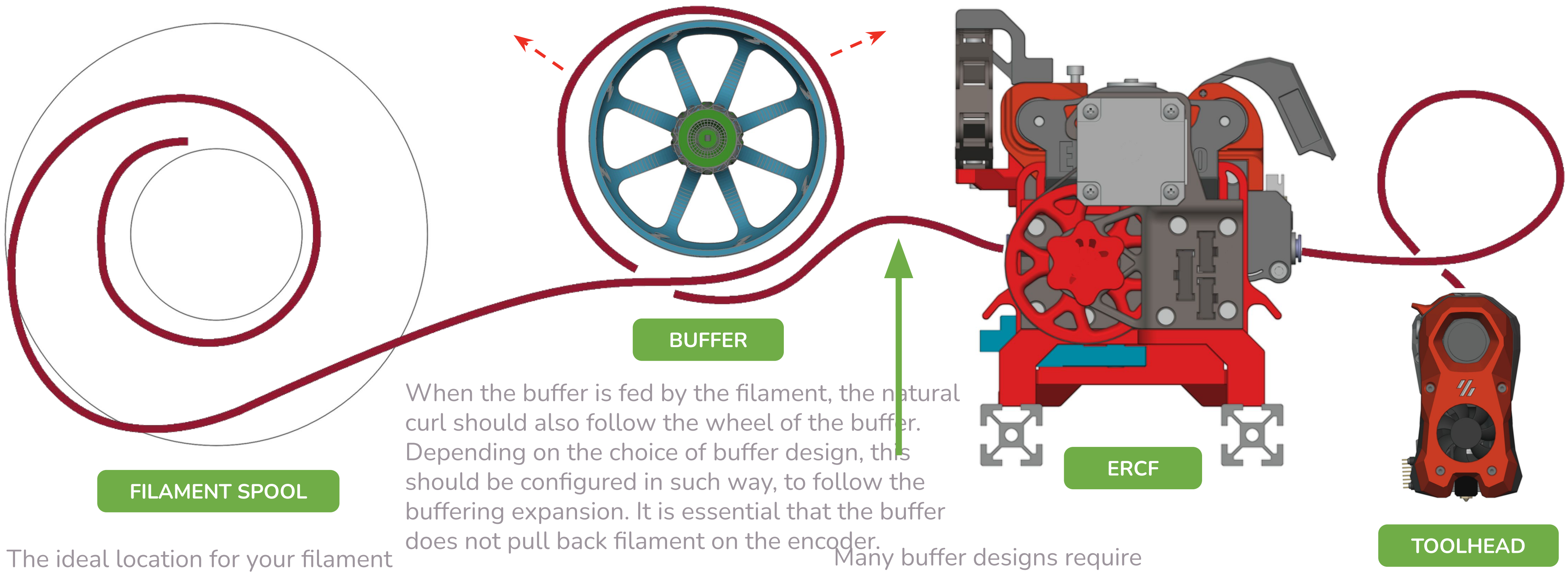
FILAMENT TUBE MANAGEMENT

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.



When the buffer is fed by the filament, the natural curl should also follow the wheel of the buffer. Depending on the choice of buffer design, this should be configured in such way, to follow the buffering expansion. It is essential that the buffer does not pull back filament on the encoder.

The ideal location for your filament spool will depend on how it feeds the buffer. The curl should naturally work with the path (filament and tube) that goes into the buffer. In this example feeding around to the back and below allows for the natural curl to remain in the tube to the buffer. Feeding from the bottom prevents the spool from tipping over

Many buffer designs require optimal paths that come into the ERCF to reduce pressure on the filament blocks. It is important to reduce that pressure by not allowing downward orientations. Also, we recommend a tube length of 1000mm or less where possible.

A final turn to the toolhead can help maintain the natural curl. This doesn't have to be small, and can be a large radius but shouldn't be too long that will introduce additional resistance.

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Pages past this point are either old outdated info, or things that need to be reworked to be made useful. They will be reworked or discarded before release.

PTFE TUBING LENGTHS

PTFE TUBING LENGTHS

We call for 4mm OD x 2.5mm ID PTFE tubing. We've found in testing that an ID of 2.0mm is too restrictive of the filament, and that an ID of 3.0mm makes the tube too thin and fragile, leading to kinks in the tube and poor feeding.

You will need the following lengths of PTFE tubing:
[# Channels] x 1500mm for the Filament Spool to Buffer connections. This is the **maximum** usable length as determined in testing. The more this length can be reduced for your setup, the smoother and easier filament feeding will be. While it is technically possible to use a longer tube, we discourage it because of the added filament path friction.

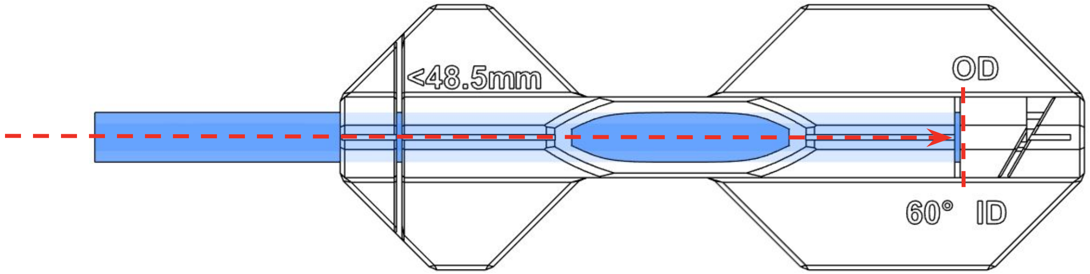
[# Channels] x 48.5mm for the Buffer to Filament Blocks connections.

1 x 1500mm for the Encoder to Toolhead connection. This is the **maximum** usable length. The more this length can be reduced for your setup, the smoother and easier filament feeding will be.

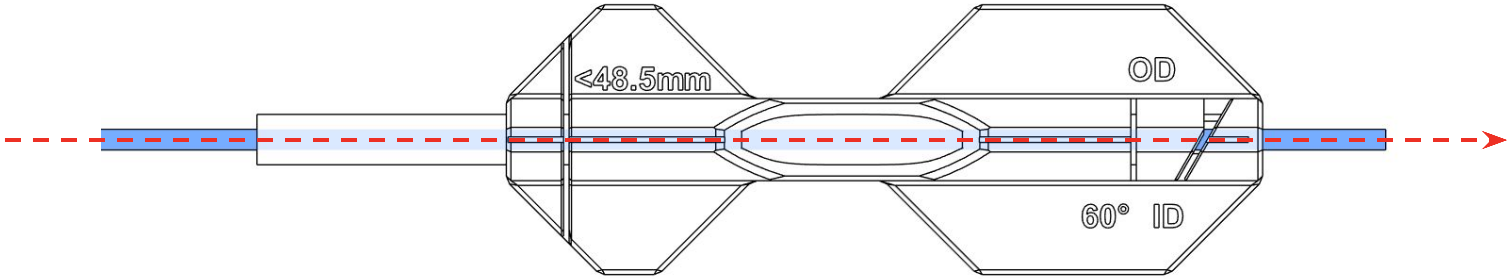
PREP PTFE TUBING

PREPPING PTFE TUBING

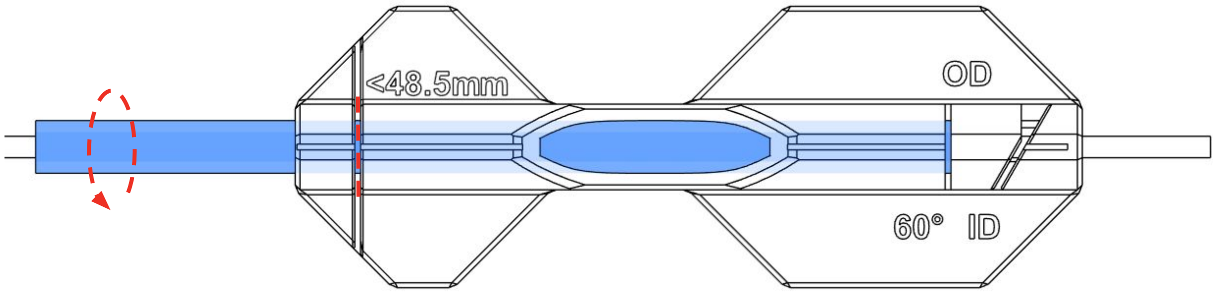
We have created a PTFE tool (ERCFv2/STLs/Tools/PTFE_Tool.stl) to aid in cutting and chamfering your PTFE tubing.
To cut the short Buffer-to-Filament Block connection tubes, begin by inserting PTFE tubing into the tool until it hits the stop.



Next, feed a piece of filament, preferably PETG, through the tubing and PTFE tool.



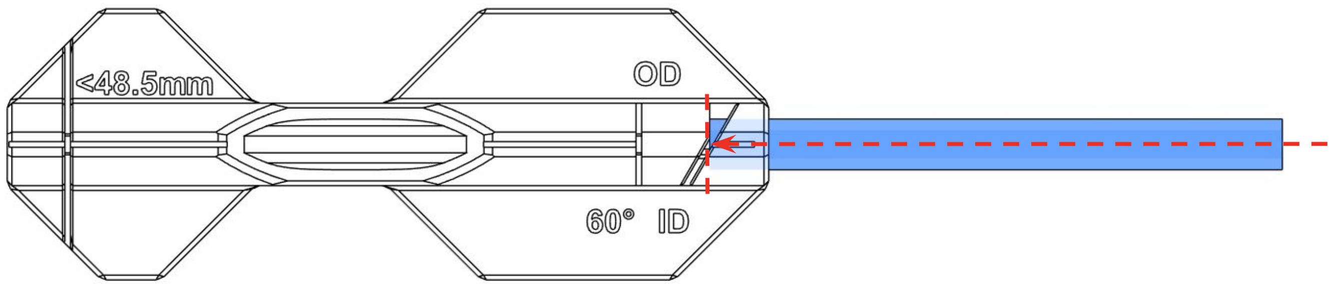
Now, cut the PTFE tube at the **48.5mm** slot. Use a hobby knife to cut down until you hit the filament, then twist the PTFE while keeping the blade in place. You should now have a very flat cut PTFE tube at the perfect length! Use the cutout to push the PTFE out of the PTFE tool.



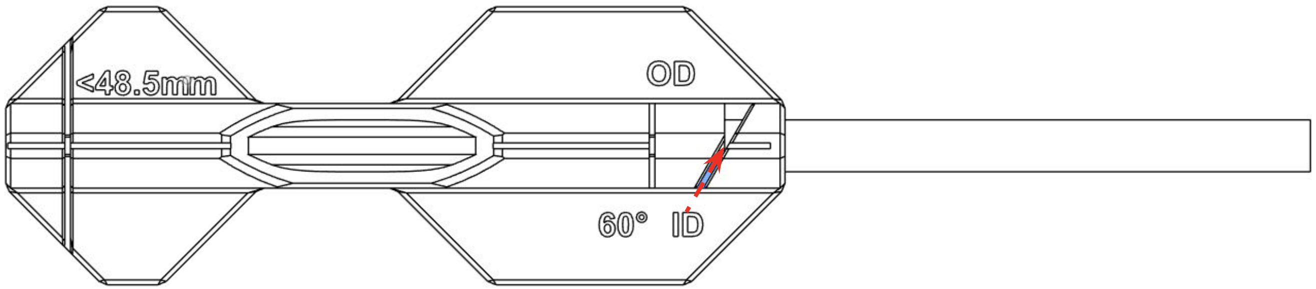
CHAMFER PTFE TUBING

CHAMFER PTFE TUBING

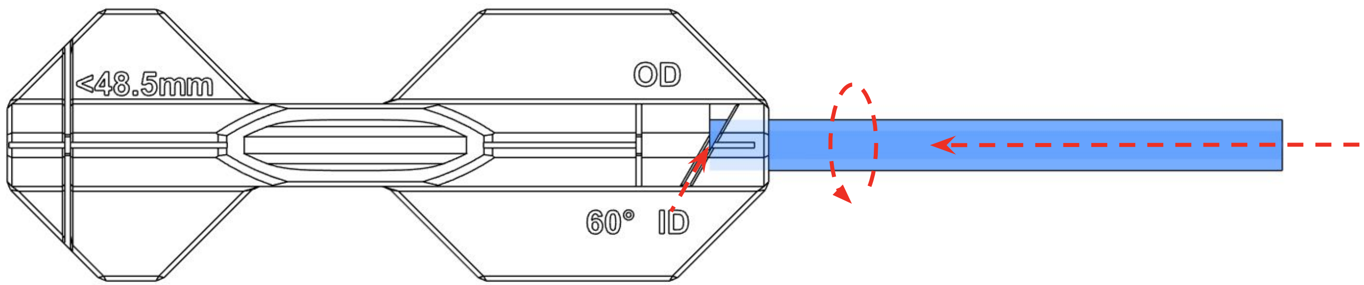
We have created a PTFE tool (ERCFv2/STLs/Tools/PTFE_Tool.stl) to aid in chamfering your PTFE tubing.
To chamfer a PTFE tubes, begin by inserting the PTFE tubing into the tool's chamfering side until it hits the stop.



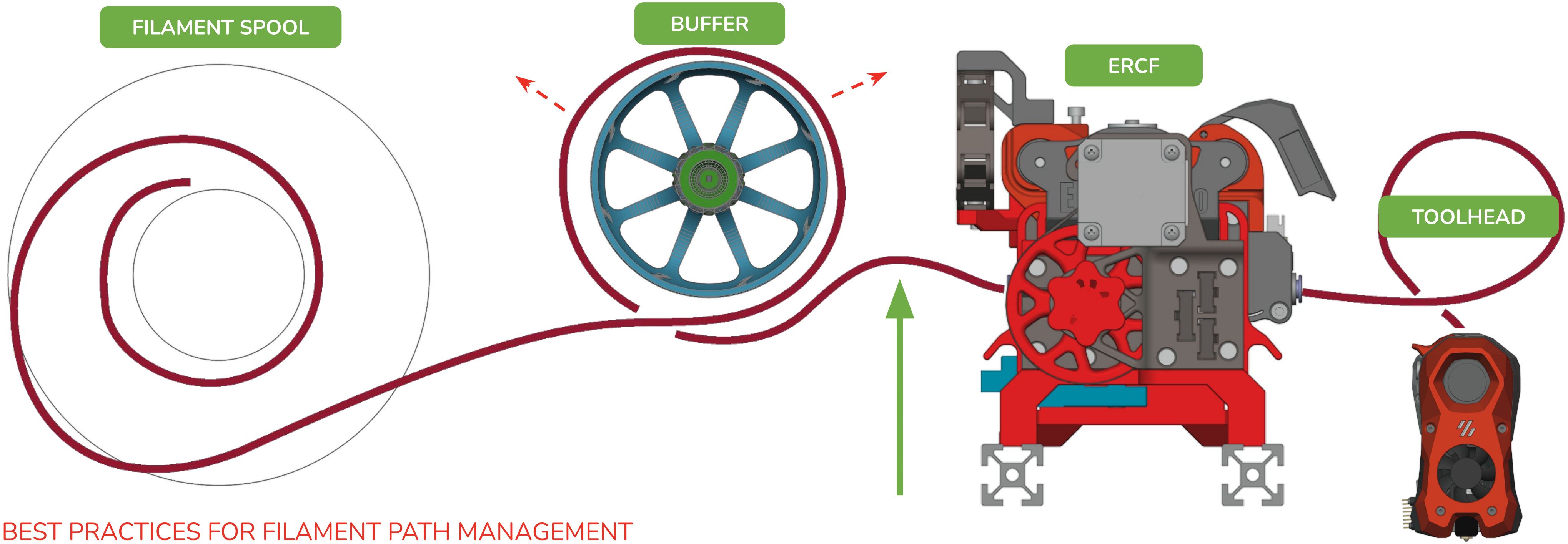
Next, take a sharp hobby knife, preferably #11, and place it into the **60° ID** slot. Be careful to align the tip of the blade to the centerline of the PTFE - you don't want to cut too far!



Keep the blade in place, and twist the PTFE tube, while maintaining pressure on the PTFE into the PTFE Tool. You should now have a nicely chamfered PTFE tube! It is recommended to do this for the entrance of every PTFE tube in the system, to prevent snags.



FILAMENT PATH MANAGEMENT



BEST PRACTICES FOR FILAMENT PATH MANAGEMENT

It is important to optimize your PTFE tube path to reduce any resistance for your MMU setup. One of the most common setup problems we see with ERCF is too much friction along the filament path, which keeps the filament from feeding consistently!

The ideal location for your filament spool will depend on how it feeds the buffer. The curl of the filament should naturally work with the PTFE tube path that goes into the buffer. In this example feeding around to the back and below allows for the natural curl to remain in the tube to the buffer.

When the buffer is loaded with filament, the natural filament curl should also follow the wheel of the buffer. Depending on the choice of buffer design, this curve should follow the buffering expansion. It is essential that the buffer does not pull on the filament feeding into the encoder.

Many buffer designs require that the filament paths into the ERCF angle slightly upward to eliminate any downward pressure on the filament blocks. It is important to reduce that pressure by orienting the tubes correctly, at a slight downward angle..

A final loop in the tube to the toolhead can help follow the natural filament curl. This can be a large radius, but shouldn't be so long that will introduce additional resistance.

We recommend testing each channel with a length of filament to make sure that the filament feeds smoothly. Adjust as needed.

KEEP THE ERCF PROJECT GOING!

ERCF is an all-volunteer, open-source project.
If you want to support the ERCF team, please donate to the Enraged Rabbit Community:

https://opencollective.com/enraged-rabbit-community

In the words of Marc, ERCF would be a dead brick of plastic without Happy Hare software.

Happy Hare is coded primarily by moggieuk, and SilverbackAttack wrote a lot of the documentation.

You can find Happy Hare here:

https://github.com/moggieuk/Happy-Hare

You can donate to support moggieuk and Happy Hare here:

https://www.paypal.me/moggieuk

Enjoy your MMU.

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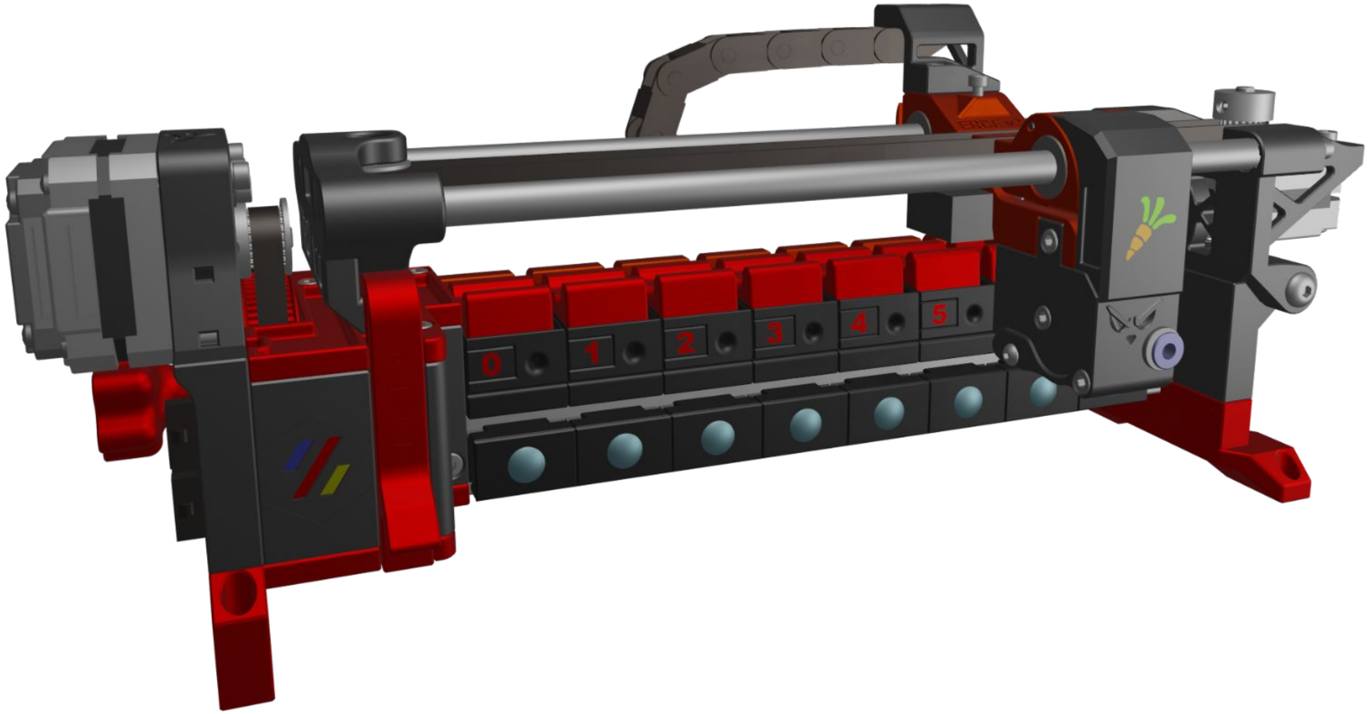
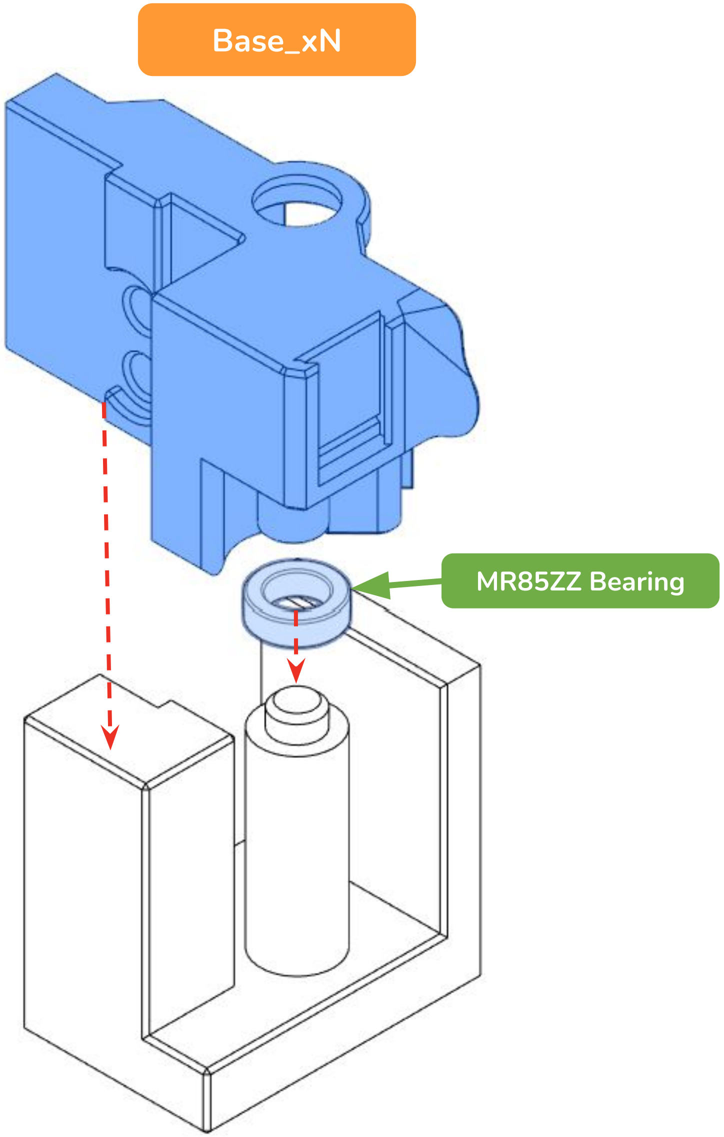

0
1
2
3
4
5

BASE BEARING INSERTION



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.

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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

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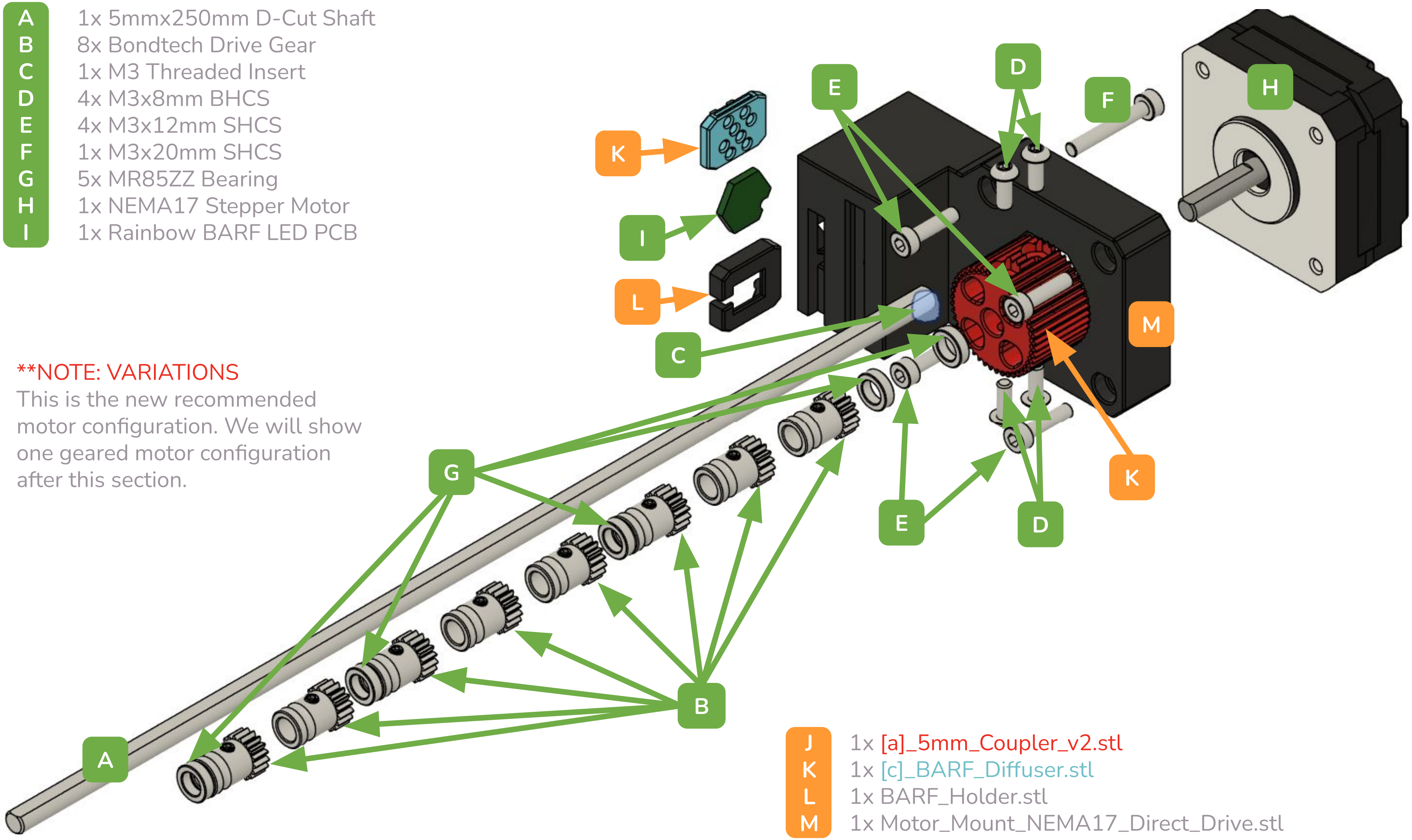
MOTOR MOUNT (DIRECT)

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.

EXPLODED VIEW



J	1x [a]_5mm_Coupler_v2.stl
K	1x [c]_BARF_Diffuser.stl
L	1x BARF_Holder.stl
M	1x Motor_Mount_NEMA17_Direct_Drive.stl

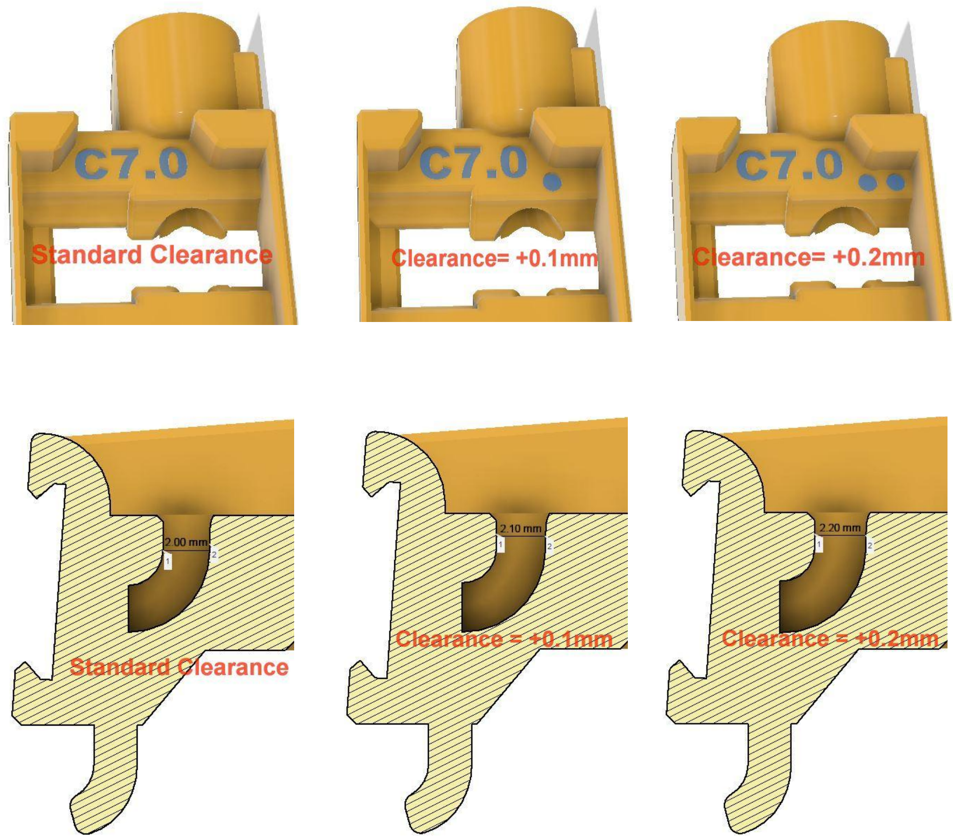
TOP HAT CLEARANCE OPTIONS

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/



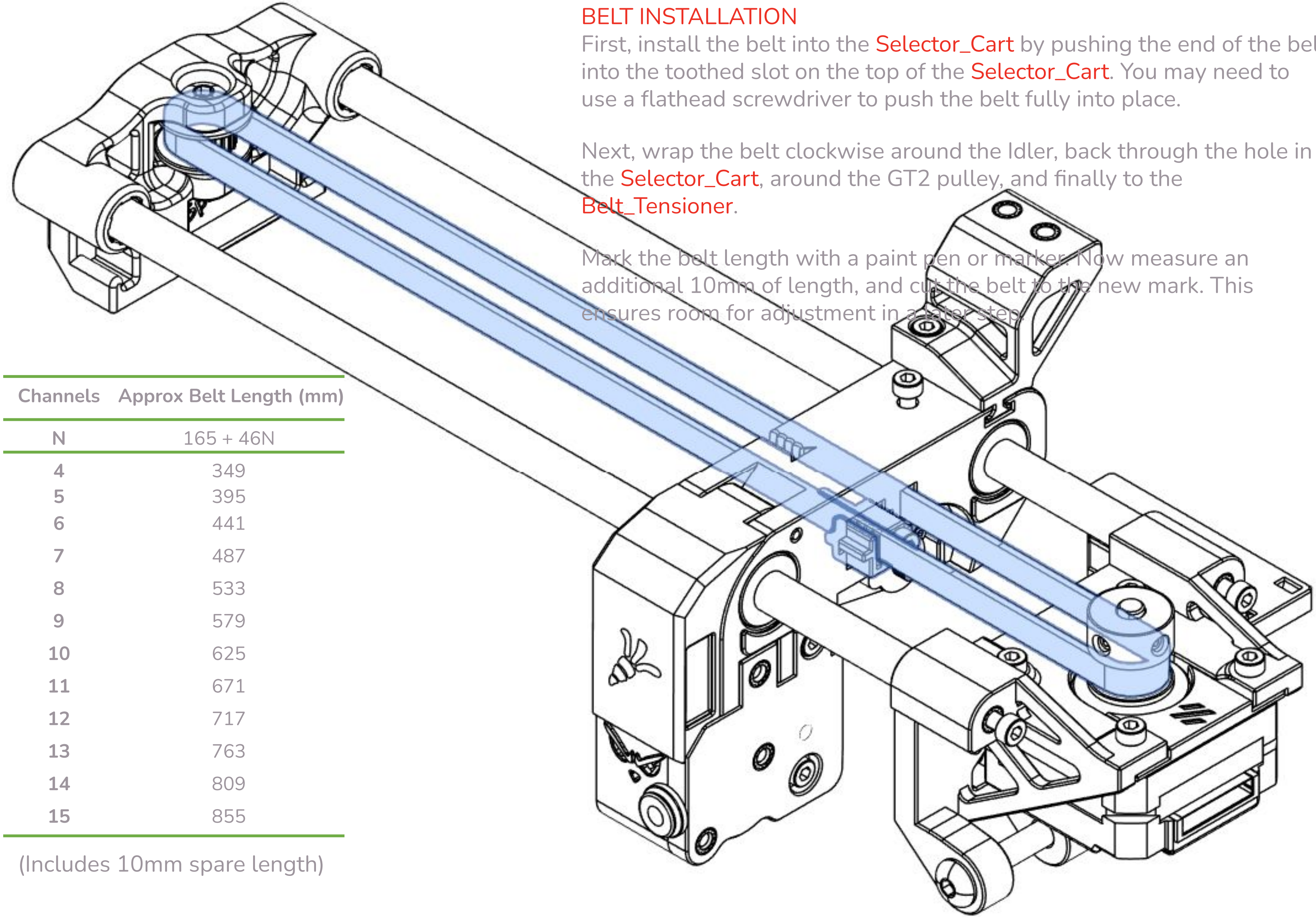
PULLEY AND BELT INSTALLATION

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.



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)

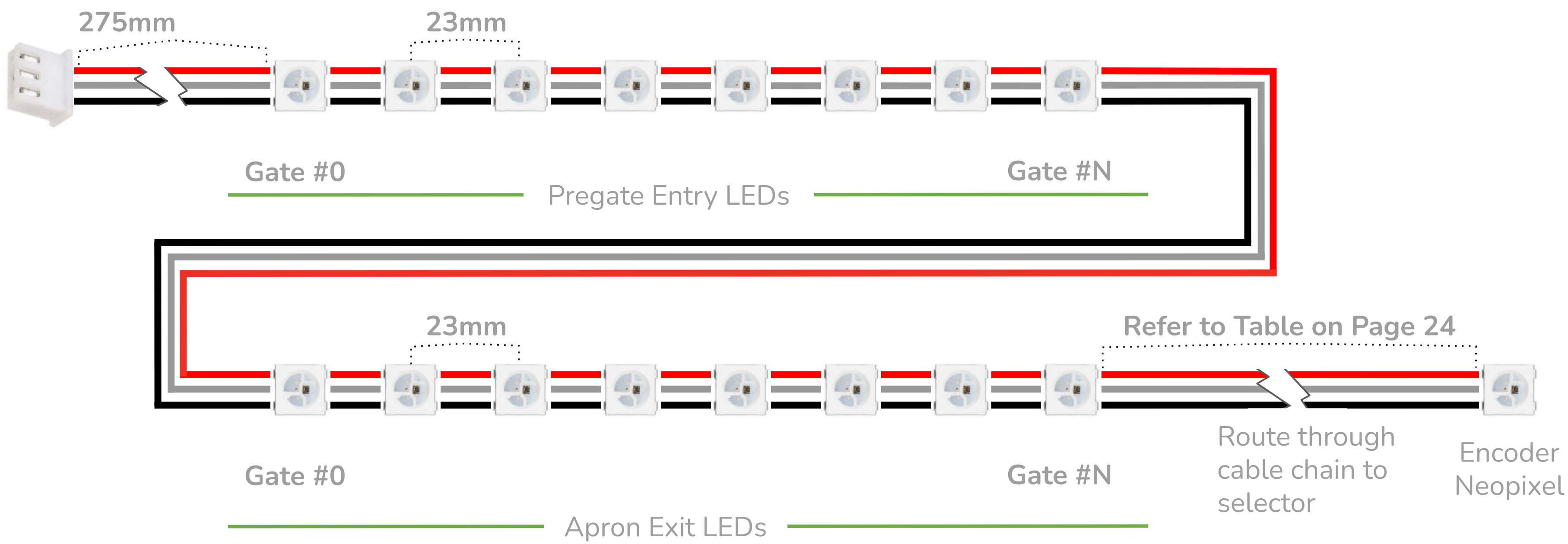
WIRING THE ENTRY LEDS

(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]



WIRING THE GEARBOX LOGO LED

(OPTIONAL) WIRING THE LOGO LED

The Gearbox Logo LED is optional.

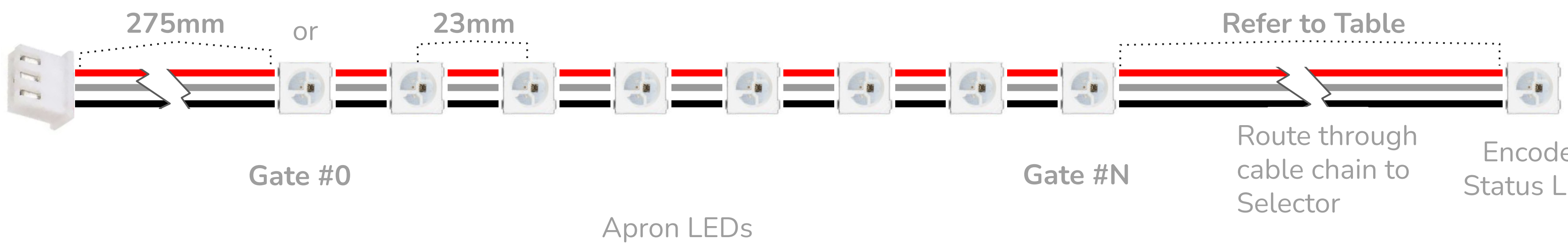
Solder 3 wires to the Gearbox Logo LED's Input solder pads.

Trim the wires to be about 100mm long.

If you are using the recommended Carrot on a Stick LED PCB: Crimp the wires into a 3-pin male DuPont 2.54mm connector. Set aside for now.

If you are using a chain of Neopixels: Solder the 3 wires onto the output of the

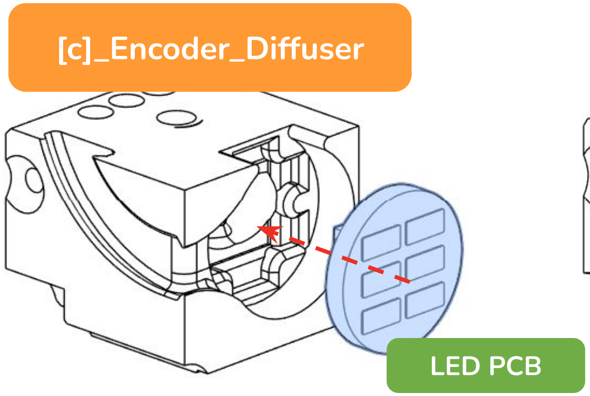
Channels	Encoder LED Wire Length (mm)
N	450 + 50N
4	650
5	700
6	750
7	800
8	850
9	900
10	950
11	1000
12	1050
13	1100
14	1150
15	1200

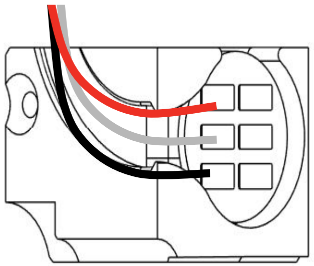


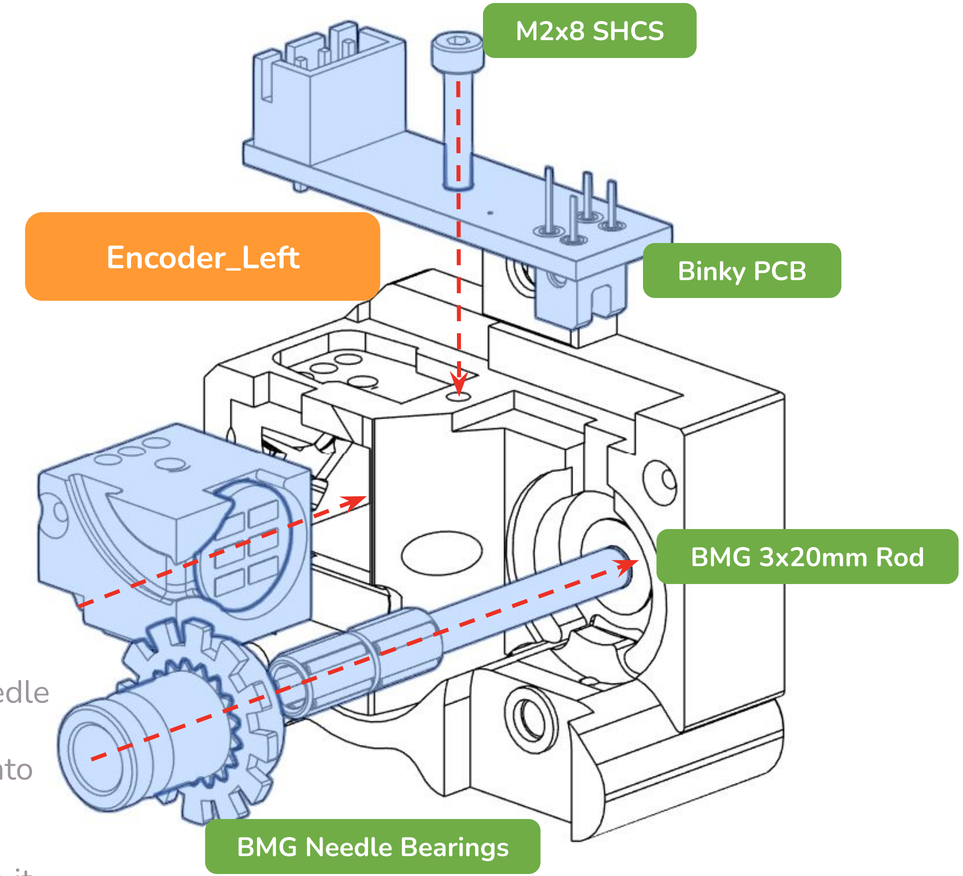
ENCODER ASSEMBLY

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.