



SWITCHWIRE ASSEMBLY MANUAL

We build space shuttles with gardening tools
so anyone can have a space shuttle of their own.

VERSION 2021-05-23



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

In the comfort of your own home you are about to assemble a robot. This machine can maim, burn, and electrocute you if you are not careful. Please do not become the first VORON fatality. There is no special Reddit 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 VORON TEAM

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PART PRINTING GUIDELINES

The Voron Team has provided the following print guidelines for you to follow 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.

3D PRINTING PROCESS

Fused Deposition Modeling (FDM)

INFILL TYPE

Grid, Gyroid, Honeycomb, Triangle or Cubic

MATERIAL

ABS

INFILL PERCENTAGE

Recommended: 40%

LAYER HEIGHT

Recommended: 0.2mm

WALL COUNT

Recommended: 4

EXTRUSION WIDTH

Recommended: Forced 0.4mm

SOLID TOP/BOTTOM LAYERS

Recommended: 5

PRINT IT FORWARD (PIF)

Often times our community members have issues printing ABS will bootstrap themselves into a VORON using our Print It Forward program. This is a service where approved members with VORON printers can make you a functional set of parts to get your own machine up and running.

Check Discord if you have any interest in having someone help you out.

HOW TO GET HELP

If you need assistance with your build, we're here to help. Head on over to our Discord group and post your questions. This is our primary medium to help VORON Users and we have a great community that can help you out if you get stuck.



<https://discord.gg/voron>

THIS IS JUST A REFERENCE

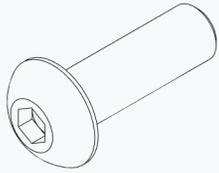
This manual is designed to be a simple reference manual. Building a Voron can be a complex endeavour and for that reason we recommend downloading the CAD files off our Github repository if there are sections you need clarification on. It can be sometimes be easier to follow along when you have the whole assembly in front of you.



<https://github.com/vorondesign>

HARDWARE

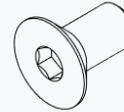
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BUTTON HEAD CAP SCREW (BHCS)

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

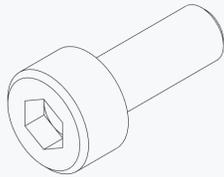
ISO 7380-1



FLAT HEAD COUNTERSUNK SCREW (FHCS)

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

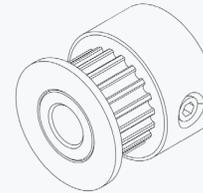
ISO 10642



SOCKET HEAD CAP SCREW (SHCS)

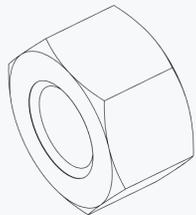
Metric fastener with a cylindrical head and hex drive. The most common fastener used on the Voron.

ISO 4762



PULLEY

GT2 pulley used on the motion system of the Voron.



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



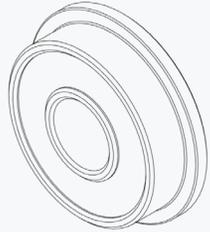
SHIM

Not to be confused with stamped washers. These are used in all M5 call-out locations in this manual.

DIN 988

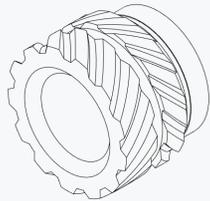
HARDWARE

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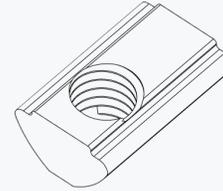
F695 BEARING

A ball bearing with a flange used in various gantry locations.



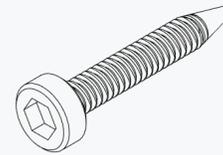
HEAT SET INSERT

Heat inserts with a soldering tip so that they melt the plastic when installed. As the plastic cools, it solidifies around the knurls and ridges on the insert for excellent resistance to both torque and pull-out.



POST INSTALL T-SLOT NUT

Nut that can be inserted into the slot of an aluminium profile. Used in both M3 and M5 variants throughout this guide.



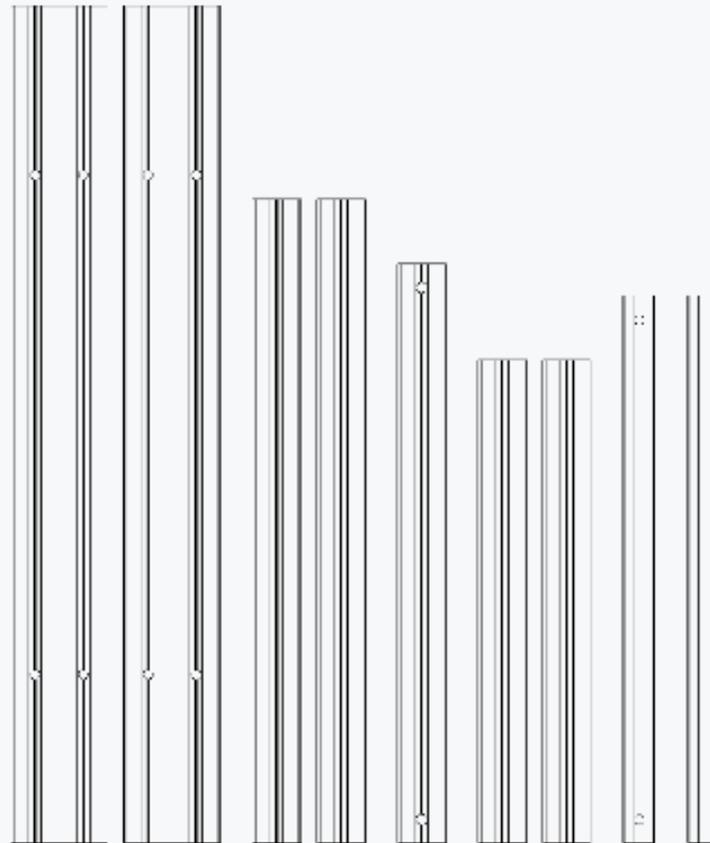
SELF TAPPING SCREW

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

FRAME

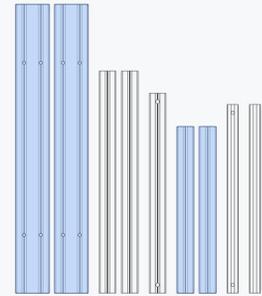
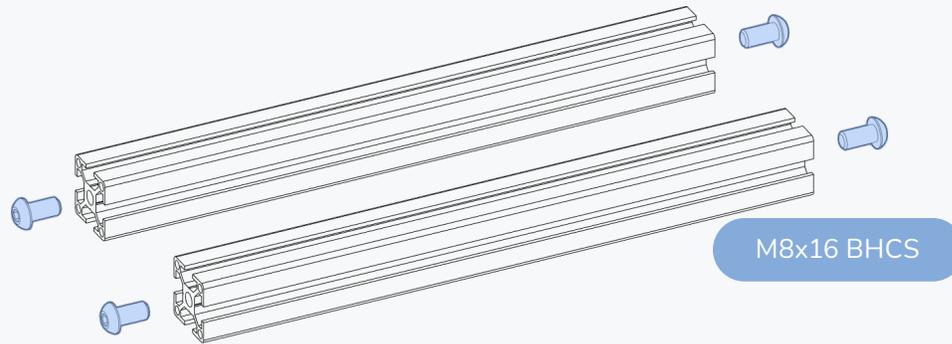
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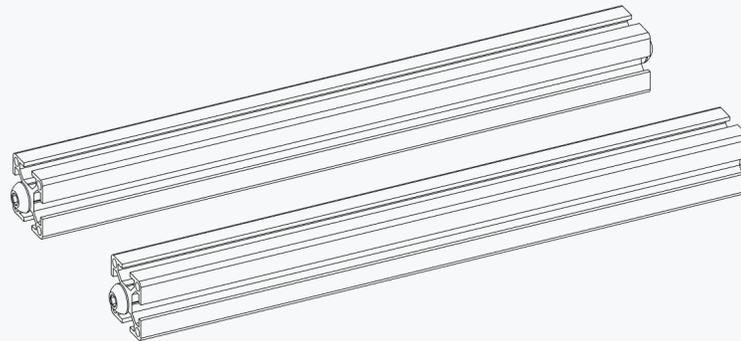
GETTING EXTRUSIONS TOGETHER

Separate the extrusions you're going to need for this section of the build. We've laid out all the parts you should have and highlighted the ones that will be used in the following sections.



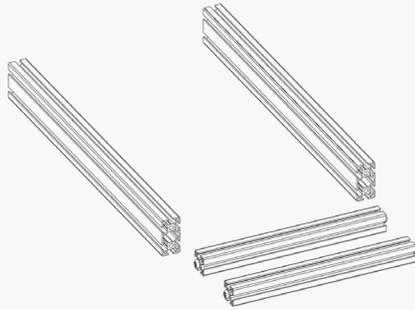
BLIND JOINT BASICS

Blind Joints provide a cost effective and rigid assembly method. The head of the BHCS is slid into the channel of another extrusion and securely fastened through a small access hole in the other extrusion.



FRAME

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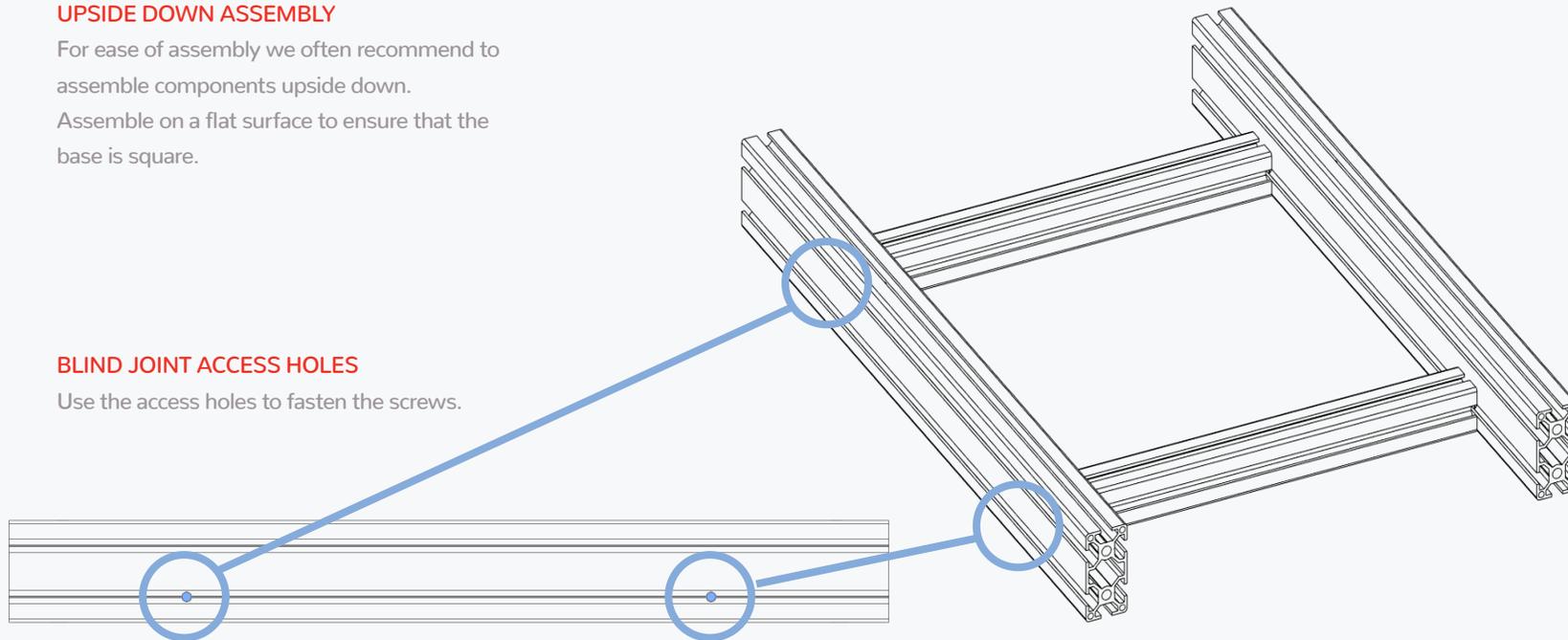


BUILD ON A FLAT SURFACE

Build the frame on a glass or granite surface to ensure you can get it as square as possible.

UPSIDE DOWN ASSEMBLY

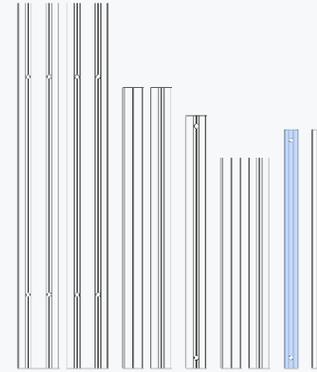
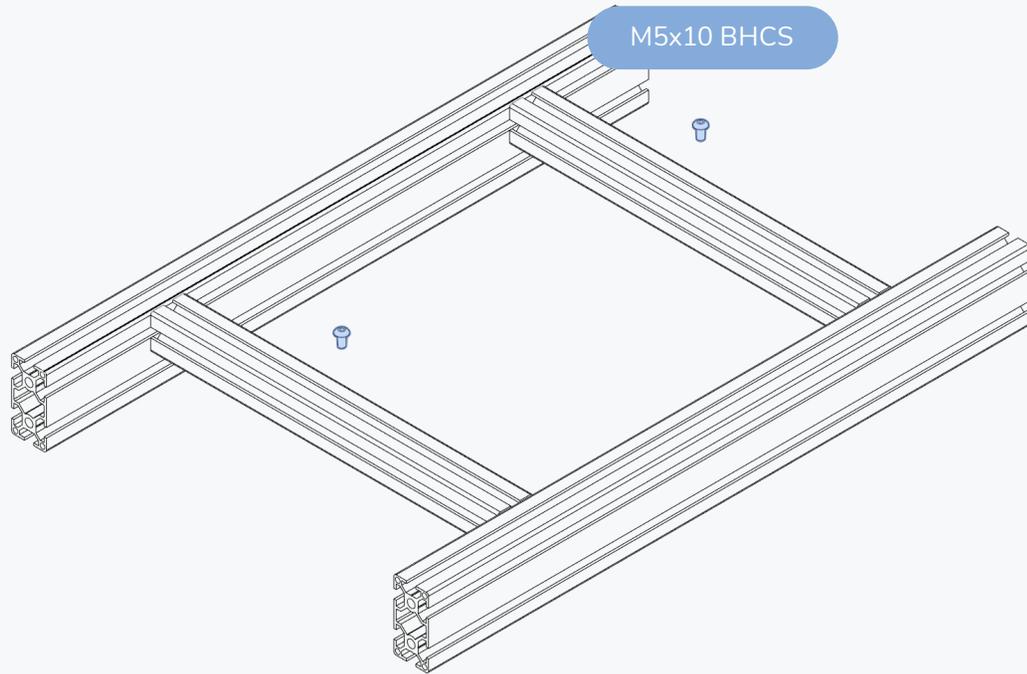
For ease of assembly we often recommend to assemble components upside down. Assemble on a flat surface to ensure that the base is square.



BLIND JOINT ACCESS HOLES

Use the access holes to fasten the screws.

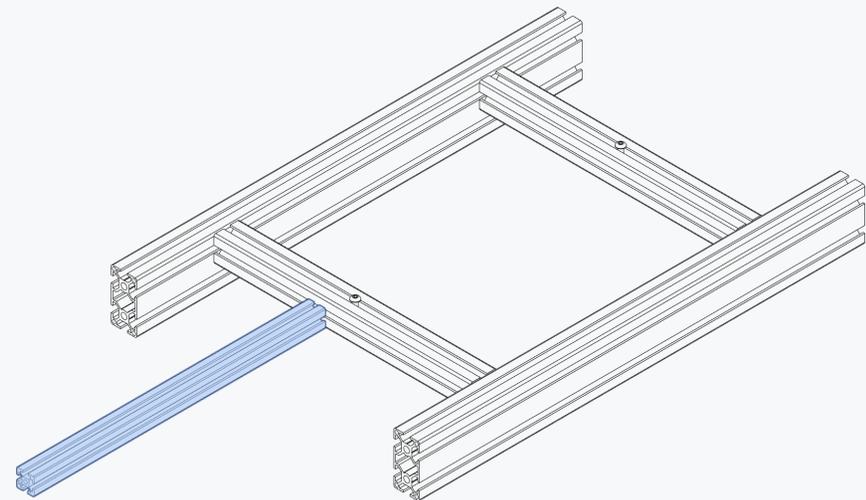
FRAME



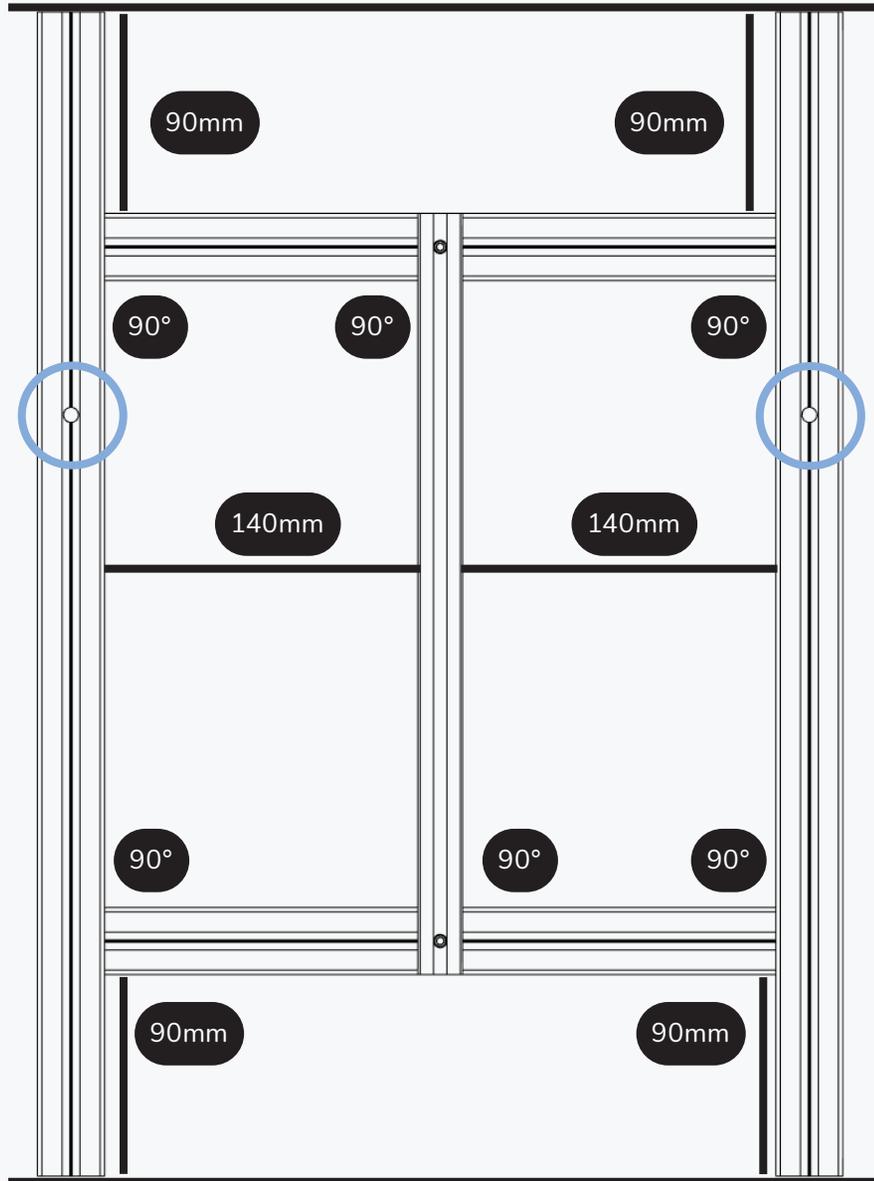
T-NUTS?

We don't show the insertion of T-Nuts in our assembly manuals.

The Post Install T-Nut's we recommend can be inserted at any point during the installation.



FRAME



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VERIFY DIMENSIONS

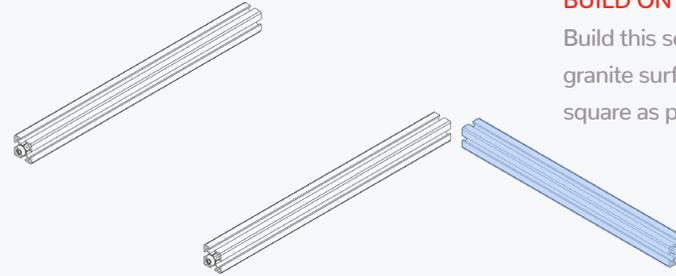
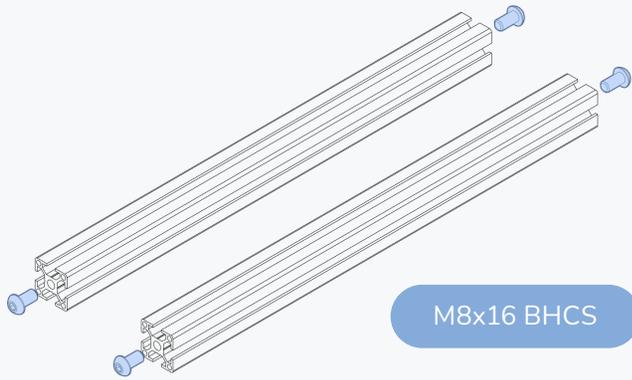
Make sure the frame is square and that all positions are set correctly before moving on. Check the 90° angles with a machinist square.

MIND ACCESS HOLE POSITION

We do our best to call out things that may bite you later in the assembly process but may skip things that seem obvious to us. If in doubt please refer to the CAD model, it might save you some considerable time down the road.

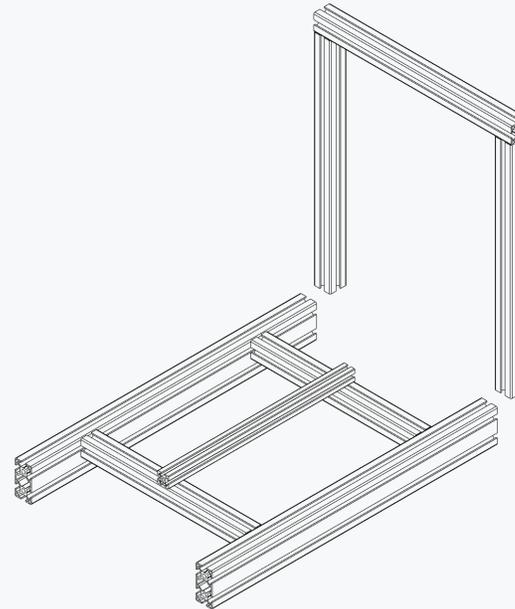
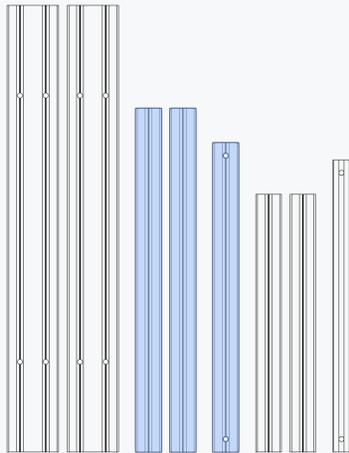
FRAME

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BUILD ON A FLAT SURFACE

Build this section of the frame on a glass or granite surface to ensure you can get it as square as possible.



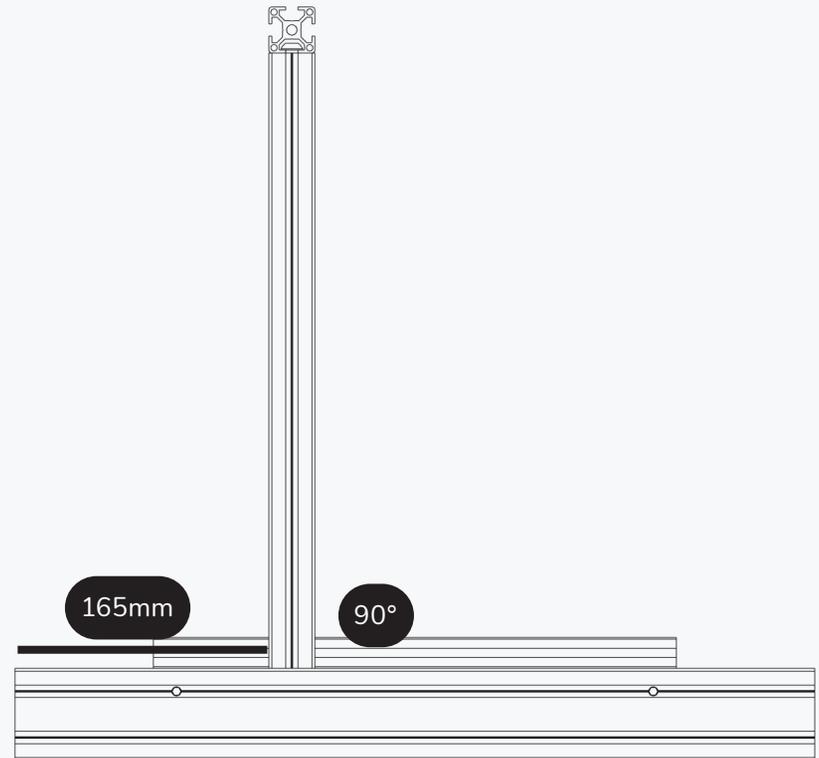
TILT FRAME 90°

The access holes for the Blind Joints are at the bottom. Lay the frame flat on it's side to access them. This also helps in mounting the uprights flush to the base.

VERIFY DIMENSIONS

Check the corners and make sure that they are at 90° angles. Use a small machinist square.
If you have the measuring equipment verify that both uprights are dead on parallel.

Correct the angle is required. Failure in doing so may result in a sticky Z Axis.



Z RAILS

MIND THE CARRIAGE

The carriages are designed to slide along the rail easily. This unfortunately also includes sliding off the rails.

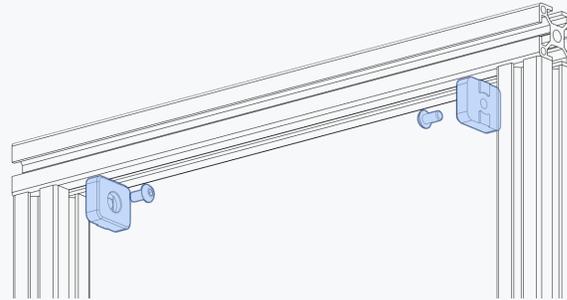
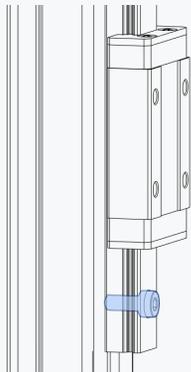
Dropping the carriage likely irreparably damages it.

NO STOPPER ON LEFT RAIL

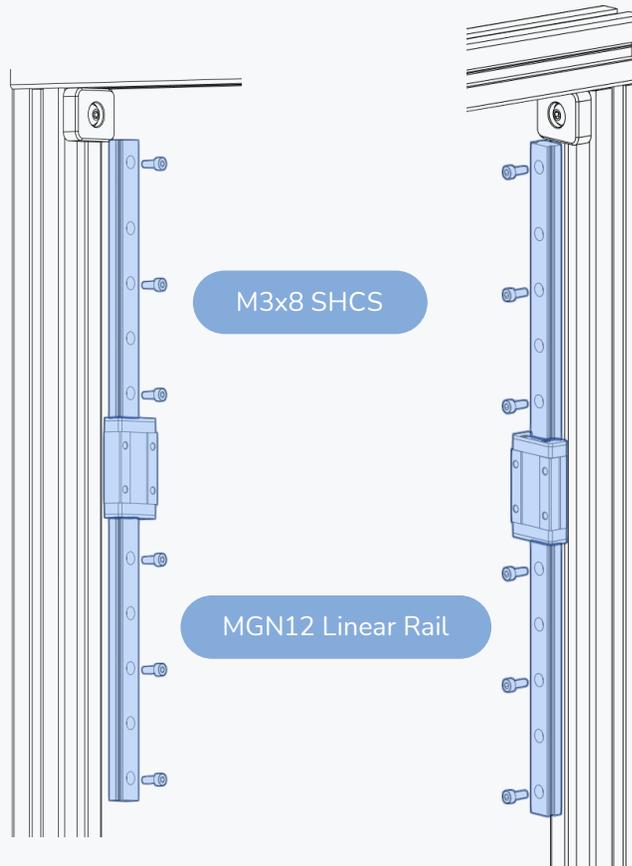
The left rail does not have a stopper in place to prevent the carriage from sliding off the rail. Some rails come with little plastic stop pins, you can leave the bottom one in place.

If your rail does not have these stop pins leave the last screw slightly loose to act as a stopper.

Tip: Mark the location with some tape to draw your attention to it later.

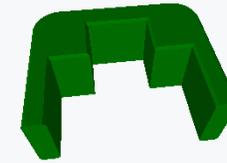


M5x10 BHCS



M3x8 SHCS

MGN12 Linear Rail



CENTERED RAIL INSTALLATION GUIDE

Use the guides to position the rail in the center of the extrusion prior to fastening the screws.



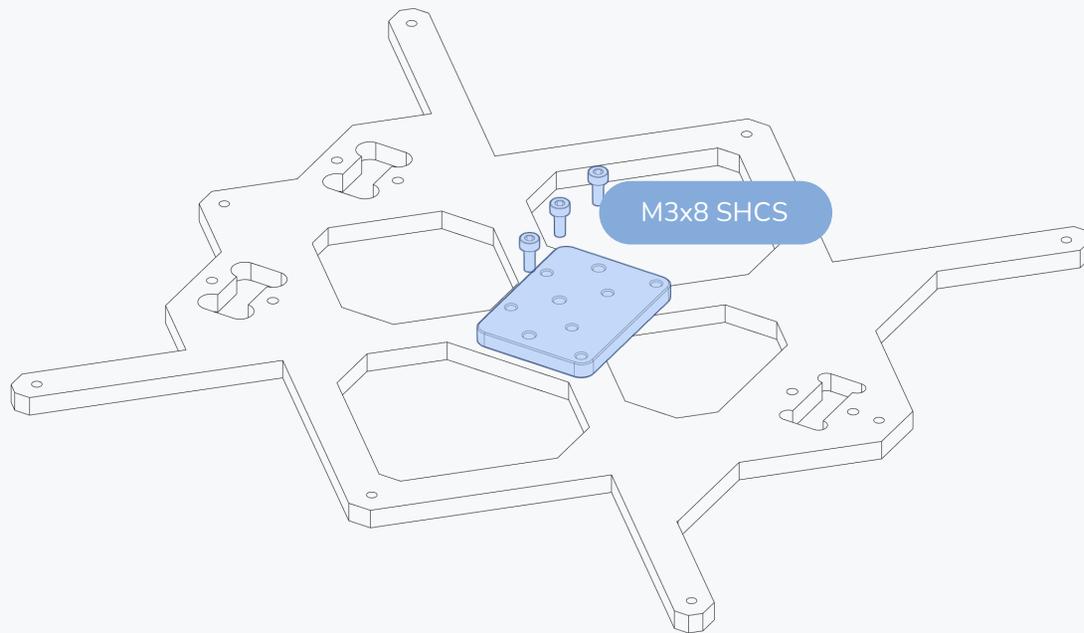
M5x10 BHCS

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Y AXIS

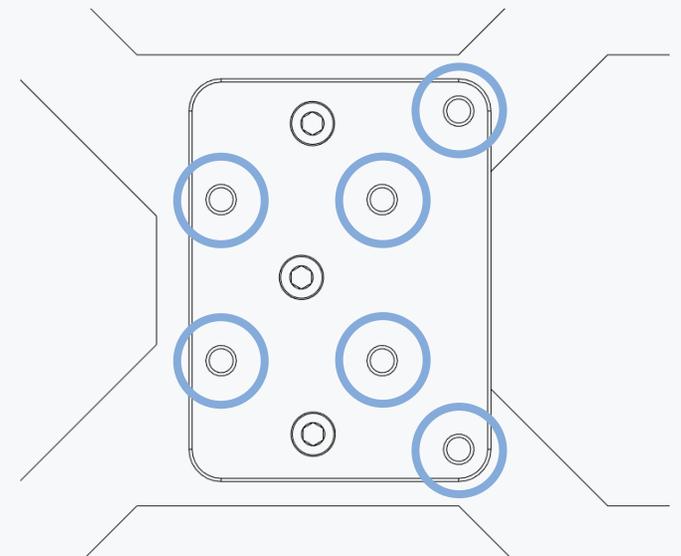
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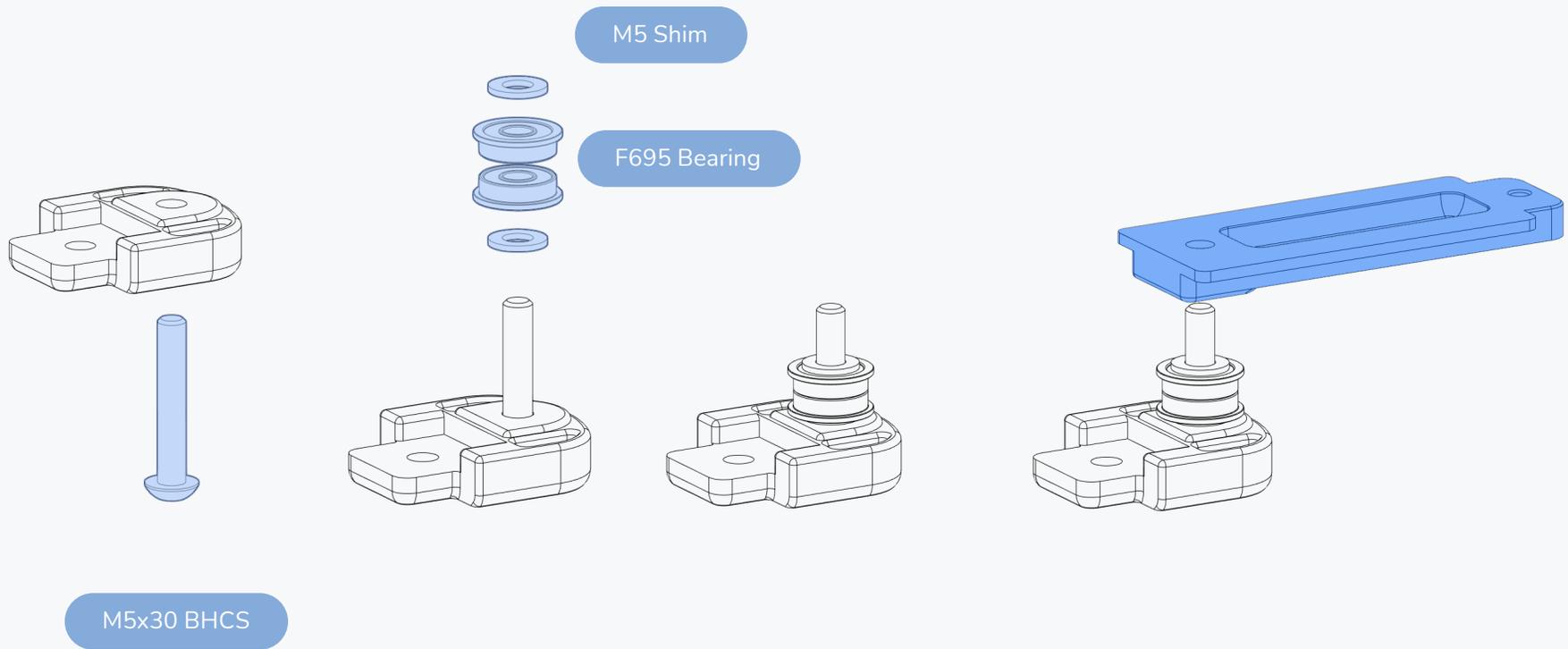




CARRIAGE MODIFICATION

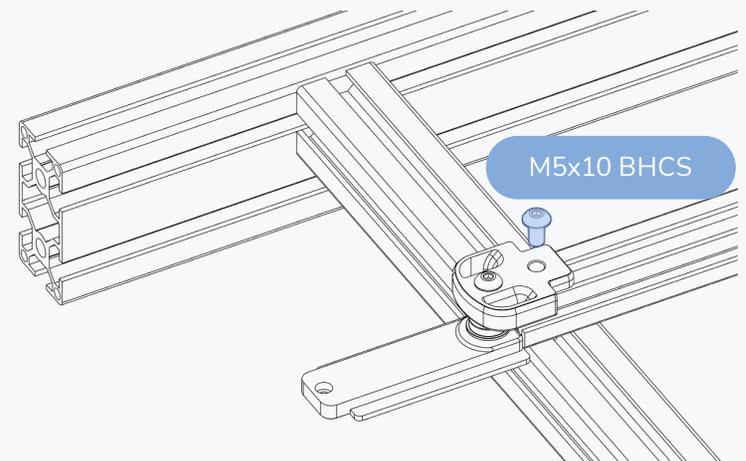
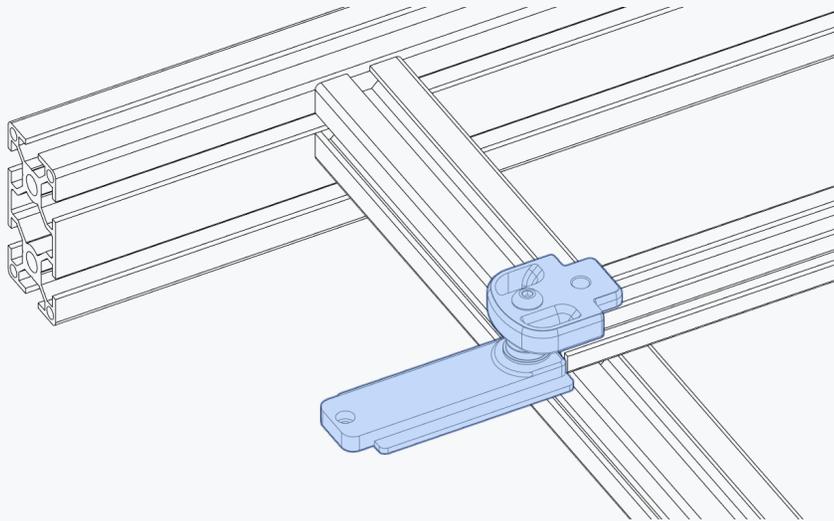
Temporarily mount the drill template to the carriage.
Drill the 6 holes marked on the right with a 3mm or 3.2mm drill bit.
Remove the template after you drilled the holes.



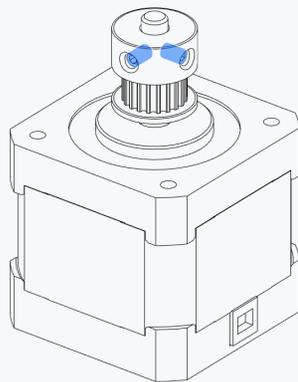
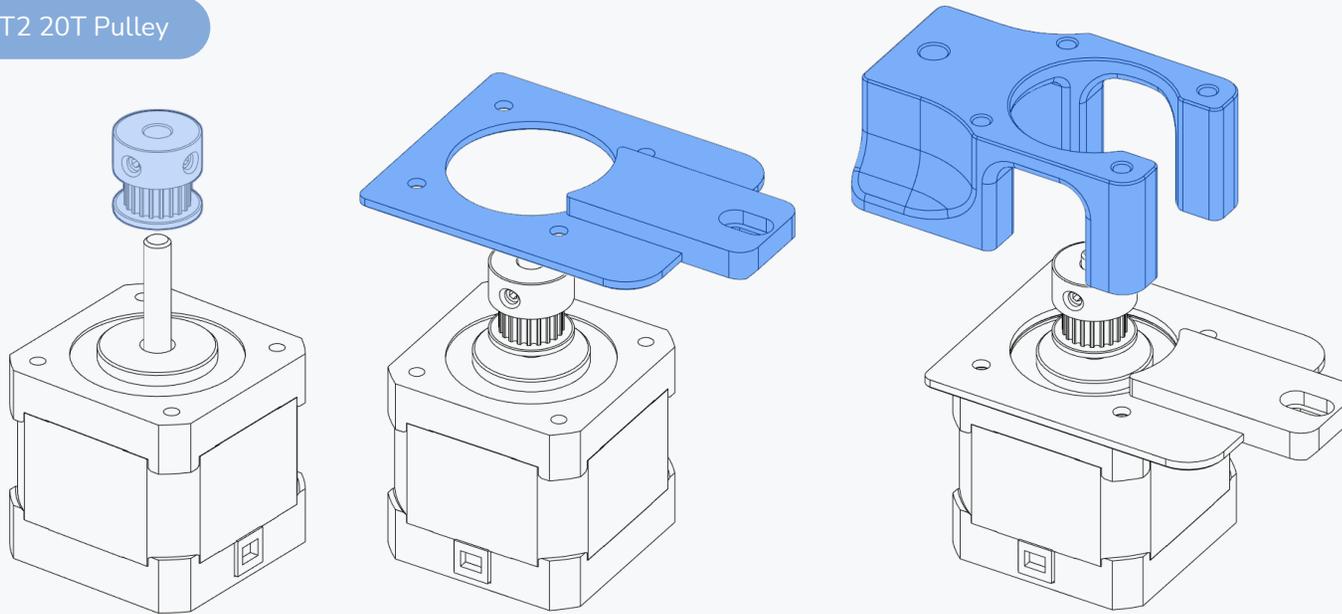


UPSIDE DOWN ASSEMBLY

Why fight gravity if it can work for us.



GT2 20T Pulley



GRUB SCREWS

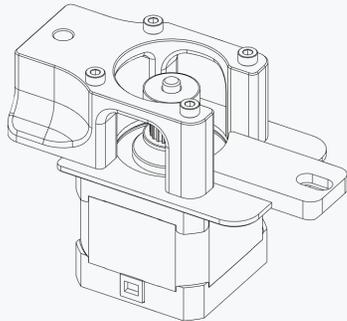
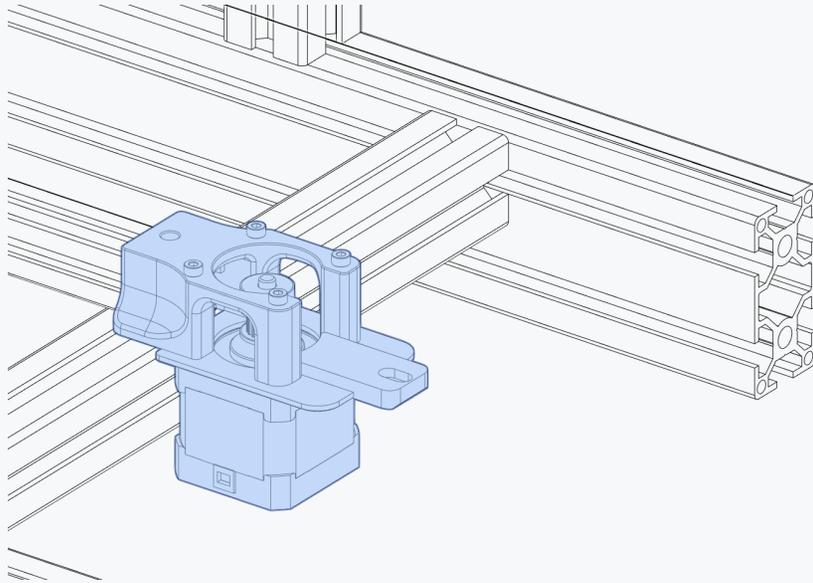
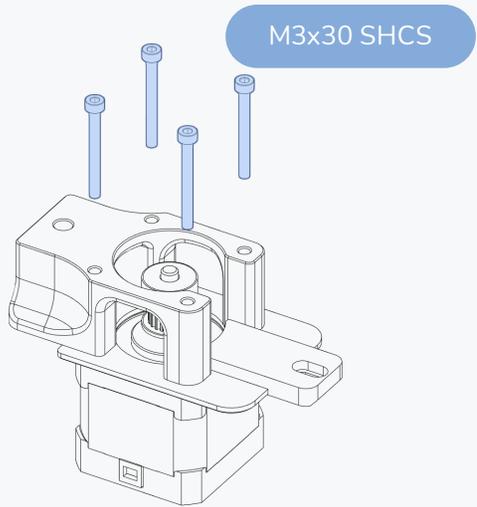
AKA THE ROOT OF ALL ISSUES

Use thread locker on all grub screws after you set their position.

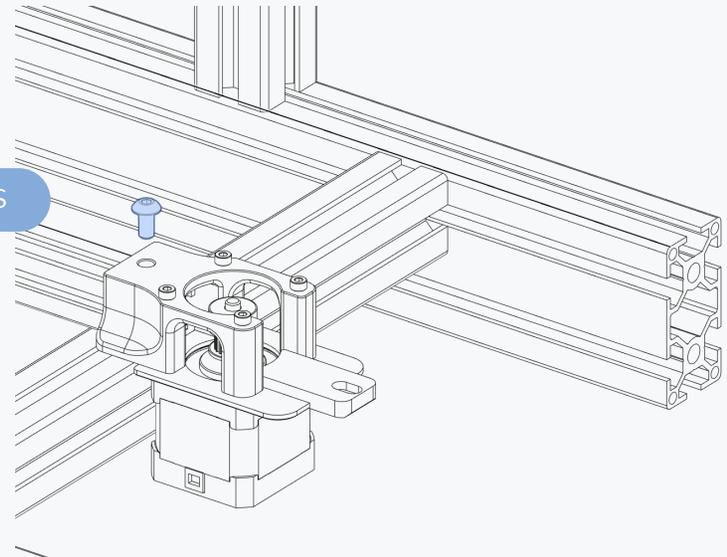
Loose grub screws account for the majority of issues that our users report. Save yourself hours of troubleshooting and apply thread locker to all grub screws during the build.

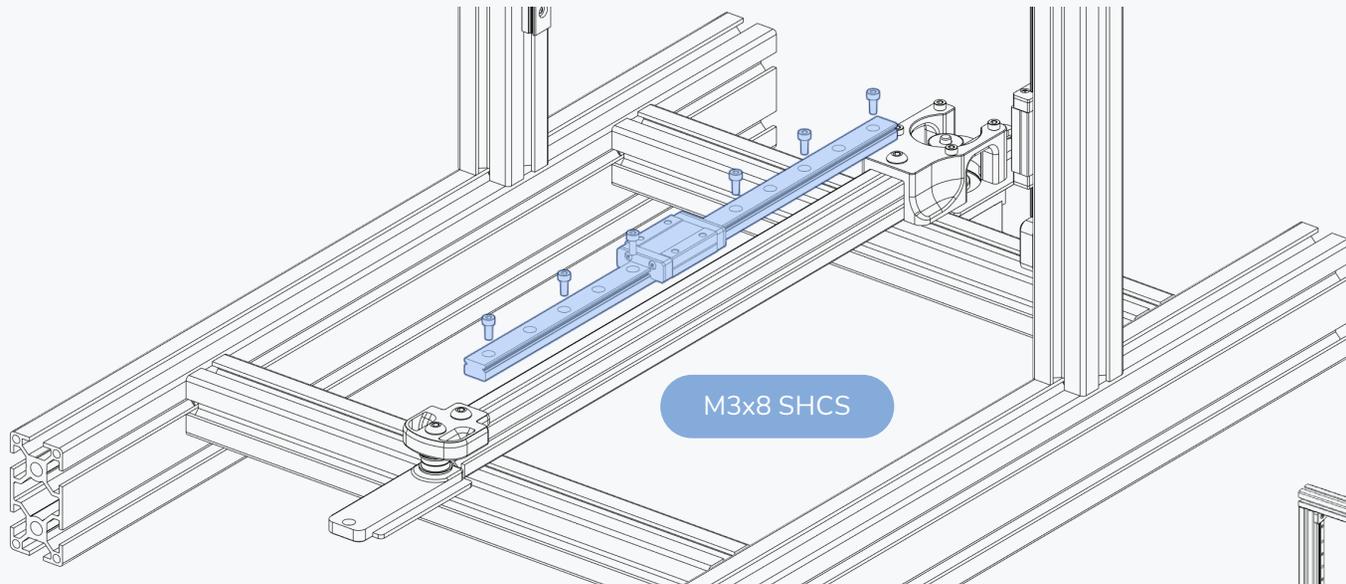
See the products application notes for instructions.

Y MOTOR



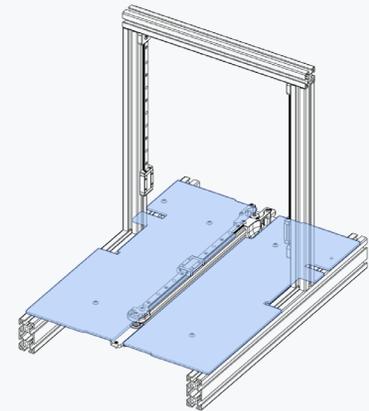
M5x10 BHCS



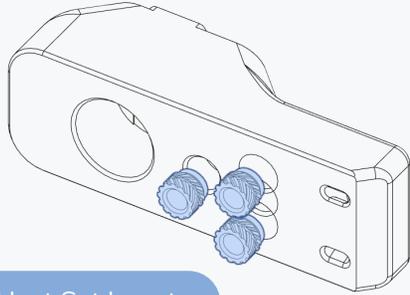


DECK PANELS?!

You can install the deck panels at this point if you like. We didn't show them to make some captures easier.



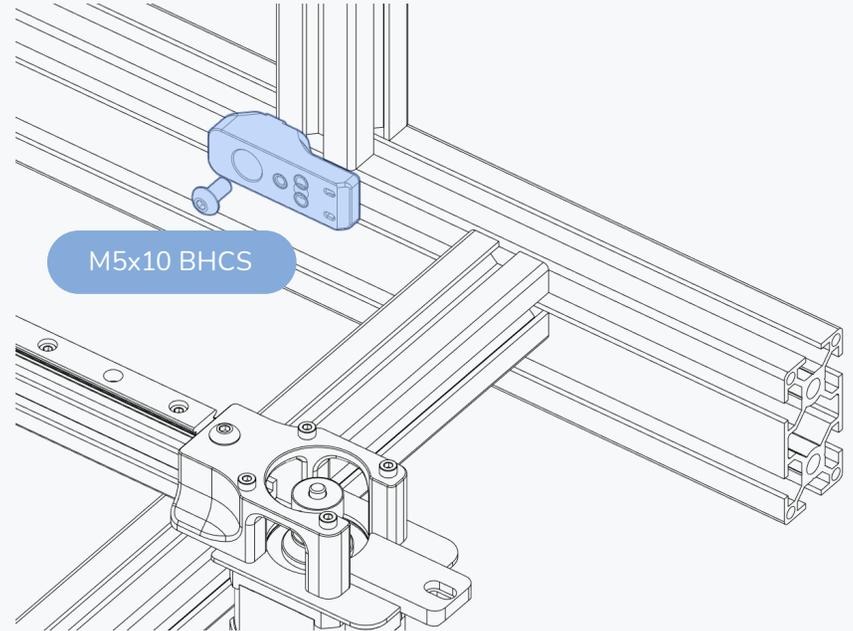
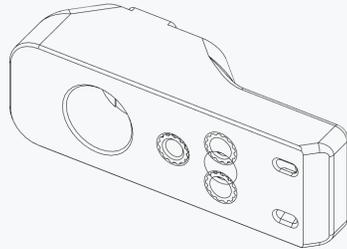
Y CABLE CHAIN MOUNT



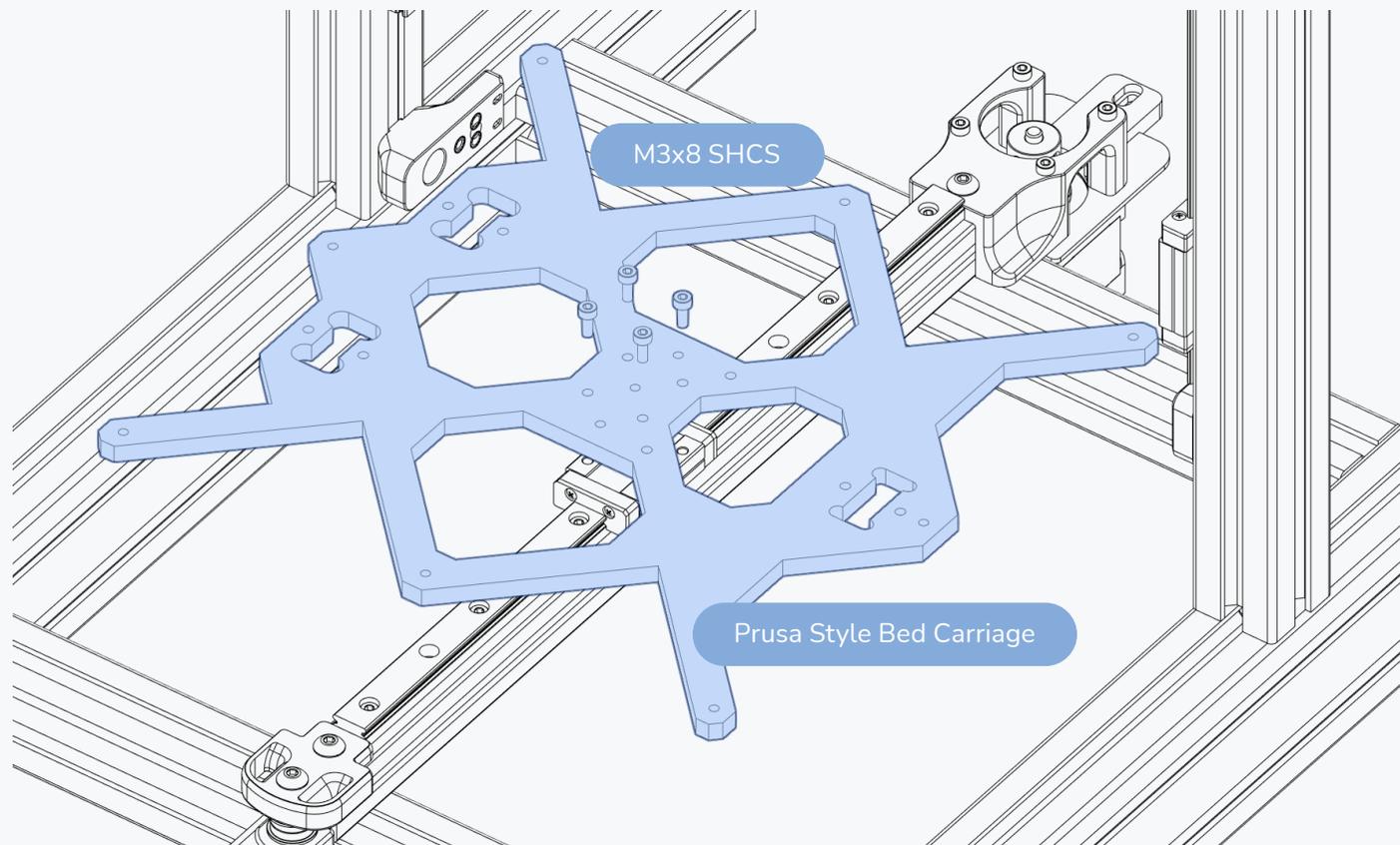
Heat Set Insert

HEAT SET INSERTS

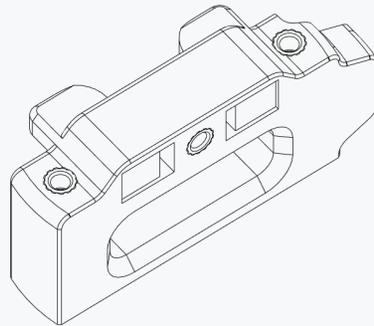
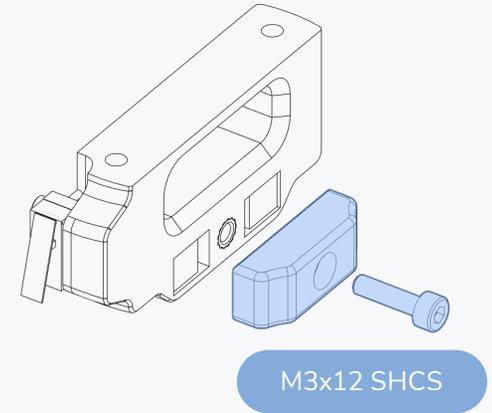
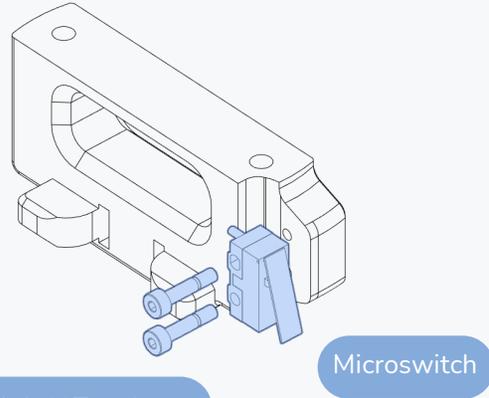
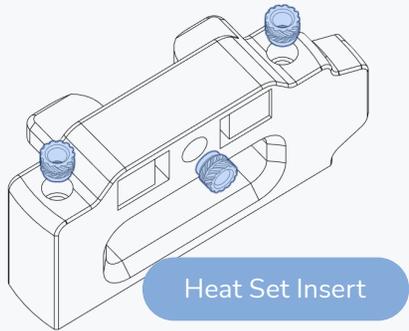
You will need to install heat set inserts into the cable chain mount. If you need help on the correct procedure, ask in Discord.



M5x10 BHCS

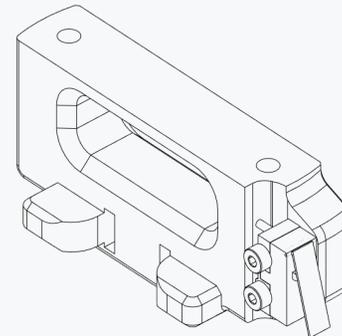


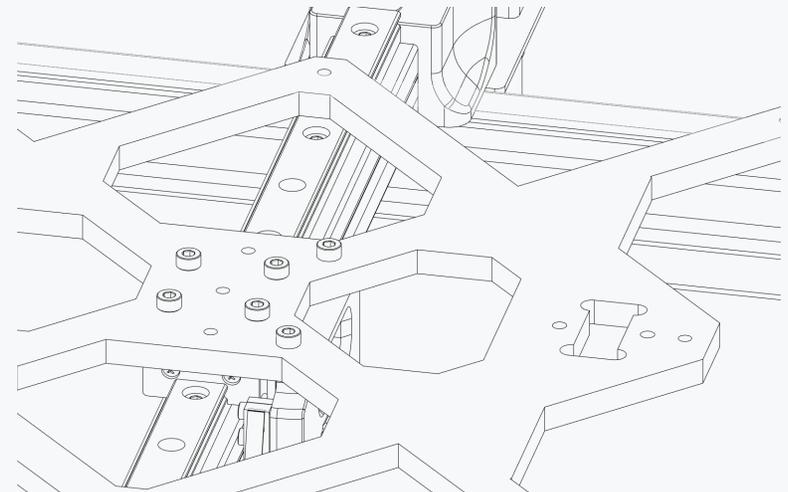
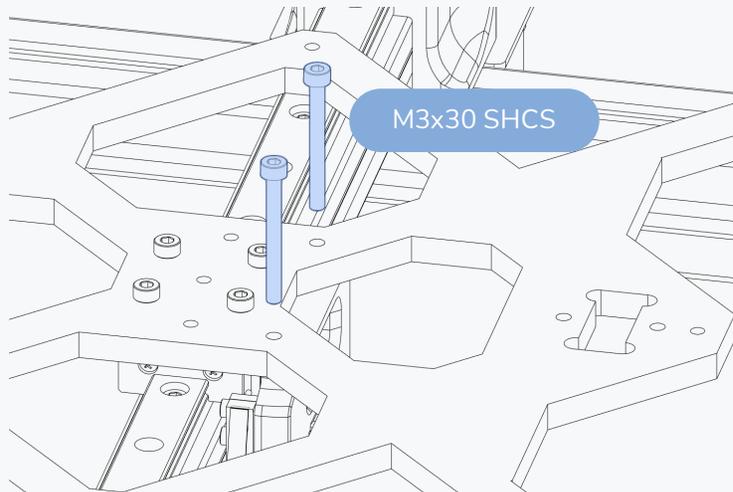
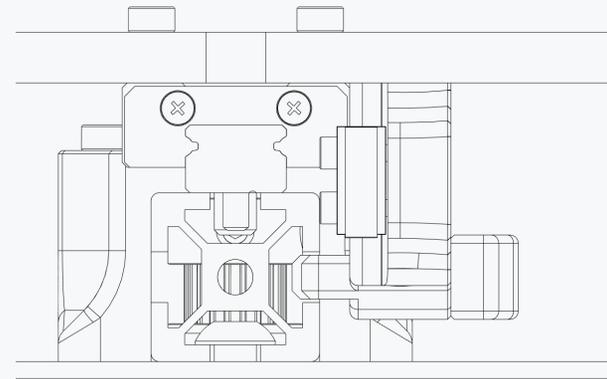
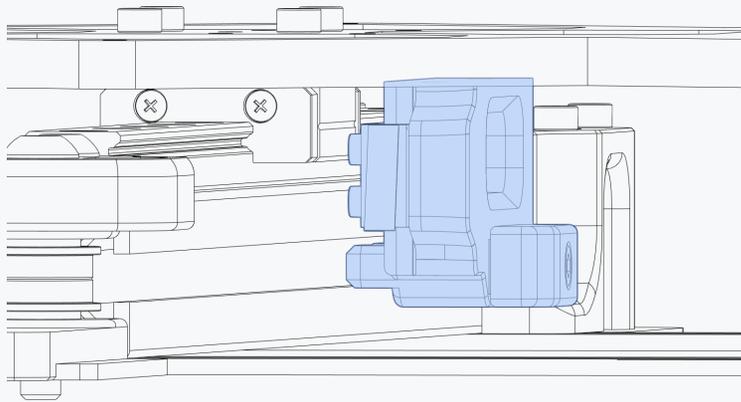
Y BELT HOLDER



SOLDER WIRES

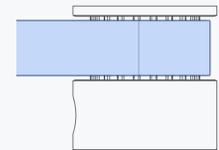
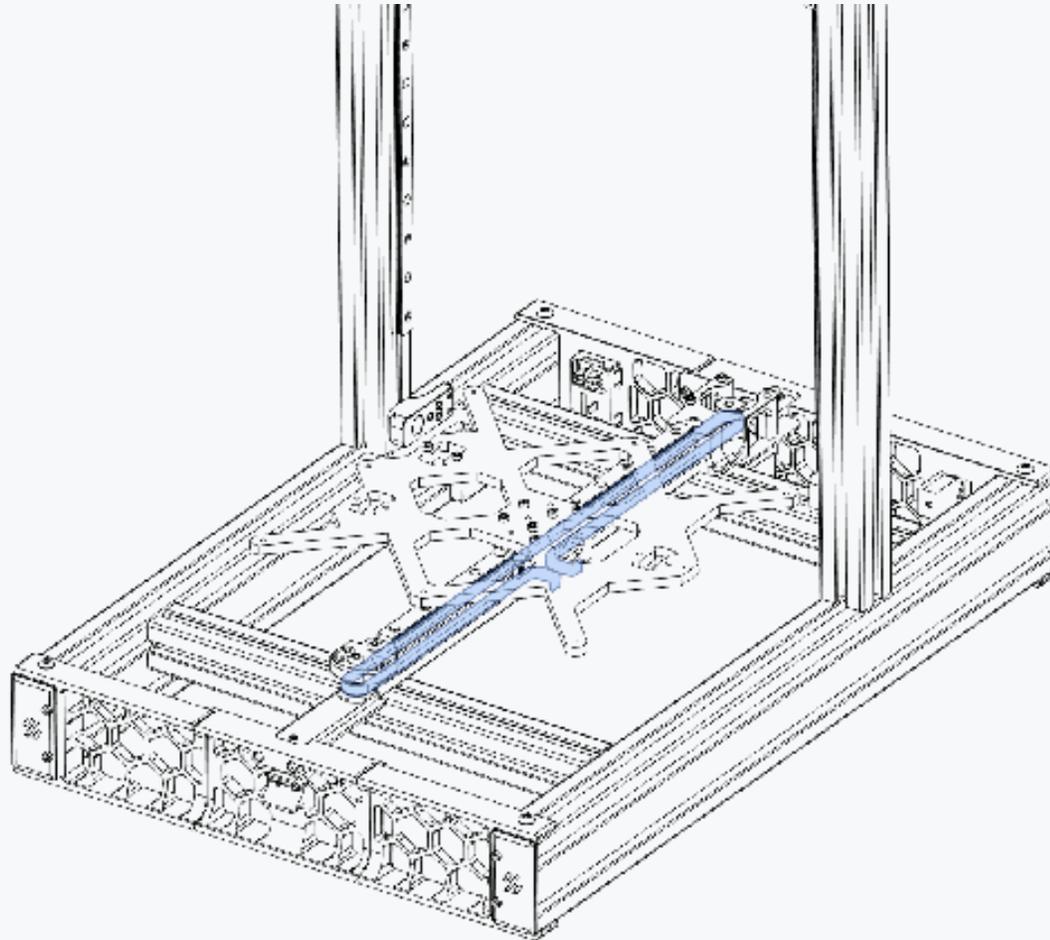
Solder approx. 100mm of wire to the microswitch before installing it. See setup guide for details.





Y BELT PATH

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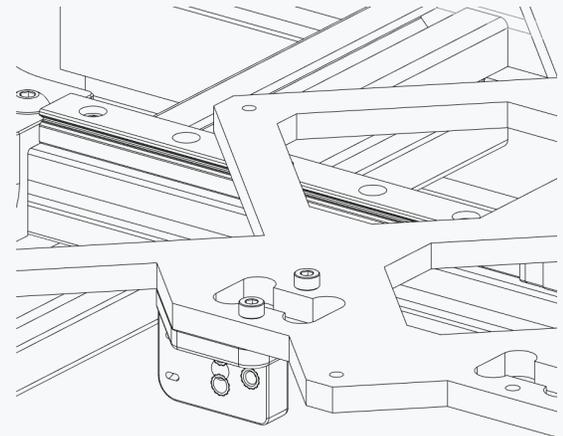
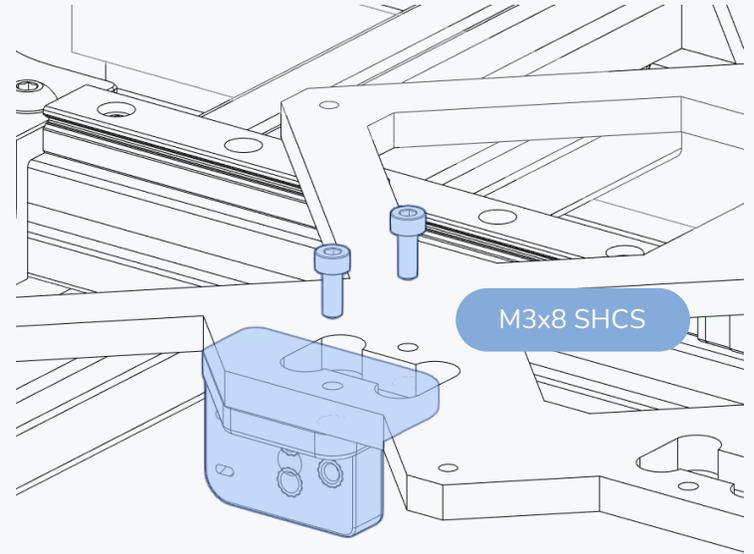
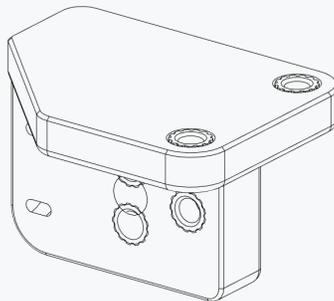
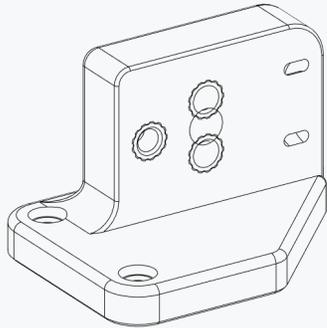
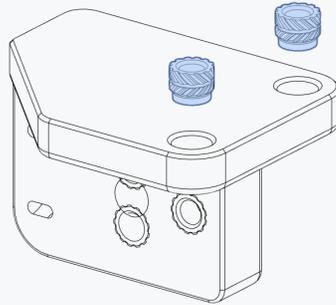
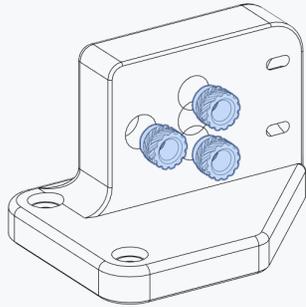


BELT POSITION

Adjust the position of the pulley if required. Heavy contact with the flanges will introduce artifacts into your prints.

Y CABLE CHAIN

Heat Set Insert



HOLE PATTERN

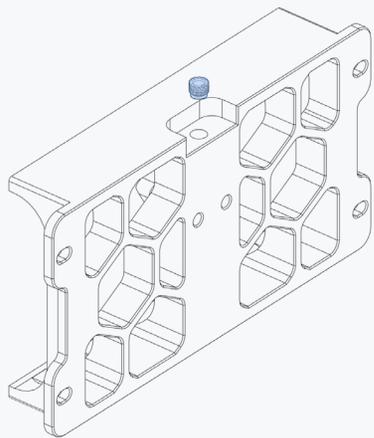
Cable chains with a variety of mounting hole pattern. We offer mounts for both the in line pattern found on IGUS chains and the triangle pattern on budget chains.

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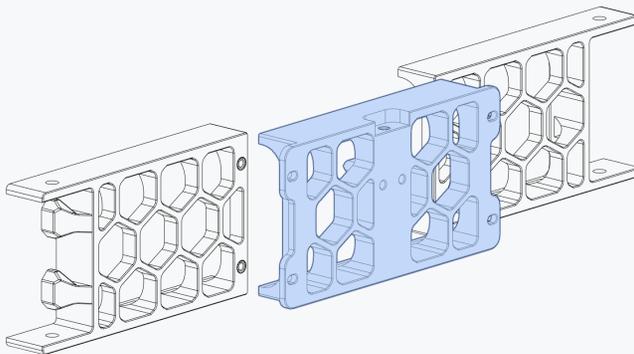
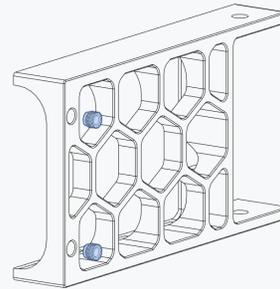
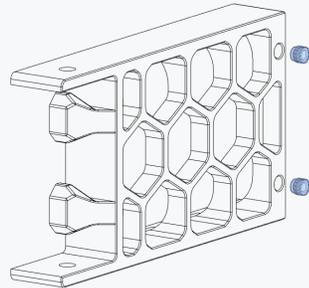


FRONT SKIRTS

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Heat Set Insert



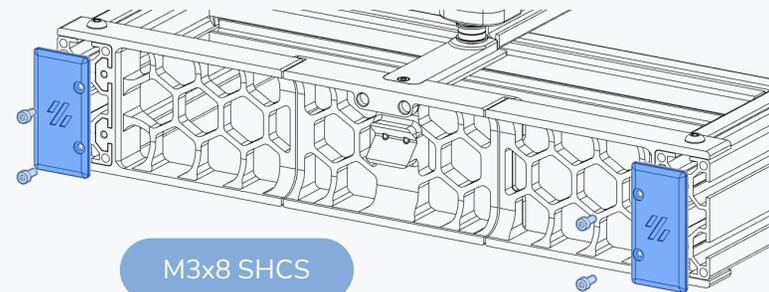
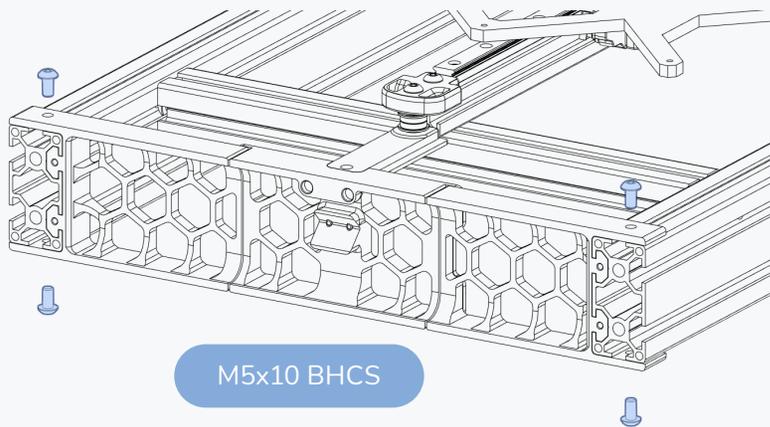
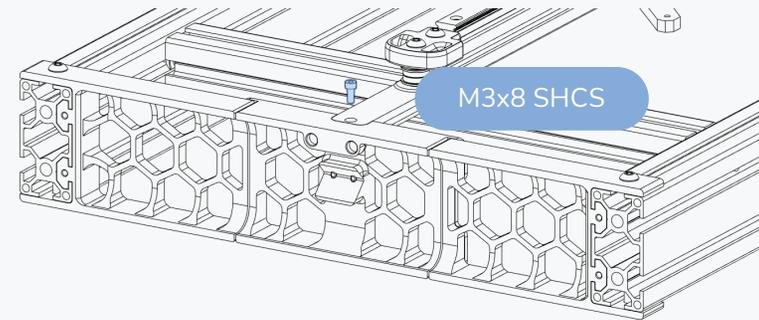
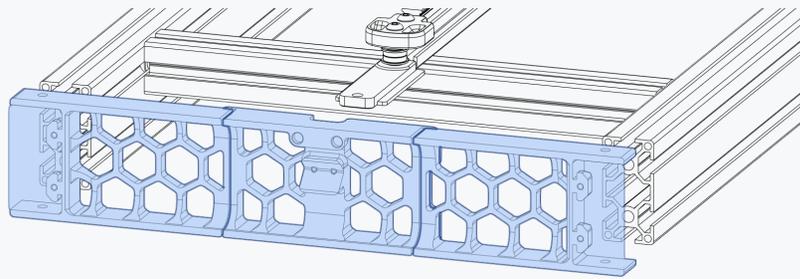
M3x8 SHCS



DON'T TIGHTEN

Leave the screws slightly loose
for the next step.

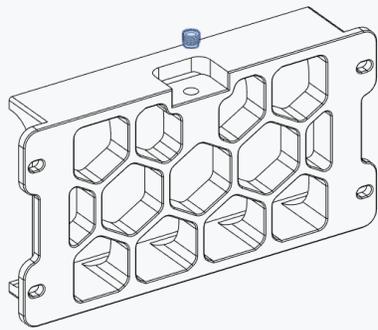
FRONT SKIRT



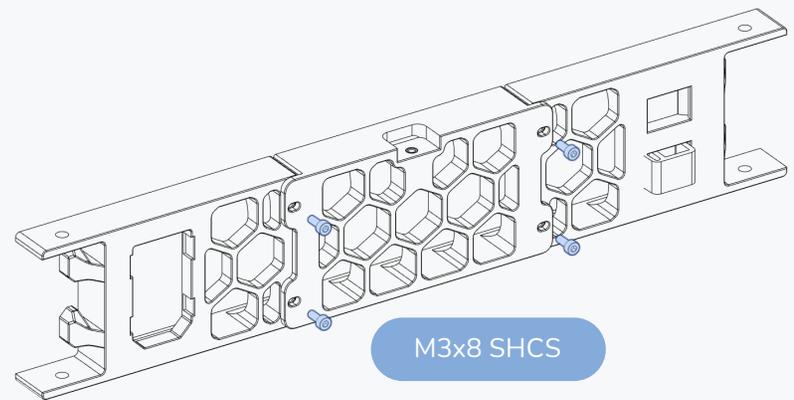
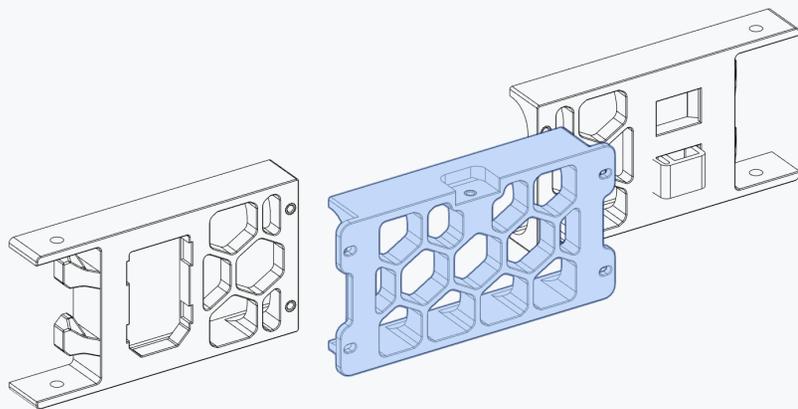
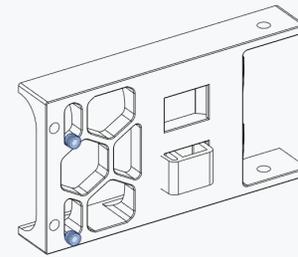
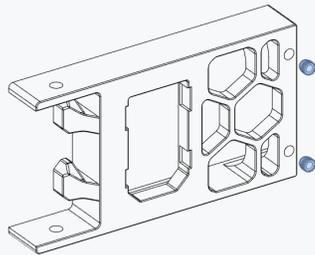
TIGHTEN SCREWS

Tighten the screws that connect the centre piece once installed on the frame.

BACK SKIRT



Heat Set Insert

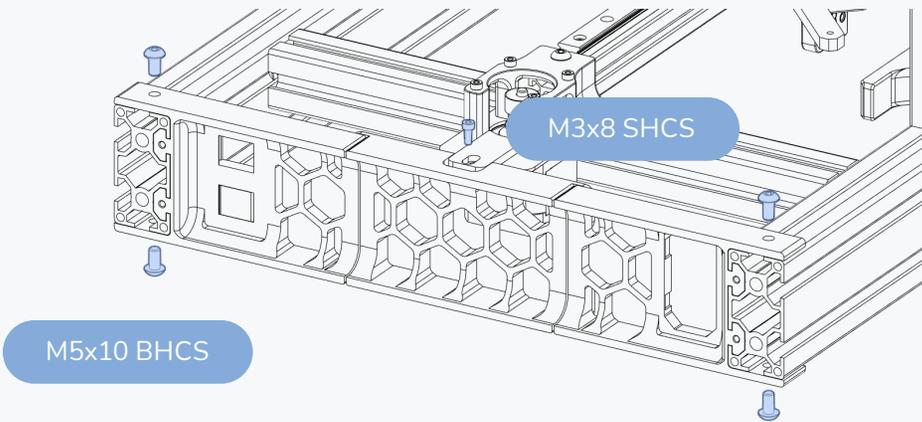
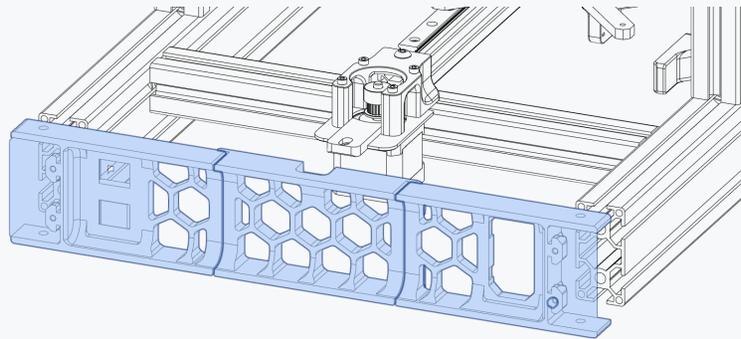


M3x8 SHCS

DON'T TIGHTEN

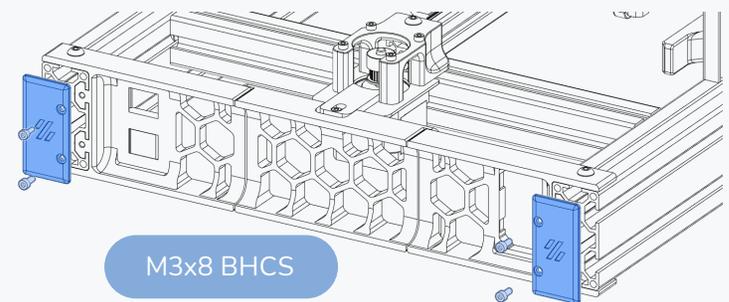
Leave the screws slightly loose for the next step.

BACK SKIRT



TIGHTEN SCREWS

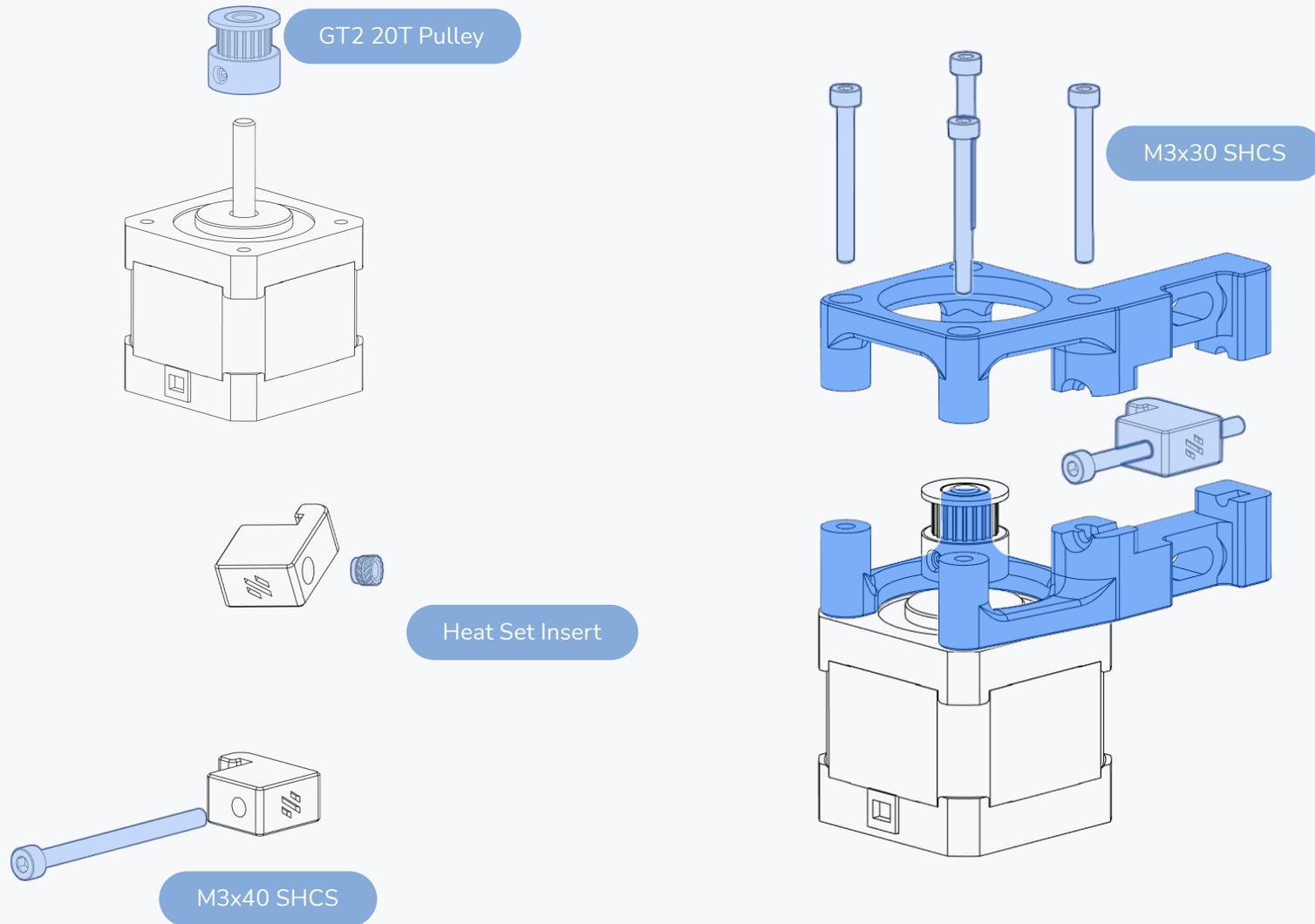
Tighten the screws that connect the centre piece once installed on the frame.



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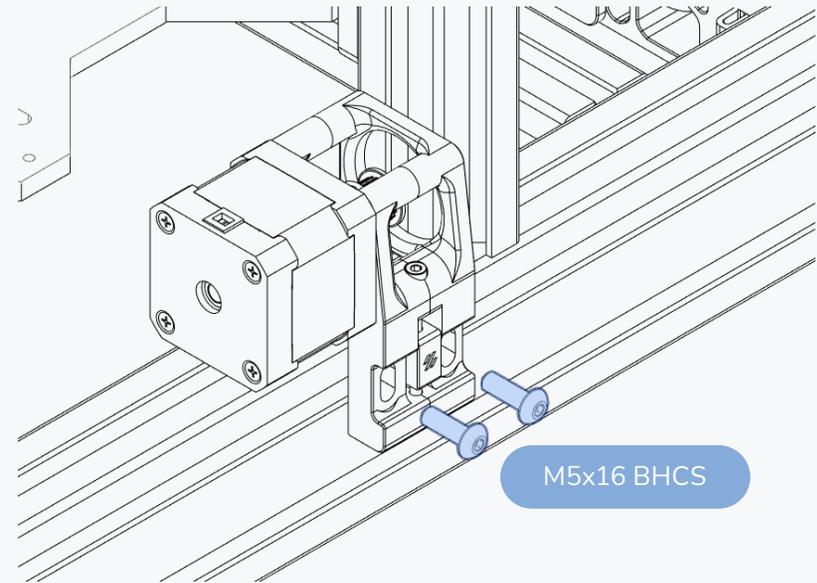
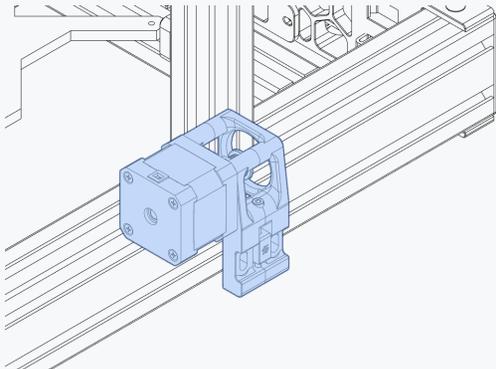
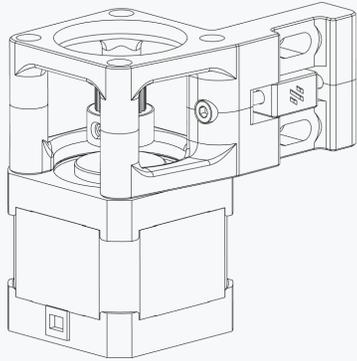


"Z" MOTOR MOUNT



"Z" MOTOR MOUNT

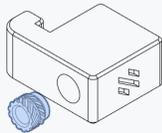
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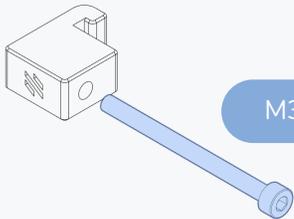
"X" MOTOR MOUNT



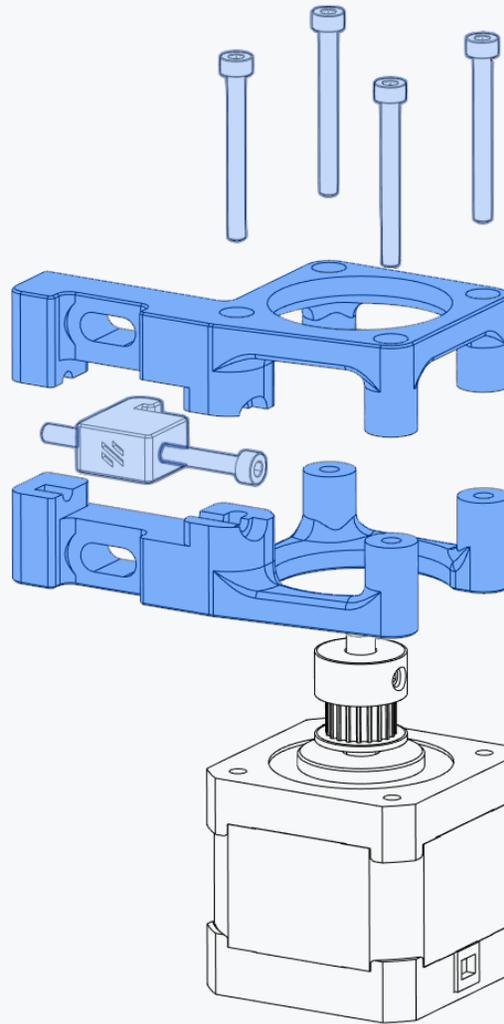
GT2 20T Pulley



Heat Set Insert



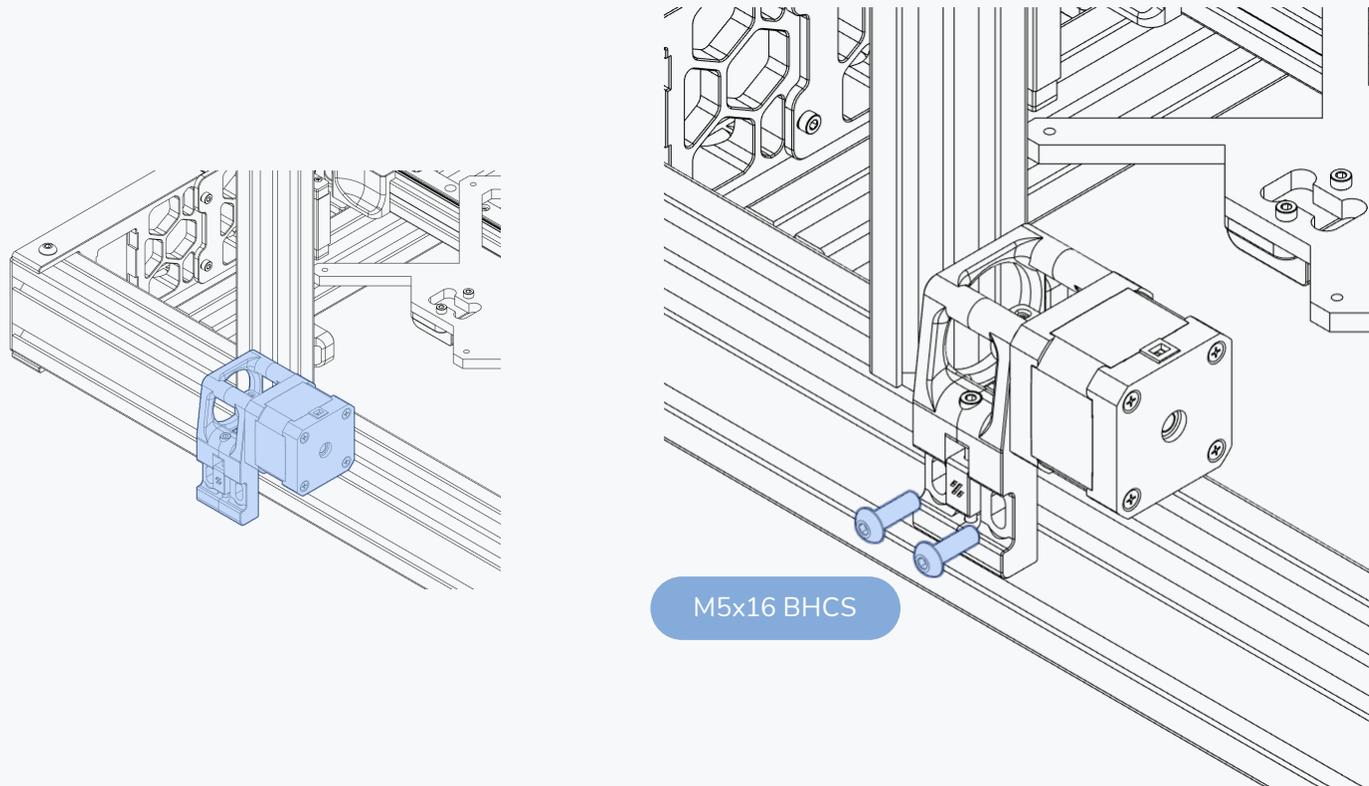
M3x40 SHCS



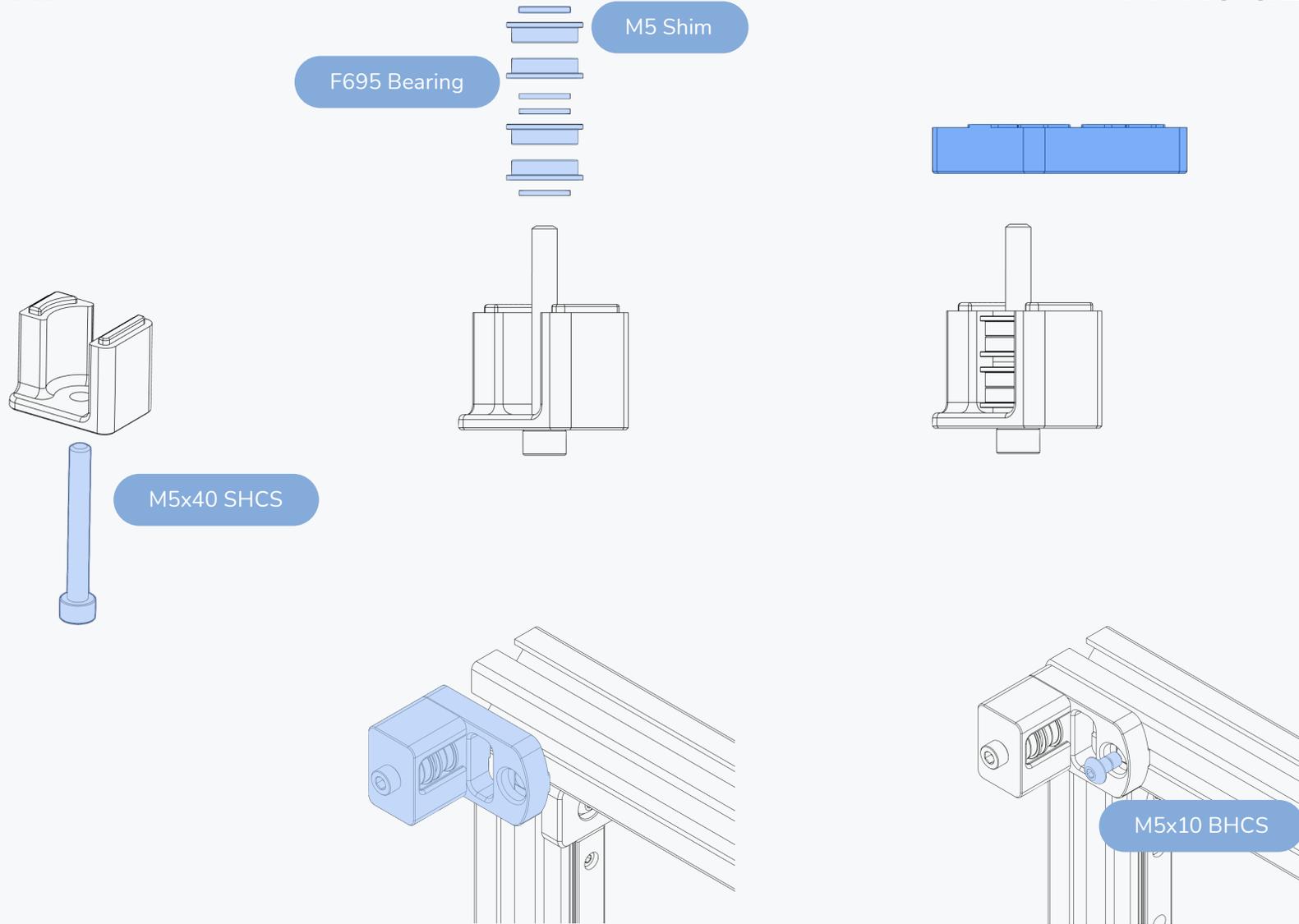
M3x30 SHCS

"X" MOTOR MOUNT

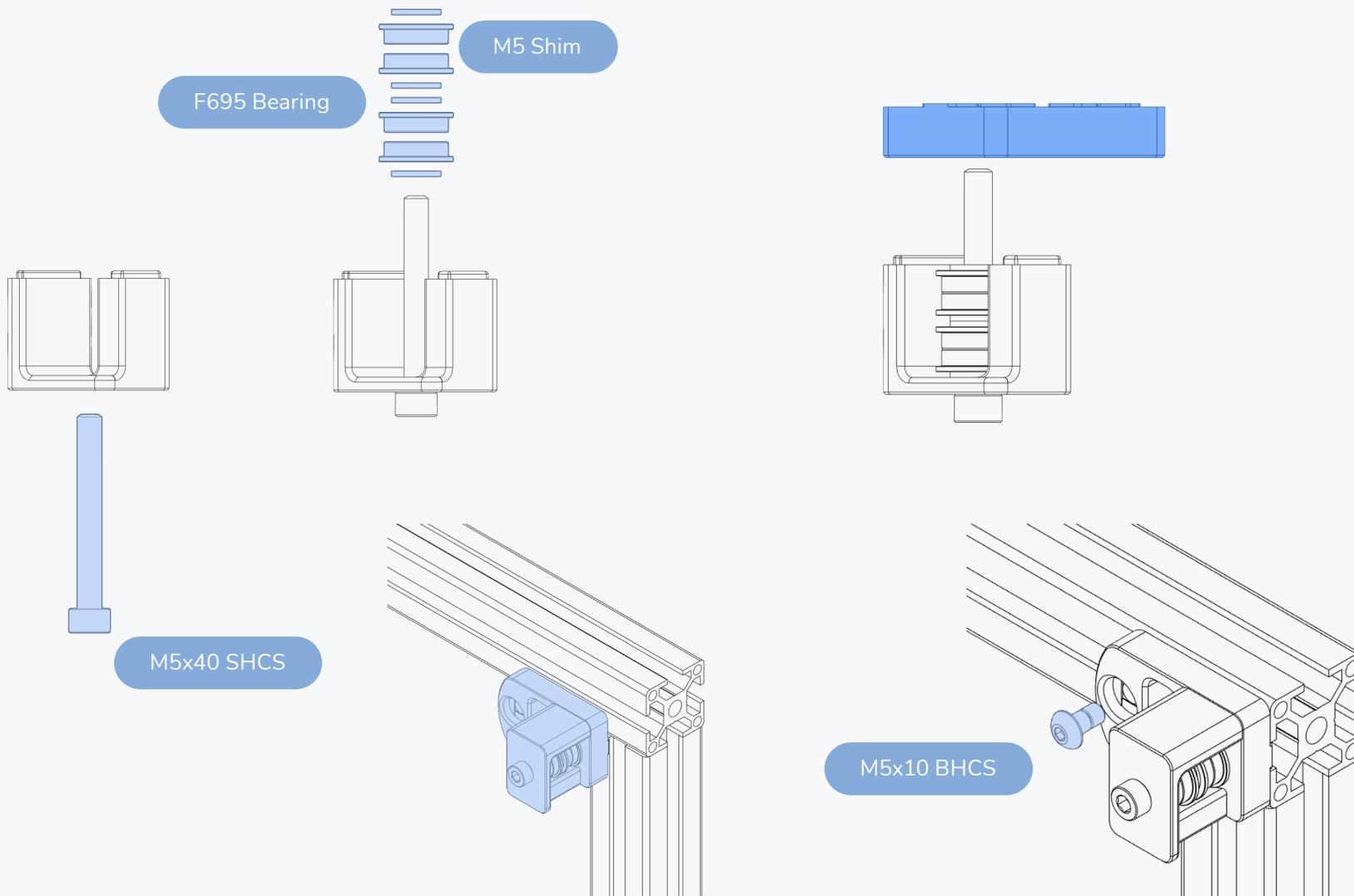
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LEFT IDLER

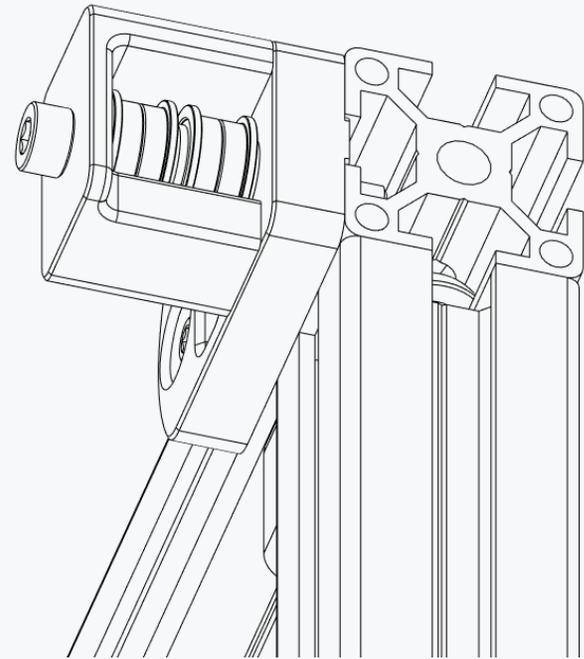
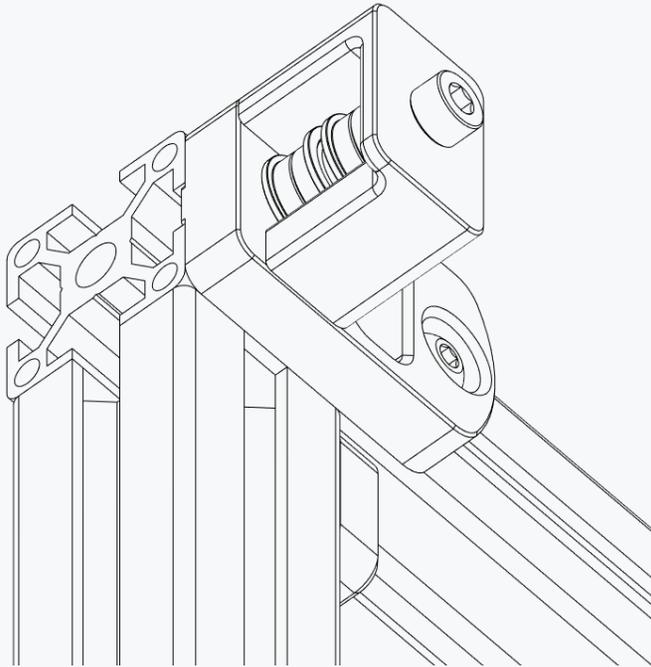


RIGHT IDLER



CHECK ORIENTATION

Make sure the cut-out is facing down.



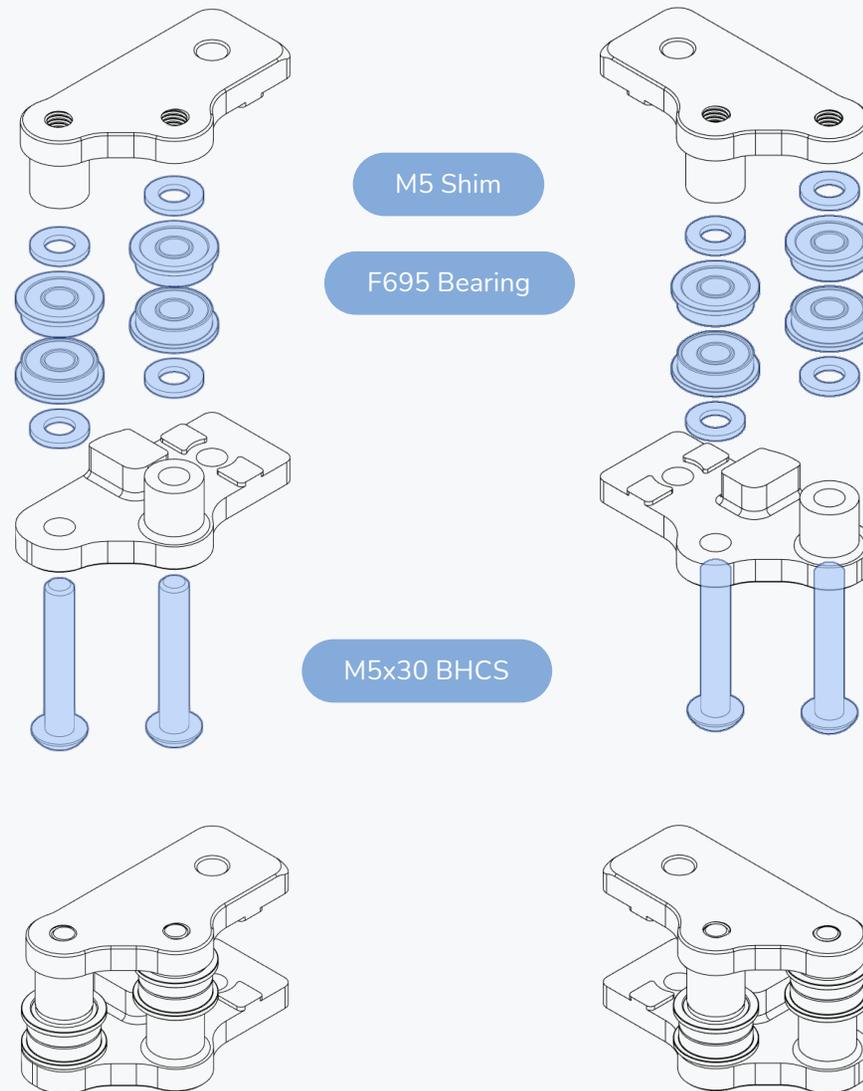
XZ BLOCKS

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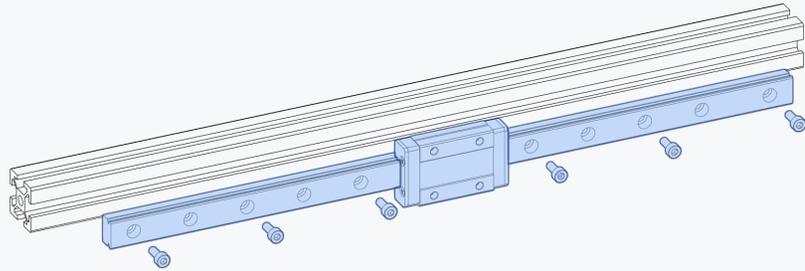
UPSIDE DOWN ASSEMBLY

We'll flip these components a few times.

Pay attention to their final orientation

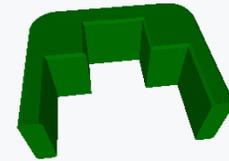


X AXIS



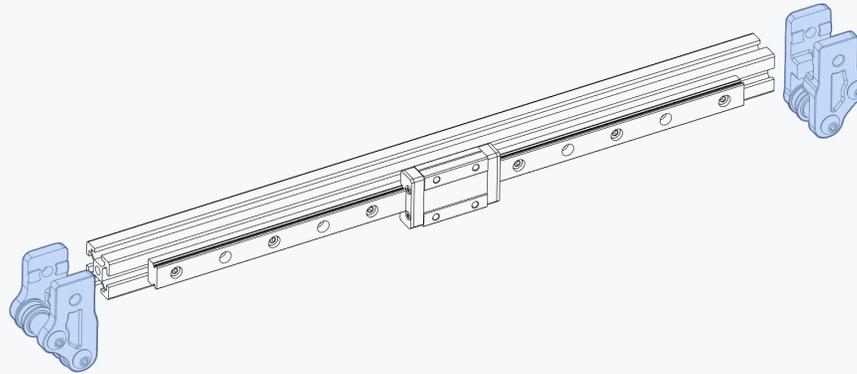
M3x8 SHCS

MGN12 Linear Rail

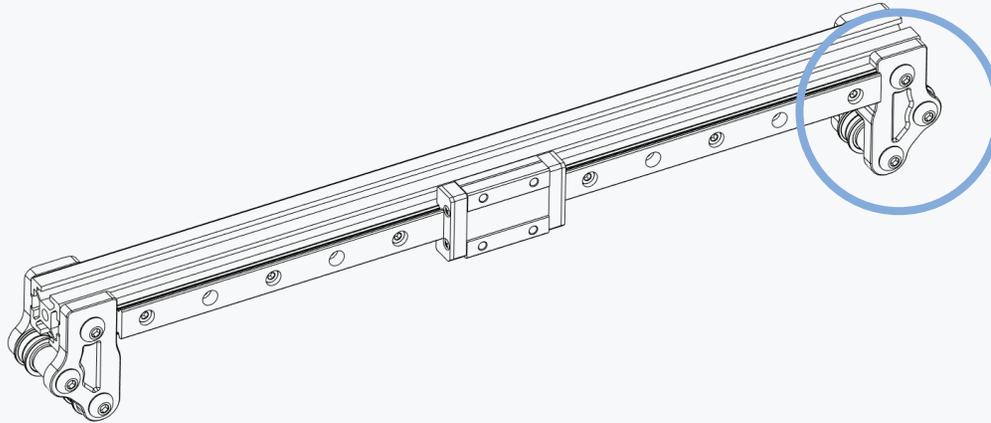


CENTERED RAIL INSTALLATION GUIDE

Use the guides to position the rail in the center of the extrusion prior to fastening the screws.



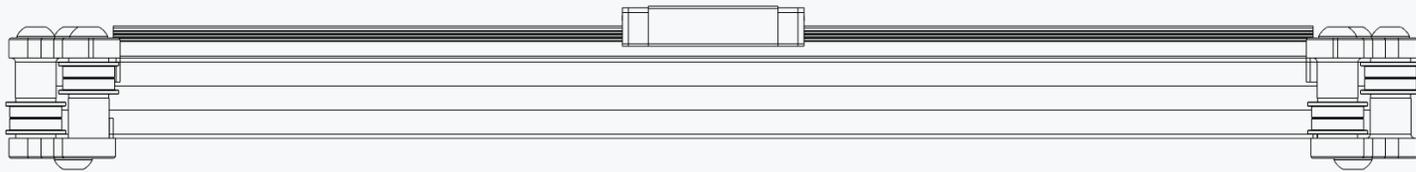
M5x10 BHCS



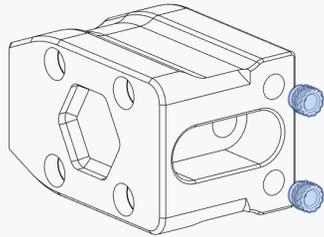
CHECK ORIENTATION

Make sure the XZ joints are oriented correctly. The relieved/cutout section points towards the front.

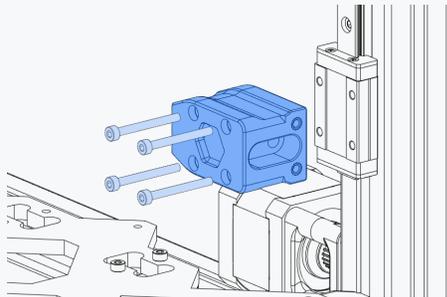
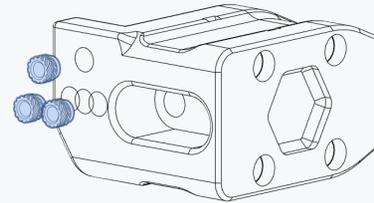
The idlers towards the bottom.



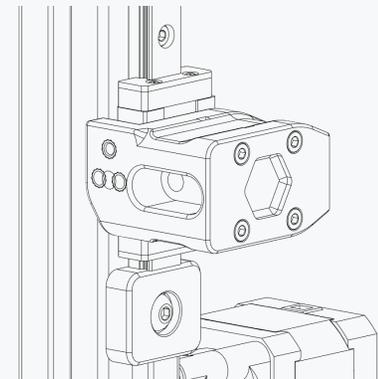
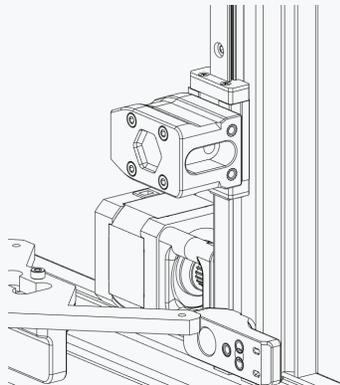
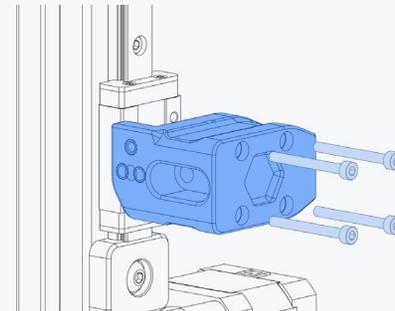
Z BEARING BLOCK

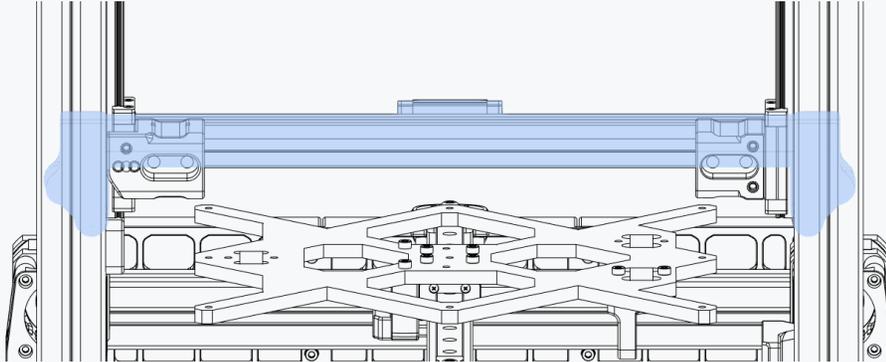


Heat Set Insert



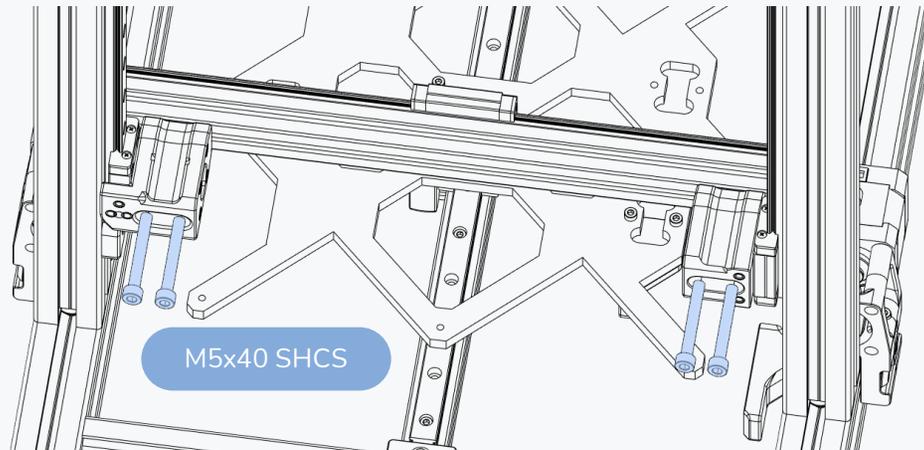
M3x30 SHCS





X AXIS INSTALLATION

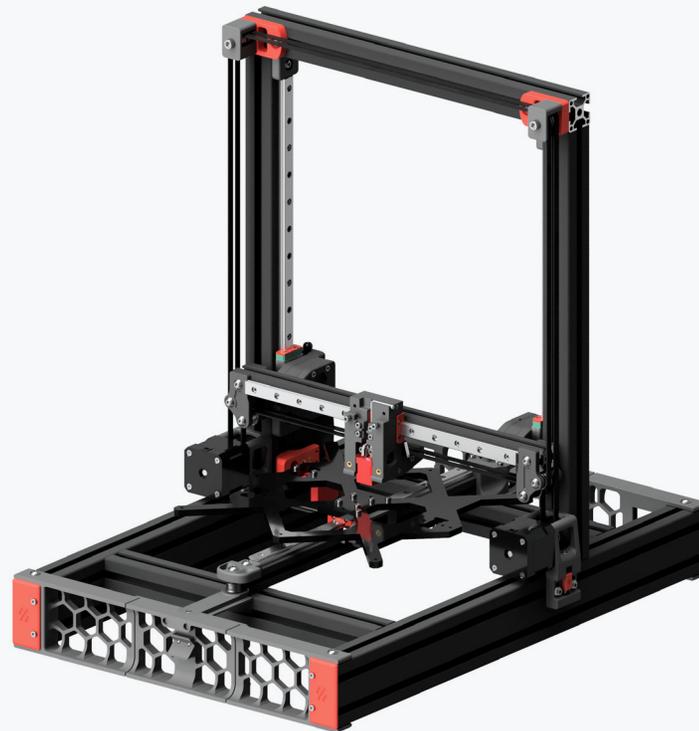
Lightly tighten the M5x40 screws and align the X axis horizontally by moving it all the way to the top. Hold the X axis against the stoppers and fully tighten the screws. Move the axis up and down and check for binding.



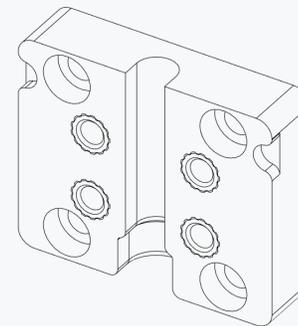
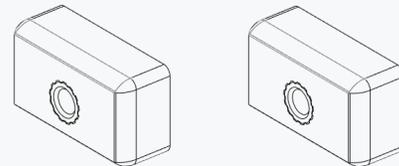
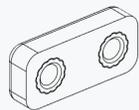
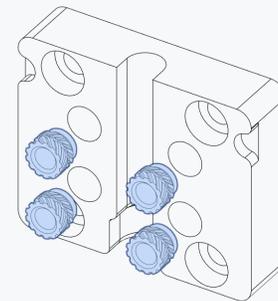
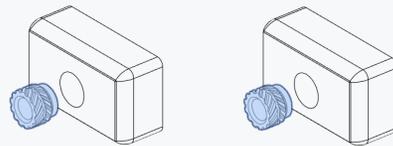
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X CARRIAGE

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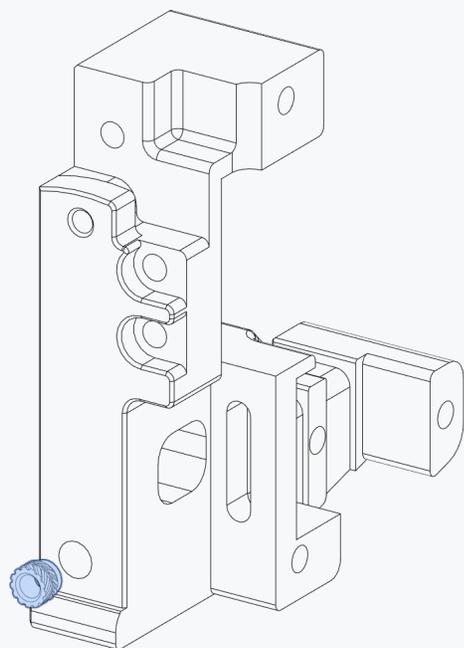


Heat Set Insert

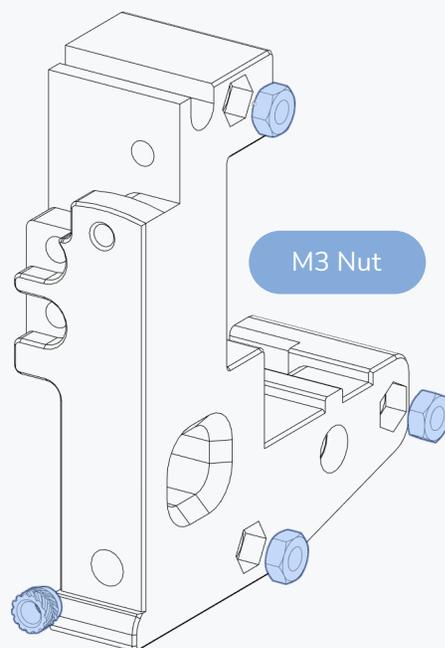


X CARRIAGE

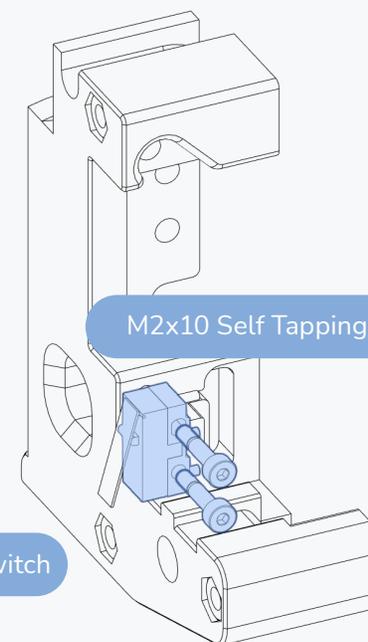
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Heat Set Insert



M3 Nut



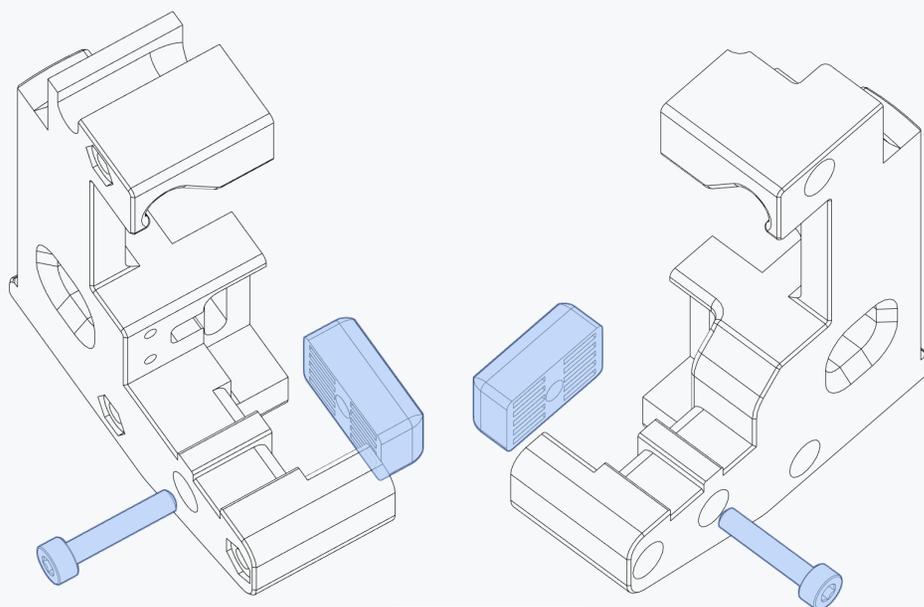
M2x10 Self Tapping

Microswitch

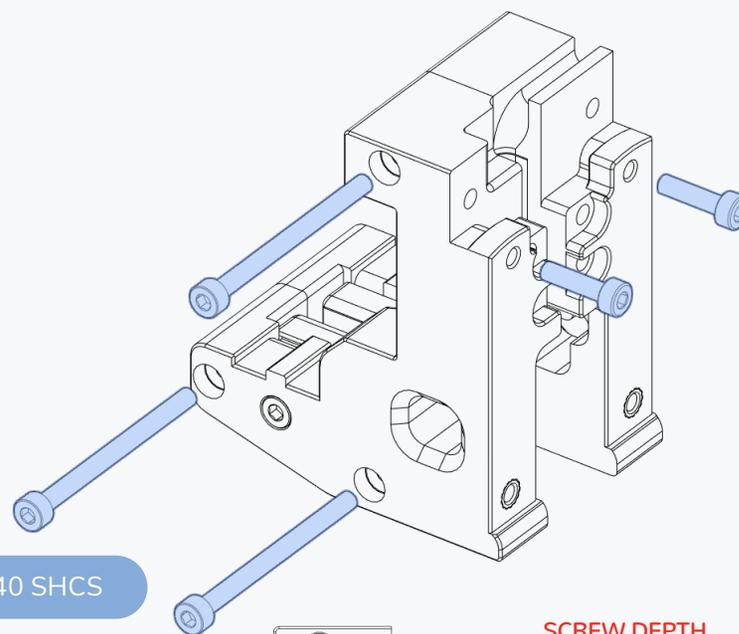
SOLDER WIRES NOW

Solder approx. 150mm of wire to the microswitch before installing it.

See setup guide for details.

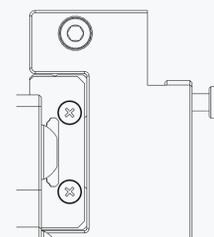


M3x16 SHCS



M3x40 SHCS

M3x12 SHCS



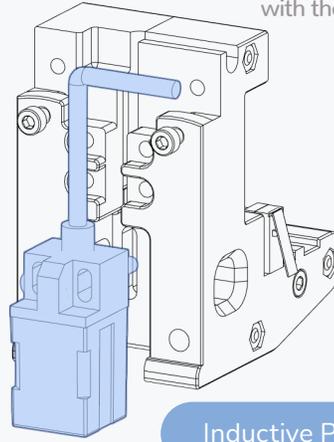
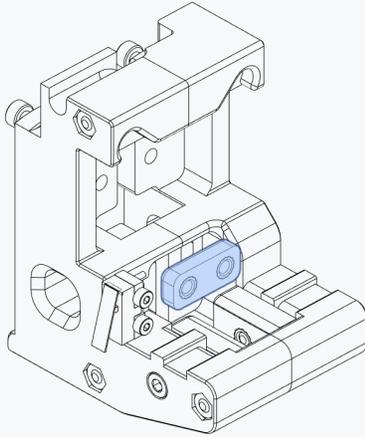
SCREW DEPTH
Don't tighten the screws all the way. Leave 3-4mm of exposed thread.

X CARRIAGE

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PROBE WIRES

Cut the probes wires to about 15cm. Don't cut them flush with the carriage frame.



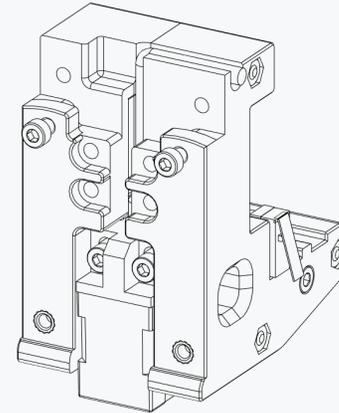
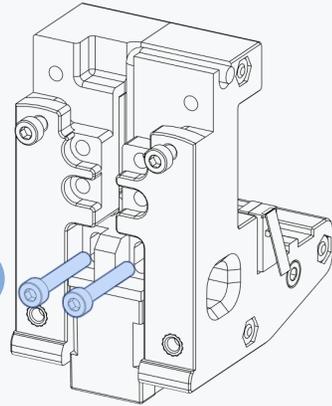
Inductive Probe

OTHER PROBE TYPES

The picture shows a PL-08 probe. The recommended Omron TL-Q5MC probe will fit in the same space but require M3x25 SHCS.

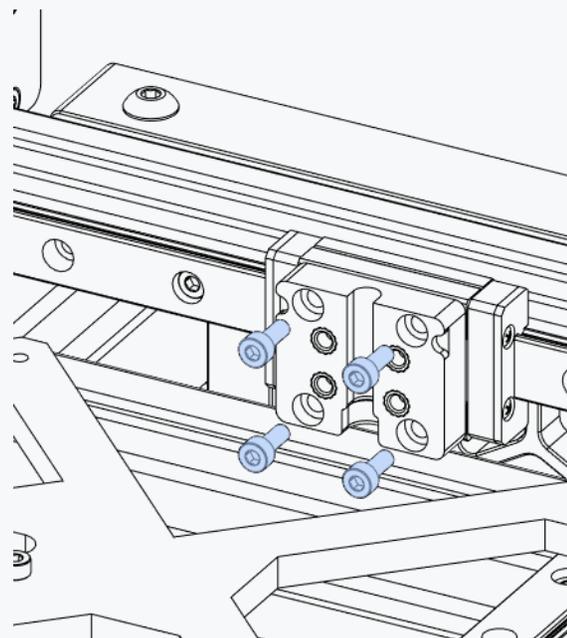
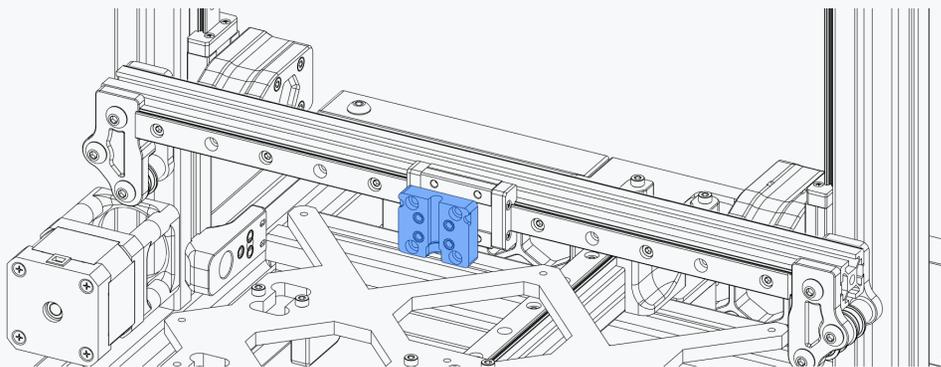
Other probes with a similar form factor and characteristics might work as well.

M3x20 SHCS



X CARRIAGE PLATE

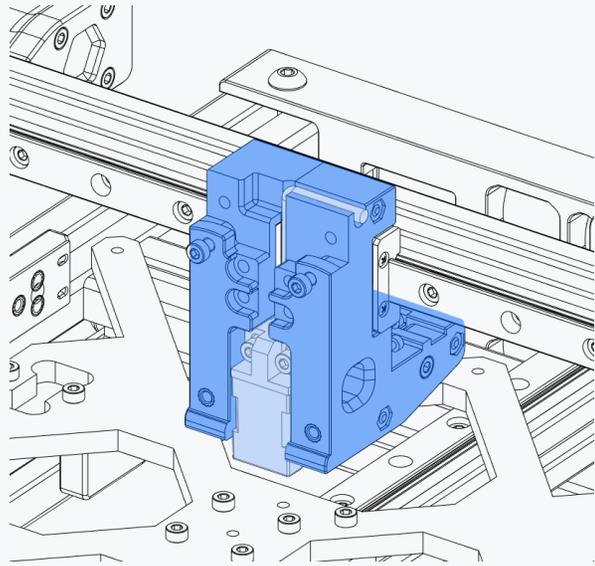
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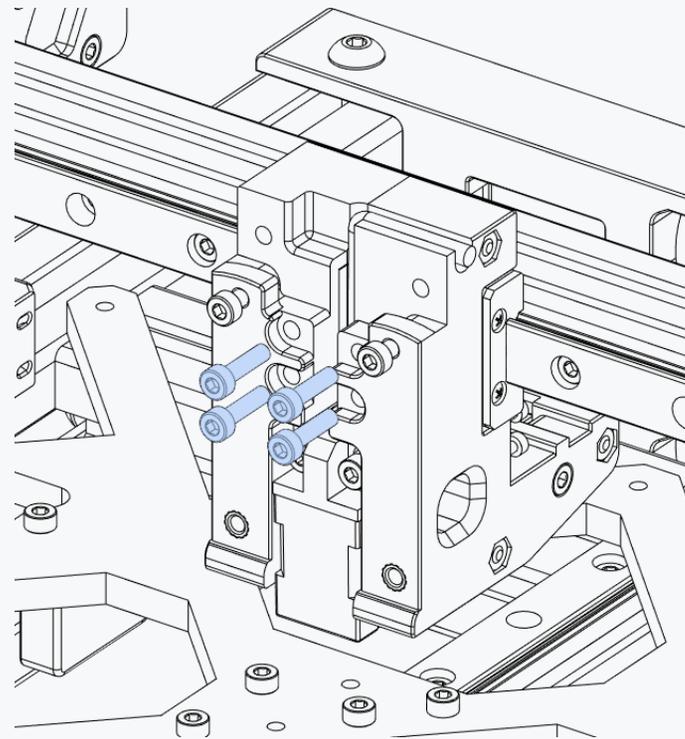
M3x8 SHCS

X CARRIAGE

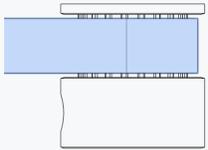
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M3x12 SHCS

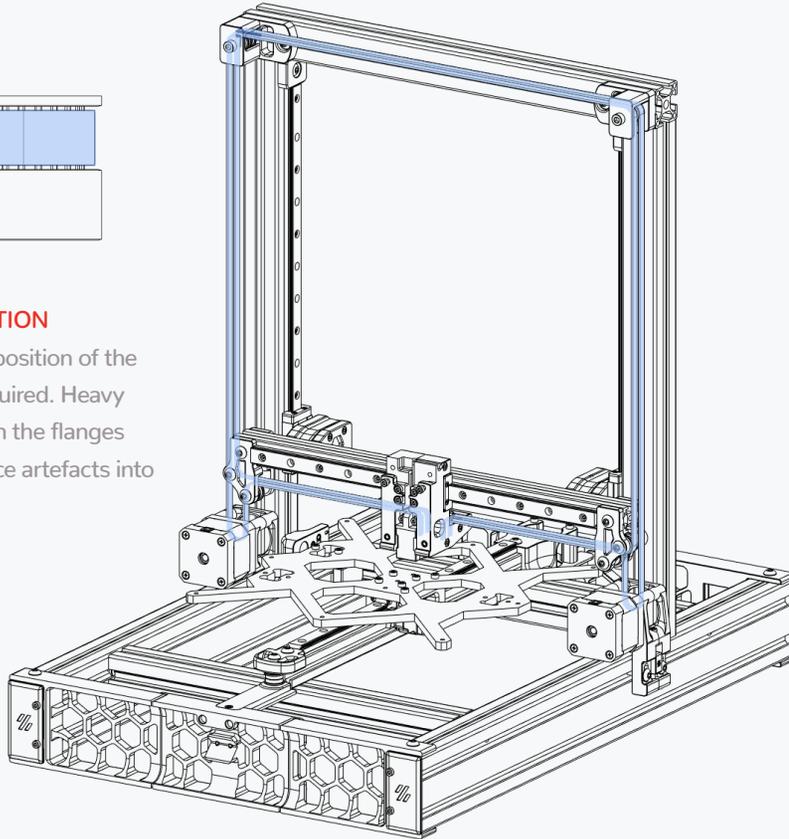


BELT PATH



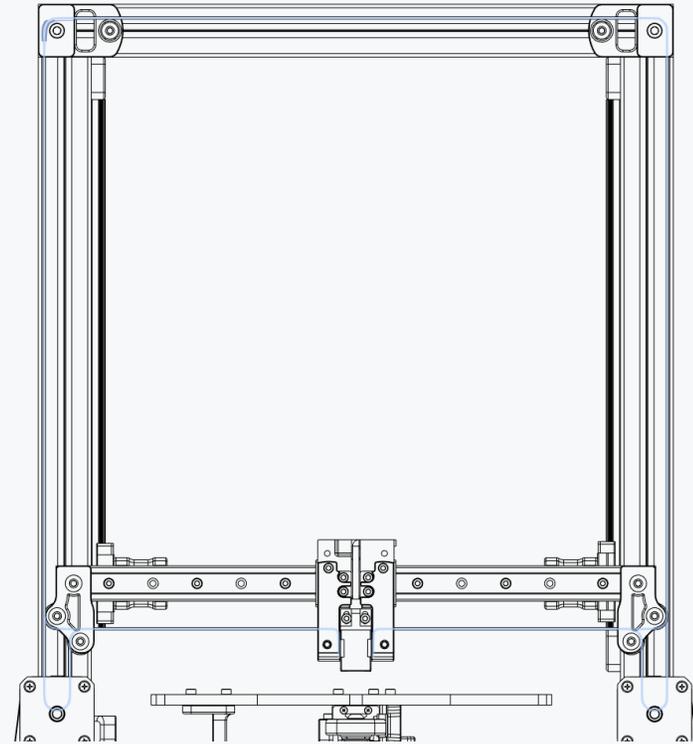
BELT POSITION

Adjust the position of the pulley if required. Heavy contact with the flanges will introduce artefacts into your prints.

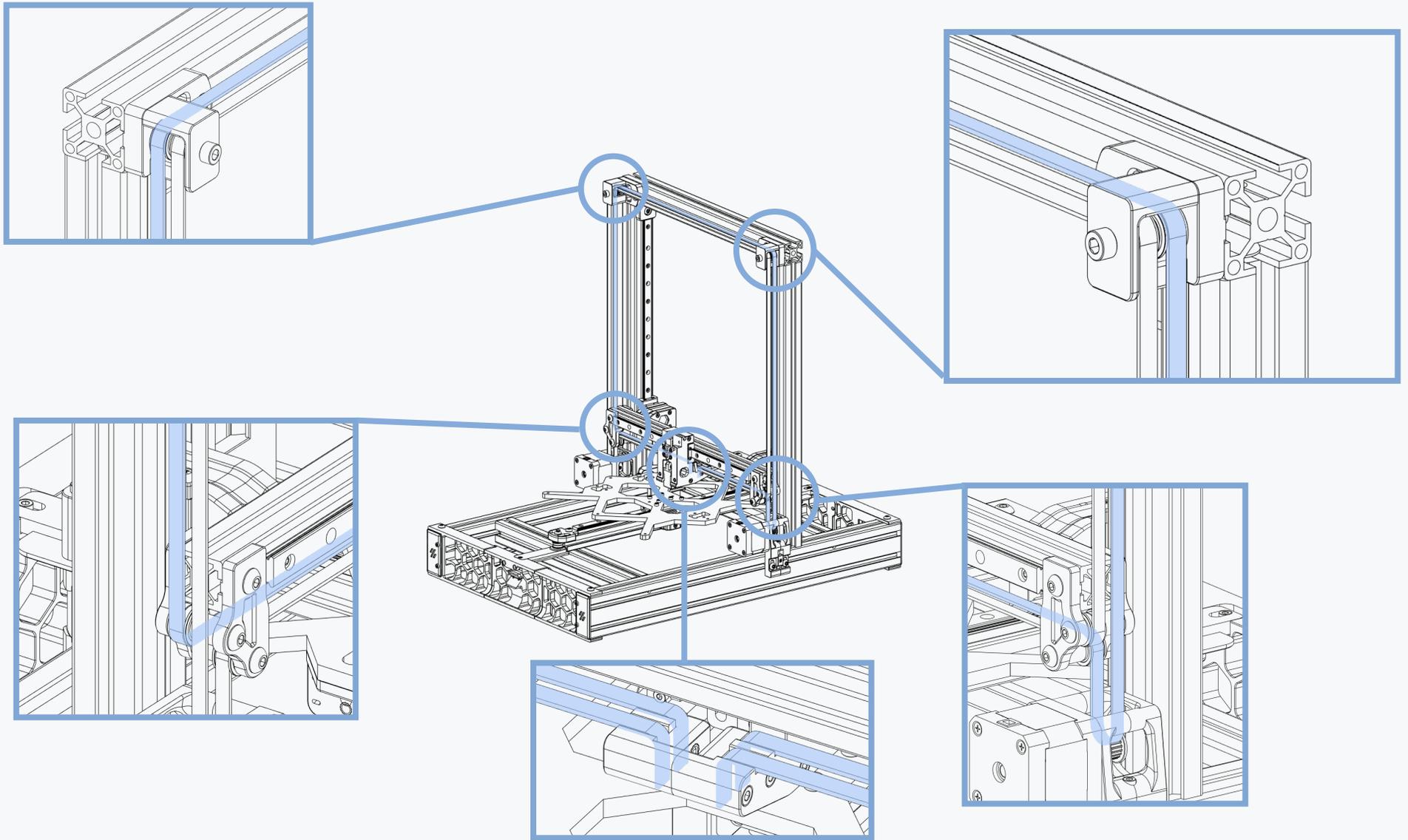


BELT PATH

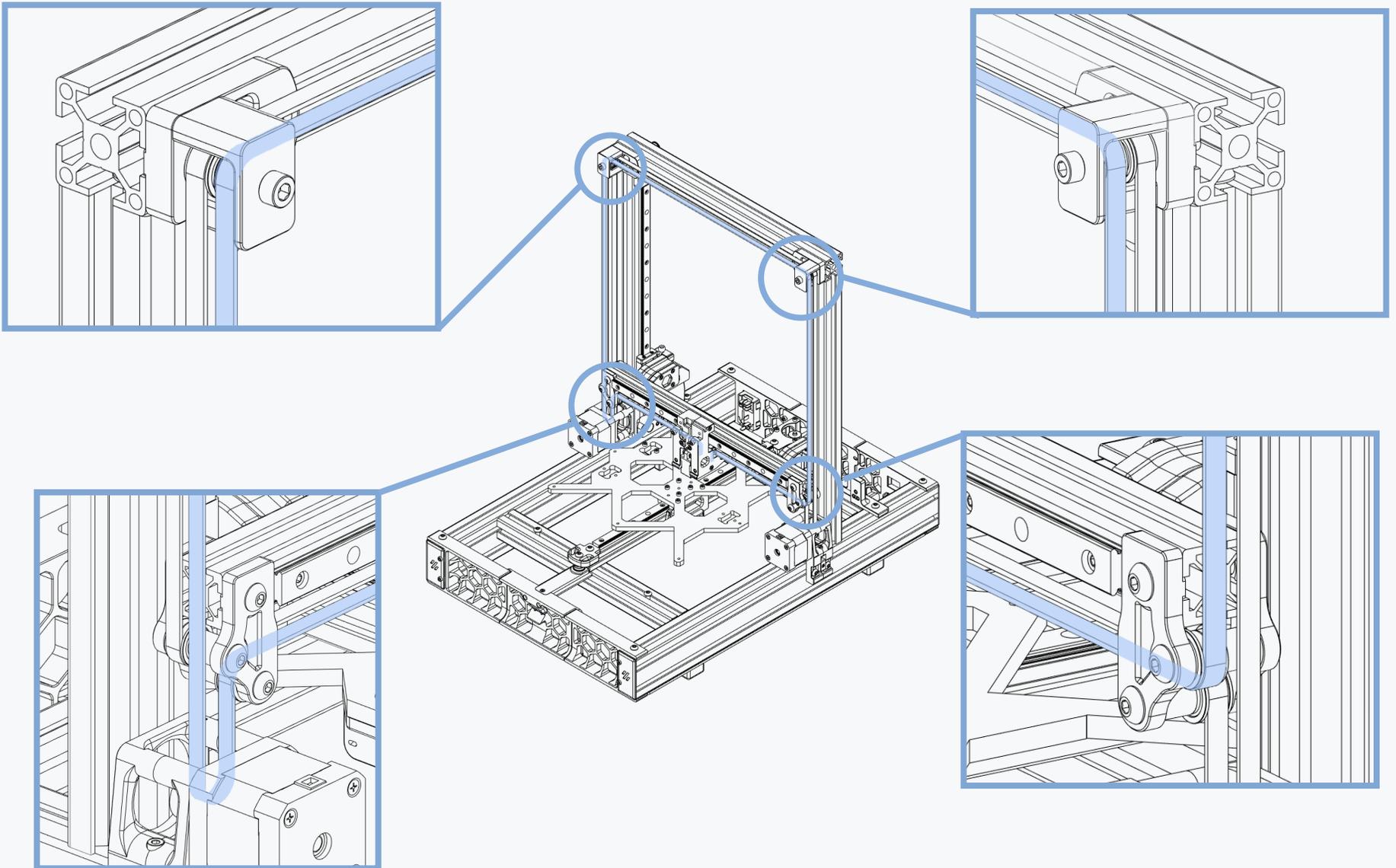
Take your time and make sure your belt routing is as intended. Belts should never rub on plastic parts.



"Z" BELT

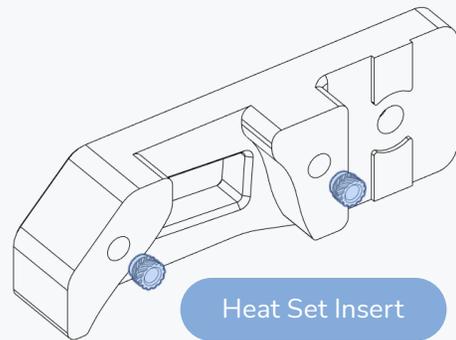


"X" BELT



COUNTERWEIGHT MOUNT

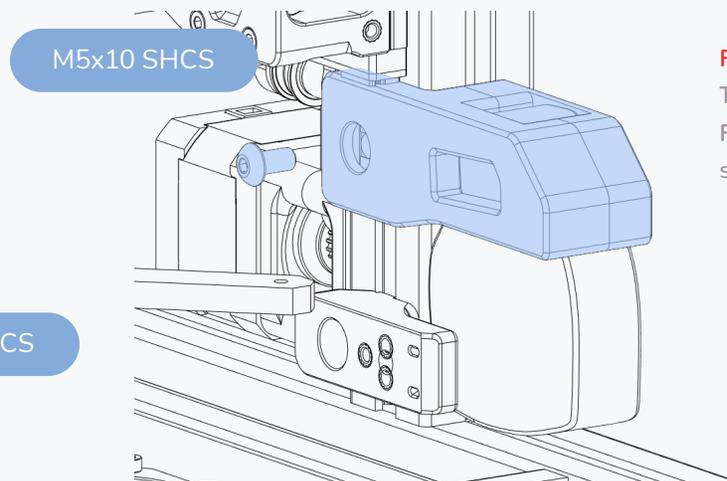
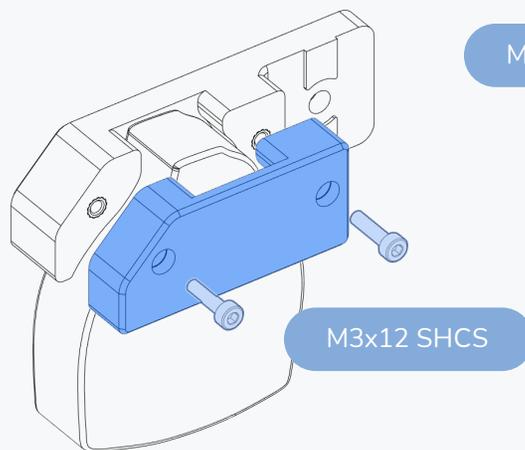
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WEAR EYE PROTECTION

The Key-Bak will violently retract if you lose grip of the end piece.

Wear eye protection or a face shield until it is securely mounted.

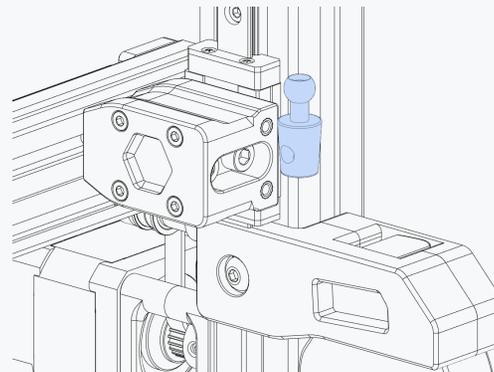
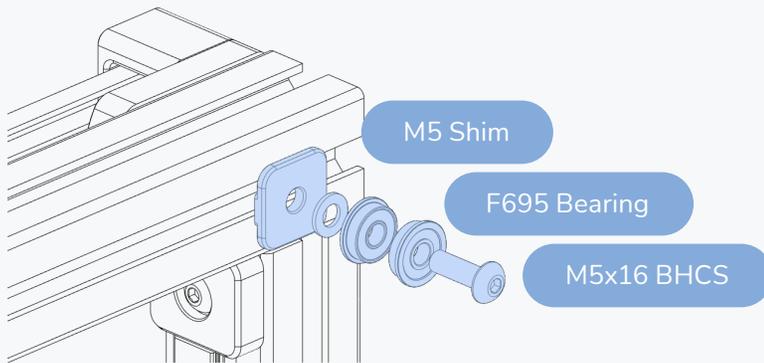


RAIL CARRIAGE

The rail carriage is now secure.
Fully fasten the bottom most screw.

COUNTERWEIGHT IDLER

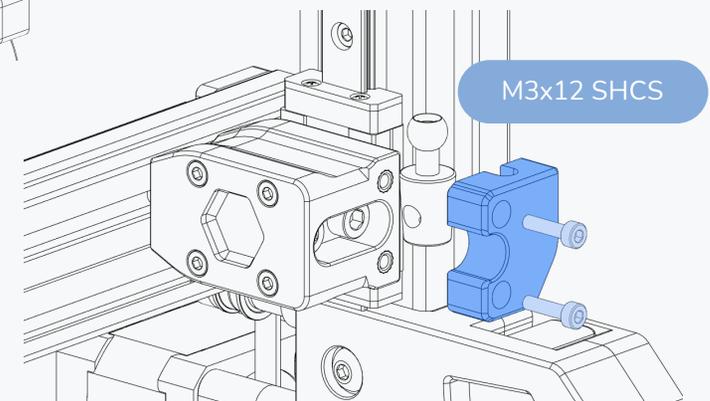
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MOUNTING THE KEYBACK END PIECE

Pull the end piece of the Key-Bak and mount it as shown.

Extend more of the cord and hook it in the idler mounted above.



AFTERBURNER

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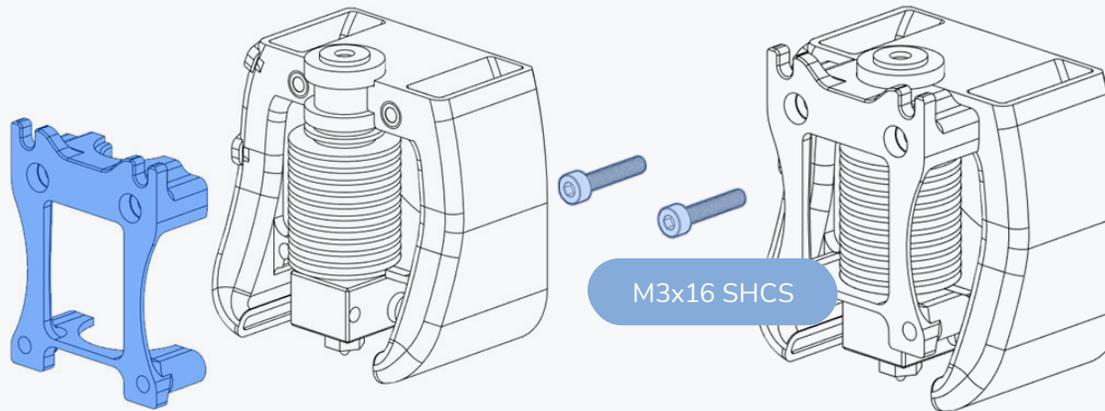
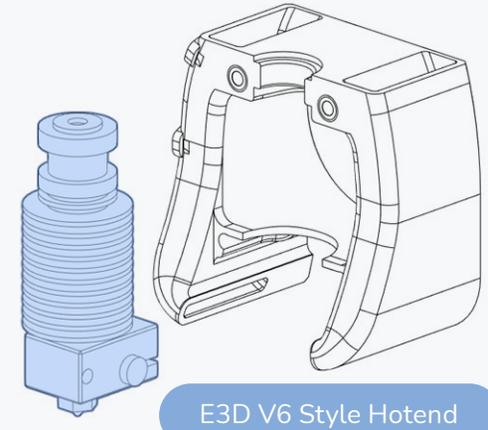
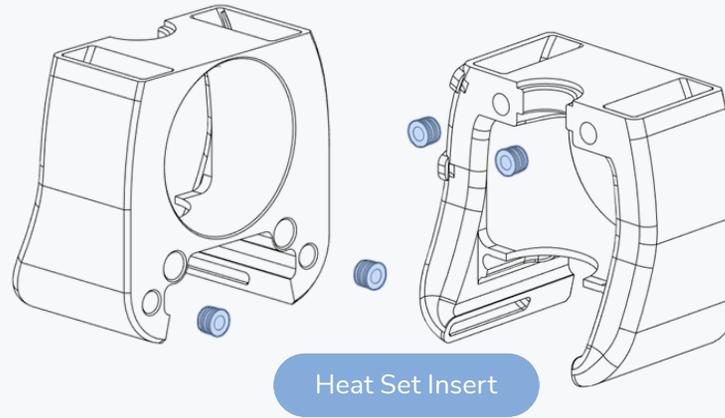
TOOL CARTRIDGE

AVAILABLE MOUNTS

We also provide mounts for the Slice Engineering Mosquito and TriangleLab/Phaetus Dragon Hotend.

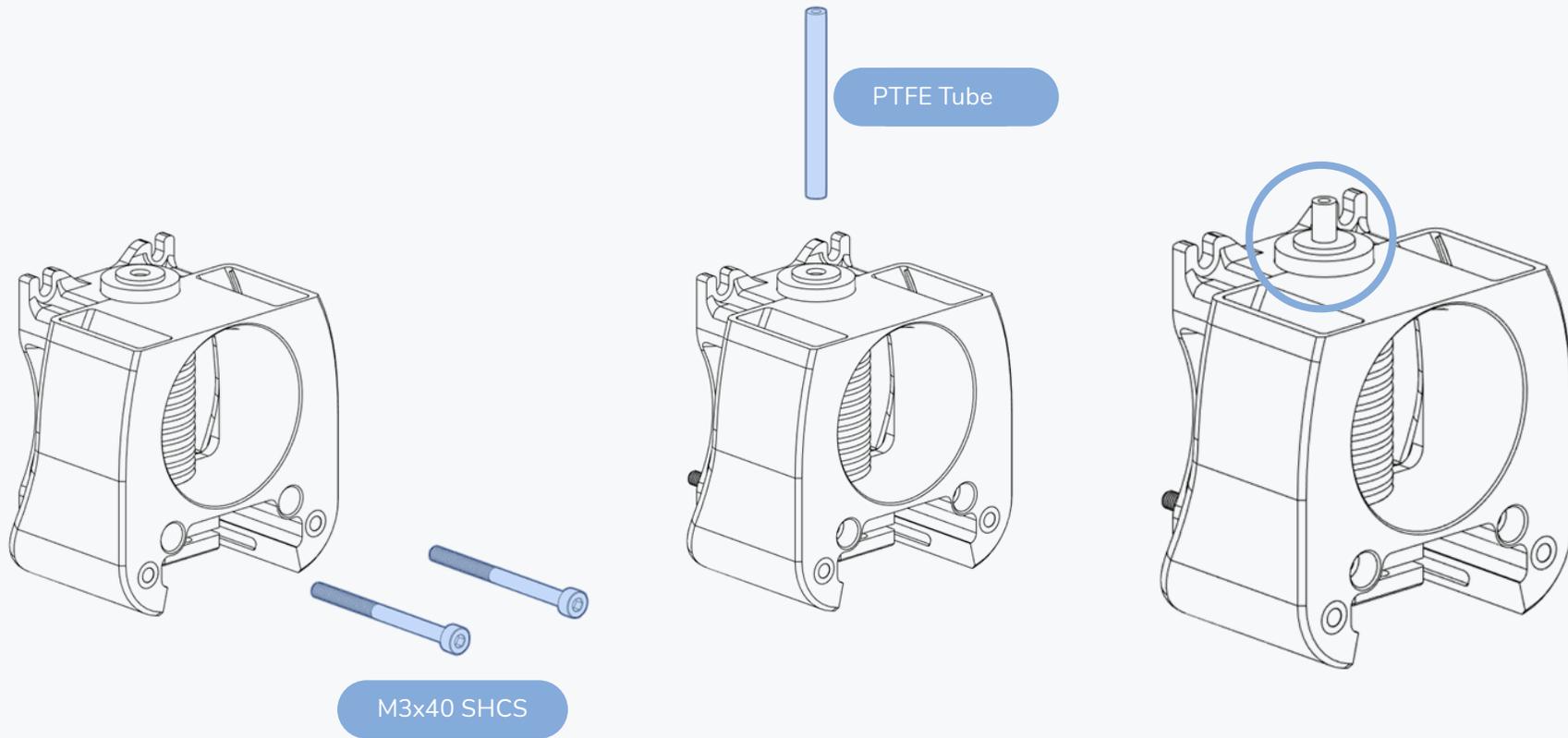
They are assembled in a similar manner.

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TOOL CARTRIDGE

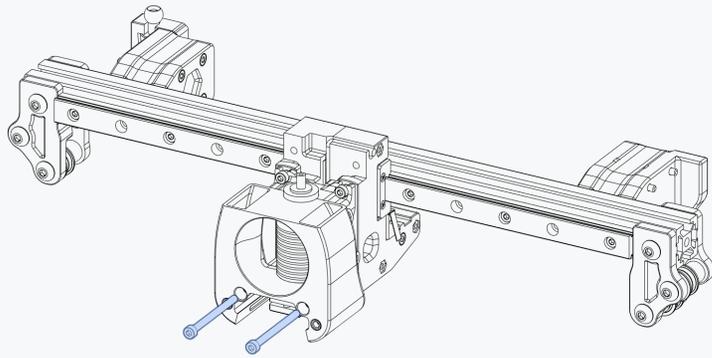
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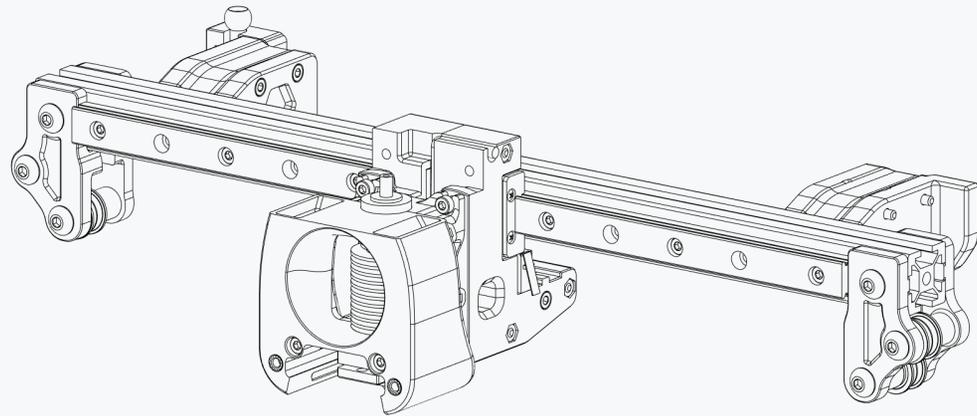
PTFE STICKOUT

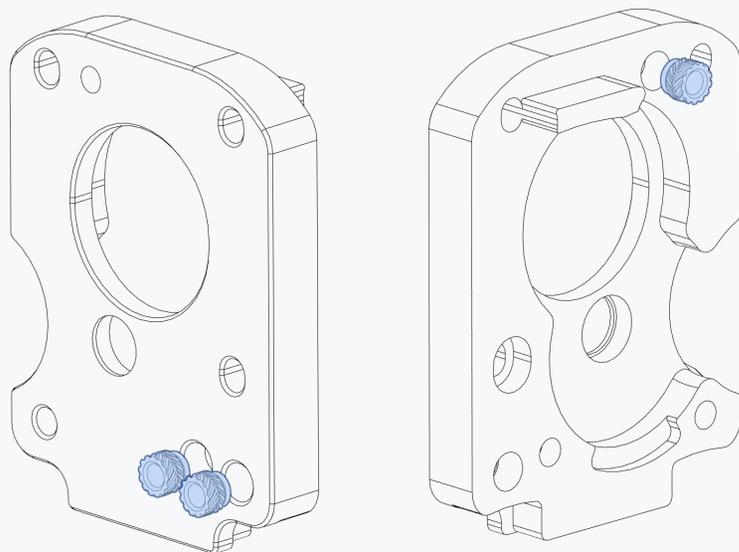
The PTFE tube should end 10mm above the surface of the printed part.

TOOL CARTRIDGE



M3x40 SHCS

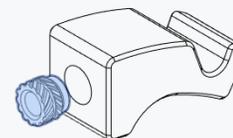




HEAT SET INSERTS

You will need to install heat set inserts into various plastic parts.

If you need help on the correct procedure, ask in Discord.



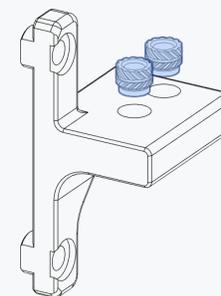
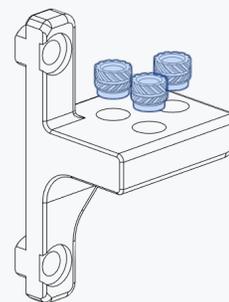
Heat Set Insert

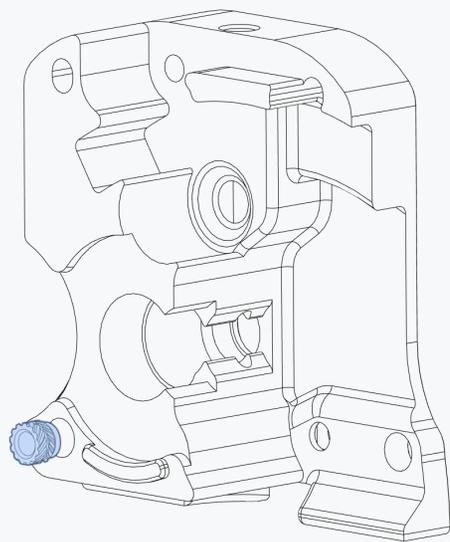
GENERIC CABLE CHAIN

The 3 hole pattern is usually found on generic cable chains.

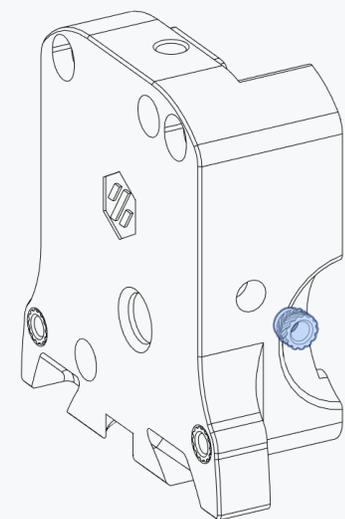
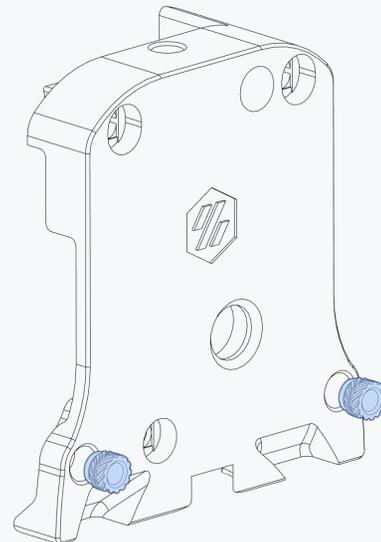
IGUS CABLE CHAIN

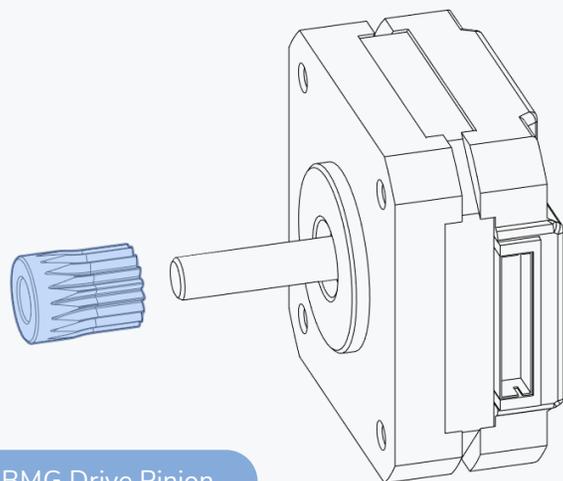
IGUS chain have 2 mounting holes.



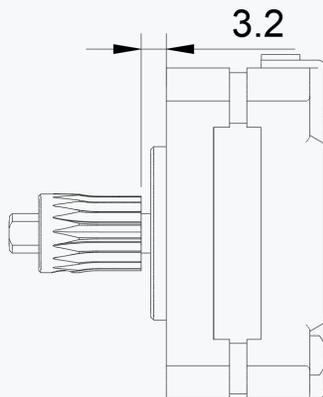


Het Set Insert

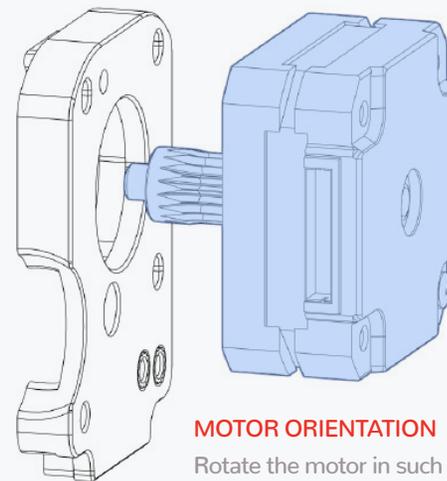




BMG Drive Pinion



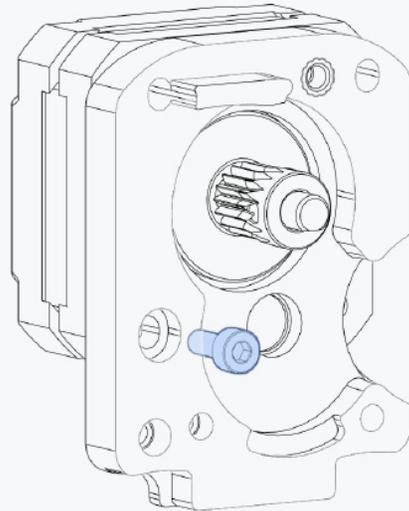
ALL UNITS ARE METRIC
If a unit is not specified
assume it's metric.



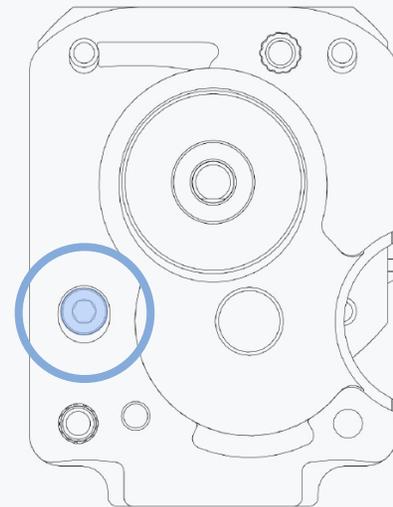
MOTOR ORIENTATION

Rotate the motor in such a way that
the connector/wires are on the left side
when looking at it from the back.

This side will be covered by the cable
cover later.



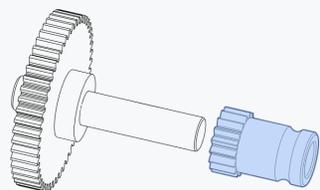
M3x8 SHCS



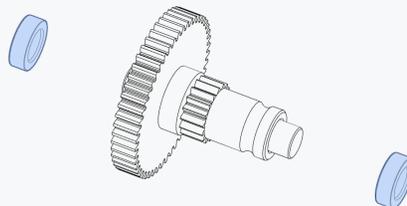
ADJUSTABLE MOTOR POSITION

The motor position is adjustable to allow for a proper meshing of the drive gears.

Start in the top most position of the slot.



BMG Drive Gear

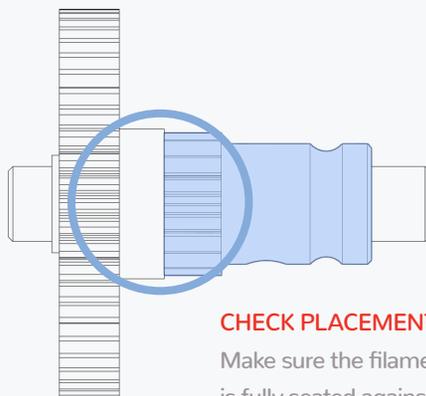


MR85 Bearing

CHECK BEARING FIT

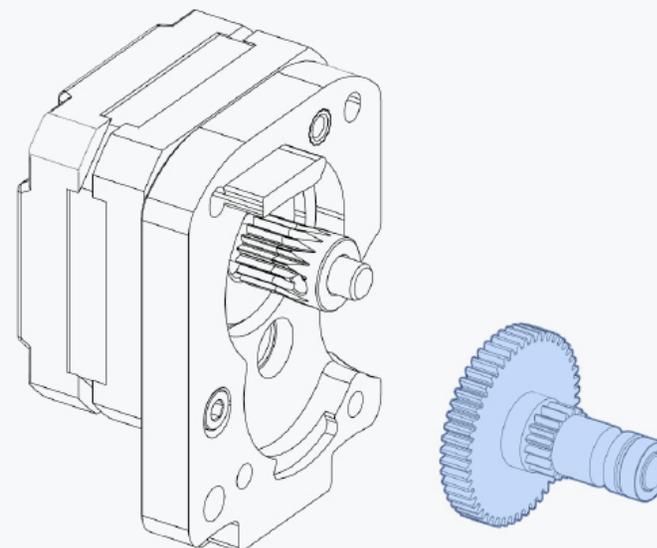
The bearings must slip on and off the shaft easily to allow the gear to self centre. Do not shim into position.

Pressing the bearings on the shaft will damage them.
Lightly sand the shaft if required.



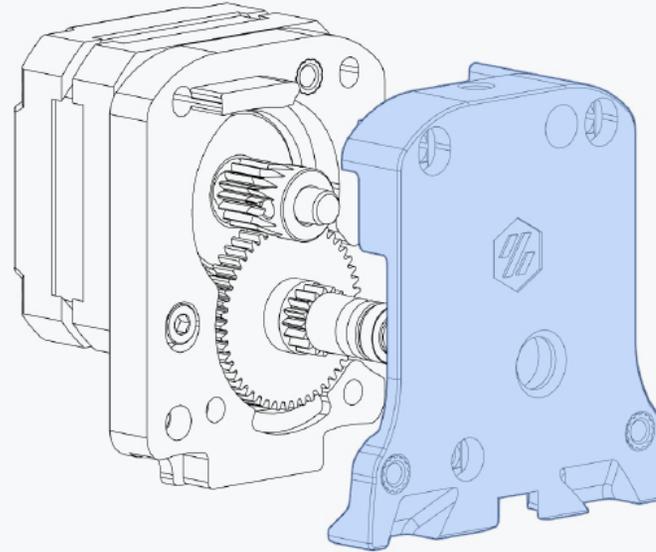
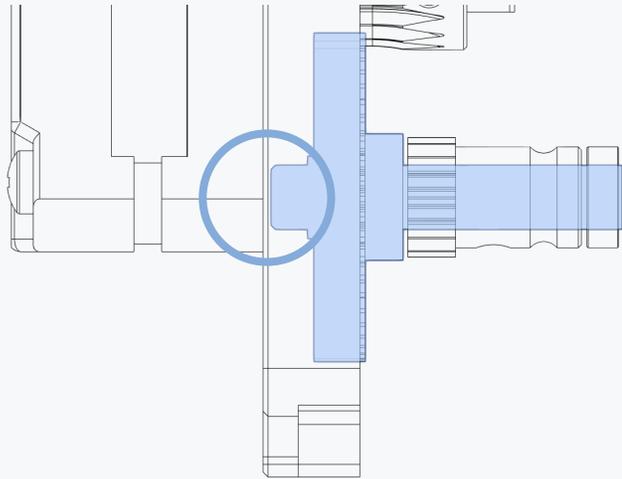
CHECK PLACEMENT

Make sure the filament drive gear is fully seated against the drive shaft gear.



CLOCKWORK

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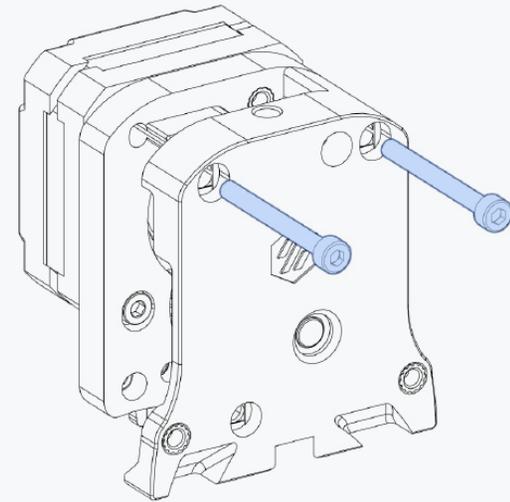


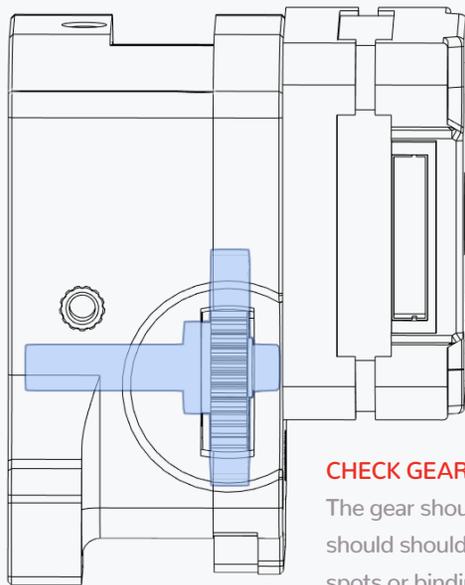
M3x30 SHCS

CHECK CLEARANCE

The drive shaft must not touch the motor housing.

You can sand the face of shaft if required.

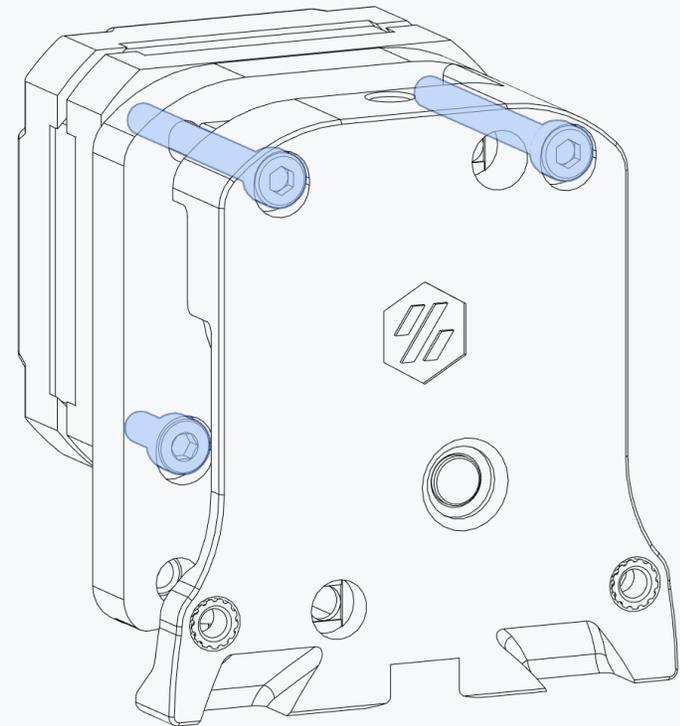




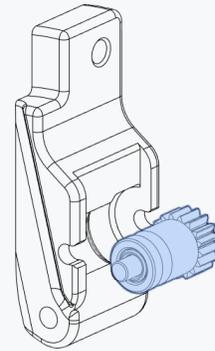
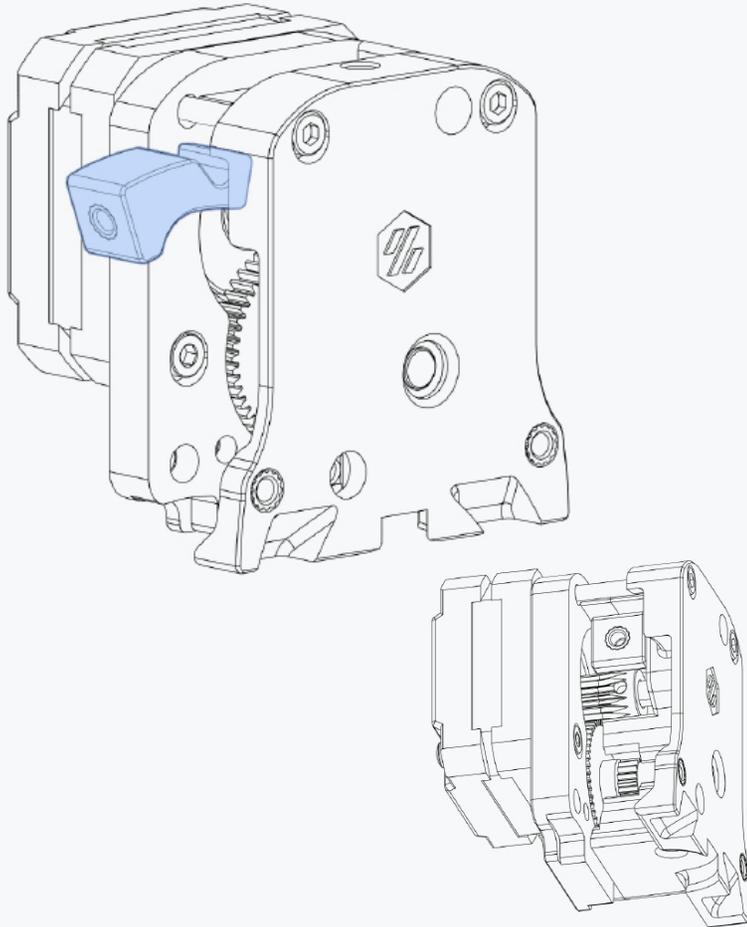
CHECK GEAR PLAY

The gear should have a slight play and should turn without any tight spots or binding.

Adjust the position of the motor if required. See page 71.

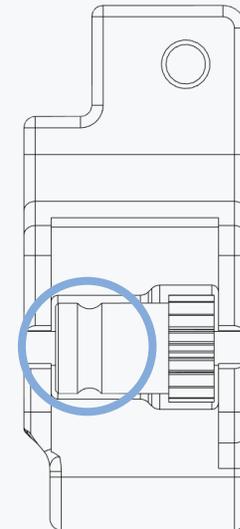


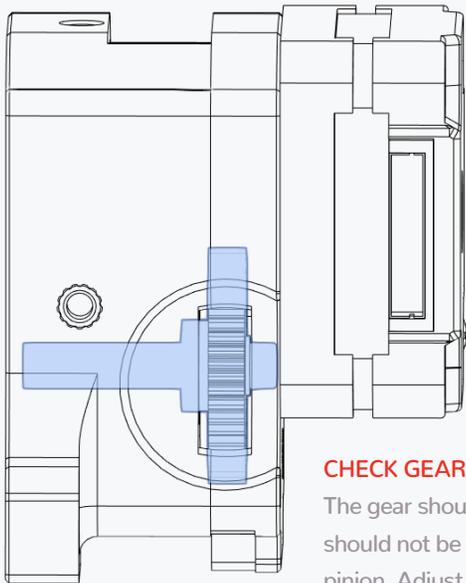
BMG Idler Assembly



LUBRICATE BEARINGS

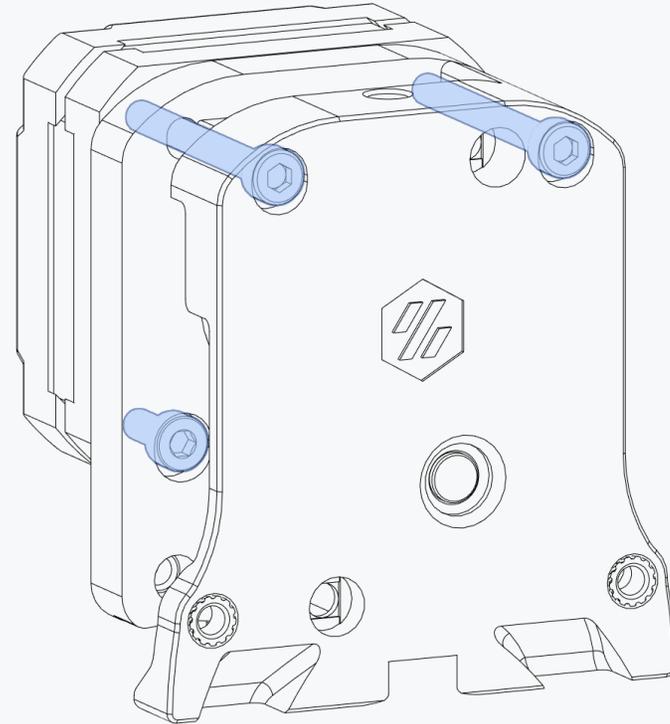
A lubrication film is required to ensure smooth operation and longevity. Refer to the BOM for lubricant options.



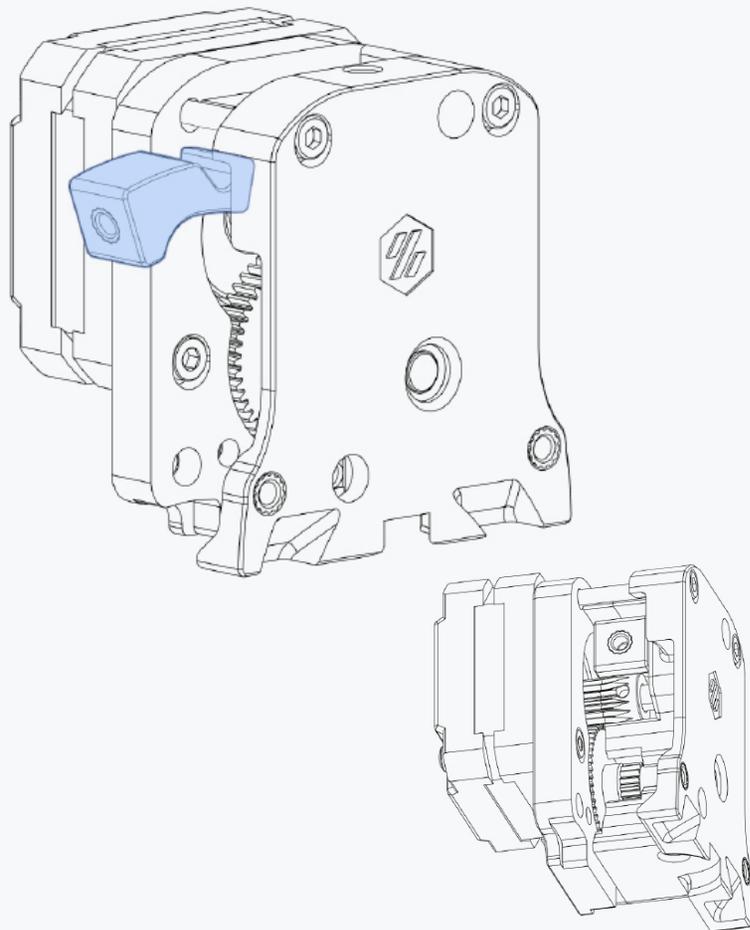


CHECK GEAR PLAY

The gear should have a slight play and should not be fully tight against the pinion. Adjust the position of the motor until you have a faint play.

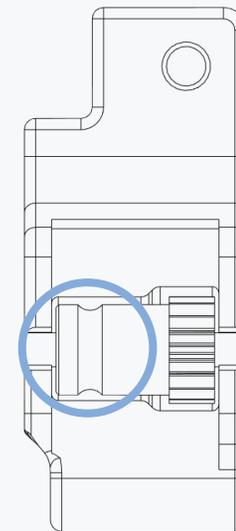
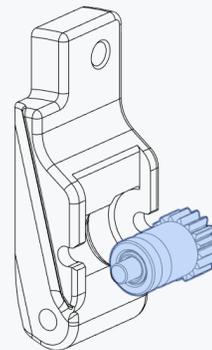


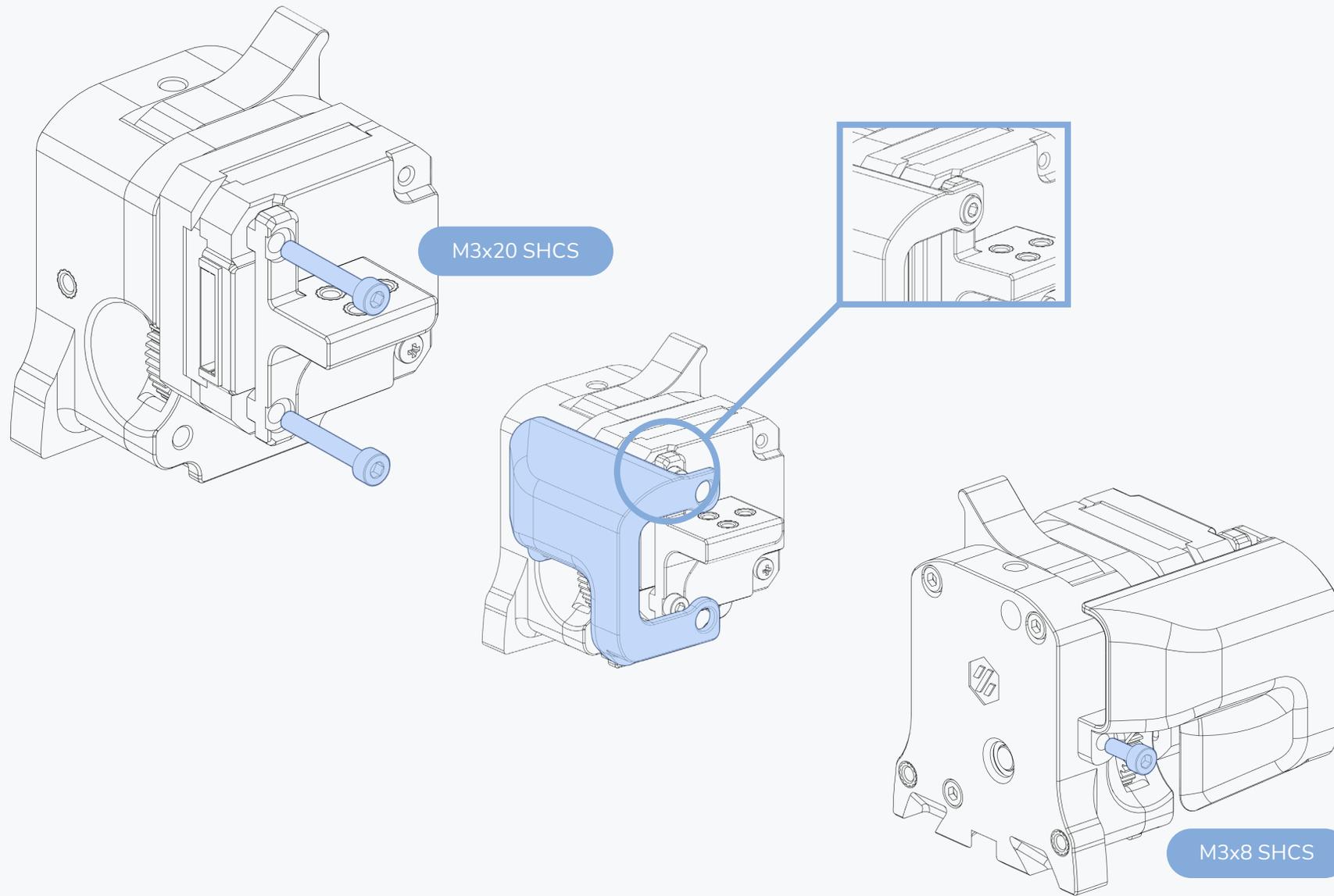
BMG Idler Assembly

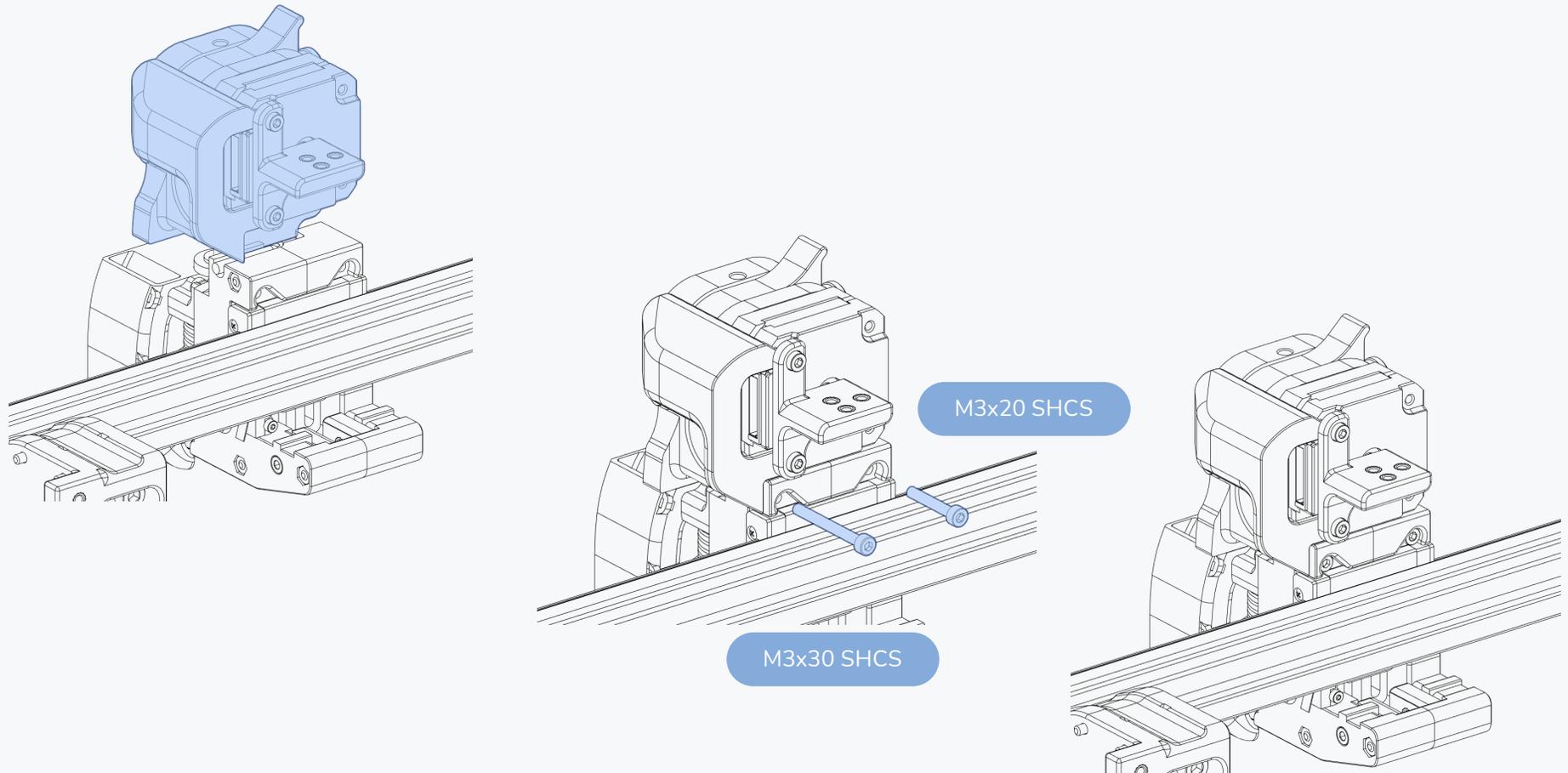


LUBRICATE BEARINGS

A lubrication film is required to ensure smooth operation and longevity. Refer to the BOM for lubricant options.

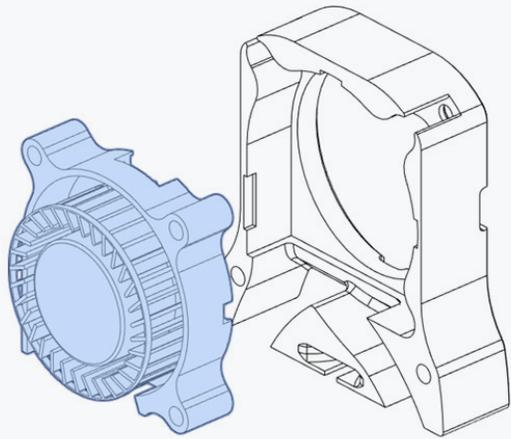






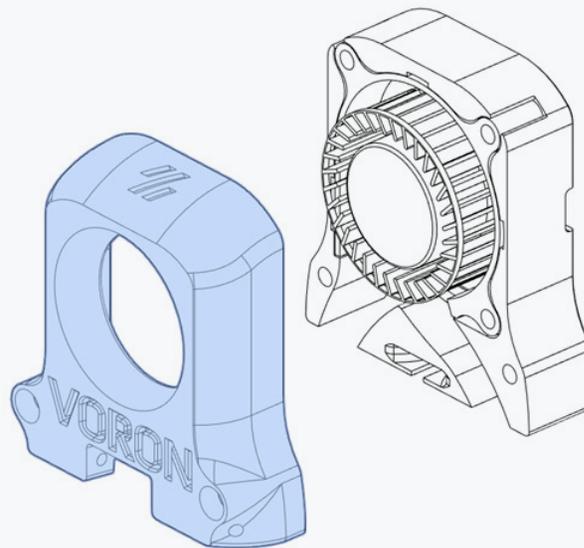
FAN ASSEMBLY

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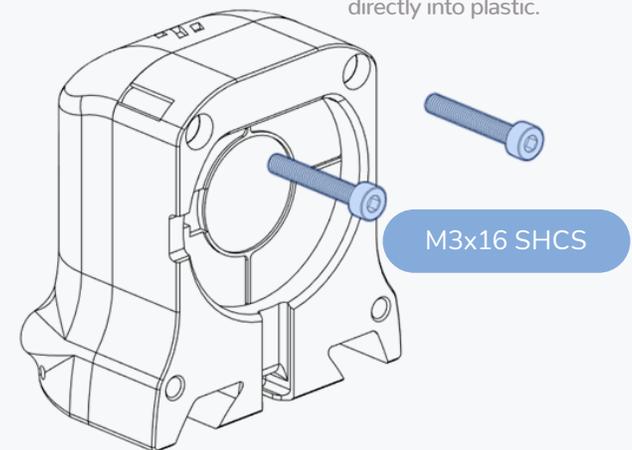
REMOVE TOP COVER

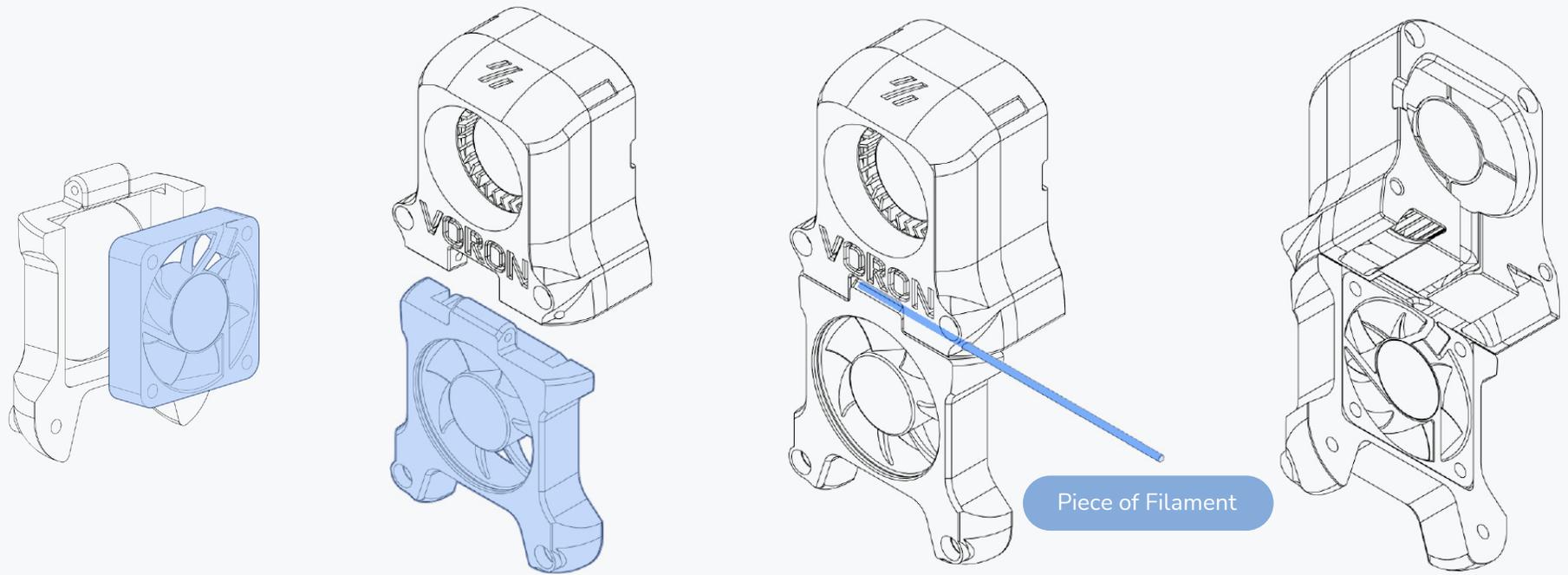
Split the fan open by bending the tabs on the side.



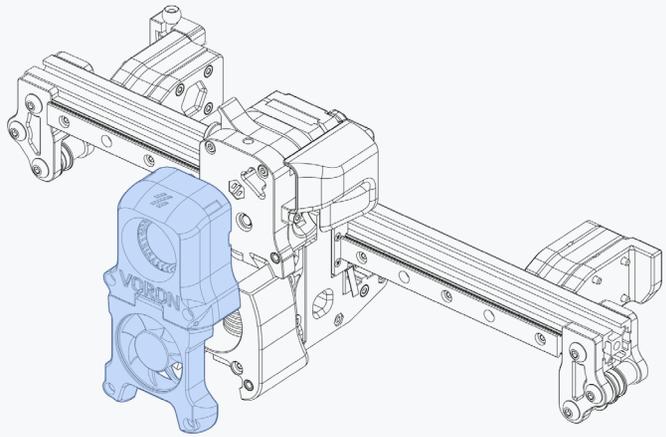
DON'T OVER TIGHTEN

The screws are screwed directly into plastic.

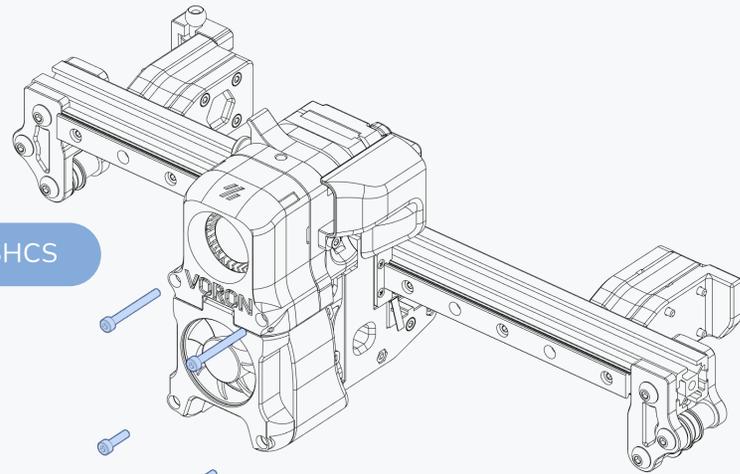




FAN ASSEMBLY

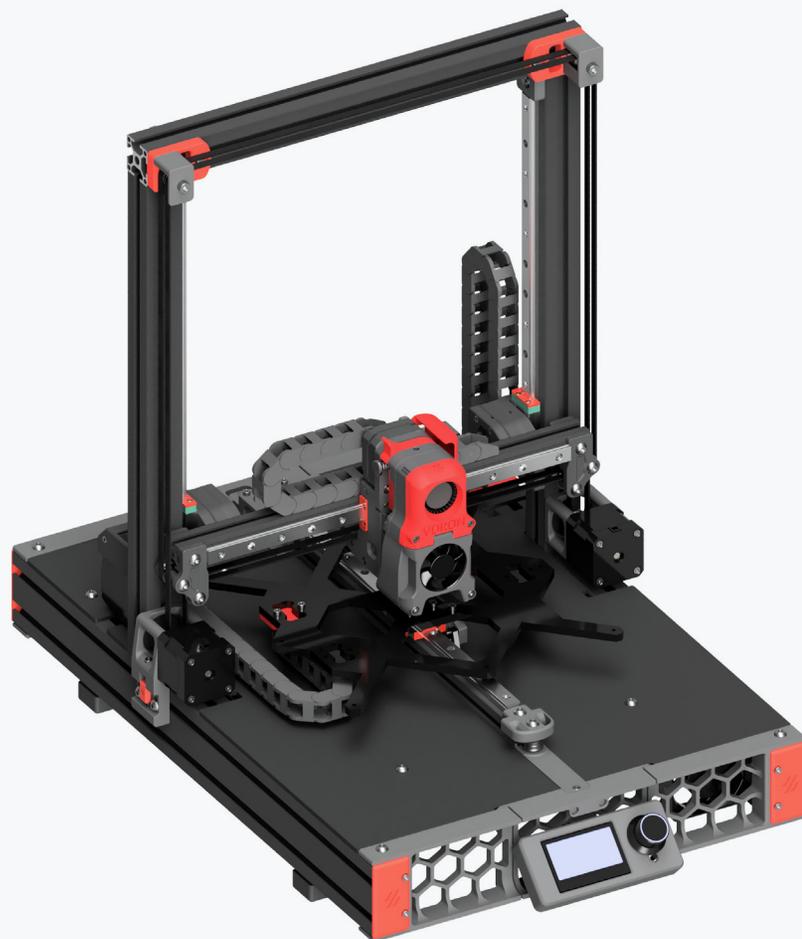


M3x30 SHCS

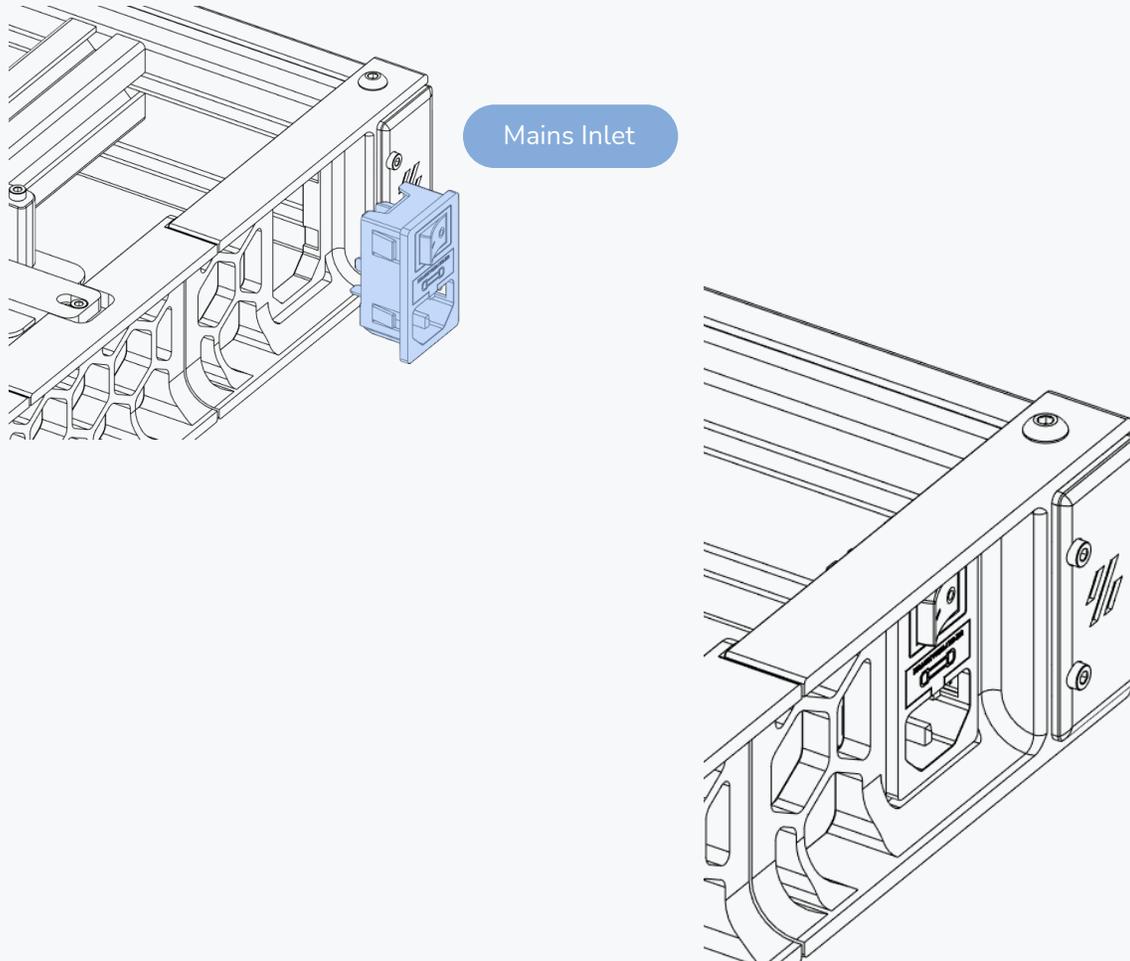


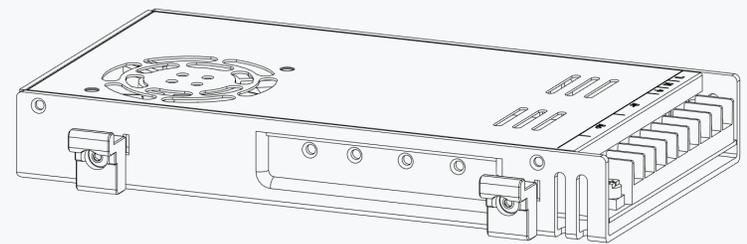
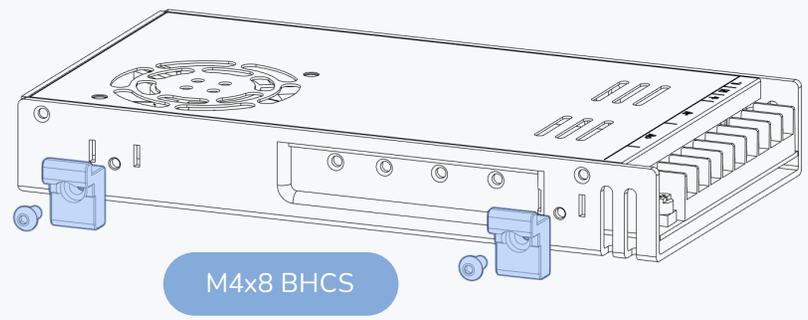
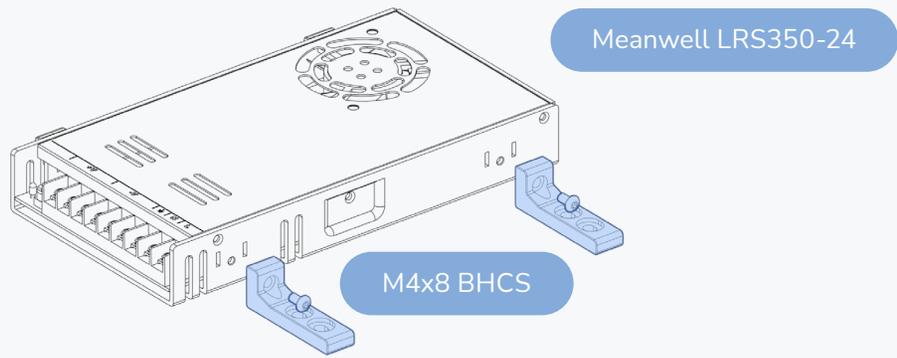
M3x12 SHCS

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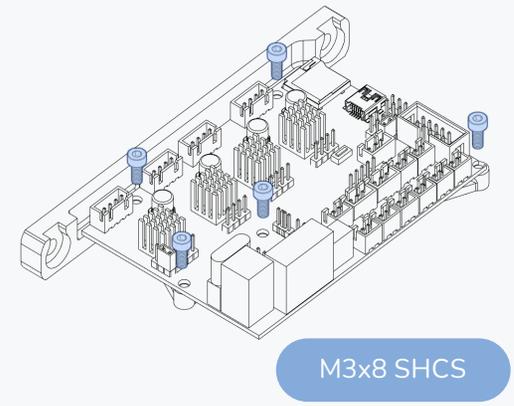
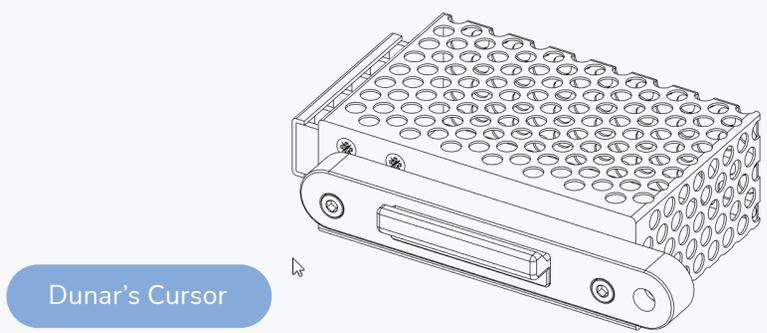
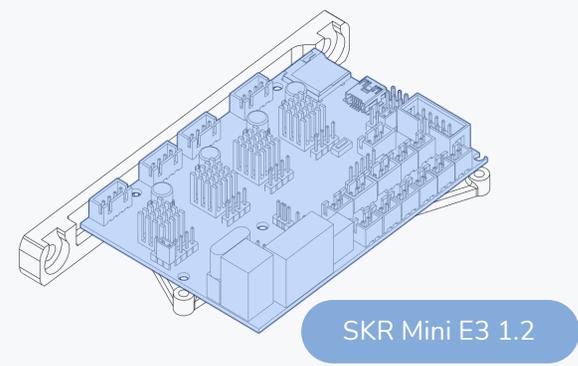
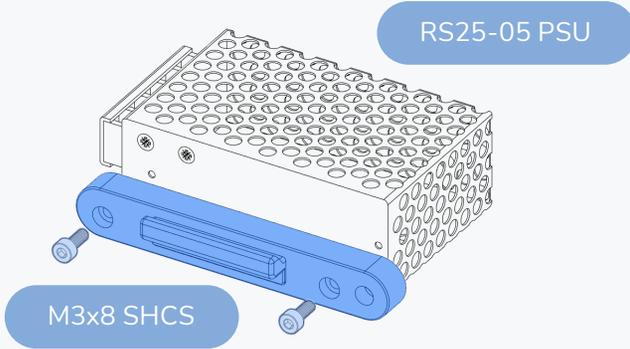
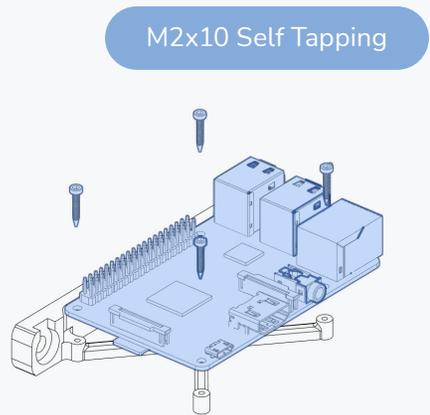
MAINS INLET

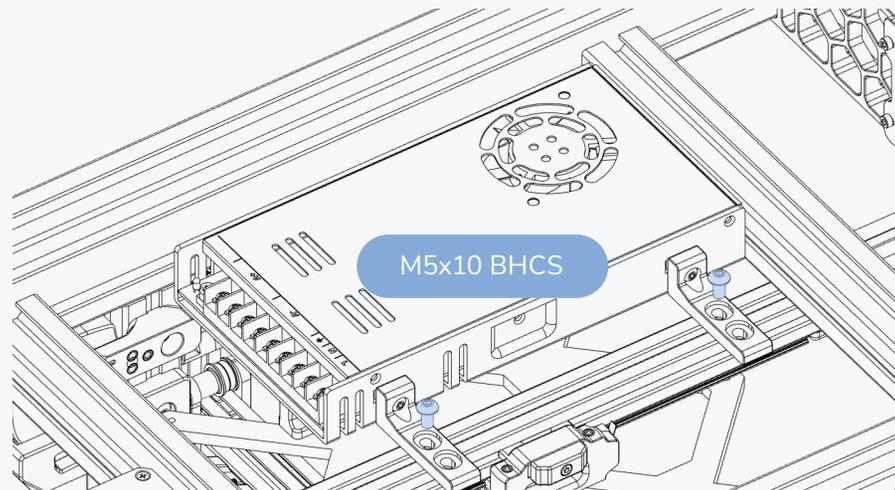
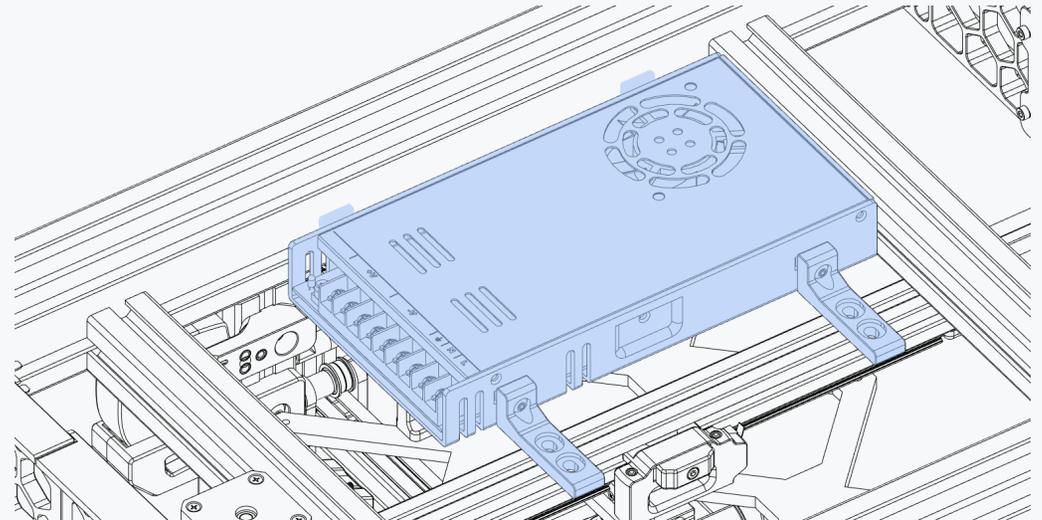
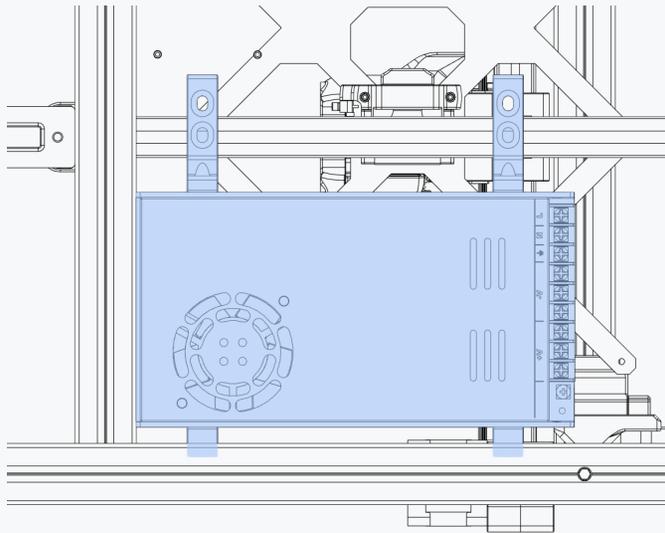




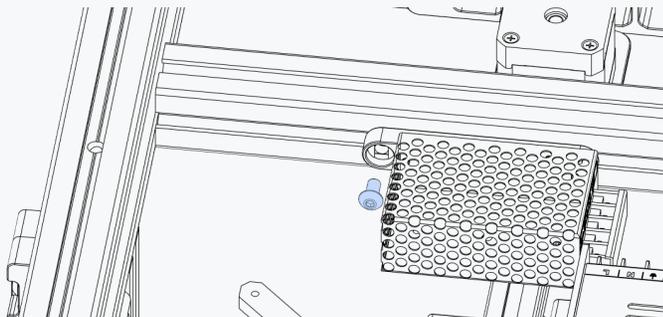
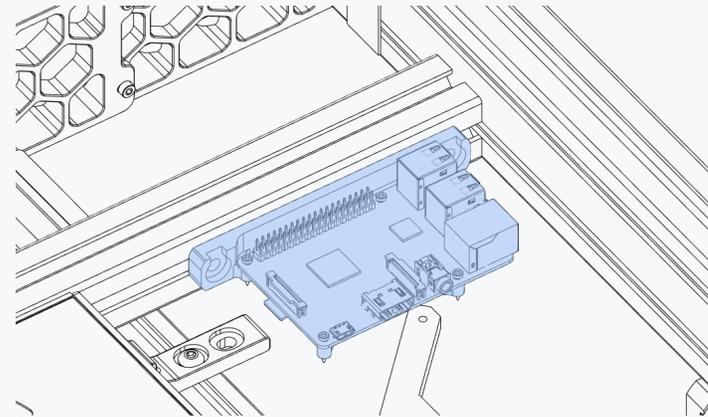
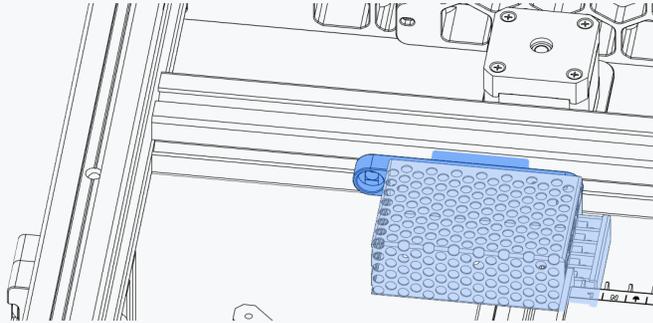
PI/SECONDARY PSU/CONTROL BOARD

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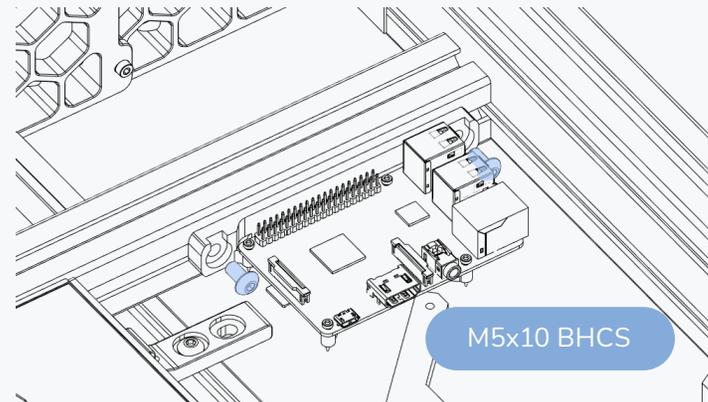




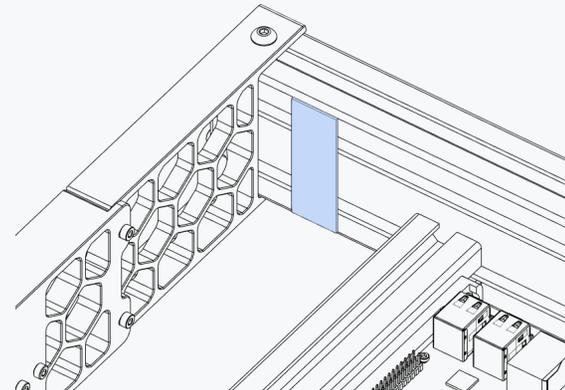
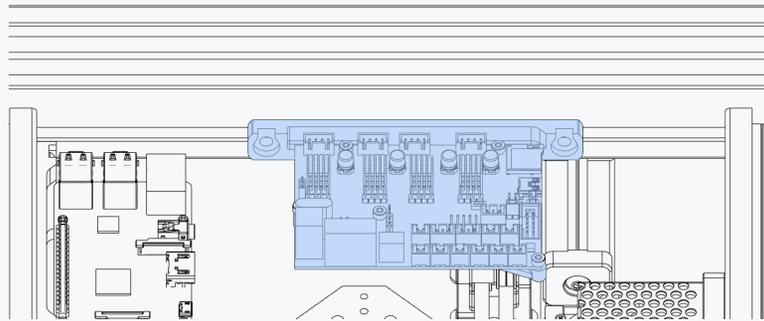
SECONDARY PSU/PI INSTALLATION



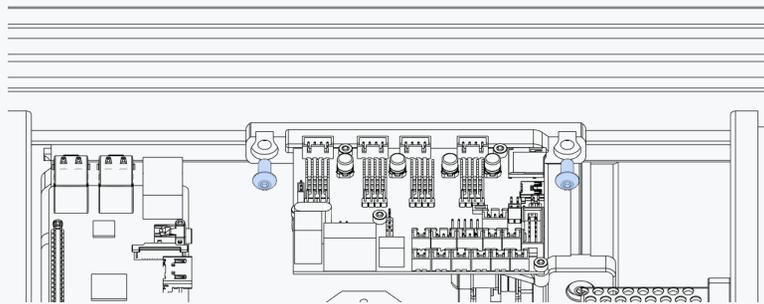
M5x10 BHCS



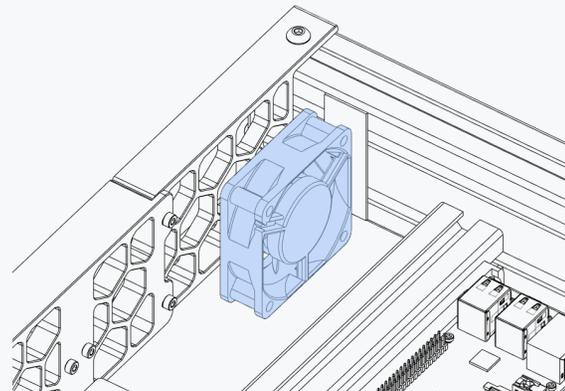
M5x10 BHCS



APPLY VHB TAPE
3M VHB tape is a double sided adhesive tape. Other vendors have similar products that you can use as a substitute.

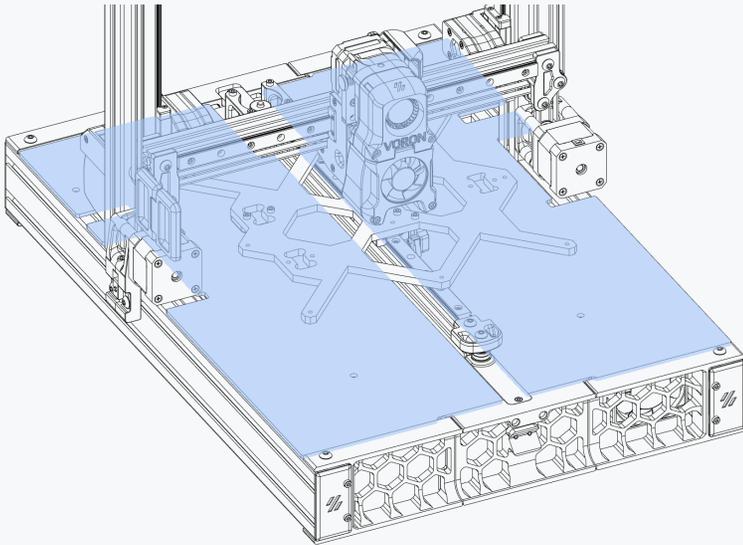


M5x10 BHCS



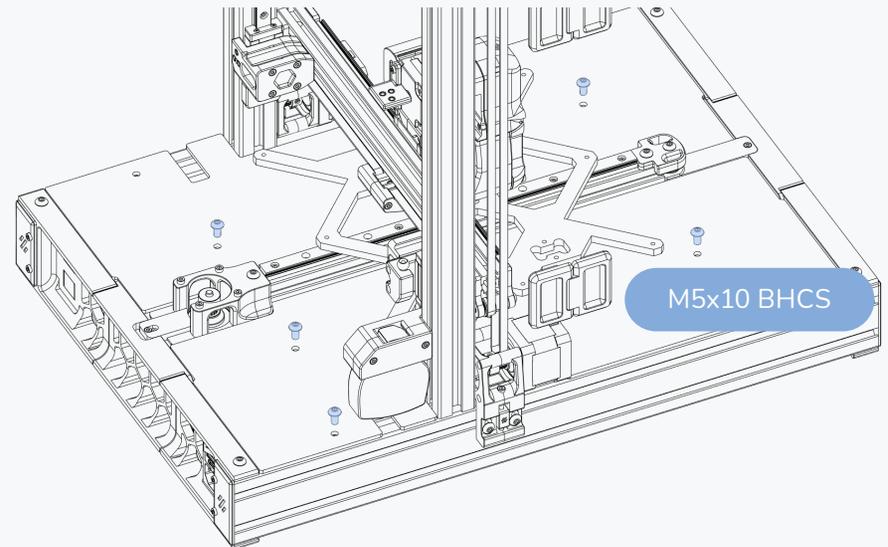
6020 Fan

DECK PANEL



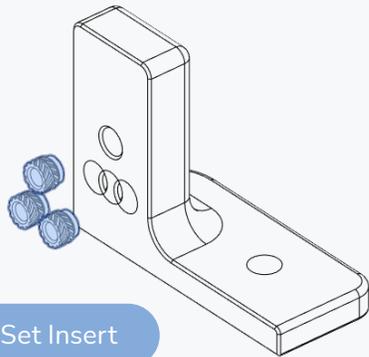
DECK PANELS

Unless you installed the panels earlier undo the 6 screws on the bed carriage and remove the bed carriage to install the panels.

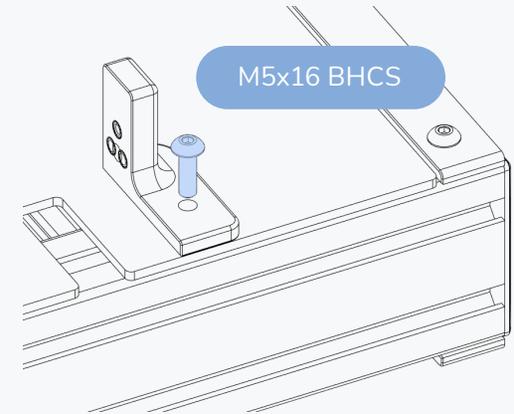
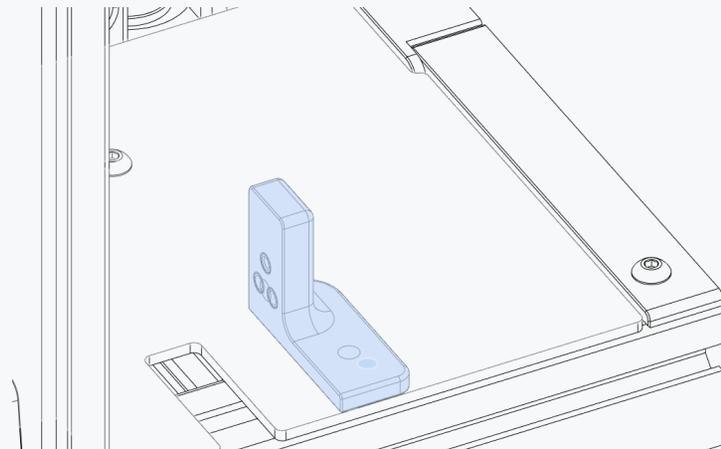


Z CHAIN MOUNT

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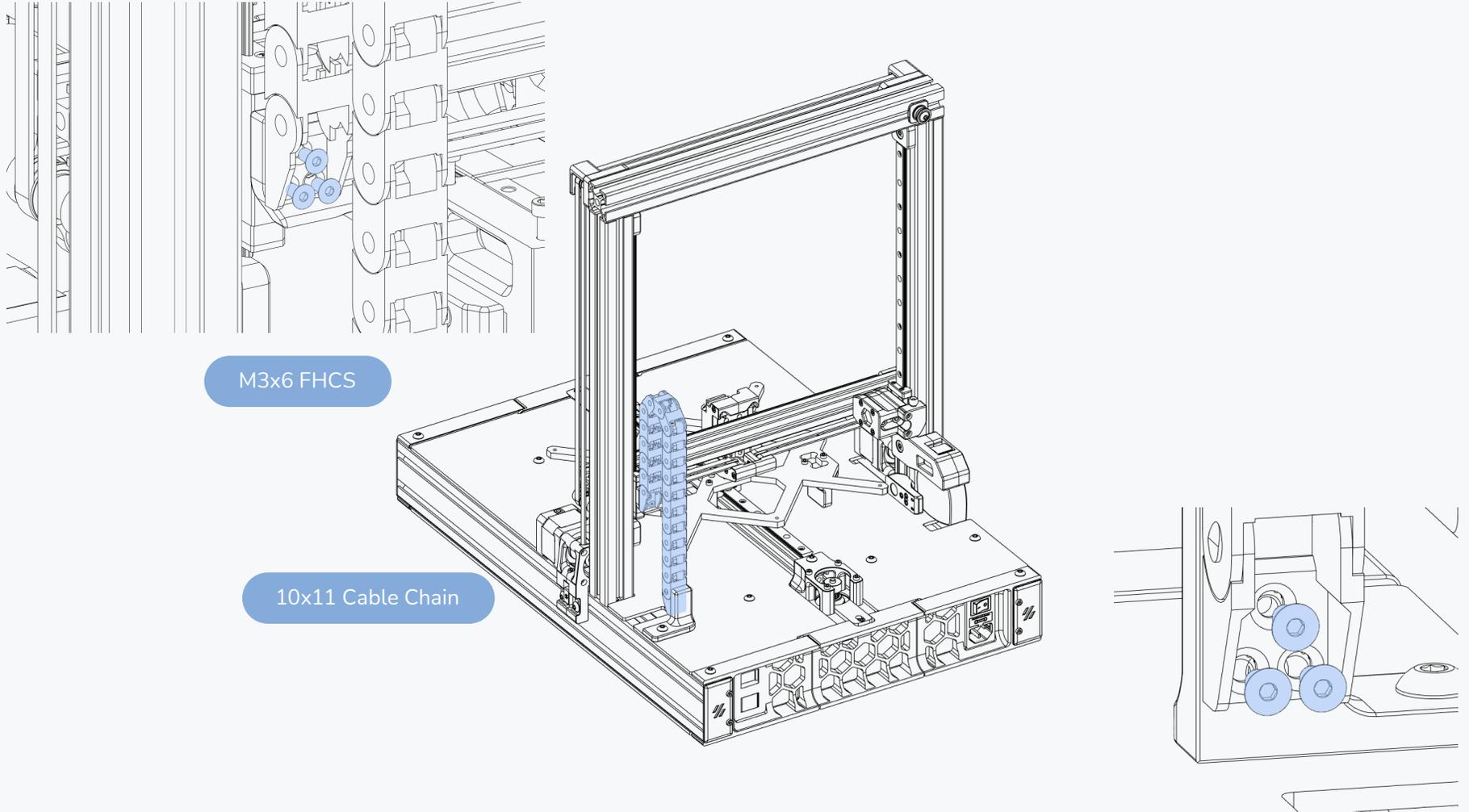


Heat Set Insert



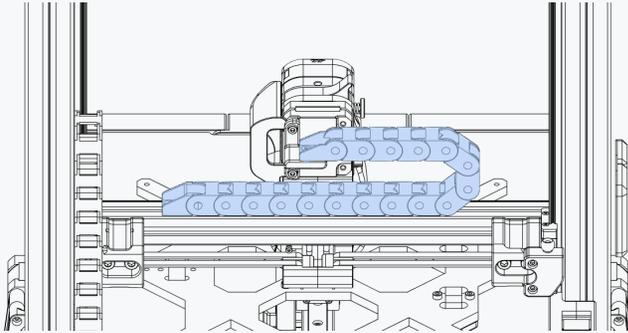
M5x16 BHCS

Z CABLE CHAIN

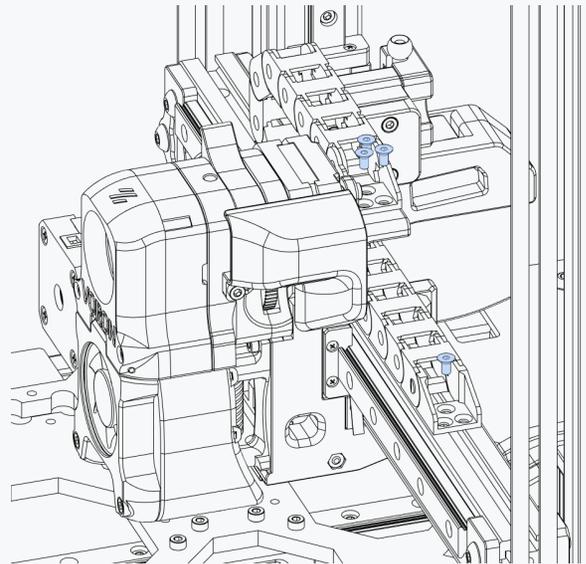


X CABLE CHAIN

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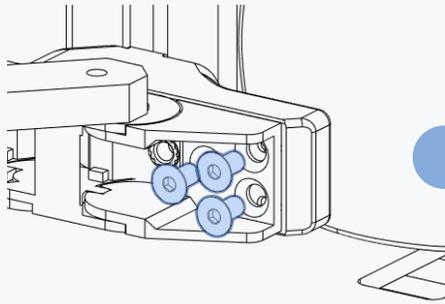


10x11 Cable Chain

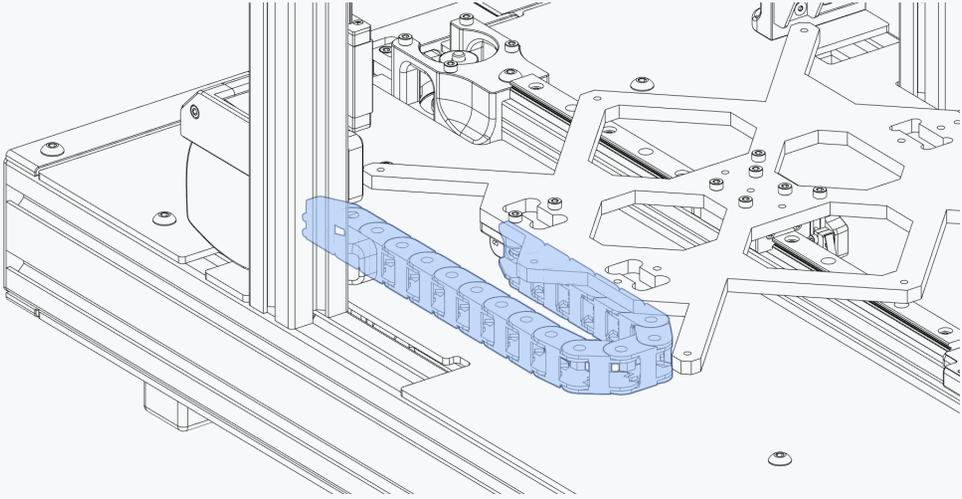


M3x6 FHCS

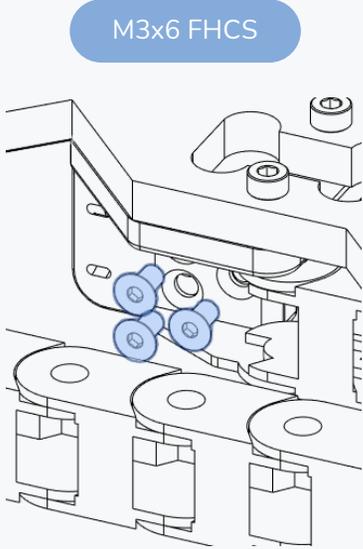
Y CABLE CHAIN



M3x6 FHCS

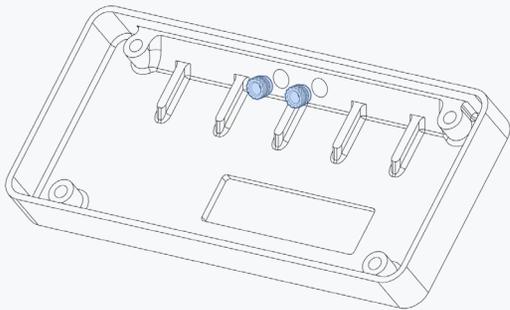


10x11 Cable Chain

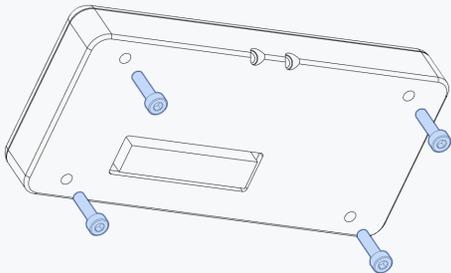
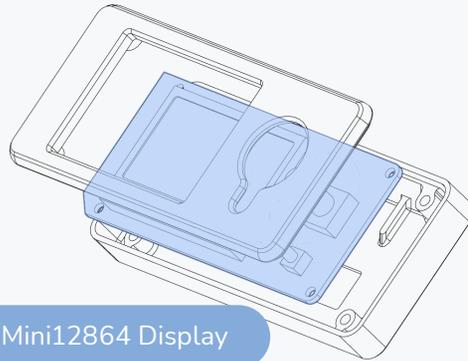


M3x6 FHCS

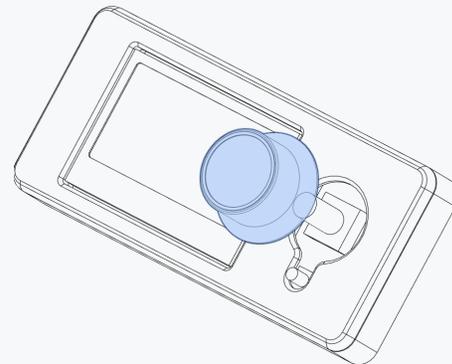
Heat Set Insert



Mini12864 Display

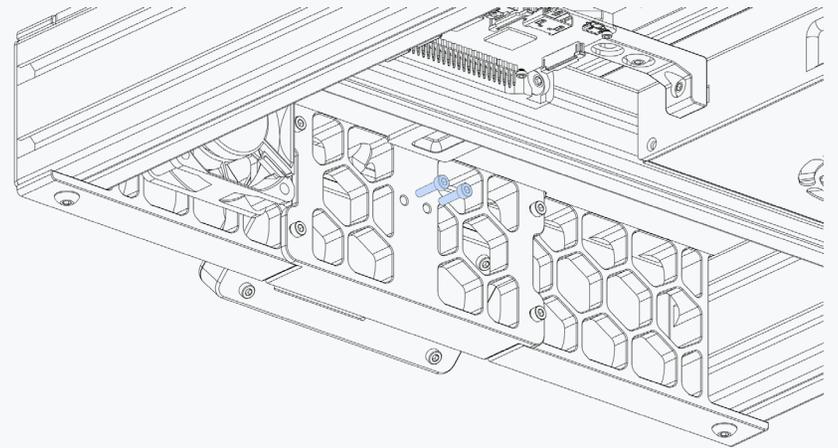
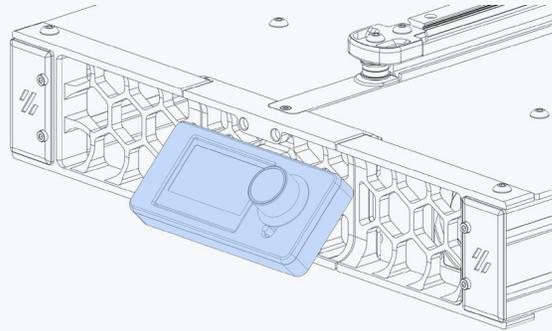
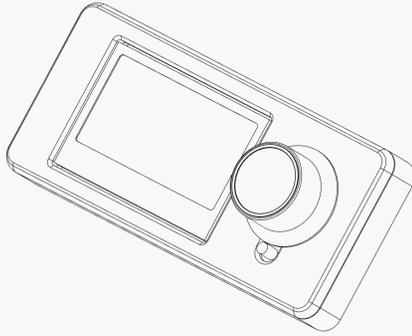


M3x12 SHCS

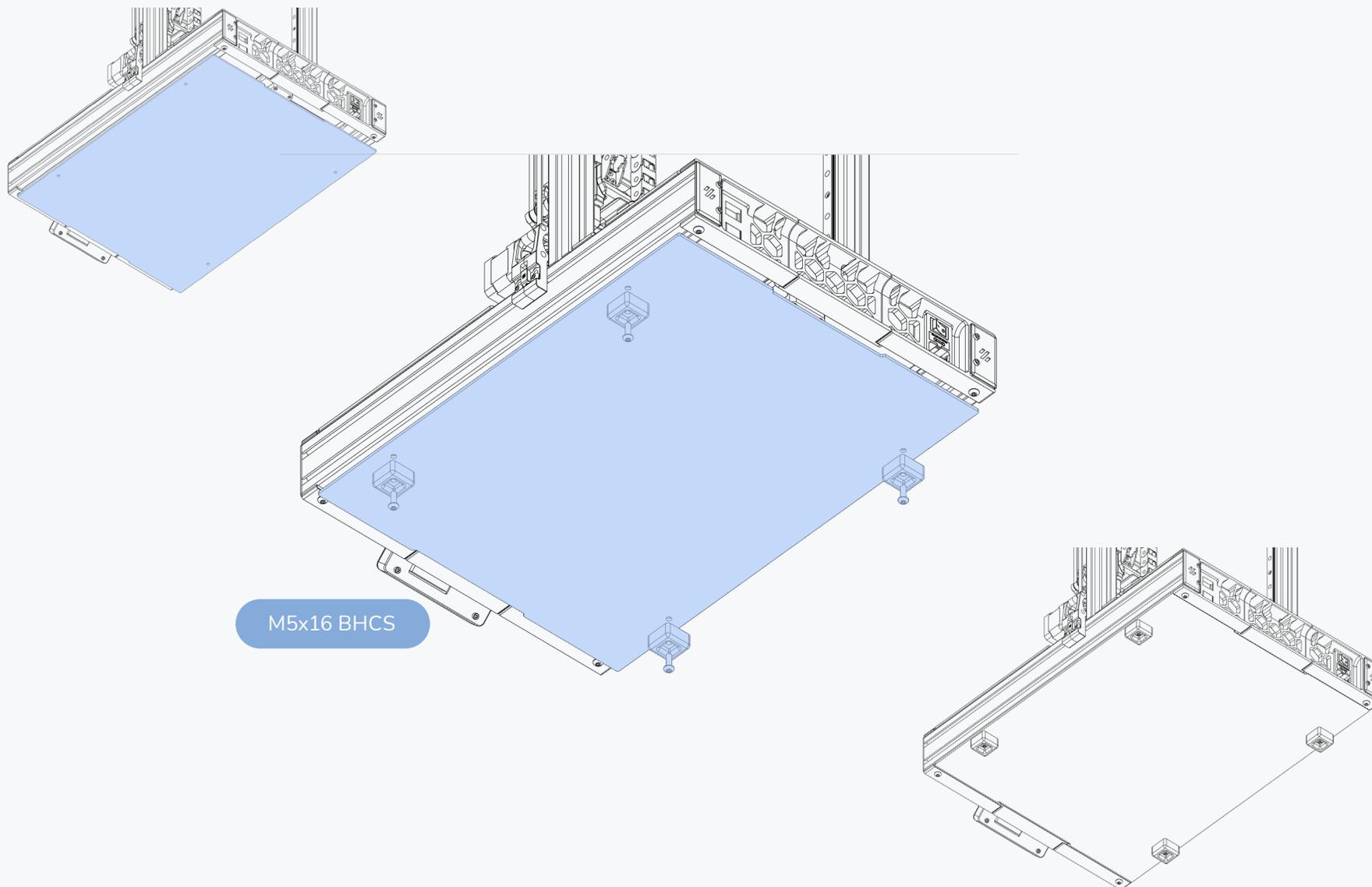


LCD THING

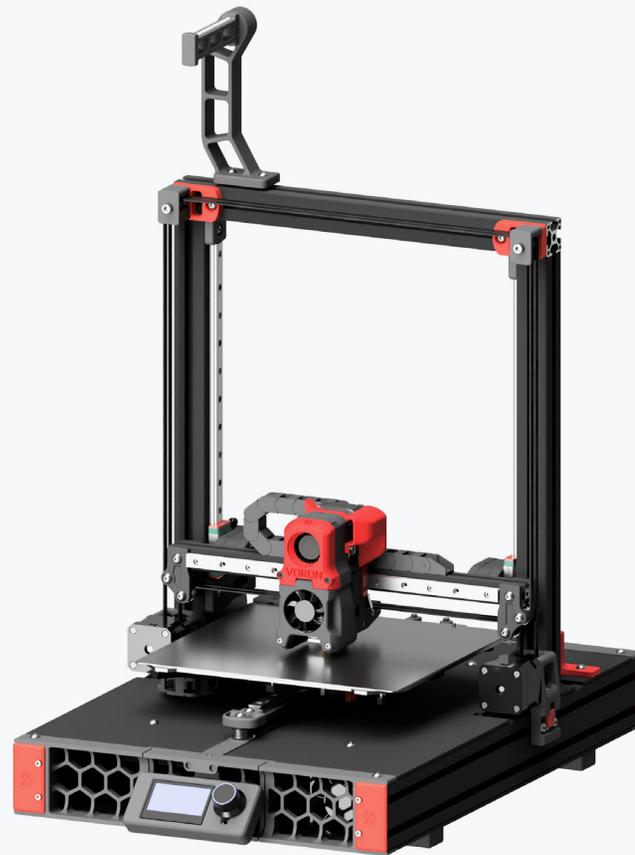
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BOTTOM PANEL

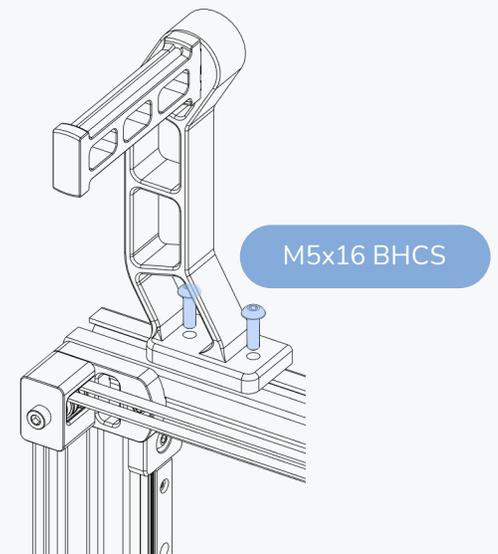
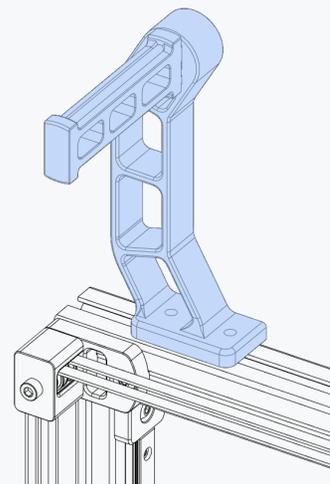
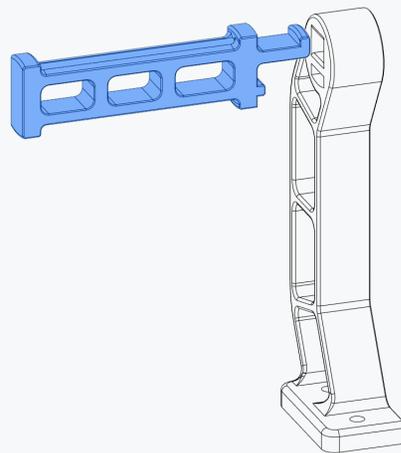
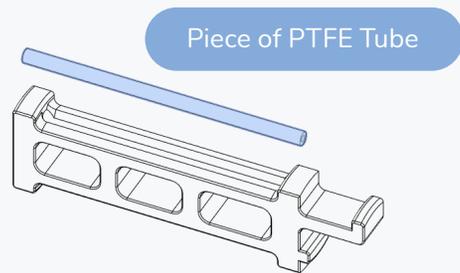


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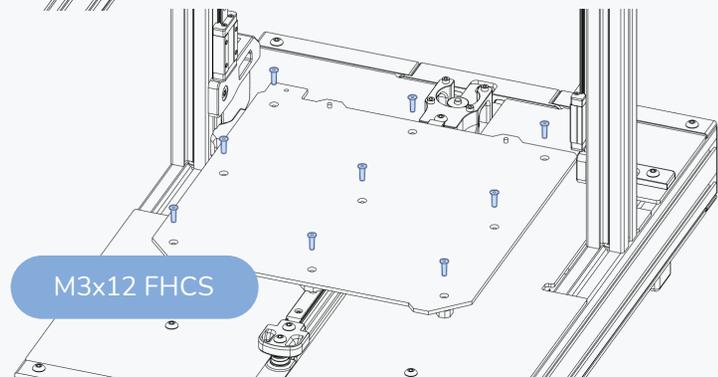
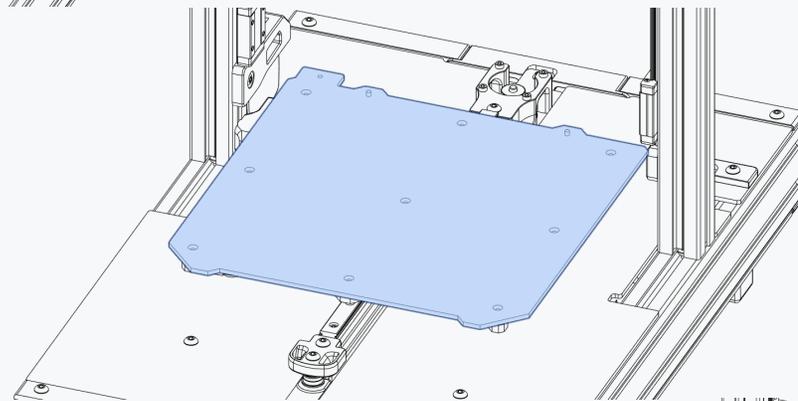
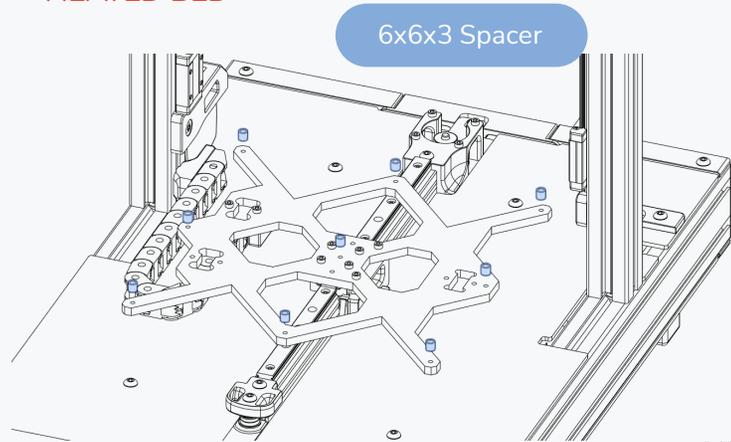


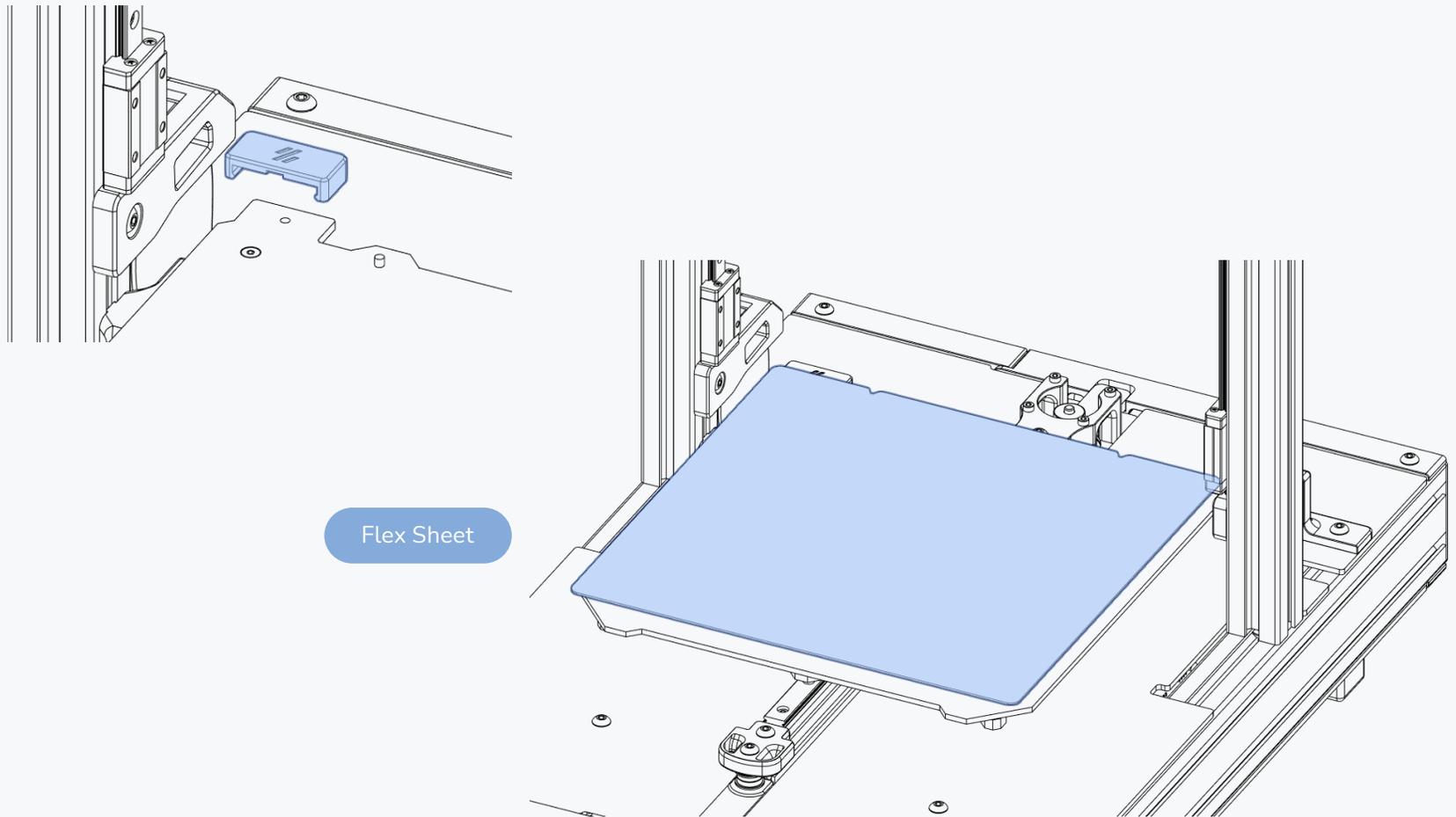
SPOOL HOLDER

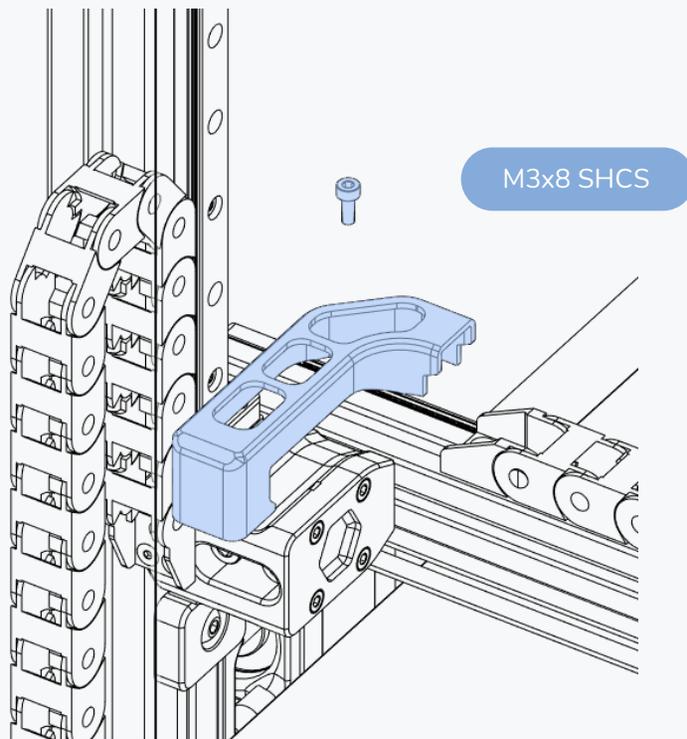
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HEATED BED







NEXT STEPS

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MECHANICAL ASSEMBLY COMPLETED ... NEXT STEP WIRING & ELECTRICAL

This manual is designed to be a simple reference manual for the build process. Wiring and the initial setup of your printer is not included.

For details on wiring, setup of the electronics and other initial steps of your new printer please visit our documentation available on github.

GitHub

<https://github.com/VoronDesign/Voron-Switchwire>

<https://docs.vorondesign.com>

HOW TO GET HELP

If you need assistance with your build, we're here to help. Head on over to our Discord group and post your questions. This is our primary medium to help VORON Users and we have a great community that can help you out if you get stuck.



<https://discord.gg/voron>



Website
www.vorondesign.com

Github
<https://github.com/vorondesign>

Discord
<https://discord.gg/voron>

